Jon Niermann, *Chairman*
Emily Lindley, *Commissioner*
Bobby Janecka, *Commissioner*
Kelly Keel, *Interim Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
Protecting Texas by Reducing and Preventing Pollution

August 18, 2023

TO: Persons on the Attached Mailing List

RE: Docket No. 2023-0617-WR
City of Lubbock (Applicant)
Request(s) filed on Permit No. WRPERM 5921

The above-referenced application and all timely filed hearing requests/requests for reconsideration on the above-referenced application will be considered by the commissioners of the Texas Commission on Environmental Quality (TCEQ) during the public meeting on **September 27, 2023**. The meeting will begin at 9:30 a.m. The agenda meeting may be held in person in Room 201S of Building E at the Commission's offices located at 12100 Park 35 Circle in Austin, Texas, virtually, or both in person and virtually. To confirm how the meeting will be held, please visit the Commissioners' Agenda webpage at https://www.tceq.texas.gov/goto/agendas eight days before the Agenda.

In accordance with commission rules, copies of the timely hearing requests/requests for reconsideration have been forwarded to the Applicant, the Executive Director of the TCEQ, and the Public Interest Counsel of the TCEQ. Each of these persons is entitled to file a formal written response to the hearing requests/requests for reconsideration on **September 1, 2023**. Persons who have filed timely hearing requests/requests for reconsideration may file a formal written reply to these responses on **September 18, 2023**.

All responses and replies must be filed with the Chief Clerk of the TCEQ. Responses and replies may be filed with the Chief Clerk electronically at www.tceq.texas.gov/goto/efilings or by filing an original and 7 copies with the Chief Clerk of the TCEQ. The mailing address of the Chief Clerk is: Office of Chief Clerk, ATTN: Agenda Docket Clerk, Mail Code 105, TCEQ, P.O. Box 13087, Austin, Texas 78711-3087 [Fax number (512) 239-3311]. On the same day any response is transmitted to the Chief Clerk, a copy must also be sent to the Executive Director, the Public Interest Counsel, the Applicant, and the requesters at their addresses listed on the attached mailing list. On the same day any reply is transmitted to the Chief Clerk, a copy must also be sent to the Executive Director, the Public Interest Counsel, other requesters, and the Applicant at their addresses listed on the attached mailing list.

The procedures for evaluating hearing requests and for filing and serving responses and replies are located in 30 Texas Administrative Code (TAC) Chapter 55, Subchapter G (§§55.250-55.256) and 30 TAC §§ 1.10-1.11. The hardcopy filing requirement is waived by the General Counsel pursuant to 30 TAC § 1.10(h). Copies of these rules may be obtained by calling the Public Education Program toll free at (800) 687-4040.

The commissioners will not take oral argument or additional comment on this matter at the public meeting. Therefore, it is important to address the sufficiency of the requests in timely filed written responses and requesters' replies. At the public meeting, the commissioners may ask questions of the Applicant, requesters, or TCEQ staff. The commissioners will make a decision on the request(s) during the meeting and will base that decision on the timely written requests, public comments, any written responses and replies, any responses to questions during the meeting, and applicable statutes and rules. Copies of all timely public comments and requests have been forwarded to the Alternative Dispute Resolution Program to determine if informal, voluntary mediation might help resolve any dispute.

The attachment to this letter is intended to help you better understand how the TCEQ processes and evaluates hearing requests and requests for reconsideration. To obtain additional information, or to ask questions about anything in this letter, please call the Public Education Program toll free at 1-800-687-4040.

Sincerely,

Laurie Gharis

Laurie Gharis
Chief Clerk

Enclosures: Copies of protestant correspondence to Applicant, Executive Director, Office of Public Interest Counsel, and Alternative Dispute Resolution.

REQUIREMENTS FOR WATER RIGHTS HEARING REQUESTS

Commission rules in 30 TAC § 55.251 (b) and (c) require a hearing request to:

1. be in writing and be filed with the Office of the Chief Clerk during the public comment period;
2. give the name, address, and daytime telephone number of the person who files the request;
3. identify the person's personal justiciable interest affected by the application including a brief, but specific, written statement explaining in plain language the requestor's location and distance relative to the activity that is the subject of the application and how and why the requestor believes he or she will be affected by the activity in a manner not common to members of the general public;
4. request a contested case hearing; and
5. provide any other information specified in the public notice of application.

A hearing request must comply with requirement (1) above and "substantially comply" with requirements (2) through (5). In addition, a group or association may request a contested case hearing only if the group or association meets all of the following requirements:

1. one or more members of the group or association would otherwise have standing to request a hearing in their own right;
2. the interests the group or association seeks to protect are germane to the organization's purpose; and
3. neither the claim asserted nor the relief requested requires the participation of the individual members in the case.

A request for a contested case hearing must be granted if the request is made by an affected person and the request: (A) complies with the requirements of 30 TAC § 55.251; (B) is timely filed; and (C) is pursuant to a right to hearing authorized by law.

An affected person is one who has a personal justiciable interest related to a legal right, duty, privilege, power, or economic interest affected by the application. An interest common to the general public does not constitute a justiciable interest. To determine whether a person is an affected person, all relevant factors must be considered, including but not limited to:

1. whether the interest claimed is one protected by the law under which the application will be considered;
2. distance restrictions or other limitations imposed by law on the affected interest;
3. whether a reasonable relationship exists between the interest claimed and the activity regulated;
4. the likely impact of the regulated activity on the health, safety, and use of property of the person;

(5) the likely impact of the regulated activity on the use of the impacted natural resource by the person; and
(6) for governmental entities, their statutory authority over or interest in the issues relevant to the application.

MAILING LIST
City of Lubbock
TCEQ Docket No. 2023-0617-WR; Permit No. WRPERM 5921

FOR THE APPLICANT:

Sarah R. Thornton, Principal
Lloyd Gosselink Rochelle & Townsend PC
816 Congress Avenue Suite 1900
Austin, Texas 78701

Thomas L. Adams, Deputy City Manager
City of Lubbock
P.O. Box 2000
Lubbock, Texas 79457

REQUESTER(S)/INTERESTED PERSON(S):

See attached list.

FOR THE EXECUTIVE DIRECTOR
via electronic mail:

Ruth Takeda, Staff Attorney
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Environmental Law Division, MC-173
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Austin, Texas 78711

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Texas Commission on Environmental Quality
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Ryan Vise, Deputy Director
Texas Commission on Environmental Quality
External Relations Division
Public Education Program, MC-108
P.O. Box 13087
Austin, Texas 78711

FOR PUBLIC INTEREST COUNSEL
via electronic mail:

Garrett T. Arthur, Attorney
Texas Commission on Environmental Quality
Public Interest Counsel, MC-103
P.O. Box 13087
Austin, Texas 78711

FOR ALTERNATIVE DISPUTE RESOLUTION
via electronic mail:

Kyle Lucas
Texas Commission on Environmental Quality
Alternative Dispute Resolution, MC-222
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Austin, Texas 78711

FOR THE CHIEF CLERK
via eFilings:

Docket Clerk
Texas Commission on Environmental Quality
Office of Chief Clerk, MC-105
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MORTON , STEVE
MOLTZ MORTON O'TOOLE LLC
2801 VIA FORTUNA STE 350
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TERRILL & WALDROP
810 W 10TH ST
AUSTIN TX 78701-2005

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

WATER USE PERMIT

PERMIT NO. 5921		TYPE: §§ 11.121, 11.042	
Permittee:	City of Lubbock	Address:	P.O. Box 2000 Lubbock, Texas 79457
Filed:	April 17, 2006	Granted:	
Purposes:	Municipal, Industrial, Agricultural	Counties:	Lubbock and Lynn
Watercourse:	North Fork Double Mountain Fork Brazos River	Watershed:	Brazos River Basin

WHEREAS, the City of Lubbock (City) seeks a Water Use Permit to construct and maintain a 20,708 acre-foot capacity reservoir (Jim Bertram Lake 7) on the North Fork Double Mountain Fork Brazos River, Brazos River Basin with the centerline of the dam being at Latitude 33.534012° N, Longitude 101.730515° W in Lubbock County; and

WHEREAS, the City also seeks to divert and use not to exceed 50,000 acre-feet of water per year from anywhere along the perimeter of the aforementioned reservoir, at a maximum diversion rate of 138.12 cfs (62,016 gpm), for municipal, industrial, and agricultural purposes within the City's service area in Lubbock and Lynn counties, Brazos River Basin; and

WHEREAS, the City further seeks to authorize the use of the bed and banks of the North Fork Double Mountain Fork Brazos River, Brazos River Basin to convey up to 14,856 acre-feet of water per year discharged from the South Central Lubbock Drainage System, up to 8,934 acre-feet of water per year discharged from the South Lubbock Drainage System, and up to 16,240 acre-feet of surface water- and groundwater-based return flows per year from the Southeast Water Reclamation Plant, authorized under TPDES Permit No. WQ00010353002, to Jim Bertram Lake 7 to support storage in and diversions from the reservoir; and

WHEREAS, water from the South Central Lubbock Drainage System and the South Lubbock Drainage System originates from stormwater collected in playa lakes and subsequently discharged to the North Fork Double Mountain Fork Brazos River; and

WHEREAS, the City will also use other water sources available to it in the North Fork Double Mountain Fork Brazos River, that are authorized under Water Permit Nos. 3985, as amended, and 3705, as amended, to support storage in and diversions from the reservoir; and

WHEREAS, water and return flows will be discharged at the following three points located on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, Lubbock County.

a. Discharge Point No. 1 (South Central Lubbock Drainage System) being at Latitude 33.55965° N, Longitude 101.79652° W at a maximum rate of 185 cfs;

b. Discharge Point No. 2 (South Lubbock Drainage System) being at Latitude 33.53363° N, Longitude 101.77879° W at a maximum rate of 75 cfs;

c. Discharge Point No. 3 (Southeast Water Reclamation Plant, TPDES Permit No. WQ00010353002) being at Latitude 33.56273° N, Longitude 101.79935° W at a maximum rate of 22.47 cfs; and

WHEREAS, the City maintains an agreement with the Brazos River Authority (BRA) in which the City will pass inflows of state water through Jim Bertram Lake 7 when the water surface elevation of Possum Kingdom Lake is below 1,000 feet msl and inflows exceed 5 cfs; and

WHEREAS, the Texas Commission on Environmental Quality finds that jurisdiction over the application is established; and

WHEREAS, the City has provided, and the Executive Director has approved, the *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7*; and

WHEREAS, the Executive Director recommends special conditions be included in the permit; and

WHEREAS, the Commission has complied with the requirements of the Texas Water Code and Rules of the Texas Commission on Environmental Quality in issuing this permit;

NOW, THEREFORE, this permit, designated as Water Use Permit No. 5921, is issued to the City of Lubbock subject to the following terms and conditions:

1. IMPOUNDMENT

Permittee is authorized to construct and maintain a 20,708 acre-foot capacity reservoir (Jim Bertram Lake 7) on the North Fork Double Mountain Fork Brazos River, Brazos River Basin with the centerline of the dam being at Latitude 33.534012° N, Longitude 101.730515° W in Lubbock County.

2. USE

A. Permittee is authorized to divert and use not to exceed 50,000 acre-feet of water per year from Jim Bertram Lake 7 for municipal, industrial, and agricultural purposes within the City's service area in Lubbock and Lynn counties.

B. Permittee is authorized to use the bed and banks of the North Fork Double Mountain Fork Brazos River to convey up to 14,856 acre-feet of water per year discharged from the South Central Lubbock Drainage System, up to 8,934 acre-feet of water per year discharged from the South Lubbock Drainage System, and up to 16,240 acre-feet of surface water- and groundwater-based return flows per year from the Southeast Water Reclamation Plant, authorized under TPDES Permit No. WQ00010353002, to Jim Bertram Lake 7 to support storage in and diversions from the reservoir.

C. Permittee is authorized to use water authorized under Water Permit Nos. 3985, as amended and 3705, as amended to support storage in and diversions from the reservoir.

3. DISCHARGE

Water will be discharged to the North Fork Double Mountain Fork Brazos River, in Lubbock County as follows:

A. Discharge Point No. 1 (South Central Lubbock Drainage System) - being at Latitude 33.55965° N, Longitude 101.79652° W at a maximum rate of 185 cfs.

B. Discharge Point No. 2 (South Lubbock Drainage System) - being at Latitude 33.53363° N, Longitude 101.77879° W at a maximum rate of 75 cfs.

C. Discharge Point No. 3 (Southeast Water Reclamation Plant, TPDES Permit No. WQ00010353002) being at Latitude 33.56273° N, Longitude 101.79935° W at a maximum rate of 22.47 cfs.

4. DIVERSION

Permittee is authorized to divert:

A. 50,000 acre-feet of water per year from anywhere along the perimeter of Jim Bertram Lake 7.

B. at a maximum diversion rate of 138.12 cfs (62,016 gpm).

5. TIME PRIORITY

A. The time priority for this right is April 17, 2006.

B. Water discharged from the South Central Lubbock Drainage System, the South Lubbock Drainage System, and return flows discharged from the Southeast Water Reclamation Plant and authorized to be conveyed via the bed and banks of a State watercourse in this permit does not have a priority date and is not subject to priority calls from senior water rights.

6. CONSERVATION

Permittee shall implement water conservation plans that provide for the utilization of those practices, techniques, and technologies that reduce or maintain the consumption of water, prevent or reduce the loss or waste of water, maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, and prevent the pollution of water, so that a water supply is made available for future or alternative uses. Such plans shall include a requirement that in every water supply contract entered into on or after the effective date of this permit, including any contract extension or renewal, that each successive wholesale customer develop and implement conservation measures. If the customer intends to resell the water, then the contract for resale of the water shall have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures.

7. SPECIAL CONDITIONS

A. Permittee shall implement reasonable measures in order to reduce impacts to aquatic resources due to entrainment or impingement. Such measures shall include, but shall not be limited to, the installation of screens at any new diversion structures.

B. For purposes of applying the environmental flow requirements in Paragraphs 7.D. – 7.J. of this permit, the measurement point shall be the dam at Jim Bertram Lake 7 and streamflows shall be measured and determined by the *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7.*

C. Notwithstanding the requirements set out in Paragraphs 7.D. – 7.J. of this permit, if Permittee has stored water in accordance with the terms and conditions of this permit at the time the water was stored, Permittee may divert and use that stored water, even if any environmental flow requirements are not met at the time of the subsequent diversion and use of that stored water.

D. Impoundment and diversion of state water under this permit shall be restricted based on the following streamflows at Permittee's measurement point, as set forth in Paragraphs 7.E. – 7.J. below.

Season	**Subsistence**	**Dry Condition Seasonal Pulse**	**Average Condition Seasonal Pulse**	**Wet Condition Seasonal Pulse**
Winter	1 cfs	N/A	N/A	N/A
Spring	1 cfs	1 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	2 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	1 per season Trigger: 88 cfs Volume: 335 af Duration: 10 days
Summer	1 cfs	1 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	2 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	1 per season Trigger: 74 cfs Volume: 278 af Duration: 10 days

cfs = cubic feet per second
af = acre-feet
N/A = not applicable

E. Seasons are defined as follows: Winter (November through February), Spring (March through June), and Summer (July through October).

F. Permittee shall determine the hydrologic condition once per season. The Palmer Hydrologic Drought Index (PHDI) value present on the last day of the month of the preceding season, as reported by the National Weather Service, shall be used to

determine the hydrologic condition for the following season as set out in Paragraphs F.i. – F.iii. below:

i Permittee shall determine the PHDI Index for a season based on the following formula:

(0.027 × High Plains PHDI) + (0.647 × Low Rolling Plains PHDI) + (0.326 × North Central PHDI)

ii. The PHDI Index and corresponding hydrologic conditions that govern diversions under this permit are:

Dry	Average	Wet
Less than -1.78	-1.78 – 2.18	Greater than 2.18

iii. Permittee may utilize an interim PHDI value to determine the hydrologic condition until the value preceding the start of the season is published in accordance with the procedure described in *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7.*

Subsistence Flow

G. Permittee shall not impound or divert water if the average streamflow at Permittee's measurement point is less than or equal to the applicable subsistence flow in Paragraph 7.D. The "average streamflow" at the measurement point is the average of measured streamflows for the previous 24 hours.

High Flow Pulse

H. If a pulse flow event required under Paragraph 7.D. is determined to have been triggered based on average streamflows at Permittee's measurement point then, until either the applicable volume amount has passed or the applicable duration time has passed since the high flow pulse was triggered, Permittee shall not impound or divert state water except during times that average streamflow exceeds the applicable pulse flow trigger level. Diversions during such times shall not exceed the rate that would reduce average streamflow to the applicable pulse flow trigger level; provided, however, Permittee is not required to adjust its diversion rate during the pulse event more frequently than once every 24 hours.

I. Each season is independent of the preceding and subsequent seasons with respect to high flow pulse frequency and the applicable high flow pulse is dependent on the applicable hydrologic condition.

J. If a qualifying pulse flow event occurs at Permittee's measurement point within a given season, the pulse event shall satisfy a pulse requirement for that season. A qualifying event occurs if the event is determined to have been triggered based on average streamflow and either the pulse flow volume or duration requirement is met.

K. Impoundment and diversion of return flows and other discharged water as authorized by this permit is dependent upon potentially interruptible return flows and discharges and is conditioned on the availability of those discharges. The right to divert return flows discharged from the Southeast Water Reclamation Plant and the water discharged from the South Central Lubbock Drainage System and the South Lubbock Drainage System is subject to revocation if all discharges become permanently unavailable for impoundment and diversion and may be subject to reduction if the return flows discharged from the Southeast Water Reclamation Plant and the water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System are not available in quantities and qualities sufficient to fully support the permit authorizations. Should any of the discharges become permanently unavailable for impoundment and diversion, Permittee shall immediately cease impoundment and diversion of return flows and other discharged water under this permit and either apply to amend the permit, or voluntarily forfeit the authorization to impound and divert return flows and other discharged water. If Permittee does not amend or forfeit the authorization, the Commission may begin proceedings to cancel these authorizations in the permit.

L. Permittee shall only impound or divert daily return flows and any water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System that is actually discharged.

M. Prior to diversion and impoundment of return flows in excess of the amount currently authorized by TPDES Permit No. WQ00010353002, described in Paragraph 2. USE and Paragraph 3. DISCHARGE, Permittee shall apply for and be granted the right to reuse those return flows. Permittee shall amend the accounting plan to include future discharges of return flows prior to diverting said return flows.

N. Prior to diversion of any additional water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System in excess of the maximum annual discharge volume described in Paragraph 2. USE and Paragraph 3. DISCHARGE, Permittee shall apply for and be granted the right to use the discharged water. Permittee shall amend the accounting plan to include additional discharges from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System prior to diverting said additional discharges.

O. Permittee shall only impound or divert water authorized under this permit pursuant to Paragraph 2. USE and Paragraph 4. DIVERSION in accordance with the most recently approved *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7.* Permittee shall maintain the plan in electronic format and make it available upon request. Any modifications to the accounting plan shall be approved by the Executive Director. Any modification to the accounting plan that changes the permit terms must be in the form of an amendment to the permit. Should Permittee fail to maintain the accounting plan or notify the Executive Director of any modifications to the plan, Permittee shall immediately cease diversion and impoundment of water authorized in this permit, and either apply to amend the permit, or voluntarily forfeit the permit. If Permittee fails to amend the accounting plan or forfeit the permit, the Commission may begin proceedings to cancel the permit. Permittee shall immediately notify the Executive Director upon modification of the accounting plan and provide copies of the appropriate documents effectuating such changes.

P. Any required mitigation plan for Jim Bertram Lake 7 shall comply with requirements set forth in 33 United States Code §1341, commonly known as the federal Clean Water Act (CWA), §401 and 30 Texas Administrative Code Chapter 279. The mitigation plan shall also comply with the requirements in §404 of the CWA as implemented through any approved U.S. Army Corps of Engineers permit for Jim Bertram Lake 7. Impoundment and diversions of water under this permit are contingent upon the initiation and completion of implementation of any U.S. Army Corps of Engineers approved mitigation plan.

Q. Permittee shall install and maintain a measuring device which accounts for, within 5% accuracy, the quantity of water diverted from the point(s) authorized above in Paragraph 4. DIVERSION.

R. Permittee shall allow representatives of the Texas Commission on Environmental Quality reasonable access to the property to inspect the measuring device and records.

S. Consistent with and subject to the conditions stated in Texas Water Code §11.147(e-1), the commission may adjust the environmental flow conditions in this permit to provide for the protection of instream flows or freshwater inflows to the bay and estuary, if the commission determines, through an expedited public review process, that such adjustment is appropriate to achieve compliance with applicable environmental flow standards adopted pursuant to Texas Water Code §11.1471. Any adjustment shall be made in accordance with the provisions of Texas Water Code §11.147(e-1).

8. TIME LIMITATIONS

A. Construction of the proposed dam for Jim Bertram Lake 7 shall be in accordance with plans approved by the Executive Director. Construction of the dam without final approval of the construction plans is a violation of this authorization.

B. Construction shall begin within two years of issuance of this permit and be completed within five years of issuance of the permit unless Permittee applies for and is subsequently granted an extension of time before the expiration of these time limitations.

The diversion and impoundment of unappropriated state water authorized in this permit is subject to all superior and senior water rights in the Brazos River Basin.

Permittee agrees to be bound by the terms, conditions, and provisions contained herein and such agreement is a condition precedent to the granting of this permit.

All other matters requested in the application which are not specifically granted by this permit are denied.

This permit is issued subject to the Rules of the Texas Commission on Environmental Quality and to the right of continuing supervision of State water resources exercised by the Commission.

For the Commission

ISSUED:

Sarah Henderson

From: Sara Thornton <[redacted]
Sent: Wednesday, February 23, 2022 11:58 AM
To: Sarah Henderson
Subject: RE: City of Lubbock WRPERM No. 5921 - Revised Draft

Hi Sarah,

Apologies, I was out sick yesterday. The City has no further comments or revisions and accepts the draft permit as revised. Can you please send me a clean version of the revised draft permit for the City to use in approaching protestants to determine whether we can get them to withdraw their hearing requests?

Thanks,

Sara

To help protect your privacy, Microsoft Office prevented automatic download of this picture from the Internet.

SARA R. THORNTON
Principal
512-322-5876 Direct
Lloyd Gosselink Rochelle & Townsend, P.C.
816 Congress Ave., Suite 1900, Austin, TX 78701
www.lglawfirm.com | 512-322-5800
OUT NOW! Season Two: Listen In With Lloyd Gosselink Podcast
News| vCard | LinkedIn | Bio

From: Sarah Henderson <sarah.henderson@tceq.texas.gov>
Sent: Wednesday, February 9, 2022 11:58 AM
To: Sara Thornton [redacted]
Subject: City of Lubbock WRPERM No. 5921 - Revised Draft

Hi Sara,
My apologies, my original email sent yesterday bounced back to me today.

Please find the attached revised, red-lined draft permit and the original technical memoranda for your reference and review.
Comments are requested by February 22, 2022.

Sincerely,
Sarah

Sarah Henderson
Water Rights Permitting Team
Water Availability Division
Texas Commission on Environmental Quality
P.O. Box 13087/MC-160
Austin, TX 78711-3087
(P) 512.239.2535
(F) 512.239.4770

Jon Niermann, *Chairman*
Emily Lindley, *Commissioner*
Bobby Janecka, *Commissioner*
Toby Baker, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

February 8, 2022

Ms. Sara Thornton **VIA E-MAIL**
Lloyd Gosselink Rochelle & Townsend, PC
816 Congress Ave., Suite 1900
Austin, Texas 78701

Re: City of Lubbock
WRPERM 5921
CN600130736, RN104918107
Application No. 5921 for a Water Use Permit
Texas Water Code §§ 11.121, 11.042, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock County

Dear Ms. Thornton:

This acknowledges receipt, on November 30, 2021, of the applicant's comments to the draft permit for Water Use Permit No. 5921.

Staff has reviewed the applicant's comments and have made changes to the draft permit. Staff recognizes that the City intends to initiate the process to obtain any other required state and federal permits and has proposed a revision to the draft permit. The revised, red-lined draft, subject to revision, and the related technical memoranda are attached.

Staff is recommending the referenced application be granted in accordance with the attached revised, red-lined draft. Please review the draft and contact me no later than February 22, 2022 with any comments or questions as the permit will be forwarded to the Office of the Chief Clerk for further processing after that date.

If you have any questions concerning this matter please contact me via e-mail at sarah.henderson@tceq.texas.gov or by telephone at (512) 239-2535.

Sincerely,

Sarah E Henderson

Sarah Henderson, Project Manager
Water Rights Permitting Team
Water Rights Permitting and Availability Section

Attachments

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

WATER USE PERMIT

PERMIT NO. 5921		TYPE: §§ 11.121, 11.042	
Permittee:	City of Lubbock	Address:	P.O. Box 2000 Lubbock, Texas 79457
Filed:	April 17, 2006	Granted:	
Purposes:	Municipal, Industrial, Agricultural	Counties:	Lubbock and Lynn
Watercourse:	North Fork Double Mountain Fork Brazos River	Watershed:	Brazos River Basin

WHEREAS, the City of Lubbock (City) seeks a Water Use Permit to construct and maintain a 20,708 acre-foot capacity reservoir (Jim Bertram Lake 7) on the North Fork Double Mountain Fork Brazos River, Brazos River Basin with the centerline of the dam being at Latitude 33.534012° N, Longitude 101.730515° W in Lubbock County; and

WHEREAS, the City also seeks to divert and use not to exceed 50,000 acre-feet of water per year from anywhere along the perimeter of the aforementioned reservoir, at a maximum diversion rate of 138.12 cfs (62,016 gpm), for municipal, industrial, and agricultural purposes within the City's service area in Lubbock and Lynn counties, Brazos River Basin; and

WHEREAS, the City further seeks to authorize the use of the bed and banks of the North Fork Double Mountain Fork Brazos River, Brazos River Basin to convey up to 14,856 acre-feet of water per year discharged from the South Central Lubbock Drainage System, up to 8,934 acre-feet of water per year discharged from the South Lubbock Drainage System, and up to 16,240 acre-feet of surface water- and groundwater-based return flows per year from the Southeast Water ~~Recycling~~ Reclamation Plant, authorized under TPDES Permit No. WQ00010353002, to Jim Bertram Lake 7 to support storage in and diversions from the reservoir; and

WHEREAS, water from the South Central Lubbock Drainage System and the South Lubbock Drainage System originates from stormwater collected in playa lakes and subsequently discharged to the North Fork Double Mountain Fork Brazos River; and

WHEREAS, the City will also use other water sources available to it in the North Fork Double Mountain Fork Brazos River, that are authorized under Water Permit Nos. 3985, as amended, and 3705, as amended, to support storage in and diversions from the reservoir; and

WHEREAS, water and return flows will be discharged at the following three points located on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, Lubbock County.

a. Discharge Point No. 1 (South Central Lubbock Drainage System) being at Latitude 33.5596 5~~7~~˚ N, Longitude 101.7965 2~~3~~˚ W at a maximum rate of 185 cfs;

b. Discharge Point No. 2 (South Lubbock Drainage System) being at Latitude 33.5336 3~~1~~˚ N, Longitude 101.7787 9~~8~~˚ W at a maximum rate of ~~18~~75 cfs;

c. Discharge Point No. 3 (Southeast Water ~~Recycling~~ Reclamation Plant, TPDES Permit No. WQ00010353002) being at Latitude 33.5 6273~~5961~~˚ N, Longitude 101.79 935~~654~~˚ W at a maximum rate of 22.47 cfs; and

WHEREAS, the City maintains an agreement with the Brazos River Authority (BRA) in which the City will pass inflows of state water through Jim Bertram Lake 7 when the water surface elevation of Possum Kingdom Lake is below 1,000 feet msl and inflows exceed 5 cfs; and

WHEREAS, the Texas Commission on Environmental Quality finds that jurisdiction over the application is established; and

WHEREAS, the City has provided, and the Executive Director has approved, the *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7*; and

WHEREAS, the Executive Director recommends special conditions be included in the permit; and

WHEREAS, the Commission has complied with the requirements of the Texas Water Code and Rules of the Texas Commission on Environmental Quality in issuing this permit;

NOW, THEREFORE, this permit, designated as Water Use Permit No. 5921, is issued to the City of Lubbock subject to the following terms and conditions:

1. IMPOUNDMENT

Permittee is authorized to construct and maintain a 20,708 acre-foot capacity reservoir (Jim Bertram Lake 7) on the North Fork Double Mountain Fork Brazos River, Brazos River Basin with the centerline of the dam being at Latitude 33.534012˚ N, Longitude 101.730515˚ W in Lubbock County.

2. USE

A. Permittee is authorized to divert and use not to exceed 50,000 acre-feet of water per year from Jim Bertram Lake 7 for municipal, industrial, and agricultural purposes within the City's service area in Lubbock and Lynn counties.

B. Permittee is authorized to use the bed and banks of the North Fork Double Mountain Fork Brazos River to convey up to 14,856 acre-feet of water per year discharged from the South Central Lubbock Drainage System, up to 8,934 acre-feet of water per year discharged from the South Lubbock Drainage System, and up to 16,240 acre-feet of surface water- and groundwater-based return flows per year from the Southeast Water ~~Recycling~~ Reclamation Plant, authorized under TPDES Permit No. WQ00010353002, to Jim Bertram Lake 7 to support storage in and diversions from the reservoir.

C. Permittee is authorized to use water authorized under Water Permit Nos. 3985, as amended and 3705, as amended to support storage in and diversions from the reservoir.

3. DISCHARGE

Water will be discharged to the North Fork Double Mountain Fork Brazos River, in Lubbock County as follows:

A. Discharge Point No. 1 (South Central Lubbock Drainage System) - being at Latitude 33.55965~~7~~° N, Longitude 101.79652~~3~~° W at a maximum rate of 185 cfs.

B. Discharge Point No. 2 (South Lubbock Drainage System) - being at Latitude 33.53363~~1~~° N, Longitude 101.77879~~8~~° W at a maximum rate of 7~~18~~5 cfs.

C. Discharge Point No. 3 (Southeast Water ~~Recycling~~ Reclamation Plant, TPDES Permit No. WQ00010353002) being at Latitude 33.56273~~5961~~° N, Longitude 101.79935~~654~~° W at a maximum rate of 22.47 cfs.

4. DIVERSION

Permittee is authorized to divert:

A. 50,000 acre-feet of water per year from anywhere along the perimeter of Jim Bertram Lake 7.

B. at a maximum diversion rate of 138.12 cfs (62,016 gpm).

5. TIME PRIORITY

A. The time priority for this right is April 17, 2006.

B. Water discharged from the South Central Lubbock Drainage System, the South Lubbock Drainage System, and return flows discharged from the Southeast Water ~~Recycling~~ Reclamation Plant and authorized to be conveyed via the bed and banks of a State watercourse in this permit does not have a priority date and is not subject to priority calls from senior water rights.

6. CONSERVATION

Permittee shall implement water conservation plans that provide for the utilization of those practices, techniques, and technologies that reduce or maintain the consumption of water, prevent or reduce the loss or waste of water, maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, and prevent the pollution of water, so that a water supply is made available for future or alternative uses. Such plans shall include a requirement that in every water supply contract entered into on or after the effective date of this permit, including any contract extension or renewal, that each successive wholesale customer develop and implement conservation measures. If the customer intends to resell the water, then the contract for resale of the water shall have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures.

7. SPECIAL CONDITIONS

A. Permittee shall implement reasonable measures in order to reduce impacts to aquatic resources due to entrainment or impingement. Such measures shall include, but shall not be limited to, the installation of screens at any new diversion structures.

B. For purposes of applying the environmental flow requirements in Paragraphs 7.D. – 7.J. of this permit, the measurement point shall be the dam at Jim Bertram Lake 7 and streamflows shall be measured and determined by the *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7.*

C. Notwithstanding the requirements set out in Paragraphs 7.D. – 7.J. of this permit, if Permittee has stored water in accordance with the terms and conditions of this permit at the time the water was stored, Permittee may divert and use that stored water, even if any environmental flow requirements are not met at the time of the subsequent diversion and use of that stored water.

D. Impoundment and diversion of state water under this permit shall be restricted based on the following streamflows at Permittee's measurement point, as set forth in Paragraphs 7.E. – 7.J. below.

Season	**Subsistence**	**Dry Condition Seasonal Pulse**	**Average Condition Seasonal Pulse**	**Wet Condition Seasonal Pulse**
Winter	1 cfs	N/A	N/A	N/A
Spring	1 cfs	1 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	2 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	1 per season Trigger: 88 cfs Volume: 335 af Duration: 10 days
Summer	1 cfs	1 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	2 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	1 per season Trigger: 74~~88~~ cfs Volume: 278 af Duration: 10 days

cfs = cubic feet per second
af = acre-feet
N/A = not applicable

E. Seasons are defined as follows: Winter (November through February), Spring (March through June), and Summer (July through October).

F. Permittee shall determine the hydrologic condition once per season. The Palmer Hydrologic Drought Index (PHDI) value present on the last day of the month of the preceding season, as reported by the National Weather Service, shall be used to

determine the hydrologic condition for the following season as set out in Paragraphs F.i. – F.iii. below:

i Permittee shall determine the PHDI Index for a season based on the following formula:

(0.027 × High Plains PHDI) + (0.647 × Low Rolling Plains PHDI) + (0.326 × North Central PHDI)

ii. The PHDI Index and corresponding hydrologic conditions that govern diversions under this permit are:

Dry	Average	Wet
Less than -1.78	-1.78 – 2.18	Greater than 2.18

iii. Permittee may utilize an interim PHDI value to determine the hydrologic condition until the value preceding the start of the season is published in accordance with the procedure described in *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7.*

Subsistence Flow

G. Permittee shall not impound or divert water if the average streamflow at Permittee's measurement point is less than or equal to the applicable subsistence flow in Paragraph 7.D. The "average streamflow" at the measurement point is the average of measured streamflows for the previous 24 hours.

High Flow Pulse

H. If a pulse flow event required under Paragraph 7.D. is determined to have been triggered based on average streamflows at Permittee's measurement point then, until either the applicable volume amount has passed or the applicable duration time has passed since the high flow pulse was triggered, Permittee shall not impound or divert state water except during times that average streamflow exceeds the applicable pulse flow trigger level. Diversions during such times shall not exceed the rate that would reduce average streamflow to the applicable pulse flow trigger level; provided, however, Permittee is not required to adjust its diversion rate during the pulse event more frequently than once every 24 hours.

I. Each season is independent of the preceding and subsequent seasons with respect to high flow pulse frequency and the applicable high flow pulse is dependent on the applicable hydrologic condition.

J. If a qualifying pulse flow event occurs at Permittee's measurement point within a given season, the pulse event shall satisfy a pulse requirement for that season. A qualifying event occurs if the event is determined to have been triggered based on average streamflow and either the pulse flow volume or duration requirement is met.

K. Impoundment and diversion of return flows and other discharged water as authorized by this permit is dependent upon potentially interruptible return flows and discharges and is conditioned on the availability of those discharges. The right to divert return flows discharged from the Southeast Water ~~Recycling~~ Reclamation Plant and the water discharged from the South Central Lubbock Drainage System and the South Lubbock Drainage System is subject to revocation if all discharges become permanently unavailable for impoundment and diversion and may be subject to reduction if the return flows discharged from the Southeast Water ~~Recycling~~ Reclamation Plant and the water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System are not available in quantities and qualities sufficient to fully support the permit authorizations. Should any of the discharges become permanently unavailable for impoundment and diversion, Permittee shall immediately cease impoundment and diversion of return flows and other discharged water under this permit and either apply to amend the permit, or voluntarily forfeit the authorization to impound and divert return flows and other discharged water. If Permittee does not amend or forfeit the authorization, the Commission may begin proceedings to cancel these authorizations in the permit.

L. Permittee shall only impound or divert daily return flows and any water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System that is actually discharged.

M. Prior to diversion and impoundment of return flows in excess of the amount currently authorized by TPDES Permit No. WQ00010353002, described in Paragraph 2. USE and Paragraph 3. DISCHARGE, Permittee shall apply for and be granted the right to reuse those return flows. Permittee shall amend the accounting plan to include future discharges of return flows prior to diverting said return flows.

N. Prior to diversion of any additional water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System in excess of the maximum annual discharge volume described in Paragraph 2. USE and Paragraph 3. DISCHARGE, Permittee shall apply for and be granted the right to use the discharged water. Permittee shall amend the accounting plan to include additional discharges from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System prior to diverting said additional discharges.

O. Permittee shall only impound or divert water authorized under this permit pursuant to Paragraph 2. USE and Paragraph 4. DIVERSION in accordance with the most recently approved *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7.* Permittee shall maintain the plan in electronic format and make it available upon request. Any modifications to the accounting plan shall be approved by the Executive Director. Any modification to the accounting plan that changes the permit terms must be in the form of an amendment to the permit. Should Permittee fail to maintain the accounting plan or notify the Executive Director of any modifications to the plan, Permittee shall immediately cease diversion and impoundment of water authorized in this permit, and either apply to amend the permit, or voluntarily forfeit the permit. If Permittee fails to amend the accounting plan or forfeit the permit, the Commission may begin proceedings to cancel the permit. Permittee shall immediately notify the Executive Director upon modification of the accounting plan and provide copies of the appropriate documents effectuating such changes.

P. Any required mitigation plan for Jim Bertram Lake 7 shall comply with requirements set forth in 33 United States Code §1341, commonly known as the federal Clean Water Act (CWA), §401 and 30 Texas Administrative Code Chapter 279. The mitigation plan shall also comply with the requirements in §404 of the CWA as implemented through any approved U.S. Army Corps of Engineers permit for Jim Bertram Lake 7. Impoundment and diversions of water under this permit are contingent upon the initiation and completion of implementation of any U.S. Army Corps of Engineers approved mitigation plan.

~~P.~~Q. Permittee shall install and maintain a measuring device which accounts for, within 5% accuracy, the quantity of water diverted from the point(s) authorized above in Paragraph 4. DIVERSION.

~~Q.~~R. Permittee shall allow representatives of the Texas Commission on Environmental Quality reasonable access to the property to inspect the measuring device and records.

~~R.~~S. Consistent with and subject to the conditions stated in Texas Water Code §11.147(e-1), the commission may adjust the environmental flow conditions in this permit to provide for the protection of instream flows or freshwater inflows to the bay and estuary, if the commission determines, through an expedited public review process, that such adjustment is appropriate to achieve compliance with applicable environmental flow standards adopted pursuant to Texas Water Code §11.1471. Any adjustment shall be made in accordance with the provisions of Texas Water Code §11.147(e-1).

8. TIME LIMITATIONS

A. Construction of the proposed dam for Jim Bertram Lake 7 shall be in accordance with plans approved by the Executive Director. Construction of the dam without final approval of the construction plans is a violation of this authorization.

B. Construction shall begin within two years of issuance of this permit and be completed within five years of issuance of the permit unless Permittee applies for and is subsequently granted an extension of time before the expiration of these time limitations.

The diversion and impoundment of unappropriated state water authorized in this permit is subject to all superior and senior water rights in the Brazos River Basin.

Permittee agrees to be bound by the terms, conditions, and provisions contained herein and such agreement is a condition precedent to the granting of this permit.

All other matters requested in the application which are not specifically granted by this permit are denied.

This permit is issued subject to the Rules of the Texas Commission on Environmental Quality and to the right of continuing supervision of State water resources exercised by the Commission.

For the Commission

ISSUED:

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Sarah Henderson, Project Manager
Water Rights Permitting Team

Date: November 10, 2021

From: Kathy Alexander, Ph.D.
Policy and Technical Analyst
Water Availability Division

Subject: City of Lubbock
WRPERM 5921
CN600130736
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn counties

WATER AVAILABILITY ANALYSIS

Application Summary

The City of Lubbock (City) requests authorization to construct and maintain a reservoir (Lake 7) impounding 20,708 acre-feet of water on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, for subsequent diversion of 50,000 acre-feet of water per year from the perimeter of the reservoir at a maximum diversion rate of 138.12 cfs (62,016 gpm) for municipal, industrial, and agricultural purposes in Lubbock and Lynn counties. The City also requests authorization to use the bed and banks of the North Fork Double Mountain Fork of the Brazos River to convey up to 14,856 acre-feet of water discharged from the South Central Lubbock Drainage System, up to 8,934 acre-feet of water from the South Lubbock Drainage System, and up to 16,240 acre-feet of surface water- and groundwater-based return flows from Southeast Water Recycling Plant, authorized by WQ00010353002, to Lake 7 to support storage in and diversions from the reservoir. The City will use other water sources available to it in the North Fork Double Mountain Fork Brazos River, that are authorized under Water Use Permit Nos. 3985, as amended, and 3705, as amended. The City maintains an agreement with the Brazos River Authority in which the City will pass water through Lake 7 when streamflow exceeds 5 cfs and when the water surface elevation of Possum Kingdom Lake is below 1,000 feet msl.

The application was declared administratively complete on April 17, 2006.

The City submitted an accounting plan on August 15, 2016, which was revised several times. The final accounting plan was submitted on February 2, 2021.

Water Availability Analysis

Pursuant to 30 Texas Administrative Code (TAC) §298 Subchapter G, Resource

Protection staff recommend that the application be subject to instream flow requirements. Resource Protection staff also recommended other special conditions. See Resource Protection staff's April 22, 2021 memorandum.

The Water Rights Analysis Package (WRAP) simulates management of the water resources of a river basin. TCEQ uses WRAP in the evaluation of water right permit applications using priority-based water allocations. WRAP is a generalized simulation model for application to any river basin, and input datasets must be developed for the particular river basin of concern. The TCEQ developed water availability models (WAMs) for Texas river basins that include geographical information, water right information, naturalized flows, evaporation rates, channel losses, and specific management assumptions. Hydrology staff operates WRAP to evaluate water rights applications to determine water availability and to ensure that senior water rights are protected.

An evaluation of a proposed appropriation of state water must consider effects of the proposed permit on groundwater or groundwater recharge. The naturalized flows that are the basis for the TCEQ WAM take into account both contribution to river flow caused by groundwater coming to the surface in the river (springs) and decreases in river flow caused by the river flowing over recharge features and losing surface water to groundwater recharge. Therefore, any effects on groundwater or groundwater recharge are incorporated into the modeling for this application. By considering any gains and losses due to groundwater/surface water interaction in its water availability analysis, the commission is protecting groundwater resources.

The City requested that compliance with the adopted environmental flow standards be measured at Lake 7. Staff reviewed this request and is not opposed to measuring compliance under the permit at Lake 7. The City translated the adopted subsistence and base flow standards from USGS Gage No. 08080500 – Double Mountain Fork Brazos River near Aspermont to Lake 7 based on their contributing drainage areas and provided the method used to translate the pulse flow standards. Staff reviewed the methods and found them adequate. Measurement of the applicable environmental flow requirements at Lake 7 would be an adequate indicator of whether operations under the permit are in compliance with the adopted standards.

TCEQ's environmental flow standards for the Brazos Basin in 30 TAC §298 Subchapter G (Brazos River and its Associated Bay and Estuary System) include a hydrologic condition (§298.470 Calculation of Hydrologic Conditions). The hydrologic condition is based on the Palmer Hydrologic Drought Index (PHDI) and the PHDI Index as defined in §298.455 (6) and (7). Based on §298.455(11), the application is located in the Upper Basin. The Climate Divisions included in the Upper Basin are the High Plains (Climate Division 1), Low Rolling Plains (Climate Division 2), and North Central (Climate Division 3). The values for the PHDI Index for the Upper Basin used to determine the hydrologic condition are calculated as follows (§298.470(b)):

(0.027 × High Plains PHDI) + (0.647 × Low Rolling Plains PHDI) + (0.326 × North Central PHDI).

The determination of the hydrologic condition for a particular season is determined once per season. The PHDI value present on the last day of the month of the preceding season, as reported by the National Weather Service, and calculated for the geographic area as described in subsection (b) of the section, determines the hydrologic condition for the following season. The values for the PHDI are available at https://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers/. Under the adopted rules, PHDI values are based on the last day of the month before the start of a new season; however, final approved PHDI values for a month are typically available from the National Climatic Data Center (NCDC) near the middle of the following month. Therefore, in order to determine the hydrologic condition for a season, the latest published monthly value can be used on an interim basis until the final value for the month preceding the season is available. When the NCDC publishes the final value for the month preceding the season, the hydrologic condition applicable for the season can be updated if required.

Staff notes that TCEQ's adopted environmental flow standards for the Brazos Basin in 30 TAC §298 Subchapter G (Brazos River and its Associated Bay and Estuary System) do not include freshwater inflow standards for the Brazos Estuary.

New Appropriation Analysis

Staff modeled the application using the Full Authorization simulation of the Brazos River Basin WAM where water rights utilize their maximum authorized amounts for storage and diversion, and return flows are not included. The period of record for the Brazos WAM is 1940 through 2018. The Brazos WAM includes the adopted standards for all measurement points required by Chapter 298, Subchapter G. Under 30 TAC §298.465, the priority date for the environmental flow standards in the Brazos WAM is March 1, 2012. For modeling purposes, this application was modeled with a priority date of March 8, 2012 so that the application would be junior to both the adopted standards and applications for new appropriations considered after the standards were adopted.

Staff first evaluated the extent to which unappropriated water was available to support the request if 50,000 acre-feet of water was diverted from the reservoir and the City's additional sources were not available to support diversion and storage. The simulation results indicate that 39,930 acre-feet is available for diversion in one year of the period of record. Staff also evaluated storage of unappropriated water assuming no diversions from the reservoir. Simulation results indicate that the reservoir was more than 50% full in 28% of the months in the period of record. Staff notes that the City has an agreement with Brazos River Authority (BRA) which states that when the elevation of BRA's Possum Kingdom Lake is below 1,000 feet msl and inflows of state water exceed 5 cfs, the City will pass inflows above 5 cfs through Lake 7. The Brazos WAM implements the prior appropriation doctrine whereby senior water rights get access to available flows first, based on their priority dates. In the simulation, BRA's senior rights in Lake

Possum Kingdom would have access to all available unappropriated water prior to the City's impoundment and diversion at Lake 7 under its junior priority date. Therefore, staff's simulation represents a very conservative estimate of the amount of unappropriated water available for storage and diversion from Lake 7.

Bed and Banks

The City also requested authorization to use the bed and banks of the North Fork Double Mountain Fork, Brazos River to convey up to 14,856 acre-feet of water discharged from the South Central Lubbock Drainage System (SCLDS) , up to 8,934 acre-feet of water from the South Lubbock Drainage System (SLDS), and up to 16,240 acre-feet of surface water and groundwater based return flows from Southeast Water Recycling Plant (SEWRP), authorized by WQ00010353002, to Lake 7. Water conveyed to Lake 7 will support storage in and diversions from the reservoir. Water from the SCLDS and SLDS originates from stormwater collected in playa lakes and subsequently discharged to the North Fork Double Mountain Fork Brazos River. This stormwater would not naturally have contributed flow to the Brazos River and its tributaries. Therefore, staff's opinion is that downstream water rights could not have relied on these flows in the river and the City's use of these flows cannot affect other water rights. The City applied for reuse of return flows from SEWRP prior to discharge of those return flows. Therefore, downstream water rights could not have been granted based on these return flows and the City's use of these flows cannot affect other water rights.

The City estimated channel losses associated with the requests to convey water and return flows from SCLDS, SLDS, and SEWRP to Lake 7 as well as revised channel losses for conveyance of return flows from NWRP and water from NDP. The proposed and revised channel losses are based on channel loss factors in TCEQ's Brazos WAM. Staff reviewed the estimates of losses and found them to be acceptable.

Consideration of other sources of water available to the City

Staff performed an additional simulation that considered use of water from SCLDS, SLDS, SEWRP and water authorized under Water Use Permit No. 3985, as amended to support diversions from and storage in Lake 7. Staff added flows from these additional sources to the Brazos WAM as follows:

- Discharges from SCLDS, SLDS, SEWRP requested in the application, and 6,725 acre-feet of return flows discharged from the Northwest Water Reclamation Plant (NWRP) and up to 7,100 acre-feet of water discharged by the Northwest Drainage Project (NDP) authorized by Water Use Permit No. 3985, as amended, were made available only for the City's use in Lake 7.
- Discharges from SEWRP and NWRP were modeled as constant monthly volumes.
- Discharges from SCLDS, SLDS and NDP are variable and dependent on rainfall. Staff used the City's estimates of the volume of water anticipated to be discharged from these facilities based on studies that are further described in a

July 15, 2015 memorandum and supplemented by an October 20, 2021 submittal of data through 2018.

- Discharges of stormwater and reuse water were adjusted for channel losses.

Simulation results indicate that the requested diversion amount, 50,000 acre-feet per year, is available in one year of the period of record. TCEQ’s rules (30 TAC §297.42(d)) provide that the required water availability for projects that are not based on the continuous availability of streamflow shall be determined on a case-by-case basis based upon whether the proposed project can be viable for the intended purpose and the water will be beneficially used without waste. The determination of whether the water will be beneficially used without waste is addressed in the conservation review of the application. Regarding whether the proposed project is viable for the intended purpose, the City owns water rights in Lakes Meredith and Alan Henry as well as groundwater sources. Given the City’s multiple sources of supply, staff’s opinion is that the project can be viable for the intended purpose.

Accounting Plan

The City submitted an accounting plan (*City of Lubbock Accounting Plan for Permit 12-5921 Lake 7*) that calculates state water inflows to Lake 7 and accounts for the use of the City’s sources of supply as well as compliance with the recommended environmental flow requirements. Staff reviewed the accounting plan and found it adequate to demonstrate compliance with the terms and conditions of the proposed permit.

Conclusion

Simulation results indicate that the amount of water requested is available during the period of record. Staff is of the opinion that if the City manages the new appropriation as part of its water supply system in accordance with the approved accounting plan, the application will not affect existing water rights and will be viable for the intended purpose. Therefore, Staff can support granting the application.

Staff recommends that the following special conditions be included in the permit:

1. If Permittee has stored water in accordance with the terms and conditions of this permit at the time the water was stored, Permittee may divert and use that stored water, even if any environmental flow requirements are not met at the time of the subsequent diversion and use of that stored water.

2. Permittee shall determine the hydrologic condition once per season. The Palmer Hydrologic Drought Index (PHDI) value present on the last day of the month of the preceding season, as reported by the National Weather Service, shall be used to determine the hydrologic condition for the following season as set out in Paragraphs 1.a. – c. below.

a. Permittee shall determine the PHDI Index for a season based on the following formula:

(0.027 × High Plains PHDI) + (0.647 × Low Rolling Plains PHDI) + (0.326 × North Central PHDI)

b. The PHDI Index and corresponding hydrologic conditions that govern diversions under this permit are:

Dry	Average	Wet
Less than -1.78	-1.78 – 2.18	Greater than 2.18

c. Permittee may utilize an interim PHDI value to determine the hydrologic condition until the value preceding the start of the season is published in accordance with the procedure described in *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7*.

2. Impoundment and diversion of return flows and other discharged water as authorized by this permit is dependent upon potentially interruptible return flows and discharges and is conditioned on the availability of those discharges. The right to divert return flows discharged from the Southeast Water Recycling Plant and the water discharged from the South Central Lubbock Drainage System and the South Lubbock Drainage System is subject to revocation if all discharges become permanently unavailable for impoundment and diversion and may be subject to reduction if the return flows discharged from the Southeast Water Recycling Plant and the water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System are not available in quantities and qualities sufficient to fully support the permit authorizations. Should any of the discharges become permanently unavailable for impoundment and diversion, Permittee shall immediately cease impoundment and diversion of return flows and other discharged water under this permit and either apply to amend the permit, or voluntarily forfeit the authorization to impound and divert return flows and other discharged water. If Permittee does not amend or forfeit the authorization, the Commission may begin proceedings to cancel these authorizations in the permit.

3. Permittee shall only divert daily return flows and any water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System that is actually discharged.

4. Prior to diversion and impoundment of return flows in excess of the amount currently authorized by TPDES Permit No. WQ00010353002, described in Paragraph 2. USE and Paragraph 3. DISCHARGE, Permittee shall apply for and be granted the right to reuse those return flows. Permittee shall amend the accounting plan to include future discharges of return flows prior to diverting said return flows.

5. Prior to diversion of any additional water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System in excess of the maximum annual discharge volume described in Paragraph 2. USE and Paragraph 3. DISCHARGE, Permittee shall apply for and be granted the right to use the discharged water. Permittee shall amend the accounting plan to include additional discharges from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System prior to diverting said additional discharges.

6. Permittee shall only divert water authorized under this permit pursuant to Paragraph 2. USE and Paragraph 4. DIVERSION in accordance with the most recently approved *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7.* Permittee shall maintain the plan in electronic format and make it available upon request. Any modifications to the accounting plan shall be approved by the Executive Director. Any modification to the accounting plan that changes the permit terms must be in the form of an amendment to the permit. Should Permittee fail to maintain the accounting plan or notify the Executive Director of any modifications to the plan, Permittee shall immediately cease diversion and impoundment of water authorized in this permit, and either apply to amend the permit, or voluntarily forfeit the permit. If Permittee fails to amend the accounting plan or forfeit the permit, the Commission may begin proceedings to cancel the permit. Permittee shall immediately notify the Executive Director upon modification of the accounting plan and provide copies of the appropriate documents effectuating such changes.

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Sarah Henderson, Project Manager
Water Rights Permitting Team

Date: April 22, 2021

Through: Jason Godeaux, Team Leader
Resource Protection Team

From: Kenneth Coonrod, Aquatic Scientist
KC Resource Protection Team

Subject: City of Lubbock
WRPERM 5921
CN600130736
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn counties

Environmental reviews of water right applications are conducted in accordance with applicable provisions of the Texas Water Code (TWC) and the administrative rules of the Texas Commission on Environmental Quality (TCEQ). The provisions applicable to environmental reviews can vary according to the type and the location of the authorization requested.

APPLICATION SUMMARY

The City of Lubbock (City) requests authorization to construct and maintain a reservoir (Lake 7) impounding 20,708 acre-feet of water on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, for subsequent diversion of 50,000 acre-feet of water per year from the perimeter of the reservoir at a maximum diversion rate of 138.12 cfs (62,016 gpm) for municipal, industrial, and agricultural purposes in Lubbock and Lynn counties. The City also requests authorization to use the bed and banks of the North Fork Double Mountain Fork Brazos River to convey up to 14,856 acre-feet of water per year discharged from the South Central Lubbock Drainage System, up to 8,934 acre-feet of water per year from the South Lubbock Drainage System, and up to 16,420 acre-feet of surface water- and groundwater-based return flows per year, to Lake 7 to support storage in and diversions from the reservoir, from the Southeast Water Recycling Plant, authorized under Texas Pollutant Discharge Elimination System Permit No. WQ00010353002. The City will use other water sources available to it in the North Fork Double Mountain Fork Brazos River, that are authorized under Water Use Permit Nos. 3985, as amended, and 3705, as amended.

The City maintains an agreement with the Brazos River Authority in which the City will pass water through Lake 7 when streamflows exceed 5 cfs and when the water surface elevation of Possum Kingdom Lake is below 1,000 feet msl.

ENVIRONMENTAL ANALYSIS

New Appropriation Request

On February 12, 2014, the TCEQ adopted environmental flow standards for the Brazos River and its associated bay and estuary system (Title 30 Texas Administrative Code (TAC) Chapter 298 Subchapter G). These environmental flow standards are considered adequate to support a sound ecological environment (Title 30 TAC § 298.460).

The City is requesting a new appropriation of water and therefore is subject to the adopted standards. This review is conducted in accordance with §11.147(e-3) of the TWC and Title 30 TAC Chapter 298 Subchapter G (Brazos River and its associated bay and estuary system). In Title 30 TAC § 298.480(1), environmental flow standards were established at United States Geological Survey (USGS) Gage No. 08080500 – Double Mountain Fork Brazos River near Aspermont, and the applicable environmental flow standards are shown in Table 1.

Table 1. Environmental Flow Standards at USGS Gage No. 08080500 – Double Mountain Fork Brazos River near Aspermont.

Season	Subsistence	Hydrologic Condition	Base	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	1 cfs	Dry	1 cfs	N/A	N/A	N/A
		Average	4 cfs			
		Wet	15 cfs			
Spring	1 cfs	Dry	1 cfs	1 per season Trigger: 280 cfs Volume: 1,270 af Duration: 10 days	2 per season Trigger: 280 cfs Volume: 1,270 af Duration: 10 days	1 per season Trigger: 570 cfs Volume: 2,600 af Duration: 12 days
		Average	3 cfs			
		Wet	8 cfs			
Summer	1 cfs	Dry	1 cfs	1 per season Trigger: 230 cfs Volume: 990 af Duration: 9 days	2 per season Trigger: 230 cfs Volume: 990 af Duration: 9 days	1 per season Trigger: 480 cfs Volume: 2,160 af Duration: 12 days
		Average	2 cfs			
		Wet	7 cfs			

cfs = cubic feet per second
af = acre-feet
N/A = not applicable

The City has requested that compliance with the adopted environmental flow standards be calculated at their measurement point. The City further requested that compliance with the adopted environmental flow standards for subsistence and base flows utilize a drainage area ratio to determine the flows that must pass the gage. The City translated the adopted subsistence and base flow standards using a drainage area ratio from the contributing drainage area of USGS Gage No. 08080500 – Double Mountain Fork Brazos River near Aspermont, TX to the contributing drainage area of the Lake 7 dam. Computation of state water inflows between USGS Gage No. 08079510 – North Fork Double Mountain Fork Brazos River at Loop 289 near Lubbock, TX and the Lake 7 dam location, translation of the pulse flow standards, and hydrologic conditions are discussed in the Water Availability Analysis. Resource Protection staff reviewed the information submitted by the City, and the translated values, and agrees that using the translated values for subsistence and base flows and applying those values at their measurement point would protect the adopted standards. Resource Protection staff recommendations are shown in Table 2.

Table 2. Environmental Flow Values at City of Lubbock's Measurement Point.

Season	Subsistence	Hydrologic Condition	Base	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	1 cfs	Dry	1 cfs	N/A	N/A	N/A
		Average	1 cfs			
		Wet	1 cfs			
Spring	1 cfs	Dry	1 cfs	1 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	2 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	1 per season Trigger: 88 cfs Volume: 335 af Duration: 10 days
		Average	1 cfs			
		Wet	1 cfs			
Summer	1 cfs	Dry	1 cfs	1 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	2 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	1 per season Trigger: 88 cfs Volume: 278 af Duration: 10 days
		Average	1 cfs			
		Wet	1 cfs			

cfs = cubic feet per second
af = acre-feet
N/A = not applicable

Seasons are defined in Title 30 TAC § 298.455 as follows: Winter (November through February), Spring (March through June), and Summer (July through October). Hydrologic conditions will be discussed in the water availability analysis for this application.

Given the applicable values for subsistence and base are equal, as shown in Table 2 above, Resource Protection staff's opinion is that the subsistence flow values alone are sufficient to provide adequate protection for the environment.

Special conditions to protect high flow pulses are required, because the City's diversion rate, 138.12 cfs, is greater than 20% of the applicable high flow pulse trigger level requirements of an applicable high flow pulse at the measurement point, as described in Title 30 TAC § 298.485.

Resource Protection staff recommend that impoundment and diversion of water under this proposed permit should be limited to comply with the applicable environmental flow values.

Bed and Banks Request

Aquatic and Riparian Habitats: The City provided an *Environmental Information Document in Support of Water Use Permit Application No. 5921* (EID), prepared by HDR, Inc. (HDR) and dated June 2011, as supplemental documentation for their application. The EID describes the area of the City's project as being located on the North Fork Double Mountain Fork Brazos River, a perennial stream in Lubbock County, which is situated in the High Plains Ecoregion in what was once characterized as shortgrass prairie but is now dominated by agriculture (HDR, Inc. 2011). The river runs in a southeasterly direction and has cut a deep canyon into the escarpment, which has caused turbidity in the stream, and riparian vegetation cited in the EID includes black willow, salt cedar, and American elm found in varying densities throughout the project area (HDR, Inc. 2011). Within the footprint of the proposed reservoir's conservation pool, playa lakes, perennial river habitat, and intermittent stream tributaries were the predominate aquatic habitats (HDR, Inc. 2011).

The EID cites the Texas Parks and Wildlife Department (TPWD), the Llano Estacado Regional Water Planning Group, and the Texas Legislature as having identified no river or stream segments of unique ecological value in the affected area (HDR, Inc. 2011).

As part of the EID, a study was conducted to assess the project area and the natural and cultural resources that would be affected by construction of a large reservoir. The EID guided the preparation of the mitigation plan that the City submitted to the United States Army Corps of Engineers (USACE) in its application for a permit to comply with Section 404 of the Clean Water Act.

In the EID, a vegetation evaluation using aerial photography was conducted simultaneously with a habitat characterization employing the Wildlife Habitat Appraisal Procedure (WHAP) developed by TPWD. The WHAP evaluates wildlife habitat with the presumption that quantity and quality of plant density and plant community is sufficient to make a determination of suitability (TPWD and USFWS 1990). The vegetation study, in conjunction with the WHAP survey, identified multiple vegetation types across approximately 795 acres of vegetated habitat, or 247 Habitat Units, within the proposed Lake 7 conservation pool (HDR, Inc. 2011).

The City also submitted a soil survey based on a United States Department of Agriculture study for Lubbock County which identified Berda loam, Berda-Potter Association soils, and Bippus clay loam as the predominate soil types found within the reservoir's proposed conservation pool (HDR, Inc. 2011).

A wetland delineation using the National Wetland Inventory identified Palustrine shrubland, intermittent emergent wetlands, and sparse areas of Riverine and Lacustrine wetlands within the proposed conservation pool (HDR, Inc. 2011). Additionally, the delineation determined that up to 45.3 acres of waters of the U.S. were found within the proposed project area (HDR, Inc. 2011).
HDR chose four locations based on site-specific water quality, habitat quality, and biological integrity, and conducted sampling of physio-chemical parameters, stream habitat, streamflow, and fish and benthic macroinvertebrate communities utilizing the Aquatic Life Monitoring protocol developed by the TCEQ in the *Surface Water Quality Monitoring Procedure Manual* and the *Biological Monitoring Fact Sheet*, and each were sampled once in June and again in September of 2009 (HDR, Inc. 2011).

The EID's benthic macroinvertebrate survey produced 1,773 individuals representing 27 taxa, and fewer intolerant species than tolerant species were found during the study, which would indicate conditions in the river reflect degraded water quality, poor habitat, and an overall Intermediate aquatic life use score (HDR, Inc. 2011).

The North Fork Double Mountain Fork Brazos River at the survey sites is a relatively saline stream, and as such, fish sampling was conducted using seines rather than a combination of seining and electrofishing (HDR, Inc. 2011). The results of HDR's study found 4,417 individuals representing seven families, 15 species, and one hybrid sunfish, and of the 15 species, four represented nearly 95% of the catch, and of those, one species represented 59% of the total catch (HDR, Inc. 2011). As with the macroinvertebrate study, most of the fish caught were highly tolerant of adverse conditions, reflecting poor water quality and habitat structure, but species diversity varied between the four sample sites, which therefore earned aquatic life use ratings ranging from Intermediate to Exceptional (HDR, Inc. 2011).

An evaluation of Lubbock County protected species by HDR found one extant, federally-listed endangered species, the whooping crane (*Grus americana*); three state-listed threatened species, the American peregrine falcon (*Falco peregrinus anatum),* the bald eagle (*Haliaeetus leucocephalus*), and the Texas horned lizard (*Phrynosoma cornutum*); and two species of fish whose historical geographic range once extended into the project area, the smalleye shiner (*Notropis buccula*) and the sharpnose shiner (*Notropis oxyrhynchus*) (HDR, Inc. 2011). The EID reports no net negative effect is expected for any of the bird species because any potential habitat would only be used temporarily during migration, and no habitat was found to be preferred by any of the three species (HDR, Inc. 2011).

The EID reports that the smalleye and sharpnose shiners, whose range once extended into the project area, have not been recorded in Lubbock County, but both species have been accounted for downstream in Garza County (HDR, Inc. 2011). Additionally, neither of the two species were caught during the surveys for this portion of the report (HDR, Inc. 2011). Two reservoirs, Buffalo Springs Lake and Lake Ransom Canyon, are found between the City's proposed reservoir and Garza County, and these reservoirs act as physical barriers between the known population and the proposed Lake 7, which led HDR to conclude that this project is not expected to impact these two species (HDR, Inc. 2011).

Because the Texas horned lizard prefers habitat that is known to occur within the proposed conservation pool of Lake 7, a rapid baseline survey was conducted to evaluate available habitat and presence of the species. The habitat assessment used aerial photography to identify approximately 619 acres of potentially suitable habitat and field surveys which guided the inspection of the roughly 240 acres of habitat sampled within the project area (HDR, Inc. 2011). Eight lizards were caught in June and July of 2009, including five hatchlings and three sub-adults/adults, and the occurrence of hatchlings in the project area suggests a healthy breeding population (HDR, Inc. 2011).

Based on the results of the Texas horned lizard survey conducted for this report, the EID recommends the following:

- Further assessments of Texas horned lizard occurrence and suitability of potential habitat within the proposed conservation pool footprint should be conducted;

- Potential off-site relocation areas should be identified;

- Development of a preliminary management plan for the Texas horned lizard addressing potential mitigation strategies for relocation to adjacent or near-site suitable habitat;

- Coordination with TCEQ/TPWD to address these concerns.

The results of the above studies were used to assign habitat values that would be impacted by construction of the proposed reservoir, and wetlands and wooded riparian areas were identified as high-priority targets for mitigation (HDR, Inc. 2011).

The request to use the bed and banks of the North Fork Double Mountain Fork Brazos River is not expected to have an effect on any federally-listed or high-interest aquatic species, because staff are recommending environmental flow requirements.

On February 12, 2014, the TCEQ adopted environmental flow standards for the Brazos River and its associated bay and estuary system (Title 30 Texas Administrative Code (TAC) Chapter 298 Subchapter G). These environmental flow standards are considered adequate to support a sound ecological environment (Title 30 TAC § 298.460). The City's request to use the bed and banks of the North Fork Double Mountain Fork Brazos River is not a new appropriation of water or an amendment that increases the amount of water stored, taken, or diverted; therefore, the environmental flow standards do not apply. The City proposes to use the bed and banks of the North Fork Double Mountain Fork Brazos River to support storage in and diversions from Lake 7. The City's request is not expected to adversely impact aquatic and riparian habitats in the area.

Recreational Uses: The North Fork Double Mountain Fork Brazos River has a presumed primary contact recreation 1 use (TCEQ 2018). The City's request should not adversely impact recreational uses.

Water Quality: The North Fork Double Mountain Fork Brazos River has a presumed limited aquatic life use for its intermittent with pools portion and a presumed high aquatic life use for its perennial portion (TCEQ 2018). Assessment Unit 1241A_02 was identified in the *Texas Integrated Report* as non-supporting for bacteria in water and with a concern for screening levels for chlorophyll-*a* in water and nitrate in water (TCEQ 2020). The City's request should not adversely impact water quality.

Freshwater Inflows: Freshwater inflows are critical for maintaining the historical productivity of bays and estuaries along the Gulf Coast. The proposed project is located more than 200 river miles from the Gulf of Mexico. The request for the use of the bed and banks is not a new appropriation of water; therefore, the City's request should not have any impact to the Brazos River Estuary.

RECOMMENDATIONS

Resource Protection staff recommend the following Special Conditions be included in the proposed permit, if granted:

1. Permittee shall implement reasonable measures in order to reduce impacts to aquatic resources due to entrainment or impingement. Such measures shall

include, but shall not be limited to, the installation of screens at the diversion structure.

2. Impoundment and diversion shall be restricted based on the following streamflows at the City's measurement point, as set forth in Special Conditions 3-7 below.

Season	**Subsistence**	**Dry Condition Seasonal Pulse**	**Average Condition Seasonal Pulse**	**Wet Condition Seasonal Pulse**
Winter	1 cfs	N/A	N/A	N/A
Spring	1 cfs	1 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	2 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	1 per season Trigger: 88 cfs Volume: 335 af Duration: 10 days
Summer	1 cfs	1 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	2 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	1 per season Trigger: 88 cfs Volume: 278 af Duration: 10 days

cfs = cubic feet per second
af = acre-feet
N/A = not applicable

3. Seasons are defined as follows: Winter (November through February), Spring (March through June), and Summer (July through October).

Subsistence Flow

4. Permittee shall not impound or divert water if the average streamflow at the City's measurement point is less than or equal to the applicable subsistence flow in Special Condition 2. The "average streamflow" at the gage is the average of measured streamflows at the gage for the previous 24 hours.

High Flow Pulse

5. If a pulse flow event required under Special Condition 2 is determined to have been triggered based on average streamflows at the City's measurement point then, until either the applicable volume amount has passed the gage or the applicable duration time has passed since the high flow pulse was triggered, Permittee shall not impound or divert except during times that average streamflow at the gage exceeds the applicable pulse flow trigger level. Diversions during such times shall not exceed the rate that would reduce average streamflow at the gage to the applicable pulse flow trigger level; provided, however, Permittee is not required to adjust its diversion rate during the pulse event more frequently than once every 24 hours.

6. Each season is independent of the preceding and subsequent seasons with respect to high flow pulse frequency and the applicable high flow pulse is dependent on the applicable hydrologic condition.

7. If a qualifying pulse flow event occurs at the City's measurement point within a given season, the pulse event shall satisfy a pulse requirement for that season. A qualifying event occurs if the event is determined to have been triggered based on average streamflow at the gage and either the pulse flow volume or duration requirement is met.

LITERATURE CITED

HDR, Inc. 2011. Environmental Information Document in Support of Water Use Permit Application No. 5921 Prepared in Response to TCEQ RFI Dated 06/23/2008. Prepared for City of Lubbock, TX.

TCEQ. 2018. Texas Surface Water Quality Standards §§ 307.1-307.10. Austin (TX): Texas Commission on Environmental Quality.

TCEQ. 2020. Texas Integrated Report of Surface Water Quality. Austin (TX): Texas Commission on Environmental Quality.

TPWD and USFWS. 1990. An Assessment of Direct Impacts to Wildlife Habitat from Future Water Development Projects [Internet]. Austin (TX): Texas Parks and Wildlife and United States Fish and Wildlife Service [cited 2019 Sep 11]. Available from https://tpwd.texas.gov/publications/pwdpubs/pwd_rp_t3200_1055/index.phtml

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Sarah Henderson, Project Manager
Water Rights Permitting Team

Date: April 22, 2021

Through: Jason Godeaux, Team Leader
Resource Protection Team

Kristin Wang, Senior Water Conservation Specialist
K.W. Resource Protection Team

From: Jennifer Allis, Senior Water Conservation Specialist
Resource Protection Team

Subject: City of Lubbock
WRPERM 5921
CN600130736
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn counties

APPLICATION SUMMARY

City of Lubbock (City) requests authorization to construct and maintain a reservoir (Lake 7) impounding 20,708 acre-feet of water on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, for subsequent diversion of 50,000 acre-feet of water per year from the perimeter of the reservoir at a maximum diversion rate of 138.12 cfs (62,016 gpm) for municipal, industrial, and agricultural purposes in Lubbock and Lynn counties. The City also requests authorization to use the bed and banks of the North Fork Double Mountain Fork Brazos River to convey up to 14,856 acre-feet of water per year discharged from the South Central Lubbock Drainage System, up to 8,934 acre-feet of water per year from the South Lubbock Drainage System, and up to 16,420 acre-feet of surface water- and groundwater-based return flows per year, to support storage in and diversions from the reservoir, from the Southeast Water Recycling Plant, authorized by Texas Pollutant Discharge Elimination System Permit No. WQ00010353002, to Lake 7 to support storage in and diversions from the reservoir. The City will use other water sources available to it in the North Fork Double Mountain Fork, that are authorized under Water Use Permit Nos. 3985, as amended, and 3705, as amended.

The City maintains an agreement with the Brazos River Authority in which the City will pass water through Lake 7 when streamflows exceed 5 cfs and when the water surface elevation of Possum Kingdom Lake is below 1,000 feet msl.

WATER CONSERVATION REVIEW

Pursuant to Title 30 Texas Administrative Code (TAC) §295.9(1), an application requesting a new appropriation of water requires the submittal of water conservation and drought contingency plans.

Resource Protection staff reviewed the water conservation and drought contingency plans and found the plans to be administratively complete per 30 TAC Chapter 288.

Additionally, the City is required to provide evidence that the amount of water appropriated will be beneficially used, i.e., effectively managed and not wasted pursuant to Texas Water Code (TWC), §11.134(b)(3)(A). Also, the City must provide evidence that reasonable diligence will be used to avoid waste and achieve water conservation pursuant to TWC §11.134(b)(4). To provide that evidence, the City must submit a water conservation plan in accordance with 30 TAC Chapter 288. In applications where a new appropriation of water is requested, the review includes an analysis of whether the requested appropriation is reasonable and necessary for the proposed uses in accordance with TWC §11.134 and 30 TAC §297.50 and §288.7.

The purpose of this review is to:

1) determine whether reasonable water conservation goals have been set;
2) determine whether the proposed strategies can achieve the stated goals;
3) determine whether there is a substantiated need for the water and whether the amount to be appropriated is reasonable for the proposed use; and
4) determine whether the water conservation plan addresses a water supply need in a manner that is consistent with the state water plan and the relevant approved regional water plan.

If these criteria are met, then Resource Protection staff considers this sufficient evidence to conclude that the City will avoid waste and achieve water conservation. This review forms a basis for permit conditions and limitations as provided by TWC §11.134.

Water Conservation Goals and Strategies

The City submitted 2019 water conservation and drought contingency plans which were reviewed by Resource Protection staff and found to meet the requirements in 30 TAC Chapter 288 for retail and wholesale water suppliers.

The City established five- and ten-year goals for water use in gallons per capita per day (gpcd). The City's annual average per capita per day usage declined by 27 percent over the past eight years. The City's water conservation goals were determined using the baseline of per capita water use of the 10-year average from

2009 to 2018 of 143 gpcd. Of note, the City met its previous goal for water use which was 150 gpcd for 2019.

The City's goals were developed utilizing a 0.5 percent per year reduction in per capita water use, resulting in a per capita goal of 139 gpcd for 2024 and of 136 gpcd for 2029.

In addition to the per capita water use goal, the City set a maximum water loss goal of 10 percent for the retail water delivery system, which corresponds to a loss rate of 13.9 gpcd in 2024 and 13.6 gpcd in 2029.

According to the City's *2018 Strategic Water Supply Plan* (SWSP), the significant reduction in per capita consumption over the past few years can be directly attributed to the effectiveness of the City's conservation block rate structure, volume rates, and two-day per week irrigation limitation on a year-round basis.

The City's water conservation program is comprised of four main strategies:

1. Maintain a rate structure that encourages conservation;
2. Reduce water loss within the City's distribution system;
3. Educate the public and provide useful information; and
4. Enforce irrigation and waste of water restrictions.

The City has implemented water conservation strategies that include public education and awareness, stringent seasonal watering restrictions, an increasing block rate structure, reducing unaccounted-for water losses, and additional measures to increase the efficiency of irrigation practices and commercial water use. Additionally, the City requires its wholesale customers to adopt and implement water conservation plans that will reduce their per capita water use.

The City also submitted an irrigation water conservation plan indicating that it uses sewage effluent from its wastewater treatment plant to irrigate two land application sites. Effluent is used to irrigate crops as wheat, jose wheat, bermuda, and rye. The City's current and future goals for this reuse system are to be able to dispose of the total wastewater volume necessary through this system. Irrigation practices are designed to prevent contamination of surface and groundwater in the area. The City monitors the delivery system for any leaks by visually inspecting the system on a regular basis, and all leaks are repaired in a timely manner.

As such, Resource Protection staff has deemed these goals and strategies to be reasonable.

Requirements for Water Right Application under 30 TAC §288.7

Under 30 TAC §288.7, a water conservation plan submitted with a water right application for a new or additional appropriation of water must include data and information which:

1) supports the applicant's proposed use of water with consideration of the water conservation goals of the water conservation plan;
2) evaluates conservation as an alternative to the proposed appropriation; and
3) evaluates any other feasible alternative to new water development including, but not limited to, waste prevention, recycling and reuse, water transfer and marketing, regionalization, and optimum water management practices and procedures.

The City developed the 2018 SWSP to actively plan for future water supplies. The 2018 SWSP includes multiple strategies to diversify the City's water supply portfolio to minimize risk associated with variable climatic conditions while emphasizing conservation efforts to delay expensive water supply projects.

Consideration of Water Conservation Goals

Based on projections, continued conservation could reduce the per capita demand for the City by 21 gpcd by 2035. This translates into a reduction in water demand of 7,564 acre-feet in 2035, or almost 14 percent when compared to the expected water demand.

Conservation as an Alternative to the Proposed Appropriation

As part of the regional water planning process, the planning groups are required to perform a comprehensive analysis of potentially feasible water management strategies, including consideration of water conservation as a strategy for all water users with supply needs. Given the large irrigation water needs in the region, the Region O Water Planning Group gave special consideration to agricultural conservation methods. In addition to conservation, strategies that include the development of new supplies and infrastructure were developed and evaluated. However, the projected shortage for the City after Conservation is expected to be 32,370 acre-feet per year in 2070.

Feasible Alternatives to New Water Development

Most recommended water management strategies in the Region O Water Plan are new groundwater development or expansion of existing well fields. Although surface water supplies are limited in the region, expansion of surface water supply from Lake Alan Henry was evaluated. New reuse and brackish groundwater development were also evaluated. Lake 7 would impound reclaimed water, developed playa lake stormwater, and natural inflows. Because Lake 7 will utilize the City's reclaimed water as the primary portion of its yield, supply from Lake 7 will be relatively drought proof. The use of reclaimed water is considered an important water supply strategy in the 2017 State Water Plan. Since the City must import its potable water from such long distances, reusing water makes economical and practical sense. Using reclaimed water can reduce dependency on new water supplies.

Water Need
The City is the largest demand center in the Region for municipal and manufacturing water use. According to the 2021 Region O Water Plan, Lubbock has the largest predicted water needs, with a shortage of 5,154 acre-feet per year in 2020 that increases to a shortage of 33,808 acre-feet per year in 2070. The City has wholesale water supply contracts with several customers. Total water use by the City and its customers is projected to be 49,863 acre-feet in 2020 and 71,477 acre-feet in 2070.

Consistency with State and Regional Water Plans
The project is included as a recommended water management strategy in the City's *2018 Strategic Water Supply Plan* and in the 2021 Region O Water Plan. As such, the application is consistent with the 2021 Region O Water Plan, and Resource Protection staff expects that the request will also be consistent with the 2022 State Water Plan once it is approved, because there is nothing in the water plans that conflicts with issuing the permit.

RECOMMENDATIONS

Based on the analysis, Resource Protection staff has evaluated the application and determined that it meets the review requirements.

The following water conservation language should be included in the permit, if granted:

Permittee shall implement water conservation plans that provide for the utilization of those practices, techniques, and technologies that reduce or maintain the consumption of water, prevent or reduce the loss or waste of water, maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, and prevent the pollution of water, so that a water supply is made available for future or alternative uses. Such plans shall include a requirement that in every water supply contract entered into on or after the effective date of this permit, including any contract extension or renewal, that each successive wholesale customer develop and implement conservation measures. If the customer intends to resell the water, then the contract for resale of the water shall have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures.

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Ron Ellis
Water Rights Permitting Team

Date: March 27, 2008

Thru:

From: Warren D. Samuelson, P. E.
Dam Safety Program, MC-174

Subject: City of Lubbock, Supplemental Application to construct and maintain a dam and reservoir, North Fork Double Mountain Fork Brazos River, Brazos River Basin, Lubbock County.

The applicant has indicated through the applicant's attorney that the applicant is not pursuing the permitting of one of the proposed dams and reservoirs (Lake No. 8). Therefore, this is a supplemental memorandum. To the original memorandum of February 17, 2006.

The applicant seeks authorization to construct and maintain one reservoir (Lake No. 8) on North Fork Double Mountain Fork Brazos River in Lubbock County. The proposed Lake No. 7 will have a capacity of 20,708 acre-feet and a surface area of 801 acres. The reservoir will be used for municipal, industrial, and agricultural purposes.

The engineer, HDR Engineering, Inc., has indicated that the proposed dam and spillways will be designed to pass 100% of the probable maximum flood (PMF) as required in Chapter 299.

It is recommended that the permit include the following language:

TIME LIMITATIONS

(a) Construction of the proposed dam for Lake No. 7 shall be in accordance with plans approved by the Executive Director. Construction of the dam without final approval of the construction plans is a violation of this authorization.

(b) Construction shall begin within two years of issuance of this permit and be completed within five years of issuance of the permit, unless Permittee applies for and is subsequently granted an extension of time before the expiration of these time limitations.

(b) Failure to commence the proposed dam and reservoir within the period stated above shall subject all rights to this permit to forfeiture, subject to notice and hearing. After beginning construction, failure to timely construct the proposed dam and reservoir stated above shall subject this permit to cancellation in whole or in part, subject to notice and hearing.

Warren D Samuelson

Warren D. Samuelson, P. E.
Dam Safety Program

Sarah Henderson

From: Lauren Thomas [redacted]
Sent: Tuesday, November 30, 2021 4:51 PM
To: Sarah Henderson
Cc: Sara Thornton; Dubelza Galvan
Subject: City of Lubbock's Comments on Draft WRPERM 5921 (2020-18)
Attachments: 2021.11.30 SRT to TCEQ WRPERM 5921 Comment Letter.pdf

Hi Sarah,

Please see attached for our comments on the draft WRPERM 5921. If you have any questions, please do not hesitate to reach out to Sara Thornton or myself.

Thanks again for your time today.

Best,
Lauren

To help protect your privacy, Microsoft Office prevented automatic download of this picture from the Internet.

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November 30, 2021

Ms. Sarah Henderson **VIA ELECTRONIC TRANSMISSION**
Project Manager
Water Rights Permitting Team
Water Rights Permitting and Availability Section (MC 160)
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Re: City of Lubbock
WRPERM 5921
CN600130736, RN104918107
Application No. 5921 for a Water Use Permit
Texas Water Code §§ 11.121, 11.042, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock County

Dear Sarah:

This letter is submitted on behalf of my client, the City of Lubbock (the "City"), in response to your correspondence dated November 15, 2021, and the proposed draft Water Use Permit No. 5921 (the "Draft Permit") and the technical memoranda attached thereto. Please see below for a list of requested revisions to the Draft Permit and associated technical memoranda.

REVISION 1:

Draft Permit, (Universal Comment)

The name "Southeast Water Recycling Plant" is incorrect.

Request: Change "Southeast Water Recycling Plant" to "Southeast Water Reclamation Plant."

REVISION 2:

Draft Permit, (Page 2, first WHEREAS clause, Item a.)

The latitude and longitude "33.55967º N, 101.79653º W" is incorrect.

Request: Change the latitude and longitude to “33.55965 º N, 101.79652 º W.”

REVISION 3:

Draft Permit, (Page 2, first WHEREAS clause, Item b.)

The latitude and longitude “33.53361° N, 101.77878° W” is incorrect.

Request: Change the latitude and longitude to “33.53363° N, 101.77879 ° W.”

REVISION 4:

Draft Permit, (Page 2, first WHEREAS clause, Item b.)

According to a 2008 report provided by Lubbock’s engineer Parkhill (formerly Parkhill, Smith, and Cooper Inc.), Discharge Point No. 2 has a maximum rate of 75 cfs.

Request: Change “185 cfs” to “75 cfs.”

REVISION 5:

Draft Permit, (Page 2, first WHEREAS clause, Item c.)

The latitude and longitude “33.55961° N, 101.79654° W” is incorrect.

Request: Change the latitude and longitude to “33.56273° N, 101.79935° W.”

REVISION 6:

Draft Permit, (Page 2, second WHEREAS clause)

The WHEREAS clause currently states, “WHEREAS, the City maintains an agreement with the Brazos River Authority (BRA) in which the City will pass water through Jim Bertram Lake 7 when the water surface elevation of Possum Kingdom Lake is below 1,000 feet msl and inflows exceed 5 cfs; and….” This does not specify which type of water must be passed through Jim Bertram Lake 7.

Request: Change “water” to say “inflows of state water” so the sentence reads as follows:

“WHEREAS, the City maintains an agreement with the Brazos River Authority (BRA) in which the City will pass inflows of state water through Jim Bertram Lake 7 when the water surface elevation of Possum Kingdom Lake is below 1,000 feet msl and inflows exceed 5 cfs; and….”

REVISION 7:

Draft Permit, (Page 3, Item 3.a.)

The latitude and longitude “33.55967º N, 101.79653º W” is incorrect.

Request: Change the latitude and longitude to “33.55965 º N, 101.79652 º W.”

REVISION 8:

Draft Permit, (Page 3, Item 3.b.)

The latitude and longitude “33.53361° N, 101.77878° W” is incorrect.

Request: Change the latitude and longitude to “33.53363° N, 101.77879 ° W.”

REVISION 9:

Draft Permit, (Page 3, Item 3.c.)

The latitude and longitude “33.55961° N, 101.79654° W” is incorrect.

Request: Change the latitude and longitude to “33.56273° N, 101.79935° W.”

REVISION 10:

Draft Permit, (Page 3, Item 3(B))

According to a 2008 report provided by Lubbock’s engineer Parkhill (formerly Parkhill, Smith, and Cooper Inc.), Discharge Point No. 2 has a maximum rate of 75 cfs.

Request: Change “185 cfs” to “75 cfs.”

REVISION 11:

Draft Permit, (Page 4, Special Condition 7.D.)

The summer wet condition seasonal pulse trigger is 74 cfs. The current value, 88 cfs, is incorrect.

Request: Change the summer wet condition seasonal pulse trigger from 88 cfs to 74 cfs.

REVISION 12:

Draft Permit, (Page 6, Special Condition 7.L.)

This special condition should also reference the impoundment of return flows.

Request: Change "Permittee shall only divert daily return flows…" to "Permittee shall only impound or divert daily return flows…."

REVISION 13:

Draft Permit, (Page 6, Special Condition 7.O.)

This special condition should also reference the impoundment of water

Request: Change "Permittee shall only divert water authorized under this permit pursuant to…" to "Permittee shall only impound or divert water authorized under this permit pursuant to…."

REVISION 14:

Environmental Review Technical Memorandum, (Pages 4-5)

The sentence going from page 4 onto page 5 states as follows, "The EID guided the preparation of the mitigation plan that the City submitted to the United States Army Corps of Engineers (USACE) in its application for a permit to comply with Section 404 of the Clean Water Act."

Request: Delete this sentence because the City has not yet submitted a Section 404 permit application to USACE.

Thank you for the opportunity to provide these comments. I look forward to your review and response. Should you have any questions, please do not hesitate to contact me at (512) 322-5876 or [redacted]

Sincerely,

Sara R. Thornton

SRT/dxg

cc: Mr. Aubrey A. Spear
Ms. Lauren C. Thomas
Ms. Dubelza Galvan

Jon Niermann, *Chairman*
Emily Lindley, *Commissioner*
Bobby Janecka, *Commissioner*
Toby Baker, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
Protecting Texas by Reducing and Preventing Pollution

November 15, 2021

Ms. Sara Thornton
Lloyd Gosselink Rochelle & Townsend, PC
816 Congress Ave., Suite 1900
Austin, Texas 78701

VIA E-MAIL

Re: City of Lubbock
WRPERM 5921
CN600130736, RN104918107
Application No. 5921 for a Water Use Permit
Texas Water Code §§ 11.121, 11.042, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock County

Dear Ms. Thornton:

A draft, subject to revision, of proposed Water Use Permit No. 5921, and the related technical memoranda are attached.

Staff is recommending that the referenced application be granted in accordance with the attached draft. Please review the draft permit and contact me no later than November 30, 2021 with any comments or questions.

If you have any questions concerning this matter please contact me via e-mail at sarah.henderson@tceq.texas.gov or by telephone at (512) 239-2535.

Sincerely,

Sarah E Henderson

Sarah Henderson, Project Manager
Water Rights Permitting Team
Water Rights Permitting and Availability Section

Attachments

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

THE STATE OF TEXAS

WATER USE PERMIT

PERMIT NO. 5921		TYPE: §§ 11.121, 11.042	
Permittee:	City of Lubbock	Address:	P.O. Box 2000 Lubbock, Texas 79457
Filed:	April 17, 2006	Granted:	
Purposes:	Municipal, Industrial, Agricultural	Counties:	Lubbock and Lynn
Watercourse:	North Fork Double Mountain Fork Brazos River	Watershed:	Brazos River Basin

WHEREAS, the City of Lubbock (City) seeks a Water Use Permit to construct and maintain a 20,708 acre-foot capacity reservoir (Jim Bertram Lake 7) on the North Fork Double Mountain Fork Brazos River, Brazos River Basin with the centerline of the dam being at Latitude 33.534012° N, Longitude 101.730515° W in Lubbock County; and

WHEREAS, the City also seeks to divert and use not to exceed 50,000 acre-feet of water per year from anywhere along the perimeter of the aforementioned reservoir, at a maximum diversion rate of 138.12 cfs (62,016 gpm), for municipal, industrial, and agricultural purposes within the City's service area in Lubbock and Lynn counties, Brazos River Basin; and

WHEREAS, the City further seeks to authorize the use of the bed and banks of the North Fork Double Mountain Fork Brazos River, Brazos River Basin to convey up to 14,856 acre-feet of water per year discharged from the South Central Lubbock Drainage System, up to 8,934 acre-feet of water per year discharged from the South Lubbock Drainage System, and up to 16,240 acre-feet of surface water- and groundwater-based return flows per year from the Southeast Water Recycling Plant, authorized under TPDES Permit No. WQ00010353002, to Jim Bertram Lake 7 to support storage in and diversions from the reservoir; and

WHEREAS, water from the South Central Lubbock Drainage System and the South Lubbock Drainage System originates from stormwater collected in playa lakes and subsequently discharged to the North Fork Double Mountain Fork Brazos River; and

WHEREAS, the City will also use other water sources available to it in the North Fork Double Mountain Fork Brazos River, that are authorized under Water Permit Nos. 3985, as amended, and 3705, as amended, to support storage in and diversions from the reservoir; and

WHEREAS, water and return flows will be discharged at the following three points located on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, Lubbock County.

a. Discharge Point No. 1 (South Central Lubbock Drainage System) being at Latitude 33.55967° N, Longitude 101.79653° W at a maximum rate of 185 cfs;

b. Discharge Point No. 2 (South Lubbock Drainage System) being at Latitude 33.53361° N, Longitude 101.77878° W at a maximum rate of 185 cfs;

c. Discharge Point No. 3 (Southeast Water Recycling Plant, TPDES Permit No. WQ00010353002) being at Latitude 33.55961° N, Longitude 101.79654° W at a maximum rate of 22.47 cfs; and

WHEREAS, the City maintains an agreement with the Brazos River Authority (BRA) in which the City will pass water through Jim Bertram Lake 7 when the water surface elevation of Possum Kingdom Lake is below 1,000 feet msl and inflows exceed 5 cfs; and

WHEREAS, the Texas Commission on Environmental Quality finds that jurisdiction over the application is established; and

WHEREAS, the City has provided, and the Executive Director has approved, the *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7*; and

WHEREAS, the Executive Director recommends special conditions be included in the permit; and

WHEREAS, the Commission has complied with the requirements of the Texas Water Code and Rules of the Texas Commission on Environmental Quality in issuing this permit;

NOW, THEREFORE, this permit, designated as Water Use Permit No. 5921, is issued to the City of Lubbock subject to the following terms and conditions:

1. IMPOUNDMENT

Permittee is authorized to construct and maintain a 20,708 acre-foot capacity reservoir (Jim Bertram Lake 7) on the North Fork Double Mountain Fork Brazos River, Brazos River Basin with the centerline of the dam being at Latitude 33.534012° N, Longitude 101.730515° W in Lubbock County.

2. USE

A. Permittee is authorized to divert and use not to exceed 50,000 acre-feet of water per year from Jim Bertram Lake 7 for municipal, industrial, and agricultural purposes within the City's service area in Lubbock and Lynn counties.

B. Permittee is authorized to use the bed and banks of the North Fork Double Mountain Fork Brazos River to convey up to 14,856 acre-feet of water per year discharged from the South Central Lubbock Drainage System, up to 8,934 acre-feet of water per year discharged from the South Lubbock Drainage System, and up to 16,240 acre-feet of surface water- and groundwater-based return flows per year from the Southeast Water Recycling Plant, authorized under TPDES Permit No. WQ00010353002, to Jim Bertram Lake 7 to support storage in and diversions from the reservoir.

C. Permittee is authorized to use water authorized under Water Permit Nos. 3985, as amended and 3705, as amended to support storage in and diversions from the reservoir.

3. DISCHARGE

Water will be discharged to the North Fork Double Mountain Fork Brazos River, in Lubbock County as follows:

A. Discharge Point No. 1 (South Central Lubbock Drainage System) - being at Latitude 33.55967° N, Longitude 101.79653° W at a maximum rate of 185 cfs.

B. Discharge Point No. 2 (South Lubbock Drainage System) - being at Latitude 33.53361° N, Longitude 101.77878° W at a maximum rate of 185 cfs.

C. Discharge Point No. 3 (Southeast Water Recycling Plant, TPDES Permit No. WQ00010353002) being at Latitude 33.55961° N, Longitude 101.79654° W at a maximum rate of 22.47 cfs.

4. DIVERSION

Permittee is authorized to divert:

A. 50,000 acre-feet of water per year from anywhere along the perimeter of Jim Bertram Lake 7.

B. at a maximum diversion rate of 138.12 cfs (62,016 gpm).

5. TIME PRIORITY

A. The time priority for this right is April 17, 2006.

B. Water discharged from the South Central Lubbock Drainage System, the South Lubbock Drainage System, and return flows discharged from the Southeast Water Recycling Plant and authorized to be conveyed via the bed and banks of a State watercourse in this permit does not have a priority date and is not subject to priority calls from senior water rights.

6. CONSERVATION

Permittee shall implement water conservation plans that provide for the utilization of those practices, techniques, and technologies that reduce or maintain the consumption of water, prevent or reduce the loss or waste of water, maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, and prevent the pollution of water, so that a water supply is made available for future or alternative uses. Such plans shall include a requirement that in every water supply contract entered into on or after the effective date of this permit, including any contract extension or renewal, that each successive wholesale customer develop and implement conservation measures. If the customer intends to resell the water, then the contract for resale of the water shall have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures.

7. SPECIAL CONDITIONS

A. Permittee shall implement reasonable measures in order to reduce impacts to aquatic resources due to entrainment or impingement. Such measures shall include, but shall not be limited to, the installation of screens at any new diversion structures.

B. For purposes of applying the environmental flow requirements in Paragraphs 7.D. – 7.J. of this permit, the measurement point shall be the dam at Jim Bertram Lake 7 and streamflows shall be measured and determined by the *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7.*

C. Notwithstanding the requirements set out in Paragraphs 7.D. – 7.J. of this permit, if Permittee has stored water in accordance with the terms and conditions of this permit at the time the water was stored, Permittee may divert and use that stored water, even if any environmental flow requirements are not met at the time of the subsequent diversion and use of that stored water.

D. Impoundment and diversion of state water under this permit shall be restricted based on the following streamflows at Permittee's measurement point, as set forth in Paragraphs 7.E. – 7.J. below.

Season	**Subsistence**	**Dry Condition Seasonal Pulse**	**Average Condition Seasonal Pulse**	**Wet Condition Seasonal Pulse**
Winter	1 cfs	N/A	N/A	N/A
Spring	1 cfs	1 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	2 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	1 per season Trigger: 88 cfs Volume: 335 af Duration: 10 days
Summer	1 cfs	1 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	2 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	1 per season Trigger: 88 cfs Volume: 278 af Duration: 10 days

cfs = cubic feet per second
af = acre-feet
N/A = not applicable

E. Seasons are defined as follows: Winter (November through February), Spring (March through June), and Summer (July through October).

F. Permittee shall determine the hydrologic condition once per season. The Palmer Hydrologic Drought Index (PHDI) value present on the last day of the month of the preceding season, as reported by the National Weather Service, shall be used to

determine the hydrologic condition for the following season as set out in Paragraphs F.i. – F.iii. below:

i Permittee shall determine the PHDI Index for a season based on the following formula:

(0.027 × High Plains PHDI) + (0.647 × Low Rolling Plains PHDI) + (0.326 × North Central PHDI)

ii. The PHDI Index and corresponding hydrologic conditions that govern diversions under this permit are:

Dry	Average	Wet
Less than -1.78	-1.78 – 2.18	Greater than 2.18

iii. Permittee may utilize an interim PHDI value to determine the hydrologic condition until the value preceding the start of the season is published in accordance with the procedure described in *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7.*

Subsistence Flow

G. Permittee shall not impound or divert water if the average streamflow at Permittee's measurement point is less than or equal to the applicable subsistence flow in Paragraph 7.D. The "average streamflow" at the measurement point is the average of measured streamflows for the previous 24 hours.

High Flow Pulse

H. If a pulse flow event required under Paragraph 7.D. is determined to have been triggered based on average streamflows at Permittee's measurement point then, until either the applicable volume amount has passed or the applicable duration time has passed since the high flow pulse was triggered, Permittee shall not impound or divert state water except during times that average streamflow exceeds the applicable pulse flow trigger level. Diversions during such times shall not exceed the rate that would reduce average streamflow to the applicable pulse flow trigger level; provided, however, Permittee is not required to adjust its diversion rate during the pulse event more frequently than once every 24 hours.

I. Each season is independent of the preceding and subsequent seasons with respect to high flow pulse frequency and the applicable high flow pulse is dependent on the applicable hydrologic condition.

J. If a qualifying pulse flow event occurs at Permittee's measurement point within a given season, the pulse event shall satisfy a pulse requirement for that season. A qualifying event occurs if the event is determined to have been triggered based on average streamflow and either the pulse flow volume or duration requirement is met.

K. Impoundment and diversion of return flows and other discharged water as authorized by this permit is dependent upon potentially interruptible return flows and discharges and is conditioned on the availability of those discharges. The right to divert return flows discharged from the Southeast Water Recycling Plant and the water discharged from the South Central Lubbock Drainage System and the South Lubbock Drainage System is subject to revocation if all discharges become permanently unavailable for impoundment and diversion and may be subject to reduction if the return flows discharged from the Southeast Water Recycling Plant and the water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System are not available in quantities and qualities sufficient to fully support the permit authorizations. Should any of the discharges become permanently unavailable for impoundment and diversion, Permittee shall immediately cease impoundment and diversion of return flows and other discharged water under this permit and either apply to amend the permit, or voluntarily forfeit the authorization to impound and divert return flows and other discharged water. If Permittee does not amend or forfeit the authorization, the Commission may begin proceedings to cancel these authorizations in the permit.

L. Permittee shall only divert daily return flows and any water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System that is actually discharged.

M. Prior to diversion and impoundment of return flows in excess of the amount currently authorized by TPDES Permit No. WQ00010353002, described in Paragraph 2. USE and Paragraph 3. DISCHARGE, Permittee shall apply for and be granted the right to reuse those return flows. Permittee shall amend the accounting plan to include future discharges of return flows prior to diverting said return flows.

N. Prior to diversion of any additional water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System in excess of the maximum annual discharge volume described in Paragraph 2. USE and Paragraph 3. DISCHARGE, Permittee shall apply for and be granted the right to use the discharged water. Permittee shall amend the accounting plan to include additional discharges from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System prior to diverting said additional discharges.

O. Permittee shall only divert water authorized under this permit pursuant to Paragraph 2. USE and Paragraph 4. DIVERSION in accordance with the most recently approved *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7*. Permittee shall maintain the plan in electronic format and make it available upon request. Any modifications to the accounting plan shall be approved by the Executive Director. Any modification to the accounting plan that changes the permit terms must be in the form of an amendment to the permit. Should Permittee fail to maintain the accounting plan or notify the Executive Director of any modifications to the plan, Permittee shall immediately cease diversion and impoundment of water authorized in this permit, and either apply to amend the permit, or voluntarily forfeit the permit. If Permittee fails to amend the accounting plan or forfeit the permit, the Commission may begin proceedings to cancel the permit. Permittee shall immediately notify the Executive Director upon modification of the accounting plan and provide copies of the appropriate documents effectuating such changes.

P. Permittee shall install and maintain a measuring device which accounts for, within 5% accuracy, the quantity of water diverted from the point(s) authorized above in Paragraph 4. DIVERSION.

Q. Permittee shall allow representatives of the Texas Commission on Environmental Quality reasonable access to the property to inspect the measuring device and records.

R. Consistent with and subject to the conditions stated in Texas Water Code §11.147(e-1), the commission may adjust the environmental flow conditions in this permit to provide for the protection of instream flows or freshwater inflows to the bay and estuary, if the commission determines, through an expedited public review process, that such adjustment is appropriate to achieve compliance with applicable environmental flow standards adopted pursuant to Texas Water Code §11.1471. Any adjustment shall be made in accordance with the provisions of Texas Water Code §11.147(e-1).

8. TIME LIMITATIONS

A. Construction of the proposed dam for Jim Bertram Lake 7 shall be in accordance with plans approved by the Executive Director. Construction of the dam without final approval of the construction plans is a violation of this authorization.

B. Construction shall begin within two years of issuance of this permit and be completed within five years of issuance of the permit unless Permittee applies for and is subsequently granted an extension of time before the expiration of these time limitations.

The diversion and impoundment of unappropriated state water authorized in this permit is subject to all superior and senior water rights in the Brazos River Basin.

Permittee agrees to be bound by the terms, conditions, and provisions contained herein and such agreement is a condition precedent to the granting of this permit.

All other matters requested in the application which are not specifically granted by this permit are denied.

This permit is issued subject to the Rules of the Texas Commission on Environmental Quality and to the right of continuing supervision of State water resources exercised by the Commission.

For the Commission

ISSUED:

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Sarah Henderson, Project Manager Date: November 10, 2021
Water Rights Permitting Team

From: Kathy Alexander, Ph.D.
Policy and Technical Analyst
Water Availability Division

Subject: City of Lubbock
WRPERM 5921
CN600130736
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn counties

WATER AVAILABILITY ANALYSIS

Application Summary

The City of Lubbock (City) requests authorization to construct and maintain a reservoir (Lake 7) impounding 20,708 acre-feet of water on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, for subsequent diversion of 50,000 acre-feet of water per year from the perimeter of the reservoir at a maximum diversion rate of 138.12 cfs (62,016 gpm) for municipal, industrial, and agricultural purposes in Lubbock and Lynn counties. The City also requests authorization to use the bed and banks of the North Fork Double Mountain Fork of the Brazos River to convey up to 14,856 acre-feet of water discharged from the South Central Lubbock Drainage System, up to 8,934 acre-feet of water from the South Lubbock Drainage System, and up to 16,240 acre-feet of surface water- and groundwater-based return flows from Southeast Water Recycling Plant, authorized by WQ00010353002, to Lake 7 to support storage in and diversions from the reservoir. The City will use other water sources available to it in the North Fork Double Mountain Fork Brazos River, that are authorized under Water Use Permit Nos. 3985, as amended, and 3705, as amended. The City maintains an agreement with the Brazos River Authority in which the City will pass water through Lake 7 when streamflow exceeds 5 cfs and when the water surface elevation of Possum Kingdom Lake is below 1,000 feet msl.

The application was declared administratively complete on April 17, 2006.

The City submitted an accounting plan on August 15, 2016, which was revised several times. The final accounting plan was submitted on February 2, 2021.

Water Availability Analysis

Pursuant to 30 Texas Administrative Code (TAC) §298 Subchapter G, Resource

Protection staff recommend that the application be subject to instream flow requirements. Resource Protection staff also recommended other special conditions. See Resource Protection staff's April 22, 2021 memorandum.

The Water Rights Analysis Package (WRAP) simulates management of the water resources of a river basin. TCEQ uses WRAP in the evaluation of water right permit applications using priority-based water allocations. WRAP is a generalized simulation model for application to any river basin, and input datasets must be developed for the particular river basin of concern. The TCEQ developed water availability models (WAMs) for Texas river basins that include geographical information, water right information, naturalized flows, evaporation rates, channel losses, and specific management assumptions. Hydrology staff operates WRAP to evaluate water rights applications to determine water availability and to ensure that senior water rights are protected.

An evaluation of a proposed appropriation of state water must consider effects of the proposed permit on groundwater or groundwater recharge. The naturalized flows that are the basis for the TCEQ WAM take into account both contribution to river flow caused by groundwater coming to the surface in the river (springs) and decreases in river flow caused by the river flowing over recharge features and losing surface water to groundwater recharge. Therefore, any effects on groundwater or groundwater recharge are incorporated into the modeling for this application. By considering any gains and losses due to groundwater/surface water interaction in its water availability analysis, the commission is protecting groundwater resources.

The City requested that compliance with the adopted environmental flow standards be measured at Lake 7. Staff reviewed this request and is not opposed to measuring compliance under the permit at Lake 7. The City translated the adopted subsistence and base flow standards from USGS Gage No. 08080500 – Double Mountain Fork Brazos River near Aspermont to Lake 7 based on their contributing drainage areas and provided the method used to translate the pulse flow standards. Staff reviewed the methods and found them adequate. Measurement of the applicable environmental flow requirements at Lake 7 would be an adequate indicator of whether operations under the permit are in compliance with the adopted standards.

TCEQ's environmental flow standards for the Brazos Basin in 30 TAC §298 Subchapter G (Brazos River and its Associated Bay and Estuary System) include a hydrologic condition (§298.470 Calculation of Hydrologic Conditions). The hydrologic condition is based on the Palmer Hydrologic Drought Index (PHDI) and the PHDI Index as defined in §298.455 (6) and (7). Based on §298.455(11), the application is located in the Upper Basin. The Climate Divisions included in the Upper Basin are the High Plains (Climate Division 1), Low Rolling Plains (Climate Division 2), and North Central (Climate Division 3). The values for the PHDI Index for the Upper Basin used to determine the hydrologic condition are calculated as follows (§298.470(b)):

(0.027 × High Plains PHDI) + (0.647 × Low Rolling Plains PHDI) + (0.326 × North Central PHDI).

The determination of the hydrologic condition for a particular season is determined once per season. The PHDI value present on the last day of the month of the preceding season, as reported by the National Weather Service, and calculated for the geographic area as described in subsection (b) of the section, determines the hydrologic condition for the following season. The values for the PHDI are available at https://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers/. Under the adopted rules, PHDI values are based on the last day of the month before the start of a new season; however, final approved PHDI values for a month are typically available from the National Climatic Data Center (NCDC) near the middle of the following month. Therefore, in order to determine the hydrologic condition for a season, the latest published monthly value can be used on an interim basis until the final value for the month preceding the season is available. When the NCDC publishes the final value for the month preceding the season, the hydrologic condition applicable for the season can be updated if required.

Staff notes that TCEQ's adopted environmental flow standards for the Brazos Basin in 30 TAC §298 Subchapter G (Brazos River and its Associated Bay and Estuary System) do not include freshwater inflow standards for the Brazos Estuary.

New Appropriation Analysis

Staff modeled the application using the Full Authorization simulation of the Brazos River Basin WAM where water rights utilize their maximum authorized amounts for storage and diversion, and return flows are not included. The period of record for the Brazos WAM is 1940 through 2018. The Brazos WAM includes the adopted standards for all measurement points required by Chapter 298, Subchapter G. Under 30 TAC §298.465, the priority date for the environmental flow standards in the Brazos WAM is March 1, 2012. For modeling purposes, this application was modeled with a priority date of March 8, 2012 so that the application would be junior to both the adopted standards and applications for new appropriations considered after the standards were adopted.

Staff first evaluated the extent to which unappropriated water was available to support the request if 50,000 acre-feet of water was diverted from the reservoir and the City's additional sources were not available to support diversion and storage. The simulation results indicate that 39,930 acre-feet is available for diversion in one year of the period of record. Staff also evaluated storage of unappropriated water assuming no diversions from the reservoir. Simulation results indicate that the reservoir was more than 50% full in 28% of the months in the period of record. Staff notes that the City has an agreement with Brazos River Authority (BRA) which states that when the elevation of BRA's Possum Kingdom Lake is below 1,000 feet msl and inflows of state water exceed 5 cfs, the City will pass inflows above 5 cfs through Lake 7. The Brazos WAM implements the prior appropriation doctrine whereby senior water rights get access to available flows first, based on their priority dates. In the simulation, BRA's senior rights in Lake

Possum Kingdom would have access to all available unappropriated water prior to the City's impoundment and diversion at Lake 7 under its junior priority date. Therefore, staff's simulation represents a very conservative estimate of the amount of unappropriated water available for storage and diversion from Lake 7.

Bed and Banks

The City also requested authorization to use the bed and banks of the North Fork Double Mountain Fork, Brazos River to convey up to 14,856 acre-feet of water discharged from the South Central Lubbock Drainage System (SCLDS) , up to 8,934 acre-feet of water from the South Lubbock Drainage System (SLDS), and up to 16,240 acre-feet of surface water and groundwater based return flows from Southeast Water Recycling Plant (SEWRP), authorized by WQ00010353002, to Lake 7. Water conveyed to Lake 7 will support storage in and diversions from the reservoir. Water from the SCLDS and SLDS originates from stormwater collected in playa lakes and subsequently discharged to the North Fork Double Mountain Fork Brazos River. This stormwater would not naturally have contributed flow to the Brazos River and its tributaries. Therefore, staff's opinion is that downstream water rights could not have relied on these flows in the river and the City's use of these flows cannot affect other water rights. The City applied for reuse of return flows from SEWRP prior to discharge of those return flows. Therefore, downstream water rights could not have been granted based on these return flows and the City's use of these flows cannot affect other water rights.

The City estimated channel losses associated with the requests to convey water and return flows from SCLDS, SLDS, and SEWRP to Lake 7 as well as revised channel losses for conveyance of return flows from NWRP and water from NDP. The proposed and revised channel losses are based on channel loss factors in TCEQ's Brazos WAM. Staff reviewed the estimates of losses and found them to be acceptable.

Consideration of other sources of water available to the City

Staff performed an additional simulation that considered use of water from SCLDS, SLDS, SEWRP and water authorized under Water Use Permit No. 3985, as amended to support diversions from and storage in Lake 7. Staff added flows from these additional sources to the Brazos WAM as follows:

- Discharges from SCLDS, SLDS, SEWRP requested in the application, and 6,725 acre-feet of return flows discharged from the Northwest Water Reclamation Plant (NWRP) and up to 7,100 acre-feet of water discharged by the Northwest Drainage Project (NDP) authorized by Water Use Permit No. 3985, as amended, were made available only for the City's use in Lake 7.
- Discharges from SEWRP and NWRP were modeled as constant monthly volumes.
- Discharges from SCLDS, SLDS and NDP are variable and dependent on rainfall. Staff used the City's estimates of the volume of water anticipated to be discharged from these facilities based on studies that are further described in a

July 15, 2015 memorandum and supplemented by an October 20, 2021 submittal of data through 2018.
- Discharges of stormwater and reuse water were adjusted for channel losses.

Simulation results indicate that the requested diversion amount, 50,000 acre-feet per year, is available in one year of the period of record. TCEQ's rules (30 TAC §297.42(d)) provide that the required water availability for projects that are not based on the continuous availability of streamflow shall be determined on a case-by-case basis based upon whether the proposed project can be viable for the intended purpose and the water will be beneficially used without waste. The determination of whether the water will be beneficially used without waste is addressed in the conservation review of the application. Regarding whether the proposed project is viable for the intended purpose, the City owns water rights in Lakes Meredith and Alan Henry as well as groundwater sources. Given the City's multiple sources of supply, staff's opinion is that the project can be viable for the intended purpose.

Accounting Plan

The City submitted an accounting plan (*City of Lubbock Accounting Plan for Permit 12-5921 Lake 7*) that calculates state water inflows to Lake 7 and accounts for the use of the City's sources of supply as well as compliance with the recommended environmental flow requirements. Staff reviewed the accounting plan and found it adequate to demonstrate compliance with the terms and conditions of the proposed permit.

Conclusion

Simulation results indicate that the amount of water requested is available during the period of record. Staff is of the opinion that if the City manages the new appropriation as part of its water supply system in accordance with the approved accounting plan, the application will not affect existing water rights and will be viable for the intended purpose. Therefore, Staff can support granting the application.

Staff recommends that the following special conditions be included in the permit:

1. If Permittee has stored water in accordance with the terms and conditions of this permit at the time the water was stored, Permittee may divert and use that stored water, even if any environmental flow requirements are not met at the time of the subsequent diversion and use of that stored water.

2. Permittee shall determine the hydrologic condition once per season. The Palmer Hydrologic Drought Index (PHDI) value present on the last day of the month of the preceding season, as reported by the National Weather Service, shall be used to determine the hydrologic condition for the following season as set out in Paragraphs 1.a. – c. below.

a. Permittee shall determine the PHDI Index for a season based on the following formula:

(0.027 × High Plains PHDI) + (0.647 × Low Rolling Plains PHDI) + (0.326 × North Central PHDI)

b. The PHDI Index and corresponding hydrologic conditions that govern diversions under this permit are:

Dry	Average	Wet
Less than -1.78	-1.78 – 2.18	Greater than 2.18

c. Permittee may utilize an interim PHDI value to determine the hydrologic condition until the value preceding the start of the season is published in accordance with the procedure described in *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7*.

2. Impoundment and diversion of return flows and other discharged water as authorized by this permit is dependent upon potentially interruptible return flows and discharges and is conditioned on the availability of those discharges. The right to divert return flows discharged from the Southeast Water Recycling Plant and the water discharged from the South Central Lubbock Drainage System and the South Lubbock Drainage System is subject to revocation if all discharges become permanently unavailable for impoundment and diversion and may be subject to reduction if the return flows discharged from the Southeast Water Recycling Plant and the water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System are not available in quantities and qualities sufficient to fully support the permit authorizations. Should any of the discharges become permanently unavailable for impoundment and diversion, Permittee shall immediately cease impoundment and diversion of return flows and other discharged water under this permit and either apply to amend the permit, or voluntarily forfeit the authorization to impound and divert return flows and other discharged water. If Permittee does not amend or forfeit the authorization, the Commission may begin proceedings to cancel these authorizations in the permit.

3. Permittee shall only divert daily return flows and any water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System that is actually discharged.

4. Prior to diversion and impoundment of return flows in excess of the amount currently authorized by TPDES Permit No. WQ00010353002, described in Paragraph 2. USE and Paragraph 3. DISCHARGE, Permittee shall apply for and be granted the right to reuse those return flows. Permittee shall amend the accounting plan to include future discharges of return flows prior to diverting said return flows.

5. Prior to diversion of any additional water discharged from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System in excess of the maximum annual discharge volume described in Paragraph 2. USE and Paragraph 3. DISCHARGE, Permittee shall apply for and be granted the right to use the discharged water. Permittee shall amend the accounting plan to include additional discharges from the City's South Central Lubbock Drainage System and the South Lubbock Drainage System prior to diverting said additional discharges.

6. Permittee shall only divert water authorized under this permit pursuant to Paragraph 2. USE and Paragraph 4. DIVERSION in accordance with the most recently approved *City of Lubbock Accounting Plan for Permit 12-5921 Lake 7.* Permittee shall maintain the plan in electronic format and make it available upon request. Any modifications to the accounting plan shall be approved by the Executive Director. Any modification to the accounting plan that changes the permit terms must be in the form of an amendment to the permit. Should Permittee fail to maintain the accounting plan or notify the Executive Director of any modifications to the plan, Permittee shall immediately cease diversion and impoundment of water authorized in this permit, and either apply to amend the permit, or voluntarily forfeit the permit. If Permittee fails to amend the accounting plan or forfeit the permit, the Commission may begin proceedings to cancel the permit. Permittee shall immediately notify the Executive Director upon modification of the accounting plan and provide copies of the appropriate documents effectuating such changes.

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Sarah Henderson, Project Manager
Water Rights Permitting Team

Date: April 22, 2021

Through: Jason Godeaux, Team Leader
Resource Protection Team

From: Kenneth Coonrod, Aquatic Scientist
KC
Resource Protection Team

Subject: City of Lubbock
WRPERM 5921
CN600130736
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn counties

Environmental reviews of water right applications are conducted in accordance with applicable provisions of the Texas Water Code (TWC) and the administrative rules of the Texas Commission on Environmental Quality (TCEQ). The provisions applicable to environmental reviews can vary according to the type and the location of the authorization requested.

APPLICATION SUMMARY

The City of Lubbock (City) requests authorization to construct and maintain a reservoir (Lake 7) impounding 20,708 acre-feet of water on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, for subsequent diversion of 50,000 acre-feet of water per year from the perimeter of the reservoir at a maximum diversion rate of 138.12 cfs (62,016 gpm) for municipal, industrial, and agricultural purposes in Lubbock and Lynn counties. The City also requests authorization to use the bed and banks of the North Fork Double Mountain Fork Brazos River to convey up to 14,856 acre-feet of water per year discharged from the South Central Lubbock Drainage System, up to 8,934 acre-feet of water per year from the South Lubbock Drainage System, and up to 16,420 acre-feet of surface water- and groundwater-based return flows per year, to Lake 7 to support storage in and diversions from the reservoir, from the Southeast Water Recycling Plant, authorized under Texas Pollutant Discharge Elimination System Permit No. WQ00010353002. The City will use other water sources available to it in the North Fork Double Mountain Fork Brazos River, that are authorized under Water Use Permit Nos. 3985, as amended, and 3705, as amended.

The City maintains an agreement with the Brazos River Authority in which the City will pass water through Lake 7 when streamflows exceed 5 cfs and when the water surface elevation of Possum Kingdom Lake is below 1,000 feet msl.

ENVIRONMENTAL ANALYSIS

New Appropriation Request

On February 12, 2014, the TCEQ adopted environmental flow standards for the Brazos River and its associated bay and estuary system (Title 30 Texas Administrative Code (TAC) Chapter 298 Subchapter G). These environmental flow standards are considered adequate to support a sound ecological environment (Title 30 TAC § 298.460).

The City is requesting a new appropriation of water and therefore is subject to the adopted standards. This review is conducted in accordance with §11.147(e-3) of the TWC and Title 30 TAC Chapter 298 Subchapter G (Brazos River and its associated bay and estuary system). In Title 30 TAC § 298.480(1), environmental flow standards were established at United States Geological Survey (USGS) Gage No. 08080500 – Double Mountain Fork Brazos River near Aspermont, and the applicable environmental flow standards are shown in Table 1.

Table 1. Environmental Flow Standards at USGS Gage No. 08080500 – Double Mountain Fork Brazos River near Aspermont.

Season	Subsistence	Hydrologic Condition	Base	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	1 cfs	Dry	1 cfs	N/A	N/A	N/A
		Average	4 cfs			
		Wet	15 cfs			
Spring	1 cfs	Dry	1 cfs	1 per season Trigger: 280 cfs Volume: 1,270 af Duration: 10 days	2 per season Trigger: 280 cfs Volume: 1,270 af Duration: 10 days	1 per season Trigger: 570 cfs Volume: 2,600 af Duration: 12 days
		Average	3 cfs			
		Wet	8 cfs			
Summer	1 cfs	Dry	1 cfs	1 per season Trigger: 230 cfs Volume: 990 af Duration: 9 days	2 per season Trigger: 230 cfs Volume: 990 af Duration: 9 days	1 per season Trigger: 480 cfs Volume: 2,160 af Duration: 12 days
		Average	2 cfs			
		Wet	7 cfs			

cfs = cubic feet per second
af = acre-feet
N/A = not applicable

The City has requested that compliance with the adopted environmental flow standards be calculated at their measurement point. The City further requested that compliance with the adopted environmental flow standards for subsistence and base flows utilize a drainage area ratio to determine the flows that must pass the gage. The City translated the adopted subsistence and base flow standards using a drainage area ratio from the contributing drainage area of USGS Gage No. 08080500 – Double Mountain Fork Brazos River near Aspermont, TX to the contributing drainage area of the Lake 7 dam. Computation of state water inflows between USGS Gage No. 08079510 – North Fork Double Mountain Fork Brazos River at Loop 289 near Lubbock, TX and the Lake 7 dam location, translation of the pulse flow standards, and hydrologic conditions are discussed in the Water Availability Analysis. Resource Protection staff reviewed the information submitted by the City, and the translated values, and agrees that using the translated values for subsistence and base flows and applying those values at their measurement point would protect the adopted standards. Resource Protection staff recommendations are shown in Table 2.

Table 2. Environmental Flow Values at City of Lubbock's Measurement Point.

Season	**Subsistence**	**Hydrologic Condition**	**Base**	**Dry Condition Seasonal Pulse**	**Average Condition Seasonal Pulse**	**Wet Condition Seasonal Pulse**
Winter	1 cfs	Dry	1 cfs	N/A	N/A	N/A
		Average	1 cfs			
		Wet	1 cfs			
Spring	1 cfs	Dry	1 cfs	1 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	2 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	1 per season Trigger: 88 cfs Volume: 335 af Duration: 10 days
		Average	1 cfs			
		Wet	1 cfs			
Summer	1 cfs	Dry	1 cfs	1 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	2 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	1 per season Trigger: 88 cfs Volume: 278 af Duration: 10 days
		Average	1 cfs			
		Wet	1 cfs			

cfs = cubic feet per second
af = acre-feet
N/A = not applicable

Seasons are defined in Title 30 TAC § 298.455 as follows: Winter (November through February), Spring (March through June), and Summer (July through October). Hydrologic conditions will be discussed in the water availability analysis for this application.

Given the applicable values for subsistence and base are equal, as shown in Table 2 above, Resource Protection staff's opinion is that the subsistence flow values alone are sufficient to provide adequate protection for the environment.

Special conditions to protect high flow pulses are required, because the City's diversion rate, 138.12 cfs, is greater than 20% of the applicable high flow pulse trigger level requirements of an applicable high flow pulse at the measurement point, as described in Title 30 TAC § 298.485.

Resource Protection staff recommend that impoundment and diversion of water under this proposed permit should be limited to comply with the applicable environmental flow values.

Bed and Banks Request

Aquatic and Riparian Habitats: The City provided an *Environmental Information Document in Support of Water Use Permit Application No. 5921* (EID), prepared by HDR, Inc. (HDR) and dated June 2011, as supplemental documentation for their application. The EID describes the area of the City's project as being located on the North Fork Double Mountain Fork Brazos River, a perennial stream in Lubbock County, which is situated in the High Plains Ecoregion in what was once characterized as shortgrass prairie but is now dominated by agriculture (HDR, Inc. 2011). The river runs in a southeasterly direction and has cut a deep canyon into the escarpment, which has caused turbidity in the stream, and riparian vegetation cited in the EID includes black willow, salt cedar, and American elm found in varying densities throughout the project area (HDR, Inc. 2011). Within the footprint of the proposed reservoir's conservation pool, playa lakes, perennial river habitat, and intermittent stream tributaries were the predominate aquatic habitats (HDR, Inc. 2011).

The EID cites the Texas Parks and Wildlife Department (TPWD), the Llano Estacado Regional Water Planning Group, and the Texas Legislature as having identified no river or stream segments of unique ecological value in the affected area (HDR, Inc. 2011).

As part of the EID, a study was conducted to assess the project area and the natural and cultural resources that would be affected by construction of a large reservoir. The EID guided the preparation of the mitigation plan that the City submitted to the United States Army Corps of Engineers (USACE) in its application for a permit to comply with Section 404 of the Clean Water Act.

In the EID, a vegetation evaluation using aerial photography was conducted simultaneously with a habitat characterization employing the Wildlife Habitat Appraisal Procedure (WHAP) developed by TPWD. The WHAP evaluates wildlife habitat with the presumption that quantity and quality of plant density and plant community is sufficient to make a determination of suitability (TPWD and USFWS 1990). The vegetation study, in conjunction with the WHAP survey, identified multiple vegetation types across approximately 795 acres of vegetated habitat, or 247 Habitat Units, within the proposed Lake 7 conservation pool (HDR, Inc. 2011).

The City also submitted a soil survey based on a United States Department of Agriculture study for Lubbock County which identified Berda loam, Berda-Potter Association soils, and Bippus clay loam as the predominate soil types found within the reservoir's proposed conservation pool (HDR, Inc. 2011).

A wetland delineation using the National Wetland Inventory identified Palustrine shrubland, intermittent emergent wetlands, and sparse areas of Riverine and Lacustrine wetlands within the proposed conservation pool (HDR, Inc. 2011). Additionally, the delineation determined that up to 45.3 acres of waters of the U.S. were found within the proposed project area (HDR, Inc. 2011).
HDR chose four locations based on site-specific water quality, habitat quality, and biological integrity, and conducted sampling of physio-chemical parameters, stream habitat, streamflow, and fish and benthic macroinvertebrate communities utilizing the Aquatic Life Monitoring protocol developed by the TCEQ in the *Surface Water Quality Monitoring Procedure Manual* and the *Biological Monitoring Fact Sheet*, and each were sampled once in June and again in September of 2009 (HDR, Inc. 2011).

The EID's benthic macroinvertebrate survey produced 1,773 individuals representing 27 taxa, and fewer intolerant species than tolerant species were found during the study, which would indicate conditions in the river reflect degraded water quality, poor habitat, and an overall Intermediate aquatic life use score (HDR, Inc. 2011).

The North Fork Double Mountain Fork Brazos River at the survey sites is a relatively saline stream, and as such, fish sampling was conducted using seines rather than a combination of seining and electrofishing (HDR, Inc. 2011). The results of HDR's study found 4,417 individuals representing seven families, 15 species, and one hybrid sunfish, and of the 15 species, four represented nearly 95% of the catch, and of those, one species represented 59% of the total catch (HDR, Inc. 2011). As with the macroinvertebrate study, most of the fish caught were highly tolerant of adverse conditions, reflecting poor water quality and habitat structure, but species diversity varied between the four sample sites, which therefore earned aquatic life use ratings ranging from Intermediate to Exceptional (HDR, Inc. 2011).

An evaluation of Lubbock County protected species by HDR found one extant, federally-listed endangered species, the whooping crane (*Grus americana*); three state-listed threatened species, the American peregrine falcon (*Falco peregrinus anatum),* the bald eagle (*Haliaeetus leucocephalus*), and the Texas horned lizard (*Phrynosoma cornutum*); and two species of fish whose historical geographic range once extended into the project area, the smalleye shiner (*Notropis buccula*) and the sharpnose shiner (*Notropis oxyrhynchus*) (HDR, Inc. 2011). The EID reports no net negative effect is expected for any of the bird species because any potential habitat would only be used temporarily during migration, and no habitat was found to be preferred by any of the three species (HDR, Inc. 2011).

The EID reports that the smalleye and sharpnose shiners, whose range once extended into the project area, have not been recorded in Lubbock County, but both species have been accounted for downstream in Garza County (HDR, Inc. 2011). Additionally, neither of the two species were caught during the surveys for this portion of the report (HDR, Inc. 2011). Two reservoirs, Buffalo Springs Lake and Lake Ransom Canyon, are found between the City's proposed reservoir and Garza County, and these reservoirs act as physical barriers between the known population and the proposed Lake 7, which led HDR to conclude that this project is not expected to impact these two species (HDR, Inc. 2011).

Because the Texas horned lizard prefers habitat that is known to occur within the proposed conservation pool of Lake 7, a rapid baseline survey was conducted to evaluate available habitat and presence of the species. The habitat assessment used aerial photography to identify approximately 619 acres of potentially suitable habitat and field surveys which guided the inspection of the roughly 240 acres of habitat sampled within the project area (HDR, Inc. 2011). Eight lizards were caught in June and July of 2009, including five hatchlings and three sub-adults/adults, and the occurrence of hatchlings in the project area suggests a healthy breeding population (HDR, Inc. 2011).

Based on the results of the Texas horned lizard survey conducted for this report, the EID recommends the following:

- Further assessments of Texas horned lizard occurrence and suitability of potential habitat within the proposed conservation pool footprint should be conducted;

- Potential off-site relocation areas should be identified;

- Development of a preliminary management plan for the Texas horned lizard addressing potential mitigation strategies for relocation to adjacent or near-site suitable habitat;

- Coordination with TCEQ/TPWD to address these concerns.

The results of the above studies were used to assign habitat values that would be impacted by construction of the proposed reservoir, and wetlands and wooded riparian areas were identified as high-priority targets for mitigation (HDR, Inc. 2011).

The request to use the bed and banks of the North Fork Double Mountain Fork Brazos River is not expected to have an effect on any federally-listed or high-interest aquatic species, because staff are recommending environmental flow requirements.

On February 12, 2014, the TCEQ adopted environmental flow standards for the Brazos River and its associated bay and estuary system (Title 30 Texas Administrative Code (TAC) Chapter 298 Subchapter G). These environmental flow standards are considered adequate to support a sound ecological environment (Title 30 TAC § 298.460). The City's request to use the bed and banks of the North Fork Double Mountain Fork Brazos River is not a new appropriation of water or an amendment that increases the amount of water stored, taken, or diverted; therefore, the environmental flow standards do not apply. The City proposes to use the bed and banks of the North Fork Double Mountain Fork Brazos River to support storage in and diversions from Lake 7. The City's request is not expected to adversely impact aquatic and riparian habitats in the area.

Recreational Uses: The North Fork Double Mountain Fork Brazos River has a presumed primary contact recreation 1 use (TCEQ 2018). The City's request should not adversely impact recreational uses.

Water Quality: The North Fork Double Mountain Fork Brazos River has a presumed limited aquatic life use for its intermittent with pools portion and a presumed high aquatic life use for its perennial portion (TCEQ 2018). Assessment Unit 1241A_02 was identified in the *Texas Integrated Report* as non-supporting for bacteria in water and with a concern for screening levels for chlorophyll-*a* in water and nitrate in water (TCEQ 2020). The City's request should not adversely impact water quality.

Freshwater Inflows: Freshwater inflows are critical for maintaining the historical productivity of bays and estuaries along the Gulf Coast. The proposed project is located more than 200 river miles from the Gulf of Mexico. The request for the use of the bed and banks is not a new appropriation of water; therefore, the City's request should not have any impact to the Brazos River Estuary.

RECOMMENDATIONS

Resource Protection staff recommend the following Special Conditions be included in the proposed permit, if granted:

1. Permittee shall implement reasonable measures in order to reduce impacts to aquatic resources due to entrainment or impingement. Such measures shall

include, but shall not be limited to, the installation of screens at the diversion structure.

2. Impoundment and diversion shall be restricted based on the following streamflows at the City's measurement point, as set forth in Special Conditions 3-7 below.

Season	**Subsistence**	**Dry Condition Seasonal Pulse**	**Average Condition Seasonal Pulse**	**Wet Condition Seasonal Pulse**
Winter	1 cfs	N/A	N/A	N/A
Spring	1 cfs	1 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	2 per season Trigger: 43 cfs Volume: 157 af Duration: 8 days	1 per season Trigger: 88 cfs Volume: 335 af Duration: 10 days
Summer	1 cfs	1 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	2 per season Trigger: 36 cfs Volume: 119 af Duration: 7 days	1 per season Trigger: 88 cfs Volume: 278 af Duration: 10 days

cfs = cubic feet per second
af = acre-feet
N/A = not applicable

3. Seasons are defined as follows: Winter (November through February), Spring (March through June), and Summer (July through October).

Subsistence Flow

4. Permittee shall not impound or divert water if the average streamflow at the City's measurement point is less than or equal to the applicable subsistence flow in Special Condition 2. The "average streamflow" at the gage is the average of measured streamflows at the gage for the previous 24 hours.

High Flow Pulse

5. If a pulse flow event required under Special Condition 2 is determined to have been triggered based on average streamflows at the City's measurement point then, until either the applicable volume amount has passed the gage or the applicable duration time has passed since the high flow pulse was triggered, Permittee shall not impound or divert except during times that average streamflow at the gage exceeds the applicable pulse flow trigger level. Diversions during such times shall not exceed the rate that would reduce average streamflow at the gage to the applicable pulse flow trigger level; provided, however, Permittee is not required to adjust its diversion rate during the pulse event more frequently than once every 24 hours.

6. Each season is independent of the preceding and subsequent seasons with respect to high flow pulse frequency and the applicable high flow pulse is dependent on the applicable hydrologic condition.

7. If a qualifying pulse flow event occurs at the City's measurement point within a given season, the pulse event shall satisfy a pulse requirement for that season. A qualifying event occurs if the event is determined to have been triggered based on average streamflow at the gage and either the pulse flow volume or duration requirement is met.

LITERATURE CITED

HDR, Inc. 2011. Environmental Information Document in Support of Water Use Permit Application No. 5921 Prepared in Response to TCEQ RFI Dated 06/23/2008. Prepared for City of Lubbock, TX.

TCEQ. 2018. Texas Surface Water Quality Standards §§ 307.1-307.10. Austin (TX): Texas Commission on Environmental Quality.

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Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Sarah Henderson, Project Manager
Water Rights Permitting Team

Date: April 22, 2021

Through: Jason Godeaux, Team Leader
Resource Protection Team

K.W. Kristin Wang, Senior Water Conservation Specialist
Resource Protection Team

From: Jennifer Allis, Senior Water Conservation Specialist
Resource Protection Team

Subject: City of Lubbock
WRPERM 5921
CN600130736
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn counties

APPLICATION SUMMARY

City of Lubbock (City) requests authorization to construct and maintain a reservoir (Lake 7) impounding 20,708 acre-feet of water on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, for subsequent diversion of 50,000 acre-feet of water per year from the perimeter of the reservoir at a maximum diversion rate of 138.12 cfs (62,016 gpm) for municipal, industrial, and agricultural purposes in Lubbock and Lynn counties. The City also requests authorization to use the bed and banks of the North Fork Double Mountain Fork Brazos River to convey up to 14,856 acre-feet of water per year discharged from the South Central Lubbock Drainage System, up to 8,934 acre-feet of water per year from the South Lubbock Drainage System, and up to 16,420 acre-feet of surface water- and groundwater-based return flows per year, to support storage in and diversions from the reservoir, from the Southeast Water Recycling Plant, authorized by Texas Pollutant Discharge Elimination System Permit No. WQ00010353002, to Lake 7 to support storage in and diversions from the reservoir. The City will use other water sources available to it in the North Fork Double Mountain Fork, that are authorized under Water Use Permit Nos. 3985, as amended, and 3705, as amended.

The City maintains an agreement with the Brazos River Authority in which the City will pass water through Lake 7 when streamflows exceed 5 cfs and when the water surface elevation of Possum Kingdom Lake is below 1,000 feet msl.

WATER CONSERVATION REVIEW

Pursuant to Title 30 Texas Administrative Code (TAC) §295.9(1), an application requesting a new appropriation of water requires the submittal of water conservation and drought contingency plans.

Resource Protection staff reviewed the water conservation and drought contingency plans and found the plans to be administratively complete per 30 TAC Chapter 288.

Additionally, the City is required to provide evidence that the amount of water appropriated will be beneficially used, i.e., effectively managed and not wasted pursuant to Texas Water Code (TWC), §11.134(b)(3)(A). Also, the City must provide evidence that reasonable diligence will be used to avoid waste and achieve water conservation pursuant to TWC §11.134(b)(4). To provide that evidence, the City must submit a water conservation plan in accordance with 30 TAC Chapter 288. In applications where a new appropriation of water is requested, the review includes an analysis of whether the requested appropriation is reasonable and necessary for the proposed uses in accordance with TWC §11.134 and 30 TAC §297.50 and §288.7.

The purpose of this review is to:

1) determine whether reasonable water conservation goals have been set;
2) determine whether the proposed strategies can achieve the stated goals;
3) determine whether there is a substantiated need for the water and whether the amount to be appropriated is reasonable for the proposed use; and
4) determine whether the water conservation plan addresses a water supply need in a manner that is consistent with the state water plan and the relevant approved regional water plan.

If these criteria are met, then Resource Protection staff considers this sufficient evidence to conclude that the City will avoid waste and achieve water conservation. This review forms a basis for permit conditions and limitations as provided by TWC §11.134.

Water Conservation Goals and Strategies

The City submitted 2019 water conservation and drought contingency plans which were reviewed by Resource Protection staff and found to meet the requirements in 30 TAC Chapter 288 for retail and wholesale water suppliers.

The City established five- and ten-year goals for water use in gallons per capita per day (gpcd). The City's annual average per capita per day usage declined by 27 percent over the past eight years. The City's water conservation goals were determined using the baseline of per capita water use of the 10-year average from

2009 to 2018 of 143 gpcd. Of note, the City met its previous goal for water use which was 150 gpcd for 2019.

The City's goals were developed utilizing a 0.5 percent per year reduction in per capita water use, resulting in a per capita goal of 139 gpcd for 2024 and of 136 gpcd for 2029.

In addition to the per capita water use goal, the City set a maximum water loss goal of 10 percent for the retail water delivery system, which corresponds to a loss rate of 13.9 gpcd in 2024 and 13.6 gpcd in 2029.

According to the City's *2018 Strategic Water Supply Plan* (SWSP), the significant reduction in per capita consumption over the past few years can be directly attributed to the effectiveness of the City's conservation block rate structure, volume rates, and two-day per week irrigation limitation on a year-round basis.

The City's water conservation program is comprised of four main strategies:

1. Maintain a rate structure that encourages conservation;
2. Reduce water loss within the City's distribution system;
3. Educate the public and provide useful information; and
4. Enforce irrigation and waste of water restrictions.

The City has implemented water conservation strategies that include public education and awareness, stringent seasonal watering restrictions, an increasing block rate structure, reducing unaccounted-for water losses, and additional measures to increase the efficiency of irrigation practices and commercial water use. Additionally, the City requires its wholesale customers to adopt and implement water conservation plans that will reduce their per capita water use.

The City also submitted an irrigation water conservation plan indicating that it uses sewage effluent from its wastewater treatment plant to irrigate two land application sites. Effluent is used to irrigate crops as wheat, jose wheat, bermuda, and rye. The City's current and future goals for this reuse system are to be able to dispose of the total wastewater volume necessary through this system. Irrigation practices are designed to prevent contamination of surface and groundwater in the area. The City monitors the delivery system for any leaks by visually inspecting the system on a regular basis, and all leaks are repaired in a timely manner.

As such, Resource Protection staff has deemed these goals and strategies to be reasonable.

Requirements for Water Right Application under 30 TAC §288.7

Under 30 TAC §288.7, a water conservation plan submitted with a water right application for a new or additional appropriation of water must include data and information which:

1) supports the applicant's proposed use of water with consideration of the water conservation goals of the water conservation plan;
2) evaluates conservation as an alternative to the proposed appropriation; and
3) evaluates any other feasible alternative to new water development including, but not limited to, waste prevention, recycling and reuse, water transfer and marketing, regionalization, and optimum water management practices and procedures.

The City developed the 2018 SWSP to actively plan for future water supplies. The 2018 SWSP includes multiple strategies to diversify the City's water supply portfolio to minimize risk associated with variable climatic conditions while emphasizing conservation efforts to delay expensive water supply projects.

Consideration of Water Conservation Goals

Based on projections, continued conservation could reduce the per capita demand for the City by 21 gpcd by 2035. This translates into a reduction in water demand of 7,564 acre-feet in 2035, or almost 14 percent when compared to the expected water demand.

Conservation as an Alternative to the Proposed Appropriation

As part of the regional water planning process, the planning groups are required to perform a comprehensive analysis of potentially feasible water management strategies, including consideration of water conservation as a strategy for all water users with supply needs. Given the large irrigation water needs in the region, the Region O Water Planning Group gave special consideration to agricultural conservation methods. In addition to conservation, strategies that include the development of new supplies and infrastructure were developed and evaluated. However, the projected shortage for the City after Conservation is expected to be 32,370 acre-feet per year in 2070.

Feasible Alternatives to New Water Development

Most recommended water management strategies in the Region O Water Plan are new groundwater development or expansion of existing well fields. Although surface water supplies are limited in the region, expansion of surface water supply from Lake Alan Henry was evaluated. New reuse and brackish groundwater development were also evaluated. Lake 7 would impound reclaimed water, developed playa lake stormwater, and natural inflows. Because Lake 7 will utilize the City's reclaimed water as the primary portion of its yield, supply from Lake 7 will be relatively drought proof. The use of reclaimed water is considered an important water supply strategy in the 2017 State Water Plan. Since the City must import its potable water from such long distances, reusing water makes economical and practical sense. Using reclaimed water can reduce dependency on new water supplies.

Water Need

The City is the largest demand center in the Region for municipal and manufacturing water use. According to the 2021 Region O Water Plan, Lubbock has the largest predicted water needs, with a shortage of 5,154 acre-feet per year in 2020 that increases to a shortage of 33,808 acre-feet per year in 2070. The City has wholesale water supply contracts with several customers. Total water use by the City and its customers is projected to be 49,863 acre-feet in 2020 and 71,477 acre-feet in 2070.

Consistency with State and Regional Water Plans

The project is included as a recommended water management strategy in the City's *2018 Strategic Water Supply Plan* and in the 2021 Region O Water Plan. As such, the application is consistent with the 2021 Region O Water Plan, and Resource Protection staff expects that the request will also be consistent with the 2022 State Water Plan once it is approved, because there is nothing in the water plans that conflicts with issuing the permit.

RECOMMENDATIONS

Based on the analysis, Resource Protection staff has evaluated the application and determined that it meets the review requirements.

The following water conservation language should be included in the permit, if granted:

Permittee shall implement water conservation plans that provide for the utilization of those practices, techniques, and technologies that reduce or maintain the consumption of water, prevent or reduce the loss or waste of water, maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, and prevent the pollution of water, so that a water supply is made available for future or alternative uses. Such plans shall include a requirement that in every water supply contract entered into on or after the effective date of this permit, including any contract extension or renewal, that each successive wholesale customer develop and implement conservation measures. If the customer intends to resell the water, then the contract for resale of the water shall have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures.

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Ron Ellis
Water Rights Permitting Team

Date: March 27, 2008

Thru:

From: Warren D. Samuelson, P. E.
Dam Safety Program, MC-174

Subject: City of Lubbock, Supplemental Application to construct and maintain a dam and reservoir, North Fork Double Mountain Fork Brazos River, Brazos River Basin, Lubbock County.

The applicant has indicated through the applicant's attorney that the applicant is not pursuing the permitting of one of the proposed dams and reservoirs (Lake No. 8). Therefore, this is a supplemental memorandum. To the original memorandum of February 17, 2006.

The applicant seeks authorization to construct and maintain one reservoir (Lake No. 8) on North Fork Double Mountain Fork Brazos River in Lubbock County. The proposed Lake No. 7 will have a capacity of 20,708 acre-feet and a surface area of 801 acres. The reservoir will be used for municipal, industrial, and agricultural purposes.

The engineer, HDR Engineering, Inc., has indicated that the proposed dam and spillways will be designed to pass 100% of the probable maximum flood (PMF) as required in Chapter 299.

It is recommended that the permit include the following language:

TIME LIMITATIONS

(a) Construction of the proposed dam for Lake No. 7 shall be in accordance with plans approved by the Executive Director. Construction of the dam without final approval of the construction plans is a violation of this authorization.

(b) Construction shall begin within two years of issuance of this permit and be completed within five years of issuance of the permit, unless Permittee applies for and is subsequently granted an extension of time before the expiration of these time limitations.

(b) Failure to commence the proposed dam and reservoir within the period stated above shall subject all rights to this permit to forfeiture, subject to notice and hearing. After beginning construction, failure to timely construct the proposed dam and reservoir stated above shall subject this permit to cancellation in whole or in part, subject to notice and hearing.

Warren D Samuelson

Warren D. Samuelson, P. E.
Dam Safety Program

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

TO: Iliana Delgado
Water Rights Permitting Team

DATE: February 17, 2006

FROM: Warren D. Samuelson, P. E.
Dam Safety Program, MC-174

SUBJECT: City of Lubbock, Application to construct and maintain two dams and reservoirs, North Fork Double Mountain Fork Brazos River, Brazos River Basin, Lubbock County.

The applicant seeks authorization to construct and maintain two reservoirs (Lake No. 7 and Lake No. 8) on North Fork Double Mountain Fork Brazos River in Lubbock County. The proposed Lake No. 7 will have a capacity of 20,708 acre-feet and a surface area of 801 acres. The proposed Lake No. 8 will have a capacity of 49,930 acre-feet and a surface area of 1,680 acres. The reservoirs will be used for municipal, industrial, and agricultural purposes.

The engineer, HDR Engineering, Inc., has indicated that the proposed dams and spillways will be designed to pass 100% of the probable maximum flood (PMF) as required in Chapter 299.

It is recommended that the permit include the following language:

TIME LIMITATIONS

(a) Construction of the dams for Lakes 7 and 8 must be in accordance with plans and specifications approved by the Executive Director and must begin within two years of issuance of this permit and be completed within five years of issuance of the permit.

(b) Failure to commence and/or complete construction of the proposed dam within the period stated above shall cause the authorization for use of the reservoirs to expire and become null and void without further Commission consideration unless the Owner applies for an extension of time to commence and/or complete construction prior to the deadline for commence and completion, and the application is subsequently granted.

Warren D Samuelson

Warren D. Samuelson, P. E.
Dam Safety Program

From:	Dunn, David
To:	Kathy Alexander
Cc:	Aubrey Spear; Sara Thornton; Lemonds, Paula Jo; Stein, Zachary
Subject:	RE: City of Lubbock Application 5921
Date:	Wednesday, October 20, 2021 10:44:38 AM
Attachments:	TS_30_1940-2018.prn TS_31_1940-2018.prn TS_North_Drainage_1940-2018.prn

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Kathy,

As requested, attached are three text files containing the TS records for the stormwater discharged at the three outfalls, extended through 2018.

Please let me know if you have any issues with the attached files.

Thanks!

David

David D. Dunn, PE (Texas)
D 512.912.5136 **M** 512.791.3671

Texas TBPE Firm No. F-754

hdrinc.com/follow-us

From: Kathy Alexander <kathy.alexander@tceq.texas.gov>
Sent: Thursday, September 23, 2021 4:36 PM
To: Dunn, David [redacted]
Subject: City of Lubbock Application 5921

Hi David,
As you may know, TCEQ has accepted the updated Brazos WAM, which includes an extension of the period of record through 2018. The current version of the modeling for the City's application utilizes TS records to model stormwater discharged at Outfalls 30 and 31 and stormwater discharged from the Northwest Drainage Project. However, these TS records only include data through 1997. Can you provide updated TS records for these facilities through 2018?
Thank you, and let me know if you have any questions.
Kathy

Kathy Alexander, Ph.D.
Policy and Technical Analyst
Water Availability Division
Office: 512-239-0778
Mobile: 512-965-9603

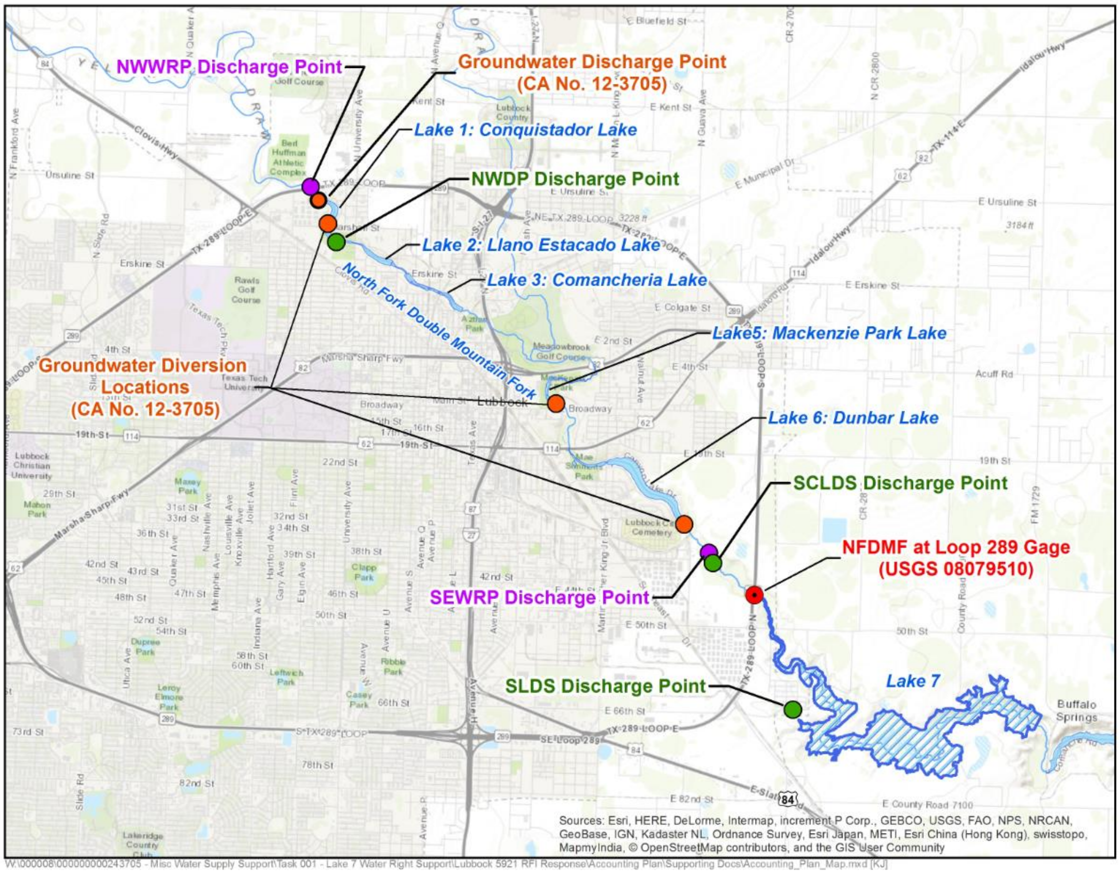
City of Lubbock WRPERM No. 5921
Accounting Plan Excel files available upon request

Contact Mr. Chris Kozlowski at (512) 239-1801

City of Lubbock
Accounting Plan for Permit No. 12-5921
Lake 7

Background

The City of Lubbock (the "City") has developed an accounting plan to track impoundment of water in the City's proposed Jim Bertram Lake 7 ("Lake 7") on the North Fork of the Double Mountain Fork of the Brazos River (the "North Fork"). The purpose of this accounting plan is to differentiate State Water from other sources of water available to the City for impoundment in Lake 7. Other sources of water include developed playa lake water, City return flows, and groundwater discharged by the City into the North Fork. Use of return flows has been authorized by the Texas Commission on Environmental Quality ("TCEQ") under Permit No. 12-3985 and Certification of Adjudication ("CA") No. 12-4146. Use of groundwater discharged into the North Fork has been authorized under CA No. 12-3705. Figure 1 provides the discharge and diversion locations of City water on the North Fork. This document outlines the principles used to develop the accounting plan.



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

W:\000008\000000000243705 - Misc Water Supply Support\Task 001 - Lake 7 Water Right Support\Lubbock 5921 RFI Response\Accounting Plan\Supporting Docs\Accounting_Plan_Map.mxd [KJ]

Figure 1. Discharge and Diversion Locations of City Water on the North Fork

Definitions for use in this Accounting Plan

State Water – water naturally flowing in the North Fork and its tributaries that is subject to appropriation and use by downstream senior and superior water rights.

City Water – water discharged into the North Fork by the City that is not subject to appropriation and use by downstream senior and superior water rights. This water would not enter the North Fork but for the actions of the City and is considered to be "developed water." City Water includes discharges of playa lake water from the City's South Lubbock Drainage System ("SLDS"), South-Central Lubbock Drainage System ("SCLDS"), and Northwest Drainage Project ("NWDP"); wastewater effluent derived from groundwater sources owned by the City; groundwater discharged into the North Fork by the City; and wastewater effluent derived from groundwater and surface water sources purchased from the Canadian River Municipal Water Authority ("CRMWA"). For purposes of this accounting plan, return flows originating from Lake Alan Henry ("LAH") are considered City Water because those return flows originate from water previously stored in LAH and would not have contributed to downstream flows.

Permit No. 12-5921 – water right permit authorizing the impoundment of water in, and diversion from, the proposed Lake 7 on the North Fork.

CA No. 12-3705 (as amended) – certificate of adjudication authorizing diversion from the perimeters of Lakes 1, 2 and 6 of the Jim Bertram Lake System ("JBLS") for irrigation purposes. A special condition in the permit stipulates that the City will supplement the water diverted with groundwater to replace any diverted water. The City currently discharges groundwater pumped from beneath the Lubbock Land Application Site ("LLAS") into the North Fork upstream of Lake 1. A special condition in the permit stipulates that these diversions "will not be subject to call by senior and superior water rights holders."

Permit No. 12-3985 (as amended) – water use permit authorizing the diversion of return flows from the North Fork.

CA No. 12-4146 – water right authorizing impoundment of water in and diversion from the existing LAH located on the South Fork of the Double Mountain Fork of the Brazos River. CA 12-4146 also authorizes reuse of effluent originating from LAH.

210 Authorization - Authorization from the TCEQ to directly reuse treated effluent under Title 30 Texas Administrative Code Chapter 210 Use of Reclaimed Water.

Accounting Plan Framework

The accounting plan will be based on direct measurement of City Water discharged to the LLAS, the Hancock Land Application Site ("HLAS") and the North Fork, diversions by the City and flows in the North Fork consisting of combined City Water and State Water.

All unmeasured inflows into the North Fork will be considered State Water for purposes of this accounting plan. Inflows of return flows or reclaimed water by entities other than the City will be considered State Water unless the City enters into a contract to reuse the water and obtains permission to reuse such flows from the TCEQ, in which event these return flows will be accounted for as City Water.

Streamflows in, and City Water discharged to, the North Fork shall be measured by the City using continuous recording devices. For this accounting plan, flows will be measured or computed at the following locations:

- All existing and future wastewater effluent outfalls from which the City has a right to reuse effluent;
- Outfalls of the SLDS, SCLDS and NWDP;
- The outfall from the discharge of groundwater, upstream of Lake 1;
- A point on the North Fork at Loop 289 (USGS Gage 08079510);
- Intervening State Water between the Loop 289 USGS gage and Lake 7, estimated using contributing drainage area ratio; and
- Outflows from Lake 7, which will be based on established rating curves of the reservoir’s outlet works.

Inflows to Lake 7 are accounted for by their source and are assigned to one of the following five categories:

- Developed stormwater inflow originating from the SLDS, SCLDS and NWDP;
- Return flows originating from in-basin State water sources including LAH and Lake 7;
- Discharges of groundwater that are not diverted under Permit No. 12-3705;
- Return flows originating from non-State water sources and out of basin State water sources including groundwater, Canadian River Basin surface water, and reuse from Lake 7; and
- State Water.

Carriage loss factors used to calculate the City Water and State Water inflows to Lake 7 are extrapolated from the TCEQ Brazos WAM and are used in lieu of the carriage loss factors included in Permit No. 12-3985. The WAM carriage losses are more conservative compared to those included in Permit No. 12-3985 and allow for consistency in calculating carriage losses to Lake 7 for all City water discharged into the North Fork authorized under the City’s various permits. The extrapolation calculations are provided in the “Instructions” tab of the accounting plan spreadsheet. The relatively short reach does not require application of lag times.

Inflows of State Water to Lake 7 are computed as State Water flows passing the USGS gage at Loop 289 less carriage losses, plus intervening flows computed using a drainage area ratio applied to the Lake 7 dam location. Inflows of City Water into Lake 7 will be determined based on the measured discharges of City Water, less losses and diversions of City Water by the City.

The City will pass inflows of State Water through Lake 7:

1. When Possum Kingdom Lake is below elevation 1,000 feet mean sea level and inflows of State Water exceed 5 cfs, per agreement between the City and the Brazos River Authority;
2. To meet subsistence and base flow standards translated from the Aspermont Gage by contributing drainage area ratio to the Lake 7 dam site. This translation is computed as the base or subsistence flow standard x (Lake 7 contributing drainage area)/(Aspermont gage contributing drainage area) = standard x 243.13/1,891.25 = Standard x 0.1286; and
3. To meet seasonal pulse standards translated from the Aspermont Gage. Pulse flows will be translated as follows:
    a. The trigger flows will be scaled using the ratio of the mean annual WAM naturalized flows for the two locations.
    b. The durations will be scaled using the $(R)^e$, where R is the naturalized flow ratio calculated above. The exponent e is a duration exponent obtained from a power law relationship between pulse volumes and trigger flows, and is equal to 0.105[1]. The scaled duration will be rounded to an integer number of days.
    c. The pulse volumes will be related such that the pulse ratio, QD/V, where Q is the pulse flow trigger level, D is the duration in days, and V is the pulse volume, is the same at the two locations.

Once State and City water inflows are impounded in Lake 7, they are considered to be stored water owned by the City. Therefore, diversions from Lake 7 are not classified as diversions of State or City water in the accounting plan, but only as diversions of stored water as authorized under Permit 12-5921. However, a portion of the water stored in Lake 7 can be attributed to inflows of state (surface) water. For purposes of determining how much effluent is derived from state water, a running total of formerly state water stored in Lake 7 is maintained. This running total is used to proportion diversions and return flows from Lake 7 to track how much water originating as state water might be effluent potentially reused directly under a 210 authorization.

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[1] http://www.crwr.utexas.edu/reports/2013/rpt13-2.shtml

The City has developed and will maintain an Excel spreadsheet recording on a daily basis the above information.

Accounting Plan Spreadsheet

Organization of Spreadsheet

The Accounting Plan spreadsheet contains five separate tabs to organize input data, calculations and monthly summaries. The following are descriptions of each tab.

- **Instructions** – This tab provides supplemental instructions to those found in this document and provides the location for the user to input the accounting year. This tab also provides the constants used in calculation for drainage area ratios and carriage losses.
- **Summary Table** - This tab provides a summary of monthly diversions from Lake 7 under Permit No. 12-5921.
- **Lake 7 Accounting** – This tab contains the daily user input and resulting calculations.
- **EFR** – This tab contains the TCEQ environmental flow regime (EFR) for the State Water inflows into Lake 7.
- **Elevation-Volume** – This tab contains the preliminary elevation-volume relationships from the 2011 Lake 7 Feasibility Report. These relationships will be updated with as-built relationships after Lake 7 is constructed.

Instructions for Use of Spreadsheet

INSTRUCTIONS TAB

Cell I13: Accounting Year – This cell is the location for the user to input the accounting year. It is imperative that the user input a value because all logic pertaining to dates and leap years depends upon this value.

Cell I14: Inflow Release Balance from Previous Year – This cell is used to carry forward the balance of the required inflow releases from the previous year, if any exists. Only zero or negative numbers should be entered.

Cell I15: State Water Inflows Stored in Lake 7 from Previous Year – This cell is used to carry forward the amount of State water inflows stored in Lake 7 from the previous year, if any exists. Only zero or positive numbers should be entered.

SUMMARY TABLE TAB

Column B: Month – The month of the year.

Column C: Lake 7 Diversions (acft) – This column summarizes the total water diverted from Lake 7 storage under Permit No. 12-5921.

LAKE 7 ACCOUNTING TAB

Columns C-U require user input when cells are highlighted tan.

Column A: Date (mm/dd/yyyy) – This column will automatically be populated with the date once the user enters the accounting year in the Instructions Tab.

Column B: Month (no units) – The numerical month of the year.

Column C: Lake Alan Henry Supply (MGD) – The daily raw water supplies sourced from LAH.

Column D: Canadian River Basin Surface Water Supply (MGD) – The daily raw water supplies from CRMWA surface water supply sources (Lake Meredith) in the Canadian River Basin.

Column E: Lake 7 Supply (MGD) – The daily raw water supplies diverted from Lake 7.

Column F: Lubbock Groundwater Supply (MGD) – The daily raw water supplies sourced from Lubbock-owned well fields.

Column G: CRMWA Groundwater Supply (MGD) – The daily raw water supplies sourced from CRMWA well fields.

Column H: LLAS Groundwater Discharge (MGD) – The amount of groundwater pumped from beneath the LLAS and discharged to the North Fork by the City.

Column I: LLAS Groundwater Diverted (MGD) – The amount of groundwater pumped from beneath the LLAS and discharged into the North Fork that is diverted from Lakes 1, 2 and 6 of JBLS under Permit No. 12-3705.

Column J: Effluent Directly Used or Land Applied within Texas (MGD) – The amount of treated effluent applied to the LLAS and/or HLAS and directly reused within Texas.

Column K: Effluent Directly Reused Out of State under 210 Authorization (MGD) – The amount of treated effluent directly used under the 210 Authorization. Only treated effluent originating from groundwater sources can be used under this authorization.

Column L: SCLDS Outfall (MGD) – The daily developed stormwater discharged from the SCLDS at Outfall 30 and recorded from the gage operated by the City.

Column M: SLDS Outfall (MGD) – The daily developed stormwater discharged from the SLDS at Outfall 31 and recorded from the gage operated by the City.

Column N: NWDP Outfall (MGD) – The daily developed stormwater discharged at the Northwest Drainage Project outfall and recorded from the gage operated by the City.

Column O: NWWRP Return Flow (MGD) – The recorded daily discharge from the City's Northwest Water Reclamation Plant into the North Fork.

Column P: SEWRP Return Flow (MGD) – The recorded daily discharge from the City's Southeast Water Reclamation Plant into the North Fork.

Column Q: USGS Recorded Streamflow at Loop 289 (cfs) – The daily mean streamflow recorded at the North Fork Double Mountain Fork Brazos River at Loop 289 near Lubbock Texas (USGS Gage No. 08079510).

Column R: Lake 7 Outflow (cfs) – The daily flow released through the Lake 7 outlet works.

Column S: Lake 7 WSEL (cfs) – The daily water surface elevation of Lake 7 as recorded by a gage to be installed after construction.

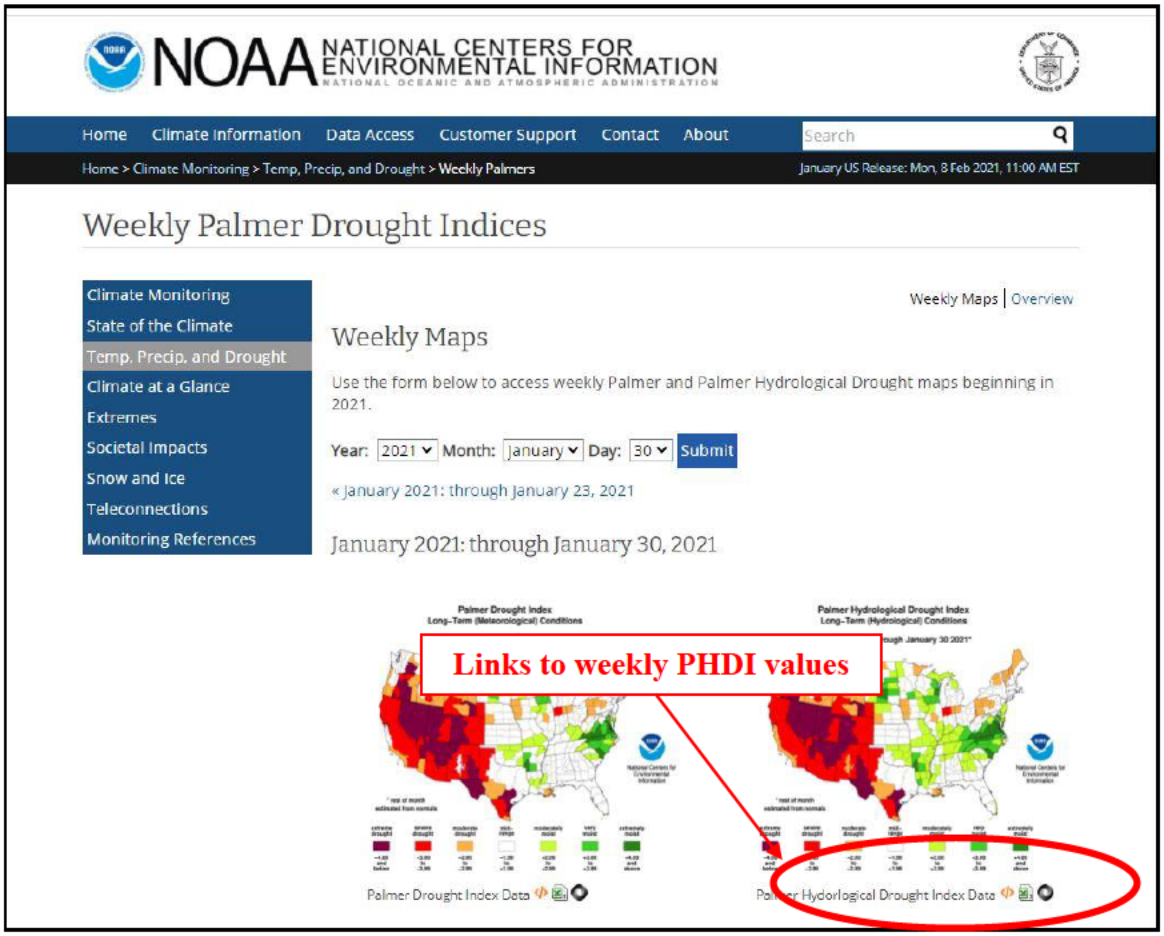
Column T: Possum Kingdom Reservoir WSEL (ft-msl) – The daily water surface elevation of Possum Kingdom Reservoir as recorded by USGS Gage 08088500 at midnight of the preceding day.

Column U: PHDI (Wt'd Ave of High Plains, Low Rolling Plains, and North Central Divisions) (no units) – The Palmer Hydrological Drought Index (PHDI), which monitors long-term drought conditions. PHDI values range from +7 to -7. The TCEQ has determined that the PHDI values should be updated on the last day of the month before the start of a new season. Preliminary PHDI values are published by the National Climatic Data Center (NCDC) on a weekly basis. Column P must be updated with the weekly PHDI value published during the week in which the last day of the month before the start of a new season occurs.

Conditional formatting (tan shading) has been applied to Column P to denote the days on which the PHDI needs to be updated (February 28th or February 29th if a leap year, June 30th and October 31st). If a cell is shaded gray, then the PHDI does not need to be updated for that day. For December 31st of the previous accounting year, the PHDI value from October 31st of the previous accounting year must be entered to designate the current drought conditions for the winter season beginning on November 1st of the previous year and ending on the last day of February in the current accounting year.

PHDI background information and links to weekly values can found on the following NCDC webpage. If the NCDC changes the current webpage address, the City will update the following link and provide an updated version of this document to TCEQ.

https://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers/[2]



Weekly Palmer Drought Indices

Weekly Maps

Use the form below to access weekly Palmer and Palmer Hydrological Drought maps beginning in 2021.

January 2021: through January 30, 2021

Links to weekly PHDI values

Lake 7 is in the Upper Basin, and per 30 TAC Rule §298.470 Calculation of Hydrologic Conditions, the PDHI for projects located in the Upper Basin is calculated as a weighted average of the PHDIs for the three applicable climatic divisions, per the following equation:

PDHI = 0.027*High Plains + 0.647*Low Rolling Plains + 0.326* North Central

In the table of weekly PDHI values published at the above website (available as a comma-delimited download), the following division numbers identify the three applicable divisions:

4101 = High Plains Climatic Division

4102 = Low Rolling Plains Climatic Division

4103 = North Central Climatic Division

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[2] Link is current as of February 2, 2021.

Column V: Total Effluent (MGD) –The total effluent is the sum of the NWWRP and SEWRP return flow discharged into the North Fork, the land-applied effluent, the effluent directly reused within Texas, and the effluent directly reused outside of Texas.

Column W: Total Source Water Consumed (MGD) – The total amount of supply (Columns C-G) from the previous day that is consumed and is not returned to the NWWRP or SEWRP for treatment.

Column X: In-Basin State Water Sourced Effluent Produced (MGD) – The amount of effluent sourced from LAH and Lake 7 that originated from State water inflows that is not consumed. The in-basin State water sourced supplies are prioritized to be consumed before all other supplies originating from other sources. If the total amount of source water consumed is greater than the in-basin State water sourced supply amount from the previous day, then no in-basin State water sourced treated effluent is produced.

Column Y: In-Basin State Water Sourced Effluent Land Applied and/or Directly Reused (MGD) – The amount of effluent sourced from LAH and Lake 7 that originated from State water inflows that is not consumed and is applied to the LLAS and/or HLAS or directly reused within Texas. This treated effluent is prioritized to be land applied before all other effluent originating from other sources.

Column Y: In-Basin State Water Sourced Effluent Discharged (MGD) – The amount of effluent sourced from LAH and Lake 7 that originated from State water inflows discharged into the North Fork. If this effluent produced is greater than the amount of treated effluent directly reused within Texas and land applied, the remaining treated effluent is discharged from the SEWRP and NWWRP into the North Fork. If the amount of this treated effluent produced is less than the amount of treated effluent directly reused within Texas and land applied, then no effluent sourced from LAH and Lake 7 that originated from State water inflows is discharged into the North Fork.

Column AA: Canadian River Basin Surface Water Sourced Effluent Produced (MGD) – The amount of effluent originating from Canadian River Basin surface water sources that is not consumed. The Canadian River Basin surface water supplies are prioritized to be consumed after in-basin State water sources. If the total amount of supply consumed is greater than the in-basin State water supply amount and Canadian River Basin surface water supply amount from the previous day, then no effluent originating from Canadian River Basin surface water sources is produced.

Column AB: Canadian River Basin Surface Water Sourced Effluent Land Applied and Directly Reused (MGD) – The amount of effluent originating from Canadian River Basin surface water supplies applied to the LLAS and/or HLAS and directly reused within Texas. The Canadian River Basin surface water sourced treated effluent is prioritized to be land applied and directly reused within Texas after the in-basin State water sourced treated effluent.

Column AC: Canadian River Basin Surface Water Sourced Effluent Discharged (MGD) – The amount of effluent originating from Canadian River Basin surface water supplies remaining after land application and direct reuse within Texas that is discharged into the North Fork.

Column AD: Lake 7 Non-State Water Sourced Effluent Produced (MGD) – The effluent sourced from Lake 7 that originated from non-State water inflows. The Lake 7 supplies originating from non-State water inflows are prioritized to be consumed after in-basin State water supplies and Canadian River Basin surface water supplies.

Column AE: Lake 7 Non-State Water Sourced Effluent Land Applied and/or Directly Reused (MGD) – The amount of effluent sourced from Lake 7 that originated from non-State water inflows applied to the LLAS and/or HLAS and directly reused by entities located within Texas. This effluent is prioritized to be land applied and directly reused within Texas after the in-basin State water sourced effluent and Canadian River Basin surface water sourced effluent.

Column AF: Lake 7 Sourced Effluent Discharged (MGD) – The amount of effluent sourced from Lake 7 that originated from non-State water inflows remaining after land application and direct reuse within Texas that is discharged into the North Fork.

Column AG: Total Groundwater Sourced Effluent Produced (MGD) – The amount of effluent originating from groundwater supplies that is not consumed. The groundwater supplies are prioritized to be consumed last.

Column AH: Groundwater Sourced Effluent Land Applied and/or Directly Reused (MGD) – The amount of effluent originating from groundwater sources applied to the LLAS and/or HLAS and directly reused by entities located within Texas and outside of Texas under the 210 Authorization. The groundwater sourced treated effluent is prioritized to be land applied and directly reused last.

Column AI: Groundwater Sourced Effluent Discharged (MGD) – The amount of effluent sourced from groundwater supplies remaining after land application and direct reuse that is discharged into the North Fork.

Column AJ: Non-Groundwater Sourced Effluent Directly Reused Out of State (should be zero) (MGD) – The amount of effluent from non-groundwater sources that is directly reused out of state. This is the portion of column K that does not originate from groundwater. This column should always be zero, as only groundwater sourced effluent may be transported out of state. This column is included as a verification that only groundwater-based effluent is being transported out of state.

Column AK: Effluent Discharged not Subject to Priority Call (MGD) – The amount of effluent from non-Brazos Basin water sources discharged into the North Fork. These supply sources include groundwater, Canadian River Basin supplies, and Lake 7 supplies originating from non-State water inflows, but does not include groundwater pumped from beneath the LLAS.

<u>Column AL: Groundwater Remaining in North Fork (MGD)</u> – The amount of groundwater discharged into the North Fork that passes the Lake 6 dam after carriage losses and diversions authorized under CA 12-3705. The accounting plan conservatively assumes all diversions made under CA 12-3705 occur at the furthest downstream authorized diversion point (Lake 6 dam), thus maximizing the carriage loss estimate of the groundwater and minimizing the amount of groundwater considered available for diversion.

<u>Column Am: Inflow of Developed Stormwater (cfs)</u> – This column calculates the developed stormwater that enters Lake 7 and accounts for the carriage losses that occur in the reach from the NWDP, SCLDS and SLDS stormwater outfalls to Lake 7.

<u>Column AN: Inflow of In-Basin State Water Sourced Return Flow (cfs)</u> – This column calculates the return flow originating from in-basin State water supplies that is discharged at the NWWRP and SEWRP outfalls and enters Lake 7 after carriage losses. Discharge of the in-basin State water return flow is proportionally split between the SEWRP and NWWRP based on total amount of return flow discharged that day from each water reclamation plant.

<u>Column AO: Inflow from Return Flow Inflow not Subject to Priority Call (cfs)</u> – This column calculates the return flow originating from non-State water supplies that is discharged at the NWWRP and SEWRP outfalls and enters Lake 7 after carriage losses. Discharge of the non-LAH sourced return flow is proportionally split between the SEWRP and NWWRP based on total amount of return flow discharged that day from each water reclamation plant. These flows are not subject to priority calls.

<u>Column AP: Discharged Groundwater Inflow (cfs)</u> – This column calculates the groundwater discharged by the City that enters Lake 7 and accounts for the carriage losses that occur in the reach between Lake 6 and Lake 7.

<u>Column AQ: State Water Inflow (cfs)</u> – This column calculates the natural inflow originating in the North Fork and its tributaries subject to appropriation and use by downstream senior and superior water rights and is subject to environmental flow criteria.

The natural inflow is calculated by first removing the developed stormwater, groundwater, and return flow components from the recorded flow at the USGS Loop 289 gage to calculate the natural flow passing the gage site. The natural flow passing the gage site is then adjusted for differences in drainage area with Lake 7 to account for the additional natural inflow originating downstream of the gage and upstream of the Lake 7 dam.

If the entered data cause the calculated natural inflow to be zero or negative when flows are measured at the USGS gage at Loop 289, the value is set to zero and conditional formatting is used to indicate to the user that the values entered for that day require inspection.

Column AR: Lake 7 Total Storage (acft) – This column calculates the total storage of Lake 7 using the recorded Lake 7 water surface elevation and the elevation-volume relationships from the 2011 Lake 7 Feasibility Report.

Column AS: Lake 7 Net Evaporation (acft) – This column calculates the net evaporation volume using a reservoir mass balance equation.

Column AT: Lake 7 Stored State Water (acft) – The amount of State water inflows stored in Lake 7, as calculated using a reservoir mass balance equation. Net evaporation is allocated to the State water pool of Lake 7 based on the ratio of the volume of the pool to the total storage of the reservoir from the previous day. Likewise, diversions from Lake 7 are allocated to the State water pool of Lake 7 based on the ratio of the volume of the pool to the total storage of the reservoir from the previous day. All releases from Lake 7 are assumed to be from the State water portion.

Column AU: Lake 7 Stored Non-State Water (acft) – The amount of non-State water inflows stored in Lake 7. The amount of non-State water inflows stored in Lake 7 is the difference in the total storage of Lake 7 and the amount of State water inflows stored in Lake 7.

Column AV: Hydrologic Condition (no units) – This column calculates the hydrologic condition used to identify dry, average, or wet conditions in the environmental flow regime and is based on the PHDI value entered by the user in Column P. Dry conditions are defined as a PHDI value less than -1.78, average conditions between -1.78 and +2.18, and wet conditions greater than +2.18.

Column AW: Required Subsistence/Base Flow Release (cfs) – This column calculates the required release of state water inflows that must be made to satisfy the subsistence and base flow environmental flow targets.

Column AX: Pulse Trigger (cfs) – This column retrieves the seasonal high flow pulse trigger rate as established for each season.

Column AY: Pulse Volume (acft) – This column retrieves the seasonal high flow pulse volume target necessary to end a pulse event.

Column AZ: Pulse Duration (days) – This column retrieves the seasonal high flow duration target necessary to end a pulse event.

Column BA: Pulse Frequency (per season) – This column retrieves the seasonal frequency target of high flow pulse events.

Column BB: Pulse Trigger Met [yes (1)/no (0)] – This column designates whether the pulse flow trigger target is met by state water inflow into Lake 7. For the pulse trigger to be met, state water inflow must be increasing from the previous day (indicating the beginning of a pulse) and be greater than or equal to the seasonal pulse trigger set in Column AE.

Column BC: Days Since Last Pulse Start (days) – This column keeps track of the number of days since the start of the last required pulse event. A subsequent required pulse event cannot start until after the seasonal high flow duration target has lapsed (Column AG).

Column BD: Pulse Event [yes (1)/no (0)] – This column indicates whether a required pulse event is occurring. A required pulse event will occur if the pulse trigger is met in Column AE, the target pulse frequency (Column AH) has not been met for the season, and sufficient days have passed since the start of the last required pulse event. The pulse event will continue until the target duration or volume has been met.

Column BE: Seasonal Pulse Counter (no units) – This column counts the number of required high flow pulse events that have occurred in a season. The counter is reset to zero at the beginning of each season.

Column BF: Pulse Duration Counter (days) – This column counts the number of days a given required pulse event has been occurring.

Column BG: Cumulative Pulse Volume (acft) – This column calculates the cumulative pulse volume.

Column BH: Turn Off Pulse [yes (1)/no (0)] – This determines whether a required pulse event has reached the target volume or duration and will return a value of 1 to signify the pulse event has ended.

Column BI: Required Pulse Flow Release (cfs) – This column calculates the required release of state water to satisfy the high flow pulse component of the environmental flow criteria.

Column BJ: Required Inflow Release (cfs) – This column calculates the total required release of state water inflows. If the Possum Kingdom Reservoir water surface elevation is below 1,000 ft-msl, then all state water inflows are to be released if the state water inflow is greater than 5 cfs, per agreement with the Brazos River Authority. If the Possum Kingdom Reservoir water surface elevation is equal to or greater than 1,000 ft-msl, then the required state water inflow release is the maximum of the required base or subsistence release (Column AD) and the required pulse flow release (Column AP).

Column BK: Balance of Required Inflow Release (acft) – This column calculates the balance of environmental flow release deficits from the current and previous days. Deficit values are carried over from one day to the next until they are satisfied with additional releases greater than the minimum required environmental flow release. Cells in Column AR are conditionally formatted to show deficits with red shading. When no deficits are occurring, the cells are shaded green.

EFR TAB

The EFR tab provides the Lake 7 environmental flow regime (EFR) as translated and rounded to the nearest integer from the environmental flow standards located at the Double Mountain Fork near Aspermont Gage (USGS 0808055). The EFR contains three seasons; Winter (Nov-Feb), Spring (Mar-Jun) and Summer (Jul-Oct), and three hydrologic conditions; Dry, Average and Wet. Note that the winter season does not contain a high flow pulse requirement; therefore, these cells are highlighted gray along with the columns containing the pulse requirement calculations (Columns AE-AP) in the JAN, FEB, NOV and DEC tabs.

From:	Kathy Alexander
Sent:	Thursday, December 3, 2020 10:39 AM
To:	Jennifer Allis; Jason Godeaux
Cc:	Brooke McGregor; Sarah Henderson
Subject:	FW: City of Lubbock Application No. 5921 (2020-18)
Attachments:	2015 Wholesale Public Water Suppliers.pdf; 2015 Retail Utility Profile Report 20160301.pdf

---

From: Sara Thornton <[redacted]
Sent: Wednesday, December 2, 2020 9:01 AM
To: Kathy Alexander <kathy.alexander@tceq.texas.gov>
Cc: Paige Hamilton <[redacted]>
Subject: RE: City of Lubbock Application No. 5921 (2020-18)

Good morning Kathy,

For TCEQ's review of the City of Lubbock Application No. 5921, please find attached the utility profiles for retail public water suppliers and wholesale public water suppliers that are part of the City of Lubbock's Water Conservation Plan. Let me know if you need anything further in your review of the City's Application.

Thanks!

Sara

From: Kathy Alexander <kathy.alexander@tceq.texas.gov>
Sent: Monday, November 30, 2020 9:14 AM
To: Sara Thornton <[redacted]>
Cc: Paige Hamilton [redacted]>
Subject: RE: City of Lubbock Application No. 5921 (2020-18)

Good morning Sara,
Can you also provide the utility profiles for retail public water suppliers and wholesale public water suppliers that are part of the WCP? It looks like they were not included in what you sent. Please let me know if you have any questions.
Kathy

Kathy Alexander, Ph.D.
Technical Specialist, Water Availability Division
Texas Commission on Environmental Quality
MC-160 P.O. Box 13087
Austin, Texas 78711-13087
Phone: office - 512-239-0778
Mobile – 512-965-9603

From: Sara Thornton <[redacted]>
Sent: Thursday, November 12, 2020 4:58 PM
To: Kathy Alexander <kathy.alexander@tceq.texas.gov>
Cc: Paige Hamilton <[redacted]>
Subject: City of Lubbock Application No. 5921 (2020-18)

Hi Kathy,

By this email, I am providing a link to download the City of Lubbock's ("Lubbock's") 2019 Water Conservation Plan and Drought and Emergency Contingency Plan for consideration in TCEQ's evaluation of Lubbock's Application No. 5921. Additionally, I am attaching Lubbock's 2018 Strategic Water Supply Plan that is referenced in the Water Conservation Plan (see Section 22.08.039 of the Plan). Please let me know if there is any additional information that you require in your review of this application.

Click to Retrieve File(s)

City of Lubbock 2018 Strategic Water Supply Plan.pdf
Lubbock Ordinance - 2019-O0044 - Amending Water Conservation Plan -2019.04.23.pdf

Thanks!

Sara

Lloyd Gosselink
ATTORNEYS AT LAW

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Texas Commission on Environmental Quality

UTILITY PROFILE AND WATER CONSERVATION PLAN REQUIREMENTS FOR MUNICIPAL WATER USE BY RETAIL PUBLIC WATER SUPPLIERS

This form is provided to assist retail public water suppliers in water conservation plan development. If you need assistance in completing this form or in developing your plan, please contact the conservation staff of the Resource Protection Team in the Water Availability Division at (512) 239-4691.

Name:	City of Lubbock	
Address:	P.O. Box 2000	
Telephone Number:	(806) 775-2585	Fax: (806) 775-3027
Water Right No.(s):	1520002	
Regional Water Planning Group:	O; Llano Estacado Regional Water Planning Group	
Form Completed by:	Malcolm Laing	
Title:	Water Resources Manager	
Person responsible for implementing conservation program:	Aubrey Spear	Phone: (806) 775-2585
Signature:	Aubrey Spear	Date: 2/1/2016

NOTE: If the plan does not provide information for each requirement, include an explanation of why the requirement is not applicable.

UTILITY PROFILE

I. POPULATION AND CUSTOMER DATA

A. *Population and Service Area Data*

1. Attach a copy of your service-area map and, if applicable, a copy of your Certificate of Convenience and Necessity (CCN).

2. Service area size (in square miles): 125

   (Please attach a copy of service-area map)

3. Current population of service area: 243,938

4. Current population served for:

   a. Water 243,938

   b. Wastewater 214,938

5. Population served for previous five years:

Year	*Population*
2011	232,035
2012	233,651
2013	235,398
2014	242,843
2015	243,938

6. Projected population for service area in the following decades:

Year	*Population*
2020	261,514
2030	294,646
2040	322,898
2050	347,259
2060	369,767

7. List source or method for the calculation of current and projected population size.

The estimates are based on the average of six parameters that are calculated using the U.S. 2010 Census population and adding current numbers and trends or average annual growth rates over the past 4 years. Natural increase, births exceeding deaths, is the main reason for the increase in population. Net migration, the difference between in-migration and out-migration, is positive. The growth rate is consistent with the annual average for Lubbock since 2000, as well as with economic indicators.

Probable Growth depicts the most likely scenario for population growth in the City and closely corresponds to the City Planning Department's projections for the First 20 years. The Probable Growth projection consists of a 1.20% per year growth rate through 2033. After this period, the growth rate drops to .80% per year and declines .10% every decade until 2074, at which point it remains constant at .40% per year growth.

B. Customers Data

Senate Bill 181 requires that uniform consistent methodologies for calculating water use and conservation be developed and available to retail water providers and certain other water use sectors as a guide for preparation of water use reports, water conservation plans, and reports on water conservation efforts. A water system must provide the most detailed level of customer and water use data available to it, however, any new billing system purchased must be capable of reporting data for each of the sectors listed below. http://www.tceq.texas.gov/assets/public/permitting/watersupply/water_rights/sb181_guidance.pdf

1. Current number of active connections. Check whether multi-family service is counted as ☒ Residential or ☐ Commercial?

Treated Water Users	*Metered*	*Non-Metered*	**Totals**
Residential	75,503	0	75,503
Single-Family	73,951	0	73,951
Multi-Family	1,552	0	1,552
Commercial	6,831	0	6,831
Industrial/Mining	133	0	133
Institutional	899	0	899
Agriculture	0	0	0
Other/Wholesale	8	0	8

2. List the number of new connections per year for most recent three years.

Year	2013	2014	2015
Treated Water Users			
Residential	898	930	936
Single-Family	853	846	895
Multi-Family	45	84	41
Commercial	170	178	146
Industrial/Mining	0	0	9
Institutional	5	3	4
Agriculture	0	0	0
Other/Wholesale	0	0	0

3. List of annual water use for the five highest volume customers.

	Customer	*Use (1,000 gal/year)*	*Treated or Raw Water*
1.	Texas Tech University	283,569	Treated
2.	Parks Department	269,505	Treated
3.	Covenant Health System	107,458	Treated
4.	X-Fab	101,078	Treated
5.	Lubbock Schools	98,297	Treated

II. WATER USE DATA FOR SERVICE AREA

A. *Water Accounting Data*

1. List the amount of water use for the previous five years (in 1,000 gallons). Indicate whether this is ☐ diverted or ☒ treated water.

Year	2011	2012	2013	2014	2015
Month					
January	913,367	883,367	818,774	895,098	818,049
February	906,623	807,793	779,267	896,107	756,881
March	1,069,310	989,955	1,034,344	1,096,026	907,136
April	1,285,460	1,082,586	1,187,137	1,187,920	1,000,348
May	1,569,101	1,140,167	1,400,347	1,308,176	840,778
June	1,735,430	1,222,502	1,345,327	1,097,661	958,492
July	1,799,648	1,458,023	1,376,063	1,244,106	1,142,181
August	1,685,326	1,522,990	1,360,777	1,316,563	1,359,942
September	1,347,153	1,222,608	1,345,182	927,378	1,240,727
October	1,230,728	1,084,412	1,149,398	987,144	981,658
November	947,331	941,711	879,317	784,388	874,184
December	839,653	869,217	855,398	770,109	832,598
Totals	15,329,130	13,225,331	13,531,331	12,510,676	11,712,974

Describe how the above figures were determine (e.g, from a master meter located at the point of a diversion from the source, or located at a point where raw water enters the treatment plant, or from water sales).

Water Treated.

2. Amount of water (in 1,000 gallons) delivered/sold as recorded by the following account types for the past five years.

Year	2011	2012	2013	2014	2015

Account Types					
Residential	8,326,840	7,259,151	7,580,476	6,967,169	6,474,439
Single-Family	7,299,041	6,325,241	6,624,880	6,050,572	5,551,195
Multi-Family	1,027,799	933,910	955,596	916,597	923,244
Commercial	2,149,686	2,055,308	2,149,348	2,059,001	2,300,384
Industrial/Mining	549,934	391,726	470,304	318,326	201,630
Institutional	906,188	705,511	789,536	1,138,386	963,183
Agriculture	0	0	0	0	0
Other/Wholesale	0	0	0	283,079	83,789

3. List the previous records for water loss for the past five years (the difference between water diverted or treated and water delivered or sold).

Year	*Amount (gallons)*	*Percent %*
2015	937,296,000	8.15
2014	1,034,009,000	9.26
2013	1,264,454,000	9.34
2012	1,576,812,000	11.92
2011	1,409,338,000	9.20

B. *Projected Water Demands*

If applicable, attach or cite projected water supply demands from the applicable Regional Water Planning Group for the next ten years using information such as population trends, historical water use, and economic growth in the service area over the next ten years and any additional water supply requirements from such growth.

III. WATER SUPPLY SYSTEM DATA

A. *Water Supply Sources*

List all current water supply sources and the amounts authorized (in acre feet) with each.

Water Type	*Source*	*Amount Authorized*
Surface Water	Lake Alan Henry	5,217
Groundwater	Bailey County Well Fields	6,156
Contracts	CRMWA	27,794
Other		

B. Treatment and Distribution System

1. Design daily capacity of system (MGD): 128

2. Storage capacity (MGD):
   a. Elevated 4.15
   b. Ground 67.5

3. If surface water, do you recycle filter backwash to the head of the plant?
   ☐ Yes ☒ No If yes, approximate amount (MGD):

IV. WASTEWATER SYSTEM DATA

A. Wastewater System Data (if applicable)

1. Design capacity of wastewater treatment plant(s) (MGD): 31.5 MGD

2. Treated effluent is used for ☒ on-site irrigation, ☒ off-site irrigation, for ☒ plant wash-down, and/or for ☐ chlorination/dechlorination.

   If yes, approximate amount (in gallons per month): 36.5 Million

3. Briefly describe the wastewater system(s) of the area serviced by the water utility. Describe how treated wastewater is disposed. Where applicable, identify treatment plant(s) with the TCEQ name and number, the operator, owner, and the receiving stream if wastewater is discharged.

The City of Lubbock is located in Lubbock, County, in northwest Texas, and has a population of 243,938. The existing City of Lubbock collection system consists of approximately 1144 miles of sanitary sewer. The City operates and maintains 33 lift stations. The collection system terminates at the City of Lubbock Southeast Water Reclamation Plant (SEWRP), TPDES 10353.002. The SEWRP consists of three different plants, Plant 2 with primary settling and secondary biological treatment with bio-tower trickling filters (currently off line) and Plant 3, with primary settling and secondary biological treatment with activated sludge. Effluent from these two plants is used for irrigation at the Lubbock Land Applications Site and the Hancock Land Application Site. Plant 4 has primary settling, secondary biological treatment with biological nutrient removal and integrated fixed film activated sludge, disinfection and effluent filtration. Effluent from this plant is discharged into the North Fork of the Brazos River and is also used for cooling water for the XCEL Jones Power Plant.

B. Wastewater Data for Service Area (if applicable)

1. Percent of water service area served by wastewater system: 88 %

2. Monthly volume treated for previous five years (in 1,000 gallons):

Year	2011	2012	2013	2014	2015

Month					
January	576,540	559,520	533,100	540,900	575,149
February	546,220	507,780	497,470	505,850	571,925
March	583,660	527,230	541,590	547,960	594,904
April	596,650	515,670	542,130	526,470	664,561
May	577,950	558,320	532,390	541,160	597,146
June	582,960	548,870	556,120	522,990	633,128
July	609,380	591,450	574,680	531,030	686,494
August	606,410	578,420	599,850	544,590	680,710
September	572,750	555,590	584,090	561,580	713,431
October	582,890	545,810	555,700	551,620	677,381
November	560,340	511,380	513,600	518,980	578,064
December	593,230	524,010	529,290	520,000	475,818
Totals	6,988,980	6,524,050	6,560,010	6,413,130	7,448,711

V. ADDITIONAL REQUIRED INFORMATION

In addition to the utility profile, please attach the following as required by Title 30, Texas Administrative Code, §288.2. Note: If the water conservation plan does not provide information for each requirement, an explanation must be included as to why the requirement is not applicable.

A. *Specific, Quantified 5 & 10-Year Targets*

The water conservation plan must include specific, quantified five-year and ten-year targets for water savings to include goals for water loss programs and goals for municipal use in gallons per capita per day. Note that the goals established by a public water supplier under this subparagraph are not enforceable

Ordinance 2010-O0167 adopted 12-18-2014
Sec. 22.08.034(d)

B. *Metering Devices*

The water conservation plan must include a statement about the water suppliers metering device(s), within an accuracy of plus or minus 5.0% in order to measure and account for the amount of water diverted from the source of supply.

Ordinance 2010-O0167 adopted 12-18-2014
Sec. 22.08.035

C. *Universal Metering*

The water conservation plan must include and a program for universal metering of both customer and public uses of water, for meter testing and repair, and for periodic meter replacement.

Ordinance 2010-O0055 adopted 7-22-2010
Sec. 22.08.036 (a) and (b)

D. *Unaccounted- For Water Use*

The water conservation plan must include measures to determine and control unaccounted-for uses of water (for example, periodic visual inspections along distribution lines; annual or monthly audit of the water system to determine illegal connections; abandoned services; etc.).

Ordinance 2010-O0055 adopted 7-22-2010
Sec. 22.08.038

E. *Continuing Public Education & Information*

The water conservation plan must include a description of the program of continuing public education and information regarding water conservation by the water supplier.

Ordinance 2010-O0055 adopted 7-22-2010
Sec. 22.08.039 (d)

F. *Non-Promotional Water Rate Structure*

The water supplier must have a water rate structure which is not "promotional," i.e., a rate structure which is cost-based and which does not encourage the excessive use of water. This rate structure must be listed in the water conservation plan.

Ordinance 2010-O0055 adopted 7-22-2010
Sec. 22.08.040

G. *Reservoir Systems Operations Plan*

The water conservation plan must include a reservoir systems operations plan, if applicable, providing for the coordinated operation of reservoirs owned by the applicant within a common watershed or river basin. The reservoir systems operations plan shall include optimization of water supplies as one of the significant goals of the plan.

Ordinance 2010-O0055 adopted 7-22-2010
Sec. 22.08.041

H. *Enforcement Procedure and Plan Adoption*

The water conservation plan must include a means for implementation and enforcement, which shall be evidenced by a copy of the ordinance, rule, resolution, or tariff, indicating official adoption of the water conservation plan by the water supplier; and a description of the authority by which the water supplier will implement and enforce the conservation plan.

Ordinance 2010-O0055 adopted 7-22-2010
Enforcement: Sec. 22.08.046

I. *Coordination with the Regional Water Planning Group(s)*

The water conservation plan must include documentation of coordination with the regional water planning groups for the service area of the wholesale water supplier in order to ensure consistency with the appropriate approved regional water plans.

Ordinance 2010-O0055 adopted 7-22-2010

Sec. 22.08.042

J. Plan Review and Update

A public water supplier for municipal use shall review and update its water conservation plan, as appropriate, based on an assessment of previous five-year and ten-year targets and any other new or updated information. The public water supplier for municipal use shall review and update the next revision of its water conservation plan not later than May 1, 2009, and every five years after that date to coincide with the regional water planning group. The revised plan must also include an implementation report.

Ordinance 2010-O0055 adopted 7-22-2010
Sec.22.08.045

ADDITIONAL REQUIREMENTS FOR LARGE SUPPLIERS

Required of suppliers serving population of 5,000 or more or a projected population of 5,000 or more within ten years

K. Leak Detection and Repair

The plan must include a description of the program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted for uses of water.

Ordinance 2010-O0055 adopted 7-22-2010
Sec. 22.08.043 (a) and (b)

L. Contract Requirements

A requirement in every wholesale water supply contract entered into or renewed after official adoption of the plan (by either ordinance, resolution, or tariff), and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures using the applicable elements in this chapter. If the customer intends to resell the water, the contract between the initial supplier and customer must provide that the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures in accordance with the provisions of this chapter.

Ordinance 2010-O0055 adopted 7-22-2010
Sec. 22.08.044

VI. ADDITIONAL CONSERVATION STRATEGIES

A. *Conservation Strategies*

Any combination of the following strategies shall be selected by the water supplier, in addition to the minimum requirements of this chapter, if they are necessary in order to achieve the stated water conservation goals of the plan. The commission may require by commission order that any of the following strategies be implemented by the water supplier if the commission determines that the strategies are necessary in order for the conservation plan to be achieved:

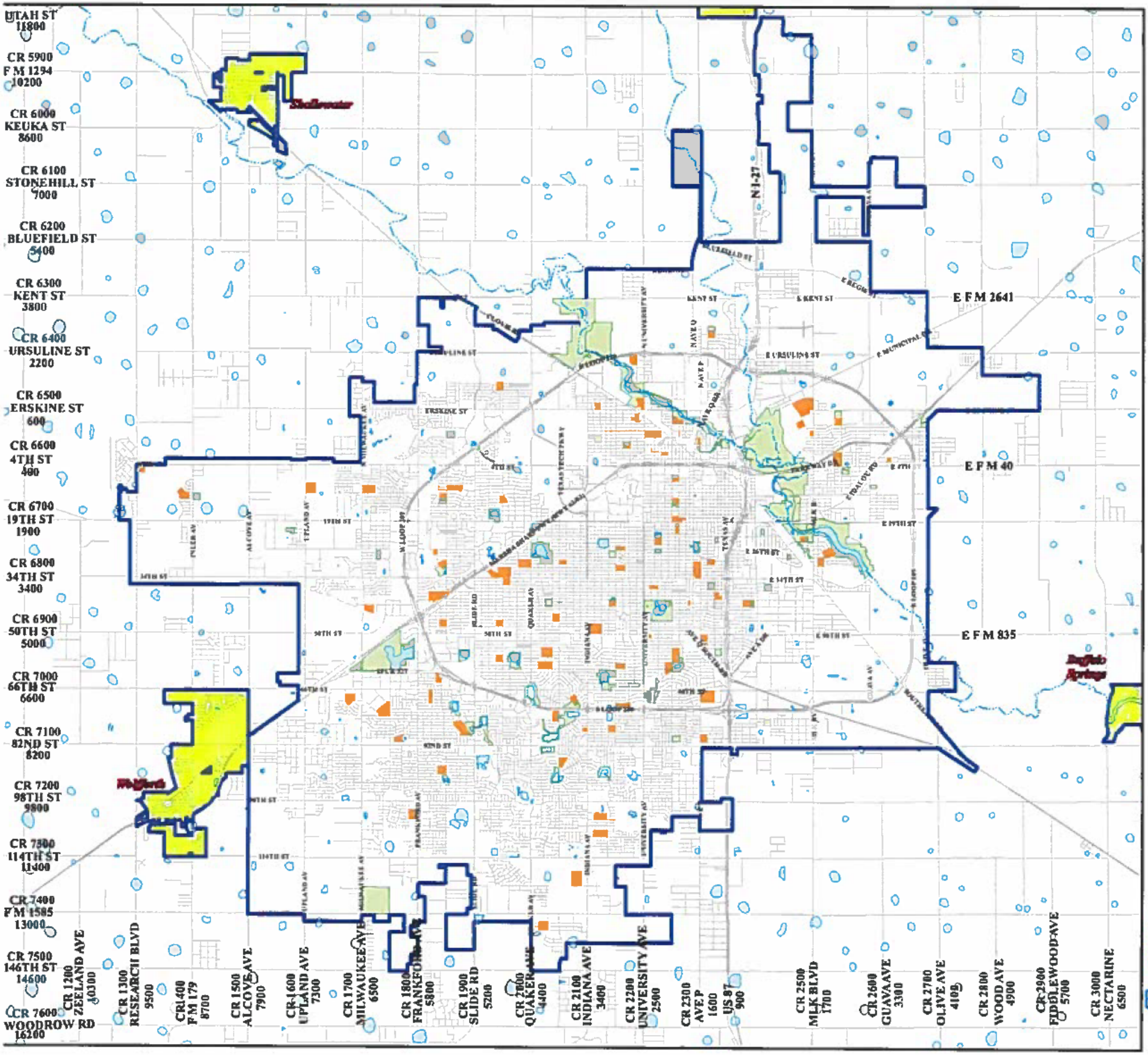
1. Conservation-oriented water rates and water rate structures such as uniform or increasing block rate schedules, and/or seasonal rates, but not flat rate or decreasing block rates;
2. Adoption of ordinances, plumbing codes, and/or rules requiring water conserving plumbing fixtures to be installed in new structures and existing structures undergoing substantial modification or addition;
3. A program for the replacement or retrofit of water-conserving plumbing fixtures in existing structures;
4. A program for reuse and/or recycling of wastewater and/or graywater;
5. A program for pressure control and/or reduction in the distribution system and/or for customer connections;
6. A program and/or ordinance(s) for landscape water management;
7. A method for monitoring the effectiveness and efficiency of the water conservation plan; and
8. Any other water conservation practice, method, or technique which the water supplier shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

Best Management Practices

The Texas Water Developmental Board's (TWDB) Report 362 is the Water Conservation Best Management Practices (BMP) guide. The BMP Guide is a voluntary list of management practices that water users may implement in addition to the required components of Title 30, Texas Administrative Code, Chapter 288. The Best Management Practices Guide broken out by sector, including Agriculture, Commercial, and Institutional, Industrial, Municipal and Wholesale along with any new or revised BMP's can be found at the following link on the Texas Water Developments Board's website: http://www.twdb.state.tx.us/conservation/bmps/index.asp

Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact 512-239-3282.

City of Lubbock



🟧 Schools

🟦 Lakes

🟩 Parks

Roads/Streets

Streams

▭ City Limits

N
W E
S

0 0.5 1 2
Miles

City of Lubbock
GIS & Data Services
1625 13th Street
Lubbock, TX 79457
(806) 775-3311

City of Lubbock
TEXAS
GIS & DATA SERVICES DEPARTMENT

Division 2. Water Conservation Plan

Sec. 22.08.031 Introduction

The city provides retail water service to city residents and also provides water on a wholesale basis to six additional entities. While the city can try to directly influence the water use of its retail water users through the water conservation measures discussed in this plan, as the six wholesale customer's retail utility systems are separate from the city's retail system, the city does not have the ability to implement most of the water conservation measures discussed in this plan for the wholesale customers. The wholesale customers will be able to implement these measures as a part of their respective retail water supply operations. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.032 Declaration of policy, purpose, and intent

In order to conserve the available water supply, the city adopts the following regulations concerning water conservation through this article. Water uses regulated or prohibited under this water conservation plan are considered to be discretionary and are deemed to constitute a waste of water which subjects the offender(s) to penalties as defined in section 22.08.046 of this plan. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.033 Authorization

The city manager or his/her designee is authorized and directed to implement the applicable provisions of this plan. The city manager or his/her designee will act as the administrator of the plan, oversee the execution and implementation of the plan, and will be responsible for keeping adequate records for program verification. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.034 Conservation goals

(a) The city's water conservation goals are to:

(1) Provide an adequate supply of suitable treated water to meet the needs of its retail and wholesale customers; and

(2) Encourage its wholesale customers to adopt and implement water conservation plans that will reduce their per capita water use rates.

(b) The city's wholesale customer water conservation program is predicated on the fact that the implementation of conservation measures must occur largely at the local level. Due to this fact, the city's wholesale program is focused on encouraging and supporting initiatives by its wholesale customers.

(c) TCEQ rules require that water conservation plans contain specific, quantifiable five- and ten-year goals for use in gallons per capita per day. The goals established as part of this plan are not enforceable. The gpcd calculation, as defined by TCEQ, is the total average daily amount of water diverted or pumped for treatment by potable uses divided by the population served.

(d) In order to set a per capita goal for municipal water conservation, baseline per capita water use was determined from the average per capita water use from 2009 to 2013 as determined by the city. In order to determine these values, the city uses total water pumped from all sources divided by the estimated city population as determined by the city's planning department. This resulted in an average value reflecting both wet and dry years. The average per capita use from 2009 to 2013 was 153 gpcd with a high of 178 gpcd in 2011 and a low of 140 gpcd in 2009. This average per capita use rate is less than the target rate of 172 gpcd recommended by the Llano Estacado Regional Water Planning Group, but greater than the target rate of 140 gpcd recommended by the state water conservation task force. The water conservation task force recommends a one percent per year reduction until the target of 140 gpcd is reached; however, in light of the fact that the city has already achieved a significant conservation response, the goals for this plan were developed utilizing a 0.5% per year reduction in per capita water use. This results in a per capita goal for year 2019 of 150 gpcd and a year 2024 goal of 147 gpcd. This reflects a reduction of 0.5% per year from the 155 gpcd in 2013.

(e) This methodology is similar to that used in the city's previous water conservation plan adopted in 2010. The former and current plans use a 0.5% per year reduction in per capita water use goal. The new goals established under this revised plan are similar to those previously established.

(f) In addition to the per capita water use goal above, the city has set a maximum water loss water goal of 10% for the retail water delivery system for both 2019 and 2024. This would correspond to a loss rate of 15 gpcd in 2019 and 14.6 gpcd in 2024. This goal is a benchmark established by the TCEQ for water loss.

(Ordinance 2010-O0055 adopted 7/22/2010; Ordinance 2014-O0167, sec. 3, adopted 12/18/2014)

Sec. 22.08.035 Metering water diverted from the source of supply

The city meters the amount of raw water pumped from the BCWF, Lake Alan Henry, and from the CRMWA supply using meters that are maintained to record flow with an accuracy of plus or minus 5.0%. The amount of water delivered to each wholesale water customer is also metered by the city. (Ordinance 2010-O0055 adopted 7/22/2010; Ordinance 2014-O0167, sec. 4, adopted 12/18/2014)

Sec. 22.08.036 Universal metering program

(a) Using meters that meet at least the minimum standards developed by the American Water Works Association and with a metering accuracy range of plus or minus 5.0%, the city individually meters all water usage, except that utilized for fire protection. Combined with the city's computerized billing system, the city's universal metering program has a water delivery accuracy rate of plus or minus 5%, which meets the TCEQ standards for meter accuracy. The city encourages each wholesale water customer to meter all water usage as well.

(b) The city uses a random sampling technique to test meter accuracy and to determine when meters need to be repaired or replaced. The city randomly samples approximately 400 water meters each year. Depending on the results of this sample, additional sampling may be done to target meters of a certain age or meters located within a certain geographical portion of the city. Meters found to have an accuracy of less than plus or minus 5% are either repaired or replaced as needed.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.037 Records management system

The city maintains a records management system which tracks the volume of water pumped, water delivered to retail customers, water sold to wholesale customers, and the volume of water losses. The city's utility billing database allows water sales and uses to be desegregated into the volume used by residential, commercial, public and institutional, and industrial customers. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.038 Measures to control unaccounted-for uses of water

The city takes the appropriate steps to monitor and audit its water system for water loss in an effort to conserve water, manages the replacement of old water lines that are prone to leaks and breaks, investigates customer complaints of low pressure and possible leaks, visually inspects suspected leaks, and tracks water delivery to customers to determine illegal connections and abandoned service lines. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.039 Program for achieving water conservation goals

(a) The city has established goals, objectives and programs that support a standard for water use. The city's water conservation program is comprised of five main strategies in the following order of priority:

(1) Administrative water conservation efforts;

(2) Water use standards;

(3) Public education and information;

(4) Enforcement; and

(5) Structural changes.

(b) The city will evaluate and implement certain administrative changes to programs, policies, and rules that support water conservation efforts. In 1992, the city moved from a declining block rate to a uniform block rate. In 2007, the city passed a revised water rate ordinance with an inclining block rate structure. Other administrative changes may include the continued review and revision of city codes to determine their affect on the use of water and active enforcement of rules, codes, and regulations affecting water use.

(c) In an effort to manage annual and maximum daily water use, the water conservation program establishes the following water use standards for outdoor landscape irrigation:

> (1) Landscape irrigation is allowed to occur only between the hours of 6:00 p.m. to 10:00 a.m. from April 1st through September 30th.
>
> (2) Summer irrigation should provide a maximum of 1.5 inches per zone per week.
>
> (3) Winter irrigation may occur only when temperatures are above 35°F so as not to cause a freezing hazard and should provide a maximum of 1.0 inch per zone per month for dormant grasses (i.e. Bermuda) and 1.0 inch per zone every two weeks for cool season grasses (i.e. Fescue).
>
> (4) Irrigation should occur without water runoff. This may be accomplished by correctly cycling the sprinkler system and allowing time for the water to soak into the landscape between irrigation events.

(d) The city will support programs to educate the public regarding water conservation activities that support its goals. This includes educating the general public on the need for and practices of water conservation through public service announcements, participation in home and garden shows, coordination efforts with the Chamber of Commerce, West Texas Home Builders Association and Lubbock Apartment Association, and supporting water conservation efforts in the local education system.

(e) Structural changes that have been and may be adopted by the city are those programs that result in a physical modification of water use devices or practices, such as landscape design and maintenance, rain and freeze sensors on automatic irrigation systems, plumbing retrofit or rehabilitation programs, controlling water loss, and by reusing treated wastewater and stormwater.

(f) In regards to the city's wholesale water customers, their retail utility systems are separate from the city's retail water system; therefore, the city does not have the ability to implement most of the water conservation items discussed above. The city encourages its wholesale customers to implement these or other appropriate water conservation measures as a part of their respective retail water supply operations.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.040 Water rate structure

The city has adopted a water rate structure which is non-promotional (see section 22.03.085 of this code). (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.041 Reservoir operations plan

This requirement is not applicable to the city at this time. The city only owns and operates one water supply reservoir, Lake Alan Henry, which is located on the South Fork of the Double Mountain Fork of the Brazos River. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.042 Coordination with regional planning groups

The water service area of the city is located within Llano Estacado Regional Planning Area (Region O) and the city has provided a copy of this plan to the Llano Estacado Regional Water Planning Group to ensure consistency with the regional water plan. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.043 Leak detection/repair and water loss accounting program

(a) The city routinely monitors the water storage, delivery, and distribution system components for leaks. Waterline leaks are detected by utility personnel while reading meters, maintaining their water and wastewater systems, and while performing other routine surveillance programs. Any reported leaks are repaired in a timely manner. The wholesale water customers are responsible for managing their ongoing leak detections, location, and repair programs.

(b) At a minimum, the city will conduct a water audit using the methodology outlined by the TWDB every five years in accordance with current TWDB rules. Water audits may be conducted on a more frequent basis if the city deems that action to be appropriate.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.044 Water supply contracts

(a) It is a mandatory requirement for the city to require wholesale customers with any new or amended contracts or successor contracts to develop a water conservation plan. Minimum plan requirements for municipal wholesale customers entering or renewing city contracts include:

(1) A completed TCEQ utility profile;

(2) Specific, quantified five-year and ten-year targets for water savings to include goals for water loss programs and goals for municipal use, in gallons per capita per day;

(3) Metering devices having accuracy within plus or minus 5 percent in order to measure and account for the amount of water diverted from the supply source;

(4) A program for universal metering of both customer and public uses of water, for meter testing and repair, and for periodic meter replacement;

(5) Measures to determine and control unaccounted-for uses of water (for example, periodic visual inspections along distribution lines, annual or monthly audit of the water system to determine illegal connections, abandoned services, etc.);

(6) A program of continuing public education and information regarding water conservation;

(7) A water rate structure which is not "promotional," meaning a rate structure which is cost-based and which does not encourage the excessive use of water;

(8) A reservoir systems operation plan, if applicable, providing for the coordinated operation of reservoirs owned by the utility within a common watershed or river basin in order to optimize available water supplies;

(9) A means of implementation and enforcement of conservation practices, as evidenced by either:

(A) A copy of the ordinance, resolution, or tariff, indicating official adoption of the water conservation plan by the customer; or

(B) A description of the authority by which the customer will implement and enforce the water conservation plan; and

(10) Documentation of coordination with the regional water planning groups for the service area of the customer in order to ensure consistency with the appropriate regional water plans.

(b) Water conservation plan must include the following additional elements if the customer serves, or plans to serve in the next 10 years, a population of 5,000 or greater:

(1) A program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted-for uses of water;

(2) A record management system to record water pumped, water deliveries, water sales, and water losses which allows for the desegregation of water sales and uses into the following user classes: residential, commercial, public and institutional, and industrial; and

(3) For wholesale water customers, that they include a requirement that every wholesale water supply contract entered into or renewed after official adoption of the customer's water conservation plan, and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures using the applicable TCEQ requirements.

(c) Other measures that the customer could adopt to meet the stated conservation goals might include but are not limited to:

(1) Measurement and control of excessive pressure in the distribution system;

(2) Ordinances to promote efficiency and avoid water waste;

(3) Plumbing fixture replacement and retrofit programs;

(4) Other beneficial reuse of water such as grey water and rainwater harvesting systems; and

(5) Other measures as may be applicable.

(d) All customer plans must be reviewed and approved by city council before water sales contracts are signed.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.045 Revisions to the water conservation plan

The city shall review and update, as appropriate, the water conservation plan at least every five (5) years, based on, in part, an assessment of the previous five- and ten-year goals, new or updated information such as the adoption or revision of the regional water plan, or changes in laws or regulations. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.046 Penalties for noncompliance with the water conservation plan

Any water customer or other user of the city's water supply that violates this water conservation plan shall be guilty of a misdemeanor and subject to a penalty and fine as set forth in section 1.01.004 of this code for each day of noncompliance. In addition:

(1) Service shall be discontinued to those customers who do not pay their water bills until all required payments are made; and

(2) New water service taps will be provided to new construction and new construction will be approved only if such construction conforms to adopted ordinances.

(Ordinance 2010-O0055 adopted 7/22/2010)

Secs. 22.08.047–22.08.070 Reserved

Texas Commission on Environmental Quality

PROFILE & WATER CONSERVATION PLAN REQUIREMENTS FOR WHOLESALE PUBLIC WATER SUPPLIERS

This form is provided to assist wholesale public water suppliers in water conservation plan development. Information from this form should be included within a wholesale public water supplier water conservation plan. If you need assistance in completing this form or in developing your plan, please contact the conservation staff of the Resource Protection Team in the Water Supply Division at (512) 239-4691.

Name of Entity: City of Lubbock

Address & Zip: P.O. Box 2000

Telephone Number: (806) 775-2585 **Fax:** (806)775-3027

Form Completed by: Aubrey Spear

Title: Director of Water Utilities

Signature: Aubrey Spear **Date:** 3/7/16

Name and Phone Number of Person/Department responsible for implementing a water conservation program: Aubrey Spear, Director of Water Utilities (806)775-2585

PROFILE

I. WHOLESALE SERVICE AREA POPULATION AND CUSTOMER DATA

A. Population and Service Area Data

1. Service area size in square miles: 125
   (attach a copy of service-area map)

2. Current population of service area: 243,938

3. Current population served for:
   a. water 243,938
   b. wastewater 214,938

4. Population served for previous five years:		5. Projected population for service area in the following decades:	
Year	**Population**	**Year**	**Population**
2011	232,035	2020	261,514
2012	233,651	2030	294,646
2013	235,398	2040	322,898
2014	242,843	2050	347,259
2015	243,938	2060	369,767

6. List source or method for the calculation of current and projected population:

The estimates are based on the average of six parameters that are calculated using the U.S. 2010 Census population and adding current numbers and trends or average annual growth rates over the past 4 years. Natural increase, births exceeding deaths, is the main reason for the increase in population. Net migration, the difference between in-migration and out-migration, is positive. The growth rate is consistent with the annual average for Lubbock since 2000, as well as with economic indicators.

Probable Growth depicts the most likely scenario for population growth in the City and closely corresponds to the City Planning Department's projections for the First 20 years. The Probable Growth projection consists of a 1.20% per year growth rate through 2033. After this period, the growth rate drops to .80% per year and declines .10% every decade until 2074, at which point it remains constant at .40% per year growth.

B. Customers Data

List (or attach) the names of all wholesale customers, amount of annual contract, and amount of the annual use for each for the previous year:

	Wholesale Customer	Contracted Amount (acre-feet)	Previous Year Amount of Water Delivered (acre-feet)
(1)	Reese Center	276.20/yr.	55.49
(2)	Ransom Canyon	1516.34/yr.	248.31
(3)	Buffalo Spring Lake (LCECID #1)	806.50/yr.	81.63
(4)	Littlefield (Emergency)	13.26 for 72 hours	0.00
(5)	Shallowater	250.11/yr.	206.90
(6)	TDCJ Montford Unit	244.90/yr.	140.36
(7)	Lubbock Cooper ISD	56.01/yr.	16.74
(8)	South Garza Water Supply	520.00/yr.	30.14

II. WATER USE DATA FOR SERVICE AREA

A. Water Delivery

Indicated if the water provided under wholesale contracts is treated or raw water and the annual amount for each for previous year:

	Total amount delivered or sold for previous year (acre-feet)
Treated	805.05
Raw	30.14

B. Water Accounting Data

1. Total amount of water diverted at point of diversion(s) for previous five years (in acre-feet) for all water uses:

Year	2011	2012	2013	2014	2015
January	2,803.02	2,710.95	2,512.73	2,746.95	2,510.50
February	2,782.32	2,479.03	2,391.48	2,750.05	2,322.78
March	3,281.59	3,038.06	3,174.29	3,363.58	2,783.90
April	3,944.93	3,322.33	3,643.19	3,645.59	3,069.96
May	4,815.39	3,499.04	4,297.51	4,014.64	2,580.25
June	5,325.84	3,751.72	4,128.66	3,368.60	2,941.50
July	5,522.92	4,474.51	4,222.98	3,818.02	3,505.22
August	5,172.08	4,673.88	4,176.07	4,040.38	4,173.51
September	4,134.26	3,752.05	4,128.21	2,846.02	3,807.65
October	3,776.97	3,327.94	3,527.37	3,029.43	3,012.60
November	2,907.25	2,890.00	2,698.52	2,407.20	2,682.77
December	2,576.80	2,667.53	2,625.12	2,363.38	2,555.15
TOTAL	47,043.37	40,587.05	41,526.13	38,393.85	35,945.80

2. Wholesale population served and total amount of water diverted for **municipal use** for previous five years:

Year	**Total Population Served**	**Total Annual Water Diverted for Municipal Use (acre feet)**
2011	4137	818.95
2012	4137	717.80
2013	4137	661.67
2014	4137	753.71
2015	4137	749.43

C. Projected Water Demands

If applicable, project and attach water supply demands for the next ten years using information such as population trends, historical water use, and economic growth in the service area over the next ten years and any additional water supply requirement from such growth.

III. WATER SUPPLY SYSTEM DATA

A. Water Supply Sources

List all current water supply sources and the amounts authorized with each:

	Source	Amount Authorized	
Surface Water:	Lake Alan Henry	5,217	acre-feet
Groundwater:	Bailey County Well Fields	6,156	acre-feet
Other:	CRMWA	27,794	acre-feet

B. Treatment and Distribution System (if provide treated water)

1. Design daily capacity of system: 128 MGD
2. Storage Capacity: Elevated 4.15 MGD, Ground 67.5 MGD
3. Please describe the water system and attach. Include the number of treatment plants, wells, and storage tanks. If possible, attach a sketch of the system layout.

IV. WASTEWATER SYSTEM DATA

A. Wastewater System Data (if applicable)

1. Design capacity of wastewater treatment plant(s): 31.5 MGD
2. Briefly describe the wastewater system(s) of the area serviced by the wholesale public water supplier. Describe how treated wastewater is disposed of. Where applicable, identify treatment plant(s) with the TCEQ name and number, the operator, owner, and, if wastewater is discharged, the receiving stream. If possible, attach a sketch or map which locates the plant(s) and discharge points or disposal sites.

The City of Lubbock is located in Lubbock, County, in northwest Texas, and has a population of 243,938. The existing City of Lubbock collection system consists of approximately 1144 miles of sanitary sewer. The City operates and maintains 33 lift stations. The collection system terminates at the City of Lubbock Southeast Water Reclamation Plant (SEWRP), TPDES 10353.002. The SEWRP consists of three different plants, Plant 2 with primary settling and secondary biological treatment with bio-tower trickling filters (currently off line) and Plant 3, with primary settling and secondary biological treatment with activated sludge. Effluent from these two plants is used for irrigation at the Lubbock Land Applications Site and the Hancock Land Application Site. Plant 4 has primary settling, secondary biological treatment with biological nutrient removal and integrated fixed film activated sludge, disinfection and effluent filtration. Effluent from this plant is discharged into the North Fork of the Brazos River and is also used for cooling water for the XCEL Jones Power Plant.

B. Wastewater Data for Service Area (if applicable)

1. Percent of water service area served by wastewater system: 88%
2. Monthly volume treated for previous three years (in 1,000 gallons):

Year	2013	2014	2015
January	533,100	540,900	575,149
February	497,470	505,850	571,925
March	541,590	547,960	594,904
April	542,130	526,470	664,561
May	532,390	541,160	597,146
June	556,120	522,990	633,128
July	574,680	531,030	686,494
August	599,850	544,590	680,710
September	584,090	561,580	713,431
October	555,700	551,620	677,381
November	513,600	518,980	578,064
December	529,290	520,000	475,818
TOTAL	6,560,010	6,413,130	7,448,711

REQUIREMENTS FOR WATER CONSERVATION PLANS FOR WHOLESALE PUBLIC WATER SUPPLIERS

In addition to the description of the wholesaler=s service area (profile from above), a water conservation plan for a wholesale public water supplier must include, at a minimum, additional information as required by Title 30, Texas Administrative Code, ' 288.5. Note: If the water conservation plan does not provide information for each requirement, an explanation must be included as to why the requirement is not applicable.

Specific, Quantified 5 & 10-Year Targets

The water conservation plan must include specific, quantified five-year and ten-year targets for water savings including, where appropriate, target goals for municipal use in gallons per capita per day for the wholesaler's service area, maximum acceptable unaccounted-for water, and the basis for the development of these goals. Note that the goals established by wholesale water suppliers under this subparagraph are not enforceable.

Ordinance 2010-O0167 adopted 12-18-2014
Sec. 22.08.034(d)

Metering Devices

The water conservation plan must include a description as to which practice(s) and/or device(s) will be utilized to measure and account for the amount of water diverted from the source(s) of supply.

Ordinance 2010-O0167 adopted 12-18-2014
Sec. 22.08.035

Record Management Program

The water conservation plan must include a monitoring and record management program for determining water deliveries, sales, and losses.

Metering/Leak-Detection and Repair Program

The water conservation plan must include a program of metering and leak detection and repair for the wholesaler's water storage, delivery, and distribution system.

Reservoir Systems Operations Plan

The water conservation plan must include a reservoir systems operations plan, if applicable, providing for the coordinated operation of reservoirs owned by the applicant within a common watershed or river basin. The reservoir systems operations plans shall include optimization of water supplies as one of the significant goals of the plan.

Ordinance 2010-O0055 adopted 7-22-2010
Sec. 22.08.041

Contract Requirements for Successive Customer Conservation

The water conservation plan must include a requirement in every water supply contract entered into or renewed after official adoption of the water conservation plan, and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures using the applicable elements of this chapter. If the customer intends to resell the water, then the contract between the initial supplier and customer must provide that the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures in accordance with the provisions of Title 30 TAC Chapter 288.

Enforcement Procedure & Official Adoption

The water conservation plan must include a means for implementation and enforcement, which shall be evidenced by a copy of the ordinance, rule, resolution, or tariff, indicating official adoption of the water conservation plan by the water supplier; and a description of the authority by which the water supplier will implement and enforce the conservation plan.
Ordinance 2010-O0055 adopted 7-22-2010
Enforcement: Sec. 22.08.046

Coordination with the Regional Water Planning Group(s)

The water conservation plan must include documentation of coordination with the regional water planning groups for the service area of the wholesale water supplier in order to ensure consistency with the appropriate approved regional water plans.
Ordinance 2010-O0055 adopted 7-22-2010
Sec. 22.08.042

Example statement to be included within the water conservation plan:

The service area of the ____________ (name of water supplier) is located within the __________ (name of regional water planning area or areas) and __________ (name of water supplier) has provided a copy of this water conservation plan to the ____________ (name of regional water planning group or groups).

Plan Review and Update

Beginning May 1, 2005, the wholesale water supplier shall review and update its water conservation plan, as appropriate based on an assessment of previous five-year and ten-year targets and any other new or updated information. A wholesale water supplier shall review and update the next revision of its water conservation plan not later than May 1, 2009, and every five years after that date to coincide with the regional water planning group. The revised plan must also include an implementation report.

Best Management Practices Guide

On November 2004, the Texas Water Development Board=s (TWDB) Report 362 was completed by the Water Conservation Implementation Task Force. Report 362 is the Water Conservation Best Management Practices (BMP) Guide. The BMP Guide is a voluntary list of management practices that water users may implement in addition to the required components of Title 30, Texas Administrative Code, Chapter 288. The BMP Guide is available on the TWDB's website at the link below or by calling (512) 463-7847.

http://www.twdb.state.tx.us/assistance/conservation/TaskForceDocs/WCITFBMPGuide.pdf

If you have any questions on how to fill out this form or about the Wholesale Public Water Suppliers program, please contact us at 512/239-4691.

Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at 512-239-3282.

Appendix A

Definitions of Commonly Used Terms

Conservation B Those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses.

Industrial use B The use of water in processes designed to convert materials of a lower order of value into forms having greater usability and commercial value, commercial fish production, and the development of power by means other than hydroelectric, but does not include agricultural use.

Irrigation B The agricultural use of water for the irrigation of crops, trees, and pastureland, including, but not limited to, golf courses and parks which do not receive water through a municipal distribution system.

Municipal per capita water use B The sum total of water diverted into a water supply system for residential, commercial, and public and institutional uses divided by actual population served.

Municipal use B The use of potable water within or outside a municipality and its environs whether supplied by a person, privately owned utility, political subdivision, or other entity as well as the use of sewage effluent for certain purposes, including the use of treated water for domestic purposes, fighting fires, sprinkling streets, flushing sewers and drains, watering parks and parkways, and recreational purposes, including public and private swimming pools, the use of potable water in industrial and commercial enterprises supplied by a municipal distribution system without special construction to meet its demands, and for the watering of lawns and family gardens.

Municipal use in gallons per capita per day B The total average daily amount of water diverted or pumped for treatment for potable use by a public water supply system. The calculation is made by dividing the water diverted or pumped for treatment for potable use by population served. Indirect reuse volumes shall be credited against total diversion volumes for the purpose of calculating gallons per capita per day for targets and goals.

Public water supplier B An individual or entity that supplies water to the public for human consumption.

Regional water planning group B A group established by the Texas Water Development Board to prepare a regional water plan under Texas Water Code, ' 16.053.

Retail public water supplier B An individual or entity that for compensation supplies water to the public for human consumption. The term does not include an individual or entity that supplies water to itself or its employees or tenants when that water is not resold to or used by others.

Reuse B The authorized use for one or more beneficial purposes of use of water that remains unconsumed after the water is used for the original purpose of use and before that water is either disposed of or discharged or otherwise allowed to flow into a watercourse, lake, or other body of state-owned water.

Water conservation plan B A strategy or combination of strategies for reducing the volume of water withdrawn from a water supply source, for reducing the loss or waste of water, for maintaining or improving the efficiency in the use of water, for increasing the recycling and reuse of water, and for preventing the pollution of water. A water conservation plan may be a separate document identified as such or may be contained within another water management document(s).

Water loss - The difference between water diverted or treated and water delivered (sold). Water loss can result from:

1. inaccurate or incomplete record keeping;
2. meter error;
3. unmetered uses such as firefighting, line flushing, and water for public buildings and water treatment plants;
4. leaks; and
5. water theft and unauthorized use.

Wholesale public water supplier B An individual or entity that for compensation supplies water to another for resale to the public for human consumption. The term does not include an individual or entity that supplies water to itself or its employees or tenants as an incident of that employee service or tenancy when that water is not resold to or used by others, or an individual or entity that conveys water to another individual or entity, but does not own the right to the water which is conveyed, whether or not for a delivery fee.

Appendix A-3

Per Capita Consumption and Water Demand Projections

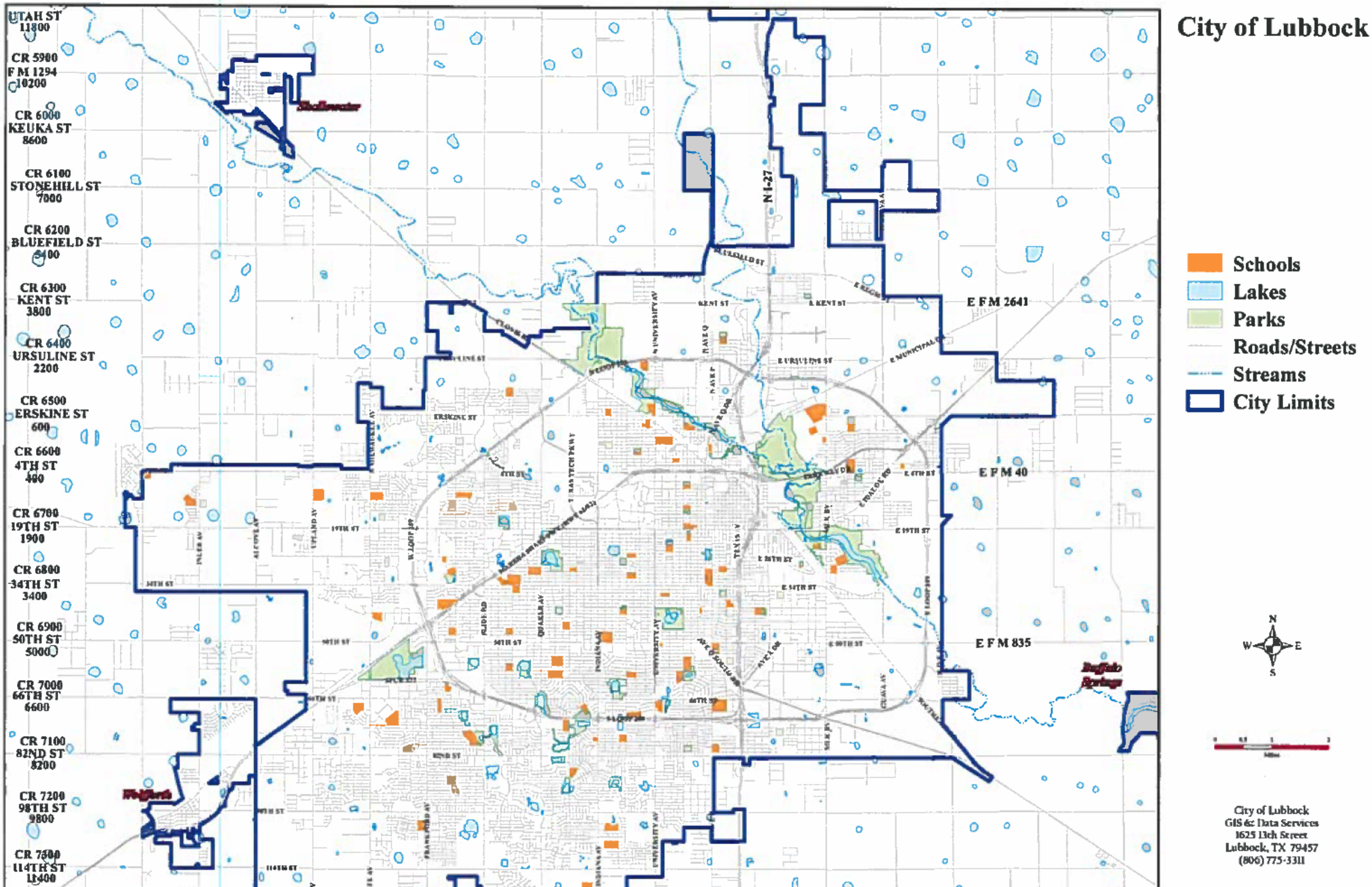
Year	Gallons per Capita per Day (gpcd)					Water Demand (ac-ft/yr)					
	Conservation	Probable	2011 Region O Plan	2007 SWSP Medium	2007 SWSP High	Conservation	Probable	Accelerated	2011 Region O Plan	2007 SWSP Medium	2007 SWSP High
Data by Decade											
2013	160	178	204	200	200	43,115	47,965	47,965	50,353	50,548	53,608
2023	145	169	201	200	200	44,006	51,193	53,253	51,836	54,024	60,391
2033	140	160	198	200	200	47,921	54,639	59,709	52,471	57,171	68,033
2043	137	157	196	200	200	50,919	58,220	66,191	52,732	59,905	76,644
2053	135	155	195	200	200	53,569	61,422	71,940	53,420	62,180	86,346
2063	132	152	n/a	200	200	55,800	64,159	77,418	n/a	64,036	97,277
2073	130	150	n/a	200	200	57,548	66,356	82,491	n/a	65,549	109,592
2083	127	147	n/a	200	200	58,764	67,948	87,028	n/a	66,778	123,468
2093	125	145	n/a	200	200	60,005	69,578	90,907	n/a	67,703	139,102
2103	123	143	n/a	200	200	61,273	71,247	93,553	n/a	68,411	156,717
2113	120	140	n/a	n/a	n/a	62,567	72,956	94,847	n/a	n/a	n/a
Data by Year											
2010	141	141	205	200	200	36,890	36,890	36,890	49,824	49,469	51,507
2011	178	178	205	200	200	47,024	47,024	47,024	50,000	49,826	52,346
2012	152	152	204	200	200	40,587	40,587	40,587	50,177	50,186	52,973
2013	160	178	204	200	200	43,115	47,965	47,965	50,353	50,548	53,608
2014	156	177	204	200	200	42,541	48,279	48,326	50,529	50,912	54,250
2015	150	176	203	200	200	41,396	48,594	48,738	50,706	51,280	54,900
2016	149	175	203	200	200	41,692	48,912	49,202	50,882	51,650	55,558
2017	149	174	203	200	200	41,989	49,231	49,719	51,058	52,023	56,224
2018	148	173	203	200	200	42,289	49,553	50,292	51,234	52,398	56,898
2019	147	172	202	200	200	42,591	49,877	50,870	51,411	52,776	57,580
2020	146	171	202	200	200	42,896	50,203	51,456	51,587	53,039	58,270
2021	146	170	202	200	200	43,263	50,531	52,048	51,670	53,365	58,969
2022	145	170	201	200	200	43,633	50,861	52,647	51,753	53,694	59,676
2023	145	169	201	200	200	44,006	51,193	53,253	51,836	54,024	60,391
2024	144	168	201	200	200	44,383	51,528	53,866	51,919	54,357	61,115
2025	144	167	200	200	200	44,763	51,865	54,486	52,002	54,692	61,847
2026	143	166	200	200	200	45,146	52,204	55,113	52,084	55,028	62,589
2027	143	165	200	200	200	45,533	52,545	55,747	52,167	55,367	63,339
2028	142	164	200	200	200	45,922	52,888	56,388	52,250	55,708	64,098
2029	142	163	199	200	200	46,315	53,234	57,037	52,333	56,051	64,867
2030	142	162	199	200	200	46,712	53,582	57,694	52,416	56,304	65,644
2031	141	161	199	200	200	47,112	53,932	58,358	52,434	56,592	66,431
2032	141	161	198	200	200	47,515	54,284	59,029	52,453	56,881	67,228
2033	140	160	198	200	200	47,921	54,639	59,709	52,471	57,171	68,033
2034	140	159	198	200	200	48,213	54,987	60,327	52,490	57,463	68,849
2035	140	159	197	200	200	48,506	55,337	60,952	52,508	57,757	69,674
2036	139	159	197	200	200	48,802	55,690	61,584	52,526	58,052	70,510
2037	139	159	197	200	200	49,099	56,044	62,222	52,545	58,348	71,355
2038	139	158	197	200	200	49,397	56,401	62,866	52,563	58,646	72,210
2039	139	158	196	200	200	49,698	56,760	63,518	52,582	58,946	73,076
2040	138	158	196	200	200	50,000	57,121	64,176	52,600	59,180	73,952
2041	138	158	196	200	200	50,304	57,485	64,841	52,644	59,421	74,839
2042	138	157	196	200	200	50,611	57,851	65,512	52,688	59,663	75,736
2043	137	157	196	200	200	50,919	58,220	66,191	52,732	59,905	76,644
2044	137	157	196	200	200	51,178	58,532	66,745	52,776	60,149	77,563
2045	137	157	195	200	200	51,438	58,846	67,303	52,820	60,394	78,493
2046	137	156	195	200	200	51,700	59,162	67,866	52,864	60,639	79,434
2047	136	156	195	200	200	51,962	59,480	68,434	52,908	60,886	80,387
2048	136	156	195	200	200	52,227	59,799	69,006	52,952	61,134	81,350
2049	136	156	195	200	200	52,492	60,120	69,583	52,996	61,382	82,326
2050	136	155	195	200	200	52,759	60,443	70,165	53,040	61,587	83,313
2051	135	155	195	200	200	53,028	60,767	70,752	53,167	61,784	84,312
2052	135	155	195	200	200	53,298	61,094	71,344	53,293	61,982	85,323
2053	135	155	195	200	200	53,569	61,422	71,940	53,420	62,180	86,346
2054	135	154	195	200	200	53,788	61,690	72,470	53,546	62,379	87,381
2055	134	154	195	200	200	54,008	61,960	73,004	53,673	62,578	88,429
2056	134	154	194	200	200	54,228	62,231	73,542	53,799	62,778	89,489
2057	134	154	194	200	200	54,450	62,502	74,083	53,926	62,979	90,562
2058	134	153	194	200	200	54,673	62,776	74,629	54,052	63,180	91,648
2059	133	153	194	200	200	54,896	63,050	75,179	54,179	63,382	92,747
2060	133	153	194	200	200	55,121	63,326	75,732	54,305	63,556	93,859

Appendix A-2

Population and Growth Rate Projections

Year	Population					Growth Rate (Percent)				
	Probable	Accelerated	2011 Region O Plan	2007 SWSP Medium	2007 SWSP High	Probable	Accelerated	2011 Region O Plan	2007 SWSP Medium	2007 SWSP High
Data by Decade										
2013	240,565	240,565	220,281	225,631	239,290	1.20	1.30	0.50	0.72	1.20
2023	271,042	281,945	230,143	241,149	269,568	1.20	1.70	0.31	0.62	1.20
2033	305,381	333,714	236,483	255,197	303,682	1.20	1.70	0.19	0.51	1.20
2043	330,710	375,993	240,563	267,400	342,118	0.80	1.20	0.13	0.41	1.20
2053	354,603	415,330	244,568	277,554	385,423	0.70	1.00	0.24	0.32	1.20
2063	376,463	454,260	n/a	285,840	434,215	0.60	0.90	n/a	0.25	1.20
2073	395,715	491,938	n/a	292,592	489,189	0.50	0.80	n/a	0.20	1.20
2083	411,832	527,479	n/a	298,076	551,127	0.40	0.70	n/a	0.15	1.20
2093	428,605	559,996	n/a	302,206	620,912	0.40	0.60	n/a	0.10	1.20
2103	446,061	585,712	n/a	305,367	699,539	0.40	0.45	n/a	0.10	1.20
2113	464,228	603,522	n/a	n/a	n/a	0.40	0.30	n/a	n/a	n/a
Data by Year										
2010	233,606	233,606	216,974	220,817	229,913	1.06	1.06	0.51	0.72	1.20
2011	236,111	236,111	218,076	222,410	233,656	0.69	0.69	0.51	0.72	1.20
2012	237,712	237,712	219,178	224,015	236,456	1.20	1.20	0.50	0.72	1.20
2013	240,565	240,565	220,281	225,631	239,290	1.20	1.30	0.50	0.72	1.20
2014	243,451	243,692	221,383	227,259	242,158	1.20	1.40	0.50	0.72	1.20
2015	246,373	247,104	222,485	228,899	245,060	1.20	1.50	0.50	0.72	1.20
2016	249,329	250,810	223,587	230,551	247,997	1.20	1.60	0.49	0.72	1.20
2017	252,321	254,823	224,689	232,214	250,970	1.20	1.70	0.49	0.72	1.20
2018	255,349	259,155	225,792	233,890	253,978	1.20	1.70	0.49	0.72	1.20
2019	258,413	263,561	226,894	235,577	257,022	1.20	1.70	0.49	0.50	1.20
2020	261,514	268,041	227,996	236,749	260,102	1.20	1.70	0.31	0.62	1.20
2021	264,652	272,598	228,712	238,207	263,220	1.20	1.70	0.31	0.62	1.20
2022	267,828	277,232	229,427	239,673	266,375	1.20	1.70	0.31	0.62	1.20
2023	271,042	281,945	230,143	241,149	269,568	1.20	1.70	0.31	0.62	1.20
2024	274,295	286,738	230,858	242,634	272,799	1.20	1.70	0.31	0.62	1.20
2025	277,586	291,613	231,574	244,128	276,069	1.20	1.70	0.31	0.62	1.20
2026	280,917	296,570	232,289	245,631	279,378	1.20	1.70	0.31	0.62	1.20
2027	284,288	301,612	233,005	247,144	282,727	1.20	1.70	0.31	0.62	1.20
2028	287,700	306,739	233,720	248,665	286,116	1.20	1.70	0.31	0.62	1.20
2029	291,152	311,954	234,436	250,197	289,546	1.20	1.70	0.31	0.45	1.20
2030	294,646	317,257	235,151	251,326	293,017	1.20	1.70	0.19	0.51	1.20
2031	298,182	322,650	235,595	252,610	296,530	1.20	1.70	0.19	0.51	1.20
2032	301,760	328,136	236,039	253,900	300,085	1.20	1.70	0.19	0.51	1.20
2033	305,381	333,714	236,483	255,197	303,682	1.20	1.70	0.19	0.51	1.20
2034	307,824	337,718	236,927	256,500	307,323	0.80	1.20	0.19	0.51	1.20
2035	310,287	341,771	237,371	257,810	311,007	0.80	1.20	0.19	0.51	1.20
2036	312,769	345,872	237,815	259,127	314,735	0.80	1.20	0.19	0.51	1.20
2037	315,271	350,023	238,259	260,451	318,509	0.80	1.20	0.19	0.51	1.20
2038	317,793	354,223	238,703	261,781	322,327	0.80	1.20	0.19	0.51	1.20
2039	320,336	358,474	239,147	263,118	326,191	0.80	1.20	0.19	0.40	1.20
2040	322,898	362,775	239,591	264,163	330,102	0.80	1.20	0.14	0.41	1.20
2041	325,482	367,129	239,915	265,238	334,060	0.80	1.20	0.14	0.41	1.20
2042	328,085	371,534	240,239	266,317	338,065	0.80	1.20	0.13	0.41	1.20
2043	330,710	375,993	240,563	267,400	342,118	0.80	1.20	0.13	0.41	1.20
2044	333,025	379,753	240,887	268,488	346,220	0.70	1.00	0.13	0.41	1.20
2045	335,356	383,550	241,211	269,580	350,371	0.70	1.00	0.13	0.41	1.20
2046	337,704	387,386	241,535	270,677	354,572	0.70	1.00	0.13	0.41	1.20
2047	340,068	391,259	241,859	271,778	358,823	0.70	1.00	0.13	0.41	1.20
2048	342,448	395,172	242,183	272,883	363,125	0.70	1.00	0.13	0.41	1.20
2049	344,845	399,124	242,507	273,993	367,479	0.70	1.00	0.13	0.33	1.20
2050	347,259	403,115	242,831	274,909	371,885	0.70	1.00	0.24	0.32	1.20
2051	349,690	407,146	243,410	275,788	376,344	0.70	1.00	0.24	0.32	1.20
2052	352,138	411,218	243,989	276,669	380,857	0.70	1.00	0.24	0.32	1.20
2053	354,603	415,330	244,568	277,554	385,423	0.70	1.00	0.24	0.32	1.20
2054	356,730	419,068	245,147	278,441	390,045	0.60	0.90	0.24	0.32	1.20
2055	358,871	422,839	245,727	279,331	394,722	0.60	0.90	0.24	0.32	1.20
2056	361,024	426,645	246,306	280,224	399,455	0.60	0.90	0.24	0.32	1.20
2057	363,190	430,485	246,885	281,120	404,245	0.60	0.90	0.23	0.32	1.20
2058	365,369	434,359	247,464	282,019	409,092	0.60	0.90	0.23	0.32	1.20
2059	367,561	438,268	248,043	282,920	413,998	0.60	0.90	0.23	0.27	1.20
2060	369,767	442,213	248,622	283,697	418,962	0.60	0.90	n/a	0.25	1.20

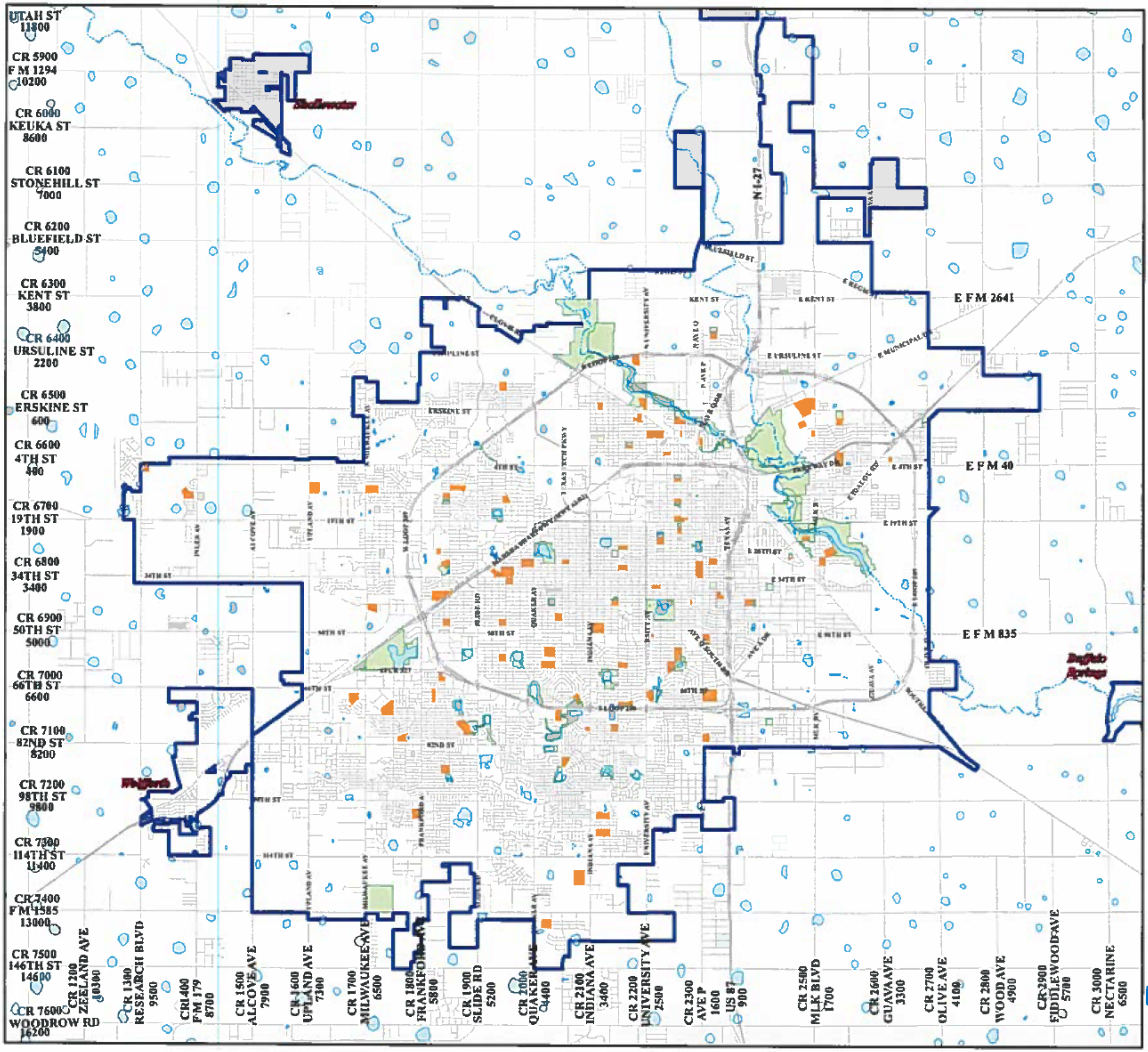
City of Lubbock



City of Lubbock
GIS & Data Services
1625 13th Street
Lubbock, TX 79457
(806) 775-3311

City of Lubbock
TEXAS
GIS & DATA SERVICES DEPARTMENT

City of Lubbock



- 🟧 Schools
- 🟦 Lakes
- 🟩 Parks
- Roads/Streets
- Streams
- ☐ City Limits

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City of Lubbock
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GENERAL FACILITY AND PROCESS INFORMATION:

Water for municipal use in Lubbock is supplied by purchased groundwater and surface water from the Canadian River Municipal Water Authority (CRMWA, PWS ID #1970003), city owned wells in Bailey and Lamb Counties (Bailey County Wellfield), and city owned surface water from Lake Alan Henry. Untreated groundwater from the CRMWA Roberts County Well field enters the 430 million gallon (MG) Terminal Storage Reservoir (TSR) at the City of Lubbock North Water Treatment Plant (NWTP). The purchased water receives the following treatment: pre-chlorination, rapid mix, coagulation, flocculation, sedimentation and filtration. The plant has the ability to post-chlorinate in the event of an emergency. The treated water from CRMWA enters the distribution system from Pump Station (PS) #11 (Entry Point (EP) #1). The maximum purchase rate from CRMWA is 43 million gallons per day (MGD) and the NWTP capacity, which is limited by the sedimentation basins, is 75 MGD.

Groundwater from the Bailey County Wellfield Plant is treated with chlorine and ammonia ahead of the 5 MG ground (GR) storage tank located at the wellfield and enters the distribution system via the Shallowater line at PS #9 (EP #6, 2.5 miles NE of Shallowater on US 84, sample tap in valve pit). The Bailey County Wellfield has 175 wells with a combined production capacity of 40.06 MGD. The transmission line capacity is limited to 42 MGD.

The Lake Alan Henry Booster PS has two raw water pumps with a capacity of 12.5 MGD each and one pump with a capacity of 16.5 MGD. Water is pumped from the lake to the 6.0 MG open top storage tank at the Post Booster PS, which has two 15.7 MGD pumps and one 12.5 MGD pump. From the Post Booster PS, water is pumped to a 225 MG TSR at the South Water Treatment Plant (SWTP). A bypass line is also available to send water directly to the plant. Water from the TSR gravity flows through a flow control structure followed by a raw water screen. Water then flows to two 7.5 MGD pretreatment trains consisting of rapid mix, flocculation, and inclined plate settler sedimentation basins. After the pretreatment trains, water flows into an equalization basin. Eight 2,700 gallon per minute (GPM) membrane feed pumps take suction from the basin and send water through four membrane feed water strainers and then to six Siemens Memcor CP L20V MF/UF membrane units. Chlorine contactor pipeline is used for disinfection. Chemical feed capability includes coagulant, sodium hypochlorite, liquid ammonium sulfate, chlorine dioxide, sulfuric acid, and sodium chlorate. From the membranes and chlorine contactor, water flows to a 2.0 MG clearwell with three 10 MGD transfer pumps. These provide water via an airgapped connection to PS #8, PS #10 and PS #14 (EP #9, sample tap in lab). The SWTP capacity, which is limited by the membrane filters, is 15 MGD.

The City of Lubbock has created three pressure zones to maximize operational control. Total system capacities are 73.75 MG GR, 20.15 MG elevated (EL), and 240,711 GPM (346.624 MGD) of service pump capacity. Water from the three different sources can be delivered to multiple points within the pressure to satisfy changes in demand and capacity requirements.

The east pressure zone has a combined GR storage tank capacity of 35.5 MG, a combined EL storage tank capacity of 1.15 MG, and a service pump capacity of 111,551 GPM.

At Pump Station (PS) #11, located at the NWTP, three service pumps with a combined capacity of 15,600 GPM take suction from the 6 MG and 2 MG clearwells and pump to the distribution system.

At PS #3, located 0.5 blocks west of University on 3rd Street, two service pumps with a combined capacity of 16,060 GPM take suction from a 5 MG GR storage tank and pump to the distribution system.

At PS #4, located at Ave. A and Municipal Dr., four service pumps with a combined capacity of 39,791 GPM take suction from the 5 MG and 10 MG GR storage tanks and pump to the distribution system.

At PS #6, located at 66th and Slaton Hwy, two service pumps with a combined capacity of 6,300 GPM take suction from a 2 MG GR storage tank and pump to the distribution system.

At PS #8, located at 66th and Loop 289, three service pumps with a combined capacity of 28,500 GPM take suction from a 5 MG GR storage tank and pump to the distribution system.

At PS #12, located southeast of the prison on Slaton Hwy, there are three booster pumps with a combined capacity of 1,500 GPM. A 0.15 MG EL storage tank is located at the PS and floats on the supply line between the PS and the prison. These pumps are not included as part of the service pump capacity.

At PS #15, located north of the NWTP, three service pumps with a combined capacity of 5,300 GPM take suction from a 0.5 MG GR storage tank and pump to the City of New Deal.

An additional 1 MG EL storage tank, located at 35th and Ave. W, floats on the system.

The west pressure zone has a combined GR storage tank capacity of 19 MG, a combined EL storage tank capacity of 3 MG, and a service pump capacity of 129,150 GPM. Due to location and topography, an additional 5 MG of elevated GR is counted for the wellfield GR storage tank and an additional 14.25 MG ground storage and 11 MG of elevated storage is counted for the transmission line from the wellfield.

At PS #7, located at 29th and Marsha Sharp Freeway, seven service pumps with a combined capacity of 49,000 GPM take suction from the 2 MG and 5 MG GR storage tanks and pump to the distribution system.

At PS #9 (or Low Head "B"), located at N. Quaker and Clovis Hwy, four service pumps with a combined capacity of 23,200 GPM take suction from a 5 MG GR storage tank and pump to the distribution system. There are four additional service pumps with a combined capacity of 38,100 GPM that are also utilized to pump to the distribution system.

At PS #10, located at 82nd and Memphis, two service pumps with a combined capacity of 18,850 GPM take suction from a 7 MG GR storage tank and pump to the distribution system.

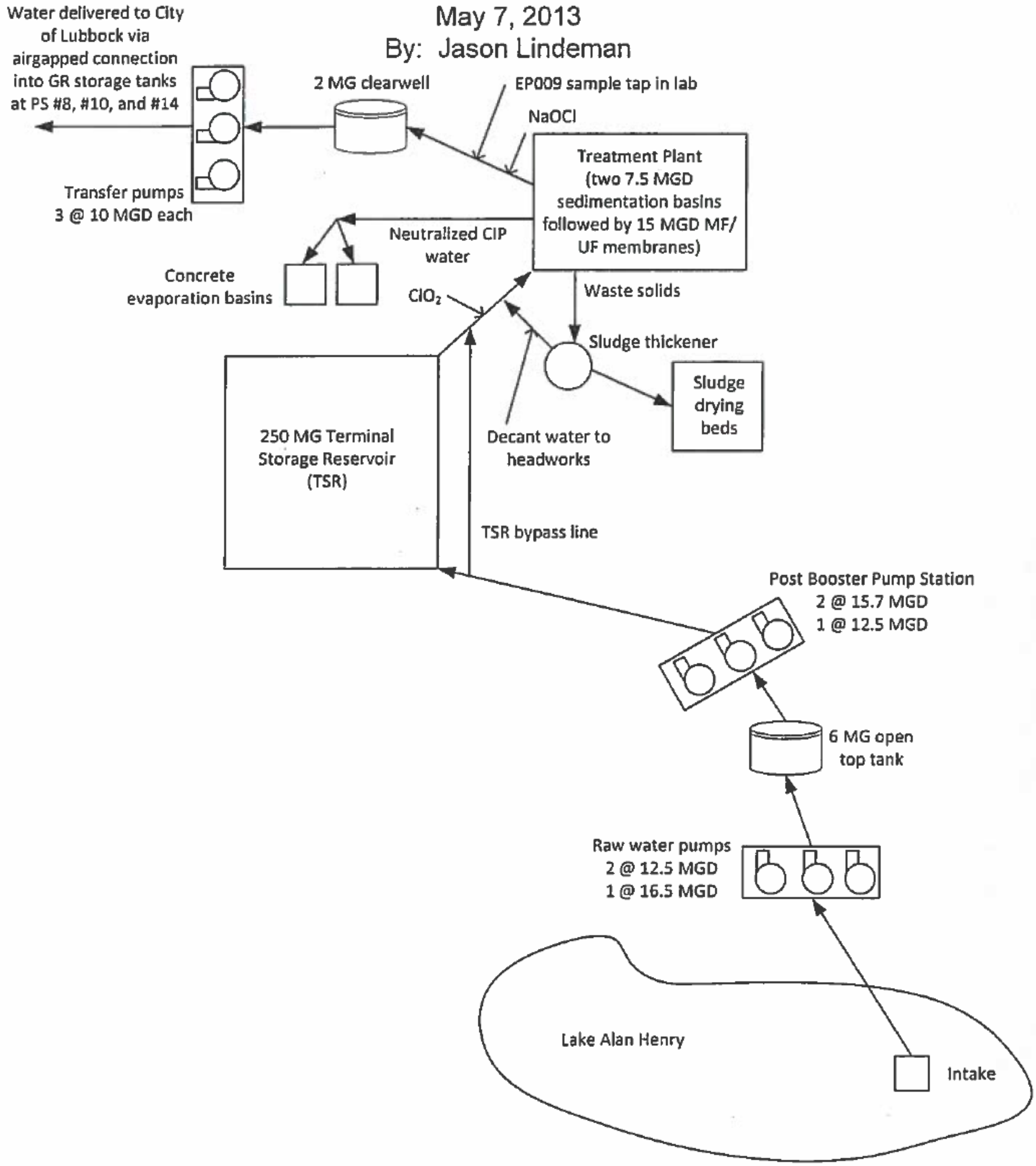
A 1.0 MG EL storage tank, located at 50th and Joliet, and a 2 MG EL storage tank, located at 74th and Genoa, float on the system.

The southwest pressure zone is served by PS #14, which has four service pumps with a combined capacity of 10,000 GPM that take suction from a 5 MG GR storage tank and pump to the distribution system.

System Sketch
Lubbock Public Water System
PWS ID # 1520002
South Water Treatment Plant

May 7, 2013

By: Jason Lindeman

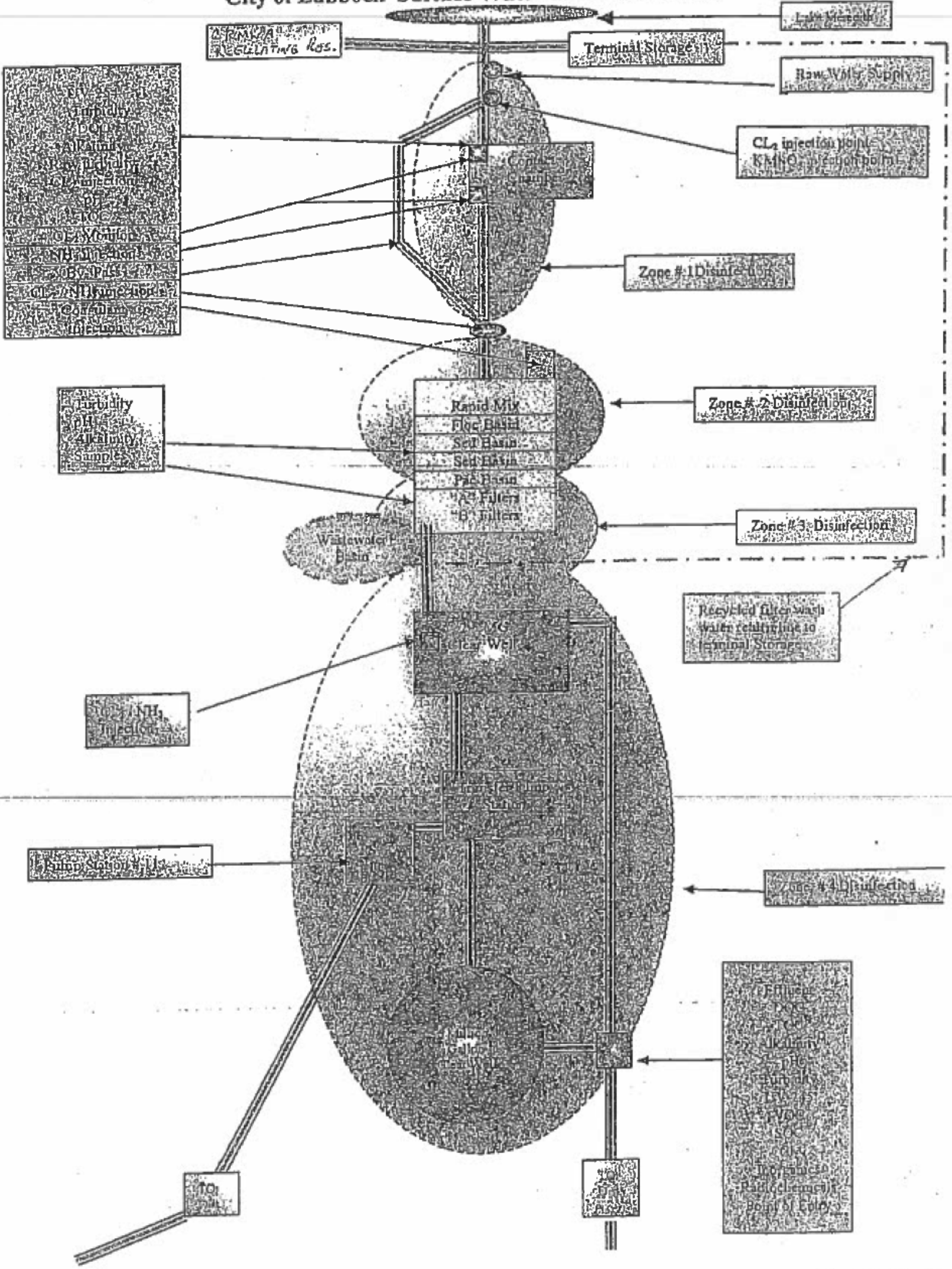


City of Lubbock
05/07/2013

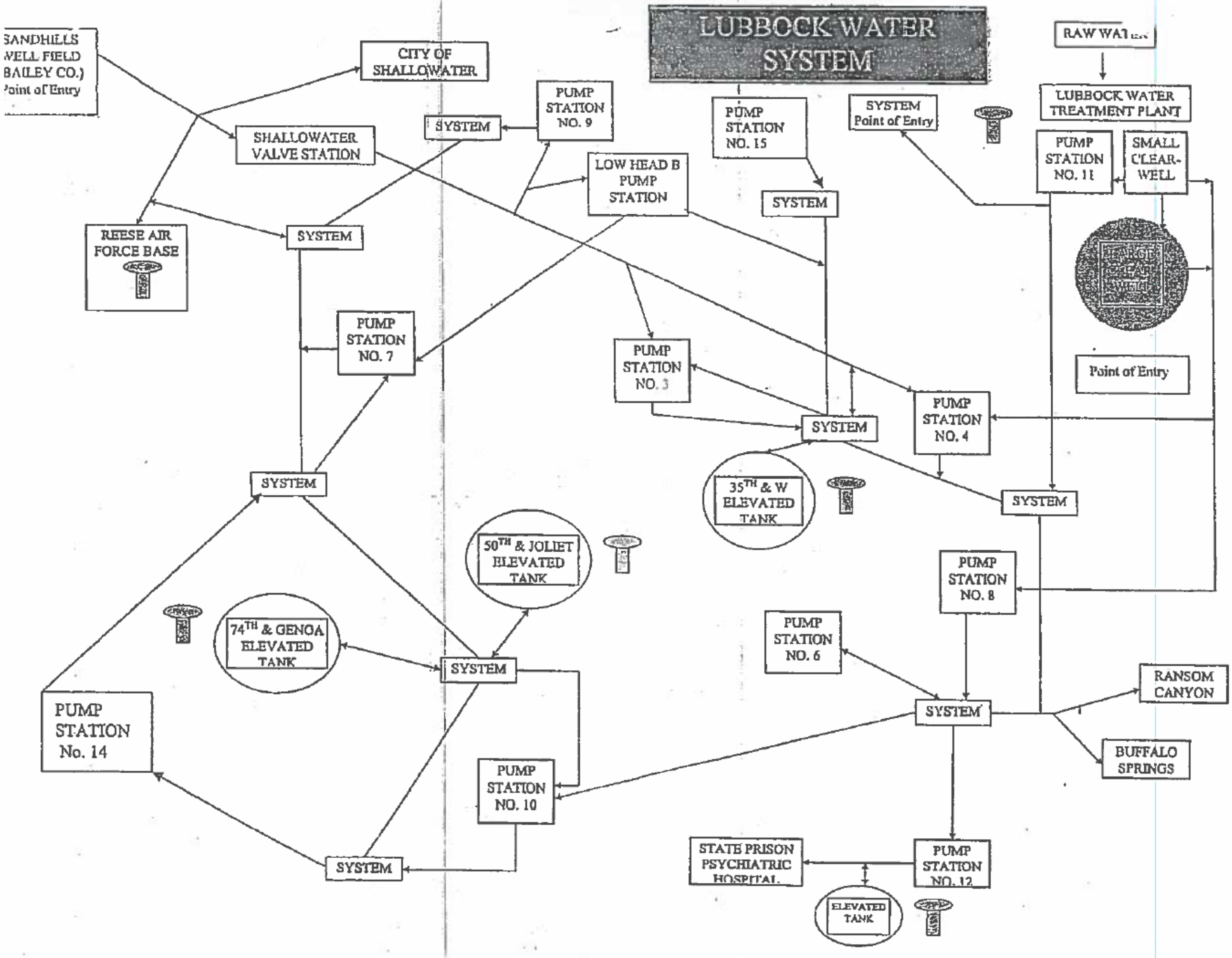
North Water
Treatment Plant

PWS/1520002/CO
PLANT SKETCHES

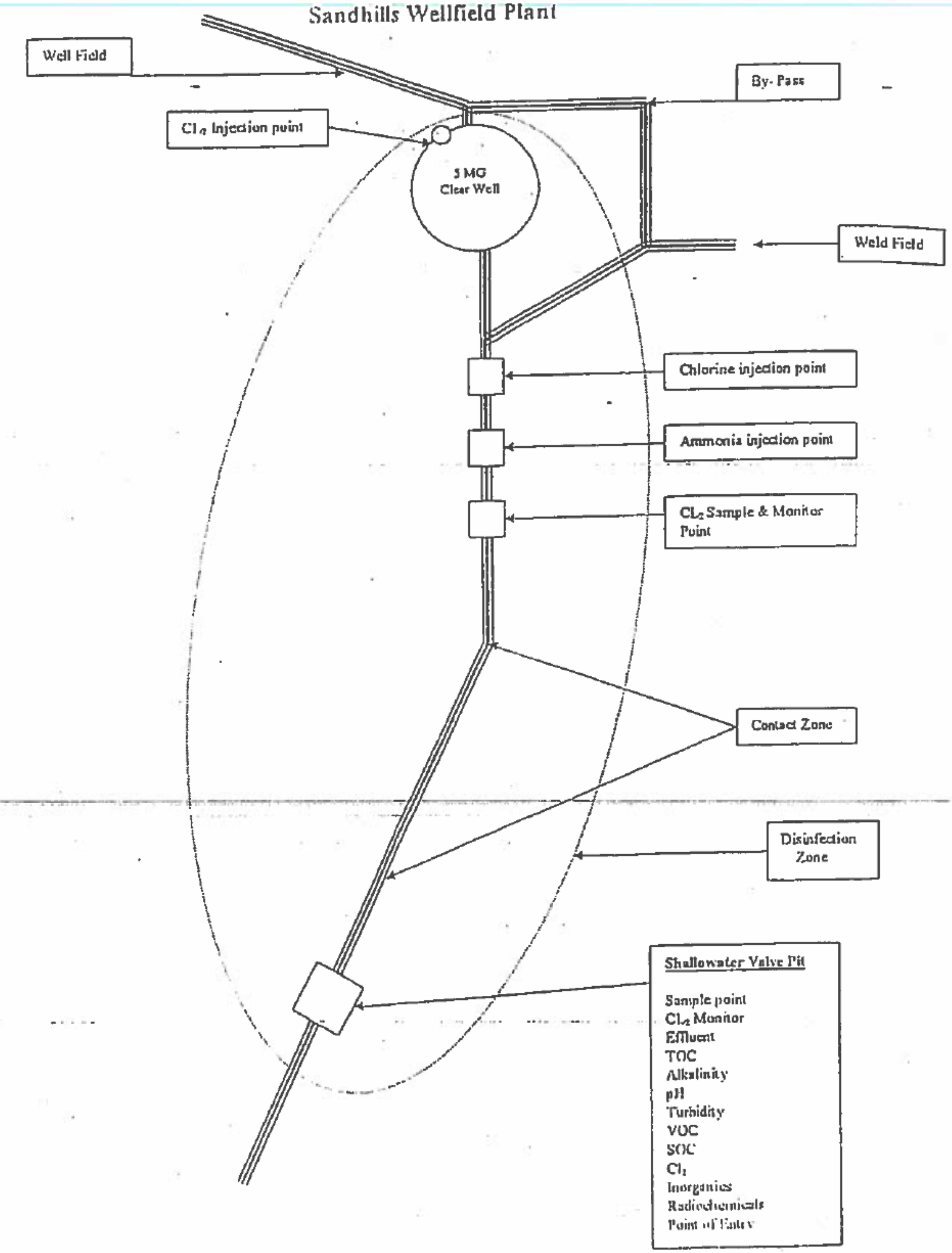
City of Lubbock Surface Water Treatment Plant



LUBBOCK WATER SYSTEM



City of Lubbock
Bailey County
Sandhills Wellfield Plant



ARTICLE 22.08 WATER USE MANAGEMENT PLAN[*]

Division 1. Generally

Sec. 22.08.001 Introduction

(a) The city is located in Lubbock County in the Texas Panhandle and is the eleventh largest city in the state and the largest city in West Texas. The city's population was estimated by the city planning department to be 242,843 in 2014. According to the Llano Estacado (Region 0) Regional Water Plan, the city's population is expected to increase to almost 232,000 by 2025, while the city's planning department estimates the most probable population to be almost 278,000 by 2025. The city is situated in a semi-arid region that requires more water per capita for landscape irrigation than in many other parts of the state. Evidence of landscape irrigation demand is apparent when comparing the average winter water usage of 121 gallons per capita per day (gpcd) to the average summer water usage of 192 gpcd. In response to this, recent city efforts on water conservation have focused on techniques to reduce the amount of water used in landscape irrigation.

(b) This water use management plan - water conservation plan and drought and emergency contingency plan pertains to the use of water by both the city's retail and wholesale water customers, and is intended to meet the requirements of the Texas Commission on Environmental Quality (TCEQ) and the Texas Water Development Board (TWDB).

(Ordinance 2010-O0055 adopted 7/22/2010; Ordinance 2014-O0167, sec. 1, adopted 12/18/2014)

Sec. 22.08.002 System description

(a) The city water system currently utilizes three separate water supply sources. During 2014, approximately 60% of the city's annual water usage will be supplied from the Canadian River Municipal Water Authority (CRMWA). Lubbock is a member city of the CRMWA. Water supplied from CRMWA is a blend of surface water and groundwater. The surface water source is Lake Meredith and the ground water source is the CRMWA well field located in Roberts County. The supply capacity of this system to Lubbock is 42 million gallons per day (MGD). This blended supply is treated at the Lubbock North Water Treatment Plant in Lubbock. The treatment plant is a conventional water treatment plant, and treats water for the city and for six other CRMWA southern division member cities: Slaton, Tahoka, O'Donnell, Lamesa, Levelland and Brownfield. CRMWA supplies the raw water to these cities.

(b) The city provides water treatment services only to these cities. These cities reimburse Lubbock for their respective portions of the water treatment cost. CRMWA operates a 250 million gallon capacity raw water reservoir located near the treatment plant. The city owns and operates a 400 million gallon raw water storage reservoir located adjacent to the CRMWA reservoir. This reservoir is used during summertime peak water use periods to supplement the normal supply from CRMWA. Its peak supply capacity is 25 MGD.

(c) During 2014, approximately 20% of the city's annual water usage will be supplied from a well field located in Bailey and Lamb Counties, which is owned and operated by the city of Lubbock. This well field is commonly referred to as the Bailey County Well Field (BCWF), and is made up of 165 production wells. All groundwater from this source is treated at a central location in the well field. Disinfection is the only treatment required for this source. The supply capacity of this system is 40 MGD.

(d) During 2014, approximately 20% of the city's annual water usage will be supplied from Lake Alan Henry located 60 miles southeast of Lubbock in Garza and Kent Counties. The supply capacity of this system to Lubbock is 15 MGD. The water pumped from Lake Alan Henry is treated at the Lubbock South Water Treatment Plant near Lubbock.

(e) The city water distribution system contains approximately 1,471 miles of pipeline mains, 12 pump stations, 12 ground storage tanks totaling 64.5 million gallons, 4 conventional elevated storage tanks totaling 4.15 million gallons, and the BCWF pipeline that functions as an unconventional elevated storage system totaling 11.0 million gallons.

(f) The city sells water on a wholesale basis to six separate public water supply systems, the City of Shallowater, Lubbock Reese Redevelopment Authority, Lubbock County Water Control & Improvement District No. 1 (also known as Buffalo Springs Lake community), the Town of Ransom Canyon, the City of Littlefield, and the City of New Deal. The water is supplied to the City of Littlefield only for infrequent emergency use. The water supplied to the City of New Deal is water purchased from the City of Slaton by the City of New Deal and delivered through the City of Lubbock water distribution system, for which Lubbock charges only a delivery fee.

(Ordinance 2010-O0055 adopted 7/22/2010; Ordinance 2014-O0167, sec. 2, adopted 12/18/2014)

Sec. 22.08.003 Definitions

For the purposes of this plan, the following definitions shall apply:

Aesthetic water use. Water use for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

Annual water supply. The amount of water available to the city within a given year. Normally measured in billions of gallons or acre-feet.

Average winter consumption. The amount of water used by a customer on average during the winter months of December, January, and February.

Conservation. Those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve efficiency in the use of water or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative use.

Domestic water use. Water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution, except as provided under the definition of nonessential water use below.

Drought. An extended period of time of below normal precipitation (rainfall, snow, etc.).

Drought of record. Extended period of time of below normal precipitation (rainfall, snow, etc.) that exceeds the length of time and impact on water supplies of previous droughts. The drought of record is used to help determine the estimated yield of reservoirs.

Hand watering. The irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf course greens, tees, fairways, parks, athletic fields, street or alley rights-of-way and medians through the use of manual water devices supplied by a water hose and actively attended to by a person.

Increasing block rate. A water rate structure that has a rate that increases as more water is consumed.

Landscape irrigation or landscape irrigation use. Water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf course greens, tees, and fairways, parks, athletic fields, street or alley rights-of-way and medians.

Maximum daily supply. The amount of water available to the city during a given day. The amount may be limited due to the water transmission line size, water pump size, the number of operating wells, the amount of raw and treated water storage, the water rights owned by the city and other related factors.

Nonessential water use. Water uses that are neither essential nor required for the protection of public health, safety, and welfare, including without limitation:

(1) Landscape irrigation;

(2) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane, or other vehicle of any kind;

(3) Use of water to spray or wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;

(4) Use of water to spray or wash down buildings or structures for purposes other than immediate fire protection;

(5) Flushing gutters or permitting water to run or accumulate in any gutter or street;

(6) In connection with stage 3 and stage 4 drought response stages, use of water to fill, refill, or add to any indoor or outdoor swimming pools or hot tubs;

(7) Use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic and avian life; and

(8) Failure to repair a leak(s) within a reasonable period of time after having been given notice directing the repair of such leak(s).

Per capita water use. A measure of water use for a city or other entity, expressed in gallons per capita per day (gpcd). The measure compares water use to the number of citizens in the area. The measure does not reflect the amount used on average by a citizen.

Water Loss. Measured as the volume of water metered into the water distribution system minus the volume billed for a given time period.

(Ordinance 2010-O0055 adopted 7/22/2010; Ordinance 2012-O0022, sec. 3, adopted 3/29/2012)

Secs. 22.08.004–22.08.030 Reserved

Division 2. Water Conservation Plan

Sec. 22.08.031 Introduction

The city provides retail water service to city residents and also provides water on a wholesale basis to six additional entities. While the city can try to directly influence the water use of its retail water users through the water conservation measures discussed in this plan, as the six wholesale customer's retail utility systems are separate from the city's retail system, the city does not have the ability to implement most of the water conservation measures discussed in this plan for the wholesale customers. The wholesale customers will be able to implement these measures as a part of their respective retail water supply operations. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.032 Declaration of policy, purpose, and intent

In order to conserve the available water supply, the city adopts the following regulations concerning water conservation through this article. Water uses regulated or prohibited under this water conservation plan are considered to be discretionary and are deemed to constitute a waste of water which subjects the offender(s) to penalties as defined in section 22.08.046 of this plan. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.033 Authorization

The city manager or his/her designee is authorized and directed to implement the applicable provisions of this plan. The city manager or his/her designee will act as the administrator of the plan, oversee the execution and implementation of the plan, and will be responsible for keeping adequate records for program verification. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.034 Conservation goals

(a) The city's water conservation goals are to:

> (1) Provide an adequate supply of suitable treated water to meet the needs of its retail and wholesale customers; and
>
> (2) Encourage its wholesale customers to adopt and implement water conservation plans that will reduce their per capita water use rates.

(b) The city's wholesale customer water conservation program is predicated on the fact that the implementation of conservation measures must occur largely at the local level. Due to this fact, the city's wholesale program is focused on encouraging and supporting initiatives by its wholesale customers.

(c) TCEQ rules require that water conservation plans contain specific, quantifiable five- and ten-year goals for use in gallons per capita per day. The goals established as part of this plan are not enforceable. The gpcd calculation, as defined by TCEQ, is the total average daily amount of water diverted or pumped for treatment by potable uses divided by the population served.

(d) In order to set a per capita goal for municipal water conservation, baseline per capita water use was determined from the average per capita water use from 2009 to 2013 as determined by the city. In order to determine these values, the city uses total water pumped from all sources divided by the estimated city population as determined by the city's planning department. This resulted in an average value reflecting both wet and dry years. The average per capita use from 2009 to 2013 was 153 gpcd with a high of 178 gpcd in 2011 and a low of 140 gpcd in 2009. This average per capita use rate is less than the target rate of 172 gpcd recommended by the Llano Estacado Regional Water Planning Group, but greater than the target rate of 140 gpcd recommended by the state water conservation task force. The water conservation task force recommends a one percent per year reduction until the target of 140 gpcd is reached; however, in light of the fact that the city has already achieved a significant conservation response, the goals for this plan were developed utilizing a 0.5% per year reduction in per capita water use. This results in a per capita goal for year 2019 of 150 gpcd and a year 2024 goal of 147 gpcd. This reflects a reduction of 0.5% per year from the 155 gpcd in 2013.

(e) This methodology is similar to that used in the city's previous water conservation plan adopted in 2010. The former and current plans use a 0.5% per year reduction in per capita water use goal. The new goals established under this revised plan are similar to those previously established.

(f) In addition to the per capita water use goal above, the city has set a maximum water loss water goal of 10% for the retail water delivery system for both 2019 and 2024. This would correspond to a loss rate of 15 gpcd in 2019 and 14.6 gpcd in 2024. This goal is a benchmark established by the TCEQ for water loss.

(Ordinance 2010-O0055 adopted 7/22/2010; Ordinance 2014-O0167, sec. 3, adopted 12/18/2014)

Sec. 22.08.035 Metering water diverted from the source of supply

The city meters the amount of raw water pumped from the BCWF, Lake Alan Henry, and from the CRMWA supply using meters that are maintained to record flow with an accuracy of plus or minus 5.0%. The amount of water delivered to each wholesale water customer is also metered by the city. (Ordinance 2010-O0055 adopted 7/22/2010; Ordinance 2014-O0167, sec. 4, adopted 12/18/2014)

Sec. 22.08.036 Universal metering program

(a) Using meters that meet at least the minimum standards developed by the American Water Works Association and with a metering accuracy range of plus or minus 5.0%, the city individually meters all water usage, except that utilized for fire protection. Combined with the city's computerized billing system, the city's universal metering program has a water delivery accuracy rate of plus or minus 5%, which meets the TCEQ standards for meter accuracy. The city encourages each wholesale water customer to meter all water usage as well.

(b) The city uses a random sampling technique to test meter accuracy and to determine when meters need to be repaired or replaced. The city randomly samples approximately 400 water meters each year. Depending on the results of this sample, additional sampling may be done to target meters of a certain age or meters located within a certain geographical portion of the city. Meters found to have an accuracy of less than plus or minus 5% are either repaired or replaced as needed.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.037 Records management system

The city maintains a records management system which tracks the volume of water pumped, water delivered to retail customers, water sold to wholesale customers, and the volume of water losses. The city's utility billing database allows water sales and uses to be desegregated into the volume used by residential, commercial, public and institutional, and industrial customers. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.038 Measures to control unaccounted-for uses of water

The city takes the appropriate steps to monitor and audit its water system for water loss in an effort to conserve water, manages the replacement of old water lines that are prone to leaks and breaks, investigates customer complaints of low pressure and possible leaks, visually inspects suspected leaks, and tracks water delivery to customers to determine illegal connections and abandoned service lines. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.039 Program for achieving water conservation goals

(a) The city has established goals, objectives and programs that support a standard for water use. The city's water conservation program is comprised of five main strategies in the following order of priority:

(1) Administrative water conservation efforts;

(2) Water use standards;

(3) Public education and information;

(4) Enforcement; and

(5) Structural changes.

(b) The city will evaluate and implement certain administrative changes to programs, policies, and rules that support water conservation efforts. In 1992, the city moved from a declining block rate to a uniform block rate. In 2007, the city passed a revised water rate ordinance with an inclining block rate structure. Other administrative changes may include the continued review and revision of city codes to determine their affect on the use of water and active enforcement of rules, codes, and regulations affecting water use.

(c) In an effort to manage annual and maximum daily water use, the water conservation program establishes the following water use standards for outdoor landscape irrigation:

(1) Landscape irrigation is allowed to occur only between the hours of 6:00 p.m. to 10:00 a.m. from April 1st through September 30th.

(2) Summer irrigation should provide a maximum of 1.5 inches per zone per week.

(3) Winter irrigation may occur only when temperatures are above 35°F so as not to cause a freezing hazard and should provide a maximum of 1.0 inch per zone per month for dormant grasses (i.e. Bermuda) and 1.0 inch per zone every two weeks for cool season grasses (i.e. Fescue).

(4) Irrigation should occur without water runoff. This may be accomplished by correctly cycling the sprinkler system and allowing time for the water to soak into the landscape between irrigation events.

(d) The city will support programs to educate the public regarding water conservation activities that support its goals. This includes educating the general public on the need for and practices of water conservation through public service announcements, participation in home and garden shows, coordination efforts with the Chamber of Commerce, West Texas Home Builders Association and Lubbock Apartment Association, and supporting water conservation efforts in the local education system.

(e) Structural changes that have been and may be adopted by the city are those programs that result in a physical modification of water use devices or practices, such as landscape design and maintenance, rain and freeze sensors on automatic irrigation systems, plumbing retrofit or rehabilitation programs, controlling water loss, and by reusing treated wastewater and stormwater.

(f) In regards to the city's wholesale water customers, their retail utility systems are separate from the city's retail water system; therefore, the city does not have the ability to implement most of the water conservation items discussed above. The city encourages its wholesale customers to implement these or other appropriate water conservation measures as a part of their respective retail water supply operations.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.040 Water rate structure

The city has adopted a water rate structure which is non-promotional (see section 22.03.085 of this code). (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.041 Reservoir operations plan

This requirement is not applicable to the city at this time. The city only owns and operates one water supply reservoir, Lake Alan Henry, which is located on the South Fork of the Double Mountain Fork of the Brazos River. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.042 Coordination with regional planning groups

The water service area of the city is located within Llano Estacado Regional Planning Area (Region O) and the city has provided a copy of this plan to the Llano Estacado Regional Water Planning Group to ensure consistency with the regional water plan. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.043 Leak detection/repair and water loss accounting program

(a) The city routinely monitors the water storage, delivery, and distribution system components for leaks. Waterline leaks are detected by utility personnel while reading meters, maintaining their water and wastewater systems, and while performing other routine surveillance programs. Any reported leaks are repaired in a timely manner. The wholesale water customers are responsible for managing their ongoing leak detections, location, and repair programs.

(b) At a minimum, the city will conduct a water audit using the methodology outlined by the TWDB every five years in accordance with current TWDB rules. Water audits may be conducted on a more frequent basis if the city deems that action to be appropriate.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.044 Water supply contracts

(a) It is a mandatory requirement for the city to require wholesale customers with any new or amended contracts or successor contracts to develop a water conservation plan. Minimum plan requirements for municipal wholesale customers entering or renewing city contracts include:

(1) A completed TCEQ utility profile;

(2) Specific, quantified five-year and ten-year targets for water savings to include goals for water loss programs and goals for municipal use, in gallons per capita per day;

(3) Metering devices having accuracy within plus or minus 5 percent in order to measure and account for the amount of water diverted from the supply source;

(4) A program for universal metering of both customer and public uses of water, for meter testing and repair, and for periodic meter replacement;

(5) Measures to determine and control unaccounted-for uses of water (for example, periodic visual inspections along distribution lines, annual or monthly audit of the water system to determine illegal connections, abandoned services, etc.);

(6) A program of continuing public education and information regarding water conservation;

(7) A water rate structure which is not "promotional," meaning a rate structure which is cost-based and which does not encourage the excessive use of water;

(8) A reservoir systems operation plan, if applicable, providing for the coordinated operation of reservoirs owned by the utility within a common watershed or river basin in order to optimize available water supplies;

(9) A means of implementation and enforcement of conservation practices, as evidenced by either:

(A) A copy of the ordinance, resolution, or tariff, indicating official adoption of the water conservation plan by the customer; or

(B) A description of the authority by which the customer will implement and enforce the water conservation plan; and

(10) Documentation of coordination with the regional water planning groups for the service area of the customer in order to ensure consistency with the appropriate regional water plans.

(b) Water conservation plan must include the following additional elements if the customer serves, or plans to serve in the next 10 years, a population of 5,000 or greater:

(1) A program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted-for uses of water;

(2) A record management system to record water pumped, water deliveries, water sales, and water losses which allows for the desegregation of water sales and uses into the following user classes: residential, commercial, public and institutional, and industrial; and

(3) For wholesale water customers, that they include a requirement that every wholesale water supply contract entered into or renewed after official adoption of the customer's water conservation plan, and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures using the applicable TCEQ requirements.

(c) Other measures that the customer could adopt to meet the stated conservation goals might include but are not limited to:

(1) Measurement and control of excessive pressure in the distribution system;

(2) Ordinances to promote efficiency and avoid water waste;

(3) Plumbing fixture replacement and retrofit programs;

(4) Other beneficial reuse of water such as grey water and rainwater harvesting systems; and

(5) Other measures as may be applicable.

(d) All customer plans must be reviewed and approved by city council before water sales contracts are signed.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.045 Revisions to the water conservation plan

The city shall review and update, as appropriate, the water conservation plan at least every five (5) years, based on, in part, an assessment of the previous five- and ten-year goals, new or updated information such as the adoption or revision of the regional water plan, or changes in laws or regulations. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.046 Penalties for noncompliance with the water conservation plan

Any water customer or other user of the city's water supply that violates this water conservation plan shall be guilty of a misdemeanor and subject to a penalty and fine as set forth in section 1.01.004 of this code for each day of noncompliance. In addition:

(1) Service shall be discontinued to those customers who do not pay their water bills until all required payments are made; and

(2) New water service taps will be provided to new construction and new construction will be approved only if such construction conforms to adopted ordinances.

(Ordinance 2010-O0055 adopted 7/22/2010)

Secs. 22.08.047–22.08.070 Reserved

Division 3. Drought and Emergency Contingency Plan

Sec. 22.08.071 Introduction

(a) A number of situations may limit the city's ability to deliver a sufficient amount of water to meet the demands of all customers. In those instances, the city will take steps to ensure that water is available for essential life and safety needs. This drought and emergency contingency plan (the plan) is designed to address the following situations. Reduction in available water supply up to a repeat of the drought of record;

(b) Water production or distribution limitations (peak water supply);

(c) Supply source contamination; and/or

(d) System outages.

(e) There are four stages to address drought and emergency conditions. Each stage has triggers for initiation, for restrictions on water use to assist in reaching water use reduction goals, and has provisions for rescinding the stage once the conditions that caused the drought or emergency have ceased to exist. The stages are defined as:

(1) Stage 1 - mild water shortage conditions.

(2) Stage 2 - moderate water shortage conditions.

(3) Stage 3 - severe water shortage conditions.

(4) Stage 4 - emergency water shortage conditions.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.072 Declaration of policy, purpose, and intent

(a) In order to conserve the available water supply and/or to protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the city adopts the following regulations and restrictions on the delivery and consumption of water through this article.

(b) Water uses regulated or prohibited under this drought and emergency contingency plan are considered to be nonessential and continuation of such uses during times of water shortage or other emergency water supply conditions are deemed to constitute a waste of water which subjects the offender(s) to penalties as defined in section 22.08.083 of this plan.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.073 Authorization

The city manager or his/her designee, is hereby authorized and directed to implement the applicable provisions of this plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The city manager, or his/her designee, shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this plan. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.074 Public involvement

Opportunity for the public and for the wholesale water customers to provide input into the preparation of the plan was provided by the city by means of scheduling and providing public notice of a public meeting to accept input on the plan held on July 8, 2010. The plan was adopted under the open meetings requirement of the TCEQ during the July 22, 2010 city council meeting. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.075 Public and wholesale customer education

(a) The city will periodically provide the public and wholesale customers with information about the plan, including information about the conditions under which each stage of the plan is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided to the public. The city will periodically provide the public and wholesale customers with information about the plan, including information about the conditions under which each stage of the plan is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided to the public by means necessary to educate and provide information to the public, including but not limited to, public service announcements, newspaper notices, utility bill inserts, and educational presentations.

(b) This information will be provided to the wholesale customers by providing them with a copy of this plan.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.076 Coordination with regional water planning groups

The water service area of the city is located within the Llano Estacado Regional Water Planning Area (Region O). The city has provided a copy of this plan to the Llano Estacado Regional Water Planning Group to ensure consistency with the approved regional water plan. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.077 Application

The provisions of this plan shall apply to all persons, customers, and property utilizing water provided by the city, including the city's wholesale water customers. The terms "person" and "customer" as used in the plan includes individuals, corporations, partnerships, associations, and all other legal entities. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.078 Triggering criteria for initiation and termination of drought response stages

(a) The city manager, or his/her designee, shall monitor water supply and/or demand conditions on a daily basis and shall determine when conditions warrant initiation or termination of each stage of the plan, that is, when the specified "triggers" are reached. Public notification of the initiation or termination of drought response stages will be made by publication in a newspaper of general circulation, public service announcements, and/or signs posted in public places. Wholesale customer notification of the initiation or termination of drought response stages will be made by email, mail, or telephone.

(b) The triggering criteria below are based on an evaluation of the historical water system capacities and customer use patterns, and consider the impact of drought, emergencies, and high use upon capacities and patterns.

(1) <u>Stage 1 - mild water shortage conditions</u>.

(A) <u>Requirements for initiation</u>. Stage 1 of the plan shall be implemented if any of the following conditions arise:

(i) Daily water use exceeds 80% of the city's maximum daily supply capacity for ten consecutive days;

(ii) Water supply available from all sources is only sufficient to meet projected needs; or

(iii) Water availability is adequate but lake levels, reservoir capacities, or groundwater supplies are low enough that some concern exists for future water supplies if the drought or emergency condition continues.

(B) Requirement for termination. Stage 1 restrictions may be rescinded when all initiation conditions have ceased to exist as determined by the city manager or his/her designee.

(2) Stage 2 - moderate water shortage conditions.

(A) Requirements for initiation. Stage 2 of the plan shall be implemented if any of the following conditions arise:

(i) Daily water use exceeds 90% of the city's maximum daily supply capacity for ten consecutive days;

(ii) Water supply available from all sources are reduced, but are greater than 90% of projected needs; or

(iii) Water availability from lakes and groundwater is below normal and may continue to decline and cause moderate concern for both current and future water supplies or water supplies have been reduced due to failure of a portion of the water supply system.

(B) Requirement for termination. Stage 2 restrictions may be rescinded when all initiation conditions have ceased to exist as determined by the city manager or his/her designee. When stage 2 is terminated, stage 1 automatically becomes effective.

(3) Stage 3 - severe water shortage conditions.

(A) Requirements for initiation. Stage 3 of the plan shall be implemented if any of the following conditions arise:

(i) Daily water use exceeds 100% of the city's maximum daily supply capacity for five consecutive days;

(ii) Water supply available from all sources are reduced to 90% or less of projected needs; or

(iii) Water availability from lakes and groundwater is well below normal, may continue to decline, and additional reductions in current or future water supplies are evident or water supplies have been reduced due to failure of a portion of the water supply system.

(B) Requirement for termination. Stage 3 restrictions may be rescinded when all initiation conditions have ceased to exist as determined by the city manager or his/her designee. When stage 3 is terminated, stage 2 automatically becomes effective.

(4) Stage 4 - emergency water shortage conditions.

(A) Requirements for initiation. Stage 4 of the plan shall be implemented if any of the following conditions arise:

(i) Daily water use exceeds 105% of the city's maximum daily supply capacity for five consecutive days;

(ii) Water supply available from all sources are reduced to less than 70% of projected needs;

(iii) There has been a failure in a major water supply source or system, such as the failure of a dam, storage reservoir, pumping system, transmission pipeline, water treatment facility, major power failure, or natural disaster that causes a severe and prolonged limit on the ability of the water supply system to meet the water supply demands; or

(iv) The source water supply has been contaminated.

(B) Requirement for termination. Stage 4 restrictions may be rescinded when all initiation conditions have ceased to exist as determined by the city manager or his/her designee. When stage 4 is terminated, stage 3 automatically becomes effective.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.079 Drought response stages

The city manager, or his/her designee, shall monitor water supply and/or demand conditions and, in accordance with the triggering criteria set forth in section 22.08.078 above, shall determine that mild, moderate, or severe water shortage conditions exist or that an emergency condition exists and shall implement the following actions. The city shall notify the executive director of the TCEQ within five business days of the implementation of any mandatory provisions of the plan.

(1) Stage 1 - mild water shortage conditions.

(A) Target. Reduce water use to less than 90% of the city's maximum daily supply capacity.

(B) Best management practices for supply management.

(i) The city may reduce or discontinue the flushing of water mains as well as utilize reclaimed water for non-potable purposes where practicable.

(ii) Wholesale customers are required in specific contract provisions to implement these measures as well as any other measures specified in the wholesale supply contract to better manage a limited water supply. Contract provisions requiring wholesale customers to implement mandatory drought restrictions consistent with the city will be added into any new contract or contract revision.

(C) Water use restrictions for reducing demand.

(i) Landscape irrigation is restricted to two days per week. The city manager or his/her designee may, after notice to the citizens of the city, designate irrigation schedules.

(ii) Irrigation shall provide a maximum of 1.5 inches per zone per week.

(iii) Irrigation shall occur without significant water runoff, which can be accomplished by correctly cycling the sprinkler system and allowing time for the water to soak into the landscape between irrigation events.

(iv) All city operations shall adhere to the water use restrictions.

(v) Hand watering for landscape irrigation purposes is allowed on a daily basis regardless of the time of year.

(vi) New plant material may be irrigated on a more frequent basis until the new plant material is established as defined in section 22.03.133(a)(4) related to the operation of irrigation systems.

(vii) The city manager, or his/her designee, will contact wholesale water customers to discuss water supply and/or demand conditions and will request that wholesale water customers initiate voluntary measures to reduce water use (i.e., implement stage 1 of the customer's drought contingency plan).

(2) Stage 2 - moderate water shortage conditions.

(A) Target. Reduce water use to less than 80% of the city's maximum daily supply capacity.

(B) Best management practices for supply management.

(i) The city will reduce or discontinue the flushing of water mains as well as utilize reclaimed water for non-potable purposes where practicable.

(ii) Wholesale customers are required in specific contract provisions to implement these measures as well as any other measures specified in the wholesale supply contract to better manage a limited water supply. Contract provisions requiring wholesale customers to implement mandatory drought restrictions consistent with the city will be added into any new contract or contract revision.

(C) Water use restrictions for reducing demand.

(i) Landscape irrigation is restricted to one day per week. The city manager, or his/her designee, after notice to the citizens of the city, may designate an irrigation watering schedule.

(ii) Irrigation shall provide a maximum of 1.5 inches per zone per week.

(iii) Irrigation shall occur without significant water runoff, which can be accomplished by correctly cycling the sprinkler system and allowing time for the water to soak into the landscape between irrigation events.

(iv) Water customers will refrain from or significantly limit aesthetic and non-essential water use as defined in section 22.08.003. Water shall not be used to wash down hard surfaced areas, including, without limitation, sidewalks, parking lots, gutters, and patios. Water shall not be used for dust control. However, water may be used for construction or to clean surfaces for painting.

(v) All city operations shall adhere to the water use restrictions.

(vi) Hand watering for landscape irrigation purposes is allowed on a daily basis regardless of the time of year.

(vii) New plant material may be irrigated on a more frequent basis until the new plant material is established as defined in section 22.03.133(a)(4) related to the operation of irrigation systems.

(viii) The city manager, or his/her designee, will request wholesale water customers to initiate mandatory measures to reduce nonessential water use (i.e., implement stage 2 of the customer's drought contingency plan).

(3) Stage 3 - severe water shortage conditions.

(A) Target. Reduce water use to less than 70% of the city's maximum daily supply capacity.

(B) Best management practices for supply management.

(i) The city will reduce or discontinue the flushing of water mains as well as utilize reclaimed water for non-potable purposes where practicable.

(ii) Wholesale customers are required in specific contract provisions to implement these measures as well as any other measures specified in the wholesale supply contract to better manage a limited water supply. Contract provisions requiring wholesale customers to implement mandatory drought restrictions consistent with the city will be added into any new contract or contract revision.

(C) Water use restrictions for reducing demand.

(i) Irrigation shall occur without significant water runoff, which can be accomplished by correctly cycling the sprinkler system and allowing time for the water to soak into the landscape between irrigation events.

(ii) Landscape irrigation shall not occur more than one day per month and not for more than 1.5 inches per zone. The city manager, or his/her designee, may designate the irrigation schedule.

(iii) Water customers will refrain from aesthetic and non-essential water use as defined in section 22.08.003. Water shall not be used to wash down hard surfaced areas, including, without limitation, sidewalks, parking lots, gutters, and patios. Water shall not be used for dust control. Pools and hot tubs may not be filled or drained and refilled.

(iv) Use of water from fire hydrants shall be limited to firefighting or other related activities necessary to maintain public health, safety, and welfare. Under the direction of the city manager, use of water from fire hydrants for construction purposes may be allowed by permit.

(v) All city operations shall adhere to the water use restrictions.

(vi) Hand watering for landscape irrigation purposes is allowed on a daily basis regardless of the time of year.

(viii) The city manager, or his/her designee, will contact wholesale water customers to discuss water supply and/or demand conditions and will request that wholesale water customers initiate additional mandatory measures to reduce non-essential water use (i.e., implement stage 3 of the customer's drought contingency plan).

(4) Stage 4 - emergency water shortage conditions.

(A) Target. Reduce water use to less than 50% of the city's maximum daily supply capacity.

(B) Best management practices for supply management.

(i) The city will discontinue the flushing of water mains, discontinue the irrigation of public landscaped areas, and will utilize reclaimed water for non-potable purposes where practicable.

(ii) In addition, in the event of a large-scale system failure or if the source water supply is contaminated, the city may truck in additional fresh water supplies as appropriate.

(iii) Wholesale customers are required in specific contract provisions to implement these measures as well as any other measures specified in the wholesale supply contract to better manage a limited water supply. Contract provisions requiring wholesale customers to implement mandatory drought restrictions consistent with the city will be added into any new contract or contract revision.

(C) Water use restrictions for reducing demand.

(i) All aesthetic and non-essential water use, as defined in section 22.08.003, including landscape irrigation use, is prohibited except where necessary to protect the health, safety, and welfare of the public. No new landscape material may be installed.

(ii) All city operations will adhere to the water use restrictions.

(iii) The city may reduce water system pressure to conserve water.

(iv) All wholesale water customers will be encouraged to implement stage 4 of their drought contingency plans.

(D) In addition, whenever emergency water shortage conditions exist as defined in section 22.08.078 of the plan, the city manager, or his/her designee(s), shall:

(i) Assess the severity of the problem and identify the actions needed and the time required to solve the problem;

(ii) Inform the utility director or other responsible official of each wholesale water customer by telephone, email, or in person and suggest actions, as appropriate to alleviate problems (i.e., notification of the public to reduce water use until service is restored);

(iii) If appropriate, notify city, county, and/or state emergency response officials for assistance;

(iv) Undertake necessary actions, including repairs and/or clean-up as needed; and

(v) Prepare a post-event assessment report on the incident and critique of emergency response procedures and actions.

(Ordinance 2010-O0055 adopted 7/22/2010; Ordinance 2012-O0022, secs. 1–2, adopted 3/29/2012; Ordinance 2014-O0167, secs. 5–9, adopted 12/18/2014)

Sec. 22.08.080 Coordination with the Canadian River Municipal Water Authority

The city is a wholesale water customer of the Canadian River Municipal Water Authority (CRMWA), and as such must coordinate any drought responses with CRMWA. The city will periodically consult with CRMWA concerning supplies available to the city and at the request of CRMWA enact additional drought conservation measures if so directed by CRMWA.
(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.081 Revisions to the drought and emergency contingency plan

The city shall review and update, as appropriate, the drought and emergency contingency plan at least every five (5) years based, in part, on new or updated information, such as the adoption or revision of the regional water plan. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.082 Pro rata water allocation

In the event that the triggering criteria specified in section 22.08.078 of the plan for stage 4 - emergency water shortage conditions have been met, the city manager, or his/her designee, is hereby authorized to initiate allocation of water supplies on a pro rata basis in accordance with Texas Water Code section 11.039. A provision shall be included in every wholesale water contract entered into or renewed after adoption of the plan, including contract extensions, that in case of a shortage of water resulting from drought, the water to be distributed shall be divided in accordance with Texas Water Code section 11.039. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.083 Enforcement

(a) Any water customer or other user of the city's water supply who violates the drought and emergency contingency plan shall be guilty of a misdemeanor and subject to a penalty and fine as set forth in section 1.01.004 of this code for each day of noncompliance. In addition, in the event: (1) the failure to comply with this article creates an imminent threat to public health, safety, or welfare; or (2) the subject person is convicted of three or more distinct violations (as opposed to consecutive multiple day events of the same violation) within a one-year period, the city, after ten-day's notice and opportunity to cure the violation, may discontinue water service until such time as the user shall be in compliance with this article and, in the case of disconnection due to an imminent health, safety, or welfare threat, pay the required charges and fees for reconnection or, in the case of disconnection due to three or more distinct violations within a one-year period, pay the required charges and fees for reconnections and provide suitable assurance to the city manager that the same action will not be repeated while the subject stage of the drought and emergency contingency plan is in effect.

(b) Any person in apparent control of the property where a violation occurs or originates shall be presumed to be the violator and proof thereof shall constitute a rebuttable presumption that the person in apparent control of such property committed the violation.

(Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.084 Variances

(a) The city water board of appeals, as established in article 2.03, division 11 of this code, may grant, in writing, a temporary variance for existing water uses otherwise prohibited under the drought and emergency contingency plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the public or the person requesting such variance and if one or more of the following conditions are met:

(1) Compliance with this plan cannot be technically accomplished during the duration of this water supply shortage or other condition for which the plan is in effect.

(2) Alternative methods can be implemented which will achieve the same level of reduction in water use.

(b) Persons requesting an exemption from the provisions of this plan shall file a petition for variance with the water board of appeals. All petitions for variances shall be reviewed by the water board of appeals and shall include, in addition to the information provided in article 2.03, division 11 of this code, the following:

(1) Name and address of the petitioner;

(2) Purpose of water use;

(3) Specific provision(s) of this plan from which the petitioner is requesting relief;

(4) Detailed statement with supporting data and information as to how the specific provision(s) of this plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if petitioner complies with this article;

(5) Description of the relief requested;

(6) Period of time for which the variance is sought;

(7) Alternative measures the petitioner is taking or proposes to take to meet the intent of this plan and the compliance date; and

(8) Other pertinent information.

(c) Variances granted by the water board of appeals shall be subject to the following conditions, unless waived or modified by the water board of appeals.

(1) Variances granted shall include a timetable for compliance.

(2) Variances granted shall expire on the earlier to occur of:

(A) The scheduled expiration;

(B) When the drought and emergency contingency plan is no longer in effect; and

(C) The date upon which the petitioner has failed to meet specified requirements.

(d) No variance shall be retroactive or otherwise justify any violation of this plan occurring prior to the issuance of the variance.

(Ordinance 2010-O0055 adopted 7/22/2010)

Secs. 22.08.085–22.08.100 Reserved

Division 4. Irrigation Water Conservation Plan

Sec. 22.08.101 General

The city owns Water Right No. 3985 in order to land apply sewage effluent from the city's wastewater treatment plant. The permit allows the city to use up to 18,430 acre-feet per year to irrigate 10,000 acres of land. The TCEQ requires a holder of an irrigation right greater than 10,000 acre-feet/year to develop an irrigation water conservation plan. This system is designed for inefficiency in order to ensure that the greatest volume of wastewater possible can be disposed of through this method. Consequently, a water conservation plan is not applicable in this circumstance. (Ordinance 2010-O0055 adopted 7/22/2010)

Sec. 22.08.102 Land application site

The city currently has two land application sites. The Lubbock Land Application Site, located east of the city, encompasses 6,000 acres with 2,500 acres irrigated by center pivot systems. The Hancock Land Application Site, located southeast of the city, encompasses 4,000 acres with 2,500 acres irrigated by center pivot systems. Effluent from the Southeast Water Reclamation Plant is used to irrigate crops such as wheat, jose wheat, bermuda, and rye. A 412 million gallon storage reservoir allows the site to store and distribute treated effluent to 31 center pivot sprinkler systems as needed. Irrigation practices are designed to prevent contamination of surface and groundwater in the area. (Ordinance 2010-O0055 adopted 7/22/2010)

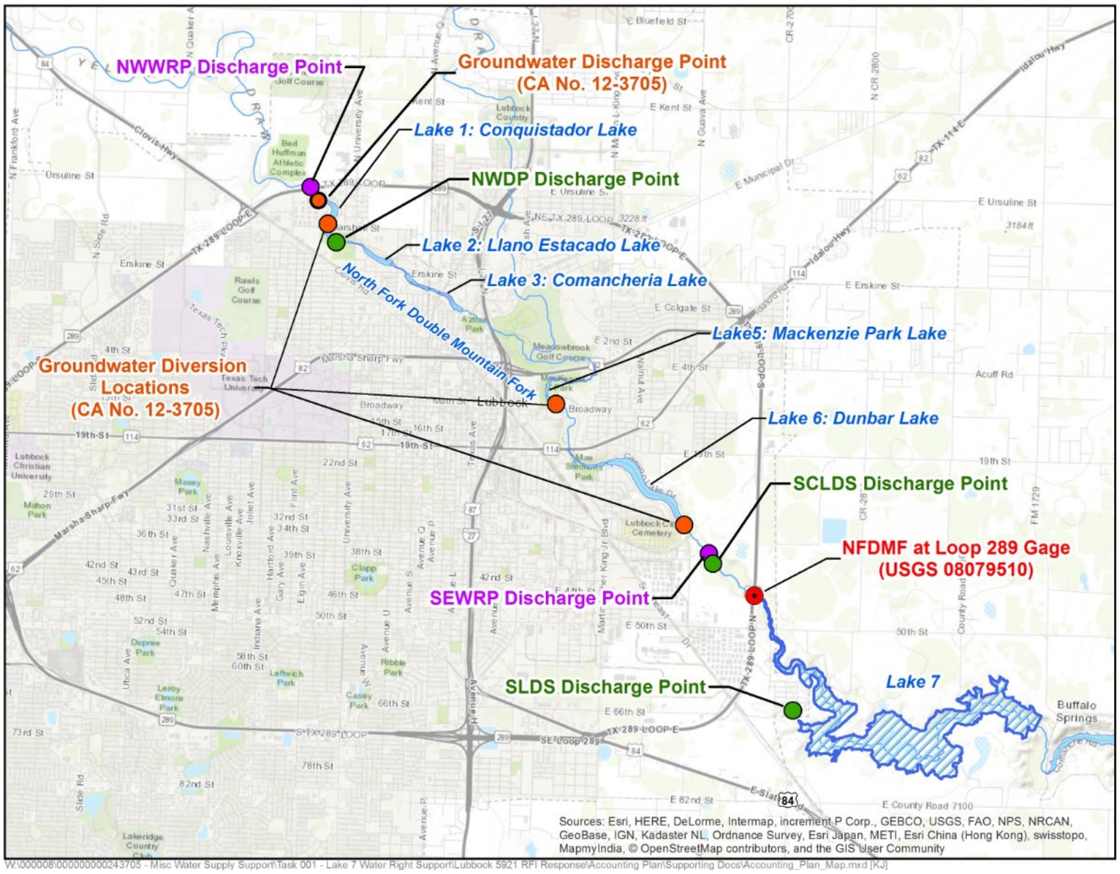
Sec. 22.08.103 Goals

The city's current and future goals for this system are to be able to dispose of the total wastewater volume necessary through this system and to not implement any water conserving devices or practices for this system. The city monitors the delivery system for any leaks by visually inspecting the system on a regular basis, and all leaks are repaired in a timely manner. (Ordinance 2010-O0055 adopted 7/22/2010)

City of Lubbock
Accounting Plan for Permit No. 12-5921
Lake 7

Background

The City of Lubbock (the "City") has developed an accounting plan to track impoundment of water in the City's proposed Jim Bertram Lake 7 ("Lake 7") on the North Fork of the Double Mountain Fork of the Brazos River (the "North Fork"). The purpose of this accounting plan is to differentiate State Water from other sources of water available to the City for impoundment in Lake 7. Other sources of water include developed playa lake water, City return flows, and groundwater discharged by the City into the North Fork. Use of return flows has been authorized by the Texas Commission on Environmental Quality ("TCEQ") under Permit No. 12-3985 and Certification of Adjudication ("CA") No. 12-4146. Use of groundwater discharged into the North Fork has been authorized under CA No. 12-3705. Figure 1 provides the discharge and diversion locations of City water on the North Fork. This document outlines the principles used to develop the accounting plan.



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

W:\000008\000000000243705 - Misc Water Supply Support\Task 001 - Lake 7 Water Right Support\Lubbock 5921 RFI Response\Accounting Plan\Supporting Docs\Accounting_Plan_Map.mxd [KJ]

Figure 1. ~~Dishcharge~~Discharge and Diversion Locations of City Water on the North Fork

Definitions for use in this Accounting Plan

State Water – water naturally flowing in the North Fork and its tributaries that is subject to appropriation and use by downstream senior and superior water rights.

City Water – water discharged into the North Fork by the City that is not subject to appropriation and use by downstream senior and superior water rights. This water would not enter the North Fork but for the actions of the City and is considered to be "developed water." City Water includes discharges of playa lake water from the City's South Lubbock Drainage System ("SLDS"), South-Central Lubbock Drainage System ("SCLDS"), and Northwest Drainage Project ("NWDP"); wastewater effluent derived from groundwater sources owned by the City; groundwater discharged into the North Fork by the City; and wastewater effluent derived from groundwater and surface water sources purchased from the Canadian River Municipal Water Authority ("CRMWA"). For purposes of this accounting plan, return flows originating from Lake Alan Henry ("LAH") are considered City Water because those return flows originate from water previously stored in LAH and would not have contributed to downstream flows.

Permit No. 12-5921 – water right permit authorizing the impoundment of water in, and diversion from, the proposed Lake 7 on the North Fork.

CA No. 12-3705 (as amended) – ~~water right permit~~certificate of adjudication authorizing diversion from the perimeters of Lakes 1, 2 and 6 of the Jim Bertram Lake System ("JBLS") for irrigation purposes. A special condition in the permit stipulates that the City will supplement the water diverted with groundwater to replace any diverted water. The City currently discharges groundwater pumped from beneath the Lubbock Land Application Site ("LLAS") into the North Fork upstream of Lake 1. A special condition in the permit stipulates that these diversions "will not be subject to call by senior and superior water rights holders."

Permit No. 12-3985 (as amended) – water use permit authorizing the diversion of return flows from the North Fork.

CA No. 12-4146 – water right authorizing impoundment of water in and diversion from the existing LAH located on the South Fork of the Double Mountain Fork of the Brazos River. CA 12-4146 also authorizes reuse of effluent originating from LAH.

210 Authorization - Authorization from the TCEQ to directly reuse treated effluent under Title 30 Texas Administrative Code Chapter 210 Use of Reclaimed Water.

Accounting Plan Framework

The accounting plan will be based on direct measurement of City Water discharged to the LLAS, the Hancock Land Application Site ("HLAS") and the North Fork, diversions by the City and flows in the North Fork consisting of combined City Water and State Water. All unmeasured inflows into the North Fork will be considered State Water for purposes of this accounting plan. Inflows of return flows or reclaimed water by entities other than the City will be considered State Water unless the City enters into a contract to reuse the water and obtains permission to reuse such flows from the TCEQ, in which event these return flows will be accounted for as City Water.

Streamflows in, and City Water discharged to, the North Fork shall be measured by the City using continuous recording devices. For this accounting plan, flows will be measured or computed at the following locations:

- All existing and future wastewater effluent outfalls from which the City has a right to reuse effluent;
- Outfalls of the SLDS, SCLDS and NWDP;
- The outfall from the discharge of groundwater, upstream of Lake 1;
- A point on the North Fork at Loop 289 (USGS Gage 08079510);
- Intervening State Water between the Loop 289 USGS gage and Lake 7, estimated using contributing drainage area ratio; and
- Outflows from Lake 7, which will be based on established rating curves of the reservoir's outlet works.

Inflows to Lake 7 are accounted for by their source and ~~fall into~~are assigned to one of the following five categories:

- Developed stormwater inflow originating from the SLDS, SCLDS and NWDP;
- Return flows originating from ~~LAH supplies~~in-basin State water sources including LAH and Lake 7;
- Discharges of groundwater that are not diverted under Permit No. 12-3705;
- Return flows originating from non-~~LAH~~State water ~~supplies~~ sources and out of basin State water sources including groundwater~~ supplies~~, Canadian River Basin surface water~~ supplies~~, and reuse ~~supplies~~ from Lake 7; and
- State Water.

Carriage loss factors used to calculate the City Water and State Water inflows to Lake 7 are extrapolated from the TCEQ Brazos WAM and are used in lieu of the carriage loss factors included in Permit No. 12-3985. The WAM carriage losses are more conservative compared to those included in Permit No. 12-3985 and allow for consistency in calculating carriage losses to Lake 7 for all City water discharged into the North Fork authorized under the City's various permits. The extrapolation calculations are provided in the "Instructions" tab of the accounting plan spreadsheet. The relatively short reach does not require application of lag times.

Inflows of State Water to Lake 7 are computed as State Water flows passing the USGS gage at Loop 289 less carriage losses, plus intervening flows computed using a drainage area ratio applied to the Lake 7 dam location. Inflows of City Water into Lake 7 will be determined based on the measured discharges of City Water, less losses and diversions of City Water by the City.

The City will pass inflows of State Water through Lake 7:

1. When Possum Kingdom Lake is below elevation 1,000 feet mean sea level and inflows of State Water exceed 5 cfs, per agreement between the City and the Brazos River Authority;
2. To meet subsistence and base flow standards translated from the Aspermont Gage by contributing drainage area ratio to the Lake 7 dam site. This translation is computed as the base or subsistence flow standard x (Lake 7 contributing drainage area)/(Aspermont gage contributing drainage area) = standard x 243.13/1,891.25 = Standard x 0.1286; and
3. To meet seasonal pulse standards translated from the Aspermont Gage. Pulse flows will be translated as follows:
    a. The trigger flows will be scaled using the ratio of the mean annual WAM naturalized flows for the two locations.
    b. The durations will be scaled using the $(R)^e$, where R is the naturalized flow ratio calculated above. The exponent e is a duration exponent obtained from a power law relationship between pulse volumes and trigger flows, and is equal to 0.105[1]. The scaled duration will be rounded to an integer number of days.
    c. The pulse volumes will be related such that the pulse ratio, QD/V, where Q is the pulse flow trigger level, D is the duration in days, and V is the pulse volume, is the same at the two locations.

Once State and City water inflows are impounded in Lake 7, they are considered to be stored water owned by the City. Therefore, diversions from Lake 7 are not classified as diversions of State or City water in the accounting plan, but only as diversions of stored water as authorized under Permit 12-5921. However, a portion of the water stored in

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[1] http://www.crwr.utexas.edu/reports/2013/rpt13-2.shtml

Lake 7 can be attributed to inflows of state (surface) water. For purposes of determining how much effluent is derived from state water, a running total of formerly state water stored in Lake 7 is maintained. This running total is used to proportion diversions and return flows from Lake 7 to track how much water originating as state water might be effluent potentially reused directly under a 210 authorization.

The City has developed and will maintain an Excel spreadsheet recording on a daily basis the above information.

Accounting Plan Spreadsheet

Organization of Spreadsheet

The Accounting Plan spreadsheet contains ~~fifteen~~five separate tabs to organize input data, calculations and monthly summaries. The following are descriptions of each tab.

- **Instructions** – This tab provides supplemental instructions to those found in this document and provides the location for the user to input the accounting year. This tab also provides the constants used in calculation for drainage area ratios and carriage losses.
- **Summary Table** - This tab provides a summary of monthly diversions from Lake 7 under Permit No. 12-5921.
- ~~**JAN-DEC** – These monthly tabs contain~~**Lake 7 Accounting** – This tab contains the daily user input and resulting calculations.
- **EFR** – This tab contains the TCEQ environmental flow regime (EFR) for the State Water inflows into Lake 7.
- **Elevation-Volume** – This tab contains the preliminary elevation-volume relationships from the 2011 Lake 7 Feasibility Report. These relationships will be updated with as-built relationships after Lake 7 is constructed.

Instructions for Use of Spreadsheet

INSTRUCTIONS TAB

Cell I13: Accounting Year – This cell is the location for the user to input the accounting year. It is imperative that the user input a value because all logic pertaining to dates and leap years depends upon this value.

Cell I14: Inflow Release Balance from Previous Year – This cell is used to carry forward the balance of the required inflow releases from the previous year, if any exists. Only zero or negative numbers should be entered.

Cell I15: State Water Inflows Stored in Lake 7 from Previous Year – This cell is used to carry forward the amount of State water inflows stored in Lake 7 from the previous year, if any exists. Only zero or positive numbers should be entered.

SUMMARY TABLE TAB

Column B: Month – The month of the year.

Column C: Lake 7 Diversions (acft) – This column summarizes the total water diverted from Lake 7 storage under Permit No. 12-5921.

~~JAN-DEC TABS~~

~~Column headings are identical for all of the monthly tabs. Columns B-P~~**LAKE 7 ACCOUNTING TAB**

Columns C-U require user input when cells are highlighted tan.

Column A: Date (mm/dd/yyyy) – This column will automatically be populated with the date once the user enters the accounting year in the Instructions Tab.

Column B: Month (no units) – The numerical month of the year.

Column C: Lake Alan Henry Supply (MGD) – The daily raw water supplies sourced from LAH.

Column ~~C: Non-Lake Alan Henry~~D: Canadian River Basin Surface Water Supply (MGD) – The daily raw water supplies from CRMWA surface water supply sources (Lake Meredith) in the Canadian River Basin.

Column E: Lake 7 Supply (MGD) – The daily raw water supplies diverted from Lake 7.

Column F: Lubbock Groundwater Supply (MGD) – The daily raw water supplies sourced from ~~groundwater, Canadian River Basin, and reuse. This supply does not include groundwater by the City~~Lubbock-owned well fields.

~~Column D:~~ Column G: CRMWA Groundwater Supply (MGD) – The daily raw water supplies sourced from CRMWA well fields.

Column H: LLAS Groundwater Discharge (MGD) – The amount of groundwater pumped from beneath the LLAS and discharged to the North Fork by the City.

Column ~~E:~~I: LLAS Groundwater Diverted (MGD) – The amount of ~~water~~groundwater pumped from beneath the LLAS and discharged into the North Fork that is diverted from Lakes 1, 2 and 6 of JBLS under Permit No. 12-3705.

Column ~~F:~~J: Effluent Directly Used or Land -Applied ~~and/or Directly Reused Effluent~~ within Texas (MGD) – The amount of treated effluent applied to the LLAS and/or HLAS and directly reused within Texas.

~~Column G~~Column K: Effluent Directly Reused Out of State under 210 Authorization (MGD) – The amount of treated effluent directly used under the 210 Authorization. Only treated effluent originating from groundwater sources can be used under this authorization.

Column L: SCLDS Outfall (MGD) – The daily developed stormwater discharged from the SCLDS at Outfall 30 and recorded from the gage operated by the City.

Column ~~H~~M: SLDS Outfall (MGD) – The daily developed stormwater discharged from the SLDS at Outfall 31 and recorded from the gage operated by the City.

Column ~~I~~N: NWDP Outfall (MGD) – The daily developed stormwater discharged at the Northwest Drainage Project outfall and recorded from the gage operated by the City.

Column ~~J~~O: NWWRP Return Flow (MGD) – The recorded daily discharge from the City's Northwest Water Reclamation Plant into the North Fork.

Column ~~K~~P: SEWRP Return Flow (MGD) – The recorded daily discharge from the City's Southeast Water Reclamation Plant into the North Fork.

Column ~~L~~Q: USGS Recorded Streamflow at Loop 289 (cfs) – The daily mean streamflow recorded at the North Fork Double Mountain Fork Brazos River at Loop 289 near Lubbock Texas (USGS Gage No. 08079510).

Column ~~M: Lake 7 Diversion (MGD)~~ ~~– The daily volume diverted from Lake 7.~~

~~Column N~~R: Lake 7 Outflow (cfs) – The daily flow released through the Lake 7 outlet works.

Column S: Lake 7 WSEL (cfs) – The daily water surface elevation of Lake 7 as recorded by a gage to be installed after construction.

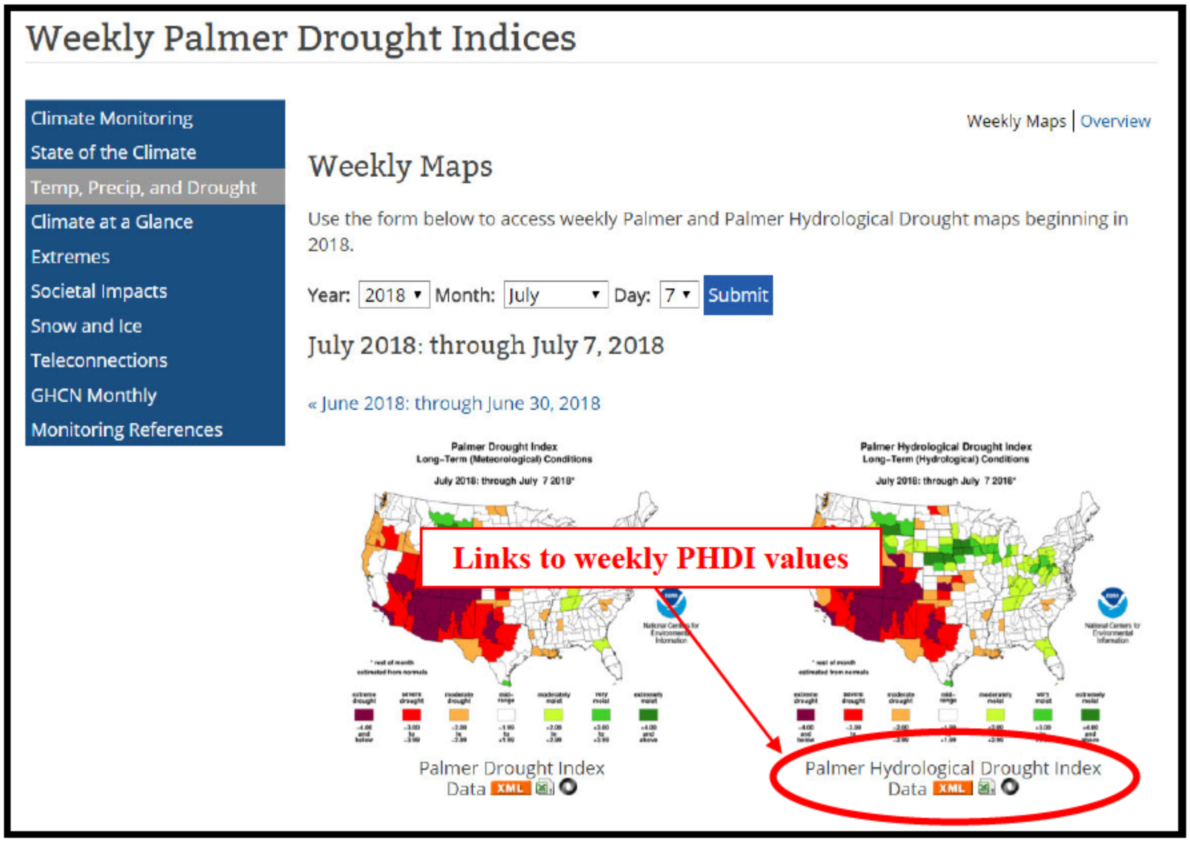
Column ~~O~~T: Possum Kingdom Reservoir WSEL (ft-msl) – The daily water surface elevation of Possum Kingdom Reservoir as recorded by USGS Gage 08088500 at midnight of the preceding day.

Column ~~P~~U: PHDI (High Plains Zone) (no units) – The Palmer Hydrological Drought Index (PHDI), which monitors long-term drought conditions. PHDI values range from +7 to -7. The TCEQ has determined that the PHDI values should be updated on the last day of the month before the start of a new season. Preliminary PHDI values are published by the National Climatic Data Center (NCDC) on a weekly basis. Column P must be updated with the weekly PHDI value published during the week in which the last day of the month before the start of a new season occurs.

Conditional formatting (tan shading) has been applied to Column P to denote the days on which the PHDI needs to be updated (~~tan shading).~~February 28th or February 29th if a leap year, June 30th and October 31st. If a cell is shaded gray, then the PHDI does not need to be updated for that day. For December 31st of the previous accounting year~~ (Tab: JAN, Cell P4),~~, the PHDI value from October 31st of the previous accounting year must be entered to designate the current drought conditions for the winter season beginning on November 1st of the previous year and ending on the last day of February in the current accounting year.

PHDI background information and links to weekly values can found on the following NCDC webpage. Lake 7 is located in the Texas High Plains Zone and has a lookup value of 4101 in the text files. If the NCDC changes the current webpage address, the City will update the following link and provide an updated version of this document to TCEQ.

http://ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers.php



Weekly Palmer Drought Indices

Weekly Maps

Use the form below to access weekly Palmer and Palmer Hydrological Drought maps beginning in 2018.

Year: 2018 Month: July Day: 7

July 2018: through July 7, 2018

« June 2018: through June 30, 2018

Links to weekly PHDI values

Column ~~Q~~V: Total Effluent (MGD) –The total effluent is the sum of the NWWRP and SEWRP return flow ~~and~~discharged into the North Fork, the land-applied effluent, the effluent directly reused within Texas, and the effluent directly reused outside of Texas.

~~**Column R: Return Flow Factor (no units)** – The daily return flow factor as calculated by the current day combined effluent from the NWWRP and SEWRP divided by the total raw water supply entering the City's water treatment facilities from the previous day. This raw water supply does not include groundwater pumped from beneath the LLAS and discharged into the North Fork.~~

~~**Column S: Total LAH-Sourced Effluent (MGD)** – The effluent originating from LAH raw water supplies. The LAH sourced effluent is calculated by multiplying the previous day LAH supply by the return flow factor.~~

Column W: Total Source Water Consumed (MGD) – The total amount of supply (Columns C-G) from the previous day that is consumed and is not returned to the NWWRP or SEWRP for treatment.

Column X: In-Basin State Water Sourced Effluent Produced (MGD) – The amount of effluent sourced from LAH and Lake 7 that originated from State water inflows that is not consumed. The in-basin State water sourced supplies are prioritized to be consumed before all other supplies originating from other sources. If the total amount of source water consumed is greater than the in-basin State water sourced supply amount from the previous day, then no in-basin State water sourced treated effluent is produced.

Column ~~T: LAH~~Y: In-Basin State Water Sourced Effluent Land Applied and/or Directly Reused (MGD) – The amount of effluent sourced from LAH ~~supplies~~ and Lake 7 that originated from State water inflows that is not consumed and is applied to the LLAS and/or HLAS~~. The LAH-sourced~~ or directly reused within Texas. This treated effluent is prioritized to be land applied before ~~non-LAH supplies. If the amount of LAH-sourced treated~~all other effluent ~~is less than the amount of treated effluent land applied, then no LAH sourced treated effluent is discharged into the North Fork~~originating from other sources.

Column ~~U: LAH-~~Y: In-Basin State Water Sourced Effluent Discharged (MGD) – The amount of effluent sourced from LAH ~~supplies~~and Lake 7 that originated from State water inflows discharged into the North Fork. If ~~the LAH sourced treated~~this effluent produced is greater than the amount of treated effluent directly reused within Texas and land applied, the remaining treated effluent is discharged from the SEWRP and NWWRP into the North Fork. If the amount of this treated effluent produced is less than the amount of treated effluent directly reused within Texas and land applied, then no effluent sourced from LAH and Lake 7 that originated from State water inflows is discharged into the North Fork.

Column ~~V: Non-LAH~~AA: Canadian River Basin Surface Water Sourced Effluent Produced (MGD) – The amount of effluent originating from Canadian River Basin surface water sources that is not consumed. The Canadian River Basin surface water supplies are prioritized to be consumed after in-basin State water sources. If the total amount of supply consumed is greater than the in-basin State water supply amount and Canadian River Basin surface water supply amount from the previous day, then no effluent originating from Canadian River Basin surface water sources is produced.

Column AB: Canadian River Basin Surface Water Sourced Effluent Land Applied and Directly Reused (MGD) – The amount of effluent originating from Canadian River Basin surface water supplies applied to the LLAS and/or HLAS and directly reused within Texas. The Canadian River Basin surface water sourced treated effluent is prioritized to be land applied and directly reused within Texas after the in-basin State water sourced treated effluent.

Column AC: Canadian River Basin Surface Water Sourced Effluent Discharged (MGD) – The amount of effluent originating from Canadian River Basin surface water supplies remaining after land application and direct reuse within Texas that is discharged into the North Fork.

Column AD: Lake 7 Non-State Water Sourced Effluent Produced (MGD) – The effluent sourced from Lake 7 that originated from non-~~LAH~~State water inflows. The Lake 7 supplies originating from non-State water inflows are prioritized to be consumed after in-basin State water supplies and Canadian River Basin surface water supplies.

Column AE: Lake 7 Non-State Water Sourced Effluent Land Applied and/or Directly Reused (MGD) – The amount of effluent sourced from Lake 7 that originated from non-State water inflows applied to the LLAS and/or HLAS and directly reused by entities located within Texas. This effluent is prioritized to be land applied and directly reused within Texas after the in-basin State water sourced effluent and Canadian River Basin surface water sourced effluent.

Column AF: Lake 7 Sourced Effluent Discharged (MGD) – The amount of effluent sourced from Lake 7 that originated from non-State water inflows remaining after land application and direct reuse within Texas that is discharged into the North Fork.

Column AG: Total Groundwater Sourced Effluent Produced (MGD) – The amount of effluent originating from groundwater supplies that is not consumed. The groundwater supplies are prioritized to be consumed last.

Column AH: Groundwater Sourced Effluent Land Applied and/or Directly Reused (MGD) – The amount of effluent originating from groundwater sources applied to the LLAS and/or HLAS and directly reused by entities located within Texas and outside of Texas under the 210 Authorization. The groundwater sourced treated effluent is prioritized to be land applied and directly reused last.

Column AI: Groundwater Sourced Effluent Discharged (MGD) – The amount of effluent sourced from groundwater supplies remaining after land application and direct reuse that is discharged into the North Fork.

Column AJ: Non-Groundwater Sourced Effluent Directly Reused Out of State (should be zero) (MGD) – The amount of effluent from non-groundwater sources that is directly reused out of state. This is the portion of column K that does not originate from groundwater. This column should always be zero, as only groundwater sourced effluent may be transported out of state. This column is included as a verification that only groundwater-based effluent is being transported out of state.

Column AK: Effluent Discharged not Subject to Priority Call (MGD) – The amount of effluent from non-Brazos Basin water sources discharged into the North Fork. These supply sources include groundwater, Canadian River Basin supplies, and ~~reuse~~Lake 7 supplies originating from non-State water inflows, but does not include groundwater pumped from beneath the LLAS.

Column ~~W~~AL: Groundwater Remaining in North Fork (MGD) – The amount of groundwater discharged into the North Fork that passes the Lake 6 dam after carriage losses and diversions authorized under CA 12-3705. The accounting plan conservatively assumes all diversions made under CA 12-3705 occur at the furthest downstream authorized diversion point (Lake 6 dam), thus maximizing the carriage loss estimate of the groundwater and minimizing the amount of groundwater considered available for diversion.

Column ~~X:~~Am: Inflow of Developed Stormwater~~ Inflow~~ (cfs) – This column calculates the developed stormwater that enters Lake 7 and accounts for the carriage losses that occur in the reach from the NWDP, SCLDS and SLDS stormwater outfalls to Lake 7.

Column ~~Y: LAH~~AN: Inflow of In-Basin State Water Sourced Return Flow ~~Inflow~~ (cfs) – This column calculates the return flow originating from ~~LAH~~in-basin State water supplies that is discharged at the NWWRP and SEWRP outfalls and enters Lake 7 after carriage losses. Discharge of the ~~LAH sourced~~in-basin State water return flow is proportionally split between the SEWRP and NWWRP based on total amount of return flow discharged that day from each water reclamation plant.

Column ~~Z: Non-LAH Sourced~~ AO: Inflow from Return Flow Inflow not Subject to Priority Call (cfs) – This column calculates the return flow originating from non-~~LAH~~State water supplies that is discharged at the NWWRP and SEWRP outfalls and enters Lake 7 after carriage losses. Discharge of the non-LAH sourced return flow is proportionally split between the SEWRP and NWWRP based on total amount of return flow discharged that day from each water reclamation plant. These flows are not subject to priority calls.

Column ~~AA:~~AP: Discharged Groundwater Inflow (cfs) – This column calculates the groundwater discharged by the City that enters Lake 7 and accounts for the carriage losses that occur in the reach between Lake 6 and Lake 7.

Column ~~AB~~AQ: State Water Inflow (cfs) – This column calculates the natural inflow originating in the North Fork and its tributaries subject to appropriation and use by downstream senior and superior water rights and is subject to environmental flow criteria.

The natural inflow is calculated by first removing the developed stormwater, groundwater, and return flow components from the recorded flow at the USGS Loop 289 gage to calculate the natural flow passing the gage site. The natural flow passing the gage site is then adjusted for differences in drainage area with Lake 7 to account for the additional natural inflow originating downstream of the gage and upstream of the Lake 7 dam.

If the entered data cause the calculated natural inflow to be zero or negative when flows are measured at the USGS gage at Loop 289, the value is set to zero and conditional formatting is used to indicate to the user that the values entered for that day require inspection.

~~Column AC~~Column AR: Lake 7 Total Storage (acft) – This column calculates the total storage of Lake 7 using the recorded Lake 7 water surface elevation and the elevation-volume relationships from the 2011 Lake 7 Feasibility Report.

Column AS: Lake 7 Net Evaporation (acft) – This column calculates the net evaporation volume using a reservoir mass balance equation.

Column AT: Lake 7 Stored State Water (acft) – The amount of State water inflows stored in Lake 7, as calculated using a reservoir mass balance equation. Net evaporation is allocated to the State water pool of Lake 7 based on the ratio of the volume of the pool to the total storage of the reservoir from the previous day. Likewise, diversions from Lake 7 are allocated to the State water pool of Lake 7 based on the ratio of the volume of the pool to the total storage of the reservoir from the previous day. All releases from Lake 7 are assumed to be from the State water portion.

Column AU: Lake 7 Stored Non-State Water (acft) – The amount of non-State water inflows stored in Lake 7. The amount of non-State water inflows stored in Lake 7 is the difference in the total storage of Lake 7 and the amount of State water inflows stored in Lake 7.

Column AV: Hydrologic Condition (no units) – This column calculates the hydrologic condition used to identify dry, average, or wet conditions in the environmental flow regime and is based on the PHDI value entered by the user in Column P. Dry conditions are defined as a PHDI value less than -1.78, average conditions between -1.78 and +2.18, and wet conditions greater than +2.18.

Column ~~AD~~AW: Required Subsistence/Base Flow Release (cfs) – This column calculates the required release of state water inflows that must be made to satisfy the subsistence and base flow environmental flow targets.

Column ~~AE~~AX: Pulse Trigger (cfs) – This column retrieves the seasonal high flow pulse trigger rate as established for each season.

Column ~~AF~~AY: Pulse Volume (acft) – This column retrieves the seasonal high flow pulse volume target necessary to end a pulse event.

Column ~~AG~~AZ: Pulse Duration (days) – This column retrieves the seasonal high flow duration target necessary to end a pulse event.

Column ~~AH~~BA: Pulse Frequency (per season) – This column retrieves the seasonal frequency target of high flow pulse events.

Column ~~AI~~BB: Pulse Trigger Met ~~(~~[yes~~/~~ (1)/no~~)~~ (0)] – This column designates whether the pulse flow trigger target is met by state water inflow into Lake 7. For the pulse trigger to be met, state water inflow must be increasing from the previous day (indicating the beginning of a pulse) and be greater than or equal to the seasonal pulse trigger set in Column AE.

Column ~~AJ~~BC: Days Since Last Pulse Start (days) – This column keeps track of the number of days since the start of the last required pulse event. A subsequent required pulse event cannot start until after the seasonal high flow duration target has lapsed (Column AG).

Column ~~AK~~BD: Pulse Event ~~(~~[yes~~/~~ (1)/no~~)~~ (0)] – This column indicates whether a required pulse event is occurring. A required pulse event will occur if the pulse trigger is met in Column AE, the target pulse frequency (Column AH) has not been met for the season, and sufficient days have passed since the start of the last required pulse event. The pulse event will continue until the target duration or volume has been met.

Column ~~AL~~BE: Seasonal Pulse Counter (no units) – This column counts the number of required high flow pulse events that have occurred in a season. The counter is reset to zero at the beginning of each season.

Column ~~AM~~BF: Pulse Duration Counter (days) – This column counts the number of days a given required pulse event has been occurring.

Column ~~AN~~BG: Cumulative Pulse Volume (acft) – This column calculates the cumulative pulse volume.

Column ~~AO~~BH: Turn Off Pulse ~~(~~[yes~~/~~ (1)/no~~)~~ (0)] – This determines whether a required pulse event has reached the target volume or duration and will return a value of 1 to signify the pulse event has ended.

Column ~~AP~~BI: Required Pulse Flow Release (cfs) – This column calculates the required release of state water to satisfy the high flow pulse component of the environmental flow criteria.

Column ~~AQ~~BJ: Required Inflow Release (cfs) – This column calculates the total required release of state water inflows. If the Possum Kingdom Reservoir water surface elevation is below 1,000 ft-msl, then all state water inflows are to be released if the state water inflow is greater than 5 cfs, per agreement with the Brazos River Authority. If the Possum Kingdom Reservoir water surface elevation is equal to or greater than 1,000 ft-msl, then the required state water inflow release is the maximum of the required base or subsistence release (Column AD) and the required pulse flow release (Column AP).

Column ~~AR~~BK: Balance of Required Inflow Release (acft) – This column calculates the balance of environmental flow release deficits from the current and previous days. Deficit values are carried over from one day to the next until they are satisfied with additional releases greater than the minimum required environmental flow release. Cells in Column AR are conditionally formatted to show deficits with red shading. When no deficits are occurring, the cells are shaded green.

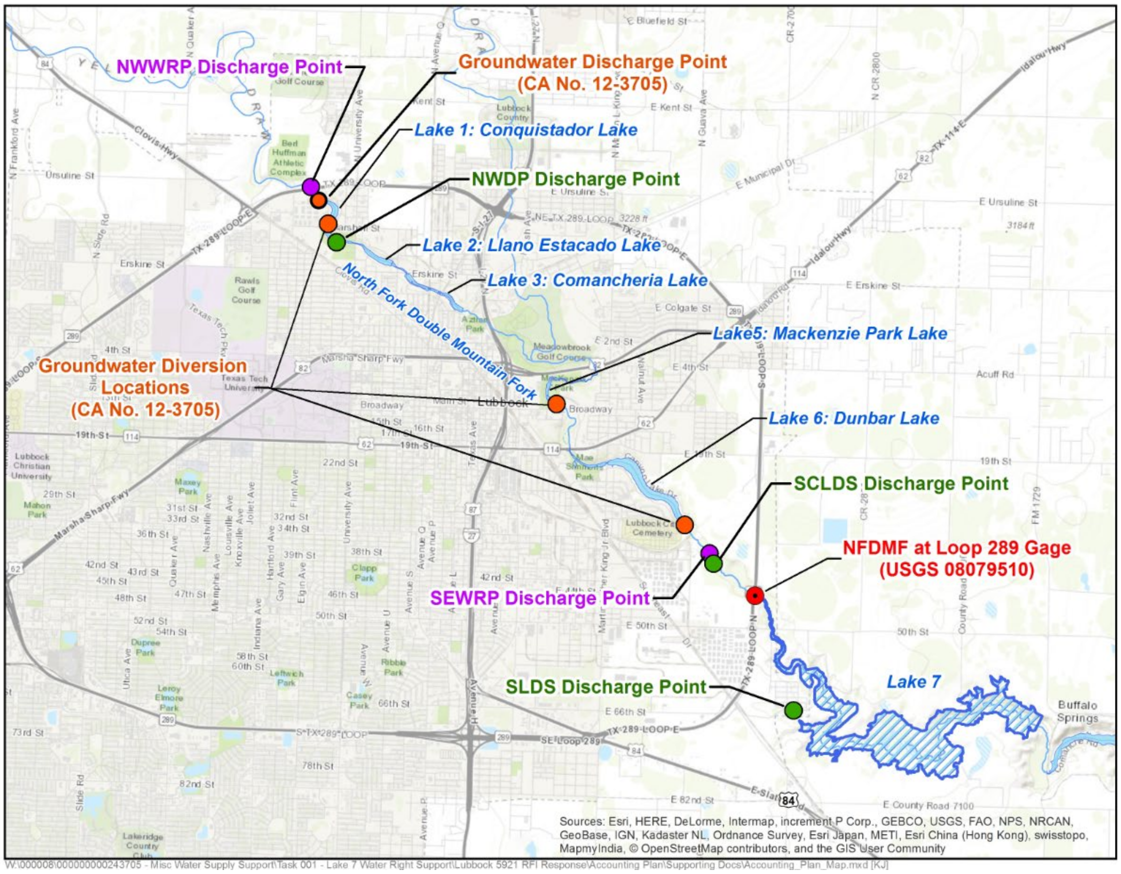
EFR TAB

The EFR tab provides the Lake 7 environmental flow regime (EFR) ~~targets~~ as translated and rounded to the nearest integer from the environmental flow standards located at the Double Mountain Fork near Aspermont Gage (USGS 0808055). The EFR contains three seasons; Winter (Nov-Feb), Spring (Mar-Jun) and Summer (Jul-Oct), and three hydrologic conditions; Dry, Average and Wet. Note that the winter season does not contain a high flow pulse requirement; therefore, these cells are highlighted gray along with the columns containing the pulse requirement calculations (Columns AE-AP) in the JAN, FEB, NOV and DEC tabs.

City of Lubbock
Accounting Plan for Permit No. 12-5921
Lake 7

Background

The City of Lubbock (the "City") has developed an accounting plan to track impoundment of water in the City's proposed Jim Bertram Lake 7 ("Lake 7") on the North Fork of the Double Mountain Fork of the Brazos River (the "North Fork"). The purpose of this accounting plan is to differentiate State Water from other sources of water available to the City for impoundment in Lake 7. Other sources of water include developed playa lake water, City return flows, and groundwater discharged by the City into the North Fork. Use of return flows has been authorized by the Texas Commission on Environmental Quality ("TCEQ") under Permit No. 12-3985 and Certification of Adjudication ("CA") No. 12-4146. Use of groundwater discharged into the North Fork has been authorized under CA No. 12-3705. Figure 1 provides the discharge and diversion locations of City water on the North Fork. This document outlines the principles used to develop the accounting plan.



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

W:\000008\000000000243705 - Misc Water Supply Support\Task 001 - Lake 7 Water Right Support\Lubbock 5921 RFI Response\Accounting Plan\Supporting Docs\Accounting_Plan_Map.mxd [KJ]

Figure 1. Discharge and Diversion Locations of City Water on the North Fork

Definitions for use in this Accounting Plan

State Water – water naturally flowing in the North Fork and its tributaries that is subject to appropriation and use by downstream senior and superior water rights.

City Water – water discharged into the North Fork by the City that is not subject to appropriation and use by downstream senior and superior water rights. This water would not enter the North Fork but for the actions of the City and is considered to be "developed water." City Water includes discharges of playa lake water from the City's South Lubbock Drainage System ("SLDS"), South-Central Lubbock Drainage System ("SCLDS"), and Northwest Drainage Project ("NWDP"); wastewater effluent derived from groundwater sources owned by the City; groundwater discharged into the North Fork by the City; and wastewater effluent derived from groundwater and surface water sources purchased from the Canadian River Municipal Water Authority ("CRMWA"). For purposes of this accounting plan, return flows originating from Lake Alan Henry ("LAH") are considered City Water because those return flows originate from water previously stored in LAH and would not have contributed to downstream flows.

Permit No. 12-5921 – water right permit authorizing the impoundment of water in, and diversion from, the proposed Lake 7 on the North Fork.

CA No. 12-3705 (as amended) – certificate of adjudication authorizing diversion from the perimeters of Lakes 1, 2 and 6 of the Jim Bertram Lake System ("JBLS") for irrigation purposes. A special condition in the permit stipulates that the City will supplement the water diverted with groundwater to replace any diverted water. The City currently discharges groundwater pumped from beneath the Lubbock Land Application Site ("LLAS") into the North Fork upstream of Lake 1. A special condition in the permit stipulates that these diversions "will not be subject to call by senior and superior water rights holders."

Permit No. 12-3985 (as amended) – water use permit authorizing the diversion of return flows from the North Fork.

CA No. 12-4146 – water right authorizing impoundment of water in and diversion from the existing LAH located on the South Fork of the Double Mountain Fork of the Brazos River. CA 12-4146 also authorizes reuse of effluent originating from LAH.

210 Authorization - Authorization from the TCEQ to directly reuse treated effluent under Title 30 Texas Administrative Code Chapter 210 Use of Reclaimed Water.

Accounting Plan Framework

The accounting plan will be based on direct measurement of City Water discharged to the LLAS, the Hancock Land Application Site ("HLAS") and the North Fork, diversions by the City and flows in the North Fork consisting of combined City Water and State Water.

All unmeasured inflows into the North Fork will be considered State Water for purposes of this accounting plan. Inflows of return flows or reclaimed water by entities other than the City will be considered State Water unless the City enters into a contract to reuse the water and obtains permission to reuse such flows from the TCEQ, in which event these return flows will be accounted for as City Water.

Streamflows in, and City Water discharged to, the North Fork shall be measured by the City using continuous recording devices. For this accounting plan, flows will be measured or computed at the following locations:

- All existing and future wastewater effluent outfalls from which the City has a right to reuse effluent;
- Outfalls of the SLDS, SCLDS and NWDP;
- The outfall from the discharge of groundwater, upstream of Lake 1;
- A point on the North Fork at Loop 289 (USGS Gage 08079510);
- Intervening State Water between the Loop 289 USGS gage and Lake 7, estimated using contributing drainage area ratio; and
- Outflows from Lake 7, which will be based on established rating curves of the reservoir's outlet works.

Inflows to Lake 7 are accounted for by their source and are assigned to one of the following five categories:

- Developed stormwater inflow originating from the SLDS, SCLDS and NWDP;
- Return flows originating from in-basin State water sources including LAH and Lake 7;
- Discharges of groundwater that are not diverted under Permit No. 12-3705;
- Return flows originating from non-State water sources and out of basin State water sources including groundwater, Canadian River Basin surface water, and reuse from Lake 7; and
- State Water.

Carriage loss factors used to calculate the City Water and State Water inflows to Lake 7 are extrapolated from the TCEQ Brazos WAM and are used in lieu of the carriage loss factors included in Permit No. 12-3985. The WAM carriage losses are more conservative compared to those included in Permit No. 12-3985 and allow for consistency in calculating carriage losses to Lake 7 for all City water discharged into the North Fork authorized under the City's various permits. The extrapolation calculations are provided in the "Instructions" tab of the accounting plan spreadsheet. The relatively short reach does not require application of lag times.

Inflows of State Water to Lake 7 are computed as State Water flows passing the USGS gage at Loop 289 less carriage losses, plus intervening flows computed using a drainage area ratio applied to the Lake 7 dam location. Inflows of City Water into Lake 7 will be determined based on the measured discharges of City Water, less losses and diversions of City Water by the City.

The City will pass inflows of State Water through Lake 7:

1. When Possum Kingdom Lake is below elevation 1,000 feet mean sea level and inflows of State Water exceed 5 cfs, per agreement between the City and the Brazos River Authority;
2. To meet subsistence and base flow standards translated from the Aspermont Gage by contributing drainage area ratio to the Lake 7 dam site. This translation is computed as the base or subsistence flow standard x (Lake 7 contributing drainage area)/(Aspermont gage contributing drainage area) = standard x 243.13/1,891.25 = Standard x 0.1286; and
3. To meet seasonal pulse standards translated from the Aspermont Gage. Pulse flows will be translated as follows:
    a. The trigger flows will be scaled using the ratio of the mean annual WAM naturalized flows for the two locations.
    b. The durations will be scaled using the $(R)^e$, where R is the naturalized flow ratio calculated above. The exponent e is a duration exponent obtained from a power law relationship between pulse volumes and trigger flows, and is equal to 0.105[1]. The scaled duration will be rounded to an integer number of days.
    c. The pulse volumes will be related such that the pulse ratio, QD/V, where Q is the pulse flow trigger level, D is the duration in days, and V is the pulse volume, is the same at the two locations.

Once State and City water inflows are impounded in Lake 7, they are considered to be stored water owned by the City. Therefore, diversions from Lake 7 are not classified as diversions of State or City water in the accounting plan, but only as diversions of stored water as authorized under Permit 12-5921. However, a portion of the water stored in Lake 7 can be attributed to inflows of state (surface) water. For purposes of determining how much effluent is derived from state water, a running total of formerly state water stored in Lake 7 is maintained. This running total is used to proportion diversions and return flows from Lake 7 to track how much water originating as state water might be effluent potentially reused directly under a 210 authorization.

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[1] http://www.crwr.utexas.edu/reports/2013/rpt13-2.shtml

The City has developed and will maintain an Excel spreadsheet recording on a daily basis the above information.

Accounting Plan Spreadsheet

Organization of Spreadsheet

The Accounting Plan spreadsheet contains five separate tabs to organize input data, calculations and monthly summaries. The following are descriptions of each tab.

- **Instructions** – This tab provides supplemental instructions to those found in this document and provides the location for the user to input the accounting year. This tab also provides the constants used in calculation for drainage area ratios and carriage losses.
- **Summary Table** - This tab provides a summary of monthly diversions from Lake 7 under Permit No. 12-5921.
- **Lake 7 Accounting** – This tab contains the daily user input and resulting calculations.
- **EFR** – This tab contains the TCEQ environmental flow regime (EFR) for the State Water inflows into Lake 7.
- **Elevation-Volume** – This tab contains the preliminary elevation-volume relationships from the 2011 Lake 7 Feasibility Report. These relationships will be updated with as-built relationships after Lake 7 is constructed.

Instructions for Use of Spreadsheet

INSTRUCTIONS TAB

Cell I13: Accounting Year – This cell is the location for the user to input the accounting year. It is imperative that the user input a value because all logic pertaining to dates and leap years depends upon this value.

Cell I14: Inflow Release Balance from Previous Year – This cell is used to carry forward the balance of the required inflow releases from the previous year, if any exists. Only zero or negative numbers should be entered.

Cell I15: State Water Inflows Stored in Lake 7 from Previous Year – This cell is used to carry forward the amount of State water inflows stored in Lake 7 from the previous year, if any exists. Only zero or positive numbers should be entered.

SUMMARY TABLE TAB

Column B: Month – The month of the year.

Column C: Lake 7 Diversions (acft) – This column summarizes the total water diverted from Lake 7 storage under Permit No. 12-5921.

LAKE 7 ACCOUNTING TAB

Columns C-U require user input when cells are highlighted tan.

Column A: Date (mm/dd/yyyy) – This column will automatically be populated with the date once the user enters the accounting year in the Instructions Tab.

Column B: Month (no units) – The numerical month of the year.

Column C: Lake Alan Henry Supply (MGD) – The daily raw water supplies sourced from LAH.

Column D: Canadian River Basin Surface Water Supply (MGD) – The daily raw water supplies from CRMWA surface water supply sources (Lake Meredith) in the Canadian River Basin.

Column E: Lake 7 Supply (MGD) – The daily raw water supplies diverted from Lake 7.

Column F: Lubbock Groundwater Supply (MGD) – The daily raw water supplies sourced from Lubbock-owned well fields.

Column G: CRMWA Groundwater Supply (MGD) – The daily raw water supplies sourced from CRMWA well fields.

Column H: LLAS Groundwater Discharge (MGD) – The amount of groundwater pumped from beneath the LLAS and discharged to the North Fork by the City.

Column I: LLAS Groundwater Diverted (MGD) – The amount of groundwater pumped from beneath the LLAS and discharged into the North Fork that is diverted from Lakes 1, 2 and 6 of JBLS under Permit No. 12-3705.

Column J: Effluent Directly Used or Land Applied within Texas (MGD) – The amount of treated effluent applied to the LLAS and/or HLAS and directly reused within Texas.

Column K: Effluent Directly Reused Out of State under 210 Authorization (MGD) – The amount of treated effluent directly used under the 210 Authorization. Only treated effluent originating from groundwater sources can be used under this authorization.

Column L: SCLDS Outfall (MGD) – The daily developed stormwater discharged from the SCLDS at Outfall 30 and recorded from the gage operated by the City.

Column M: SLDS Outfall (MGD) – The daily developed stormwater discharged from the SLDS at Outfall 31 and recorded from the gage operated by the City.

Column N: NWDP Outfall (MGD) – The daily developed stormwater discharged at the Northwest Drainage Project outfall and recorded from the gage operated by the City.

Column O: NWWRP Return Flow (MGD) – The recorded daily discharge from the City's Northwest Water Reclamation Plant into the North Fork.

Column P: SEWRP Return Flow (MGD) – The recorded daily discharge from the City's Southeast Water Reclamation Plant into the North Fork.

Column Q: USGS Recorded Streamflow at Loop 289 (cfs) – The daily mean streamflow recorded at the North Fork Double Mountain Fork Brazos River at Loop 289 near Lubbock Texas (USGS Gage No. 08079510).

Column R: Lake 7 Outflow (cfs) – The daily flow released through the Lake 7 outlet works.

Column S: Lake 7 WSEL (cfs) – The daily water surface elevation of Lake 7 as recorded by a gage to be installed after construction.

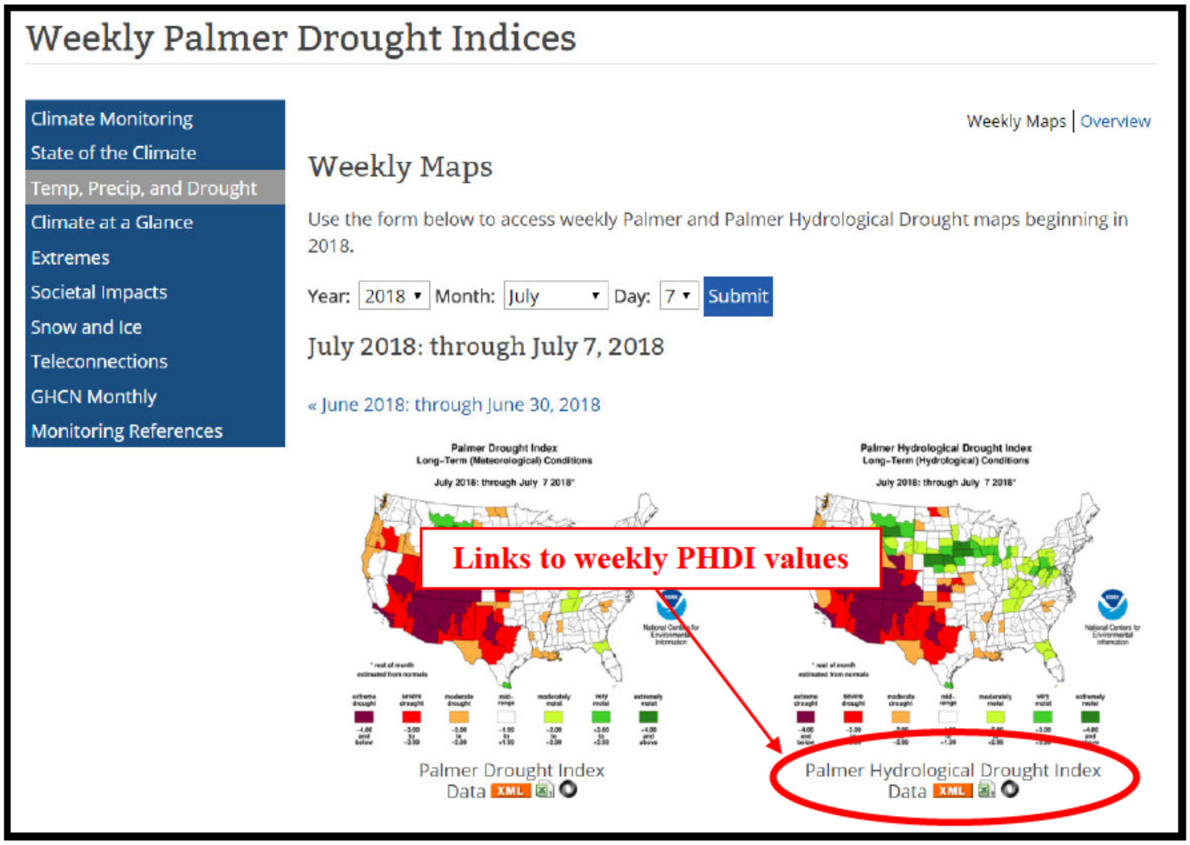
Column T: Possum Kingdom Reservoir WSEL (ft-msl) – The daily water surface elevation of Possum Kingdom Reservoir as recorded by USGS Gage 08088500 at midnight of the preceding day.

Column U: PHDI (High Plains Zone) (no units) – The Palmer Hydrological Drought Index (PHDI), which monitors long-term drought conditions. PHDI values range from +7 to -7. The TCEQ has determined that the PHDI values should be updated on the last day of the month before the start of a new season. Preliminary PHDI values are published by the National Climatic Data Center (NCDC) on a weekly basis. Column P must be updated with the weekly PHDI value published during the week in which the last day of the month before the start of a new season occurs.

Conditional formatting (tan shading) has been applied to Column P to denote the days on which the PHDI needs to be updated (February 28th or February 29th if a leap year, June 30th and October 31st. If a cell is shaded gray, then the PHDI does not need to be updated for that day. For December 31st of the previous accounting year, the PHDI value from October 31st of the previous accounting year must be entered to designate the current drought conditions for the winter season beginning on November 1st of the previous year and ending on the last day of February in the current accounting year.

PHDI background information and links to weekly values can found on the following NCDC webpage. Lake 7 is located in the Texas High Plains Zone and has a lookup value of 4101 in the text files. If the NCDC changes the current webpage address, the City will update the following link and provide an updated version of this document to TCEQ.

http://ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers.php



Weekly Palmer Drought Indices

Weekly Maps

Use the form below to access weekly Palmer and Palmer Hydrological Drought maps beginning in 2018.

Year: 2018 Month: July Day: 7

July 2018: through July 7, 2018

Links to weekly PHDI values

Column V: Total Effluent (MGD) –The total effluent is the sum of the NWWRP and SEWRP return flow discharged into the North Fork, the land-applied effluent, the effluent directly reused within Texas, and the effluent directly reused outside of Texas.

Column W: Total Source Water Consumed (MGD) – The total amount of supply (Columns C-G) from the previous day that is consumed and is not returned to the NWWRP or SEWRP for treatment.

Column X: In-Basin State Water Sourced Effluent Produced (MGD) – The amount of effluent sourced from LAH and Lake 7 that originated from State water inflows that is not consumed. The in-basin State water sourced supplies are prioritized to be consumed before all other supplies originating from other sources. If the total amount of source water consumed is greater than the in-basin State water sourced supply amount from the previous day, then no in-basin State water sourced treated effluent is produced.

Column Y: In-Basin State Water Sourced Effluent Land Applied and/or Directly Reused (MGD) – The amount of effluent sourced from LAH and Lake 7 that originated from State water inflows that is not consumed and is applied to the LLAS and/or HLAS or directly reused within Texas. This treated effluent is prioritized to be land applied before all other effluent originating from other sources.

Column Y: In-Basin State Water Sourced Effluent Discharged (MGD) – The amount of effluent sourced from LAH and Lake 7 that originated from State water inflows discharged into the North Fork. If this effluent produced is greater than the amount of treated effluent directly reused within Texas and land applied, the remaining treated effluent is discharged from the SEWRP and NWWRP into the North Fork. If the amount of this treated effluent produced is less than the amount of treated effluent directly reused within Texas and land applied, then no effluent sourced from LAH and Lake 7 that originated from State water inflows is discharged into the North Fork.

Column AA: Canadian River Basin Surface Water Sourced Effluent Produced (MGD) – The amount of effluent originating from Canadian River Basin surface water sources that is not consumed. The Canadian River Basin surface water supplies are prioritized to be consumed after in-basin State water sources. If the total amount of supply consumed is greater than the in-basin State water supply amount and Canadian River Basin surface water supply amount from the previous day, then no effluent originating from Canadian River Basin surface water sources is produced.

Column AB: Canadian River Basin Surface Water Sourced Effluent Land Applied and Directly Reused (MGD) – The amount of effluent originating from Canadian River Basin surface water supplies applied to the LLAS and/or HLAS and directly reused within Texas. The Canadian River Basin surface water sourced treated effluent is prioritized to be land applied and directly reused within Texas after the in-basin State water sourced treated effluent.

Column AC: Canadian River Basin Surface Water Sourced Effluent Discharged (MGD) – The amount of effluent originating from Canadian River Basin surface water supplies remaining after land application and direct reuse within Texas that is discharged into the North Fork.

Column AD: Lake 7 Non-State Water Sourced Effluent Produced (MGD) – The effluent sourced from Lake 7 that originated from non-State water inflows. The Lake 7 supplies originating from non-State water inflows are prioritized to be consumed after in-basin State water supplies and Canadian River Basin surface water supplies.

Column AE: Lake 7 Non-State Water Sourced Effluent Land Applied and/or Directly Reused (MGD) – The amount of effluent sourced from Lake 7 that originated from non-State water inflows applied to the LLAS and/or HLAS and directly reused by entities located within Texas. This effluent is prioritized to be land applied and directly reused within Texas after the in-basin State water sourced effluent and Canadian River Basin surface water sourced effluent.

Column AF: Lake 7 Sourced Effluent Discharged (MGD) – The amount of effluent sourced from Lake 7 that originated from non-State water inflows remaining after land application and direct reuse within Texas that is discharged into the North Fork.

Column AG: Total Groundwater Sourced Effluent Produced (MGD) – The amount of effluent originating from groundwater supplies that is not consumed. The groundwater supplies are prioritized to be consumed last.

Column AH: Groundwater Sourced Effluent Land Applied and/or Directly Reused (MGD) – The amount of effluent originating from groundwater sources applied to the LLAS and/or HLAS and directly reused by entities located within Texas and outside of Texas under the 210 Authorization. The groundwater sourced treated effluent is prioritized to be land applied and directly reused last.

Column AI: Groundwater Sourced Effluent Discharged (MGD) – The amount of effluent sourced from groundwater supplies remaining after land application and direct reuse that is discharged into the North Fork.

Column AJ: Non-Groundwater Sourced Effluent Directly Reused Out of State (should be zero) (MGD) – The amount of effluent from non-groundwater sources that is directly reused out of state. This is the portion of column K that does not originate from groundwater. This column should always be zero, as only groundwater sourced effluent may be transported out of state. This column is included as a verification that only groundwater-based effluent is being transported out of state.

Column AK: Effluent Discharged not Subject to Priority Call (MGD) – The amount of effluent from non-Brazos Basin water sources discharged into the North Fork. These supply sources include groundwater, Canadian River Basin supplies, and Lake 7 supplies originating from non-State water inflows, but does not include groundwater pumped from beneath the LLAS.

Column AL: Groundwater Remaining in North Fork (MGD) – The amount of groundwater discharged into the North Fork that passes the Lake 6 dam after carriage losses and diversions authorized under CA 12-3705. The accounting plan conservatively assumes all diversions made under CA 12-3705 occur at the furthest downstream authorized diversion point (Lake 6 dam), thus maximizing the carriage loss estimate of the groundwater and minimizing the amount of groundwater considered available for diversion.

Column Am: Inflow of Developed Stormwater (cfs) – This column calculates the developed stormwater that enters Lake 7 and accounts for the carriage losses that occur in the reach from the NWDP, SCLDS and SLDS stormwater outfalls to Lake 7.

Column AN: Inflow of In-Basin State Water Sourced Return Flow (cfs) – This column calculates the return flow originating from in-basin State water supplies that is discharged at the NWWRP and SEWRP outfalls and enters Lake 7 after carriage losses. Discharge of the in-basin State water return flow is proportionally split between the SEWRP and NWWRP based on total amount of return flow discharged that day from each water reclamation plant.

Column AO: Inflow from Return Flow Inflow not Subject to Priority Call (cfs) – This column calculates the return flow originating from non-State water supplies that is discharged at the NWWRP and SEWRP outfalls and enters Lake 7 after carriage losses. Discharge of the non-LAH sourced return flow is proportionally split between the SEWRP and NWWRP based on total amount of return flow discharged that day from each water reclamation plant. These flows are not subject to priority calls.

Column AP: Discharged Groundwater Inflow (cfs) – This column calculates the groundwater discharged by the City that enters Lake 7 and accounts for the carriage losses that occur in the reach between Lake 6 and Lake 7.

Column AQ: State Water Inflow (cfs) – This column calculates the natural inflow originating in the North Fork and its tributaries subject to appropriation and use by downstream senior and superior water rights and is subject to environmental flow criteria.

The natural inflow is calculated by first removing the developed stormwater, groundwater, and return flow components from the recorded flow at the USGS Loop 289 gage to calculate the natural flow passing the gage site. The natural flow passing the gage site is then adjusted for differences in drainage area with Lake 7 to account for the additional natural inflow originating downstream of the gage and upstream of the Lake 7 dam.

If the entered data cause the calculated natural inflow to be zero or negative when flows are measured at the USGS gage at Loop 289, the value is set to zero and conditional formatting is used to indicate to the user that the values entered for that day require inspection.

Column AR: Lake 7 Total Storage (acft) – This column calculates the total storage of Lake 7 using the recorded Lake 7 water surface elevation and the elevation-volume relationships from the 2011 Lake 7 Feasibility Report.

Column AS: Lake 7 Net Evaporation (acft) – This column calculates the net evaporation volume using a reservoir mass balance equation.

Column AT: Lake 7 Stored State Water (acft) – The amount of State water inflows stored in Lake 7, as calculated using a reservoir mass balance equation. Net evaporation is allocated to the State water pool of Lake 7 based on the ratio of the volume of the pool to the total storage of the reservoir from the previous day. Likewise, diversions from Lake 7 are allocated to the State water pool of Lake 7 based on the ratio of the volume of the pool to the total storage of the reservoir from the previous day. All releases from Lake 7 are assumed to be from the State water portion.

Column AU: Lake 7 Stored Non-State Water (acft) – The amount of non-State water inflows stored in Lake 7. The amount of non-State water inflows stored in Lake 7 is the difference in the total storage of Lake 7 and the amount of State water inflows stored in Lake 7.

Column AV: Hydrologic Condition (no units) – This column calculates the hydrologic condition used to identify dry, average, or wet conditions in the environmental flow regime and is based on the PHDI value entered by the user in Column P. Dry conditions are defined as a PHDI value less than -1.78, average conditions between -1.78 and +2.18, and wet conditions greater than +2.18.

Column AW: Required Subsistence/Base Flow Release (cfs) – This column calculates the required release of state water inflows that must be made to satisfy the subsistence and base flow environmental flow targets.

Column AX: Pulse Trigger (cfs) – This column retrieves the seasonal high flow pulse trigger rate as established for each season.

Column AY: Pulse Volume (acft) – This column retrieves the seasonal high flow pulse volume target necessary to end a pulse event.

Column AZ: Pulse Duration (days) – This column retrieves the seasonal high flow duration target necessary to end a pulse event.

Column BA: Pulse Frequency (per season) – This column retrieves the seasonal frequency target of high flow pulse events.

Column BB: Pulse Trigger Met [yes (1)/no (0)] – This column designates whether the pulse flow trigger target is met by state water inflow into Lake 7. For the pulse trigger to be met, state water inflow must be increasing from the previous day (indicating the beginning of a pulse) and be greater than or equal to the seasonal pulse trigger set in Column AE.

Column BC: Days Since Last Pulse Start (days) – This column keeps track of the number of days since the start of the last required pulse event. A subsequent required pulse event cannot start until after the seasonal high flow duration target has lapsed (Column AG).

Column BD: Pulse Event [yes (1)/no (0)] – This column indicates whether a required pulse event is occurring. A required pulse event will occur if the pulse trigger is met in Column AE, the target pulse frequency (Column AH) has not been met for the season, and sufficient days have passed since the start of the last required pulse event. The pulse event will continue until the target duration or volume has been met.

Column BE: Seasonal Pulse Counter (no units) – This column counts the number of required high flow pulse events that have occurred in a season. The counter is reset to zero at the beginning of each season.

Column BF: Pulse Duration Counter (days) – This column counts the number of days a given required pulse event has been occurring.

Column BG: Cumulative Pulse Volume (acft) – This column calculates the cumulative pulse volume.

Column BH: Turn Off Pulse [yes (1)/no (0)] – This determines whether a required pulse event has reached the target volume or duration and will return a value of 1 to signify the pulse event has ended.

Column BI: Required Pulse Flow Release (cfs) – This column calculates the required release of state water to satisfy the high flow pulse component of the environmental flow criteria.

Column BJ: Required Inflow Release (cfs) – This column calculates the total required release of state water inflows. If the Possum Kingdom Reservoir water surface elevation is below 1,000 ft-msl, then all state water inflows are to be released if the state water inflow is greater than 5 cfs, per agreement with the Brazos River Authority. If the Possum Kingdom Reservoir water surface elevation is equal to or greater than 1,000 ft-msl, then the required state water inflow release is the maximum of the required base or subsistence release (Column AD) and the required pulse flow release (Column AP).

Column BK: Balance of Required Inflow Release (acft) – This column calculates the balance of environmental flow release deficits from the current and previous days. Deficit values are carried over from one day to the next until they are satisfied with additional releases greater than the minimum required environmental flow release. Cells in Column AR are conditionally formatted to show deficits with red shading. When no deficits are occurring, the cells are shaded green.

EFR TAB

The EFR tab provides the Lake 7 environmental flow regime (EFR) as translated and rounded to the nearest integer from the environmental flow standards located at the Double Mountain Fork near Aspermont Gage (USGS 0808055). The EFR contains three seasons; Winter (Nov-Feb), Spring (Mar-Jun) and Summer (Jul-Oct), and three hydrologic conditions; Dry, Average and Wet. Note that the winter season does not contain a high flow pulse requirement; therefore, these cells are highlighted gray along with the columns containing the pulse requirement calculations (Columns AE-AP) in the JAN, FEB, NOV and DEC tabs.

Memorandum

Date: Thursday, April 30, 2020

Project: City of Lubbock – Lake 7 Water Right Application

To: Kathy Alexander, Texas Commission on Environmental Quality

From: Zach Stein, PE
David Dunn, PE

CC: Aubrey Spear, PE – City of Lubbock, Director of Water Utilities

Subject: City of Lubbock Projected Return Flows Available for Impoundment in Lake 7

The City of Lubbock (City) has submitted an application to the Texas Commission on Environmental Quality (TCEQ) for a water right to construct a dam and reservoir (Lake 7) on the North Fork Double Mountain Fork of the Brazos River (North Fork) downstream of the City. The earliest anticipated construction of Lake 7 is estimated to be 2030. Lake 7 will impound treated effluent (return flows) discharged into the North Fork, developed playa lake stormwater, and unappropriated state water for subsequent diversion and use. This technical memorandum summarizes the projected treated effluent available for impoundment in, and diversion from, the proposed Lake 7 considering the potential sale of 6 mgd of treated effluent directly to a customer for commercial purposes. The purchasing party would be required to obtain authorization from the TCEQ to reuse the treated effluent under Title 30 Texas Administrative Code Chapter 210 Use of Reclaimed Water before using the treated effluent for any purposes. These authorizations are commonly referred to as “210 authorizations.”

The City currently treats on average about 20 million gallons per day (mgd) of combined wastewater effluent at the City’s Northwest and Southeast Water Reclamation Plants. The City projects the amount of treated effluent to increase to more than 28 mgd in 2070 in response to increased water demands. Xcel Energy (Xcel) holds a contract for the purchase of up to 9 mgd of treated wastewater effluent directly from the City. However, Xcel’s current usage of treated effluent is approximately 5 mgd and a significant increase in need for the treated effluent supply is not anticipated. The remaining treated effluent not purchased by Xcel is either land applied or discharged to the North Fork.

The City is considering the potential sale of 6 mgd of treated effluent directly to a commercial customer, with a portion potentially used outside of Texas, and needs to confirm that sufficient effluent will be available to impound in Lake 7. Table 1 provides a summary by decade of projected total treated effluent, direct reuse of treated effluent by Xcel and the commercial customer, and remaining treated effluent available for land application or for discharge to the North Fork for subsequent impoundment in Lake 7. Discharge of treated effluent into the North Fork is authorized under Texas Pollution Discharge Elimination System (TPDES) Permit Nos. WQ0010353002 and WQ0010353011. These TPDES permits authorize multiple discharge locations, including up to 14.5 mgd from the Southeast Water Reclamation

Plant at Outfall Number 007, which is immediately upstream of the proposed Lake 7, and up to 6 mgd from the Northwest Water Reclamation Plant, which discharges at a point about 15 miles upstream of the proposed Lake 7.

As shown in Table 1, the additional commercial use of 6 mgd of treated effluent will result in approximately 7.3 mgd of treated effluent remaining in 2030, the earliest date by which Lake 7 could be constructed. By 2040, the remaining effluent after direct reuse by Xcel and the potential commercial customer is anticipated to be 9.5 mgd, increasing each decade thereafter. Yield analyses for Lake 7 indicates that 8 mgd of effluent is required to maintain a one-year safe yield of 11,975 acft/yr[1]. Note that with no return flows discharged upstream of Lake 7, the one-year safe yield of Lake 7 is 4,675 acft/yr utilizing limited unappropriated flows and developed stormwater[2,3]. The safe yield varies almost linearly in proportion to the volume of effluent discharged upstream.

Based on the above information, the City will have sufficient effluent remaining after sales to Xcel and the new commercial customer to sustain a reliable safe yield in Lake 7.

Table 1. City of Lubbock Treated Effluent Projections (mgd)

Year	Total Treated Effluent[1]	Direct Reuse of Treated Effluent: Xcel Energy Contracted Amount	Direct Reuse of Treated Effluent: Potential New Contract Amount	Remaining Treated Effluent	Remaining Treated Effluent (acft/yr)
2020	20.1	9.0	6.0	5.1	5,712
2030	22.3	9.0	6.0	7.3	8,176
2040	24.5	9.0	6.0	9.5	10,640
2050	26.0	9.0	6.0	11.0	12,320
2060	27.3	9.0	6.0	12.3	13,776
2070	28.4	9.0	6.0	13.4	15,008
1 – City of Lubbock 2018 Strategic Water Supply Plan					

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[1] City of Lubbock 2018 Strategic Water Supply Plan

[2] ibid

[3] The safe yield analyses documented in the 2018 Strategic Water Supply Plan do not reflect discharges of developed stormwater from the Northwest Lubbock Drainage Project.

Memorandum

Date:	Thursday, April 30, 2020
Project:	City of Lubbock – Lake 7 Water Right Application
To:	Kathy Alexander, Texas Commission on Environmental Quality
From:	David Dunn, PE
CC:	Aubrey Spear, PE – City of Lubbock, Director of Water Utilities

Subject: **Firm Yield and Maximum Annual Diversion Available from Lake 7**

The City of Lubbock (City) has submitted Application No. 5921 to the Texas Commission on Environmental Quality (TCEQ) for a water right to construct a dam and reservoir (Lake 7) on the North Fork Double Mountain Fork of the Brazos River (North Fork) downstream of the City. Lake 7 will impound treated effluent (return flows) discharged into the North Fork, developed playa lake stormwater, and unappropriated state water for subsequent diversion and use. Discharge of treated effluent into the North Fork is authorized under Texas Pollution Discharge Elimination System (TPDES) Permit Nos. WQ0010353002 and WQ0010353011. These TPDES permits authorize multiple discharge locations, including up to 14.5 mgd from the Southeast Water Reclamation Plant at Outfall Number 007, which is immediately upstream of the proposed Lake 7, and up to 6 mgd from the Northwest Water Reclamation Plant, which discharges at a point about 15 miles upstream of the proposed Lake 7.

Previous analyses of the safe yield of Lake 7 are documented in the City's response to the Request for Information (RFI) from TCEQ dated June 14, 2016.

This technical memorandum summarizes the annual firm yield supply available from Lake 7 and the maximum annual diversion that could be made from Lake 7, assuming the maximum amounts of treated effluent authorized under the City's TPDES permits are discharged upstream of Lake 7 (14.5 mgd from the SW Water Reclamation Plant and 6 mgd from the Northwest Water Reclamation Plant).

The most recent Run 3 Brazos Basin Water Availability Model (WAM) was obtained from the TCEQ and modified by including the proposed Lake 7[1]. The modeling utilized the entire 57-year period of record of 1940 – 1997. The Lake 7 modifications incorporate the following flows available only to Lake 7[2,3].

- Discharge of developed playa lake stormwater from the South Lubbock Drainage Project;
- Discharge of developed playa lake stormwater from the South-Central Lubbock Drainage Project;

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[1] The current estimate of the Lake 7 conservation storage is 20,921 acre-feet.

[2] Discharges from the South Lubbock and South Central Lubbock Drainage Projects are included in Application No. 5921.

[3] Reuse of discharges from the Northwest Lubbock Drainage Project, the Southeast Water Reclamation Plant and the Northwest Water Reclamation Plant are included in Water Use Permit No. 3985C, a bed-and-banks authorization.

- Discharge of developed playa lake stormwater from the Northwest Lubbock Drainage Project[4];
- Discharge of 14.5 mgd (16,240 acre-feet per year [acft/yr]) of treated effluent from the Southeast Water Reclamation Plant; and
- Discharge of 6 mgd (6,725 acft/yr) of treated effluent from the Northwest Water Reclamation Plant.

The developed playa lake stormwater discharges were modeled as monthly time series of discharges, adjusted for channel losses between their individual discharge locations and Lake 7. The discharges of treated effluent were modeled as constant annual volumes, adjusted for channel losses between their discharge locations and Lake 7. The developed stormwater and treated effluent discharges were made available only to Lake 7 at its junior priority date. A limited amount of unappropriated natural streamflow is also available to Lake 7 at the assumed junior priority date, subject to downstream senior water rights and instream flow requirements existing in the Run 3 Brazos WAM.

Under the above conditions, the firm yield supply that can be developed from Lake 7 is 28,415 acft/yr.

The maximum annual diversion that could be made from Lake 7 was determined by increasing the annual diversion from Lake 7 until shortages occurred in all but one year of the simulation. This resulted in a maximum annual diversion of 59,400 acft with no diversion shortage in year 1961.

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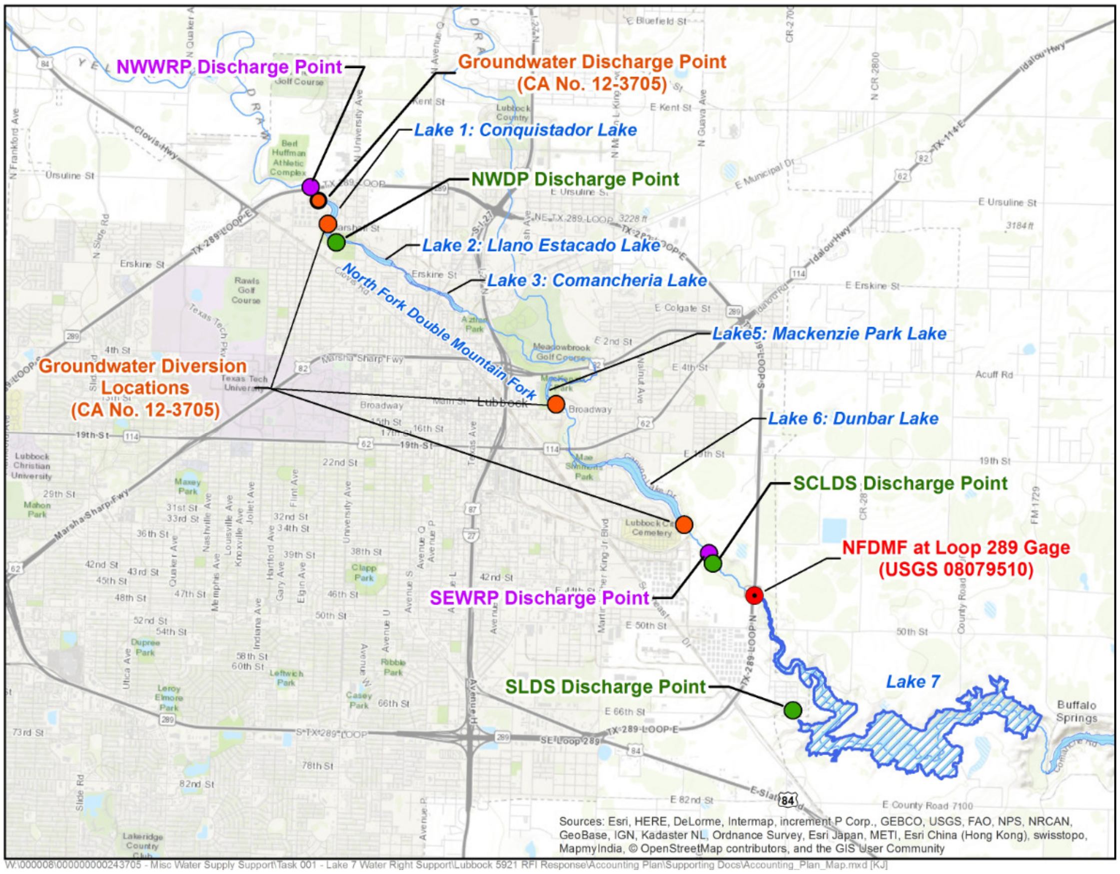
[4] Discharges of developed playa lake stormwater from the Northwest Lubbock Drainage Project were not included in the safe yield analyses documented in the RFI response.

City of Lubbock
Accounting Plan for Permit No. 12-5921
Lake 7

Background

The City of Lubbock (the "City") has developed an accounting plan to track impoundment of water in the City's proposed Jim Bertram Lake 7 ("Lake 7") on the North Fork of the Double Mountain Fork of the Brazos River (the "North Fork"). The purpose of this accounting plan is to differentiate State Water from other sources of water available to the City for impoundment in Lake 7. Other sources of water include developed playa lake water, City return flows, and groundwater discharged by the City into the North Fork. Use of return flows has been authorized by the Texas Commission on Environmental Quality ("TCEQ") under Permit No. 12-3985 and Certification of Adjudication ("CA") No. 12-4146. Use of groundwater discharged into the North Fork has been authorized under CA No. 12-3705. Figure 1 provides the discharge and diversion locations of City water on the North Fork. This document outlines the principles used to develop the accounting plan.



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

W:\000008\000000000243705 - Misc Water Supply Support\Task 001 - Lake 7 Water Right Support\Lubbock 5921 RFI Response\Accounting Plan\Supporting Docs\Accounting_Plan_Map.mxd [KJ]

Figure 1. Dishcharge and Diversion Locations of City Water on the North Fork

Definitions for use in this Accounting Plan

State Water – water naturally flowing in the North Fork and its tributaries that is subject to appropriation and use by downstream senior and superior water rights.

City Water – water discharged into the North Fork by the City that is not subject to appropriation and use by downstream senior and superior water rights. This water would not enter the North Fork but for the actions of the City and is considered to be "developed water." City Water includes discharges of playa lake water from the City's South Lubbock Drainage System ("SLDS"), South-Central Lubbock Drainage System ("SCLDS"), and Northwest Drainage Project ("NWDP"); wastewater effluent derived from groundwater sources owned by the City; groundwater discharged into the North Fork by the City; and wastewater effluent derived from groundwater and surface water sources purchased from the Canadian River Municipal Water Authority ("CRMWA"). For purposes of this accounting plan, return flows originating from Lake Alan Henry ("LAH") are considered City Water because those return flows originate from water previously stored in LAH and would not have contributed to downstream flows.

Permit No. 12-5921 – water right permit authorizing the impoundment of water in, and diversion from, the proposed Lake 7 on the North Fork.

CA No. 12-3705 (as amended) – water right permit authorizing diversion from the perimeters of Lakes 1, 2 and 6 of the Jim Bertram Lake System ("JBLS") for irrigation purposes. A special condition in the permit stipulates that the City will supplement the water diverted with groundwater to replace any diverted water. The City currently discharges groundwater pumped from beneath the Lubbock Land Application Site ("LLAS") into the North Fork upstream of Lake 1. A special condition in the permit stipulates that these diversions "will not be subject to call by senior and superior water rights holders."

Permit No. 12-3985 (as amended) – water use permit authorizing the diversion of return flows from the North Fork.

CA No. 12-4146 – water right authorizing impoundment of water in and diversion from the existing LAH located on the South Fork of the Double Mountain Fork of the Brazos River. CA 12-4146 also authorizes reuse of effluent originating from LAH.

Accounting Plan Framework

The accounting plan will be based on direct measurement of City Water discharged to the land application site and the North Fork, diversions by the City and flows in the North Fork consisting of combined City Water and State Water. All unmeasured inflows into the North Fork will be considered State Water for purposes of this accounting plan. Inflows of return flows or reclaimed water by entities other than the City will be considered State Water unless the City enters into a contract to reuse the water and obtains permission to reuse such flows from the TCEQ, in which event these return flows will be accounted for as City Water.

Streamflows in, and City Water discharged to, the North Fork shall be measured by the City using continuous recording devices. For this accounting plan, flows will be measured or computed at the following locations:

- All existing and future wastewater effluent outfalls from which the City has a right to reuse effluent;
- Outfalls of the SLDS, SCLDS and NWDP;
- The outfall from the discharge of groundwater, upstream of Lake 1;
- A point on the North Fork at Loop 289 (USGS Gage 08079510);
- Intervening State Water between the Loop 289 USGS gage and Lake 7, estimated using contributing drainage area ratio; and
- Outflows from Lake 7, which will be based on established rating curves of the reservoir's outlet works.

Inflows to Lake 7 are accounted for by their source and fall into one of the following five categories:

- Developed stormwater inflow originating from the SLDS, SCLDS and NWDP;
- Return flows originating from LAH supplies;
- Discharges of groundwater that are not diverted under Permit No. 12-3705;
- Return flows originating from non-LAH supplies including groundwater supplies, Canadian River Basin supplies, and reuse supplies from Lake 7; and
- State Water.

Carriage loss factors used to calculate the City Water and State Water inflows to Lake 7 are extrapolated from the TCEQ Brazos WAM and are used in lieu of the carriage loss factors included in Permit No. 12-3985. The WAM carriage losses are more conservative compared to those included in Permit No. 12-3985 and allow for consistency in calculating carriage losses to Lake 7 for all City water discharged into the North Fork authorized under the City's various permits. The extrapolation calculations are provided in the "Instructions" tab of the accounting plan spreadsheet. The relatively short reach does not require application of lag times.

Inflows of State Water to Lake 7 are computed as State Water flows passing the USGS gage at Loop 289 less carriage losses, plus intervening flows computed using a drainage area ratio applied to the Lake 7 dam location. Inflows of City Water into Lake 7 will be determined based on the measured discharges of City Water, less losses and diversions of City Water by the City.

The City will pass inflows of State Water through Lake 7:

1. When Possum Kingdom Lake is below elevation 1,000 feet mean sea level and inflows of State Water exceed 5 cfs, per agreement between the City and the Brazos River Authority;
2. To meet subsistence and base flow standards translated from the Aspermont Gage by contributing drainage area ratio to the Lake 7 dam site. This translation is computed as the base or subsistence flow standard x (Lake 7 contributing drainage area)/(Aspermont gage contributing drainage area) = standard x 243.13/1,891.25 = Standard x 0.1286; and
3. To meet seasonal pulse standards translated from the Aspermont Gage. Pulse flows will be translated as follows:
    a. The trigger flows will be scaled using the ratio of the mean annual WAM naturalized flows for the two locations.
    b. The durations will be scaled using the $(R)^e$, where R is the naturalized flow ratio calculated above. The exponent e is a duration exponent obtained from a power law relationship between pulse volumes and trigger flows, and is equal to 0.105[1]. The scaled duration will be rounded to an integer number of days.
    c. The pulse volumes will be related such that the pulse ratio, QD/V, where Q is the pulse flow trigger level, D is the duration in days, and V is the pulse volume, is the same at the two locations.

Once State and City water inflows are impounded in Lake 7, they are considered to be stored water owned by the City. Therefore, diversions from Lake 7 are not classified as diversions of State or City water in the accounting plan, but only as diversions of stored water as authorized under Permit 12-5921.

The City has developed and will maintain an Excel spreadsheet recording on a daily basis the above information.

Accounting Plan Spreadsheet

Organization of Spreadsheet

The Accounting Plan spreadsheet contains fifteen separate tabs to organize input data, calculations and monthly summaries. The following are descriptions of each tab.

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[1] http://www.crwr.utexas.edu/reports/2013/rpt13-2.shtml

- **Instructions** – This tab provides supplemental instructions to those found in this document and provides the location for the user to input the accounting year. This tab also provides the constants used in calculation for drainage area ratios and carriage losses.
- **Summary Table** - This tab provides a summary of monthly diversions from Lake 7 under Permit No. 12-5921.
- **JAN-DEC** – These monthly tabs contain the daily user input and resulting calculations.
- **EFR** – This tab contains the TCEQ environmental flow regime (EFR) for the State Water inflows into Lake 7.

Instructions for Use of Spreadsheet

INSTRUCTIONS TAB

Cell I13: Accounting Year – This cell is the location for the user to input the accounting year. It is imperative that the user input a value because all logic pertaining to dates and leap years depends upon this value.

Cell I14: Inflow Release Balance from Previous Year – This cell is used to carry forward the balance of the required inflow releases from the previous year, if any exists. Only zero or negative numbers should be entered.

SUMMARY TABLE TAB

Column B: Month – The month of the year.

Column C: Lake 7 Diversions (acft) – This column summarizes the total water diverted from Lake 7 storage under Permit No. 12-5921.

JAN-DEC TABS

Column headings are identical for all of the monthly tabs. Columns B-P require user input when cells are highlighted tan.

Column A: Date (mm/dd/yyyy) – This column will automatically be populated with the date once the user enters the accounting year in the Instructions Tab.

Column B: Lake Alan Henry Supply (MGD) – The daily raw water supplies sourced from LAH.

Column C: Non-Lake Alan Henry Supply (MGD) – The daily raw water supply sourced from groundwater, Canadian River Basin, and reuse. This supply does not include groundwater by the City.

Column D: Groundwater Discharge (MGD) – The amount of groundwater discharged to the North Fork by the City.

Column E: Groundwater Diverted (MGD) – The amount of water diverted from Lakes 1, 2 and 6 of JBLS under Permit No. 12-3705.

Column F: Land-Applied Effluent (MGD) – The amount of treated effluent applied to the LLAS.

Column G: SCLDS Outfall (MGD) – The daily developed stormwater discharged from the SCLDS at Outfall 30 and recorded from the gage operated by the City.

Column H: SLDS Outfall (MGD) – The daily developed stormwater discharged from the SLDS at Outfall 31 and recorded from the gage operated by the City.

Column I: NWDP Outfall (MGD) – The daily developed stormwater discharged at the Northwest Drainage Project outfall and recorded from the gage operated by the City.

Column J: NWWRP Return Flow (MGD) – The recorded daily discharge from the City's Northwest Water Reclamation Plant into the North Fork.

Column K: SEWRP Return Flow (MGD) – The recorded daily discharge from the City's Southeast Water Reclamation Plant into the North Fork.

Column L: USGS Recorded Streamflow at Loop 289 (cfs) – The daily mean streamflow recorded at the North Fork Double Mountain Fork Brazos River at Loop 289 near Lubbock Texas (USGS Gage No. 08079510).

Column M: Lake 7 Diversion (MGD) – The daily volume diverted from Lake 7.

Column N: Lake 7 Outflow (cfs) – The daily flow released through the Lake 7 outlet works.

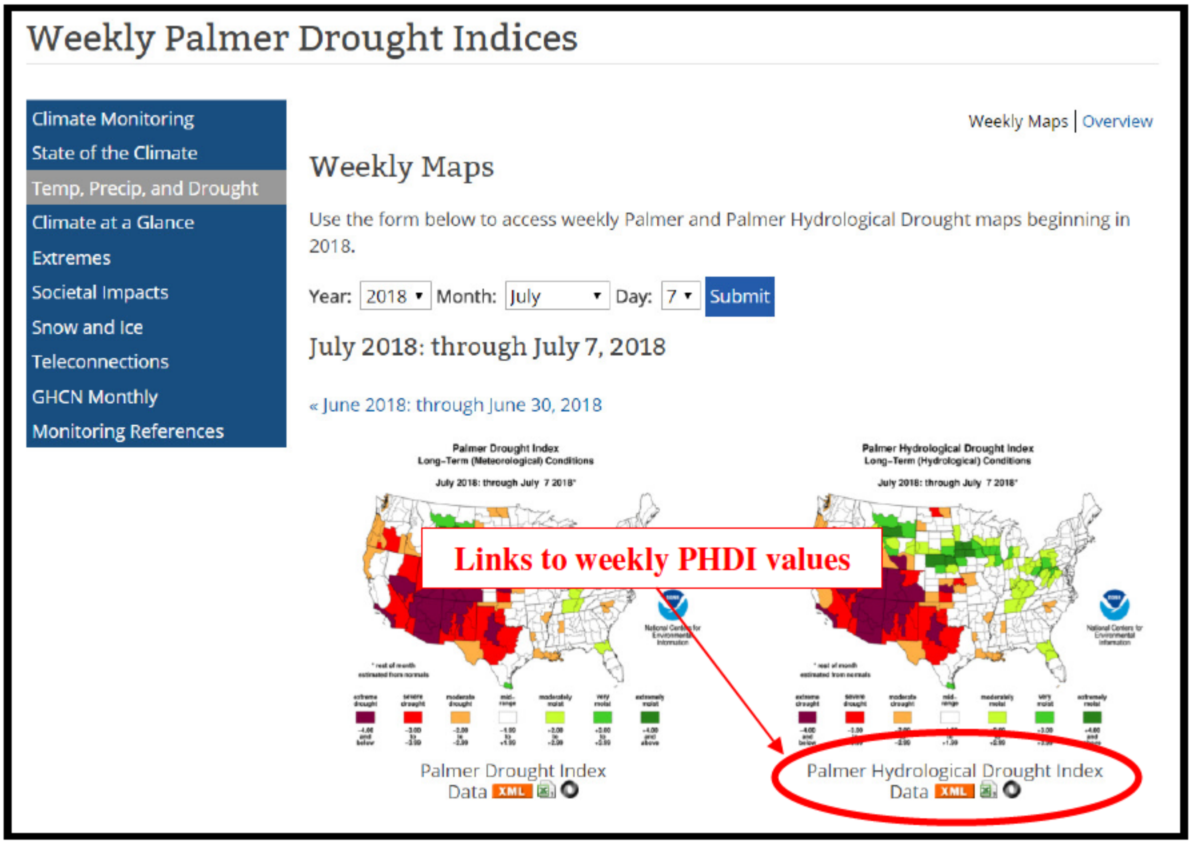
Column O: Possum Kingdom Reservoir WSEL (ft-msl) – The daily water surface elevation of Possum Kingdom Reservoir as recorded by USGS Gage 08088500 at midnight of the preceding day.

Column P: PHDI (High Plains Zone) (no units) – The Palmer Hydrological Drought Index (PHDI), which monitors long-term drought conditions. PHDI values range from +7 to -7. The TCEQ has determined that the PHDI values should be updated on the last day of the month before the start of a new season. Preliminary PHDI values are published by the National Climatic Data Center (NCDC) on a weekly basis. Column P must be updated with the weekly PHDI value published during the week in which the last day of the month before the start of a new season occurs.

Conditional formatting has been applied to Column P to denote the days on which the PHDI needs to be updated (tan shading). If a cell is shaded gray, then the PHDI does not need to be updated for that day. For December 31st of the previous accounting year (Tab: JAN, Cell P4), the PHDI value from October 31st of the previous accounting year must be entered to designate the current drought conditions for the winter season beginning on November 1st of the previous year and ending on the last day of February in the current accounting year.

PHDI background information and links to weekly values can found on the following NCDC webpage. Lake 7 is located in the Texas High Plains Zone and has a lookup value of 4101 in the text files. If the NCDC changes the current webpage address, the City will update the following link and provide an updated version of this document to TCEQ.

http://ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers.php


Weekly Palmer Drought Indices

Weekly Maps

Use the form below to access weekly Palmer and Palmer Hydrological Drought maps beginning in 2018.

Year: 2018 Month: July Day: 7

July 2018: through July 7, 2018

« June 2018: through June 30, 2018

Column Q: Total Effluent (MGD) –The total effluent is the sum of the NWWRP and SEWRP return flow and the land-applied effluent.

Column R: Return Flow Factor (no units) – The daily return flow factor as calculated by the current day combined effluent from the NWWRP and SEWRP divided by the total raw water supply entering the City's water treatment facilities from the previous day.

This raw water supply does not include groundwater pumped from beneath the LLAS and discharged into the North Fork.

Column S: Total LAH-Sourced Effluent (MGD) – The effluent originating from LAH raw water supplies. The LAH sourced effluent is calculated by multiplying the previous day LAH supply by the return flow factor.

Column T: LAH Sourced Effluent Land Applied (MGD) – The amount of effluent sourced from LAH supplies applied to the LLAS. The LAH-sourced treated effluent is prioritized to be land applied before non-LAH supplies. If the amount of LAH-sourced treated effluent is less than the amount of treated effluent land applied, then no LAH sourced treated effluent is discharged into the North Fork.

Column U: LAH-Sourced Effluent Discharged (MGD) – The amount of effluent sourced from LAH supplies discharged into the North Fork. If the LAH sourced treated effluent is greater than the amount of treated effluent land applied, the remaining treated effluent is discharged from the SEWRP and NWWRP into the North Fork.

Column V: Non-LAH Sourced Effluent Discharged (MGD) – The amount of effluent from non-LAH sources discharged into the North Fork. These supply sources include groundwater, Canadian River Basin supplies, and reuse, but does not include groundwater pumped from beneath the LLAS.

Column W: Groundwater Remaining in North Fork (MGD) – The amount of groundwater discharged into the North Fork that passes the Lake 6 dam after carriage losses and diversions authorized under CA 12-3705. The accounting plan conservatively assumes all diversions made under CA 12-3705 occur at the furthest downstream authorized diversion point (Lake 6 dam), thus maximizing the carriage loss estimate of the groundwater and minimizing the amount of groundwater considered available for diversion.

Column X: Developed Stormwater Inflow (cfs) – This column calculates the developed stormwater that enters Lake 7 and accounts for the carriage losses that occur in the reach from the NWDP, SCLDS and SLDS stormwater outfalls to Lake 7.

Column Y: LAH Sourced Return Flow Inflow (cfs) – This column calculates the return flow originating from LAH supplies that is discharged at the NWWRP and SEWRP outfalls and enters Lake 7 after carriage losses. Discharge of the LAH-sourced return flow is proportionally split between the SEWRP and NWWRP based on total amount of return flow discharged that day from each water reclamation plant.

Column Z: Non-LAH Sourced Return Flow Inflow (cfs) – This column calculates the return flow originating from non-LAH supplies that is discharged at the NWWRP and SEWRP outfalls and enters Lake 7 after carriage losses. Discharge of the non-LAH sourced return flow is proportionally split between the SEWRP and NWWRP based on total amount of return flow discharged that day from each water reclamation plant.

Column AA: Groundwater Inflow (cfs) – This column calculates the groundwater discharged by the City that enters Lake 7 and accounts for the carriage losses that occur in the reach between Lake 6 and Lake 7.

Column AB: State Water Inflow (cfs) – This column calculates the natural inflow originating in the North Fork and its tributaries subject to appropriation and use by downstream senior and superior water rights and is subject to environmental flow criteria.

The natural inflow is calculated by first removing the developed stormwater, groundwater, and return flow components from the recorded flow at the USGS Loop 289 gage to calculate the natural flow passing the gage site. The natural flow passing the gage site is then adjusted for differences in drainage area with Lake 7 to account for the additional natural inflow originating downstream of the gage and upstream of the Lake 7 dam.

If the entered data cause the calculated natural inflow to be zero or negative when flows are measured at the USGS gage at Loop 289, the value is set to zero and conditional formatting is used to indicate to the user that the values entered for that day require inspection.

Column AC: Hydrologic Condition (no units) – This column calculates the hydrologic condition used to identify dry, average, or wet conditions in the environmental flow regime and is based on the PHDI value entered by the user in Column P. Dry conditions are defined as a PHDI value less than -1.78, average conditions between -1.78 and +2.18, and wet conditions greater than +2.18.

Column AD: Required Subsistence/Base Flow Release (cfs) – This column calculates the required release of state water inflows that must be made to satisfy the subsistence and base flow environmental flow targets.

Column AE: Pulse Trigger (cfs) – This column retrieves the seasonal high flow pulse trigger rate as established for each season.

Column AF: Pulse Volume (acft) – This column retrieves the seasonal high flow pulse volume target necessary to end a pulse event.

Column AG: Pulse Duration (days) – This column retrieves the seasonal high flow duration target necessary to end a pulse event.

Column AH: Pulse Frequency (per season) – This column retrieves the seasonal frequency target of high flow pulse events.

Column AI: Pulse Trigger Met (yes/no) – This column designates whether the pulse flow trigger target is met by state water inflow into Lake 7. For the pulse trigger to be met, state water inflow must be increasing from the previous day (indicating the beginning of a pulse) and be greater than or equal to the seasonal pulse trigger set in Column AE.

Column AJ: Days Since Last Pulse Start (days) – This column keeps track of the number of days since the start of the last required pulse event. A subsequent required pulse event cannot start until after the seasonal high flow duration target has lapsed (Column AG).

Column AK: Pulse Event (yes/no) – This column indicates whether a required pulse event is occurring. A required pulse event will occur if the pulse trigger is met in Column AE, the target pulse frequency (Column AH) has not been met for the season, and sufficient days have passed since the start of the last required pulse event. The pulse event will continue until the target duration or volume has been met.

Column AL: Seasonal Pulse Counter (no units) – This column counts the number of required high flow pulse events that have occurred in a season. The counter is reset to zero at the beginning of each season.

Column AM: Pulse Duration Counter (days) – This column counts the number of days a given required pulse event has been occurring.

Column AN: Cumulative Pulse Volume (acft) – This column calculates the cumulative pulse volume.

Column AO: Turn Off Pulse (yes/no) – This determines whether a required pulse event has reached the target volume or duration and will return a value of 1 to signify the pulse event has ended.

Column AP: Required Pulse Flow Release (cfs) – This column calculates the required release of state water to satisfy the high flow pulse component of the environmental flow criteria.

Column AQ: Required Inflow Release (cfs) – This column calculates the total required release of state water inflows. If the Possum Kingdom Reservoir water surface elevation is below 1,000 ft-msl, then all state water inflows are to be released if the state water inflow is greater than 5 cfs, per agreement with the Brazos River Authority. If the Possum Kingdom Reservoir water surface elevation is equal to or greater than 1,000 ft-msl, then the required state water inflow release is the maximum of the required base or subsistence release (Column AD) and the required pulse flow release (Column AP).

Column AR: Balance of Required Inflow Release (acft) – This column calculates the balance of environmental flow release deficits from the current and previous days. Deficit values are carried over from one day to the next until they are satisfied with additional releases greater than the minimum required environmental flow release. Cells in Column

AR are conditionally formatted to show deficits with red shading. When no deficits are occurring, the cells are shaded green.

EFR TAB

The EFR tab provides the Lake 7 environmental flow regime (EFR) targets as translated and rounded to the nearest integer from the environmental flow standards located at the Double Mountain Fork near Aspermont Gage (USGS 0808055). The EFR contains three seasons; Winter (Nov-Feb), Spring (Mar-Jun) and Summer (Jul-Oct), and three hydrologic conditions; Dry, Average and Wet. Note that the winter season does not contain a high flow pulse requirement; therefore, these cells are highlighted gray along with the columns containing the pulse requirement calculations (Columns AE-AP) in the JAN, FEB, NOV and DEC tabs.

Sarah Henderson

From: Humberto Galvan
Sent: Thursday, July 5, 2018 1:39 PM
To: Sarah Henderson
Cc: Chris Kozlowski
Subject: FW: DRAFT - Lake 7 Accounting Plan - Permit No. 12-5921
Attachments: LubbockAccountingPlanNarrative_20180702.pdf; Lake7_Accounting Plan_20180702.xlsm

From: Kathy Alexander
Sent: Thursday, July 5, 2018 1:34 PM
To: Humberto Galvan <Humberto.Galvan@tceq.texas.gov>; Young-Hoon Jin <Young-Hoon.Jin@Tceq.Texas.Gov>
Cc: Christine Peters <Christine.Peters@tceq.texas.gov>; Alisa Patterson <Alisa.Patterson@Tceq.Texas.Gov>
Subject: FW: DRAFT - Lake 7 Accounting Plan - Permit No. 12-5921

All,
Please see the revised accounting plan for Water Use Permit 5921. The attached accounting plan is also applicable to Application 3985C for the City of Lubbock.
Kathy

From: Dunn, David [mailto:[redacted]
Sent: Thursday, July 05, 2018 1:28 PM
To: Kathy Alexander <kathy.alexander@tceq.texas.gov>
Subject: FW: DRAFT - Lake 7 Accounting Plan - Permit No. 12-5921

Kathy,

I didn't realize when I sent this Monday that I had used an old email address. I received a bounce-back notification yesterday.

I hope you had a nice holiday yesterday.

David

David D. Dunn, PE
D 512.912.5136 M 512.791.3671

Texas TBPE Firm No. F-754

hdrinc.com/follow-us

From: Dunn, David
Sent: Monday, July 2, 2018 4:48 PM
To: Kathy Alexander <KALEXAND@tceq.state.tx.us>
Cc: Stein, Zachary <[redacted]; Aubrey Spear <[redacted]>
Subject: DRAFT - Lake 7 Accounting Plan - Permit No. 12-5921

Kathy,

On behalf of the City of Lubbock, attached for your review is the draft Lake 7 accounting plan for Water Right Permit No. 12-5921 (Excel format), accompanied by a narrative explaining the logic of the plan (PDF format).

Please feel free to contact me or Zach Stein if you have any questions.

Best regards,

David

David D. Dunn, PE
Vice President

HDR
4401 West Gate Blvd., Suite 400
Austin, Texas 78745
D 512.912.5136 M 512.791.3671
[redacted]

Texas TBPE Firm No. F-754

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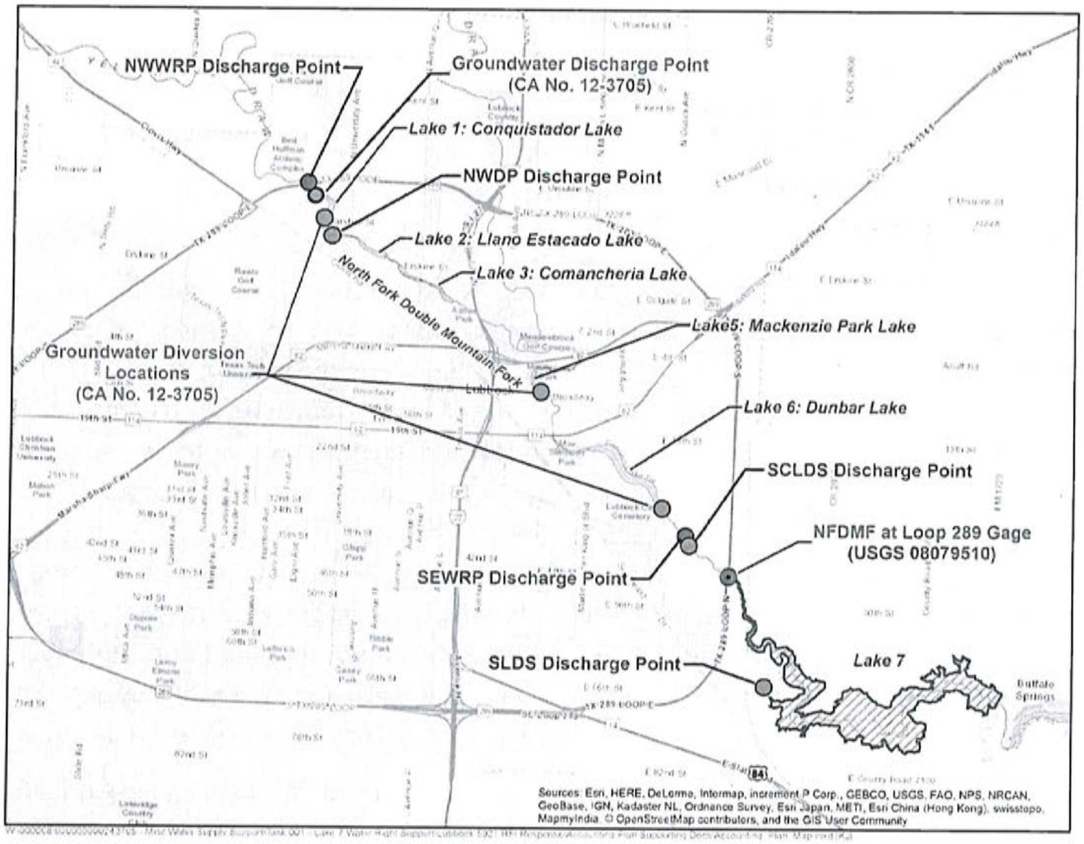
-DRAFT-

City of Lubbock
Accounting Plan for Permit No. 12-5921
Lake 7

Background

The City of Lubbock (the "City") has developed an accounting plan to track impoundment of water in the City's proposed Jim Bertram Lake 7 ("Lake 7") on the North Fork of the Double Mountain Fork of the Brazos River (the "North Fork"). The purpose of this accounting plan is to differentiate State Water from other sources of water available to the City for impoundment in Lake 7. Other sources of water include developed playa lake water, City return flows, and groundwater discharged by the City into the North Fork. Use of return flows has been authorized by the Texas Commission on Environmental Quality ("TCEQ") under Permit No. 12-3985 and Certification of Adjudication ("CA") No. 12-4146. Use of groundwater discharged into the North Fork has been authorized under CA No. 12-3705. Figure 1 provides the discharge and diversion locations of City water on the North Fork. This document outlines the principles used to develop the accounting plan.



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Figure 1. Dishcharge and Diversion Locations of City Water on the North Fork

Definitions for use in this Accounting Plan

State Water – water naturally flowing in the North Fork and its tributaries that is subject to appropriation and use by downstream senior and superior water rights.

City Water – water discharged into the North Fork by the City that is not subject to appropriation and use by downstream senior and superior water rights. This water would not enter the North Fork but for the actions of the City and is considered to be "developed water." City Water includes discharges of playa lake water from the City's South Lubbock Drainage System ("SLDS"), South-Central Lubbock Drainage System ("SCLDS"), and Northwest Drainage Project ("NWDP"); wastewater effluent derived from groundwater sources owned by the City; groundwater discharged into the North Fork by the City; and wastewater effluent derived from groundwater and surface water sources purchased from the Canadian River Municipal Water Authority ("CRMWA"). For purposes of this accounting plan, return flows originating from Lake Alan Henry ("LAH") are considered City Water because those return flows originate from water previously stored in LAH and would not have contributed to downstream flows.

Permit No. 12-5921 – water right permit authorizing the impoundment of water in, and diversion from, the proposed Lake 7 on the North Fork.

CA No. 12-3705 (as amended) – water right permit authorizing diversion from the perimeters of Lakes 1, 2 and 6 of the Jim Bertram Lake System ("JBLS") for irrigation purposes. A special condition in the permit stipulates that the City will supplement the water diverted with groundwater to replace any diverted water. The City currently discharges groundwater pumped from beneath the Lubbock Land Application Site ("LLAS") into the North Fork upstream of Lake 1. A special condition in the permit stipulates that these diversions "will not be subject to call by senior and superior water rights holders."

Permit No. 12-3985 (as amended) – water use permit authorizing the diversion of return flows from the North Fork.

CA No. 12-4146 – water right authorizing impoundment of water in and diversion from the existing LAH located on the South Fork of the Double Mountain Fork of the Brazos River. CA 12-4146 also authorizes reuse of effluent originating from LAH.

Accounting Plan Framework

The accounting plan will be based on direct measurement of City Water discharged to the land application site and the North Fork, diversions by the City and flows in the North Fork consisting of combined City Water and State Water. All unmeasured inflows into the North Fork will be considered State Water for purposes of this accounting plan. Inflows of return flows or reclaimed water by entities other than the City will be considered State Water unless the City enters into a contract to reuse the water and obtains permission to reuse such flows from the TCEQ, in which event these return flows will be accounted for as City Water.

Streamflows in, and City Water discharged to, the North Fork shall be measured by the City using continuous recording devices. For this accounting plan, flows will be measured or computed at the following locations:

- All existing and future wastewater effluent outfalls from which the City has a right to reuse effluent;
- Outfalls of the SLDS, SCLDS and NWDP;
- The outfall from the discharge of groundwater, upstream of Lake 1;
- A point on the North Fork at Loop 289 (USGS Gage 08079510);
- Intervening State Water between the Loop 289 USGS gage and Lake 7, estimated using contributing drainage area ratio; and
- Outflows from Lake 7, which will be based on established rating curves of the reservoir's outlet works.

Inflows to Lake 7 are accounted for by their source and fall into one of the following five categories:

- Developed stormwater inflow originating from the SLDS, SCLDS and NWDP;
- Return flows originating from LAH supplies;
- Discharges of groundwater that are not diverted under Permit No. 12-3705;
- Return flows originating from non-LAH supplies including groundwater supplies, Canadian River Basin supplies, and reuse supplies from Lake 7; and
- State Water.

Carriage loss factors used to calculate the City Water and State Water inflows to Lake 7 are extrapolated from the TCEQ Brazos WAM and are used in lieu of the carriage loss factors included in Permit No. 12-3985. The WAM carriage losses are more conservative compared to those included in Permit No. 12-3985 and allow for consistency in calculating carriage losses to Lake 7 for all City water discharged into the North Fork authorized under the City's various permits. The extrapolation calculations are provided in the "Instructions" tab of the accounting plan spreadsheet. The relatively short reach does not require application of lag times.

Inflows of State Water to Lake 7 are computed as State Water flows passing the USGS gage at Loop 289 less carriage losses, plus intervening flows computed using a drainage area ratio applied to the Lake 7 dam location. Inflows of City Water into Lake 7 will be determined based on the measured discharges of City Water, less losses and diversions of City Water by the City.

The City will pass inflows of State Water through Lake 7:

1. When Possum Kingdom Lake is below elevation 1,000 feet mean sea level and inflows of State Water exceed 5 cfs, per agreement between the City and the Brazos River Authority;
2. To meet subsistence and base flow standards translated from the Aspermont Gage by contributing drainage area ratio to the Lake 7 dam site. This translation is computed as the base or subsistence flow standard x (Lake 7 contributing drainage area)/(Aspermont gage contributing drainage area) = standard x 243.13/1,891.25 = Standard x 0.1286; and
3. To meet seasonal pulse standards translated from the Aspermont Gage. Pulse flows will be translated as follows:
    a. The trigger flows will be scaled using the ratio of the mean annual WAM naturalized flows for the two locations.
    b. The durations will be scaled using the $(R)^e$, where R is the naturalized flow ratio calculated above. The exponent e is a duration exponent obtained from a power law relationship between pulse volumes and trigger flows, and is equal to 0.105[1]. The scaled duration will be rounded to an integer number of days.
    c. The pulse volumes will be related such that the pulse ratio, QD/V, where Q is the pulse flow trigger level, D is the duration in days, and V is the pulse volume, is the same at the two locations.

Once State and City water inflows are impounded in Lake 7, they are considered to be stored water owned by the City. Therefore, diversions from Lake 7 are not classified as diversions of State or City water in the accounting plan, but only as diversions of stored water as authorized under Permit 12-5921.

The City has developed and will maintain an Excel spreadsheet recording on a daily basis the above information.

Accounting Plan Spreadsheet

Organization of Spreadsheet

The Accounting Plan spreadsheet contains fifteen separate tabs to organize input data, calculations and monthly summaries. The following are descriptions of each tab.

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[1] http://www.crwr.utexas.edu/reports/2013/rpt13-2.shtml

- **Instructions** – This tab provides supplemental instructions to those found in this document and provides the location for the user to input the accounting year. This tab also provides the constants used in calculation for drainage area ratios and carriage losses.
- **Summary Table** - This tab provides a summary of monthly diversions from Lake 7 under Permit No. 12-5921.
- **JAN-DEC** – These monthly tabs contain the daily user input and resulting calculations.
- **EFR** – This tab contains the TCEQ environmental flow regime (EFR) for the State Water inflows into Lake 7.

Instructions for Use of Spreadsheet

INSTRUCTIONS TAB

Cell I13: Accounting Year – This cell is the location for the user to input the accounting year. It is imperative that the user input a value because all logic pertaining to dates and leap years depends upon this value.

Cell I14: Inflow Release Balance from Previous Year – This cell is used to carry forward the balance of the required inflow releases from the previous year, if any exists. Only zero or negative numbers should be entered.

SUMMARY TABLE TAB

Column B: Month – The month of the year.

Column C: Lake 7 Diversions (acft) – This column summarizes the total water diverted from Lake 7 storage under Permit No. 12-5921.

JAN-DEC TABS

Column headings are identical for all of the monthly tabs. Columns B-P require user input when cells are highlighted tan.

Column A: Date (mm/dd/yyyy) – This column will automatically be populated with the date once the user enters the accounting year in the Instructions Tab.

Column B: Lake Alan Henry Supply (MGD) – The daily raw water supplies sourced from LAH.

Column C: Non-Lake Alan Henry Supply (MGD) – The daily raw water supply sourced from groundwater, Canadian River Basin, and reuse. This supply does not include groundwater by the City.

Column D: Groundwater Discharge (MGD) – The amount of groundwater discharged to the North Fork by the City.

Column E: Groundwater Diverted (MGD) – The amount of water diverted from Lakes 1, 2 and 6 of JBLS under Permit No. 12-3705.

Column F: Land-Applied Effluent (MGD) – The amount of treated effluent applied to the LLAS.

Column G: SCLDS Outfall (MGD) – The daily developed stormwater discharged from the SCLDS at Outfall 30 and recorded from the gage operated by the City.

Column H: SLDS Outfall (MGD) – The daily developed stormwater discharged from the SLDS at Outfall 31 and recorded from the gage operated by the City.

Column I: NWDP Outfall (MGD) – The daily developed stormwater discharged at the Northwest Drainage Project outfall and recorded from the gage operated by the City.

Column J: NWWRP Return Flow (MGD) – The recorded daily discharge from the City's Northwest Water Reclamation Plant into the North Fork.

Column K: SEWRP Return Flow (MGD) – The recorded daily discharge from the City's Southeast Water Reclamation Plant into the North Fork.

Column L: USGS Recorded Streamflow at Loop 289 (cfs) – The daily mean streamflow recorded at the North Fork Double Mountain Fork Brazos River at Loop 289 near Lubbock Texas (USGS Gage No. 08079510).

Column M: Lake 7 Diversion (MGD) – The daily volume diverted from Lake 7.

Column N: Lake 7 Outflow (cfs) – The daily flow released through the Lake 7 outlet works.

Column O: Possum Kingdom Reservoir WSEL (ft-msl) – The daily water surface elevation of Possum Kingdom Reservoir as recorded by USGS Gage 08088500 at midnight of the preceding day.

Column P: PHDI (High Plains Zone) (no units) – The Palmer Hydrological Drought Index (PHDI), which monitors long-term drought conditions. PHDI values range from +7 to -7. The TCEQ has determined that the PHDI values should be updated on the last day of the month before the start of a new season. Preliminary PHDI values are published by the National Climatic Data Center (NCDC) on a weekly basis. Column J must be updated with the weekly PHDI value published during the week in which the last day of the month before the start of a new season occurs.

Conditional formatting has been applied to Column P to denote the days on which the PHDI needs to be updated (tan shading). If a cell is shaded gray, then the PHDI does not need to be updated for that day. For December 31st of the previous accounting year (Tab: JAN, Cell P4), the PHDI value from October 31st of the previous accounting year must be entered to designate the current drought conditions for the winter season beginning on November 1st of the previous year and ending on the last day of February in the current accounting year. The links below provide background information on the PHDI and the location of text files containing the weekly published preliminary values. Lake 7 is located in the Texas High Plains Zone and has a lookup value of 4101 in the text files.

http://ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers.php

http://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers/phd-20160723.csv

Column Q: Total Effluent (MGD) –The total effluent is the sum of the NWWRP and SEWRP return flow and the land-applied effluent.

Column R: Return Flow Factor (no units) – The daily return flow factor as calculated by the current day combined effluent from the NWWRP and SEWRP divided by the total raw water supply entering the City's water treatment facilities from the previous day. This raw water supply does not include groundwater pumped from beneath the LLAS and discharged into the North Fork.

Column S: Total LAH-Sourced Effluent (MGD) – The effluent originating from LAH raw water supplies. The LAH sourced effluent is calculated by multiplying the previous day LAH supply by the return flow factor.

Column T: LAH Sourced Effluent Land Applied (MGD) – The amount of effluent sourced from LAH supplies applied to the LLAS. The LAH-sourced treated effluent is prioritized to be land applied before non-LAH supplies. If the amount of LAH-sourced treated effluent is less than the amount of treated effluent land applied, then no LAH sourced treated effluent is discharged into the North Fork.

Column U: LAH-Sourced Effluent Discharged (MGD) – The amount of effluent sourced from LAH supplies discharged into the North Fork. If the LAH sourced treated effluent is greater than the amount of treated effluent land applied, the remaining treated effluent is discharged from the SEWRP and NWWRP into the North Fork.

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Column X: Developed Stormwater Inflow (cfs) – This column calculates the developed stormwater that enters Lake 7 and accounts for the carriage losses that occur in the reach from the NWDP, SCLDS and SLDS stormwater outfalls to Lake 7.

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Column Z: Non-LAH Sourced Return Flow Inflow (cfs) – This column calculates the return flow originating from non-LAH supplies that is discharged at the NWWRP and SEWRP outfalls and enters Lake 7 after carriage losses. Discharge of the non-LAH sourced return flow is proportionally split between the SEWRP and NWWRP based on total amount of return flow discharged that day from each water reclamation plant.

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The natural inflow is calculated by first removing the developed stormwater, groundwater, and return flow components from the recorded flow at the USGS Loop 289 gage to calculate the natural flow passing the gage site. The natural flow passing the gage site is then adjusted for differences in drainage area with Lake 7 to account for the additional natural inflow originating downstream of the gage and upstream of the Lake 7 dam.

If the entered data cause the calculated natural inflow to be zero or negative when flows are measured at the USGS gage at Loop 289, the value is set to zero and conditional formatting is used to indicate to the user that the values entered for that day require inspection.

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Column AL: Seasonal Pulse Counter (no units) – This column counts the number of required high flow pulse events that have occurred in a season. The counter is reset to zero at the beginning of each season.

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Column AQ: Required Inflow Release (cfs) – This column calculates the total required release of state water inflows. If the Possum Kingdom Reservoir water surface elevation is below 1,000 ft-msl, then all state water inflows are to be released if the state water inflow is greater than 5 cfs, per agreement with the Brazos River Authority. If the Possum Kingdom Reservoir water surface elevation is equal to or greater than 1,000 ft-msl, then the required state water inflow release is the maximum of the required base or subsistence release (Column AD) and the required pulse flow release (Column AP).

Column AR: Balance of Required Inflow Release (acft) – This column calculates the balance of environmental flow release deficits from the current and previous days. Deficit values are carried over from one day to the next until they are satisfied with additional releases greater than the minimum required environmental flow release. Cells in Column AR are conditionally formatted to show deficits with red shading. When no deficits are occurring, the cells are shaded green.

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The EFR tab provides the Lake 7 environmental flow regime (EFR) targets as translated and rounded to the nearest integer from the environmental flow standards located at the Double Mountain Fork near Aspermont Gage (USGS 0808055). The EFR contains three seasons; Winter (Nov-Feb), Spring (Mar-Jun) and Summer (Jul-Oct), and three hydrologic conditions; Dry, Average and Wet. Note that the winter season does not contain a high flow pulse requirement; therefore, these cells are highlighted gray along with the columns containing the pulse requirement calculations (Columns AE-AP) in the JAN, FEB, NOV and DEC tabs.

City of Lubbock - Water Right Permit No. 12-5921
Accounting Plan

This spreadsheet contains the calculations for tracking required pass throughs and water consumed under Water Right Permit No. 12-5921. Please contact Zach Stein (zstein@hdrinc.com) or David Dunn (david.dunn@hdrinc.com) with any questions regarding this accounting plan.

Cells highlighted in this color indicate that a user entered value is required.

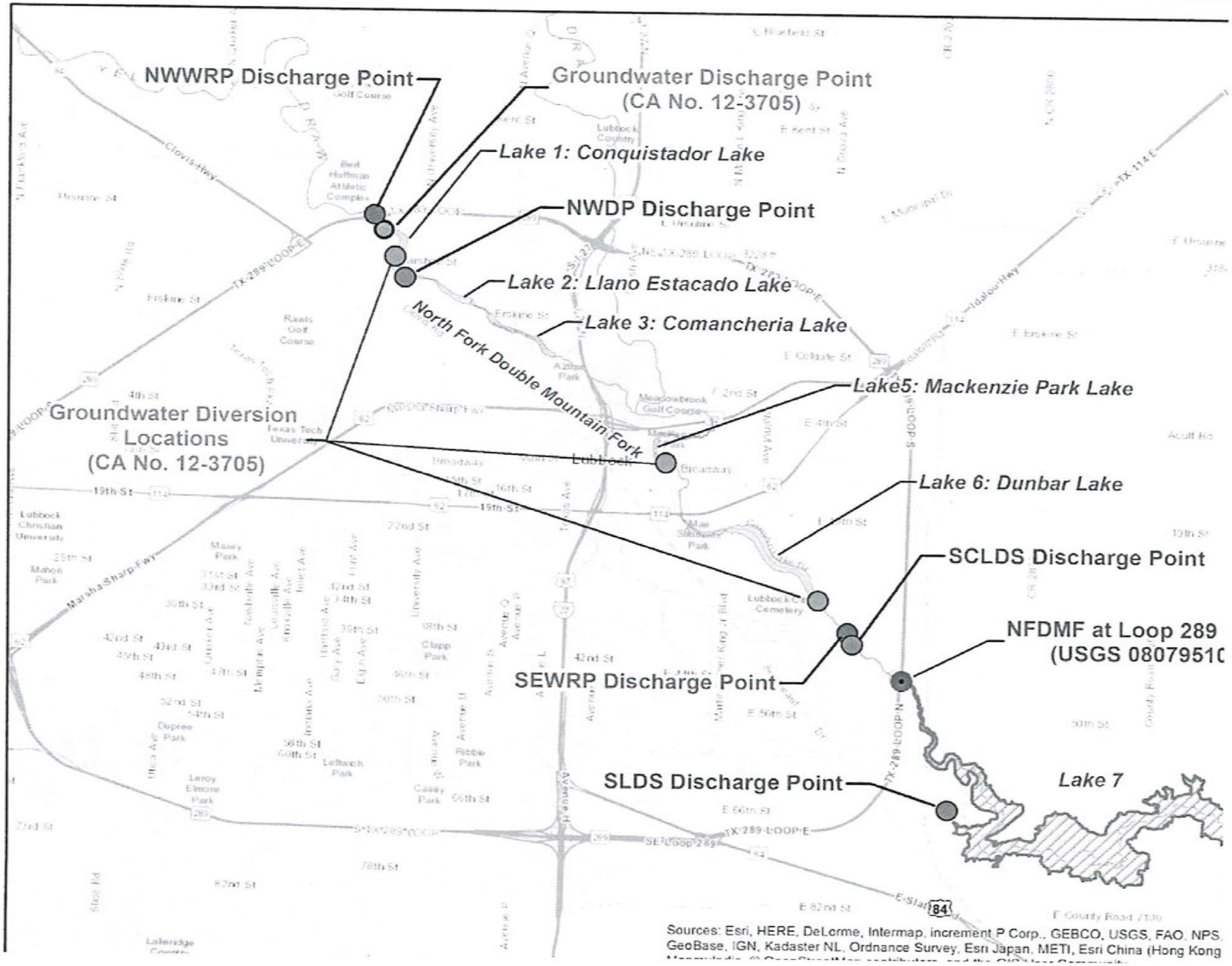
ACCOUNTING YEAR: 2016

INFLOW RELEASE BALANCE FROM PREVIOUS YEAR (acft):

CONSTANTS		
Contributing Drainage Areas		
NFDMF at Loop 289 Gage Drainage Area (sq-mi)	220.00	placeholder value until USGS provides contributing drainage area
Lake 7 Drainage Area (sq-mi)	243.13	
Delivery Factors		
LLAS Groundwater Discharge Point to Lake 6 Dam	0.9533	
NWWRP to NFDMF at Loop 289 Gage	0.9437	
NWDP to NFDMF at Loop 289 Gage	0.9486	
Lake 6 Dam to NFDMF at Loop 289 Gage	0.9917	
SEWRP to NFDMF at Loop 289 Gage	0.9960	
Outfall 30 (SCLDS) to NFDMF at Loop 289 Gage	0.9960	
NWWRP to Lake 7 Dam	0.9077	
NWDP to Lake 7 Dam	0.9125	
Lake 6 Dam to Lake 7	0.9538	
SEWRP to Lake 7 Dam	0.9580	
SCLDS (Outfall 30) to Lake 7 Dam	0.9581	
Loop 289 Gage to Lake 7 Dam	0.9619	
SLDS (Outfall 31) to Lake 7 Dam	0.9788	

BRAZOS WAM CARRIAGE LOSS EXTRAPOLATION

Reach	Length (miles)	Carriage Loss
Brazos WAM - Buffalo Springs Lake nr Lubbock to Double Mountain Fk nr Aspermont (BSLU07 to DMAS09)	180.70	0.6635
LLAS Groundwater Discharge Point to Lake 6 Dam	7.94	0.0467
NWWRP to NFDMF at Loop 289 Gage	9.62	0.0563
NWDP to NFDMF at Loop 289 Gage	8.75	0.0514
Lake 6 Dam to NFDMF at Loop 289 Gage	1.39	0.0083
SEWRP to NFDMF at Loop 289 Gage	0.67	0.0040
Outfall 30 (SCLDS) to NFDMF at Loop 289 Gage	0.66	0.0040
NWWRP to Lake 7 Dam	16.07	0.0923
NWDP to Lake 7 Dam	15.2	0.0875
Lake 6 Dam to Lake 7	7.84	0.0462
SEWRP to Lake 7 Dam	7.12	0.0420
SCLDS (Outfall 30) to Lake 7 Dam	7.11	0.0419
Loop 289 Gage to Lake 7 Dam	6.45	0.0381
SLDS (Outfall 31) to Lake 7 Dam	3.55	0.0212



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong

2018 Strategic Water Supply Plan

City of Lubbock
TEXAS

HDR

August
2018

HDR

2018 Strategic Water Supply Plan

August 2018

Prepared for

City of
Lubbock
TEXAS

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TEXAS

2018 Strategic Water Supply Plan

August 2018

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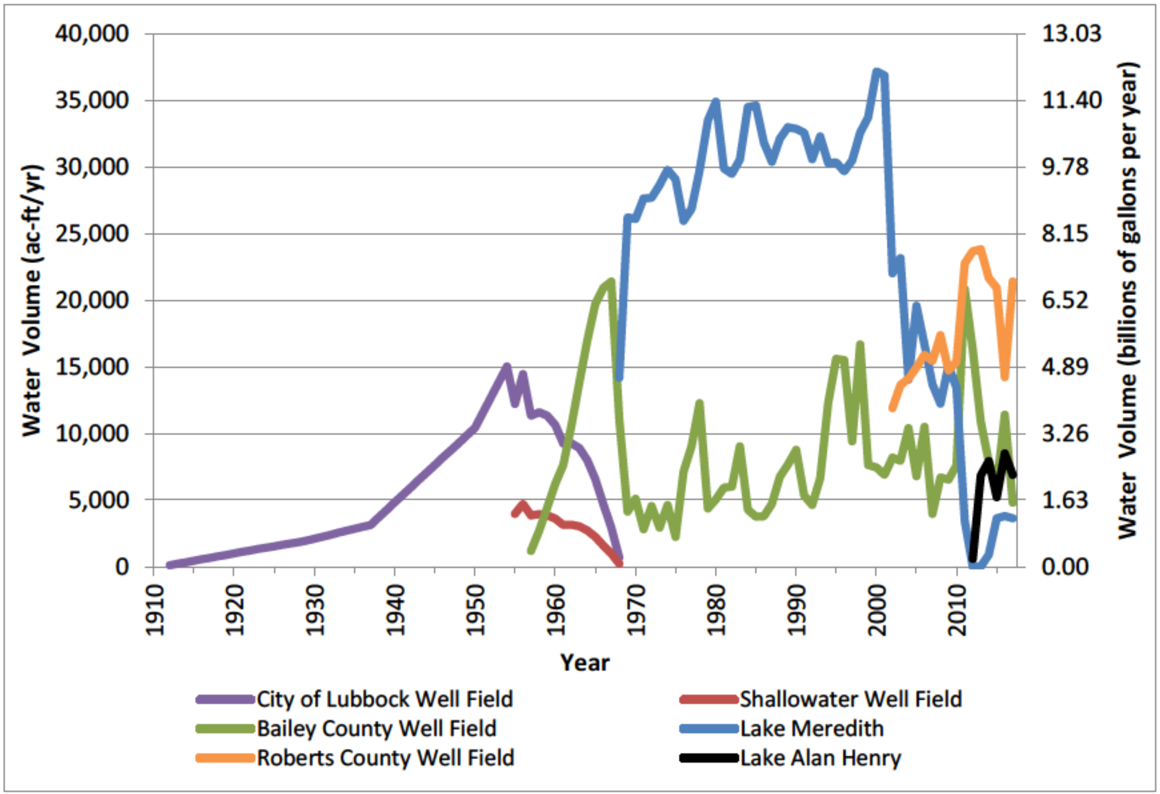
ES Executive Summary

The City of Lubbock (City) has actively planned for future water supplies through development of the City's Strategic Water Supply Plan (SWSP). The SWSP provides a "road map" to guide the development and implementation of cost-effective and sustainable water supplies over the next 100 years. This 2018 SWSP includes multiple strategies to diversity the City's water supply portfolio to minimize risk associated with variable climatic conditions while emphasizing conservation efforts to delay expensive water supply projects. This 2018 SWSP is a comprehensive update of the 2013 SWSP, and will be updated in the future as additional information about specific strategies becomes available or as conditions change.

ES.1 Historic Water Supplies

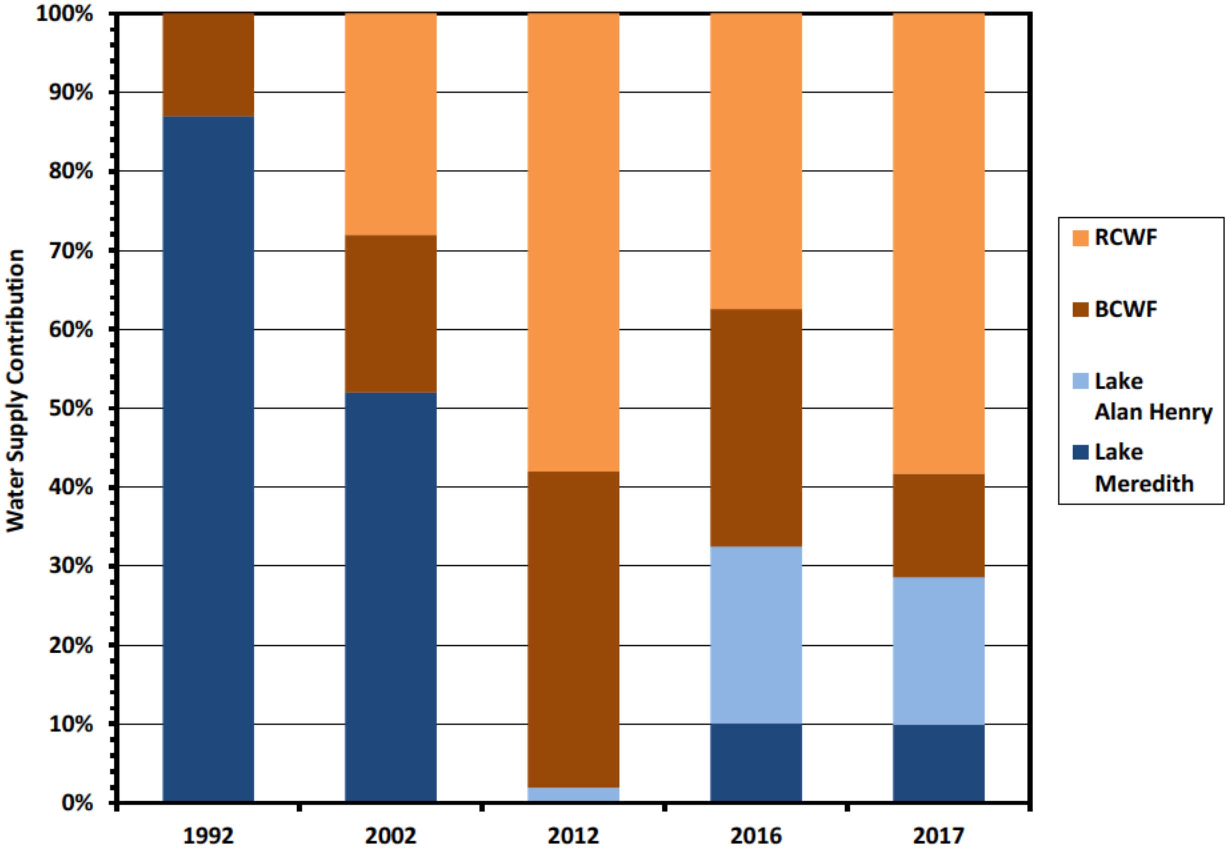
Historically, Lubbock's water supplies have varied between groundwater and surface water. Some water supplies have been discontinued due to diminished water quality, reduction in the water availability, and/or more stringent drinking water regulations. Lubbock's historic water supply usage is illustrated in Figure ES.1.

Figure ES.1. Lubbock's Historic Water Supply Usage



Lubbock currently enjoys a diverse water supply portfolio, consisting of two groundwater sources (Bailey County Well Field [BCWF] and Roberts County Well Field [RCWF]) and two surface water sources (Lake Meredith and Lake Alan Henry [LAH]). The City's utilization of those supplies varies from year to year, as illustrated in Figure ES.2. This dynamic water supply situation requires careful planning and adaptive management to meet the requirements of changing conditions.

Figure ES.2. Water Supply Contribution Comparison for 1992 and 2012



ES.2 Water Demand Projections

The planning process included in this document begins with projecting the City's water demand over a 100-year timeframe. Water demand projections are the driving force behind water supply decisions, and are dependent upon population and per capita consumption estimates. In Section 2, three important annual water demand scenarios are developed as follows:

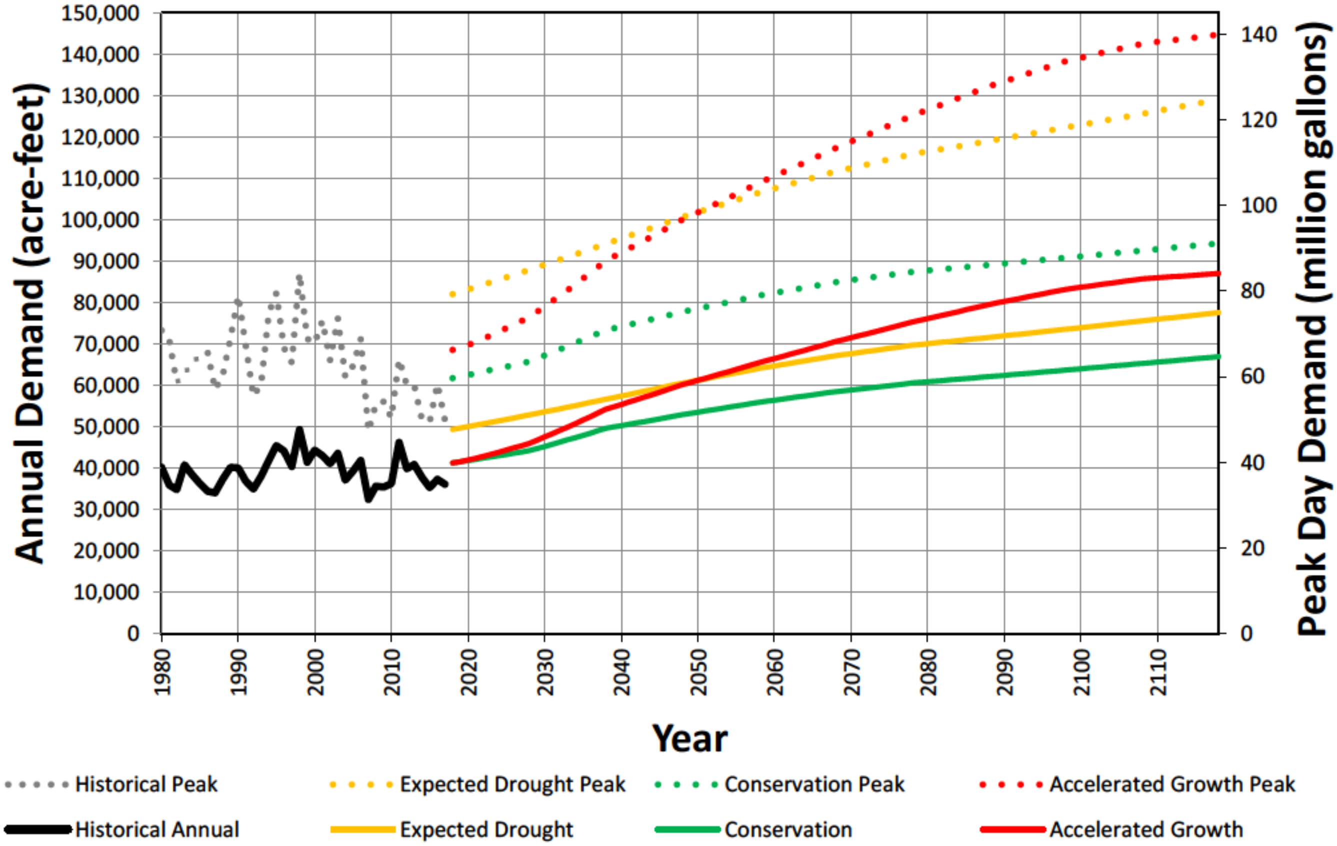
- Expected Drought Demand = Expected Population Growth x Drought Consumption
- Conservation Demand = Expected Population Growth x Conservation Consumption
- Accelerated Growth Demand = Accelerated Population Growth x Conservation Consumption

Peak day demand is also important to consider when planning for new water supplies. Satisfying peak demand can in some cases accelerate the need for a new water supply. Peak day water demand scenarios are developed as follows:

- Expected Peak Day = Expected Average Day Demand x Expected Peak Factor
- Conservation Peak Day = Expected Average Day Demand x Conservation Peak Factor
- Accelerated Peak Day = Accelerated Average Day Demand x Expected Peak Factor

Projections for these three scenarios for both Average Annual Demand and Peak Day Demand are shown in Figure ES.3.

Figure ES.3. Average Annual Demand and Peak Day Demand Projections



ES.3 Current Water Supplies

Lubbock's current water supply sources consist of the BCWF, the RCWF, Lake Meredith, and LAH, as discussed in Section 4, and shown in Figures ES.4 and ES.5. The City owns LAH and BCWF. The Lake Meredith and RCWF water supplies are owned and operated by the Canadian River Municipal Water Authority (CRMWA). RCWF and BCWF are groundwater supplies from the Ogallala Aquifer. As shown in the figures, groundwater production from the Ogallala well fields will decline over time if additional wells are not added periodically to maintain production capacity. Supplies from Lake Meredith are considered temporary, because lake levels as recently as 2011 prevented water from being supplied from the lake. However, LAH should be a renewable supply of water throughout the planning period as long as its yield does not change due to dramatic changes in the lake's environment.

A comparison of the annual water demand and current supplies projections are shown in Figure ES.4. A comparison of the peak day demand and current peak day capacity projections are shown in Figure ES.5. If the "Expected Drought" curve is followed in these figures, it demonstrates that the City does not currently have sufficient supplies to meet annual or peak day demands. However, the City's actual water usage is currently more closely aligned with the "Conservation" curve in these figures. Based on these projections, if water consumption continues to exhibit the strong conservation trend, the City will have adequate supplies until at least 2032 (when Lake Meredith supplies are assumed to no longer be available). In addition, if Lake Meredith supplies can be sustained past 2032, the City can delay implementing an additional water supply project until about 2036. Following the "Accelerated Growth" curve in these figures, an additional water supply project would be necessary as early as 2028.

Figure ES.4. Annual Water Demand vs. Current Water Supply Projections

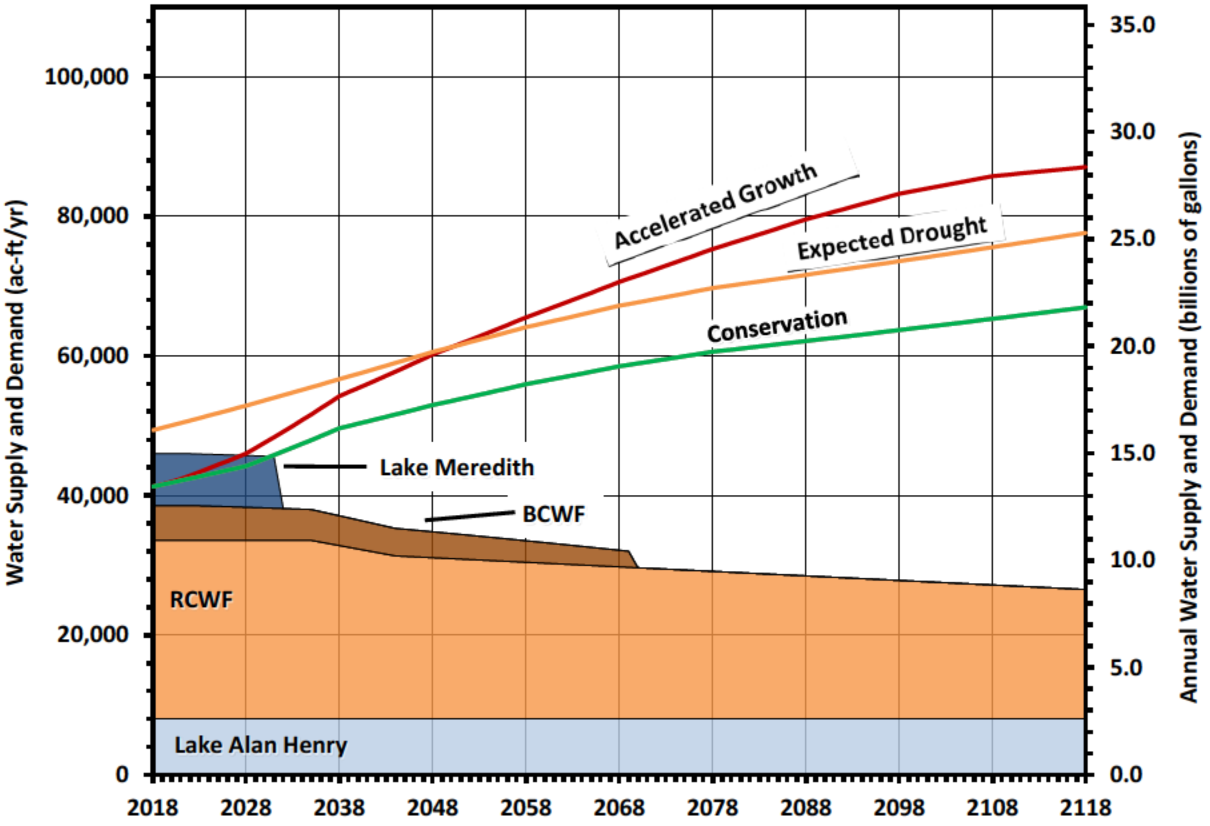
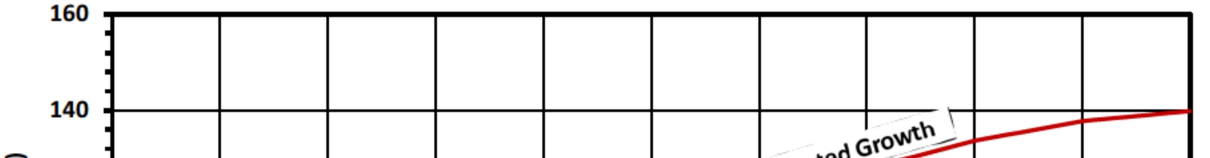


Figure ES.5. Peak Day Demand vs. Current Peak Day Capacity Projections



ES.4 Water Conservation Strategies

Water conservation is considered the least expensive supply of water that we possess. Projected Conservation demands lag projected Expected Drought demands by about 20 years, indicating that the City could potentially delay some future water supply projects by as much as 20 years by continuing to pursue its effective water conservation program. In Section 6, the conservation strategies discussed include public education and awareness, stringent seasonal watering restrictions, an increasing block rate structure, reducing unaccounted-for water losses, and additional measures to increase the efficiency of irrigation practices and commercial water use. The significant reduction in per capita consumption over the past few years can be directly attributed to the effectiveness of the City's conservation block rate structure, volume rates, and 2-day per week irrigation limitation on a year round basis.

ES.5 Potential Water Supply Strategies

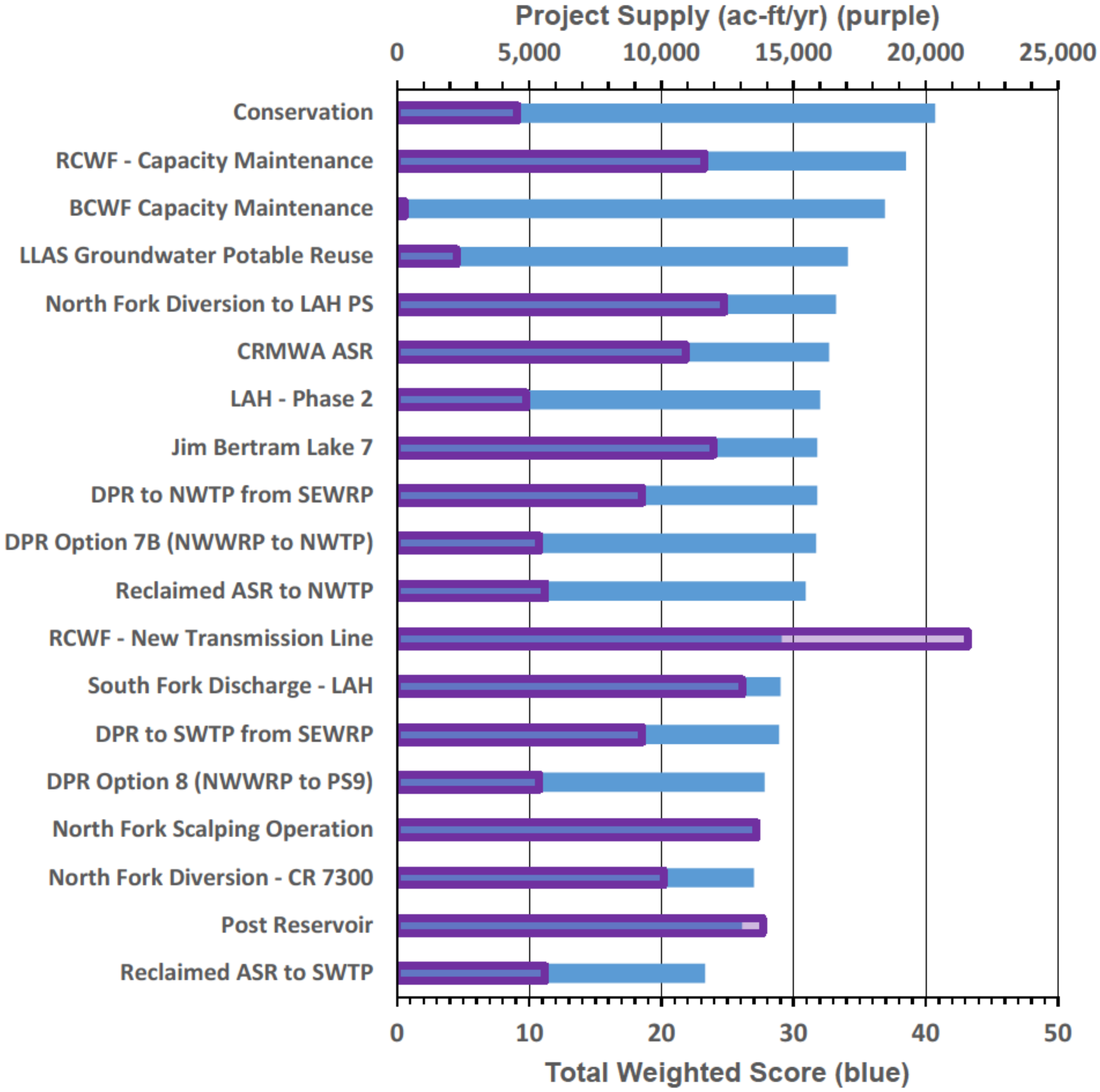
Table ES.1 provides a short explanation of each of the 17 non-conservation water supply strategies evaluated as part of this plan. These strategies, as described in Sections 7, 8, 9 and 10, are categorized as reclaimed water, groundwater, aquifer storage and recovery (ASR), and surface water, respectively. Other strategies considered but not evaluated fully are described in section 11.

In order to evaluate the strategies relative to one another, each strategy has been scored on a scale from 1 (low) to 5 (high) in 8 different criteria. Each criteria is weighted 0.5, 1.0, 1.5 or 2.0, depending on the criteria's importance. The range of possible total weighted scores is between 0 and 45. Section 12 describes the criteria and the scoring process in detail. Figure ES.6 summarizes the results of the scoring process and the relative amount of water that is available from each strategy. The amount of available water and the amount of time needed to implement each strategy are not factored into the scores. However, these two factors are used to determine the most cost effective way to satisfy future needs as demonstrated in each supply package scenario.

Table ES.1. Strategies Evaluated

Reclaimed Water	North Fork Diversion at County Road 7300	Reclaimed water discharged at Outfall 001 on the North Fork will be re-captured 2.7 miles downstream and pumped to the South Water Treatment Plant (SWTP) for further treatment.
	Direct Potable Reuse to the NWTP from SEWRP	Reclaimed water from the Southeast Water Reclamation Plant (SEWRP) will be treated and pumped to the North Water Treatment Plant (NWTP), and blended with other raw water supplies before further treatment.
	Direct Potable Reuse to the SWTP from SEWRP	Reclaimed water from the SEWRP will be treated and blended with other raw water supplies and pumped to the SWTP for further treatment.
	South Fork Discharge – LAH Supplement	The existing effluent pipeline to the Hancock Land Application Site will be extended to a tributary on the South Fork so that reclaimed water can be discharged and flow into Lake Alan Henry (LAH).
	North Fork Diversion to LAH Pump Station	Reclaimed water discharged at Outfall 001 will travel 67 miles downstream on the North Fork to the diversion site where it will be pumped directly to the LAH Pump Station.
	Direct Potable Reuse Option 7B (NWWRP to NWTP)	Reclaimed water from the Northwest Water Reclamation Plant (NWWRP) will be treated and pumped to the NWTP, and blended with other raw water supplies before further treatment.
	Direct Potable Reuse Option 8 (NWWRP to PS9)	Reclaimed water from the NWWRP will be treated to potable quality standards and introduced into the water distribution system at Pump Station 9.
Groundwater	RCWF – Capacity Maintenance	New wells will be installed to maintain the capacity of the existing Roberts County Well Field (RCWF).
	BCWF – Capacity Maintenance	New wells will be installed to maintain the capacity of the existing Bailey County Well Field (BCWF).
	RCWF New Transmission Line	Construction of additional wells and a second transmission line from the RCWF to the Canadian River Municipal Water Authority (CRMWA) Aqueduct will almost double Lubbock's CRMWA allocation and fill the aqueduct to capacity.
Aquifer Storage and Recovery (ASR)	Reclaimed ASR to NWTP	Reclaimed water from the SEWRP will be treated and pumped to an Aquifer Storage and Recover (ASR) facility near the NWTP, where it will be injected into the Ogallala Aquifer, recovered later and pumped to the NWTP for blending with other raw water supplies before further treatment.
	Reclaimed ASR to SWTP	Reclaimed water from the SEWRP would be treated and pumped to an ASR facility near the SWTP through the Hancock Land Application Site pipeline, where it will be injected into the Edwards-Trinity High Plains Aquifer, recovered about one mile downgradient to the east, and pumped to the SWTP for disinfection and blending with other treated water.
	CRMWA to ASR	Water received from CRMWA during winter months will be injected into the Ogallala Aquifer and recovered from the aquifer during summer months.
Surface Water	LAH Phase 2	Expansion of existing infrastructure will substantially increase the quantity of water that Lubbock can transport and treat from LAH.
	Jim Bertram Lake 7	A reservoir will be constructed on the North Fork upstream of Buffalo Springs Lake. Lake 7 water will be pumped to the NWTP for treatment.
	Post Reservoir	A reservoir will be constructed on the North Fork located east of Post in Garza County. Post Reservoir water will be pumped to the Post Pump Station and then to the SWTP for treatment.
	North Fork Scalping Operation	Stormwater on the North Fork will be captured and transported to LAH, increasing the lake's yield.

Figure ES.6. Supply Strategies Sorted by Score (Highest to Lowest)



ES.6 Supply Packages that Satisfy Future Needs

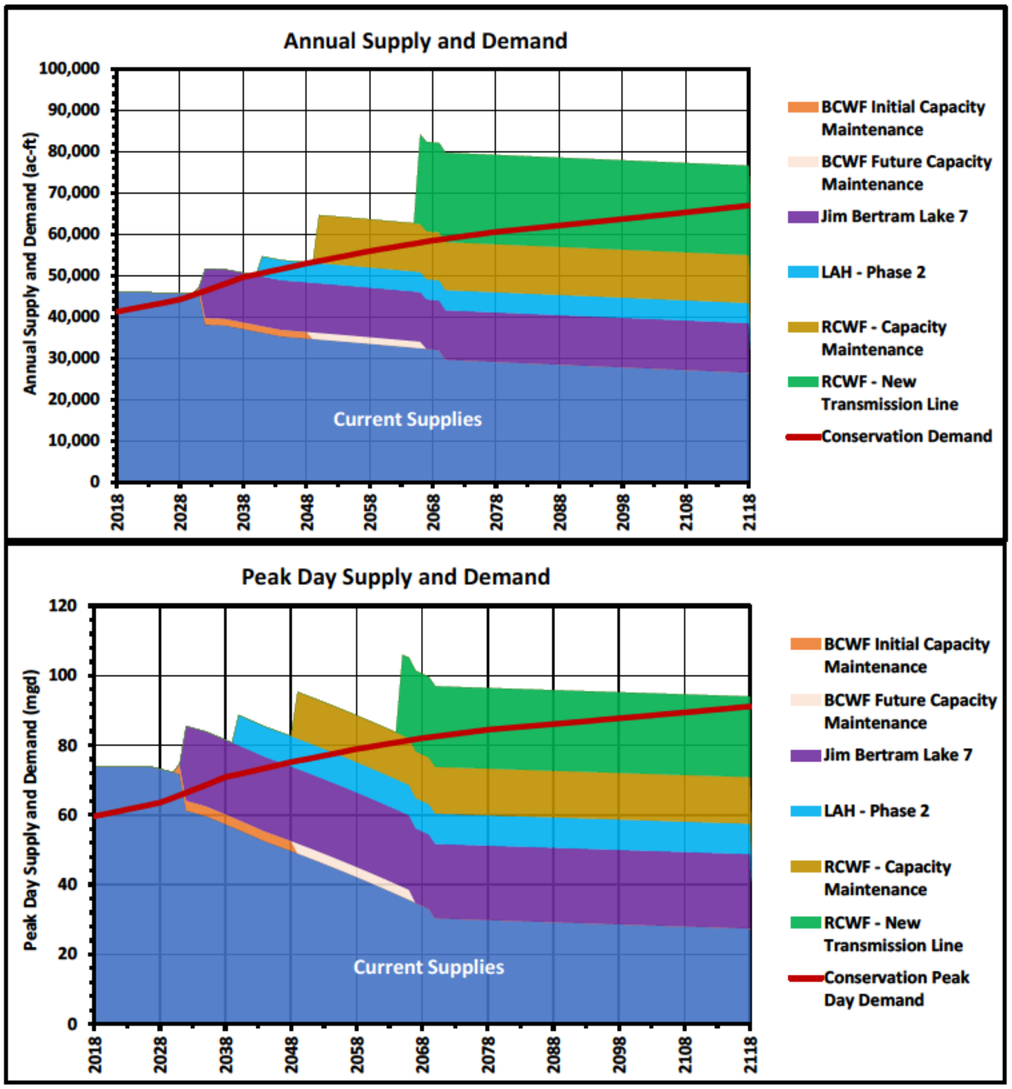
Combinations of supply strategies in conjunction with the various demand projections were used to develop five different supply packages that can potentially provide the City with water over the 100-year planning period. ***Many strategies used in these supply packages are interchangeable with other strategies that may not be included in the packages. Just because a strategy is not used in one of these examples, does not mean the strategy may not prove to be a more appropriate strategy in the future.*** Strategies were selected for inclusion in these packages based on a combination of meeting annual water volume needs and meeting peak day capacity needs. Many of the reuse strategies are not selected for inclusion in a package because they have limited capability to meet peak day capacity needs.

Section 13 describes these supply packages in greater detail. The five different supply packages developed are described below and presented in Figures ES.7 – ES.11. Table ES.2 compares strategy timelines and implementation dates for each of the five supply packages.

Supply Package 1 – Early Diversification

The Early Diversification supply package is intended to continue diversifying the City's water supplies so that the City is not overly dependent on a single source of supply. This supply package meets water demands under the Conservation demand scenario by maintaining and/or increasing supplies from the existing RCWF and BCWF and LAH, and also develops a new source of supply at a fairly early stage, Jim Bertram Lake 7. Because Lake 7 will utilize the City's reclaimed effluent as the primary portion of its yield, supply from Lake 7 will be relatively drought proof. Its proximate location to the City renders it somewhat less vulnerable to extended interruption than the City's existing supplies that are located much further away from Lubbock. Figure ES.7 illustrates the timing and supplies from this supply package.

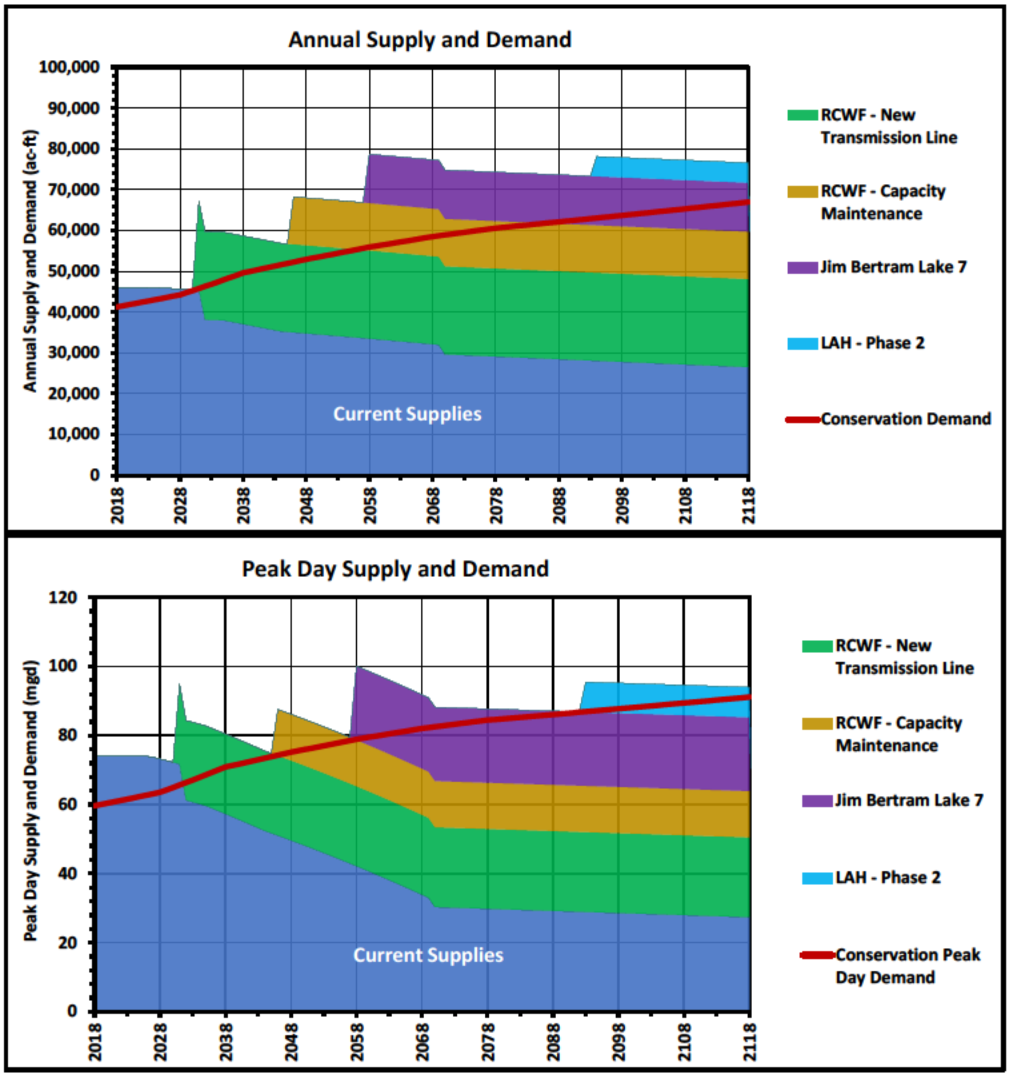
Figure ES.7. Early Diversification Supply Package



Supply Package 2 – Maximize RCWF

This supply package meets water demands under the Conservation demand scenario. The Maximize RCWF supply package is intended to, as much as possible, increase reliance on supplies from the RCWF, which is a drought proof, dependable supply that is easily maintained and expanded, and requires minimal water treatment. This supply package capitalizes on those characteristics early in the timeline. Expansion of surface water supplies (Lake 7 and LAH Phase 2) is delayed, and the BCWF is not maintained beyond its current configuration. Implementation of Lake 7 is needed by 2058 in order to meet peak day demands, but could be delayed until almost 2088 if annual supplies were the only consideration. Figure ES.8 illustrates the timing and supplies from this supply package.

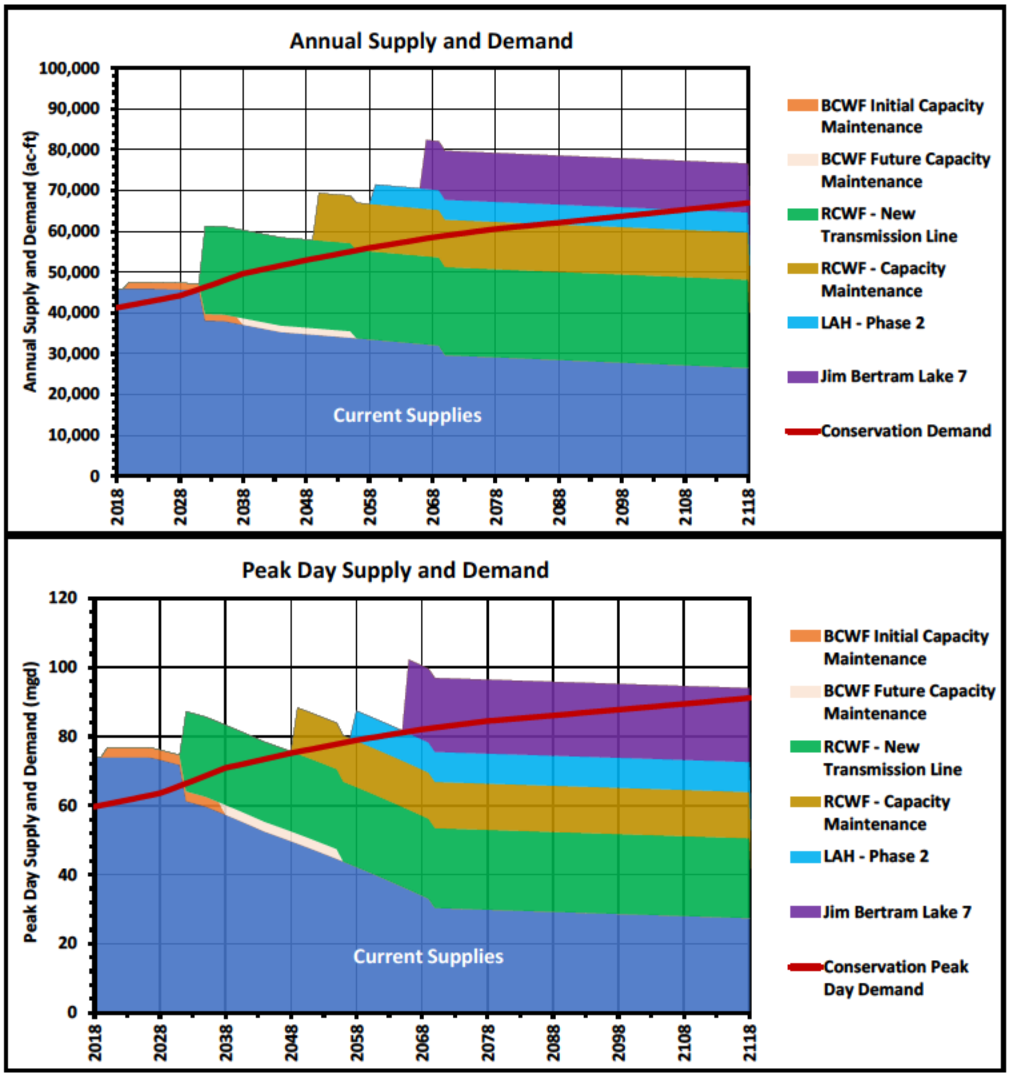
Figure ES.8. Maximize RCWF Supply Package



Supply Package 3 – Maximize Groundwater

This supply package meets water demands under the Conservation demand scenario. The Maximize Groundwater supply package is similar to the Maximize RCWF package, except that the BCWF continues to be expanded and maintained in order to retain its current 30 mgd peak day supply capacity, and the order in which the surface water supply projects (LAH Phase 2 and Lake 7) are implemented is reversed. Figure ES.9 illustrates the timing and supplies from this supply package.

Figure ES.9. Maximize Groundwater Supply Package



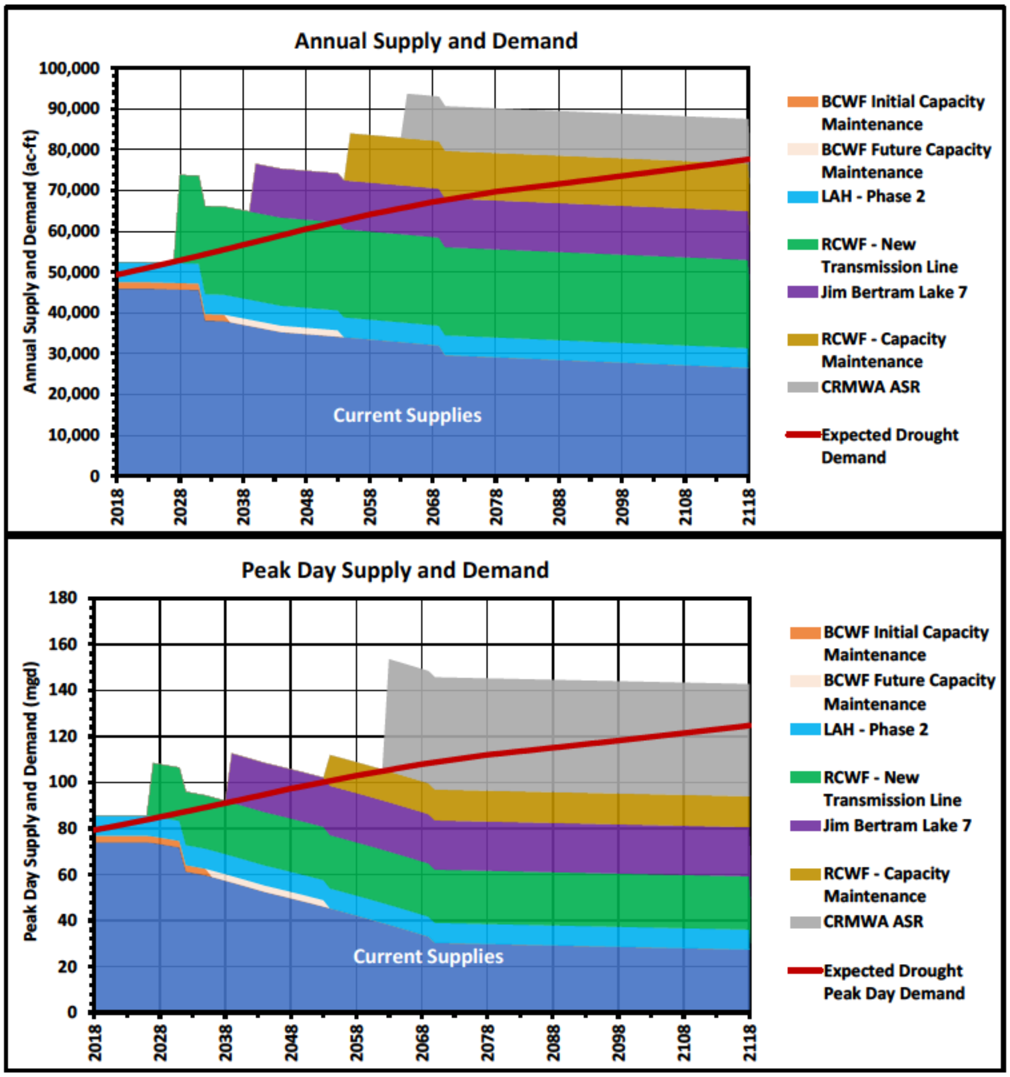
Annual Supply and Demand

Peak Day Supply and Demand

Supply Package 4 – Expected Drought Demands

This supply package is intended to meet the larger water demands under the Expected Drought Demand scenario. Under the Expected Drought Demand scenario, population growth follows the Expected Growth progression, but water demands are not mitigated by successful conservation efforts and is what would be expected under severe drought conditions. The Drought Demands supply package initiates water supply strategies sooner than the previous packages. If peak day demands can be mitigated, then the CRMWA ASR project can be delayed or phased in more slowly over time during the later years. This supply package demonstrates the intensive water supply development that would be required if anticipated conservation savings are not realized. Figure ES.10 illustrates the timing and supplies from this supply package.

Figure ES.10. Drought Demands Supply Package



Package 5 – Accelerated Population Growth

The Accelerated Population Growth supply package is designed to meet water demands under a combination of faster than expected population growth, but with annual water demands mitigated by conservation savings. Under the Accelerated Population Growth scenario, annual water demands are actually smaller than the Expected Drought water demands met by the Expected Drought Demand water supply package in early years of the timeline because it is assumed that the accelerated population growth would necessitate more immediate water conservation savings. However, this scenario assumes that peak day reduction efforts are not as effective, and the timing of most of this package is driven by the need to meet future peak day demands. Figure ES.11 illustrates the timing and supplies from this supply package.

Figure ES.11. Accelerated Population Growth Supply Package

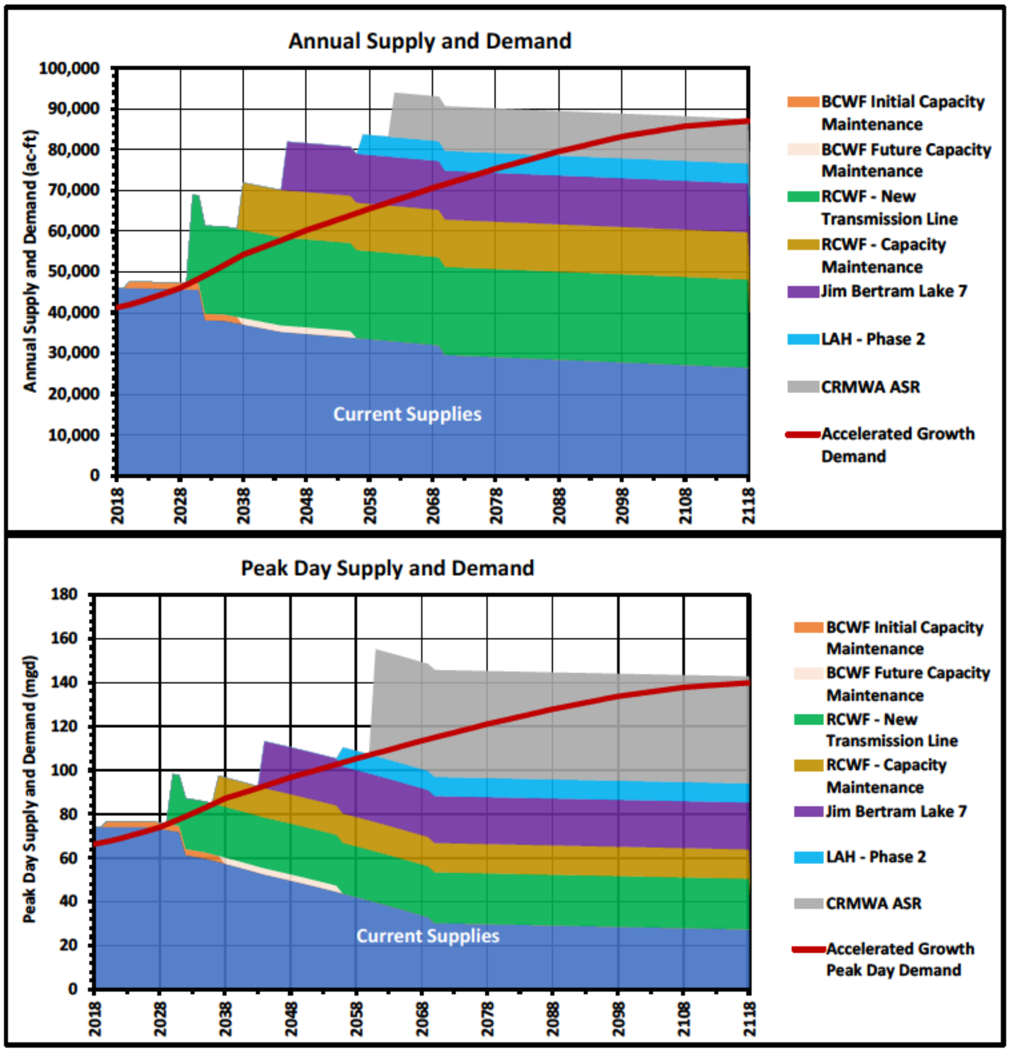


Table ES.2. Comparison of Supply Packages

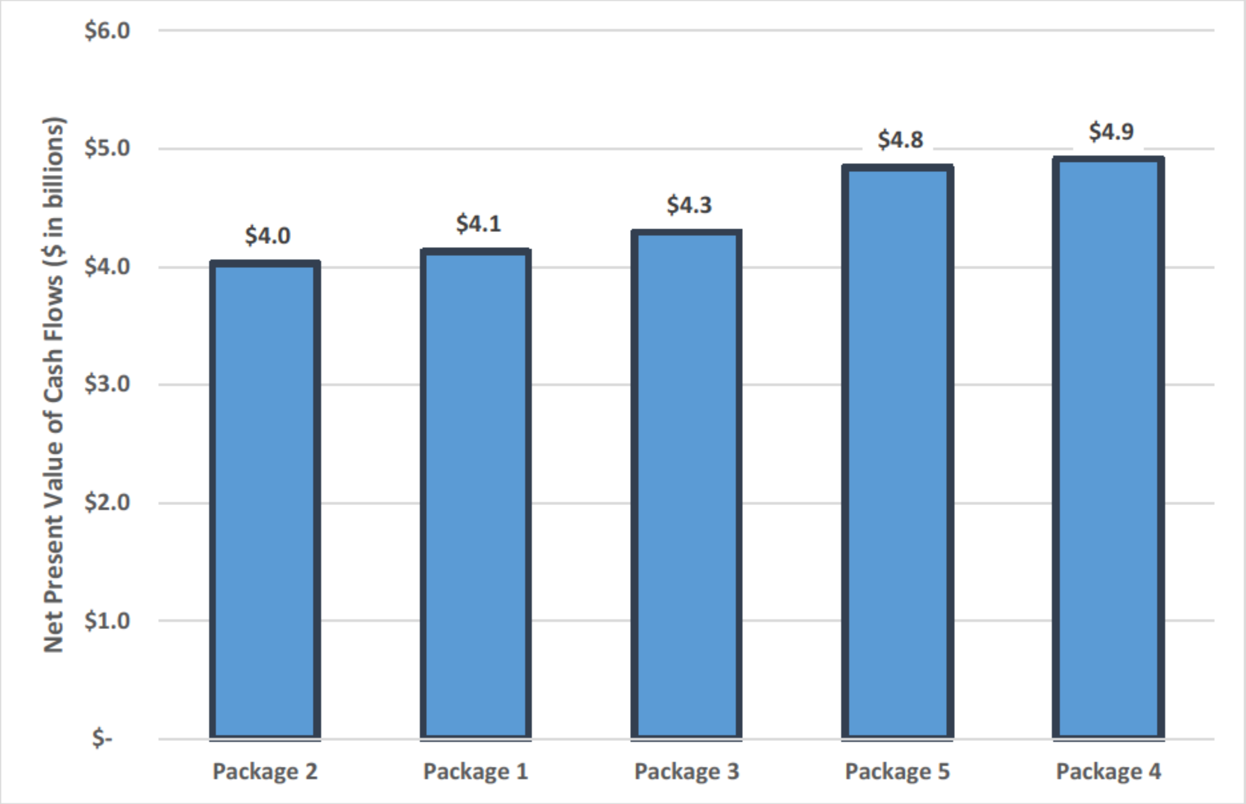
Supply Package 1 Early Diversification	Supply Package 2 Maximize RCWF	Supply Package 3 Maximize Groundwater	Supply Package 4 Drought Demands	Supply Package 5 Accelerated Population Growth
2018				
		2020: BCWF ICM 2026: BCWF CM-1	2018: BCWF ICM 2018: LAH Phase 2 2024: BCWF CM-1	2020: BCWF ICM 2026: BCWF CM-1
2028				
2031: BCWF ICM 2032: Jim Bertram Lake 7 2037: BCWF CM-1	2031: RCWF New Transmission	2032: RCWF New Transmission 2032: BCWF CM-2	2027: RCWF New Transmission 2030: BCWF CM-2	2032: BCWF CM-2 2030: RCWF New Transmission
2038				
2040: LAH Phase 2 2043: BCWF CM-2	2046: RCWF ICM	2038: BCWF CM-3 2044: BCWF CM-4	2036: BCWF CM-3 2039: Jim Bertram Lake 7 2042: BCWF CM-4	2037: RCWF ICM 2038: BCWF CM-3 2044: BCWF CM-4 2044: Jim Bertram Lake 7
2048				
2049: BCWF CM-3 2049: RCWF ICM 2055: BCWF CM-4		2049: RCWF ICM 2050: BCWF CM-5	2048: BCWF CM-5 2054: RCWF ICM	2050: BCWF CM-5 2056: LAH Phase 2
2058				
2061: BCWF CM-5 2065: RCWF New Transmission	2058: Jim Bertram Lake 7	2058: LAH Phase 2 2066: Jim Bertram Lake 7	2063: CRMWA ASR	2061: CRMWA ASR 2067: RCWF CM-1
2068				
	2076: RCWF CM-1			
2078				
2079: RCWF CM-1		2079: RCWF CM-1	2084: RCWF CM-1	
2088				
	2093: LAH Phase 2			2097: RCWF CM-2
2098				
	2106: RCWF CM-2			
2108				
2109: RCWF CM-2		2109: RCWF CM-2	2114: RCWF CM-2	
2118				

Note: ICM = Initial Capacity Maintenance, CM-1 = Capacity Maintenance-1, CM-2 = Capacity Maintenance-2, etc.

ES.7 Financial Impact of the Water Supply Packages

Each water supply package represents a substantial capital investment by the City, which will vary based upon the actual timing of when specific projects are implemented. In order to illustrate the costs and provide a comparison between the packages, the net present value of each package was determined based upon the implementation schedule proposed for each package. Figure ES.12 presents the net present value of each water supply package. In addition, the future debt service was determined for each package, which is presented in Section 13.

Figure ES.12. Net Present Value Comparison of Supply Packages



Supply Packages 1, 2 and 3 have the smallest net present values and are based on satisfying the Conservation Demands projection. Supply Packages 4 and 5 are the most costly and are based on meeting the greater Expected Demands and Accelerated Growth Demands projections.

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  - B.1. Current Annual and Peak Day Water Supply Projections
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Acronyms and Abbreviations

Term	Definition
210 Authorization	30 Texas Administrative Code Chapter 210
AAD	Average Annual Day
ac-ft/yr	acre-feet per year
AOP	advanced oxidation process
APAI	Alan Plummer Associates, Inc.
ASR	aquifer storage and recovery
ATP	advanced treatment plant
AWC	average winter consumption
AWD	Annual Water Demand
AWWA	American Water Works Association
BCWF	Bailey County Well Field
BNR	biological nutrient removal
BRA	Brazos River Authority
CCL	Candidate Contaminate List
cfs	cubic feet per second
City	City of Lubbock, Texas
CM	Capacity Maintenance
CR	County Road
CRMWA	Canadian River Municipal Water Authority
DBS&A	Daniel B. Stephens & Associates
DFC	Desired Future Conditions
DPR	Direct Potable Reuse
ECC	Emerging Constituents of Concern
EID	Environmental Information Document
EPS	effluent pumping stations
ETHP	Edwards-Trinity High Plains
FM	Farm-to-Market Road
GAC	Granular Activated Carbon
GAM	Groundwater Availability Model
GCD	Groundwater Conservation District
GMA	Groundwater Management Area
gpcd	gallons per capita per day

Term	Definition
gpf	gallons per flush
gpm	gallons per minute
HET	high-efficiency toilet
HLAS	Hancock Land Application Site
Hp	horsepower
HPUWCD	High Plains Underground Water Conservation District No. 1
ICI	industrial, commercial and institutional
IFAS	Integrated Fixed-film Activated Sludge
JBLS	Jim Bertram Lake System
kwh	kilowatt-hour
LAH	Lake Alan Henry
LAHPS	Lake Alan Henry Pump Station
LLAS	Lubbock Land Application Site
µS/cm	microSiemens per centimeter
mg	million gallons
mg/L	milligrams per liter
mgd	million gallons per day
NFD-LAHPS	North Fork Diversion to Lake Alan Henry Pump Station
NFDMF	North Fork of the Double Mountain Fork of the Brazos River
NPV	net present value
NTU	Nephelometric Turbidity Units
NWTP	North Water Treatment Plant
NWWRP	Northwest Water Reclamation Plant
PDD	Peak Day Demand
PF	Peaking Factor
PPCP	pharmaceuticals and personal care products
PPS	Post Pump Station
PS	Pump Station
RCWF	Roberts County Well Field
Region A	Panhandle Water Planning Area or Group
Region O	Llano Estacado Water Planning Area or Group
RO	reverse osmosis
ROI	Return on Investment
RWA	Reclaimed Water Availability
SB3	Senate Bill 3

Term	Definition
SCADA	Supervisory Control and Data Acquisition
SEWRP	Southeast Water Reclamation Plant
SLPS	Southland Pump Station
SWSP	Strategic Water Supply Plan
SWTP	South Water Treatment Plant
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDS	total dissolved solids
TPDES	Texas Pollutant Discharge Elimination System
TWDB	Texas Water Development Board
USACE	United States Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UV	ultraviolet
WAM	Water Availability Model
WET	Water Education Team
WRMWD	White River Municipal Water District

1 Introduction

1.1 History

The City of Lubbock, Texas (the City) city council approved an initial Strategic Water Supply Plan (SWSP) in July 2007. The goal of the Water Utilities Department is to update the Plan every five years in order to keep planning information as current as possible. Prior to the 2007 Plan, other water planning documents were prepared as needed by the City or by consultants hired by the City. Excerpts from these documents are referenced in the 2007 Plan[1] and summarized in Table 1.1.

Table 1.1. Studies referenced during the development of the Lubbock 2007 SWSP

Study Name	Study Date	Author
2004 City of Lubbock Strategic Water Plan	2004	Water Texas
2001 City of Lubbock Water Supply Evaluation	2001	Black & Veatch
1999 City of Lubbock 50-Year Water Plan	1999	City water staff
1992 Comprehensive Groundwater Management Study for the City of Lubbock	1992	Geraghty & Miller, Inc
1975 Plan for Additional Water Supply- Lubbock, Texas	1975	Freese & Nichols
1971 Report on Water Supply – Lubbock, Texas	1971	Freese, Nichols & Endress
1968 Interim Report on Water Supply – Lubbock, Texas	1968	Freese, Nichols & Endress

In 2013, the City prepared a comprehensive 100-year Strategic Water Supply Plan (2013 SWSP), which evaluated the City's projected population growth and associated water demands through year 2113, summarized the City's current water supplies, and evaluated various water supply strategies for meeting projected water supply shortages. The 2013 SWSP combines those strategies into several packages, any of which can be pursued to meet the City's goals. These packages take into account the City's annual water supply volume needed, as well as the City's maximum, or peak, day demands. Since development of the 2013 SWSP, the City has evaluated several water supply strategies in greater detail and developed additional information regarding the strategies, including cost and implementation issues. This 2018 SWSP is an update of the 2013 SWSP, and takes into account the results of strategy evaluations since 2013.

In addition to Lubbock's planning efforts, the State of Texas passed legislation in 1999 which required the creation of 16 Regional Water Planning Areas across the State. Regional Water Planning Groups were appointed for each area, and are tasked with developing water supply plans for their respective areas. Lubbock is located within the Llano Estacado (Region O) Water Planning Area as depicted in Figure 1.1 and is currently represented by the Director of

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[1] 2007 Strategic Water Supply Plan for the City of Lubbock, Section 4.0.

Water Utilities on the Region O Water Planning Group. The first regional plans were completed in 2001 with subsequent updates to the plans in 2006, 2011 and 2016. All of the regional plans are incorporated into the State Water Plan which is released one year later (i.e. 2002, 2007, 2012, and 2017). The Region O Plan includes water management strategies for Lubbock and surrounding communities as well as for agriculture, mining, and industry.

1.2 Purpose

The City of Lubbock will continuously refine and implement its 100-year strategic water supply plan. Continual updates are essential in order to ensure that a sufficient water supply is available at the time that it is needed. The purpose of this Plan is to provide the framework for the City to develop sustainable water sources that can be implemented within appropriate time frames and in the most cost efficient manner. This Plan will also be utilized to support the City's position in the on-going regional water planning process. The City's goals include:

- Providing a roadmap to development and implement cost-effective and sustainable water supplies over the next 100-years;
- Diversifying the City's water supply portfolio to minimize risk associated with variable climate conditions and weaknesses associated with each water supply. Diversification strategies include implementing multiple groundwater, surface water and reclaimed water supplies to create a more reliable, sustainable, and resilient system; and
- Emphasize water conservation efforts to delay expensive water supply projects.

1.3 Description

The following steps are involved in the water supply planning process:

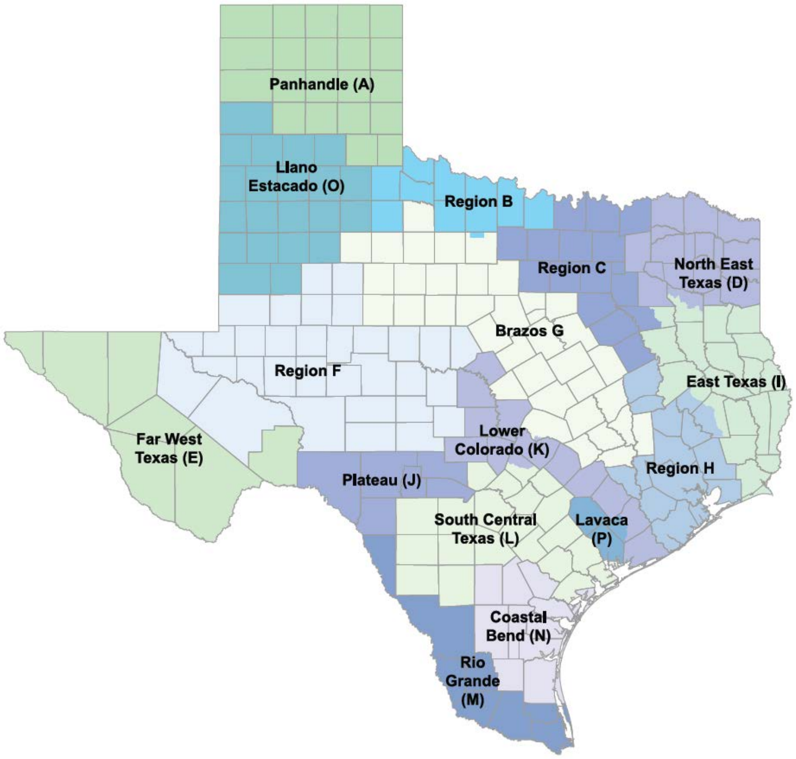
- Step 1 – Estimate Water Demand
- Step 2 – Calculate Long-term Yield of Current Water Supplies
- Step 3 – Determine When Water Deficits Begin to Occur
- Step 4 – Evaluate the Role of Water Conservation
- Step 5 – Identify Water Supply Strategies
- Step 6 – Evaluate and Rank Water Supply Strategies
- Step 7 – Create Supply Packages to Satisfy Future Needs
- Step 8 – Calculate the Financial Impact
- Step 9 – Implement the Plan
- Step 10 – Continuously Analyze and Refine the Plan

This Plan follows Steps 1 through 8. Steps 9 and 10 are dynamic steps that will evolve year by year. The planning horizon in this document includes the next 100 years. Projections have been made with the following three planning periods in mind:

Short Range Planning	12 years	2018 – 2030
Medium Range Planning	50 years	2031 – 2068
Long Range Planning	100 years	2069 – 2118

Potential water conservation strategies with associated costs are evaluated. In addition, potential water supply strategies are grouped into four categories: reclaimed water, groundwater, surface water and aquifer storage and recovery (ASR). These strategies include estimated volumes of available water and costs to implement each strategy. The 18 water supply strategies are evaluated, ranked, and subsequently packaged to meet future needs. Various strategies are placed into five supply packages to demonstrate ways to meet expected conservation demand, expected drought demand, and accelerated drought demand scenarios. Supply packages are presented for planning purposes only. Many strategies are interchangeable with flexible implementation schedules based upon a variety of unpredictable variables including climate conditions, population, per capita consumption, industry need, changes in regulatory environments, etc. Each package of strategies includes a net present value financial analysis.

Figure 1.1. Regional Water Planning Areas



Source: Texas Water Development Board. http://www.twdb.texas.gov/publications/shells/RegionalWaterPlanning.pdf

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2 Water Demand Projections

Water demand projections are the driving force behind water supply decisions and are dependent upon population and per capita consumption estimates. In this section, the 2018 Strategic Water Supply Plan (SWSP) (or "2018 Plan") projections are compared with former projections from the City's 2013 SWSP[1] and the 2021 Llano Estacado (Region O) Regional Water Plan.[2] It is important to note that the 2021 Region O Water Plan projections extend only to the year 2070, whereas the City's 2013 SWSP extends to 2113, and this 2018 Plan extends to 2118. Where applicable, at least 35 years of historic data are presented to provide context for future projections.

2.1 Population

The population projections in this 2018 Plan are based on the 2010 Federal Census data[3] and the City Planning Department's historical population information. This Plan projects population for the following four communities that receive water from the City of Lubbock Water System (2010 Census populations included):

- City of Lubbock (229,573 people)
- City of Shallowater (2,484 people)
- Town of Ransom Canyon (1,096 people)
- Buffalo Springs Lake (453 people)

The smaller communities make up less than 2% of Lubbock's total population, which is well within the margin of error for population projections.

The two following population scenarios are presented in this 2018 Plan.

Expected Growth – This scenario depicts the expected population growth in the City and closely corresponds to the City Planning Department's projections for the first 20 years. The Expected Growth projection consists of a 1.20% per year growth rate through 2038.[4] After this period, the growth rate drops to 0.80% per year and declines 0.10% every decade until 2079, at which point it remains constant at 0.40% per year growth. This scenario is comparable to the Probable Population scenario from the 2013 Plan.

Accelerated Growth – This scenario depicts what would occur if the City experiences accelerated growth over the next 20 years. The rate for the Accelerated Growth projection starts at 1.20% per year and increases by 0.10% per year until it reaches 1.70% per year and

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[1] Strategic Water Supply Plan. City of Lubbock. February 2013: Section 2.3 Annual Water Demand.

[2] Llano Estacado (Region O) 2021 Regional Water Plan. DRAFT Population and Water Demand Projections.

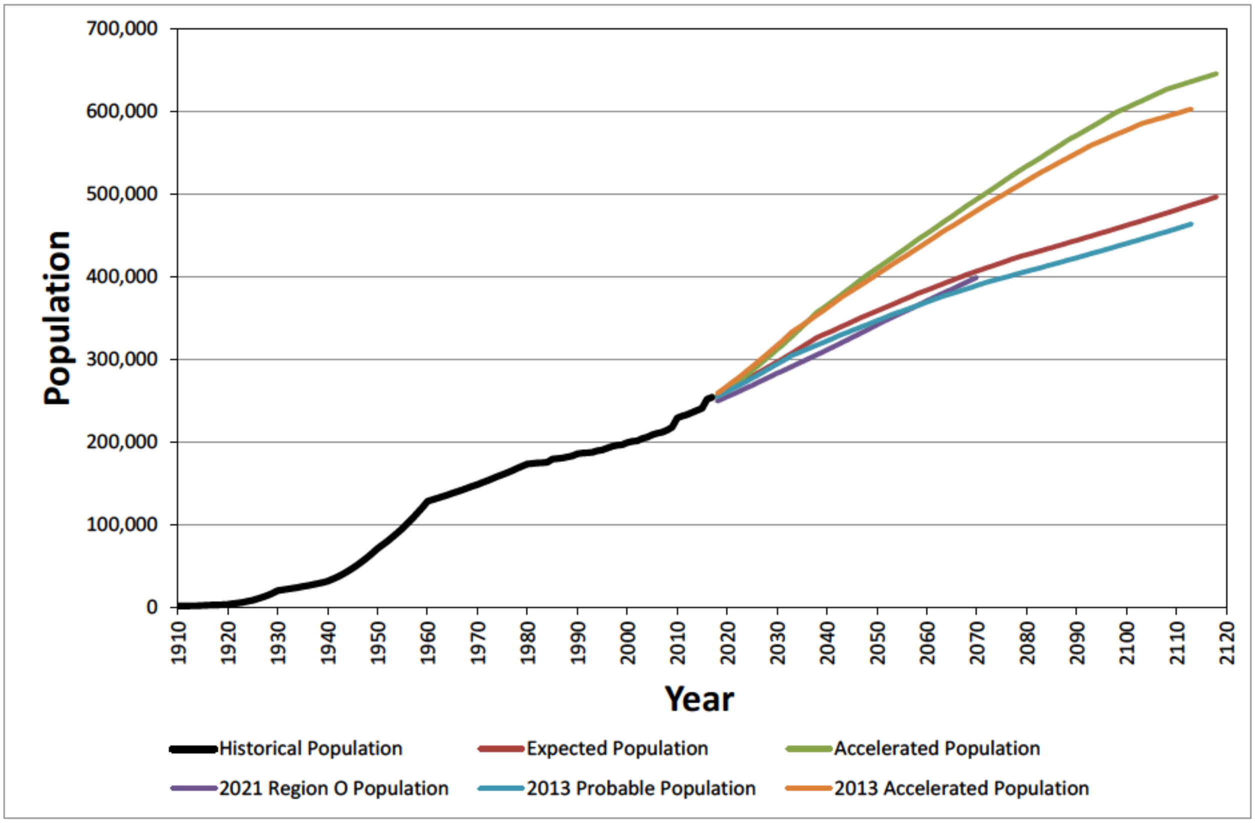
[3] United States Census Bureau Quick Facts United States. Address: https://www.census.gov/quickfacts/table/PST045216/4845000,48.

[4] In comparison, the City of Lubbock Planning Department projects a 1.12% annual growth rate from 2010-2040. The Planning Department has not generated population projections beyond 2040.

remains constant through 2038. After 2038, the growth rate declines to 1.20% per year for a decade, 1.00% per year for the following decade, and then declines 0.10% per decade from 2058 through 2098. For the last two decades, the growth rate declines by 0.15% per decade.

Figure 2.1 compares the population projections from these two scenarios with the projections utilized in the 2013 SWSP and those planned for use in the 2021 Region O Plan. Historic and projected population tables are included in Appendix A.1 and A.2, respectively.

Figure 2.1. Historical and Projected Population



The Expected Growth scenario for this 2018 Plan projects the following populations for the City of Lubbock and three customer cities:

- 290,258 in the year 2028
- 403,152 in the year 2068
- 497,140 in the year 2118

2.2 Per Capita Consumption

The State of Texas Water Conservation Task Force has established municipal per capita consumption goals, urging cities to implement measures that lower their per capita consumption each year. The Water Conservation Task Force has recommended a per capita consumption goal of 140 gallons per capita per day (gpcd).[5] The recommendation is for entities above 140 gpcd to implement management practices that reduce annual consumption by one percent of the total gpcd, based upon a five-year rolling average until the entity achieves a total gpcd less than 140.[6] The Llano Estacado Regional Water Planning Group considers the one percent annual reduction to be too aggressive for municipalities in the region and has recommended a more conservative 0.5 percent annual gpcd reduction based on a five-year rolling average until the goal of 140 gpcd is met. A slower reduction in consumption will assist water utilities to maintain revenue stability.[7]

For this 2018 Plan, two per capita consumption scenarios were developed. Both reflect the more stringent goal of 140 gpcd set by the Water Conservation Task Force, but the scenarios differ in terms of the time in which this is accomplished. The two consumption scenarios are described below.

Drought Consumption – This scenario starts at 171 gpcd. The gpcd was calculated from the gpcd of 178 in 2011 (the driest year on record) and declines at a 0.54% per year to have a starting value of 171 gpcd in 2018. The consumption continues to decline at 0.50% per year until 2038, when it reaches a gpcd of 155. Over the next 80 years, the per capita consumption declines at a slower rate of 0.13% per year, reaching 139 gpcd in 2118.

Conservation Consumption – This scenario demonstrates the effect on water demand if the City continues focusing on their water conservation efforts. The Conservation Consumption scenario starts at 143 gpcd in 2018 (Lubbock's five-year rolling average per capita consumption from 2012 to 2016). Note that the City's water conservation efforts have lowered the gpcd below the goals set forth in the City of Lubbock's Water Conservation Plan[8] of 150 gpcd by 2019 and 147 gpcd by 2024. By 2022, the gpcd reaches 140, the goal set by the Water Conservation Task Force. After this period, the per capita consumption declines at a slower rate of 0.149% per year, reaching 120 gpcd in 2118.

The drought consumption and conservation consumption scenarios from this 2018 Plan and the 2013 Plan are compared with the consumption values to be used in the draft 2021 Region O Plan in Figure 2.2, which also includes historical consumption values since 1980. Historic and projected per capita consumption tables are included in Appendix A.1 and A.3 respectively.

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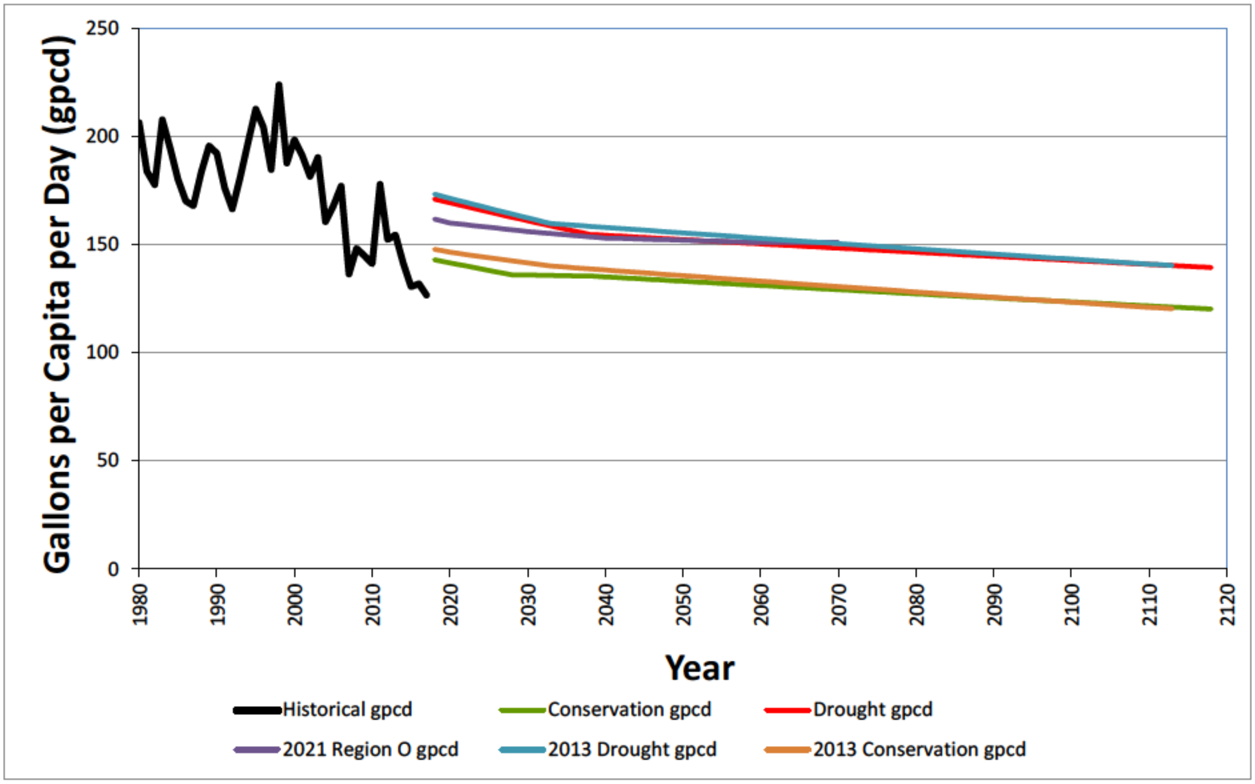
[5] Texas Water Development Board Special Report: Report to the 79th Legislature. Water Conservation Implementation Task Force. Austin, TX. November 2004: 31-33.

[6] 2016 Llano Estacado Regional Water Plan. Llano Estacado Regional Water Planning Group. December 2015: Section 5.2.1.

[7] 2016 Llano Estacado Regional Water Plan. Llano Estacado Regional Water Planning Group. December 2015: Section 5.2.1.

[8] Water Use Management Plan – Water Conservation Plan. City of Lubbock. Ordinance 2010-O0055 adopted 7/22/2010; Ordinance 2014-O0167, sec. 3, adopted 12/18/2014.

Figure 2.2. Historical and Projected Per Capita Water Consumption



2.3 Annual Water Demand

Lubbock's Annual Water Demand (AWD) projections consist of three scenarios, which were developed from different combinations of the two population scenarios described in Section 2.1 and the two per capita consumption scenarios described in Section 2.2. The AWD scenarios are as follows.

Expected Drought Demand – (Expected Growth x Drought Consumption) – This scenario represents the expected demand during times of drought since it includes the expected population and drought consumption projections. This scenario is comparable to the Probable Drought scenario from the 2013 Plan.

Conservation Demand – (Expected Growth x Conservation Consumption) – This scenario is included to provide an understanding of the impact that aggressive water conservation efforts will continue to have on future water demands.

Accelerated Growth Demand – (Accelerated Growth x Conservation Consumption) – This water demand projection reflects an accelerated population growth combined with conservation consumption. If population growth rates exceed the Expected projections, then this scenario assumes that conservation efforts will be implemented to offset the increased demands of the faster population growth. Note that these Accelerated Growth Demands are smaller than the Expected Drought Demands during the earlier years of the plan, but exceed the Expected Drought Demands beginning in year 2051. This indicates that aggressive conservation efforts alone will not be able to meet future needs if population grows substantially faster than expected.

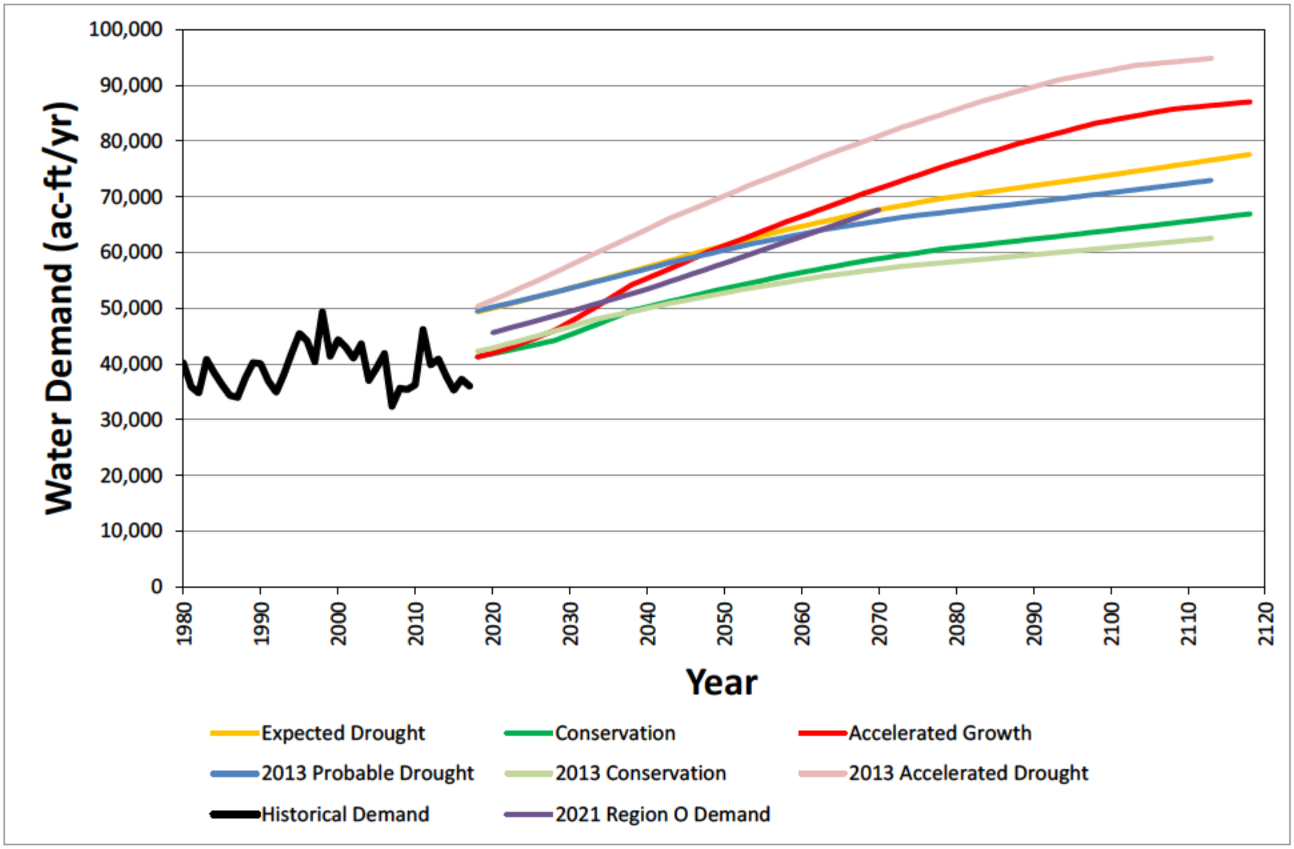
Historic and projected tables of AWD are included in Appendix A.1 and A.3 respectively, and are summarized in Table 2.1. A comparison of this Plan's AWDs to the 2021 Region O Plan and the City's 2013 Plan is shown in Figure 2.3. Historical and Projected Annual Water Demands. The demand curves for the expected population growth scenarios are similar to those utilized for Probable and Conservation scenarios in the 2013 Plan, except that the 2018 Plan demands exceed those from the 2013 Plan starting between years 2040 and 2050. The Accelerated Demands are not similar between the two plans because of the aggressive conservation assumed for the Accelerated Growth scenario in the 2018 Plan.

Table 2.1. Annual Water Demand Projections

Scenario	2018	2028	2068	2118
Expected Drought	49,344	52,878	67,180	77,625
Conservation	41,266	44,221	58,498	66,954
Accelerated Growth	42,266	45,999	70,587	87,044

Note: measurements are in acre-feet per year (ac-ft/yr). One ac-ft is 325,851 gallons.

Figure 2.3. Historical and Projected Annual Water Demands



2.4 Peak Day Water Demand

Peak Day Demand (PDD) must be considered when planning and designing water systems, and is used in this Plan to determine the size of infrastructure necessary to support expected maximum daily demands on the water system. The PDD typically is associated with outside water use during summer months, and will vary from year to year as precipitation patterns and temperatures fluctuate. The PDD is based on the AWD discussed in Section 2.3. Projections for PDD are calculated as follows:

Average Annual Day (AAD) in million gallons (mg) = AWD / 365 days

PDD in mg = AAD x Peaking Factor (PF)

The PF is a constant determined using historically observed daily water production records. Table 2.2 shows highlighted years for Lubbock's historic PDD, ADD and PF. Appendix A.1 includes a more comprehensive table of historical PFs.

Table 2.2. Historic Peak Day Data

Year	Historic PDD (mg)	Historic AAD (mg)	Historic PF
Historic Reference			
1980	70.85	35.89	1.97
1985	65.18	32.41	2.01
1990	79.00	35.79	2.21
1995	79.54	41.32	1.92
2000	67.82	39.51	1.72
2005	62.54	35.09	1.78
Last 10 Years			
2008	53.66	31.85	1.69
2009	54.23	31.63	1.71
2010	50.40	32.38	1.56
2011	64.12	41.25	1.55
2012	58.07	35.59	1.63
2013	57.96	36.51	1.59
2014	50.04	33.76	1.48
2015	49.56	31.51	1.57
2016	58.37	33.29	1.75
2017	49.94	32.24	1.55

Notes: PDD = Peak Day Demand; mg = million gallons; AAD = Average Annual Day; PF = Peaking Factor

For planning purposes, the following two PFs have been developed.

Expected PF – A common rule of thumb employed in the water planning industry is to assume a PF of 2.0. However, over the last 10 years, the City of Lubbock's PF has been much lower than 2.0. Therefore, an Expected PF of 1.8 is used in this Plan. This number is derived from evaluating the previous 10 years and identifying the maximum PF, which was 1.75 in 2016, rounded to 1.80. The City is projecting that the amount of water used on a peak day will be 1.8 times greater than on an "average" day. This is comparable to the Probable scenario from the 2013 Plan.

Conservation PF – The Conservation PF shows the reduction in PDD that may be achieved if the City adopts more aggressive water conservation policies. The conservation PF begins at 1.62 (the average PF from the previous 10 years) and then decreases from 1.62 to 1.52 over the 100-year planning period.

These two PFs were used to create three PDD scenarios. The Expected PF was combined with the Expected Drought AWD to produce the Expected Drought PDD and with the Accelerated Growth AWD to produce the Accelerated Growth PDD. The Conservation PF was multiplied by the Conservation AWD to produce the Conservation PDD. The resulting PDDs are summarized in Table 2.3.

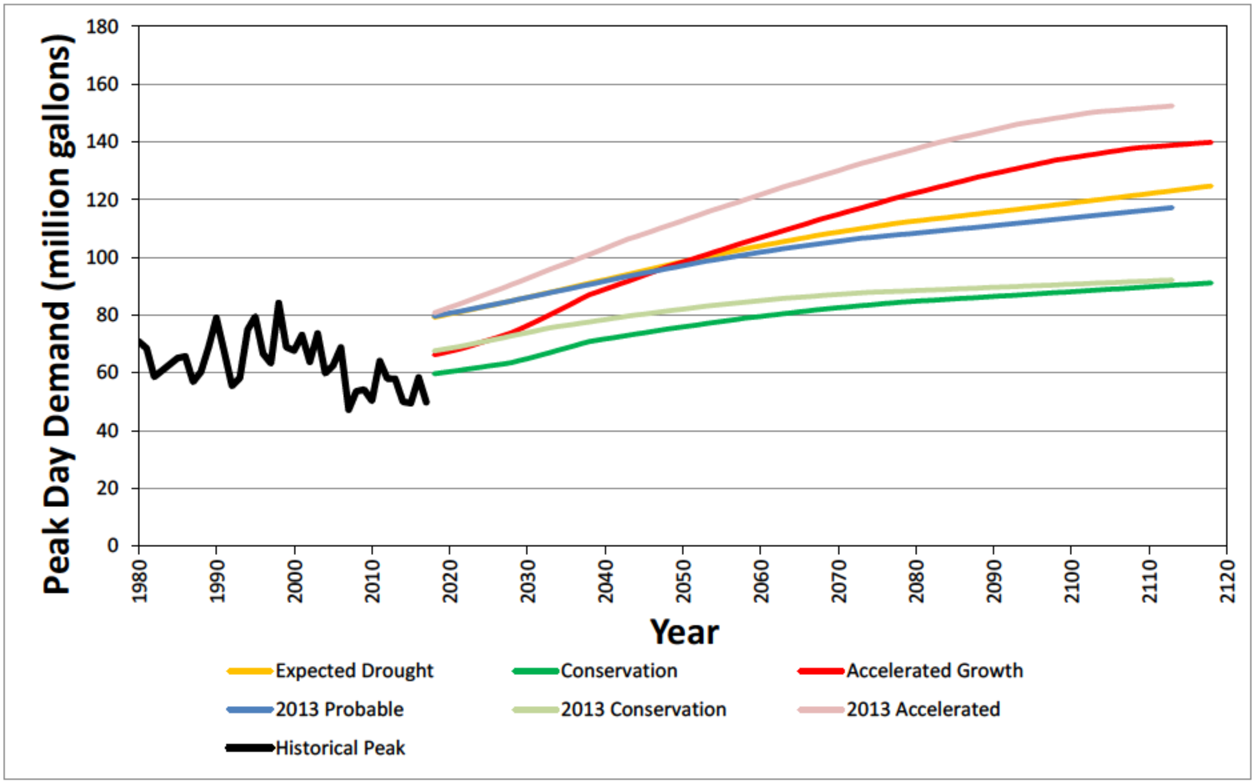
Table 2.3. Peak Day Water Demand Projections

Scenario	2018	2028	2068	2118
Expected Drought	79.29	84.97	107.95	124.74
Conservation	59.64	63.53	82.05	91.14
Accelerated Growth	66.31	73.92	113.43	139.87

Note: measurements in million gallons per day (mgd)

A comparison of this Plan's PDD to the 2013 Plan is provided in Figure 2.4 (see Appendix A.1 and A.4). The 2021 Region O Plan does not include PDD information, although a PF of 2.0 typically is used to size new infrastructure in the regional plans.

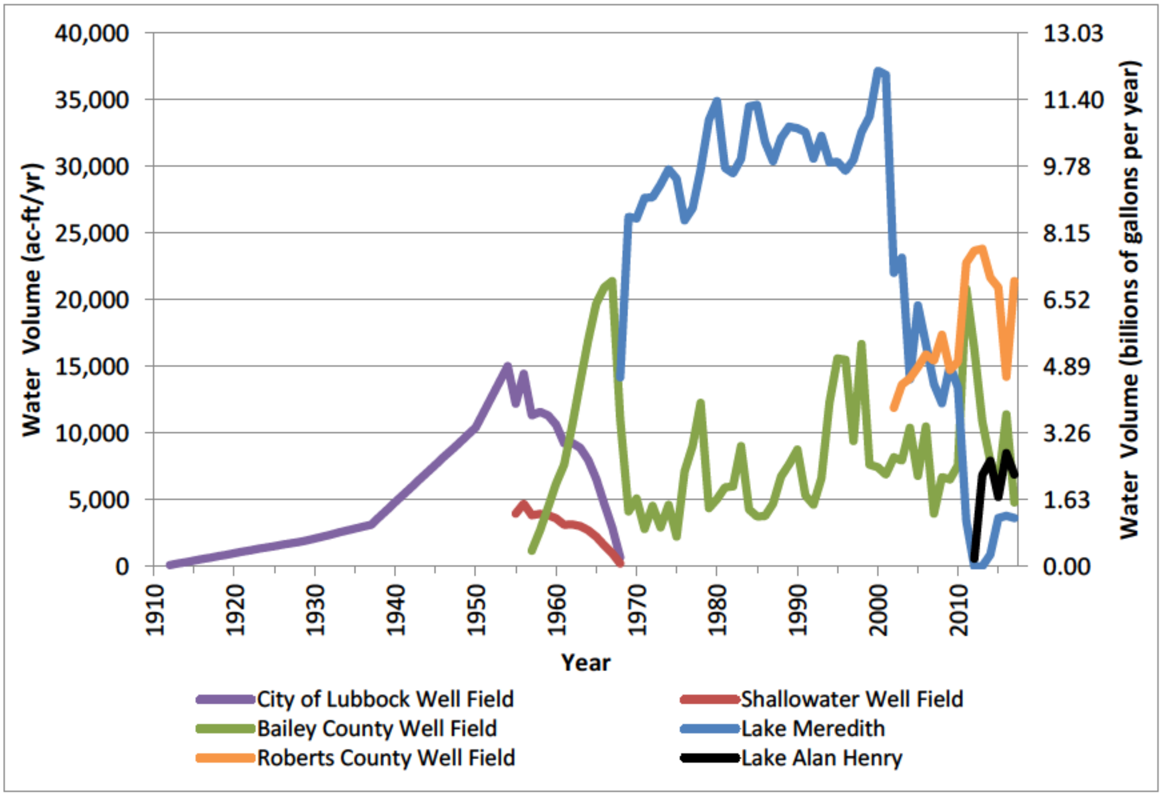
Figure 2.4. Historical and Projected Peak Day Demands



3 Decommissioned Water Supplies

Water supplies are dynamic natural resources. Over a period of decades, a once productive and cost effective water supply can become less desirable for a variety of reasons. Undesirable changes that can occur in a water supply include decreases in water quality, a decline in the sustainable yield, a depletion of the source of water, or a shift in the regulations governing water. Figure 3.1 depicts the City's historic water supply usage since the establishment of the City in 1911.

Figure 3.1. Lubbock's Historic Water Supply Usage

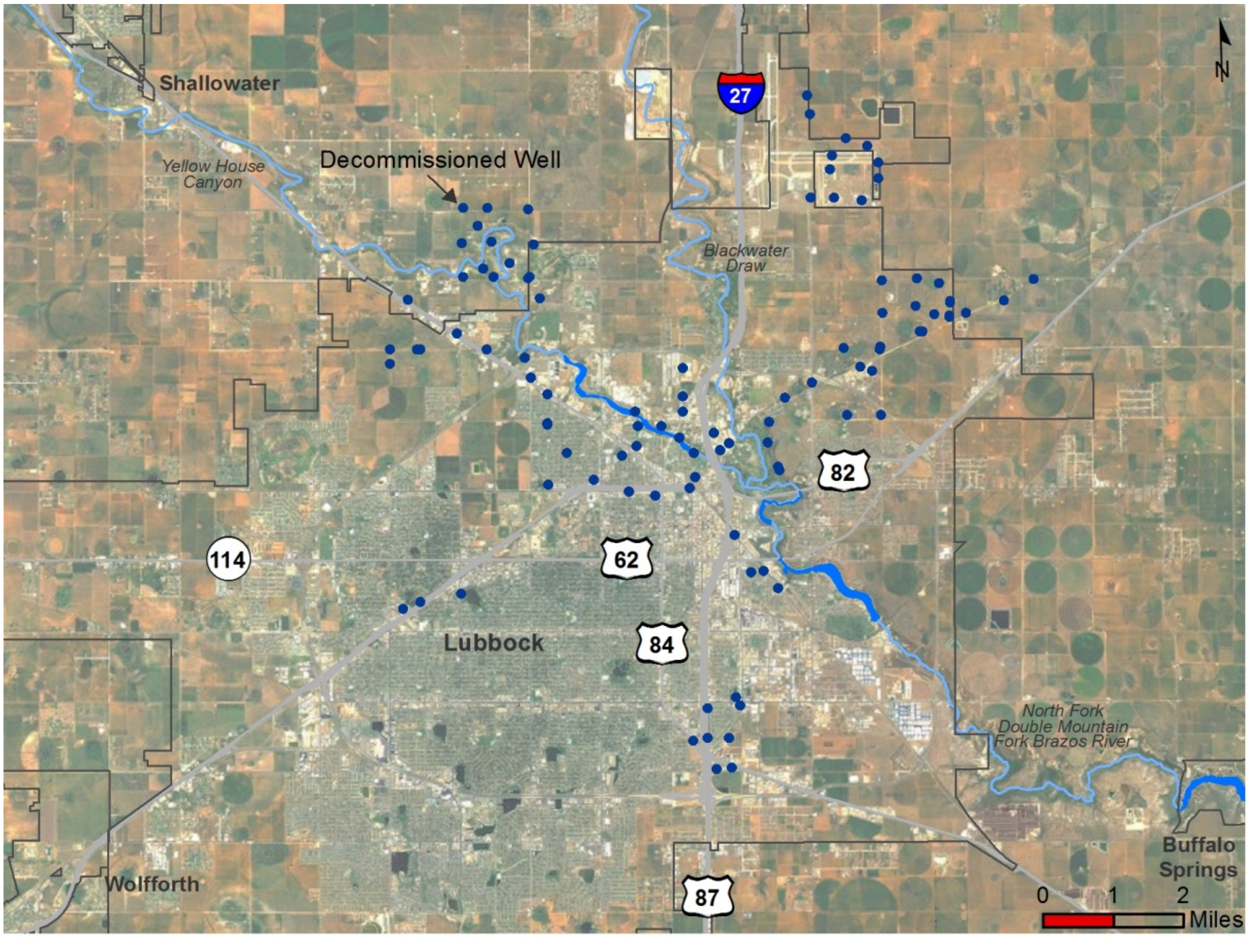


As shown on the graph, two of the City's past water supplies (City and Shallowater Well Fields) were used for a period of time and later decommissioned. A brief history of each of these decommissioned supplies is presented in this section.

3.1 City of Lubbock Well Field

When the first municipal water system was constructed for the City in 1911, it consisted of one well installed at a depth of 206 feet near the current intersection of 5th Street and Avenue J. From 1911 to 1954, the City owned 5.0 acres of water rights in and adjacent to the city limits. The City gradually expanded the number of wells it used. Groundwater pumped from well fields near the City was the only water supply for the City until the late 1950s when the Shallowater and Bailey County (Sandhills) Well Fields began to be used. Local well fields owned and operated by the City included the Northeast Well Field, the Airport Well Field, Pump Station #3 Well Field, Pump Station #6 Well Field, and Pump Station #7 Well Field. Figure 3.2 shows the location of the wells in the City Well Field.

Figure 3.2. City Well Field Locations



At its peak, the City Well Field included 61 wells. In the mid-1950s, the City began reducing the City Well Field production as the Shallowater Well Field and subsequently the Bailey County Well Field became operational. The City discontinued the use of the City Well Field when Lake Meredith water became available in 1968. The only local wells that were in operating condition and could potentially produce water for the City in the 1990s were the eight wells associated with Pump Station #6. At that time, it was estimated the combined production of these wells was 8 million gallons per day (mgd).[1]

The City eventually decided to decommission the City Well Field due to changes in the water quality of the groundwater under the City as Lubbock became more populated and urban sources of contamination impacted the groundwater supply. In addition, some of the naturally occurring minerals (such as fluoride) could not meet the increasingly stringent water quality standards set by regulatory agencies. These local wells that were once used for potable purposes are no longer part of the City's water supply. By 2012, all of the inactive City potable water supply wells had been plugged and abandoned.

3.2 Shallowater Well Field

In 1953, the City purchased 2,060 acres of water rights in Hockley and Lubbock counties, about 12 miles northwest of the City of Lubbock, and subsequently constructed the Shallowater Well Field.[2] The well field was used by the City from 1955 until 1968 when Lake Meredith became the main source of drinking water for the City. It appears that the City stopped using the Shallowater Well Field in the 1960s due to water quality issues. Furthermore, the production capacity of the Ogallala Aquifer near the well field had declined rapidly due to heavy agricultural irrigation surrounding the well field over the past century.

The Shallowater Well Field consists of 17 wells, which cover the entire water rights acreage. The well field location and infrastructure are depicted in Figure 3.3.

In 2011, City staff evaluated whether the well field should be rehabilitated or decommissioned, and recommended that the well field be decommissioned for the following reasons:[3]

- Production capacity of the Shallowater Well Field is poor (average well capacity is 20 gallons per minute [gpm]);
- Ogallala Aquifer groundwater underlying the well field is of poor quality; and
- Existing water system infrastructure in the well field is in very poor condition.

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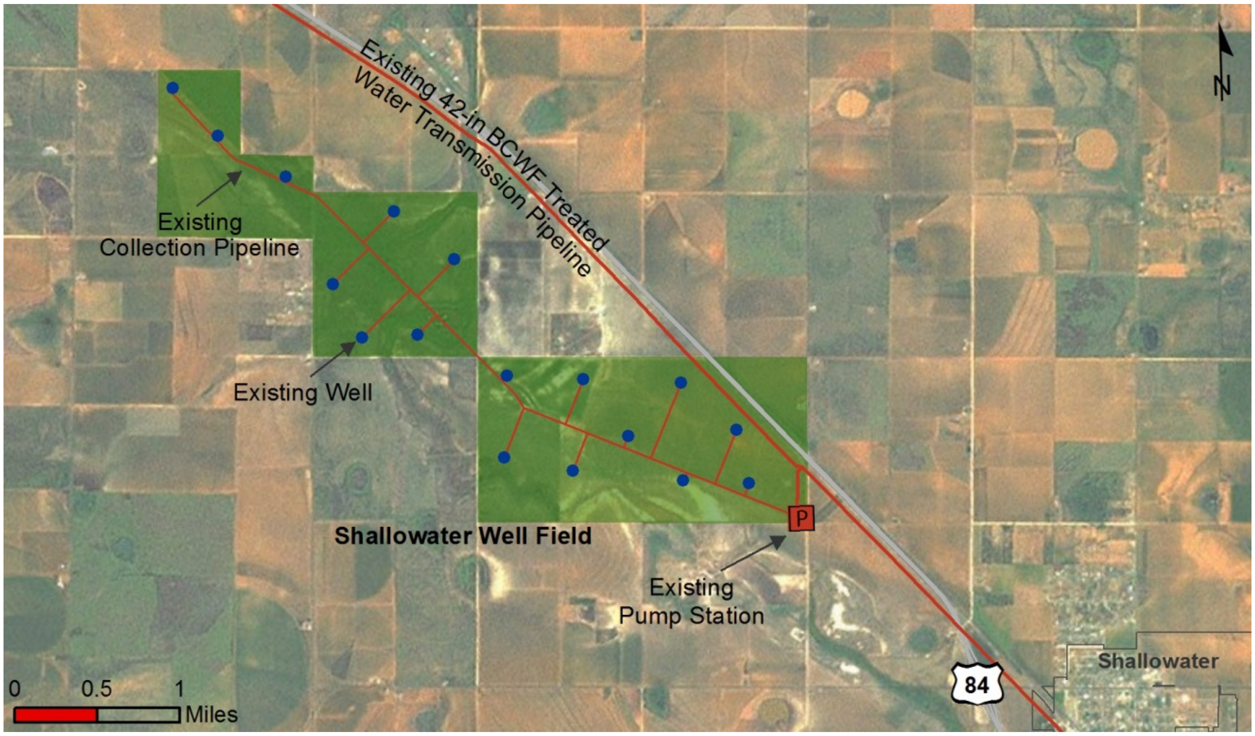
[1] Comprehensive Groundwater Management Study for the City of Lubbock. Geraghty & Miller, Inc. April 1992: Vol. 1, 57.

[2] City of Lubbock Water Advisory Commission; Orientation Manual. September 18, 2003.

[3] Shallowater Well Field Decommissioning Evaluation Memorandum. April 8, 2011.

Figure 3.3. Shallowater Well Field



It was estimated that it could cost more than $8,000,000 to replace all of the wells and upgrade the related infrastructure to meet current regulatory standards. These estimates did not include the cost of advanced water treatment facilities to correct water quality problems. Overall, the cost per recoverable acre-foot of groundwater for the Shallowater Well Field was determined to be at least seven times more expensive than expansions associated with the Roberts County (John C. Williams) and Bailey County (Sandhills) Well Fields.

4 Existing Water Supplies

The City of Lubbock (City) has relied upon a combination of both surface and groundwater for the last half century. Currently, the City's main water supplies consist of the following sources:

Canadian River Municipal Water Authority (CRMWA):

- Lake Meredith
- Roberts County Well Field (RCWF)

City-Owned:

- Bailey County Well Field (BCWF)
- Lake Alan Henry (LAH)

These four raw water supply sources and transmission facilities are shown in Figure 4.1. The current and future estimates of Lubbock's existing supplies presented in this section assume no expansion or maintenance over the 100-year planning period.

As depicted in Figure 4.1, Lubbock's closest existing water supply source is LAH, which is over 60 miles southeast of Lubbock. Lake Meredith and the RCWF are Lubbock's most distant water supply sources, located over 150 miles northeast of Lubbock. Their supplies must be transported through the CRMWA transmission pipeline and aqueduct.

Prior to 1968, groundwater withdrawals from the BCWF and local well fields were sufficient to meet the City's total water demand. In 1968, with the availability of surface water from Lake Meredith, groundwater withdrawals were reduced substantially. By the 1980s, Lake Meredith provided up to 90% of the City's water demand. However, Lake Meredith's yield began declining in the 1990's and by the end of 2001, groundwater was being used to replace a portion of Lake Meredith's supply. By September 2011, Lake Meredith's water level dropped to a point where CRMWA could no longer provide water from the reservoir to its member cities. From the Fall of 2011 until the Fall of 2012, the City met its water demand with 100% groundwater from the RCWF and the BCWF. Water from LAH became available in the Fall of 2012. LAH provided the City with 17% of its annual supply in 2013. In 2015, CRMWA began drawing water from Lake Meredith again. By 2017, Lake Meredith represented 11% of Lubbock's water supply used to meet demand.

Lubbock's water supplies have constantly changed over time depending on the demand and availability of surface water or groundwater supplies. Within the last 25 years, the profile of Lubbock's water supply has changed dramatically, as depicted in Figure 4.2.

- In 1992, Lubbock received 87% of its water supply from Lake Meredith, and the RCWF did not exist.
- By 2012, Lake Meredith was no longer a supply, and RCWF provided 58% of Lubbock's water supply.

- In 2016, a pipeline break forced the City to utilize additional supplies from the BCWF and less from the RCWF, but reliance on the BCWF was reduced in 2017 following repairs.
- In 2016 and 2017, surface water from Lake Meredith and LAH made up about 30 percent of the City's supply as all four sources were utilized.

As a result, continuous planning is essential to maximize the City's dynamic water supply situation.

4.1 Canadian River Municipal Water Authority Supplies

CRMWA was created by the Texas Legislature in 1953 to provide a source of municipal and industrial water for its eleven member cities located in the Texas Panhandle and South Plains. The CRMWA headquarters is located at Sanford Dam (Lake Meredith) about 37 miles northeast of Amarillo, Texas. Originally, CRMWA was organized to operate Lake Meredith, which was built and financed by the U.S. Bureau of Reclamation as part of the Canadian River Project. Later, the RCWF was constructed to supplement the lake supply.

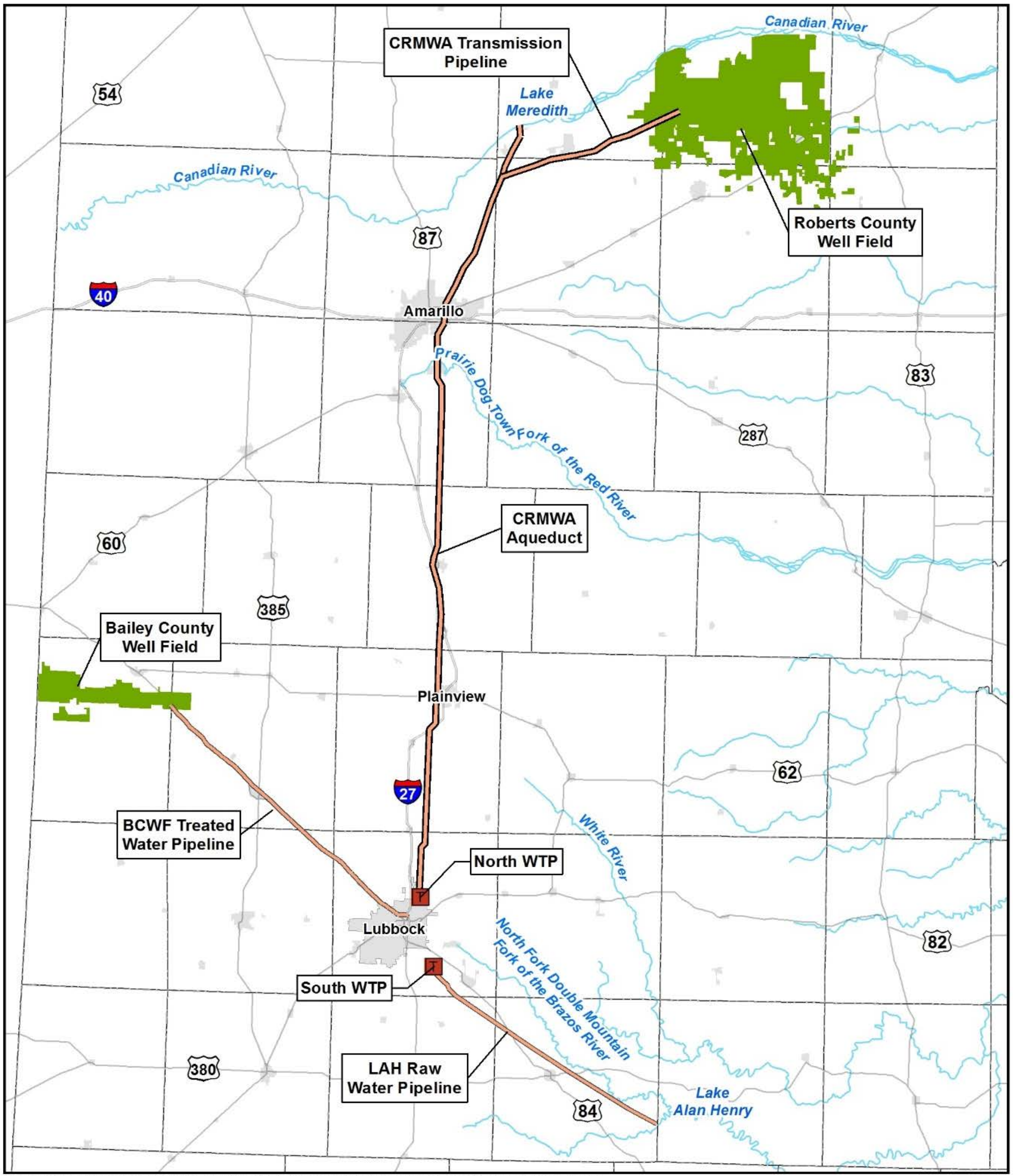
The water supply from CRMWA is conveyed via a 358-mile underground pipeline aqueduct system. Figure 4.3 depicts the current groundwater allocation of CRMWA supplies between the eleven member cities.

4.1.1 Lake Meredith

When construction began on Lake Meredith in 1962, initial estimates placed the firm yield of the Lake at 103,000 acre-feet per year (ac-ft/yr). Lake Meredith began to fill shortly after the Sanford Dam was completed in 1965. In 1968, CRMWA began delivering supply from Lake Meredith to member cities. Lubbock's initial allocation was 38,169 ac-ft/yr or 37 percent of the initial firm yield estimate. Later studies indicated that the firm yield of the lake was only 76,000 ac-ft/yr and Lubbock's allocation was reduced to 28,164 ac-ft/yr. As drought conditions continued over the last decade, the firm yield of the reservoir was further reduced to less than 50,000 ac-ft/yr. By 2011, insufficient inflows rendered the lake unusable until 2015 when the lake began to refill.

As a result of the declining water levels in the lake, the allocations to the member cities including Lubbock were proportionally reduced. Groundwater from the RCWF was used to make up the difference as much as possible. In 2011, during the worst one-year drought on record, Lake Meredith was used for summer peaking capacity only. After the summer of 2011, water could not be pumped from the lake until 2015, when inflows allowed water levels to begin recovering. Historic water levels in Lake Meredith are presented in Figure 4.4.

Figure 4.1. Current Water Supply Location Map



\\tx-austin\ActiveProjects\3291\10055566\7.0_GIS_Models\7.2_Work_In_Progress\GIS\Map_Docs\Draft\Current_Water_Supply_Location_Map.mxd [KJ]

Figure 4.2. Water Supply Contributions for 1992, 2002, 2012, 2016 and 2017

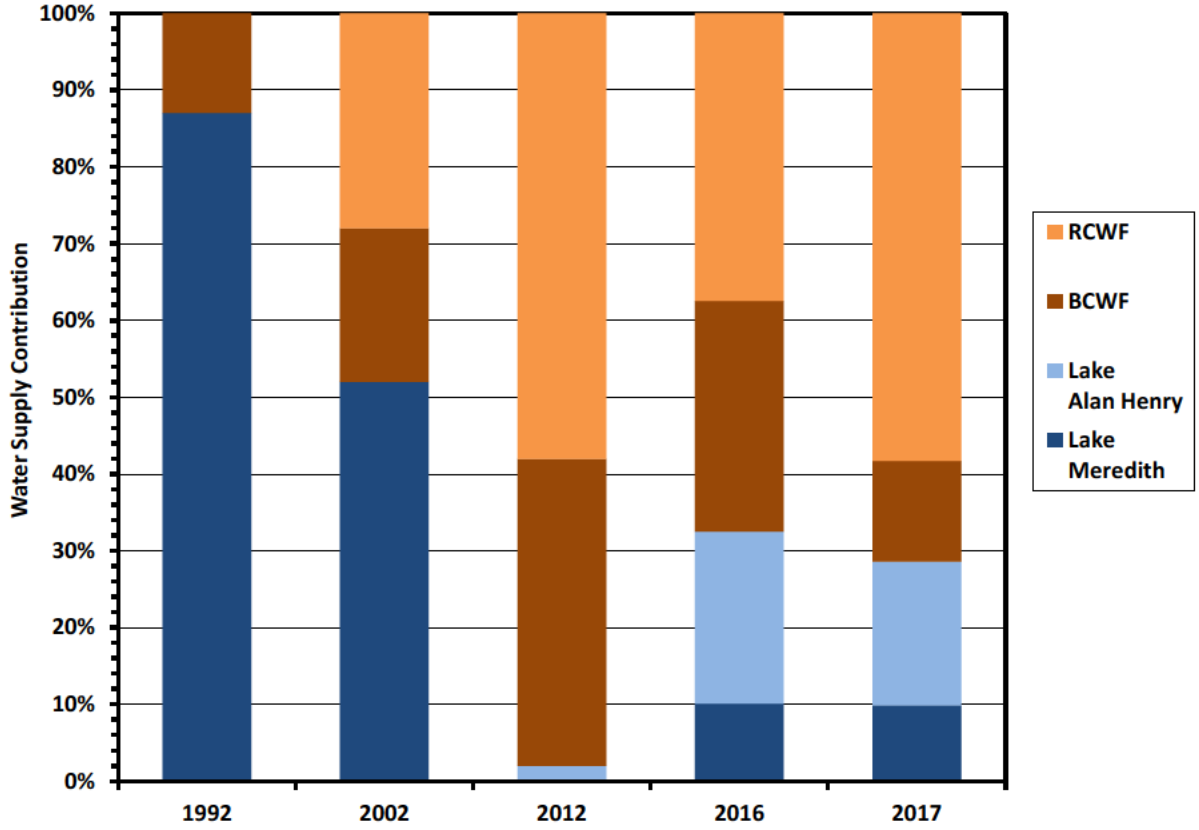


Figure 4.3. Current CRMWA Member City Groundwater Allocations

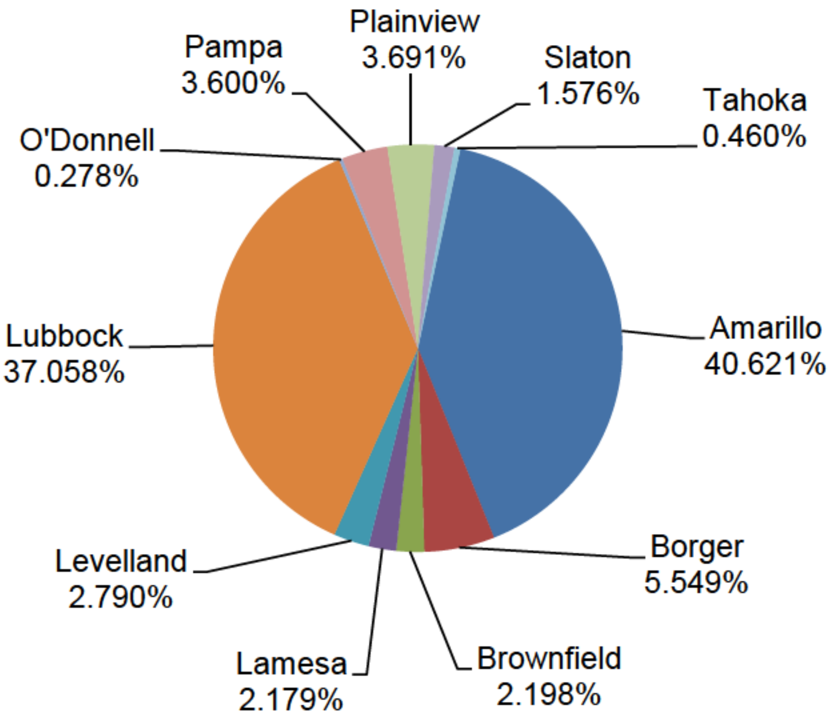
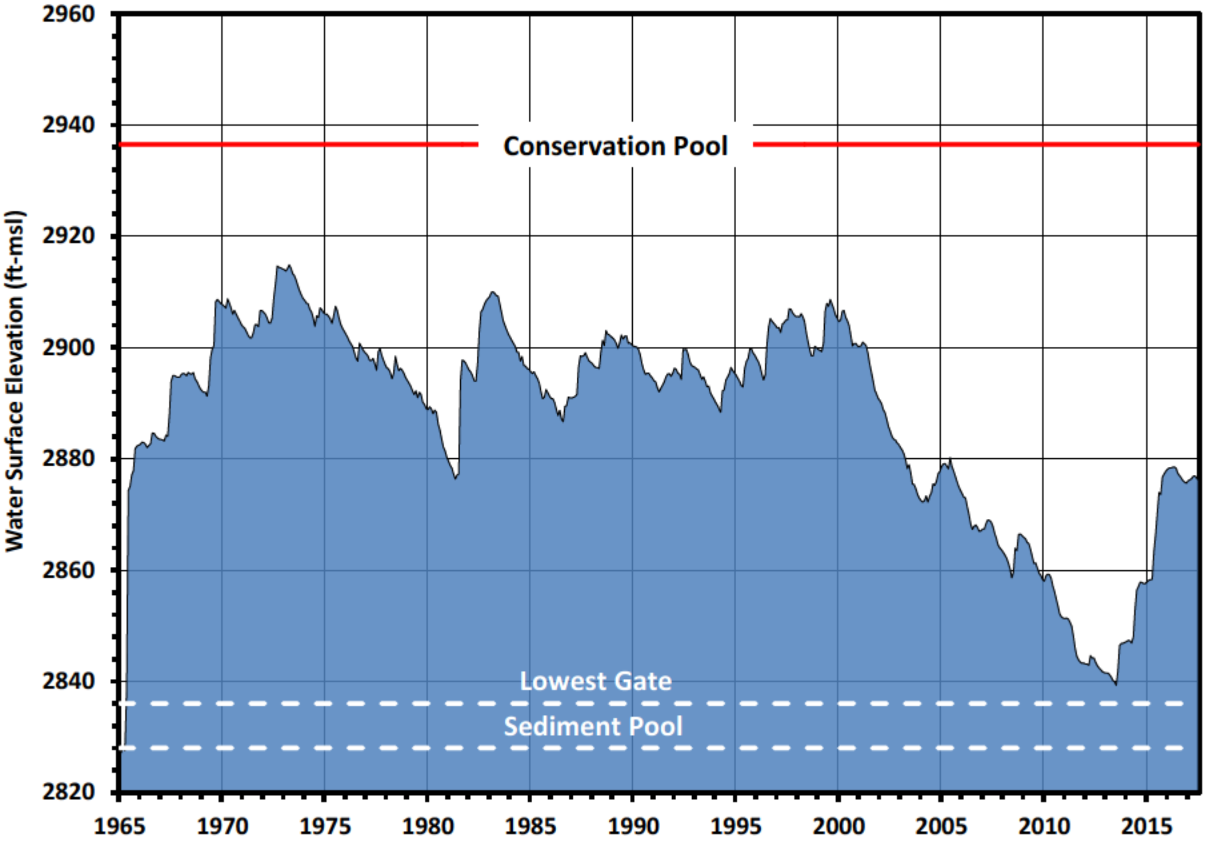


Figure 4.4. Historic Water Levels in Lake Meredith



In January 2009, the results of a Freese & Nichols, Inc. report[1] concerning Lake Meredith were presented to the Panhandle (Region A) Regional Water Planning Group. The conclusions of this study indicate that the decreased inflows to Lake Meredith is most likely attributed to changes in the groundwater to surface water interactions and land-use changes in the watershed. Declines in the Ogallala Aquifer and Dockum Formation water levels appear to have impacted spring flow into the lake. In addition, the increase in shrub (especially salt cedar) in the watershed also appears to contribute to reduced reservoir inflows. The report indicates that the decreased inflows to the lake do not appear to be meteorological in origin. Changes in precipitation amounts, precipitation intensity and evaporation were not considered to be contributing factors.

In 2015, CRMWA resumed deliveries from Lake Meredith to the City, delivering approximately 3,826 ac-ft to Lubbock in 2016. However, considering the findings of the 2009 study and the lack of substantial storage recovery during the recent wet period, the City does not consider Lake Meredith to be a long-term viable water supply source. As a result, the City estimates that approximately 7,400 ac-ft/yr of supplies will be available until 2031 from Lake Meredith.

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[1] Surface Water Study. Freese and Nichols. January 2009.

4.1.2 Roberts County (John C. Williams) Well Field

CRMWA began efforts to supplement supply from Lake Meredith with groundwater as early as the 1990s. In 1994, CRMWA purchased 42,864 acres of water rights in Roberts and Hutchinson counties and began construction of the RCWF (also called the John C. Williams Well Field). Phase 1 and Phase 2 of the RCWF were completed in 2002 and 2006, respectively, containing 29 wells permitted to supply 40,000 ac-ft/yr of groundwater from the Ogalla Aquifer. A 35-mile, 54-inch diameter transmission line was also constructed connnecting the RCWF to the main CRMWA Aqueduct that transports water to its member cities. CRMWA began blending the groundwater with Lake Meredith water in 2002. Due to the need to replace lost capacity created by Lake Meredith's decline, Phase 3 of the RCWF was constructed and placed into operation in 2011, expanding the total number of wells to 43.

On June 23, 2011, CRMWA signed a contract with Mesa Water to purchase 211,000 additional acres of water rights that are predominately contiguous to the RCWF. According to an internal memorandum[2] prepared by City staff to evaluate the purchase of the Mesa Water rights, the strategic value of this purchase included:

- expansion of the RCWF which is one of Lubbock's key water supplies;
- Mesa's water rights' accessibility to the existing RCWF infrastructure;
- Mesa's water rights' volume of water per surface acre that is at least three times greater than well fields on the South Plains; and
- the high quality of the groundwater in Roberts County.

By 2011, CRMWA began supplying its members with 100 percent groundwater when Lake Meredith's water levels declined to a level which precluded releasing water from the lowest gate of the intake structure (Figure 4.4). The layout of the RCWF is depicted in Figure 4.5.

CRMWA's goal is to maintain the peak capacity of the RCWF at 93 million gallons per day (mgd) even though the 54-inch diameter transmission line can only supply approximately 65 mgd. At a 93 mgd peaking capacity, the RCWF can maintain a 70% load factor giving CRMWA the operational flexibility to rotate and rest wells. The current capacity of the RCWF is estimated to be 83.2 mgd. Without capacity maintenance, the well field capacity will continue to decrease over time as regional water levels decline in response to pumping.

In 2018, CRMWA anticipates delivering 25,570 ac-ft/yr of supply from the RCWF to Lubbock. The City anticipates that the 2018 level of supplies from the RCWF will remain constant until 2035 when performance will begin to decline from heavy utilization. Near the end of the century, the source will be exhausted if the well field is not expanded to maintain its capacity.

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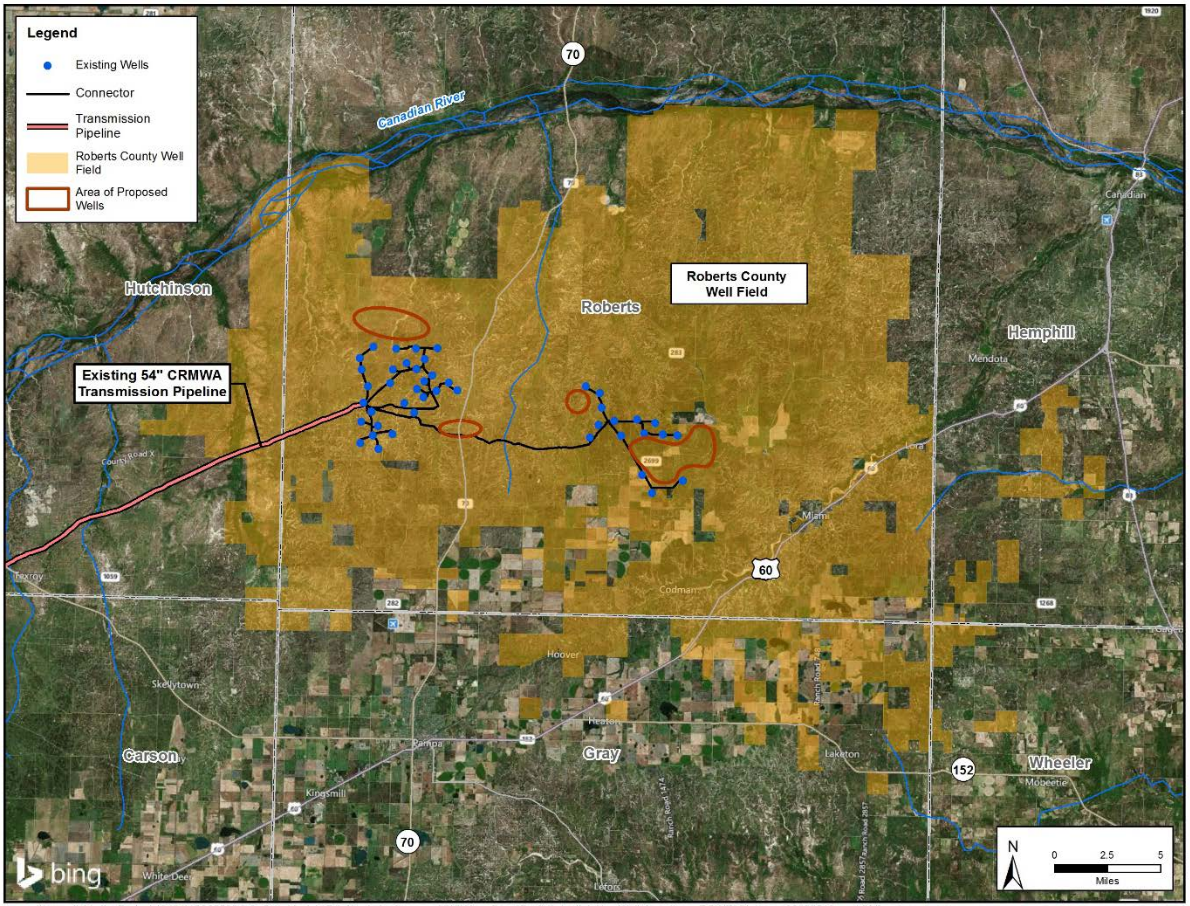
[2] Evaluation of Mesa Water Rights in Roberts County – Memo, City Staff, August 9, 2011.

Figure 4.5. Roberts County Well Field



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4.2 Bailey County (Sandhills) Well Field

The BCWF (also called the Sandhills Well Field) is located approximately 60 miles northwest of the City of Lubbock in Bailey and Lamb counties. In 1954, the City purchased the initial 53,910 acres of water rights to create the well field. In 1957, the City's water rights were expanded to 75,041 acres.[3] Today, the current water right holdings for the BCWF are approximately 83,305 acres. Water from the BCWF is pumped from the Ogallala Aquifer from wells constructed mostly in the 1950s and 1960s.[4] The 175 active wells are distributed over approximately 50% of the water rights owned by the City in the well field. Figure 4.6 shows a layout of the BCWF with the associated well locations and collection system. Note that the number of irrigated fields (identifiable in Figure 4.6) surrounding the BCWF indicates extensive agricultural usage of groundwater adjacent to the well field.

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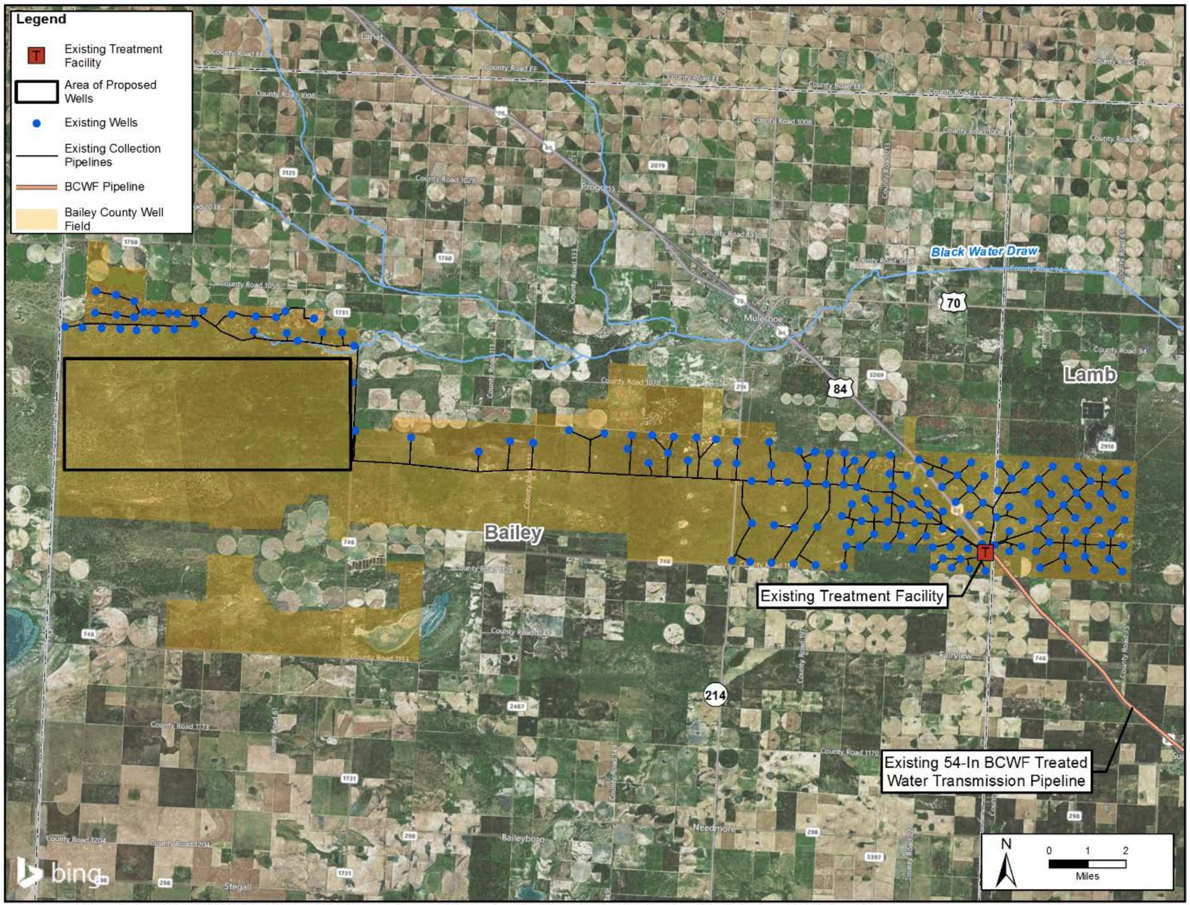
[3] City of Lubbock Water Advisory Commission; Orientation Manual. September 18, 2003.

[4] Comprehensive Ground Water Management Study for the City of Lubbock. Geraghty & Miller, Inc. April 1992: (Vol. 1) 36.

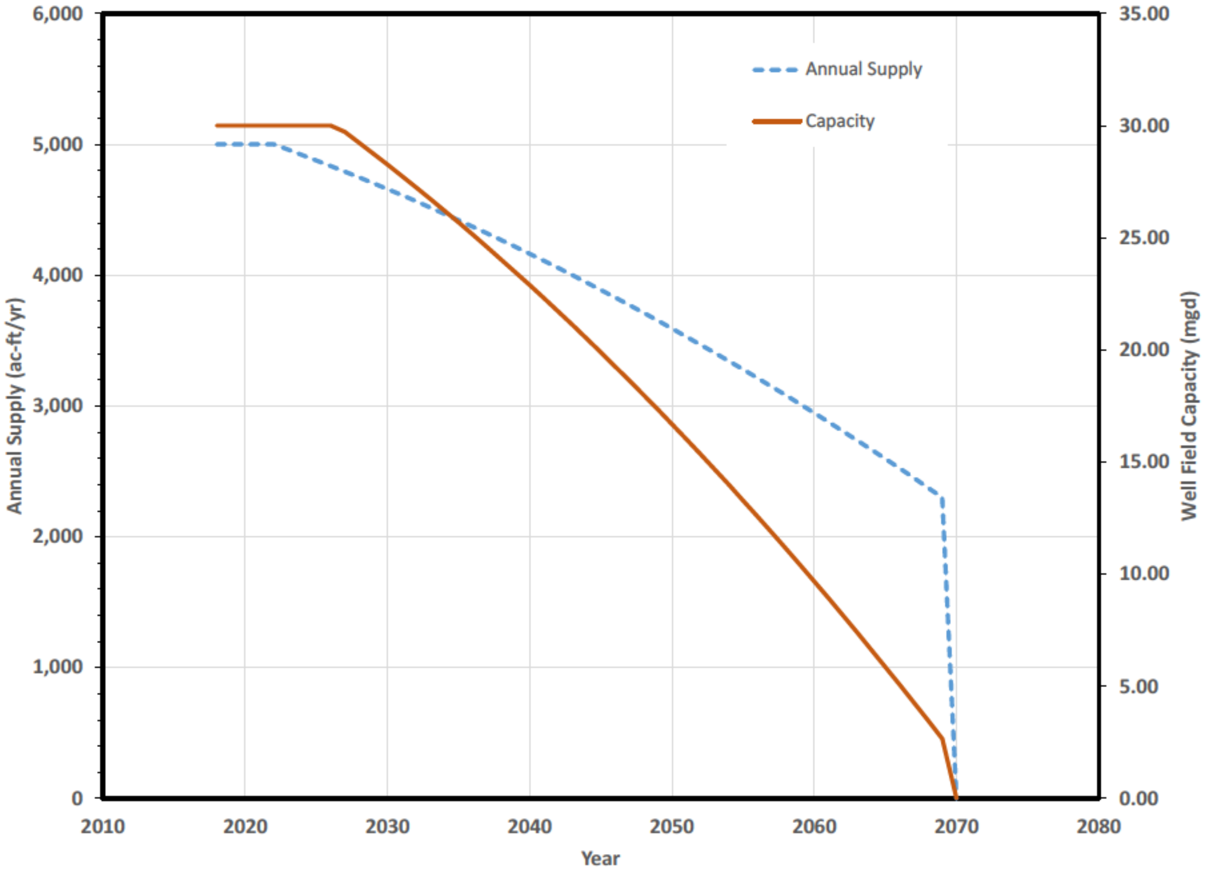
Figure 4.6. Bailey County Well Field



\\tx-austin\ActiveProjects\3291\10055566\7.0_GIS_Models\7.2_Work_In_Progress\GIS\Map_Docs\Draft\Potential_NewWell_Locations_BCWF_Strategy_08082018.mxd [KJ]

The City produced 6,000 ac-ft/yr of groundwater, on average, from 2000 to 2010 from the BCWF. However, with the loss of Lake Meredith as a water supply in 2011, the City was forced to pump 20,630 ac-ft from the BCWF in 2011 and 10,881 ac-ft in 2013. Pumping from the BCWF was less than 8,000 ac-ft/yr in 2014 and 2015, but increased to 11,407 ac-ft in 2016. As a result of this increased pumping, the well field's capacity has dropped below the 38 mgd capacity of the transmission line that transports water from the BCWF to the City. The well field capacity is expected to continue to decrease each year unless additional wells are installed. Figure 4.7 illustrates the projected decrease in the well field's supply and production capacity under an initial annual demand of 5,000 ac-ft/yr without construction of additional wells. As shown in the figure, under a target demand of 5,000 ac-ft/yr, well capacities will continue to decrease as water levels decline. When the production capacity decreases below 2 mgd, the transmission pipeline will not be able to operate effectively and supply from the BCWF will cease. Since the average well production capacity in the well field is 200-250 gallons per minute, a minimum of 28 wells would be required for every additional 10 mgd capacity needed.

Figure 4.7. Projected Supplies from Bailey County Well Field



The goal for this well field is to extend its useful life by limiting its usage to 5,000 ac-ft/yr. This includes a year-round base load supply of 2 mgd (2,240 ac-ft/yr) to maintain continuous operation of the transmission pipeline, with the remainder taken during the summer months to provide peaking supply. Limiting use of the BCWF to meet primarily peaking demands is recommended in a 2012 report completed by Daniel B. Stephens & Associates, Inc.[5]

4.3 Lake Alan Henry

Construction of the John T. Montford Dam was completed in October 1993, creating LAH. The most recent bathymetric survey completed by the Texas Water Development Board (TWDB) in 2017 estimates a storage capacity of 96,239 ac-ft. Results from this survey were released in draft form in the spring of 2018. This is somewhat larger than the previous estimate of 94,808 ac-ft, which was based on a 2005 TWDB survey. The difference is attributable to improved survey techniques in the later survey. The reservoir completely filled for the first time in 2004 and remained near capacity until 2011 when extreme drought conditions began. Over the course of the recent drought, lake level dropped almost 20 ft from the conservation pool level before significant rainfall and flooding refilled the reservoir to its capacity in the summer of 2015. Historic water levels are presented in Figure 4.7.

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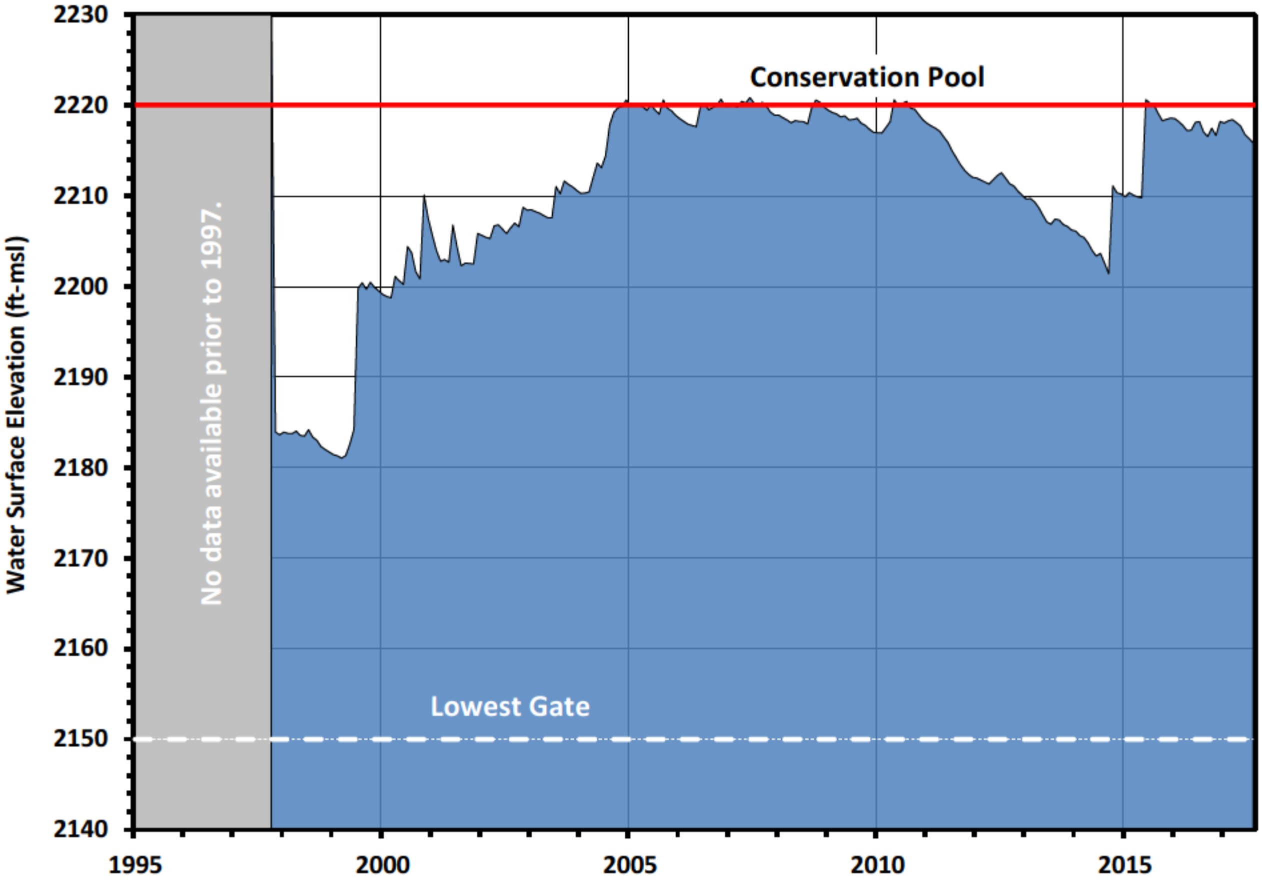
[5] Updated Bailey County Well Field Modeling, Daniel B. Stephens & Associates, Inc. October 2012: 6.

Figure 4.8. Lake Alan Henry Water Levels



During development of the 2018 Strategic Water Supply Plan, the yield of LAH was updated considering the recent and new critical drought of record occurring between 2011 and 2015. The new yield analysis estimates the 2-year safe yield to be 12,875 ac-ft/yr under current (2018) sediment conditions, and 11,375 ac-ft/yr under future (2118) conditions, based on the 2005 TWDB capacity survey.

In 2007, the City began the preliminary engineering for the water supply infrastructure that would deliver treated water from LAH to the City's distribution system. Infrastructure for LAH was designed to be completed in two phases. Phase 1 infrastructure includes two pump stations, 50-miles of raw water pipeline, a water treatment plant, and finished/treated water transmission pipelines connecting to the City's distribution system. Phase 1 was completed in September 2012 with a peak raw water transmission line capacity to the South Water Treatment Plant (SWTP) of 15 mgd and an annual delivery of 8,000 ac-ft. However, the peak supply rate into the distribution system is limited to 10 mgd, based on a limitation in the capacity of the system to integrate increased supplies. Phase 2 of the LAH infrastructure project (described in detail in Section 10.2) would expand the system to a peak capacity of 30 mgd and an annual delivery of 16,000 acft.

Considering the updated 2-year safe yield for current and future conditions is greater than the current delivery infrastructure, the City anticipates that 8,000 ac-ft/yr of supply will be available reliably from LAH throughout the planning horizon.

4.4 Existing Supplies Water Quality

Table 4.1 compares the water quality for each of Lubbock's current water supplies. Overall, Lubbock's sources of water are generally compatible with one another in terms of water quality. The groundwater quality in Roberts County is comparable to the City's groundwater resources in Bailey County and the City's surface water resource at LAH. Lake Meredith water quality has degraded significantly as the lake's volume of water has been depleted over the past decade. In general, the water in the Ogallala Aquifer underlying CRMWA's existing well field in Roberts County becomes saltier with depth. Therefore, total dissolved solids (TDS), chloride, and sodium are higher in the RCWF than the BCWF.

Water quality issues became a concern in Lake Meredith shortly after CRMWA began delivering water to its member cities. In 1969, CRMWA began preparing a plan to address the elevated levels of chlorides in the lake. In 1971, the source of the problem was identified when salt springs along the Canadian River were discovered near Logan, New Mexico. This problem was eventually addressed in 2001 when the Lake Meredith Salinity Control Project was placed into operation to mitigate the salt springs. In addition to salinity, CRMWA also made plans to address the general water quality of the lake. In 2002, water from the RCWF was blended with Lake Meredith at the aqueduct system, improving delivered water quality. In the early 2000s, Lake Meredith's water level began to decline, which led to further water quality issues. Figure 4.9 shows the increasing chloride concentration in the lake as water levels in the reservoir have declined over time. However, the recent inflows that have led to some recovery in water levels have significantly reduced the chloride levels in the lake.

Table 4.1. Water Quality of Lubbock Raw Water Supplies

Selected Water Quality Parameters	Lake Alan Henry[1]	Lake Meredith[2]	BCWF[3]	RCWF[4]
pH	8.0	8.5	7.4	7.7
Total Alkalinity (mg/L)[5]	170	224	157	200
Turbidity (NTU)[6]	1.72	6.1	0.1	0.5
Conductivity (uS/cm)[7]	1490	2835	536	1002
Total Dissolved Solids (mg/L)	777	1429	408	571
Fluoride (mg/L)	1.06	0.51	1.46	0.75
Chloride (mg/L)	291	586	17.5	148
Nitrate (mg/L)	0.114	<0.02	1.52	1.44
Sulfate (mg/L)	125	309	41.5	67.6
Potassium (mg/L)[8]	5.5	8.8	4.7	5.5
Sodium (mg/L)[8]	248	499	32.9	199
Calcium (mg/L)[8]	31.4	74.6	53.4	47.6
Magnesium (mg/L)[8]	11.9	41.5	17.9	25.5

1. Analytical results extracted from the City of Lubbock's 2017 water quality compliance monitoring.
2. Analytical results provided by Rod Goodwin, Canadian River Municipal Water Authority. Sample collected from intake tower May 2018.
3. Analytical results extracted from the City of Lubbock's 2017 water quality compliance monitoring.
4. Analytical results provided by Rod Goodwin, Canadian River Municipal Water Authority. Composite sample for all Phases collected May 2018.
5. mg/L = milligrams per liter
6. NTU = Nephelometric Turbidity Units
7. µS/cm = microSiemens per centimeter
8. Bailey County Well Field minerals results extracted from the City of Lubbock's water quality compliance monitoring.

Figure 4.9. Lake Meredith Chloride Concentration

4.5 Current Water Supply Capacity

In order to evaluate the amount of water that Lubbock can supply to its customers, the existing water system infrastructure capacity must be evaluated. Figure 4.10 shows Lubbock's current water sources and supply infrastructure with the corresponding capacity or firm supply from each. As the City adds new water supplies and increases the amount of water being delivered, improvements to the supply and distribution system will be necessary.

Current peak-day supply projections were developed for each of the City's water supply sources as described below. These peak-day supply projections represent the supply capabilities of the City's existing water sources with no expansion or maintenance over the 100-year planning period.

Lake Alan Henry – The current transmission line and pump stations from LAH were constructed to deliver 15 mgd to the SWTP. However, the SWTP capacity of 12.5 mgd sets the maximum peak-day capacity that can be delivered to the City's distribution system from LAH. Because of hydraulic limitations in the City's water distribution system, only 10 mgd can actually be pumped into the system until system improvements are implemented.

CRMWA Supplies – Water supplies from Lake Meredith are delivered through a 148 mile aqueduct system (CRMWA Aqueduct). Supplies from the RCWF are delivered through a 54-

inch transmission line that discharges into the CRMWA Aqueduct near Amarillo. The RCWF pipeline has a peak capacity of 65 mgd, of which Lubbock's share is 24 mgd. The capacity of the aqueduct after the RCWF supplies enter the system is 103 mgd, with Lubbock having a share of 38 mgd. The capacity of the system is reduced to 53 mgd between Amarillo's delivery point and the Lubbock Regulating Reservoir, with Lubbock holding a 42 mgd portion.

Bailey County Well Field – The 54-inch transmission line from the BCWF to Lubbock has a maximum capacity of 38 mgd. However, due to heavy utilization, the BCWF has a production capacity of only 30 mgd. The BCWF will continue to decline in capacity until the well field is exhausted in 2073.

The total terminal storage reservoir capacities associated with the North Water Treatment Plant (NWTP) and SWTP are not included in the water supply capacity estimates because they are reserved for emergency situations only. During an emergency situation, Lubbock has 615 million gallons of storage when the terminal storage reservoirs are full (see Figure 4.10). This would be an equivalent of almost 8 days of water supply at a peak demand of 78 mgd.

Lubbock's raw water supplies are treated at one of three treatment facilities before entering into the City's distribution system. These treatment facilities include the BCWF chlorination facility, the NWTP, and the SWTP. The NWTP has excess capacity to treat and deliver additional water into the distribution system. However, the SWTP does not have any additional capacity, although current plans are to re-rate and increase the rated capacity of the treatment plant based upon recent analyses. LAH Phase 1 can deliver up to 10 mgd of treated water to Pump Stations 8, 10, and 14. These pump stations are operating at maximum capacity; therefore, additional quantities of water delivered to the SWTP for treatment will need to be routed to a different pump station, such as PS 7. Figure 4.11 provides the locations of the SWTP, existing pump stations, and a proposed pump station and 4.5-mile, 30-inch connection from Pump Station 14 to Pump Station 16 (formerly Pump Station 7), also known as the Low Head C Transmission Line. The proposed connection is represented by the solid yellow line in the figure. Several of the water supply strategies in this Plan include the cost of the connection between Pump Station 14 and Pump Station 16 to allow for the additional water to be treated and transported from the SWTP into the distribution system.

Currently, treated water from the BCWF is transported to Lubbock and enters the distribution system at either Pump Station 9 or Pump Station 16 (formerly Pump Station 7).

Figure 4.10. Current Water Supply Capacity Schematic

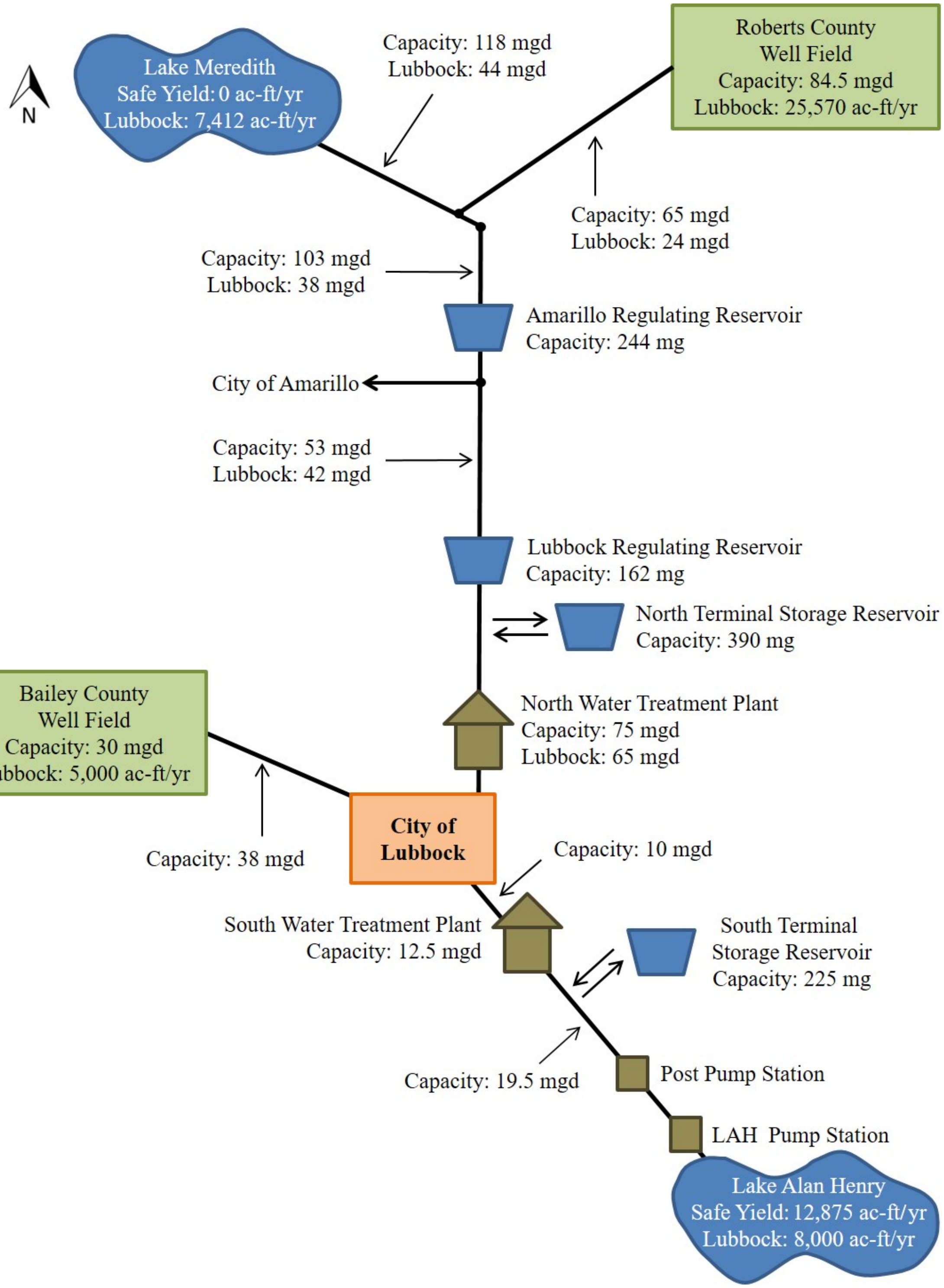
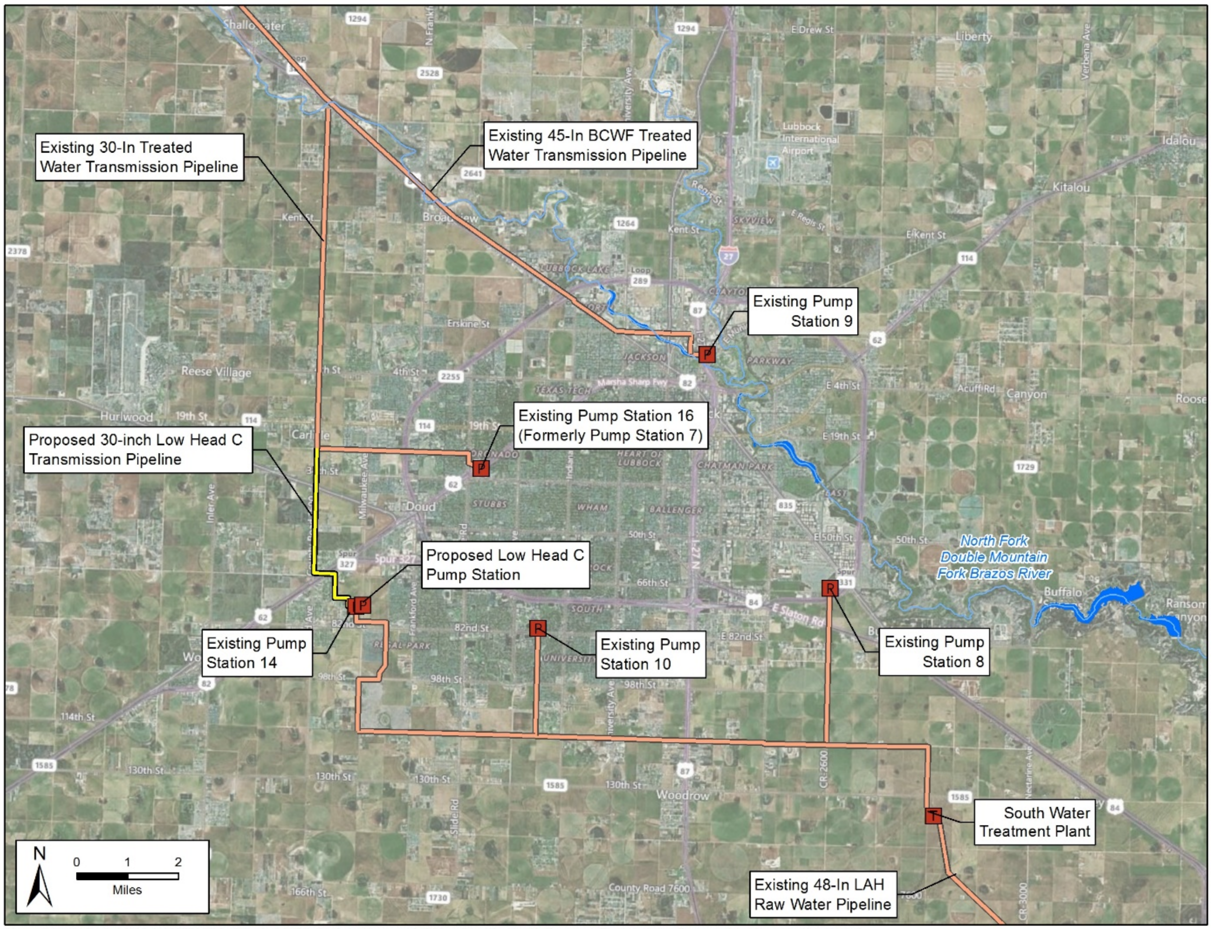


Figure 4.11. Proposed Low Head C Transmission Line



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5 Water Needs

This section compares Lubbock's future water supply and capacity needs resulting from growth in population and water demands that were presented in Section 2 to the projected supplies from existing sources presented in Section 4. Future water supply and capacity needs (or shortages) are considered to be the difference between future demands and available supplies or capacities. Projected available supplies and capacities are based on a "do nothing" scenario where the City of Lubbock (City) does not maintain the current water supply capacities by adding additional wells or other infrastructure.

Water supply strategies must be evaluated, recommended, and implemented to meet the City's future water needs. Evaluations of several water supply strategies are documented in Sections 6-10. These strategies are grouped into four main categories: water conservation, reclaimed water, groundwater, aquifer storage and recovery (ASR), and surface water. A scoring and ranking of the alternatives is presented in Section 12. Five alternative water supply package of various strategies that can meet Lubbock's future water needs have been formulated and are presented in Section 13.

5.1 Water Supply Needs

Needs are presented for the three demand scenarios presented in Section 2 and visually illustrated in Figure 5.1. Table 5.1 provides a decadal summary of projected demands, current supplies, and expected surplus or need of annual supplies for Lubbock throughout the 100-year planning period. For the expected demand scenario, the City is expected to need additional supplies now, should a severe drought occur and demands not be mitigated by aggressive conservation measures. Assuming continued conservation demand levels, the City is not expected to have a water supply need until around 2030. As Lubbock's population and water demands grow and the performance of its current supplies declines over time, the expected water supply needs will increase. By the end of the 100-year planning period, Lubbock's water supply needs are expected to range between about 40,000 acre-feet per year (ac-ft/yr) to 60,500 ac-ft/yr, depending on the demand scenario.

Figure 5.1. Comparison of Annual Water Supply and Demands

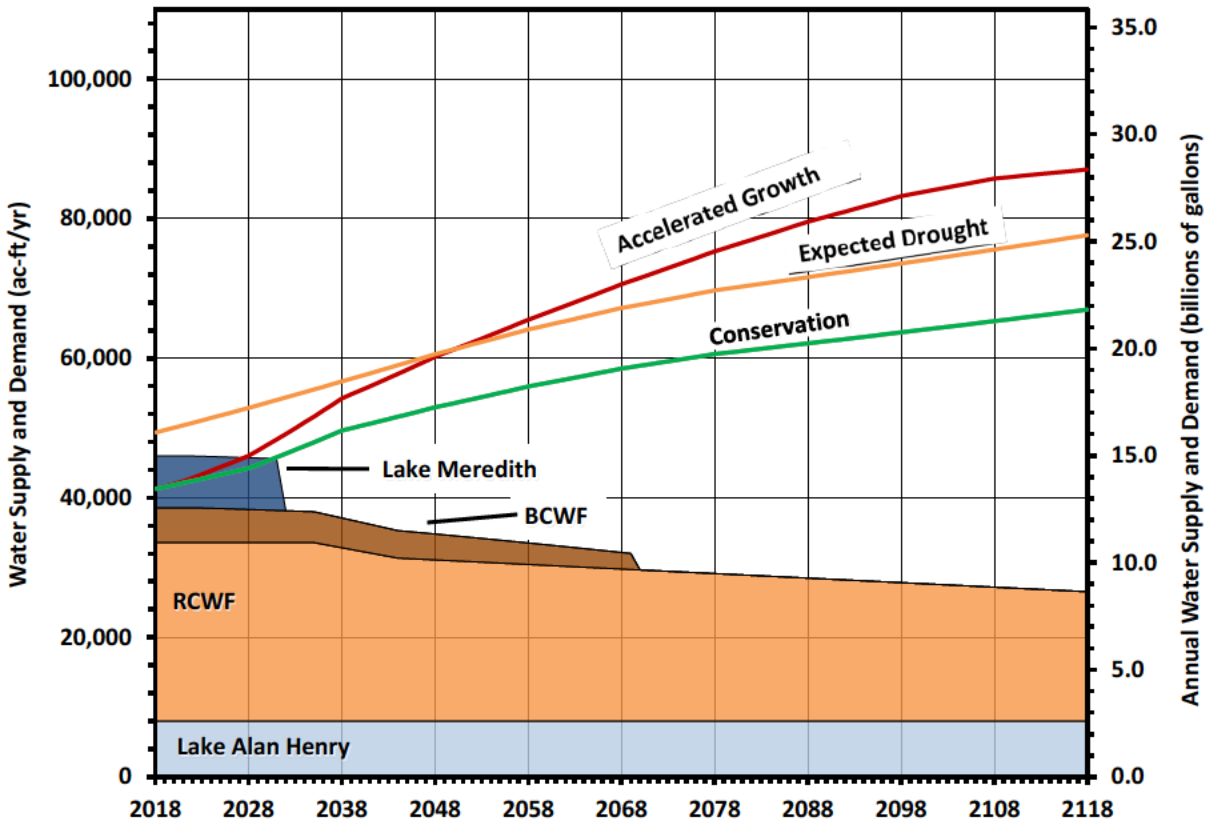


Table 5.1. Decadal Summary of Annual Demands, Supplies and Needs

Demands, Supplies and Needs	2018	2038	2058	2078	2098	2118
Projected Demands (ac-ft/yr)						
Conservation Demands	41,266	49,624	55,929	60,580	63,687	66,954
Expected Drought Demands	49,344	56,664	64,108	69,703	73,558	77,625
Accelerated Growth Demands	41,266	54,228	65,508	75,311	83,211	87,044
Current Supplies (ac-ft/yr)						
Lake Meredith	7,412	0	0	0	0	0
Bailey County Well Field	5,000	4,268	3,082	0	0	0
Roberts County Well Field	25,570	24,829	22,437	21,130	19,830	18,530
Lake Alan Henry	8,000	8,000	8,000	8,000	8,000	8,000
Total Current Supply	**45,982**	**37,097**	**33,519**	**29,130**	**27,830**	**26,530**
Surplus/(Need) (ac-ft/yr)						
Conservation Demands	4,716	(12,527)	(22,410)	(31,450)	(35,857)	(40,424)
Expected Demands	(3,362)	(19,567)	(30,588)	(40,573)	(45,728)	(51,095)
Accelerated Demands	4,716	(17,131)	(31,988)	(46,181)	(55,381)	(60,514)

5.2 Water System Capacity Needs

In addition to meeting the Annual Water Demands (AWDs), the supply system must be capable of supplying water at Peak Day Demand (PDD) rates. In 2018, Lubbock's water supply is expected to be capable of delivering a maximum peak day supply of 74 million gallons per day (mgd). The current water supply peak day projections for the next 100 years are summarized with respect to the three PDD scenarios in Figure 5.2 and Table 5.2. Development of the projected PDD scenarios is discussed in Section 2.

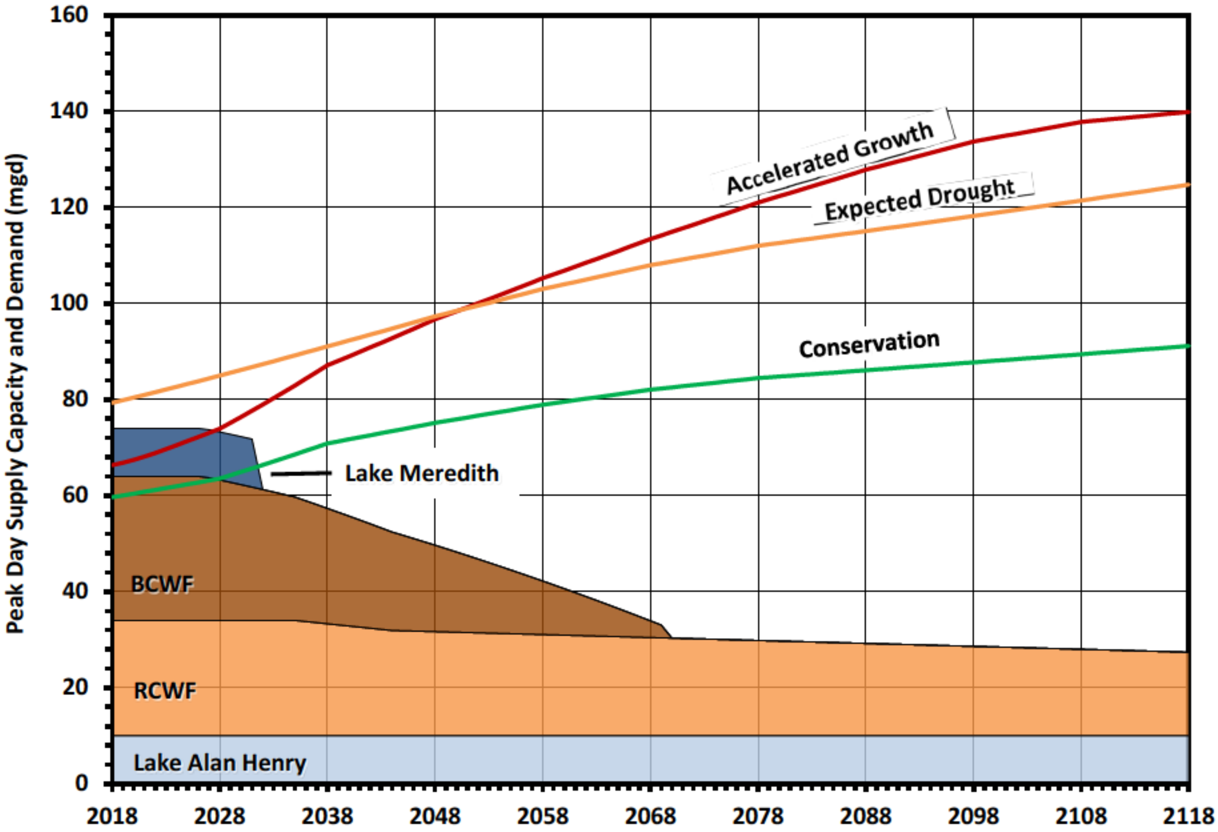
The current system lacks the capacity to meet PDDs under the expected demand scenario, which does not include any conservation efforts under the PDDs. Assuming that current conservation efforts will continue to reduce PDDs, the City will not need additional capacity to meet PDDs until about 2029 under the Accelerated Growth demand projection, and about 2033 under the Conservation demand projection. By the end of the 100-year planning period, the capacity of the system is expected to have a deficit in meeting PDDs ranging between 63.8 mgd and 112.5 mgd, depending on the demand scenario.

Table 5.2. Decadal Summary of Peak Day Demands, Supplies and Needs

Supplies, Demands, and Needs	2018	2038	2058	2078	2098	2118
Projected Demands (mgd)						
Conservation Demands	59.6	70.9	78.9	84.5	87.7	91.1
Expected Drought Demands	79.3	91.1	103.0	112.0	118.2	124.7
Accelerated Growth Demands	66.3	87.1	105.3	121.0	133.7	139.9
Current Supply Capacity (mgd)						
Lake Meredith (Lubbock's portion)[1]	10.0	0.0	0.0	0.0	0.0	0.0
Roberts County Well Field (Lubbock's portion)	24.0	23.30	21.06	19.83	18.61	17.39
Bailey County Well Field[2]	30.0	24.03	11.15	0.0	0.0	0.0
Lake Alan Henry[3]	10.0	10.0	10.0	10.0	10.0	10.0
Total Current Supply	74.0	57.33	42.21	29.83	28.61	27.39
Surplus/(Need) (mgd)						
Conservation Demands	14.4	(13.5)	(36.7)	(54.6)	(59.1)	(63.8)
Expected Demands	(5.3)	(33.7)	(60.8)	(82.2)	(89.6)	(97.4)
Accelerated Demands	7.69	(29.8)	(63.1)	(91.2)	(105.1)	(112.5)

1. Due to susceptibility to drought, the supplies from Lake Meredith are considered to be temporary and subject to interruption.
2. The current well field capacity of the Bailey County Well Field is 30 mgd, less than the 38 mgd capacity of the transmission line.
3. While the capacity of the South Water Treatment Plant is 12.5 mgd, hydraulic constraints within the water distribution system limit supplies from Lake Alan Henry to 10 mgd.

Figure 5.2. Comparison of Peak Day Capacity and Demands



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6 Water Conservation Strategies

Water conservation can be defined as a beneficial reduction in water loss, water use, or water waste.[1] A reduction in water use can be accomplished by implementing water conservation or water efficiency measures.

A *water conservation measure* is an action, behavioral change, device, technology, or improved design or process implemented to reduce water loss, waste, or use.

Water efficiency is application of a water conservation practice that results in more efficient water use and reduces water demand. The value and cost-effectiveness of a water efficiency measure should be evaluated in relation to its effects on the use and cost of other natural resources (e.g. energy or chemicals).

Water conservation is the "least expensive supply of water" that can be developed since it represents a water savings of existing water supplies. In addition, water conservation can effectively delay expensive water supply projects and reduce Peak Day Demand (PDD) impacts during the summer months. In this section, the City of Lubbock's (City's) current conservation efforts are discussed along with other potential future conservation strategies. Each water conservation strategy presented in this section is not ranked against other water supply strategies in this Plan because it is difficult to accurately quantify the full impact of conservation efforts. However, all of the strategies as a combined package are compared to the other water supply strategies as a point of reference.

In February 2013, the City adopted the 2013 Strategic Water Supply Plan (SWSP). As part of that plan, several water conservation options were included and evaluated. In November 2013, Alan Plummer Associates Inc., (APAI) completed a technical memorandum,[2] which further examined the effectiveness of those options. The City of Lubbock has since implemented some of the options identified in the APAI memorandum. The current water conservation actions implemented by the City are summarized in Section 6.4, 6.6 and 6.7. In 2016, the City engaged APAI to provide an updated memorandum that examined additional conservation strategies selected after a public involvement process.[3] These additional conservation strategies are summarized in Section 6.8.

6.1 Overall Water Conservation Trends

Lubbock's overall water conservation (combined indoor and outdoor) can be quantified by calculating the change in per capita potable water consumption (that is, gallons per capita per day [gpcd]) from year to year before and after implementation of water conservation measures.

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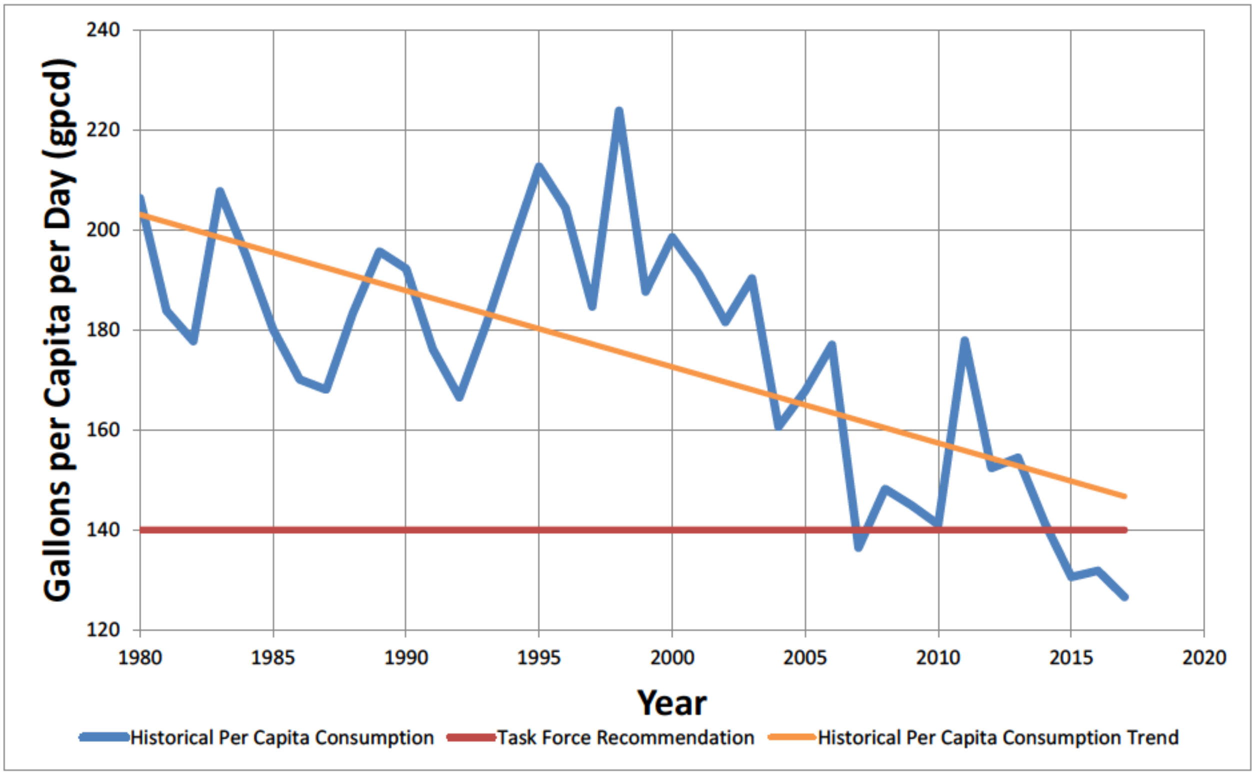
[1] Conservation also includes the preservation of water quality.

[2] Alan Plummer, Inc. City of Lubbock Water Conservation Planning and Strategy Evaluation – Technical Memorandum, November 22, 2013.

[3] Alan Plummer Inc., City of Lubbock Water Conservation Program Development – Technical Memorandum, August 31, 2016.

The City's per capita consumption has declined gradually over the past 36 years, with an approximate 34% reduction from 1980 to 2016 as depicted in Figure 6.1 (see Appendix A.1).

Figure 6.1. Lubbock's Historic Per Capita Water Consumption



The Texas Commission on Environmental Quality (TCEQ) rules[4] require water conservation plans to contain specific, quantifiable five- and ten-year goals. In accordance with TCEQ rules, the City's Water Use Management Plan adopted by City Council on December 18, 2014 set a per capita goal of 150 gpcd for year 2019 and a goal of 147 gpcd for year 2024. The State of Texas Water Conservation Task Force, developed by the 78th Texas Legislature to realize water conservation's full potential, has recommended that cities seek to achieve a per capita consumption of 140 gpcd.[5]

Based on a comparison of the Expected Consumption and the Conservation Consumption projections shown in Section 2.2, continued conservation, such as that outlined in Section 6.8, could reduce the per capita demand for the City by 21 gpcd by 2035 (see Figure 6.2). This translates into a reduction in water demand of 7,564 acre-feet (ac-ft) in 2035, or almost 14% when compared to the Expected Water Demand. By achieving this reduction, some water supply projects could be delayed as much as 20 years.

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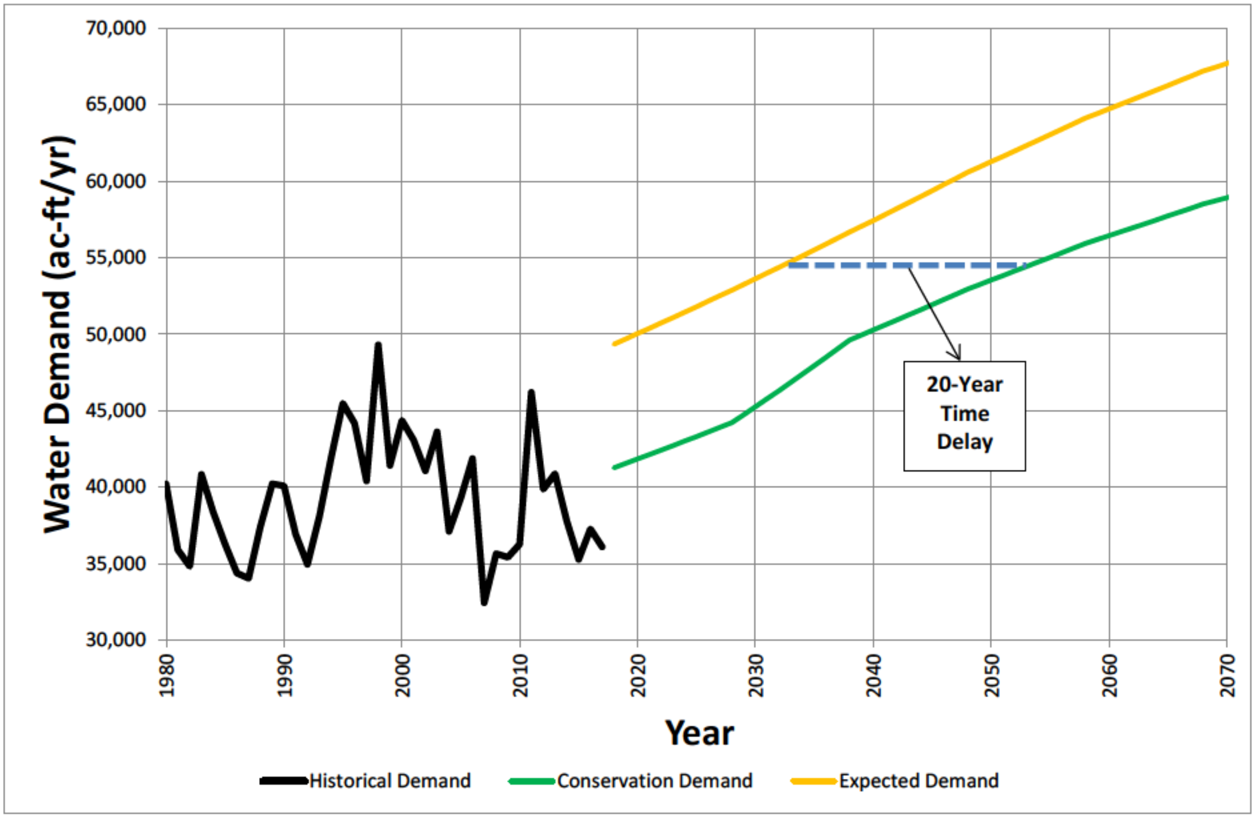
[4] Texas Administrative Code. Title 30; Part 1; Chapter 288; Subchapter A; Rule 288.2; section (a); subsection (1) (C).

[5] Texas Water Development Board Special Report: Report to the 79th Legislature. Water Conservation Implementation Task Force. Austin, TX. 2004: 31-33.

Figure 6.2. Time Delay in Expected Demand vs. Conservation Demand



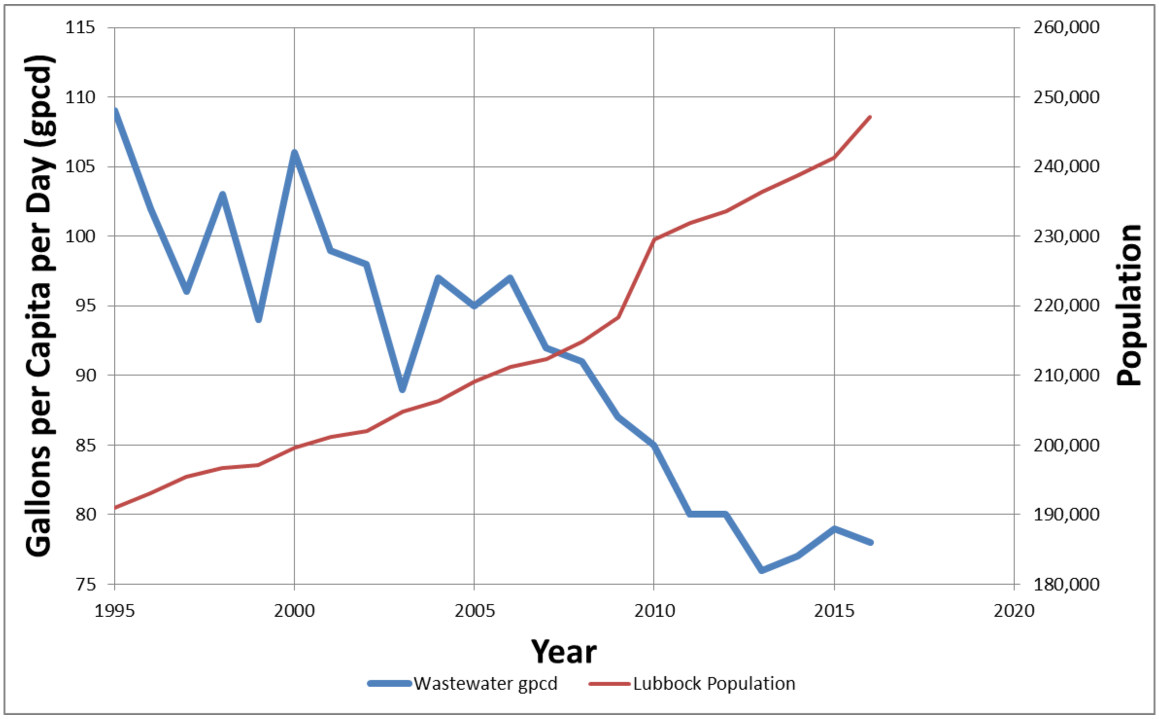
To continue to achieve its water conservation goals, the City must continue to facilitate and support cost effective measures that reduce residential and commercial water use year round. Much of the water conservation achieved thus far can be attributed to the implementation of a conservation rate structure, conservation education, and water conservation ordinances.

6.2 Indoor Water Conservation Trends

Wastewater usage trends provide insight into the amount of indoor water conservation that is occurring. Figure 6.3 reveals that the City has experienced a long history of indoor water conservation, presumably due to more efficient residential and commercial plumbing fixtures as well as reduced potable water usage in industrial processes and commercial ventures such as restaurants.

Figure 6.3 shows that the wastewater per capita use decreased by 28% from 1995 to 2016 while the population served has increased by 29% over the same time period.

Figure 6.3. Per Capita Wastewater Usage and Population



Much of the indoor water savings has been driven by State of Texas legislative actions. The State acknowledged the need for indoor water conservation in 1991 when the Texas Legislature passed the Water Saving Performance Standards (Senate Bill 587), placing stringent water-use standards on indoor plumbing equipment.[6] Toilets sold in Texas prior to January 1, 1992 used between 3.0 to 8.0 gallons per flush (gpf), whereas toilets installed after January 1, 1992 were required to use 1.6 gpf or less.[7] This legislation also set standards for urinals (1.0 gpf), faucets (2.2 gallons per minute [gpm]), and showerheads (2.5 gpm). The 2016 Llano Estacado (Region O) Plan estimated that the City of Lubbock could conserve up to 3,382 ac-ft (or a reduction of 8 gpcd) by 2017 simply with these new indoor plumbing standards.[8] Subsequently, the State passed House Bill 2667 which took effect in 2014 and raised the standards by requiring that toilets sold in Texas must be high-efficiency toilets (HET) that use 1.28 gpf or less.

These state initiatives support the findings from an American Water Works Association (AWWA) study from 1999 which showed that the main water using fixtures related to average household indoor water usage are toilets, washing machines, and showerheads (as shown in

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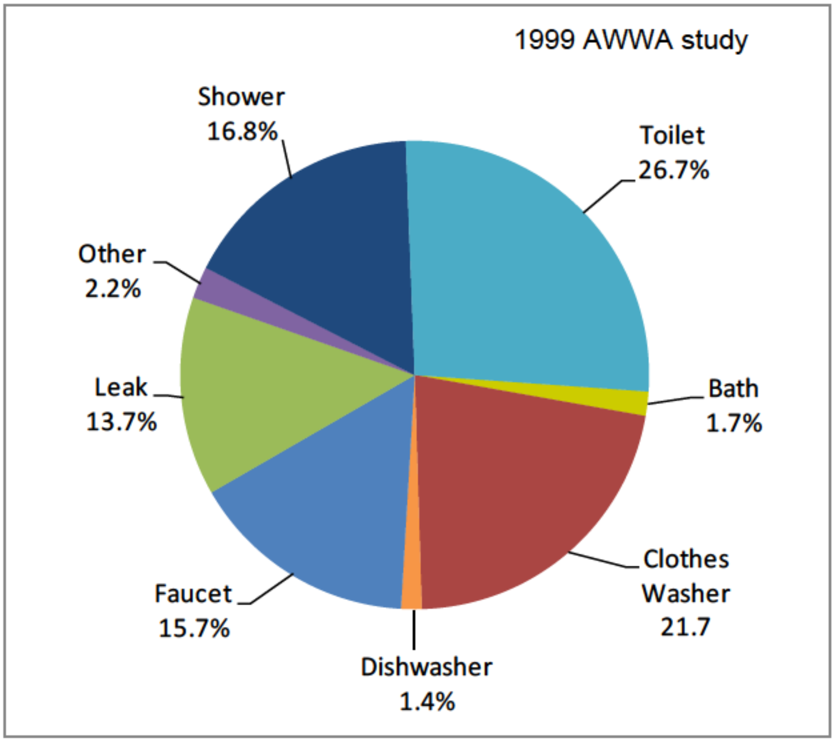
[6] State of Texas Health and Safety Code; Water Saving Performance Standards. Section 372.002.

[7] Waskom, R. and M. Neibauer. “Water Conservation In and Around the Home.” Colorado State University; Consumer Series, Housing: Fact Sheet No. 9.952. 2010: 1.

[8] 2016 Llano Estacado Regional Water Plan. Llano Estacado Regional Water Planning Group. December 2015: 5-72.

Figure 6.4). The greatest potential for indoor water conservation savings exists by addressing water use associated with these fixtures.

Figure 6.4. Average Household Indoor Water Usage[9]



6.3 Current Conservation Rate Structure

Prior to 1991, the City used a decreasing water block rate structure. This meant that the cost of water per 1,000 gallons decreased as a customer used more. In 1991, the City changed the decreasing block rate to a uniform rate where the customer paid the same rate regardless of the volume used. In 2007, the City implemented an increasing block, or conservation, rate structure with a unique average winter consumption (AWC) calculated for each residential customer annually which determined the cost and rate ranges for each of the three blocks. The first conservation block rate structure began approximately 10 years ago. Water usage data during this period suggests that the conservation rate structure contributed to the decline in the City's per capita consumption.

In 2017, the City's rate consultant, NewGen Strategies, evaluated the effectiveness of the City's existing water rate structure. A modified block rate structure that continues to encourage conservation was recommended for City Council consideration and approval. The new structure eliminated the annual residential AWC calculation and established four block rates rather than three block rates for residential customers. The new rate structure was

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[9] Mayer, P.W., W.B. DeOreo, E.M. Opitz, J.C. Kiefer, W.Y. Davis, B. Dziegielewski, and J.O. Nelson. Residential End Uses of Water. AWWA Research Foundation and American Water Works Association. 1999: ES 6.

implemented in December 2017. The current structure encourages customers to use their water more efficiently by charging higher rates for the higher volumes of water used. See Table 6.1 for Lubbock's current residential volume block rates. Additional details regarding Lubbock's current and historic water rates are located in Appendix C.1.

Table 6.1. Lubbock's Current Water Rate Structure

Monthly Rate per 1,000 Gallons	0 to 1,000 gallons	1,001 to 5,000 gallons	5,001 to 10,000 gallons	10,001 to 30,000 gallons	30,001 gallons and over
Single Family Residential	$18.00 base rate	$4.03	$6.97	$8.36	$8.57

Monthly Rate per 1,000 Gallons	Block 1 0 to AWC	Block 2 AWC to 150% of AWC	Block 3 150% of AWC and over
Multi-Family & Commercial	$4.76	$6.50	$7.79

The City of Lubbock's rate structure attempts to optimize three competing goals that all water systems must seek to balance. These goals are revenue stability, water conservation, and affordability.

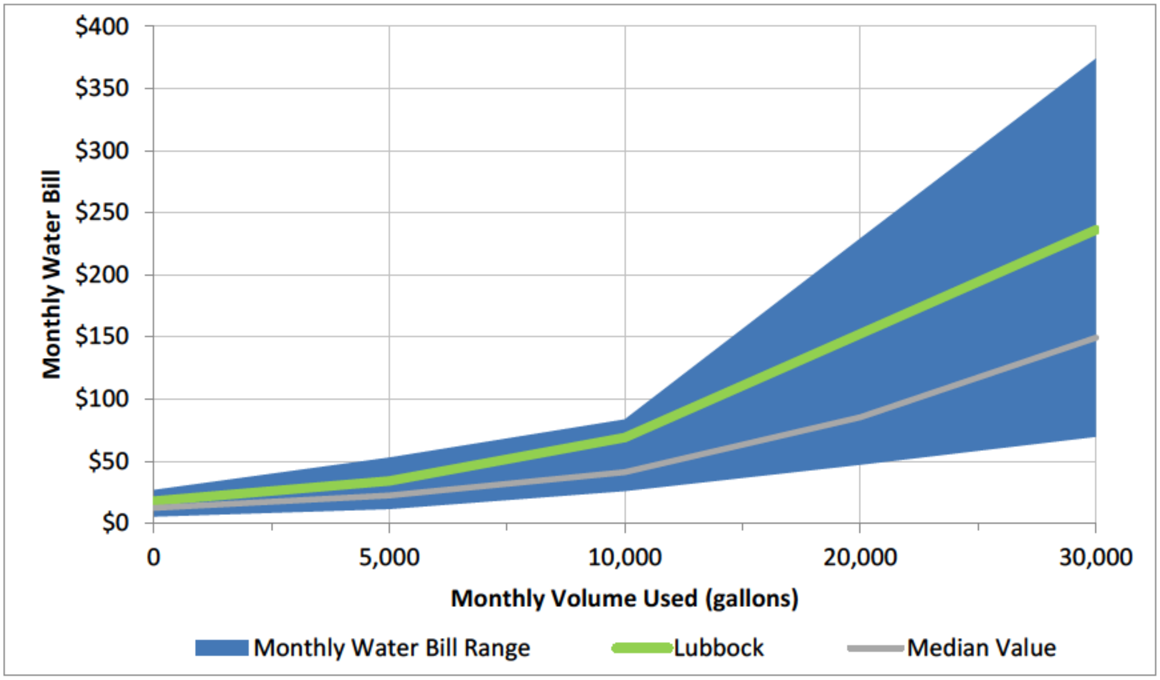
- **Revenue stability** is strengthened by covering a portion of the City's debt through the base rate.
- **Water conservation** is facilitated through an increasing volume block rate structure.
- **Affordability** is addressed by seeking to set base charges and Block 1 volume rates at reasonable levels.

Overall, Lubbock's water rates have encouraged customers to conserve and use water more efficiently. However, when certain drought triggers are met, Lubbock's Drought and Emergency Contingency Plan requires additional short-term conservation measures to be implemented.

Figure 6.5 compares the City's water rates to those of 16 other major Texas cities with populations over 150,000, as of May 2018 (see Appendix C.2). The monthly water bills used in this comparison include the base charge, volume charges, and water supply fees (if applicable). The following cities were used in the comparison:

Amarillo
Arlington
Austin
Brownsville
Corpus Christi
Dallas
El Paso
Fort Worth
Garland
Grand Prairie
Houston
Irving
Laredo
Pasadena
Plano
San Antonio

Figure 6.5. 2018 Residential Water Bill Comparison for Major Texas Cities



(Rates shown are for 5/8″ and/or 3/4″ meters as of May 2018.)

6.4 Water Use Management Plan

The City's Water Use Management Plan consists of a Water Conservation Plan and a Drought and Emergency Contingency Plan.

In July 1991, the City of Lubbock adopted its first Water Conservation and Drought Contingency Plans. The original water conservation goal was to reduce the overall water usage by 9.5 gpcd, which was five percent of the water demand. The first plan outlined eight principal water conservation methods: public education and information, plumbing codes, efficiency retrofit programs, universal metering and meter repair, water conservation landscaping, leak detection and repair, recycling and reuse, and non-declining block rate structure. The City subsequently updated the Water Use Management Plan in August 1999, June 2002, April 2004, July 2006, July 2010, March 2012, December 2014, and January 2017.

In 2006, the City moved into Stage 1 of its Drought and Emergency Contingency plan for the first time. During the severe drought in 2012, the City moved into Stage 2 in an effort to reduce water demand until Lake Alan Henry (LAH) was capable of delivering water to the City later that same year. At the same time, the City designated specific days that a customer could irrigate landscaping based on the last digit of their address. The City continued to be in at least Stage 1 of its drought restrictions without interruption from 2006 to 2016. Trends in per capita consumption and overall water usage during this period indicate that the drought restrictions were effective in reducing the City's PPD during the summer months as well as the overall annual water usage. The reduction in water demand has allowed the City to delay construction of major, costly water supply projects. As a result, in January 2017, the City Council adopted a new Water Use Management Plan that moved twice a week irrigation in Stage 1 to normal water conservation measures to be implemented regardless of drought condition. The City is currently implementing the following water conservation measures year round as detailed in the Code of Ordinances Articles 22.08.039(c)(4) through (c)(6):

> Landscape irrigation is allowed to occur twice each week and is based on the last digit of the property address with Sundays not allowing for landscape irrigation. For summer irrigation (April 1st through September 30th) the maximum irrigation rate is 1.5 inches per zone per week and is restricted to the hours of 6:00 p.m. to 10:00 a.m. For winter irrigation (October 1st through March 31st) the maximum irrigation rate is 1 inch per zone per month for dormant grasses (i.e. Bermuda) and 1 inch per zone per week for cool season grasses (i.e. Fescue). During the winter, irrigation can occur when temperatures are above 35°F eliminating the time of day restrictions.
>
> The following schedule is the twice a week water schedule using the last digit of the property address:
>
> > Monday and Thursday for addresses ending in 3, 4, 9, and 0
> >
> > Tuesday and Friday for addresses ending in 1, 5, and 6
> >
> > Wednesday and Saturday for addresses ending in 2, 7, and 8
>
> Irrigation should occur without water runoff. This may be accomplished by correctly cycling the sprinkler system and allowing time for the water to soak into the landscape between irrigation events.
>
> Hand watering for landscape irrigation purposes is allowed on a daily basis regardless of the time of year and regardless of the time of day.
>
> New plant material may be irrigated on a more frequent basis until the new plant material is established as defined in Section 22.03.133(a)(4) of this Code of Ordinances related to the operation of irrigation systems.

6.5 Unaccounted for Water

One important method of conserving water is to reduce the amount of unaccounted for water, often considered to be water lost from the system. The City's historic unaccounted for water as a percent of the total water used in the system is depicted in Figure 6.6. The Texas Water Development Board (TWDB) indicates that system water losses greater than 15% is excessive.

The AWWA Benchmarking Performance Indicators for Water and Wastewater - 2016 Edition changed its water loss performance measure from a percent of total water used to gallons lost per connection. Using the new benchmark method, the City's water loss for 2017 was 21.74 gallons of water lost per connection, or 8.05 gallons less than the mean AWWA benchmark of 29.79 gallons lost per connection for Region IV.[10]

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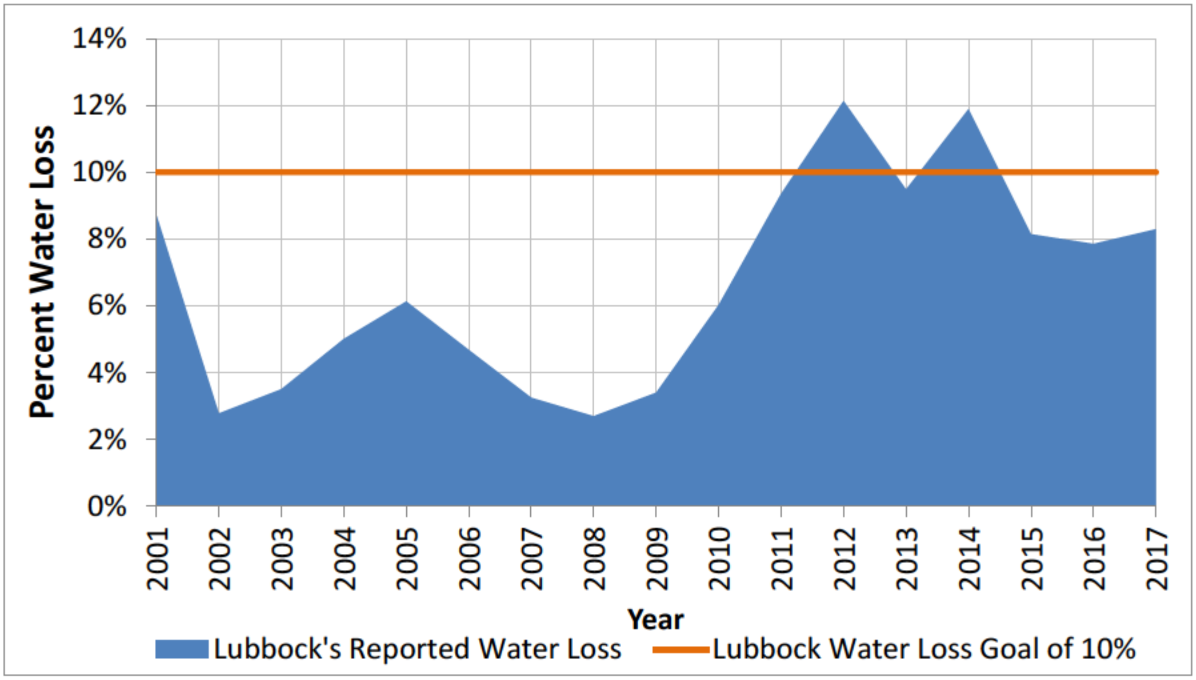
[10] Benchmarking – Performance Indications for Water and Wastewater Utilities: 2016 Annual Survey Data and Analyses Report. American Water Works Association. 2016.

Figure 6.6. City of Lubbock Water Loss History



The City's goal as stated in the City's Water Conservation Plan is to keep water losses below 10% for its delivery system.[11] As depicted in Figure 6.6, the City has been successful in meeting this goal except for the years 2012 and 2013. In 2017, water losses were at 8.2%. The City seeks to continually improve this measure by implementing effective meter change out, construction meter control, and water main repair and replacement programs.

6.5.1 Water Main Replacement Program

This program manages the replacement of old water lines that are prone to leaks and breaks. In the past 10 years, the City has spent more than $20 million on the replacement of aging pipelines and valves, including the 34th Street and Downtown Waterline Replacement projects. The City routinely monitors the water system for leaks. The goal is to repair detected and/or reported leaks in a timely manner. In the past four years, the City has repaired 2,846 leaks.

6.5.2 Meter Change-out Program

The City uses a random sampling technique to test meter accuracy and to determine when meters need to be repaired or replaced. The City randomly samples approximately 400 water meters each year. Depending on the results of this sample, additional sampling may be done to target meters of a certain age or meters located within a certain geographic area of the City. Meters found to have an accuracy worse than +/- 4% are either repaired or replaced as appropriate.

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[11] City of Lubbock Code of Ordinances; Water Use Management Plan. Article 22.08.034.

6.5.3 Fire Hydrant - Construction Meter Program

This program measures water used from fire hydrants by construction contractors and City departments to reduce unaccounted for water use. Contractors lease the fire hydrant meters and are billed at the Commercial Block 2 rate for water used. Any City department using water from a fire hydrant must also use a fire hydrant meter.

6.6 Water Education Team Effort

Educating the public and customers is a crucial component of the City of Lubbock's water conservation efforts. To make wise water-use decisions, customers must be equipped with accurate information and knowledge about how they can help. With this in mind, the City created the Water Education Team (WET) in 1996 to raise awareness and disseminate information about water conservation opportunities in the City. The WET focuses on reaching people through public school programs, community events, digital and social media outreach, water surveys and assessments, and irrigation consultations.

The mission statement of the WET is to "*Support sustainable development of the community through outreach and education. Seek to enhance our customer's trust in our Utilities' ability to provide sustainable water and wastewater services at an optimal value*."

Figure 6.7 shows the City's water conservation efforts over the last ten years through educational outreach programs, including public school lessons, residential home water surveys[12], and TCEQ mandated irrigation inspections.

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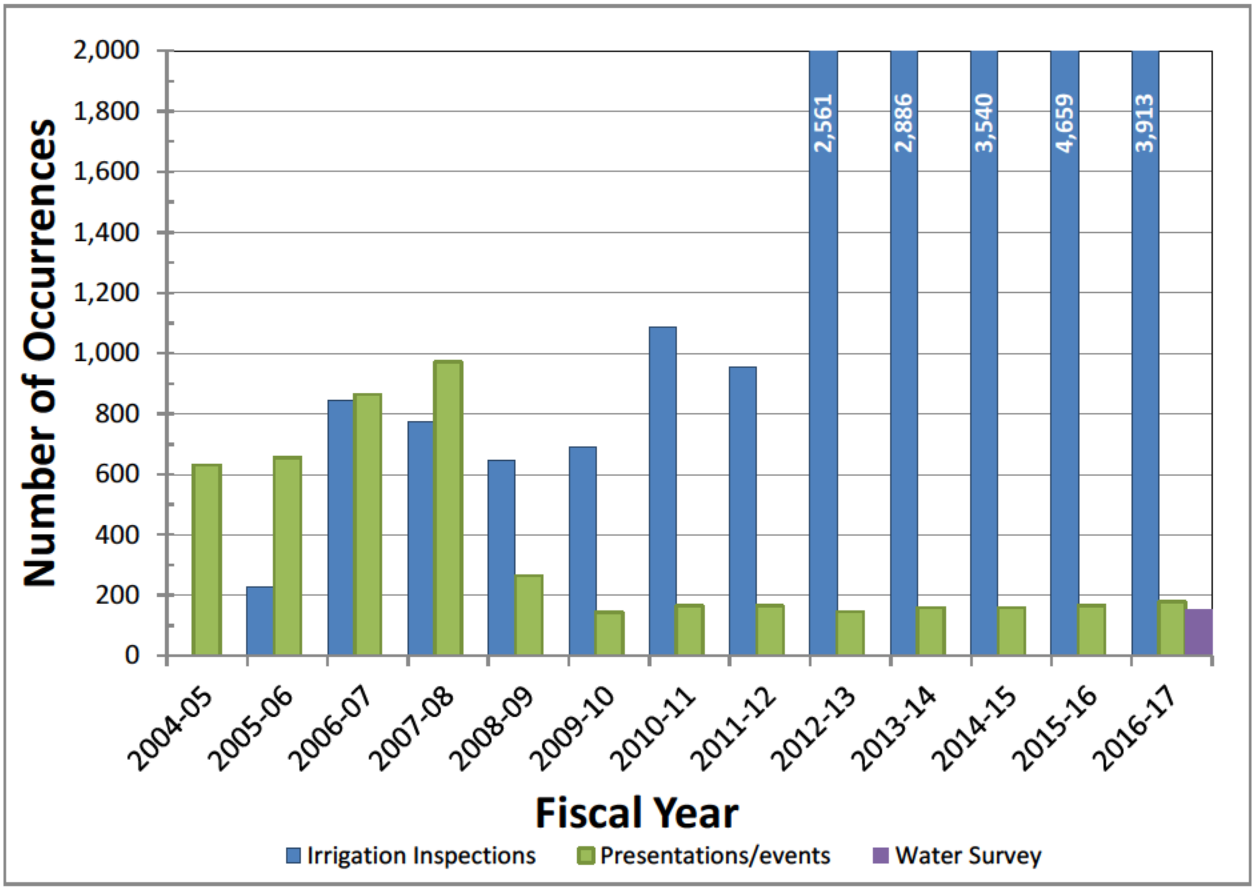
[12] The residential home water survey program began in 2016.

Figure 6.7. Water Conservation Education Outreach



6.6.1 Public-School Programs

The WET, since creation in 1996, has coordinated and implemented educational programs that allow students (kindergarten through 12th grade) to explore the science of water and become familiar with water stewardship concepts. The program is free of charge and consists of nine interactive presentations (see Appendix C.3). Teachers can either request that the City's educator give the presentation or teachers can request lesson plans and materials be delivered to their classroom at http://mylubbock.us/k-12education.

6.6.2 Annual Home & Garden Show

The WET has participated in the annual West Texas Home Builder's Home and Garden Show since 2001. Each year 4,000-6,000 citizens attend. The WET is available at the event to provide information, answer questions, and support the community-wide water conservation effort through home and landscape design.

6.6.3 Digital & Social Media Outreach

Social media and website content have become a valuable resource to the WET since 2015. Currently WET manages four social sites: Facebook, Twitter, Nextdoor, and Instagram and a website with forty associated website pages. These sites have assisted the City in educating citizens about conservation practices, water quality, and water ordinances.

6.6.4 Residential Home Water Surveys

In 2016, the Water Resource Department began offering Residential Home Water Surveys at no charge for Lubbock residents who have an abnormally high water bill. Over the past two years, surveyors have assisted customers by checking for water fixture leaks and making recommendations about optimizing water conservation in homes. They also educate customers on how to read their water meters, check for leaks and other home conservation strategies. Some examples include installing high efficiency toilet parts, sink aerators, showerheads, and using toilet tank bladders.

6.6.5 Irrigation Consultations

The City's irrigation inspectors routinely conduct one-on-one consultation with customers regarding the proper use of their sprinkler systems. These consultations typically are identified while performing inspections on irrigation systems. The inspectors assist homeowners and businesses in optimizing their sprinkler system by determining proper "cycle and soak" run times. When requested, the City's irrigation inspectors assist in teaching customers how to operate controllers and settings.

6.7 Existing Water Conservation Ordinances

The City Council has adopted ordinances that encourage customers to conserve water. These ordinances include:

A *Water Rate Structure Ordinance* (Sec. 22.03.081 – 22.03.097) that defines the City's conservation block rate structure where higher rates apply to greater volumes of water consumed. See Section 6.3 for more details.

A *Water Conservation Plan* (Sec. 22.03.131 – 22.03.134) that restricts the use of outdoor irrigation throughout the year. This ordinance prohibits irrigation systems and devices from being used between 10:00 am and 6:00 pm as well as assigning days for watering landscape each week based on customers' addresses. These restrictions are permanent and year-round.

A *Drought and Emergency Contingency Plan* (Sec. 22.08.001 – 22.08.103) that mandates additional water conservation by providing an implementation plan for drought and emergency contingency measures.

The City's Water Use Management Plan includes both the Water Conservation Plan and Drought and Emergency Contingency Plan.

6.8 Additional Potential Water Conservation Strategies

In addition to the water conservation strategies outlined above, the City is also considering other water conservation opportunities as described in an APAI technical memorandum[13] prepared for the City that describes various conservation programs that could be implemented in the future. The summaries provided below are extracted from the technical memorandum.

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[13] Alan Plummer Inc., City of Lubbock Water Conservation Program Development – Technical Memorandum, August 31, 2016.

6.8.1 Residential Water Conservation Checklist

The Residential Checklist is intended to accomplish the same goals as the Residential Indoor Water Efficiency Survey Program. The major difference is that the checklist allows the residential customer to conduct their own indoor water efficiency survey by utilizing an online checklist.

Based on analysis of 2012 residential water consumption data, average residential indoor water use accounts for approximately 61.5 gpcd or 64,242 gallons per account per year.

The average administrative cost per home was estimated at $10.

The anticipated water savings were estimated at 9,000 gallons per home per year. The water savings associated with program recommendations and findings are based on an average 10-year equipment life.

Over the 10-year program, assuming that 2,500 homes participate in the program, the projected water savings are 225 million gallons (mg) at a cost to the City of $25,000 ($10 per home) and a unit cost of $0.11 per thousand gallons.

At a projected savings rate of 22.5 mg per year, the Residential Checklist would be expected to reduce per capita consumption by 0.25 gpcd.

6.8.2 Residential Indoor Water Efficiency Surveys

The intent of this program would be twofold. The first intent is to assist residential water customers in lowering their indoor water consumption by conducting a free residential indoor water efficiency survey. The second intent would be to assist the Water Utilities staff and Water Board of Appeals in cases where residential customers are contesting a high bill. Under the proposed system, a residential customer contesting a high bill would be required to undergo a residential water efficiency survey as part of the appeals process.

This program would be administered in-house and conducted by City staff. The average audit cost per home was estimated to be $192.50, including administrative costs.

The anticipated water savings are estimated at 9,000 gallons per home per year. Assuming that 1,000 homes participate in the program, over 10 years the projected water savings are 90 mg at a cost to the City of $192,500 and a unit cost of $2.14 per thousand gallons.

At a projected savings of 9.0 mg per year, the Residential Indoor Water Efficiency Survey Program would be expected to reduce per capita consumptions by 0.10 gpcd.

6.8.3 Residential Irrigation Checkup

Based on analysis of 2012 residential water consumption data, average residential outdoor water use accounts for approximately 22.5 gpcd or 23,570 gallons per account per year.

The first intent of this program would be to assist residential water customers in lowering their outdoor water consumption by conducting a free residential irrigation checkup. The second intent of the program would be to assist the Lubbock Water Board of Appeals in cases where residential customers are contesting a high bill. Under the proposed program, a residential customer contesting a high bill where an automatic irrigation system is in operation would be required to undergo a residential irrigation audit checkup.

The average irrigation checkup cost per home was estimated at $192.50, including administrative costs. The anticipated water savings are estimated at 7,800 gallons per home per year.

During the 10 year program, assuming that 500 homes participate in the program, the projected water savings are 3.9 mg per year (39,000,000 gallons total) at a cost to the City of $96,250 and a unit cost of $2.47 per thousand gallons saved.

At a projected savings of 3,900,000 gallons per year, the Residential Irrigation Checkup Program would be expected to reduce per capita consumption by 0.04 gpcd.

6.8.4 Industrial, Commercial and Institutional Customers Water Efficiency Surveys

This program would offer free comprehensive water efficiency surveys for Lubbock industrial, commercial and institutional (ICI) customers. The approximately 5,200 ICI customers in the City use an average of about 390,000 gallons per year.

The anticipated average identified water savings are estimated at 25% of average annual consumption, or 97,500 gallons per building per year for 10 years (975,000 gallons total). The average audit is expected to cost $1,200 per building.

Assuming a rate of 110 building audits per year, the projected water savings are 329 ac-ft over the 10 year program at a cost to the City of $132,000 and a unit cost of $1.23 per thousand gallons. At a projected savings of 10,725,000 gallons per year, the ICI Water Efficiency Survey Program would be expected to reduce per capita consumption by 0.12 gpcd.

6.8.5 Car Wash Certification Program

The goal of this program would be to facilitate long-term water efficiency gains through a cooperative program between the City and area car washes. This voluntary program would provide recommended best management practices that are intended to insure both water efficiency and customer satisfaction.

It is estimated that there are approximately 30 active car washes within the City. Those 30 car washes use approximately 55 mg of water per year or an average of 5,022 gallons per car wash per day. The anticipated average identified water savings are estimated at 10% of average annual consumption, or an average of 500 gallons per participating car wash per day. The average administrative cost per facility was estimated to be $200.

Assuming a participation rate of 50%, or 15 car washes, the projected water savings are 2,737,500 gallons per year during the 5 year program (13,687,500 gallons total), at a total cost to the City of $3,000 and a unit cost of $1.10 per thousand gallons. At a projected savings of 2,737,500 gallons per year, the Car Wash Certification Program is expected to reduce per capita consumption by 0.03 gpcd.

6.8.6 Restaurant Certification Program

The goal of this program would be to facilitate long-term water efficiency gains through a cooperative program between the City and restaurants. This voluntary program would provide recommended best management practices that are intended to insure both water efficiency and customer satisfaction.

It is estimated that there are approximately 270 active restaurants within the City. Those 270 restaurants use approximately 248 mg of water per year or an average of 2,516 gallons per restaurant per day. The anticipated average identified water savings are estimated at 15% of average annual consumption, or an average of 377 gallons per participating restaurant per day. The average administrative cost per facility was estimated to be $100.

Assuming a participation rate of 50%, or 135 restaurants, the projected water savings are 18,576,665 gallons per year at a total cost to the City of $13,500 and a unit cost of $0.73 per thousand gallons. At a projected savings of 18,576,665 gallons per year, the Restaurant Certification Program is expected to reduce per capita consumption by 0.21 gpcd.

6.8.7 Low Income Leak Repair Program

Under this program, only homeowners that meet specific qualification requirements would be eligible for assistance. Qualification of homeowners would be accomplished by the City, County, or other non-profit agency that already qualifies citizens for other types of assistance programs. Upon receiving the referral, the Lubbock Water Department would schedule a contracted plumber to assess the situation and make the necessary repairs. The average repair cost per home was estimated to be $500, and the average administrative cost per home was estimated at $50.

The anticipated water savings were estimated at 57,800 gallons per home per year and are based on an average leak rate of 0.11 gpm.

Assuming that 50 percent of qualified homes participate in the program, or 483 homes, the projected water savings are 27,917,400 gallons per year. After 10 years, 279,174,000 gallons would have been saved at a cost to the City of $265,650 and a unit cost of $0.95 per thousand gallons. At a projected savings of 28,023,186 gallons per year, the Low Income Leak Repair Program would be expected to reduce per capita consumption by 0.32 gpcd.

6.8.8 Commercial Non-Profit Retrofit Program

This program would be intended to provide authorized domestic plumbing retrofits to qualifying non-profit facilities, including both residential and commercial customers.

Assuming that 1,000 residential units are retrofitted each year during the 10-year program, the projected water savings are 31,217,000 gallons per year (312,170,000 gallons total) at a cost to the City of $339,000 and a unit cost of $1.09 per thousand gallons saved. At the projected water savings volume, the residential component of the Non-Profit Retrofit Program would be expected to reduce per capita consumption by 0.35 gpcd.

Assuming that 1,000 commercial toilet and faucet combinations are retrofitted each year during the 10 year program, the projected water savings are 39,625,000 gallons per year (396,250,000 gallons total) at a cost to the City of $279,000 and a unit cost of $0.70 per thousand gallons saved. At the projected water savings volume, the commercial component of the Non-Profit Retrofit Program would be expected to reduce per capita consumption by 0.45 gpcd.

6.8.9 Summary of Conservation Strategies

Table 6.2 provides a summary of the conservation strategies discussed in this section. The table compares the expected number of participants, estimated annual cost, unit cost per 1,000 gallons, gpcd reduction potential, and total potential water savings.

It was estimated that the total cost to implement all of these strategies would be approximately $1.346 million. These strategies could reduce per capita water use by 1.87 gpcd. This translates to approximately 1.464 billion gallons saved during the program or 4,545 ac-ft.

Table 6.2. Summary of Conservation Strategies

Program	Participants per Year (Estimated)	Total Estimated Cost	Cost per 1,000 Gallons	GPCD Reduction Potential	Total Potential Water Savings in Gallons
Residential Water Conservation Checklist	2,500 homes	$25,000	$0.11	0.25	225,000,000
Residential Indoor Water Efficiency Survey	1,000 homes	$192,500	$2.14	0.10	90,000,000
Residential Irrigation Checkup	500 homes	$96,250	$2.47	0.04	39,000,000
ICI Water Efficiency Surveys	110 buildings	$132,000	$1.23	0.12	107,725,000
Car Wash Certification Program	15 facilities	$3,000	$0.22	0.03	13,687,500
Restaurant Certification Program	135 facilities	$13,500	$0.73	0.21	18,576,665
Low Income Leak Repair Program	483 homes	$265,650	$0.95	0.32	279,174,000
Commercial Non-Profit Retrofit Program (Residential Unit)	1,000 units	$339,000	$1.09	0.35	312,700,000
Commercial Non-Profit Retrofit Program (Commercial Unit)	1,000 units	$279,000	$0.70	0.45	396,250,000
TOTAL		$1,345,900		1.87	1,463,536,500

Note: gpcd = gallons per capita per day; ICI = industrial, commercial and institutional (customers).

7 Reclaimed Water Strategies

The use of reclaimed water (treated wastewater or effluent) is considered an important water supply strategy in the 2017 State Water Plan.[1] The State Water Plan predicts that by 2070, reclaimed water will represent over 14% of the water produced by all water strategies in Texas. Since Lubbock must import its potable water from such long distances, reusing water makes economical and practical sense. Using reclaimed water can reduce dependency on new water supplies. Various types of reclaimed water uses are discussed in the following section. The Jim Bertram Lake 7 strategy, which uses reclaimed supplies, is evaluated in the Section 10 on Surface Water Strategies.

7.1 Types of Reclaimed Water Uses

Reclaimed water can be used for a variety of beneficial uses depending on the level of wastewater treatment. This includes both non-potable and potable uses, and can include both indirect and direct methods of delivery.

Indirect reuse is the process of discharging treated effluent into the bed and banks of a river or stream, allowing it to flow downstream to a point where it is diverted and used for a beneficial purpose. The discharged water co-mingles with existing streamflows and can be used as-is for some purposes (gravel pit operations, irrigation, etc.), or the captured water can be pumped back into the raw water supply for treatment to potable standards. Water that is discharged into a river basin for conveyance downstream requires a permit from the Texas Commission on Environmental Quality (TCEQ) before it can be re-diverted. Several of the City of Lubbock's (City's) potential water supply strategies utilize this process.

Direct reuse is the process of utilizing the reclaimed water directly from the wastewater treatment plant, with no intervening discharge into a river or stream. The water can be used for non-potable or potable uses, depending on how much additional treatment is provided after the reclaimed water leaves the wastewater treatment facility.

7.1.1 Non-Potable Reuse

Non-potable reuse is the process of conveying treated wastewater effluent to an end-user for beneficial uses such as irrigation, manufacturing, oil/gas operations, mining, or power generation. The reclaimed water can be conveyed either directly or indirectly. The effluent may need to go through additional treatment by the end user depending on the final use of the water. Reclaimed water used in this way can reduce demand on the City's potable water supply, which is more expensive due to the costs to transport, treat, and deliver potable water to customers.

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[1] Water for Texas: 2017 State Water Plan. Texas Water Development Board. May 2016.

30 Texas Administrative Code (TAC) Chapter 210.32 identifies the following two types of non-potable reclaimed water uses, when the water is conveyed directly to the end user (direct reuse).

- Type I Reclaimed Water is defined as using reclaimed water where contact between humans and the water is likely. Examples of this type of use include landscape irrigation, public golf course irrigation, fire protection, and toilet or urinal flushing.
- Type II Reclaimed Water is defined as using reclaimed water where contact between humans and the water is unlikely. Examples of this type of use include dust control, cooling tower applications, irrigation of food crops where the reclaimed water is not expected to come in direct contact with the edible part of the crop, and maintenance of impoundments or natural water bodies where direct human contact is not likely.

In order for the City to reuse Type I and II reclaimed water directly, it must maintain an authorization from the TCEQ pursuant to 30 TAC Chapter 210 (commonly referred to as a “210 Authorization”). The City is considering the possibility of amending the existing 210 Authorization to expand the potential non-potable reuses of its treated wastewater.

The City has not deployed a widespread reclaimed water distribution system since most potential users have opted to use more economical local groundwater supplies. Currently the City’s non-potable reuse customers include two private cotton farming operations and the Xcel Energy (Southwestern Public Service) Jones Power Plant.

- *Private Cotton Farming Operations* – In March 2016, the City entered into new contracts with two cotton farmers to supply them Type II reclaimed water under the current 210 Authorization from the TCEQ. The City is not obligated to provide a specific amount of water to the farmers. The contracts expire in 2021.
- *Xcel Energy – Jones Power Plant* – In May 1968, the City entered into a contract with Southwestern Public Service (now Xcel Energy) to supply up to 7.7 million gallons per day (mgd) of reclaimed water to the Jones Power Plant located a few miles southeast of the City’s water reclamation plant. The contract was amended in 1992 to send a total of 7.0 mgd. Then, in July 2009, the City amended the contract again to supply up to 9.0 mgd to the Jones Power Plant until 2045.[2] Jones Power Plant typically uses less than 5.0 mgd throughout the year.

7.1.2 Potable Reuse

Potable reuse typically is done directly, wherein the treated wastewater is transmitted through a pipeline back to the raw water supply used for potable purposes. The wastewater will go through additional advanced treatment barriers before being injected back into the raw water supply. A direct potable reuse system could also be developed where the reclaimed water is not injected back into the raw water supply, but is treated to potable quality through consecutive treatment barriers and introduced directly into the potable water system. This type of system would require substantial safeguards to minimize the risk of contaminated water supply being introduced into the potable water system.

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[2] Third Amendment to Contract between the City of Lubbock and Southwestern Public Service for the sale and purchase of treated sewage effluent. July 28, 2009: Resolution 2009-R0271.

The primary concerns associated with the use of reclaimed water to supplement the potable water supply include regulatory limitations and public perception. Particular challenges to public acceptance of reuse projects include: perceptions of health risks, the source of recycled water, the issue of choice and options, trust and knowledge, and the cost of recycled water. A successful project will need to address these public acceptance issues. Direct potable reuse strategies are evaluated in Sections 7.5, 7.6, and 7.9.

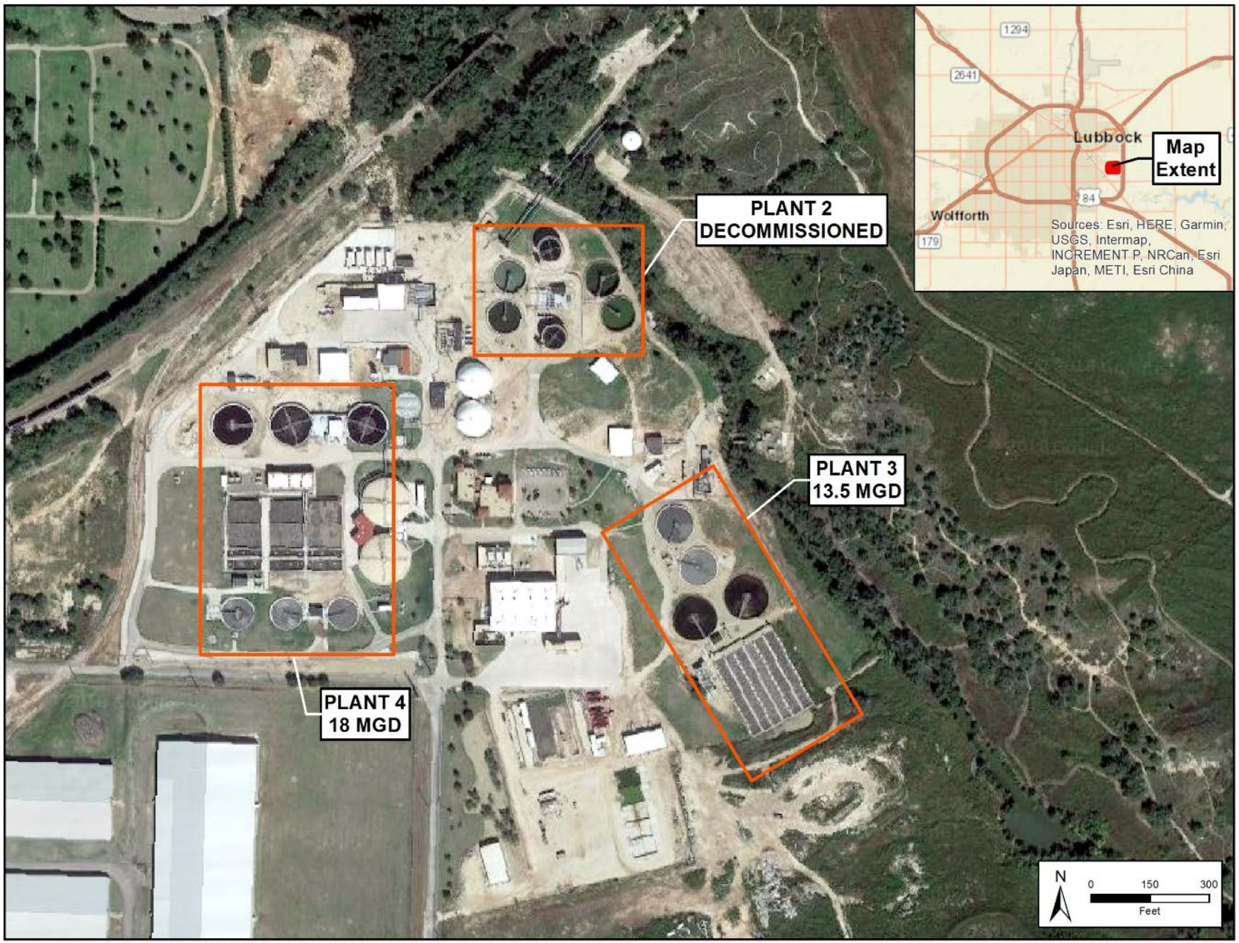
7.2 Existing Reclaimed Water Infrastructure

Two wastewater treatment facilities are owned and operated by the City: that Southeast Water Reclamation Plant (SEWRP) and the Northwest Water Reclamation Plant (NWWRP).

Southeast Water Reclamation Plant

Over the past decade, specific improvements have been undertaken by the City to improve the quality of effluent produced at the SEWRP so it can be discharged into the North Fork of the Double Mountain Fork of the Brazos River (North Fork). The SEWRP currently consists of two operating treatment facilities, Plants 3 and 4. Plant 1 was taken out of service and demolished. Plant 2 is also out of service and plans are being developed to decommission and potentially repurpose Plant 2 structures. Plants 3 and 4 are connected at the headworks of the SEWRP, but function independently until the plants discharge into two effluent pumping stations (EPS) (EPS-1 and EPS-2). Plant 4 modifications completed in 2012 include a conversion of the conventional activated sludge process with aeration basins to biological nutrient removal (BNR) utilizing an Integrated Fixed-film Activated Sludge (IFAS) process. Effluent from the two plants are filtered through new cloth media units and disinfected with an ultraviolet (UV) disinfection system prior to discharge or disposal.

Figure 7.1. Southeast Water Reclamation Plant



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China

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Digester and sludge handling improvements were completed in 2018, which has further improved the quality of the effluent. In order for all of the City's effluent to meet stream discharge requirements, Plant 3 will need to be upgraded in a manner similar to Plant 4. The design of Plant 3 improvements is estimated to be completed by 2021. By increasing the quality of the effluent, the City achieves greater flexibility in how it can beneficially reuse its reclaimed water. Evaluation of new reclaimed water strategies that take effluent from the SEWRP assume the Plant 3 BNR upgrade has been completed. The Plant 3 13.5 mgd BNR upgrade is estimated at $24.8 M in January 2017 prices, based on the Texas Water Development Board (TWDB) costing model. The existing SEWRP layout is depicted in Figure 7.1.

Two of the SEWRP's permitted outfalls allow discharges into the North Fork. Outfall 001 is located at the intersection of Farm-to-Market Road (FM) 400 and the North Fork. Outfall 007 is located next to the SEWRP at the North Fork.

Northwest Water Reclamation Plant

The NWWRP began operations in early 2018. This new wastewater plant will accommodate growth in the northwest portion of the City. It will initially discharge up to 3 mgd at its permitted outfall (NWWRP Outfall 001) into Jim Bertram Lake No. 1. The NWWRP is projected to treat and discharge up to 6 mgd by 2022. Treated effluent discharged into Jim Bertram Lake No. 1 in Yellow House Draw flows into the North Fork. Treated water from the NWWRP will be high quality and ideal for reuse applications. The layout of the NWWRP (during construction) is shown in Figure 7.2.

Figure 7.2. Northwest Water Reclamation Plant (NWWRP) During Construction

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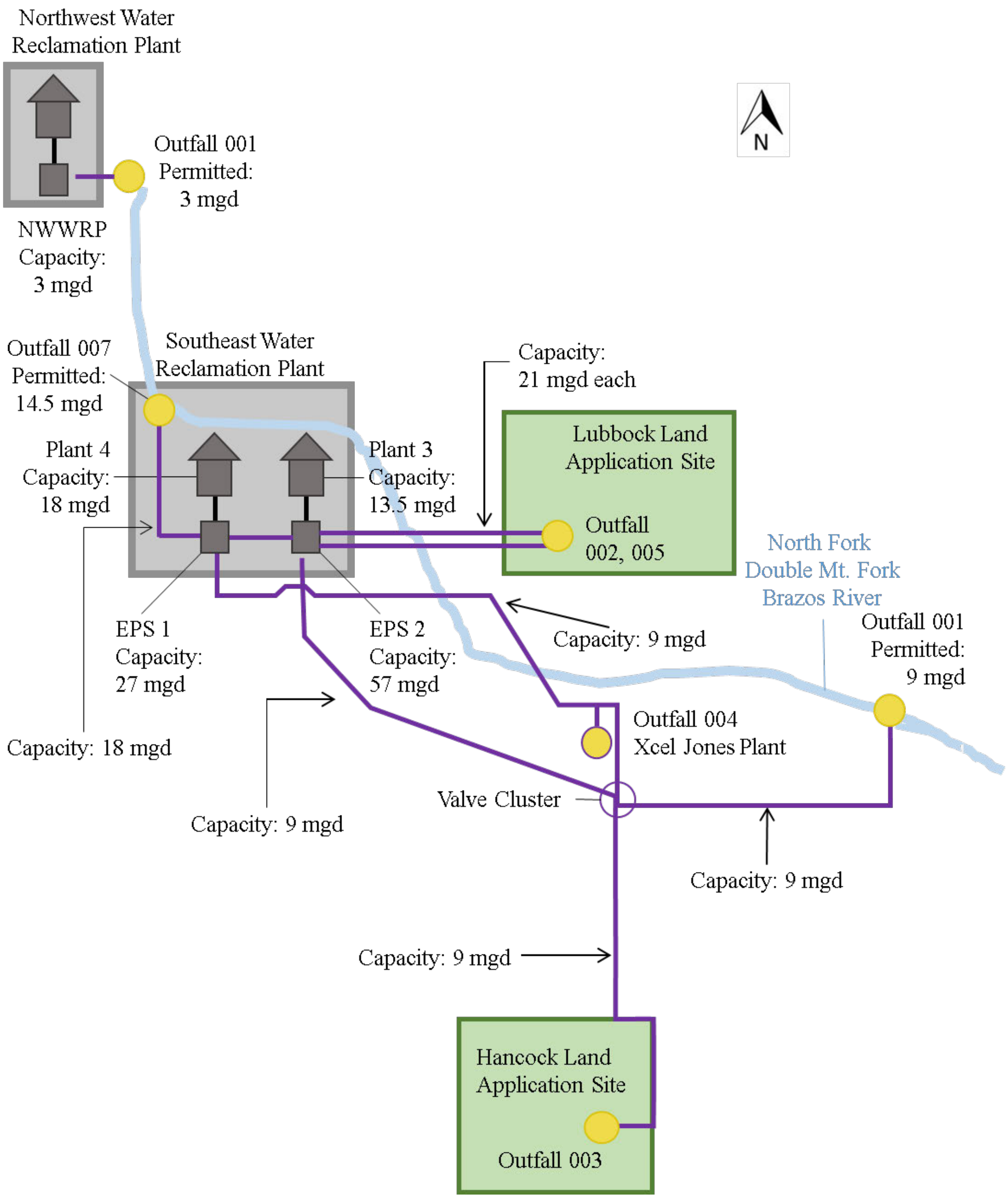
The current location of the effluent pipeline with its associated capacity is important in the evaluation of potential reuse strategies. Some reuse strategies may require modifications to the treatment and discharge facilities. Figure 7.3 shows a schematic of the existing reclaimed water effluent pipeline configuration. The permitted outfalls are labeled on the map.

Figure 7.3. Wastewater Effluent Pipeline System Schematic



7.3 Available Reclaimed Water

Reclaimed water volume projections are necessary to determine when associated water supply strategies will become viable options. Volume projections are developed by multiplying estimated population by the estimated per capita wastewater effluent usage each year.

7.3.1 Population

Population projections were calculated using the City's population and growth rates discussed in Section 2.1. However, the populations of the four communities that receive potable water from the City were not included in these projections since they operate their own wastewater collection and treatment systems. The Expected Growth scenario is used (as described in Section 2.1) to develop the reclaimed water projections.

7.3.2 Per Capita Wastewater Usage

The City has experienced an average decrease of 1.2% per year in its per capita wastewater usage since 1995. Due to conservation and reuse, most large cities in Texas are continuing to experience decreasing per capita wastewater flows. Therefore, Lubbock's future per capita wastewater usage was determined by using the previous five-year average per capita usage of 78 gallons per capita per day (gpcd) as a baseline and reducing the gpcd for 100 years until it reaches 65 gpcd. The City's wastewater flows have dropped as low as 65 gpcd during some months of the year. This projection is used in determining the reclaimed water demand projections.

7.3.3 Gross Reclaimed Water Availability

Lubbock's annual Reclaimed Water Availability (RWA) projections consist of a scenario which was developed using the Expected Growth scenario and the per capita wastewater usage described in the preceding paragraphs.

Expected RWA (Expected Growth x Per Capita Wastewater Usage) – This scenario is the most likely projection since it includes probable population growth projections.

A comparison of this Plan's RWA projections to the City's 2009 Wastewater Master Plan[3] and the 2013 Plan[4] is depicted in Figure 7.4 (see Appendix D.1).

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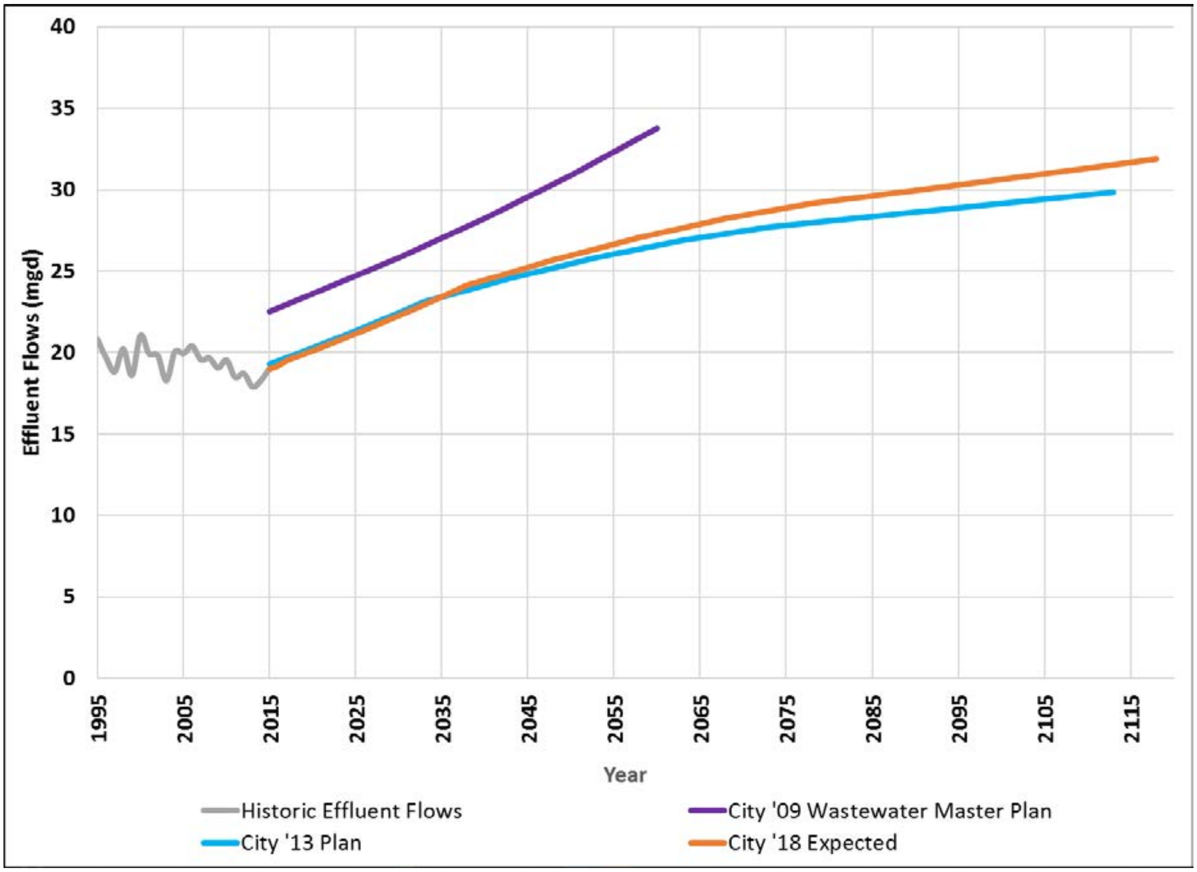
[3] Wastewater Master Plan. City of Lubbock, Texas. Jacobs Engineering, Inc. 2009.

[4] City of Lubbock, "Strategic Water Supply Plan". February 2013.

Figure 7.4. Reclaimed Water Availability Projections



Note that the City's 2009 Wastewater Master Plan projects wastewater demands to 2060 while the 2013 Plan ends in 2113. The Expected RWA scenario projects that the following total volume of reclaimed water will be available for reuse in the designated years:

- 19.70 mgd (22,071 acre-feet per year [ac-ft/yr]) by the year 2018
- 24.15 mgd (27,057 ac-ft/yr) by the year 2038
- 28.24 mgd (31,639 ac-ft/yr) by the year 2068
- 31.88 mgd (35,717 ac-ft/yr) by the year 2118

7.3.4 Net Reclaimed Water Availability

Commitments to electric generation and land application uses must be subtracted from the total RWA in order to determine how much reclaimed water will be available for potable water supply strategies. Therefore, the following assumptions have been made.

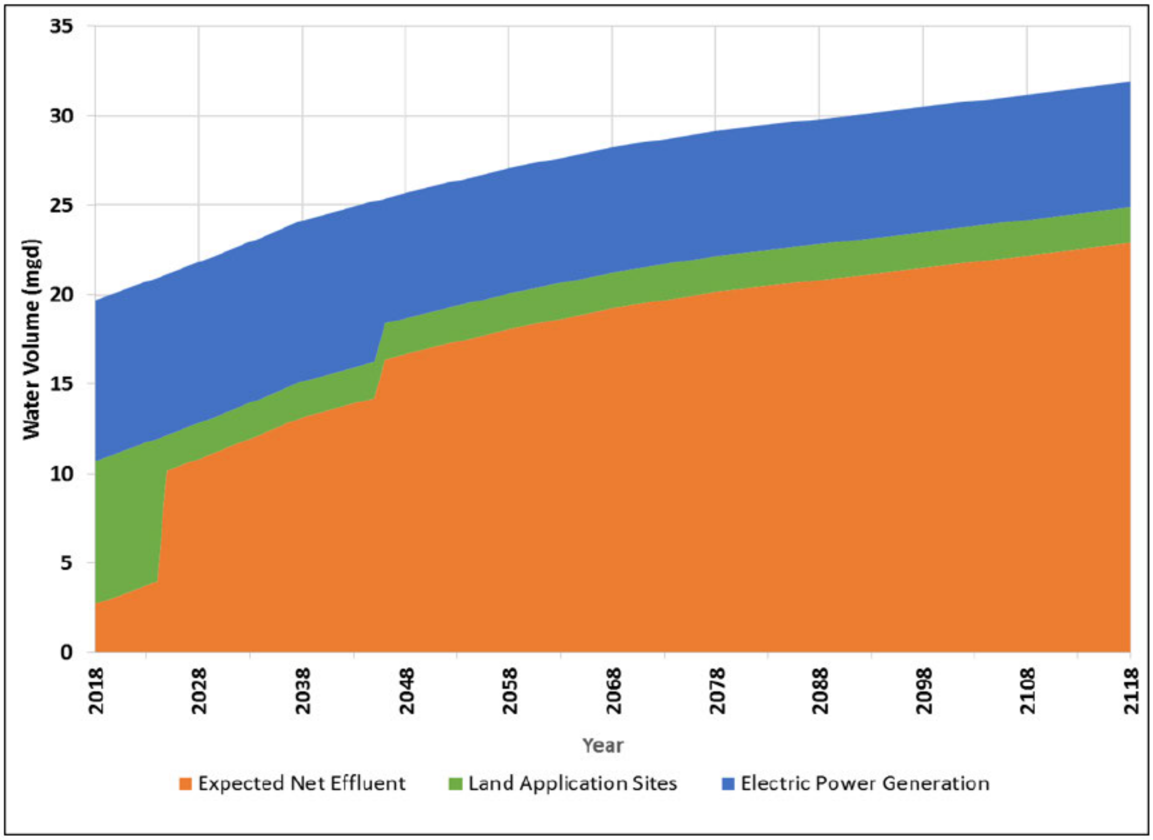
Electric Power Generation – Currently the reclaimed water for power generation is set to 9 mgd as per contract. The City is not anticipating any additional power generation plants being built in the future that will require access to the reclaimed water. It is anticipated Lubbock Power and Light will continue to purchase power and is not considering building a power generation plant at this time.

It is anticipated that in 2045 (Xcel's Jones Power Plant contract expiration), the Xcel contract will be renegotiated to match more closely the actual reclaimed water that is needed for electric power generation. Therefore, the total electric power commitment drops by 2 mgd to 7 mgd in 2045.

Land Application Operations – It is anticipated that it will take a minimum of 4 mgd of effluent to keep the Lubbock Land Application Site (LLAS) and 4 mgd of effluent to keep the Hancock Land Application Site (HLAS) operational. Projections assume that by 2024, the LLAS will be reduced in its size and the HLAS site will be decommissioned. Therefore, the combined reclaimed water commitment to the land application sites will drop from 8 mgd in 2018 to 2 mgd in 2025.

Figure 7.5 depicts the projected net reclaimed water that will be available for water supply projects. In addition, it depicts the water reserved for electric power generation and land application operations. Appendix D.2 includes a table of available net reclaimed water projections.

Figure 7.5. Net Reclaimed Water Availability



In the following sections, nine water supply strategies are presented that rely upon the net reclaimed water available during a given year. Both direct and indirect reuse strategies are discussed. Without the availability of reclaimed water, these strategies are not viable options. Each of the strategies utilizes the same reclaimed water source. As a result, if one of the strategies is implemented, it may necessitate the elimination or downsizing of other strategies that use the same reclaimed water source.

7.4 North Fork Diversion at County Road 7300 Strategy

The North Fork Diversion at County Road (CR) 7300 Strategy is considered an indirect reuse strategy. The City of Lubbock is permitted to discharge 9 mgd of treated effluent at SEWRP Outfall 001 located at the intersection of FM 400 and the North Fork (see Figure 7.2). With this strategy, the City will construct a diversion facility 2.7 river miles downstream from SEWRP Outfall 001 to recapture the discharged effluent. After diversion, the water (reclaimed effluent commingled with actual flows) will be pumped through the transmission line to the South Water Treatment Plant (SWTP). Costs for these facilities have been evaluated separately in a 2015 memorandum[5] which were reviewed but not utilized for the costing of this strategy in order to maintain a consistent costing approach within the strategies evaluated in this plan. A 9 mgd expansion of the SWTP and the new Low Head C transmission pipeline and pump station will be necessary to make this strategy viable. A recent evaluation indicates that the relatively short distance (2.7 miles) between the discharge and the intake may not provide sufficient natural attenuation and blending of supply for enhanced water quality. Therefore, additional advanced treatment facilities have been added to address water quality concerns. Alternatively, Section 7.6 presents a (Direct Potable Reuse (DPR) strategy taking reclaimed water directly to an advanced treatment facility near the SWTP.

The major design features of this strategy include:

- Design flows associated with the intake, pump station, and transmission pipeline estimated at 5% downtime;
- A new intake structure and a 1,136 horsepower (hp) pump station at the CR 7300 crossing to divert the City’s water from the North Fork;
- An 8-mile, 24-in transmission pipeline to deliver the water to the SWTP;
- A 9.5 mgd advanced treatment plant (ATP) constructed at the Lubbock SWTP;
- Reverse osmosis (RO) concentrate will be discharged through a 8-in, 7.5 mile transmission line to the North Fork Double Mountain Fork of the Brazos River
- A 4.5-mile, 30-in Low Head C Transmission pipeline to allow flow from the SWTP to reach Pump Station (PS) 16 or Bailey County groundwater to flow to PS 14 (see Figure 4.10);
- A 15 mgd Low Head C Pump Station to transfer water from the SWTP to PS 16; and
- An expansion of the SWTP capacity and the associated high service pump station by 9 mgd.

Figure 7.6 depicts the relative locations of the required CR 7300 infrastructure.

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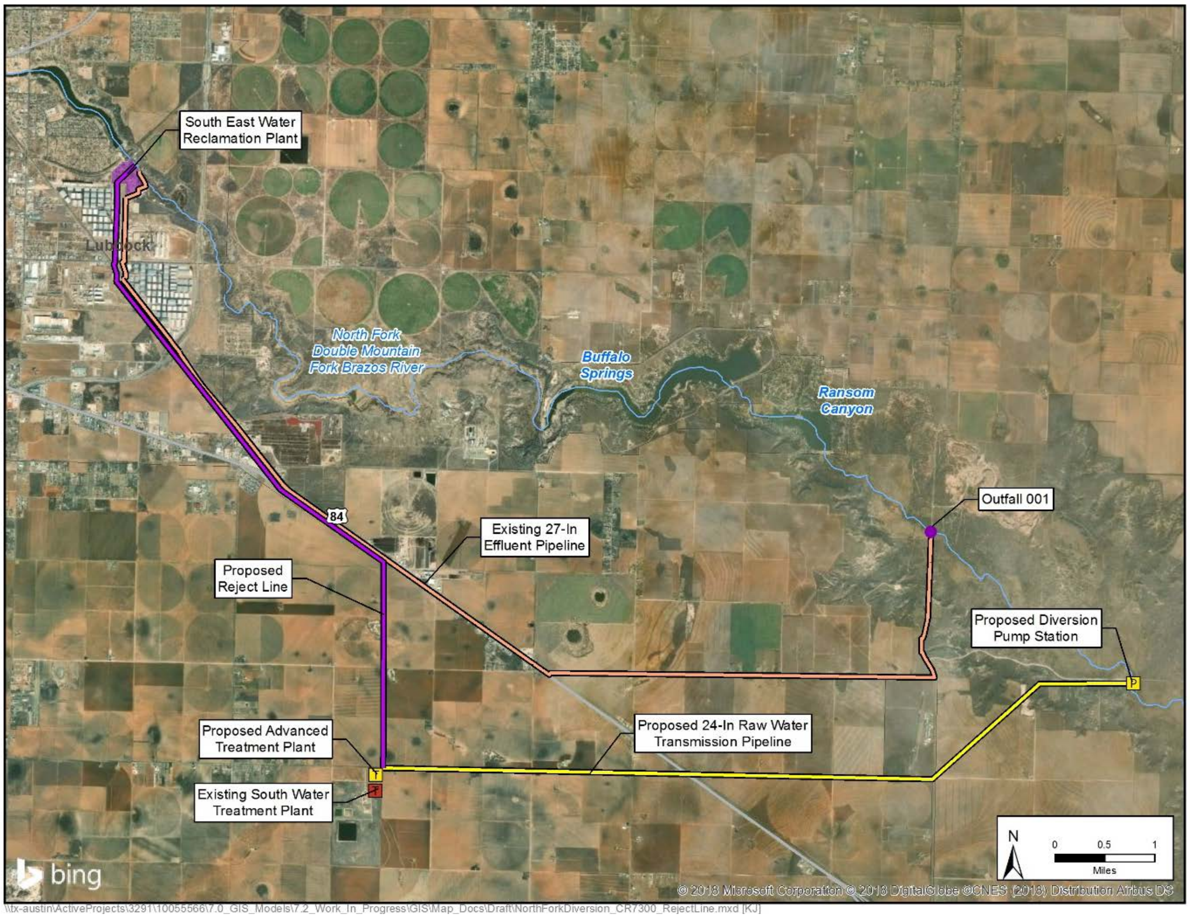
[5] CR 7300 Conceptual Design and Opinion of Probable Construction Cost. HDR. November 2015.

Figure 7.6 North Fork Diversion at County Road 7300



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7.4.1 Quantity of Available Water

This strategy is designed to treat and deliver an average of 9 mgd (10,089 ac-ft/yr) to the ATP; however, the efficiency of the RO is assumed 80 percent resulting in 0.72 mgd of reject and 8.28 mgd of treated reclaimed water to the SWTP each year. Carriage losses within the 2.7 miles of stream bed of the North Fork are considered negligible.

7.4.2 Strategy Costs

Costs associated with this strategy are presented in Table 7.1. Assumptions and conditions associated with these costs include:

- Existing infrastructure will be used for transmission of treated water from the SWTP into the City’s water distribution system;
- Energy costs associated with the Low Head C Pump Station are not included with the transmission pipeline costs;
- Engineering, legal, and contingency costs are 30% of pipeline construction and 35% of other facilities constructed;
- Power is available at $0.09 per kilowatt-hour (kwh);
- Interest during construction is estimated at 4.0%, and a 1% return on investments over a 2-year period; and
- The project will be financed for 20 years at a 5.5% annual interest rate.

These costs do not include the costs necessary for advanced treatment required for a DPR project, which should be added to the costs shown below.

As shown, the total project cost is estimated to be $182,012,000. Annual debt service is $15,231,000; and, annual operational cost, including power, is $5,220,000. This results in a total annual cost of $20,451,000. The unit cost for 8.3 mgd or 9,274 ac-ft/yr supply of water is estimated to be $2,205 per ac-ft, or $6.77 per 1,000 gallons.

Table 7.1. North Fork Diversion at County Road 7300 Costs (January 2017 Prices)

Item	Estimated Costs for Facilities
Channel Dam and Intake Pump Station (9.5 mgd)	$11,496,000
Transmission Pipeline (24 in dia., 8 miles)	$5,170,000
RO Concentrate Pipeline (8 in dia., 7.5 miles)	$1,373,000
Low Head C Pipeline and Pump Station	$21,393,000
SWTP Expansion (9 mgd)	$18,776,000
Advanced Treatment Plant (9.5 mgd)	$67,807,000
TOTAL COST OF FACILITIES	**$126,015,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$43,309,000
Environmental & Archaeology Studies and Mitigation	$511,000
Land Acquisition and Surveying (107 acres)	$269,000
Interest During Construction (4% for 2 years with a 1% ROI)	$11,908,000
TOTAL COST OF PROJECT	**$182,012,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$15,231,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$159,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$587,000
Water Treatment Plant	$3,419,000
Pumping Energy Costs (11,725,477 kW-hr @ 0.09 $/kW-hr)	$1,055,000
TOTAL ANNUAL COST	**$20,451,000**
Available Project Yield (ac-ft/yr)	9,274
Annual Cost of Water ($ per ac-ft), based on a Peaking Factor of 1	$2,205
Annual Cost of Water ($ per 1,000 gallons), based on a Peaking Factor of 1	$6.77

7.4.3 Implementation Issues

Environmental Issues

The primary environmental issue related to this strategy includes the construction of the diversion facilities. Therefore, there will be a potential impact on animal habitats, which must be mitigated. Studies will be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species. However, the construction of the diversion facilities should have a low to moderate impact relative to most of these concerns.

Permitting Issues

The City started discharging at Outfall 001 in May 2003 pursuant to Texas Pollutant Discharge Elimination System (TPDES) Permit No. 10353-002. Outfall 001 is permitted to discharge a maximum of 9.0 mgd (10,089 ac-ft/yr). In April 2004, the City filed an amendment to Water Use Permit 3985 with the TCEQ. The amendment's approval was delayed due to a contested case hearing regarding ownership of developed water return flows. The TCEQ ruled on the case and issued the City the Water Use Permit in December 2012. This permit authorizes the diversion of up to 10,089 ac-ft annually (minus 0.47% carriage losses) at the CR 7300 facility. Additional permitting will be required to construct the proposed diversion facility.

Other Issues

Property will need to be acquired at the proposed diversion location. In addition, pipeline utility easements will be necessary to construct a raw water transmission line to the SWTP.

7.5 Direct Potable Reuse to NWTP from SEWRP Strategy

This strategy includes conveying 9 mgd of reclaimed water from the SEWRP to an ATP for advanced treatment with multiple barriers before transporting and discharging into the raw water headworks at the North Water Treatment Plant (NWTP). The project purifies reclaimed water from the SEWRP through advanced treatment (RO, UV disinfection and advanced oxidation process [AOP]) to create a water supply that will be of higher quality than the City's other raw water sources. The treated reclaimed water will be blended with other raw water from Canadian River Municipal Water Authority (CRMWA) at the NWTP and undergo conventional treatment for distribution to customers. Human health risks for direct potable reuse are equal or less than those of other water supply sources when full advanced treatment is used (RO, UV disinfection and AOP). These processes are effective at removing identified emerging constituents of concern (ECCs) and other contaminants, including pathogens, from treated wastewater.

In the 2017 Direct Potable Reuse Feasibility Study[6] two alternatives were evaluated that provided DPR supplies to the NWTP. Option 6A delivered purified water from the SEWRP while Option 7B delivered purified water from the NWWRP. These alternatives varied based on the treatment scheme.

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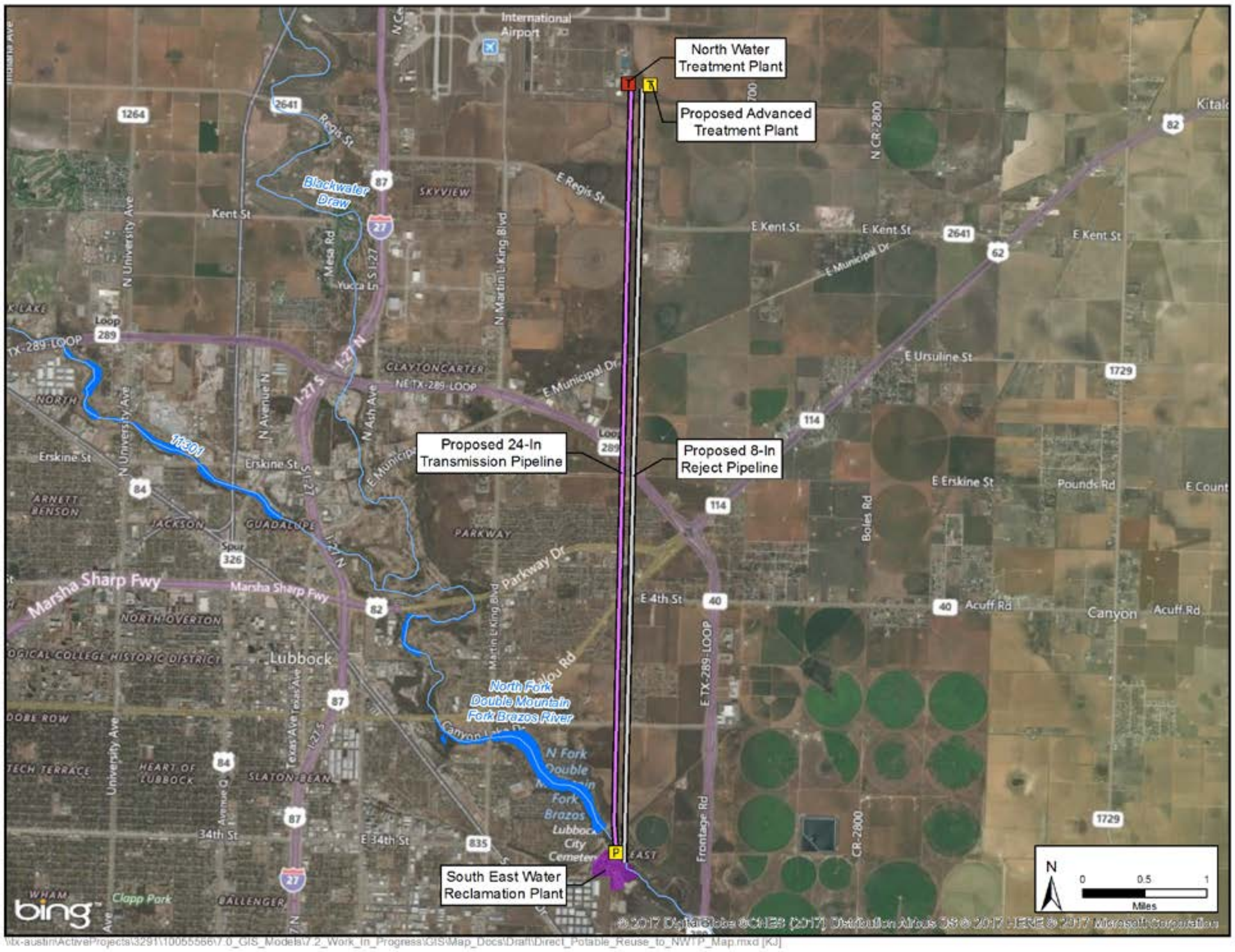
[6] City of Lubbock, "Potable Water Reuse Implementation Feasibility Study". March 2017

The major design features of this strategy include:

- The NWTP has an existing capacity adequate to treat and distribute the additional 9 mgd of reclaimed water. Therefore, an expansion of the NWTP is not necessary;
- A 9.5 mgd ATP at the Lubbock NWTP;
- A new 785 hp pump station at the SEWRP to deliver the treated reclaimed water to the ATP via a new 24-in, 6-mile transmission pipeline; and
- RO concentrate will be discharged through a 8-in, 6-mile transmission line to the North Fork Double Mountain Fork of the Brazos River

Figure 7.7 depicts the relative locations of the infrastructure needed for the Direct Potable Reuse to NWTP strategy.

Figure 7.7. Direct Potable Reuse to NWTP



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7.5.1 Quantity of Available Water

This strategy is designed to treat and deliver an average of 9 mgd (10,089 ac-ft/yr) to the ATP; however, the efficiency of the RO is assumed to be 80 percent resulting in 0.72 mgd of reject and 8.28 mgd of treated reclaimed water to the NWTP each year.

7.5.2 Strategy Costs

Costs associated with this strategy are presented in Table 7.2. Assumptions and conditions associated with these costs include:

- Facilities are sized with a 1.0 Peaking Factor (PF);
- Concentrate reject from the RO plant will be stream discharged;
- Engineering, legal, and contingency costs are 30% of pipeline construction and 35% of other facilities constructed;
- Power is available at $0.09 per kwh;
- Interest during construction is estimated at 4.0%, and a 1% return on investments over a 2-year period;
- The project will be financed for 20 years at a 5.5% annual interest rate; and
- The project is assumed to have a 2-year construction period.

As shown, the total cost is estimated to be $117,104,000. Annual debt service is $9,799,000; and annual operational cost, including power, is $2,561,000. This results in a total annual cost of $12,360,000. The unit cost for 9,274 ac-ft/yr of supply at the NWTP is estimated to be $1,333 per ac-ft, or $4.09 per 1,000 gallons. This cost does not include the distribution of the potable water from the NWTP to potential customers.

7.5.3 Implementation Issues

Environmental Issues

Since the advanced treatment facilities are being constructed on property owned by Lubbock that is currently being used for similar purposes, environmental issues should be minimal. The transmission line corridor that will convey the reclaimed and concentrate water should be selected to avoid potentially sensitive areas.

Table 7.2. Direct Potable Reuse to NWTP from SEWRP Costs (January 2017 Prices)

Item	Estimated Costs for Facilities
Pump Station at SEWRP (9.5 mgd)	$3,740,000
Transmission Pipeline (24 in dia., 6 miles)	$8,306,000
Transmission Pipeline (8 in dia., 6 miles)	$1,320,000
Advanced Treatment Plant (9.5 mgd)	$67,807,000
TOTAL COST OF FACILITIES	**$81,173,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$27,929,000
Environmental & Archaeology Studies and Mitigation	$195,000
Land Acquisition and Surveying (91 acres)	$145,000
Interest During Construction (4% for 2 years with a 1% ROI)	$7,662,000
TOTAL COST OF PROJECT	**$117,104,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$9,799,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$96,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$94,000
Water Treatment Plant	$1,542,000
Pumping Energy Costs (8,646,512 kW-hr @ 0.09 $/kW-hr)	$829,000
TOTAL ANNUAL COST	**$12,360,000**
Available Project Yield (ac-ft/yr)	9,274
Annual Cost of Water ($ per ac-ft), based on a Peaking Factor of 1.0	$1,333
Annual Cost of Water ($ per 1,000 gallons), based on a Peaking Factor of 1.0	$4.09

Permitting Issues

The drinking water produced for the project will meet or exceed all state and federal drinking water standards. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Disposal of residuals from the project would meet all state and federal requirements for discharge of waste. A TPDES permit will be required to discharge RO concentrate. The water quality for RO concentrate discharged into the North Fork of the Double Mountain Fork (NFDMF) of the Brazos River will meet or exceed the stream standards for that segment.[7]

Stream crossings would be subject to Section 404 of the Clean Water Act. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that most of the proposed project would be authorized by Nationwide Permit 12.

Monitoring is likely to include Cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on the U.S. Environmental Protection Agency (USEPA) Candidate Contaminate List (CCL), including ECCs and pharmaceuticals and personal care products (PPCPs).

Other Issues

Due to the nature of the project, a public outreach plan will be essential for successful implementation of the proposed reuse project.

Advanced treatment design considerations should include:

- multiple process barriers;
- redundancy and backup power sources;
- alternate storage or discharge locations to divert reclaimed water from the potable distribution system during an acute episode; and
- real-time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

7.6 Direct Potable Reuse to SWTP from SEWRP Strategy

This strategy includes conveying 9 mgd of reclaimed water from the SEWRP to an ATP for advanced treatment with multiple barriers before transporting and discharging into the raw water supply headworks at the SWTP. The project purifies reclaimed water from the SEWRP through advanced treatment using RO, UV disinfection and AOP to create a water supply that will be of higher quality than the City’s other raw water sources. The treated reclaimed water will be blended with other raw water supplies at the SWTP and treated again prior to being introduced into the distribution system. Human health risks for direct potable reuse are equal or less than those of other water supply sources when full advanced treatment is used (RO, UV disinfection and AOP). These processes are effective for removing identified ECCs and other contaminants, including pathogens, from treated wastewater.

The major design features of this strategy include:

- Property for the SEWRP expansion and SWTP expansion is owned by the City;
- A 9.5 mgd ATP constructed at the Lubbock SWTP;
- A 0.45 mg ground storage tank and 500 hp pump station will be constructed at the SEWRP;

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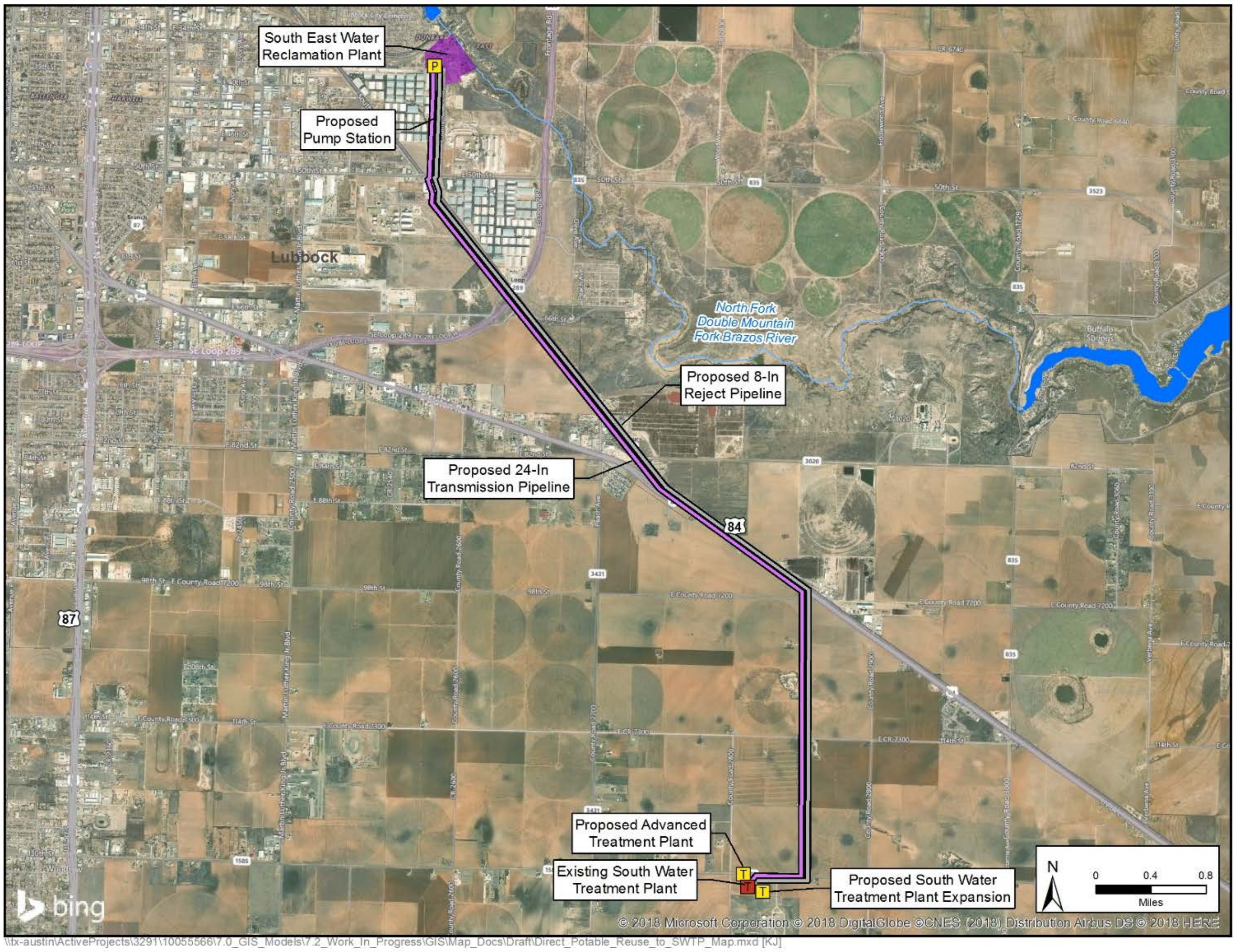
[7] City of Lubbock, “Potable Water Reuse Implementation Feasibility Study”. March 2017. 7-9.

- A 7.5 mile, 24-inch diameter transmission pipeline to the SWTP.
- RO concentrate will be discharged through a 8-in, 7.5 mile transmission line to the North Fork Double Mountain Fork of the Brazos River
- A 8.3 mgd expansion of the SWTP's treatment facilities;
- A 4.5-mile, 30-in Low Head C Transmission pipeline to allow flow from the SWTP to reach PS#16 or Bailey County groundwater to flow to PS 14 (see Figure 4.10); and
- A 15 mgd Low Head C Pump Station to transfer water from the SWTP to PS 16.

Figure 7.8 depicts the relative locations of the infrastructure needed for the Direct Potable Reuse to SWTP strategy.

Figure 7.8. Direct Potable Reuse to SWTP



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7.6.1 Quantity of Available Water

This strategy is designed to treat and deliver an average of 9 mgd (10,089 ac-ft/yr) to the ATP; however, the efficiency of the RO is assumed 80 percent resulting in 0.72 mgd of reject and 8.28 mgd of treated reclaimed water to the SWTP each year.

7.6.2 Strategy Costs

Costs associated with this strategy are presented in Table 7.3. Assumptions and conditions associated with these costs include:

- Concentrate reject from the ATP will be stream discharged;
- Engineering, legal, and contingency costs are 30% of pipeline construction and 35% of other facilities constructed;
- Power is available at $0.09 per kwh;
- Interest during construction is estimated at 4.0%, and a 1% return on investments over a 2-year period; and
- The project will be financed for 20 years at a 5.5% annual interest rate.

As shown, the total cost is estimated to be $168,380,000. Annual debt service is $14,090,000; and, annual operational cost, including power, is $4,525,000. This results in a total annual cost of $18,615,000. The unit cost for a 9,274 ac-ft/yr uniform supply is estimated to be $2,007 per ac-ft, or $6.16 per 1,000 gallons.

7.6.3 Implementation Issues

Environmental Issues

Since the RO treatment facilities are being constructed on property owned by Lubbock that is currently being used for similar purposes, environmental issues should be minimal. The transmission line corridor that will convey the raw water to the SWTP should be designed to avoid any potentially sensitive areas.

Permitting Issues

The drinking water produced for the project will meet or exceed all state and federal drinking water standards. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Disposal of residuals from the project would meet all state and federal requirements for discharge of waste. A TPDES permit will be required to discharge RO concentrate. The water quality for RO concentrate discharged into the NFDMF of the Brazos River will meet or exceed the stream standards for that segment[8].

Stream crossings, if any, would be subject to Section 404 of the Clean Water Act. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that most of the proposed project would be authorized by Nationwide Permit 12.

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[8] City of Lubbock, "Potable Water Reuse Implementation Feasibility Study". March 2017. 7-9.

Monitoring is likely to include Cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on the USEPA CCL, including ECCs and PPCPs.

Table 7.3. Direct Potable Reuse to SWTP Costs (January 2017 Prices)

Item	Estimated Costs for Facilities
8.7 mgd Pump Station and Storage Tank	$3,750,000
Transmission Pipeline (24 in dia., 7.5 miles)	$5,063,000
RO Concentrate Pipeline (8 in dia., 7.5 miles)	$1,141,000
Low Head C Transmission Line	$9,393,000
Low Head C Transmission Pump Station	$12,000,000
SWTP Expansion (8.3 mgd)	$17,600,000
Advanced Treatment Plant (9.5 mgd)	$67,807,000
TOTAL COST OF FACILITIES	**$116,754,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$40,084,000
Environmental & Archaeology Studies and Mitigation	$401,000
Land Acquisition and Surveying (84 acres)	$125,000
Interest During Construction (4% for 2 years with a 1% ROI)	$11,016,000
TOTAL COST OF PROJECT	**$168,380,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$14,090,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$160,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$384,000
Water Treatment Plant	$3,302,000
Pumping Energy Costs (7318440 kW-hr @ 0.09 $/kW-hr)	$679,000
TOTAL ANNUAL COST	**$18,615,000**
Available Project Yield (ac-ft/yr)	9,274
Annual Cost of Water ($ per ac-ft), based on a Peaking Factor of 1.0	$2,007
Annual Cost of Water ($ per 1,000 gallons), based on a Peaking Factor of 1.0	$6.16

Other Issues

Due to the nature of the project, a public outreach plan will be essential for successful implementation of the proposed reuse project.

Advanced treatment design considerations should include:

- multiple process barriers;
- redundancy and backup power sources;
- alternate storage or discharge locations to divert reclaimed water from the potable distribution system during an acute episode; and
- real-time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

7.7 South Fork Discharge Strategy

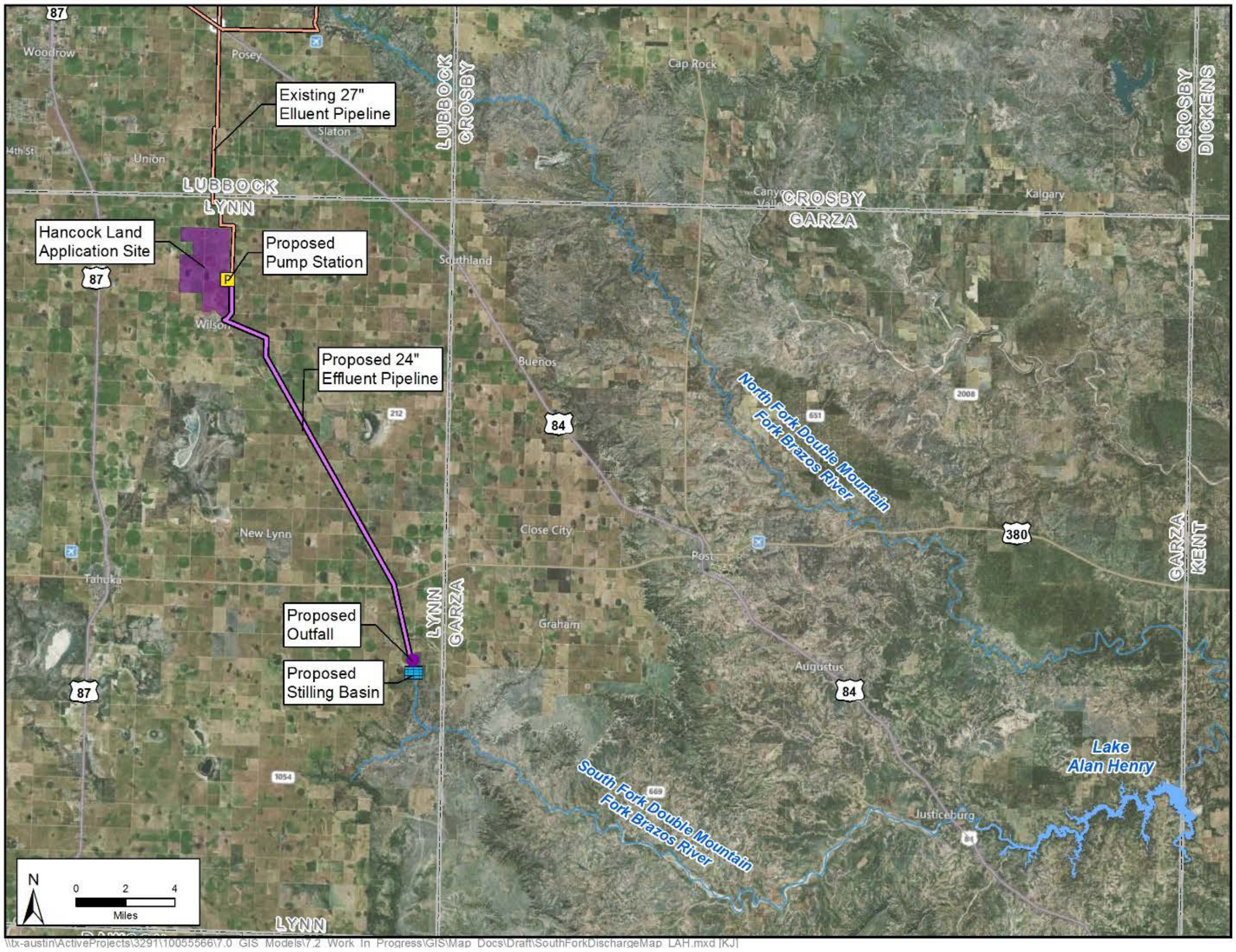
Another potential indirect reuse strategy includes the discharge of treated effluent into the South Fork of the Double Mountain Fork of the Brazos River (South Fork) to increase the firm yield of LAH. The City operates an existing pipeline that transports reclaimed water from the SEWRP to the HLAS located north of the community of Wilson, Texas. This strategy extends the existing reclaimed water pipeline from the HLAS to a tributary on the South Fork enabling the City to discharge up to 9 mgd of reclaimed water into the South Fork. The discharged water will flow downstream and be stored in LAH. The additional water will be pumped to the SWTP via the LAH raw water pipeline.

The major design features of this strategy include:

- A new 9 mgd pump station at the HLAS;
- An 18-mile, 24-in transmission pipeline to discharge reclaimed water into the South Fork tributary;
- A stilling basin located at the discharge point of the 24-in transmission pipeline;
- Expansion of the Lake Alan Henry Pump Station (LAHPS) and Post Pump Station (PPS);
- The construction of the Southland Pump Station (SLPS);
- A 7.3 mgd expansion of the SWTP and associated high service pump station;
- A 4.5-mile, 30-in Low Head C Transmission pipeline to allow flow from the SWTP to reach PS 16 or Bailey County groundwater to flow to PS 14 (see Figure 4.10); and
- A 15 mgd Low Head C Pump Station to transfer water from the SWTP to PS 16..

Figure 7.9 depicts the relative locations of the South Fork Discharge infrastructure needed.

Figure 7.9. South Fork Discharge



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7.7.1 Quantity of Available Water

The City will discharge up to 9 mgd of reclaimed water into the South Fork tributary. The water will flow 36 river miles to LAH where the water will be stored until it is pumped back to the SWTP. Carriage losses from the discharge point to LAH are estimated to be 19% or 1.7 mgd. Therefore, this strategy is estimated to provide an additional peak day of 7.3 mgd or an average of 8,183 ac-ft/yr of water supply.

7.7.2 Strategy Costs

Costs associated with this strategy are presented in Table 7.4 and are provided with and without the inclusion of the LAH pipeline expansion. Assumptions and conditions associated with these costs include:

- Expansion costs for the LAH and PPSs;
- Construction of the SLPS;
- Energy costs to transmit water through the LAHPS and pipeline are included;
- Existing infrastructure will be used for transmission of treated water from the SWTP into the City's water distribution system;

- Energy costs associated with the Low Head C Pump Station were not included in transmission pipeline costs;
- Engineering, legal, and contingency costs are 30% of pipeline construction and 35% of other facilities constructed;
- Power is available at $0.09 per kwh;
- Interest during construction is estimated at 4.0%, and a 1% return on investments over a 2-year period; and
- The project will be financed for 20 years at a 5.5% annual interest rate.

As shown, the total project cost not including the LAH pipeline expansion is estimated to be $74,554,000. Annual debt service is $6,242,000; and, annual operational cost, including power, is $3,389,000. This results in a total annual cost of $9,631,000. The unit cost for 7.3 mgd or 8,183 ac-ft/yr of supply is estimated to be $1,177 per ac-ft, or $3.61 per 1,000 gallons. If the LAH pipeline expansion is included, the unit cost of the project is increased to $1,536 per ac-ft or $4.71 per 1,000 gal.

7.7.3 Implementation Issues

Environmental Issues

This strategy should have minimal impact on the environment since the return flows will be discharged into an existing river basin. The discharge parameters dictated by the TCEQ in the TPDES discharge permit that will be required should ensure that the treated effluent does not impair this segment of the South Fork. Mitigation for the impact to wildlife habitats has already been accomplished for LAH.

Permitting Issues

The City's existing discharge permit (TPDES Permit WQ0010353002) will need to be amended to include an additional outfall on the South Fork. If the existing HLAS pipeline is used, the amendment must include a request to discharge up to 10,089 ac-ft annually into the South Fork. The current permit only authorizes the discharge of treated effluent at FM 400 and the North Fork (Outfall 001) and at the SEWRP (Outfall 007). A water rights permit (bed and banks permit) will be required pursuant to the Texas Water Code Section 11.042 to authorize the conveyance and diversion of the City's reclaimed water. In addition, authorization to construct the discharge facility will be required.

Table 7.4. South Fork Discharge Costs (January 2017 Prices)

Item	Costs	Cost Including LAH Pipeline Expansion
Pump Station (9 mgd)	$2,840,000	$2,840,000
Transmission Pipeline (24 in dia., 18 miles)	$11,577,000	$11,577,000
Low Head C Transmission Pipeline	$9,393,000	$9,393,000
Low Head C Pump Station	12,000,000	12,000,000
LAH Pipeline Expansion		
LAH Pump Station Expansion (additional 15 mgd)		$6,150,000
Post Pump Station Expansion (additional 15 mgd)		$4,865,000
Southland Pump Station (30 mgd)		$9,147,000
SWTP Expansion (7.3 mgd)	$15,921,000	$15,921,000
TOTAL COST OF FACILITIES	**$51,731,000**	**$71,893,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$17,070,000	$24,127,000
Environmental & Archaeology Studies and Mitigation	$566,000	$566,000
Land Acquisition and Surveying (130 acres)	$306,000	$306,000
Interest During Construction (4% for 2 years with a 1% ROI)	$4,881,000	$6,785,000
TOTAL COST OF PROJECT	**$74,554,000**	**$103,677,000**
ANNUAL COST		
Debt Service (5.5 percent, 20 years)	$6,242,000	$8,679,000
Operation and Maintenance		
Pipeline, Wells, and Storage Tanks (1% of Facilities)	$210,000	$210,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$371,000	$875,000
Water Treatment Plant	$1,592,000	$1,592,000
Pumping Energy Costs (20,011,259 kW-hr @ 0.09 $/kW-hr)	$1,216,000	$1,216,000
TOTAL ANNUAL COST	**$9,631,000**	**$12,572,000**
Available Project Yield (ac-ft/yr)	8,183	8,183
Annual Cost of Water ($ per ac-ft)	$1,177	$1,536
Annual Cost of Water ($ per 1,000 gallons)	$3.61	$4.71

Other

Pipeline utility easements will be necessary to extend the existing reclaimed water pipeline to the South Fork. Easements will also be required for the construction of the stilling basin.

7.8 North Fork Diversion to Lake Alan Henry Pump Station Strategy

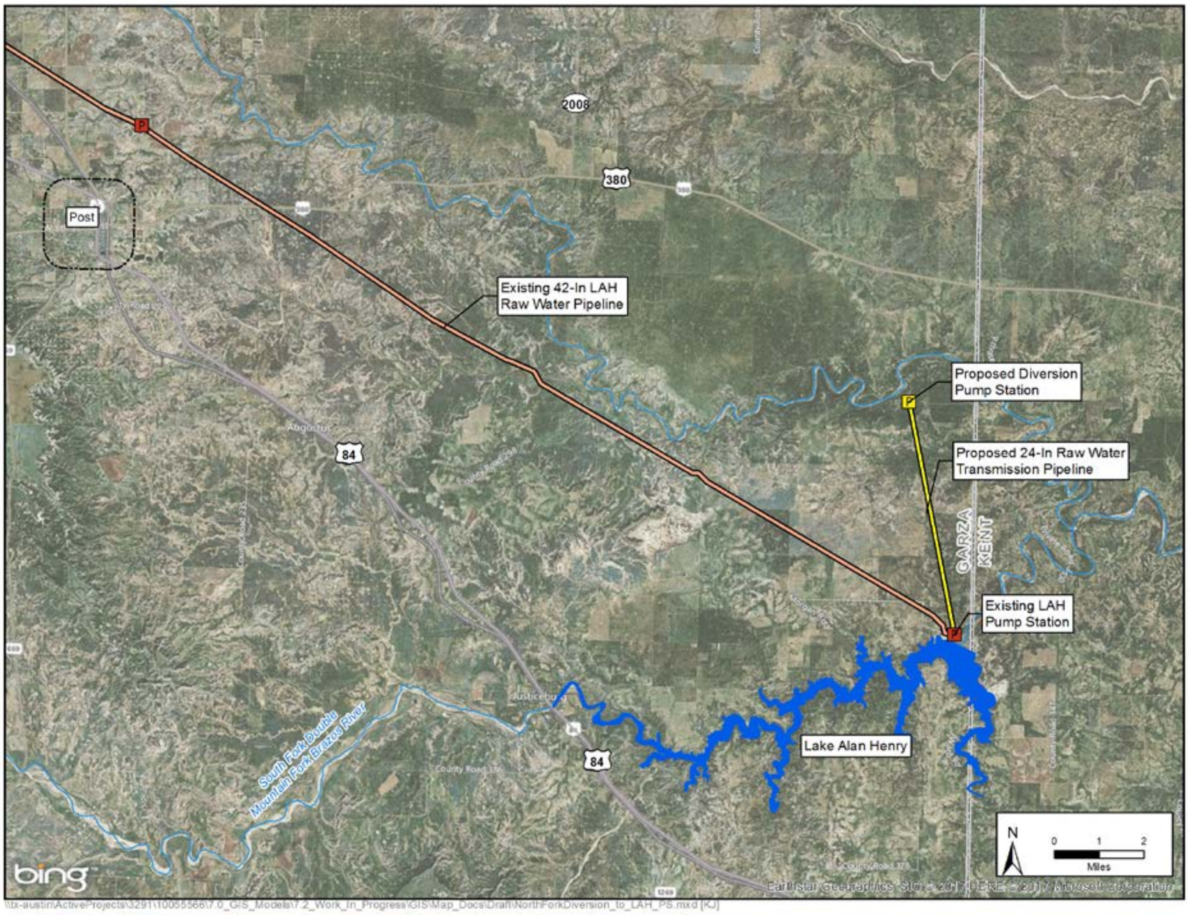
The North Fork Diversion to Lake Alan Henry Pump Station (NFD-LAHPS) is another potential indirect reuse strategy. Under this strategy, the City would discharge up to 9 mgd as permitted from Outfall 001. The water will travel approximately 67 miles downstream on the North Fork to the diversion site. Accounting for carriage losses, about 6.7 mgd of the discharged reclaimed water is estimated to be available for diversion. The water will then be pumped from the diversion site to the LAHPS. From the LAHPS, the water will be transported to the SWTP near Lubbock via the existing LAH raw water pipeline. The LAH pipeline's capacity was designed to transport up to 36 mgd of raw water.

The major design features of this strategy include:

- Design flows associated with the intake structure adjusted for carriage losses;
- Design associated with the intake, diversion pump station, and transmission pipeline excludes downtime allocation;
- A new intake structure and a 460 hp pump station constructed at the diversion location.
- The intake structure and diversion pump station include a small coffer dam to allow for the diversion of the reclaimed water at low flows;
- A 5-mile, 24-in transmission pipeline to deliver the diverted water to the LAHPS;
- Expansion of the LAHPS and PPS;
- The construction of the SLPS;
- A 6.7 mgd expansion of the SWTP and associated expansion of the high service pump station at the SWTP;
- A 4.5-mile, 30-in Low Head C Transmission pipeline to allow flow from the SWTP to reach PS 16 or Bailey County groundwater to flow to PS 14 (see Figure 4.11); and
- A 15 mgd Low Head C Pump Station to transfer water from the SWTP to PS 16.

Figure 7.10 depicts the relative locations of the NFD-LAHPS infrastructure needed. This strategy could be combined with the North Fork Scalping Operation strategy (diverting storm water flows) described in Section 10.5 because both strategies could utilize the same diversion dam and lake, and pipeline easement.

Figure 7.10. North Fork Diversion to Lake Alan Henry Pump Station



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7.8.1 Quantity of Available Water

The strategy is estimated to provide a constant 6.7 mgd or 7,510 ac-ft/yr of reclaimed water for treatment at the SWTP. This quantity is calculated based on 9 mgd of treated effluent being discharged by the City at Outfall 001, reduced by approximately 26% due to carriage losses between the discharge and diversion points on the North Fork.

7.8.2 Strategy Costs

Costs associated with this strategy are presented in Table 7.5. Assumptions and conditions associated with these costs include:

- Expansion costs for the LAHPS, PPS, and SLPS are included in costs;
- Energy costs to transmit water through the LAHPS and pipeline are included;
- Existing infrastructure will be used for transmission of treated water from the SWTP into the City's water distribution system;
- Energy costs associated with the Low Head C Pump Station were not included in transmission pipeline costs;

- Engineering, legal, and contingency costs are 30% of pipeline construction and 35% of other facilities constructed;
- Power is available at $0.09 per kwh;
- Interest during construction is estimated at 4.0%, and a 1% return on investments over a 2-year period; and
- The project will be financed for 20 years at a 5.5% annual interest rate.

As shown, the total project cost not including the LAH pipeline expansion is estimated to be $67,285,000. Annual debt service is $5,630,000; and, annual operational cost, including power, is $3,413,000. This results in a total annual cost of $9,043,000. The unit cost for 6.71 mgd or 7,510 ac-ft/yr supply is estimated to be $1,204 per ac-ft, or $3.69 per 1,000 gallons. If the LAH pipeline expansion is included, the unit cost of the project is increased to $1,596 per ac-ft or $4.90 per 1,000 gal.

7.8.3 Implementation Issues

Environmental Issues

The primary environmental issue related to this strategy is the change in land use from ranchland to a low-head diversion lake, resulting in potential impacts to animal habitats, which must be mitigated. Studies will be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species. However, the construction of the diversion lake should have a low to moderate impact associated with most of these concerns. The sharpnose shiner and smalleye shiner exist within this part of the Brazos River Basin and are listed on the Federal threatened and endangered species list. The location of the diversion lake and intake pump station is in the critical habitat area of the shiners, which will make permitting of those structures difficult. Other threatened species that potentially live in the region surrounding the North Fork include the Texas horned lizard and black-footed ferret.

Permitting Issues

The City started discharging at Outfall 001 in May 2003 under its existing discharge permit TPDES Permit 10353-002. Outfall 001 is permitted to discharge a maximum of 9.0 mgd (10,089 ac-ft/yr). In order to implement this strategy, the City would need to submit an application to the TCEQ for a new water use permit which includes a bed and banks authorization allowing for the transportation and diversion of up to 10,089 ac-ft annually (minus carriage losses) of the City's return flows at the diversion location. Additional permitting will be required to construct the proposed diversion facility.

Table 7.5. North Fork Diversion to the Lake Alan Henry Pump Station Costs (January 2017 Prices)

Item	Costs	Cost Including LAH Pipeline Expansion
Intake Pump Stations and Channel Dam (7.1 mgd)	$7,094,000	$7,094,000
Transmission Pipeline (24 in dia., 5 miles)	$3,262,000	$3,262,000
LAH Transmission Pump Station Expansions		
LAH Pump Station Expansion (additional 15 mgd)		$6,150,000
Post Pump Station Expansion (additional 15 mgd)		$4,865,000
Southland Pump Station (30 mgd)		$9,147,000
Low Head C Transmission Pipeline	$9,393,000	$9,393,000
Low Head C Pump Station	12,000,000	12,000,000
SWTP Expansion (6.7 mgd)	$14,913,000	$14,913,000
TOTAL COST OF FACILITIES	**$46,662,000**	**$66,824,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$15,699,000	$22,756,000
Environmental & Archaeology Studies and Mitigation	$356,000	$356,000
Land Acquisition and Surveying (79 acres)	$166,000	$166,000
Interest During Construction (4% for 2 years with a 1% ROI)	$4,402,000	$6,307,000
TOTAL COST OF PROJECT	**$67,285,000**	**$96,409,000**
ANNUAL COST		
Debt Service (5.5 percent, 20 years)	$5,630,000	$8,068,000
Operation and Maintenance		
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$127,000	$127,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$477,000	$981,000
Water Treatment Plant	$1,491,000	$1,491,000
Pumping Energy Costs (11,841,882 kW-hr @ 0.09 $/kW-hr)	$1,318,000	$1,318,000
TOTAL ANNUAL COST	**$9,043,000**	**$11,985,000**
Available Project Yield (ac-ft/yr)	7,510	7,510
Annual Cost of Water ($ per ac-ft)	$1,204	$1,596
Annual Cost of Water ($ per 1,000 gallons)	$3.69	$4.90

Other Issues

Property will need to be acquired at the proposed diversion location to accommodate the pumping facilities. In addition, pipeline utility easements will be necessary to construct a raw water transmission line to the LAHPS.

7.9 Other Strategies

A number of strategies that were evaluated in the 2017 Lubbock DPR study have been included below. These include treatment and delivery of reclaimed supplies from the:

- NWWRP to the NWTP in Option 7B.
- NWWRP to PS 9 in Option 8.

The Lake 7 to NWTP in Option 4 utilizes reclaimed water; however, the description of this strategy is included in the Surface Water Strategies in Section 10.3.

7.9.1 DPR Option 7B from NWWRP to NWTP

This strategy includes conveying 6 mgd of reclaimed water from the NWWRP to an ATP for advanced treatment with multiple barriers before transporting and discharging into the raw water headworks at the NWTP. The project purifies reclaimed water from the NWWRP through advanced treatment (RO, UV disinfection and AOP) to create a water supply that will be of higher quality than the City's other raw water sources. The treated reclaimed water will be blended with other raw water from CRMWA at the NWTP and undergo conventional treatment for distribution to customers. Human health risks for direct potable reuse are equal or less than those of other water supply sources when full advanced treatment is used (RO, RO, UV disinfection and AOP). These processes are effective at removing identified ECCs and other contaminants, including pathogens, from treated wastewater.

In the 2017 Direct Potable Reuse Feasibility Study[9] two alternatives were evaluated that provided DPR supplies to the NWTP. Option 6A delivered purified water from the SEWRP while Option 7B delivered purified water from the NWWRP. These alternatives varied based on the treatment scheme

The major design features of this strategy include:

- The NWTP has an existing capacity adequate to treat and distribute the additional 6 mgd of reclaimed water. Therefore, an expansion of the NWTP is not necessary;
- A 6 mgd ATP at the Lubbock NWTP;
- A new 312 hp pump station at the NWWRP to deliver the treated reclaimed water to the ATP via a new 24-in, 8.8-mile transmission pipeline; and
- RO concentrate will be discharged through a 10-in, 6-mile transmission line to the North Fork Double Mountain Fork of the Brazos River.

Figure 7.11 depicts the relative locations of the infrastructure needed for the Direct Potable Reuse from NWWRP to NWTP strategy.

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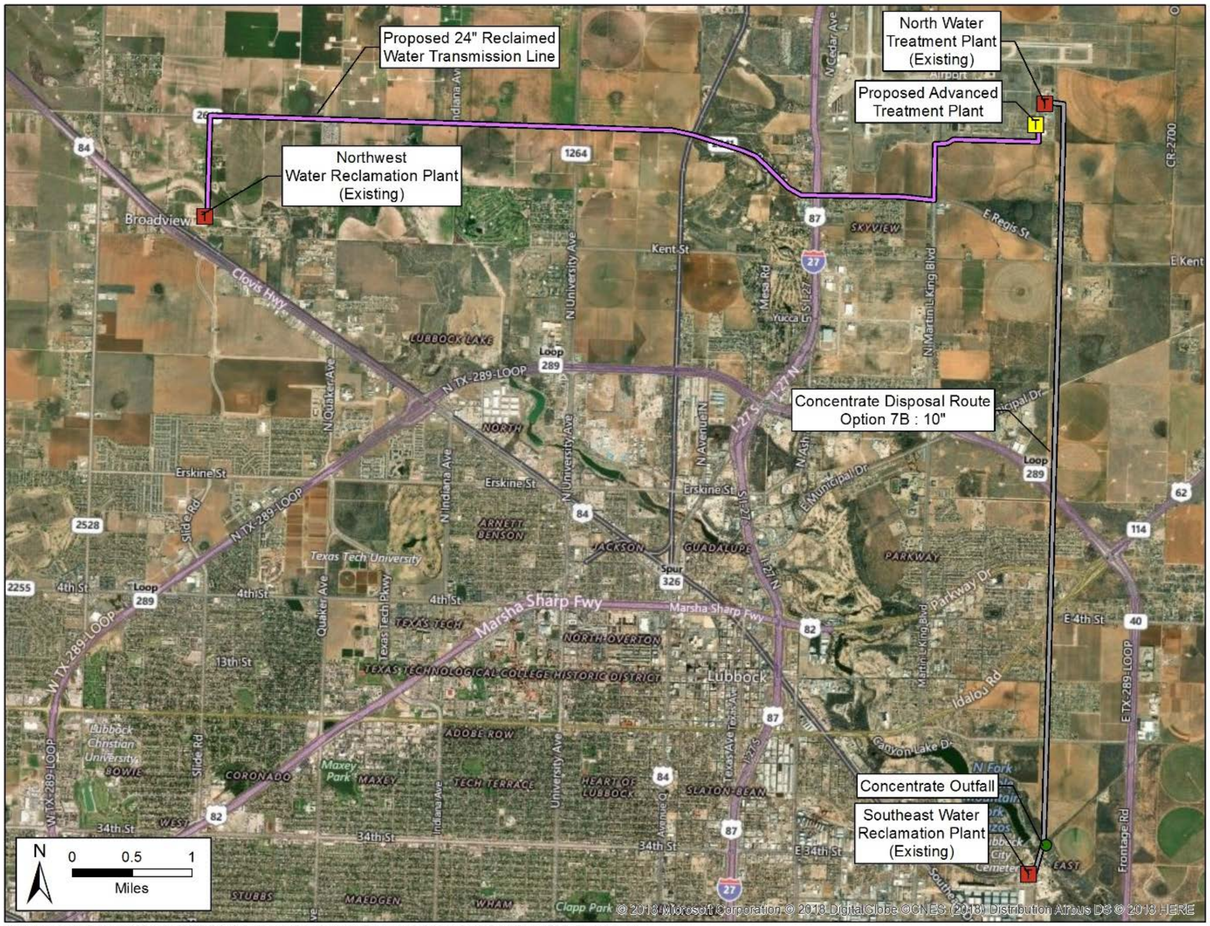
[9] City of Lubbock, "Potable Water Reuse Implementation Feasibility Study". March 2017

Quantity of Available Water

This strategy is designed to treat and deliver an average of 6 mgd (6,720 ac-ft/yr) to the ATP; however, the efficiency of the RO is assumed 80 percent resulting in 1.2 mgd of reject and 4.8 mgd of treated reclaimed water to the NWTP each year.

Figure 7.11. DPR Option 7B from NWWRP to NWTP



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Strategy Costs

Costs associated with this strategy are presented in Table 7.6. Assumptions and conditions associated with these costs include:

- Facilities are sized with a 1.2 PF;
- Concentrate reject from the RO plant will be stream discharged;
- Engineering, legal, and contingency costs are 30% of pipeline construction and 35% of other facilities constructed;
- Power is available at $0.09 per kwh;
- Interest during construction is estimated at 4.0%, and a 1% return on investments over a 2-year period;
- The project will be financed for 20 years at a 5.5% annual interest rate; and

- The project is assumed to have a 2-year construction period.

As shown, the total cost is estimated to be $74,886,000. Annual debt service is $6,266,000; and, annual operational cost, including power, is $2,039,000. This results in a total annual cost of $8,305,000. The unit cost for 5,376 ac-ft/yr of supply at NWTP is estimated to be $1,545 per ac-ft, or $4.74 per 1,000 gallons. This cost does not include the distribution of the potable water from the NWTP to potential customers.

Implementation Issues

Environmental Issues

Since the advanced treatment facilities are being constructed on property owned by Lubbock that is currently being used for similar purposes, environmental issues should be minimal. The transmission line corridor that will convey the reclaimed water should be selected to avoid potentially sensitive areas.

Permitting Issues

The drinking water produced for the project will meet or exceed all state and federal drinking water standards. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Disposal of residuals from the project would meet all state and federal requirements for discharge of waste. A TPDES permit will be required to discharge RO concentrate. The water quality for RO concentrate discharged into the NFDMF of the Brazos River will meet or exceed the stream standards for that segment[10].

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[10] City of Lubbock, “Potable Water Reuse Implementation Feasibility Study”. March 2017. 7-9.

Table 7.6. Cost Estimate Summary for DPR Option 7B from NWWRP to NWTP (January 2017 Prices)

Item	Estimated Costs for Facilities
Pump Stations (7.2 mgd)	$2,653,000
Transmission Pipeline (24 in dia., 15 miles)	$9,326,000
Water Treatment Plant (6 mgd)	$41,443,000
TOTAL COST OF FACILITIES	**$53,422,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$18,232,000
Environmental & Archaeology Studies and Mitigation	$412,000
Land Acquisition and Surveying (105 acres)	$287,000
Interest During Construction (4% for 1 years with a 1% ROI)	$2,533,000
TOTAL COST OF PROJECT	**$74,886,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$6,266,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$93,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$66,000
Water Treatment Plant	$1,300,000
Pumping Energy Costs (6,444,568 kW-hr @ 0.09 $/kW-hr)	$580,000
TOTAL ANNUAL COST	**$8,305,000**
Available Project Yield (ac-ft/yr)	5,376
Annual Cost of Water ($ per ac-ft), based on a Peaking Factor of 1.2	$1,545
Annual Cost of Water ($ per 1,000 gallons), based on a Peaking Factor of 1.2	$4.74

Stream crossings, if any, would be subject to Section 404 of the Clean Water Act. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that most of the proposed project would be authorized by Nationwide Permit 12.

Monitoring is likely to include Cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on the USEPA CCL, including ECCs and PPCPs.

Other Issues

Due to the nature of the project, a public outreach plan will be essential for successful implementation of the proposed reuse project.

Advanced treatment design considerations should include:

- multiple process barriers;
- redundancy and backup power sources;
- alternate storage or discharge locations to divert reclaimed water from the potable distribution system during an acute episode; and
- real time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

7.9.2 DPR Option 8 from NWWRP to PS9

This strategy includes treating 6 mgd of reclaimed water from the NWWRP at an adjacent ATP for advanced treatment with multiple barriers before transporting and discharging into the potable water line from the Bailey County Well Field near PS 9. The project purifies reclaimed water from the NWWRP through advanced treatment (RO, ultrafiltration, granular activated carbon [GAC] contactor and UV disinfection and AOP). This advanced treatment process is more robust than the other DPR options since it is not blended and retreated through other water treatment plants but introduced directly into the distribution system after advanced treatment.

The major design features of this strategy include:

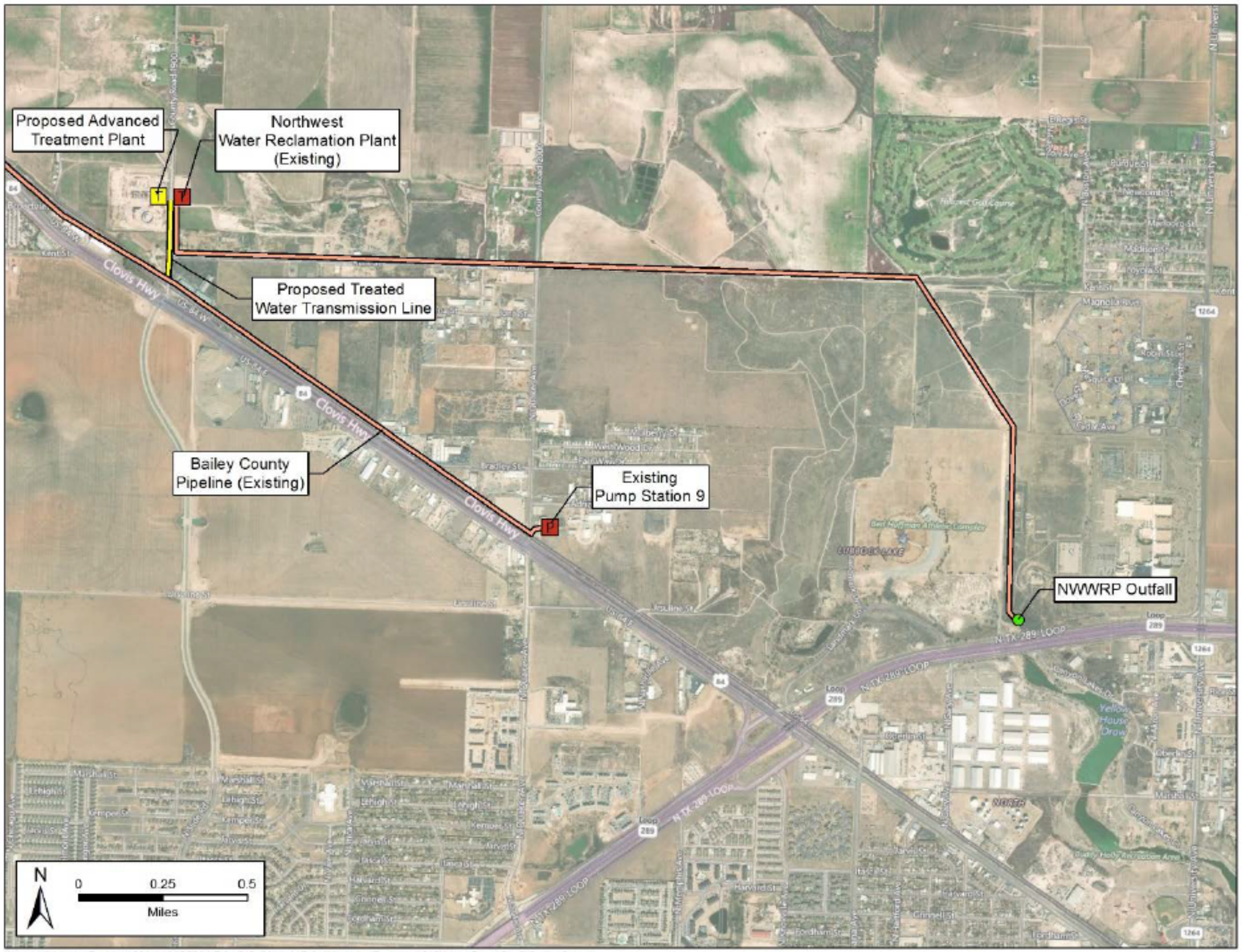
- A 6 mgd ATP at the Lubbock NWWRP;
- A new 126 hp pump station at the NWWRP to deliver the treated reclaimed water to the ATP via a new 18-in, ½ mile transmission pipeline; and
- 1.2 mgd of RO concentrate will be discharged through the existing NWWRP effluent pipeline and discharged at the NWWRP outfall.

Figure 7.12 depicts the relative locations of the infrastructure needed for the Direct Potable Reuse from the NWWRP to PS9.

Quantity of Available Water

This strategy is designed to treat and deliver an average of 6 mgd (6,720 ac-ft/yr) to the ATP; however, the efficiency of the RO is assumed 80 percent resulting in 1.2 mgd of reject and 4.8 mgd of treated reclaimed water to PS9 each year.

Figure 7.12. DPR Option 8 from NWWRP to PS9



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Strategy Costs

As shown, the total cost is estimated to be $81,728,000. Annual debt service is $6,839,000; and, annual operational cost, including power, is $2,267,000. This results in a total annual cost of $9,106,000. The unit cost for 5,376 ac-ft/yr of supply at PS9 is estimated to be $1,694 per ac-ft, or $5.20 per 1,000 gallons. This cost does not include the distribution of the potable water from the PS9 to potential customers.

Table 7.7. Cost Estimate Summary for DPR Option 8 from NWWRP to PS9 (January 2017 Prices)

Item	Estimated Costs for Facilities
Intake Pump Stations (5.8 mgd)	$1,492,000
Transmission Pipeline (18 in dia., 1 miles)	$284,000
Water Treatment Plant (6 mgd)	$56,674,000
TOTAL COST OF FACILITIES	**$58,450,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$20,443,000
Environmental & Archaeology Studies and Mitigation	$37,000
Land Acquisition and Surveying (11 acres)	$34,000
Interest During Construction (4% for 1 years with a 1% ROI)	$2,764,000
TOTAL COST OF PROJECT	**$81,728,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$6,839,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$37,000
Water Treatment Plant	$1,638,000
Pumping Energy Costs (6,544,334 kW-hr @ 0.09 $/kW-hr)	$589,000
TOTAL ANNUAL COST	**$9,106,000**
Available Project Yield (ac-ft/yr)	5,376
Annual Cost of Water ($ per ac-ft), based on a Peaking Factor of 1.2	$1,694
Annual Cost of Water ($ per 1,000 gallons), based on a Peaking Factor of 1.2	$5.20

Implementation Issues

Environmental Issues

Since the advanced treatment facilities are being constructed on property owned by Lubbock that is currently being used for similar purposes, environmental issues should be minimal. The transmission line corridor that will convey the reclaimed water should be selected to avoid potentially sensitive areas.

Permitting Issues

The drinking water produced for the project will meet or exceed all state and federal drinking water standards. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Disposal of residuals from the project would meet all state and federal requirements for discharge of waste. A TPDES permit will be required to discharge RO concentrate. The water quality for RO concentrate discharged into the NFDMF of the Brazos River will meet or exceed the stream standards for that segment.[11]

Stream crossings, if any, would be subject to Section 404 of the Clean Water Act. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that most of the proposed project would be authorized by Nationwide Permit 12.

Monitoring is likely to include Cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on the USEPA CCL, including ECCs and PPCPs.

Other Issues

Due to the nature of the project, a public outreach plan will be essential for successful implementation of the proposed reuse project.

Advanced treatment design considerations should include:

- multiple process barriers;
- redundancy and backup power sources;
- alternate storage or discharge locations to divert reclaimed water from the potable distribution system during an acute episode; and
- real-time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

7.9.3 Land Application Groundwater Potable Reuse

The City currently land applies reclaimed water from Plant 3 of the SEWRP at the LLAS. The City has constructed a number of groundwater wells in the LLAS as part of a nitrate mitigation project associated with the SEWRP Texas Pollutant Elimination System (TPDES) discharge permit. Currently, the City withdraws approximately 2 mgd of groundwater from the LLAS and discharges it into the Jim Bertram Lake System (JBLS). Rather than discharging this supply into the JBLS, this strategy will deliver 2 mgd of groundwater from an existing storage tank to an ATP for treatment prior to blending with other raw water sources at the

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[11] City of Lubbock, “Potable Water Reuse Implementation Feasibility Study”. March 2017. 7-9.

NWTP. Raw water supplies at the NWTP will be blended with the treated groundwater at a ratio of 10:1 to provide an adequate total dissolved solids (TDS) concentration.

The major design features of this strategy include:

- Expand existing pump station to deliver the reclaimed water from the existing ground storage tank to the advanced water treatment facility;
- A new 16-in, 7.5 mile pipeline to deliver the recovered water to the NWTP; and
- A 2 mgd ATP at the NWTP.

Figure 7.13 depicts the relative locations of the Land Application Groundwater Potable Reuse and associated infrastructure.

Quantity of Available Water

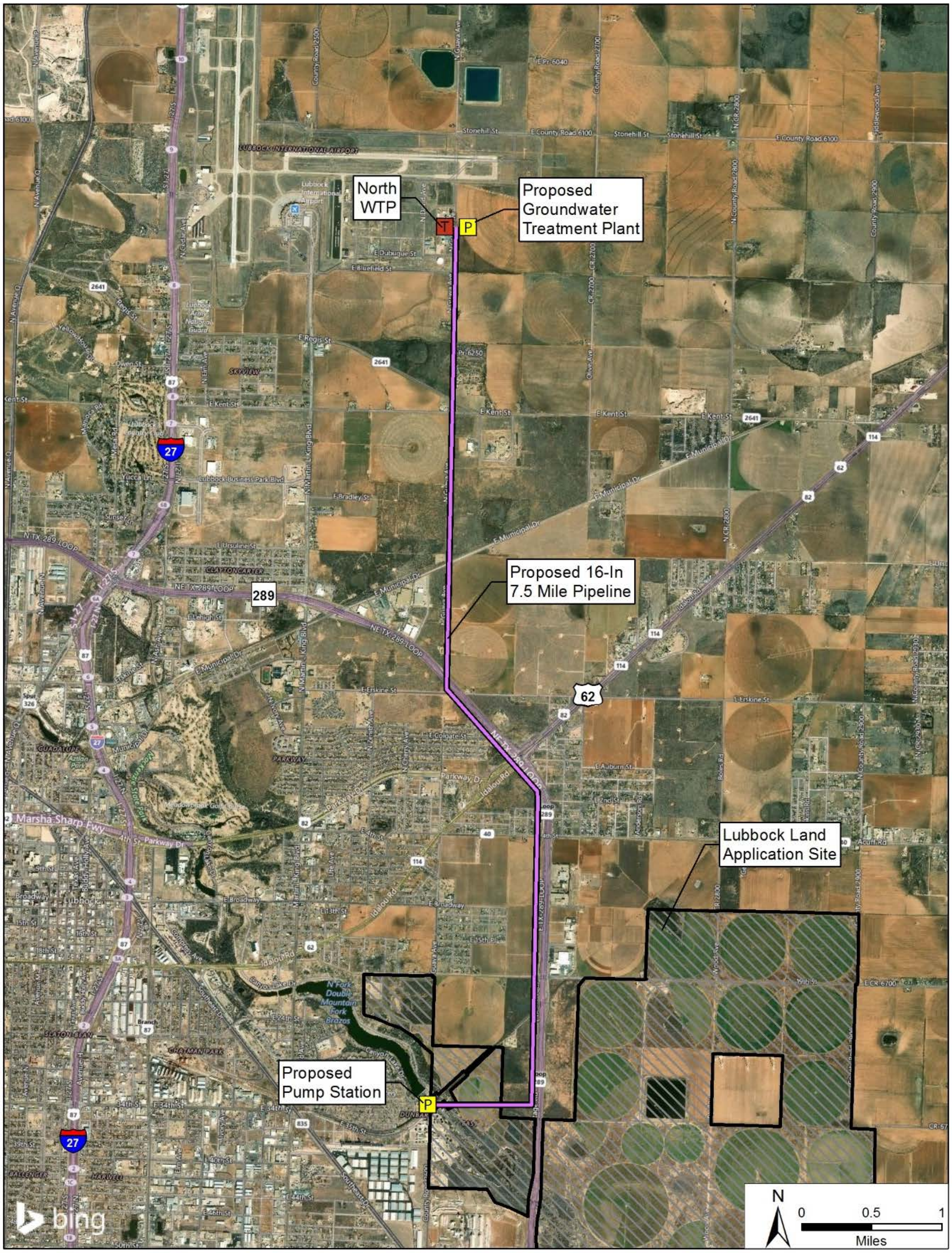
This groundwater reuse strategy assumes that up to 2 mgd of reclaimed water will be sent to the NWTP.

Strategy Costs

Costs associated with this strategy are presented in Table 7.8. Assumptions and conditions associated with these costs include:

- The costs are based on information provided by Alan Plummer Associates, Inc. (APAI);
- Engineering, legal, and contingency costs is 30% of pipelines and 35% for other facilities;
- Power is available at $0.09 per kwh;
- Interest during construction is 4%, and a 1% return on investments;
- The project will be financed for 20-years at a 5.5% interest rate; and
- The project is assumed to have a 1-year construction period.

Figure 7.13. Land Application Groundwater Potable Reuse Infrastructure



\\tx-austin\ActiveProjects\3291\10055566\7.0_GIS_Models\7.2_Work_In_Progress\GIS\Map_Docs\Draft\Conceptual_Groundwater_ReuseMap.mxd

Table 7.8. LLAS Groundwater Reuse Costs (January 2017 Prices)[1]

Item	Estimated Costs for Facilities
Pump Station Expansion (2 mgd)	$1,446,000
Transmission Pipeline (16 in dia., 7.5 miles)	$4,387,000
Advanced Groundwater Treatment Plant (2 mgd)	$4,890,000
TOTAL COST OF FACILITIES	**$10,723,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,534,000
Environmental & Archaeology Studies and Mitigation	$204,000
Land Acquisition and Surveying (52 acres)	$143,000
Interest During Construction (4% for 1 years with a 1% ROI)	$512,000
TOTAL COST OF PROJECT	**$15,116,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,265,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$44,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$36,000
Water Treatment Plant	$353,000
Pumping Energy Costs (449,000 kW-hr @ 0.09 $/kW-hr)	$40,000
TOTAL ANNUAL COST	**$1,738,000**
Available Project Yield (ac-ft/yr)	2,240
Annual Cost of Water ($ per ac-ft), based on a Peaking Factor of 1.0	$776
Annual Cost of Water ($ per 1,000 gallons), based on a Peaking Factor of 1.0	$2.38

Note: Costs based on 11/13/17 Land Application Groundwater Potable Reuse Evaluation.

As shown, the total cost is estimated to be $15,116,000. Annual debt service is $1,265,000; and, annual operational cost, including power, is $473,000. This results in a total annual cost of $1,738,000. The unit cost for 2,240 ac-ft/yr of supply at the SWTP is estimated to be $776 per ac-ft, or $2.38 per 1,000 gallons. This cost does not include the distribution of the potable water from the NWTP to potential customers.

Implementation Issues

Environmental Issues

Since the advanced treatment facilities are being constructed on property owned by Lubbock that is currently being used for similar purposes, environmental issues should be minimal. The transmission line corridor that will convey the reclaimed water should be selected to avoid potentially sensitive areas.

Permitting Issues

The water produced for the project will meet or exceed all state and federal drinking water standards. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Any potential stream crossings would be subject to Section 404 of the Clean Water Act. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that any such crossings would be authorized by Nationwide Permit 12.

Monitoring is likely to include Cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on the USEPA CCL, including ECCs and PPCPs.

Other Issues

Due to the nature of the project, a public outreach plan will be essential for successful implementation of the proposed reuse project.

Advanced treatment design considerations should include:

- multiple process barriers;
- redundancy and backup power sources;
- alternate storage or discharge locations to divert reclaimed water from the potable distribution system during an acute episode; and
- real-time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

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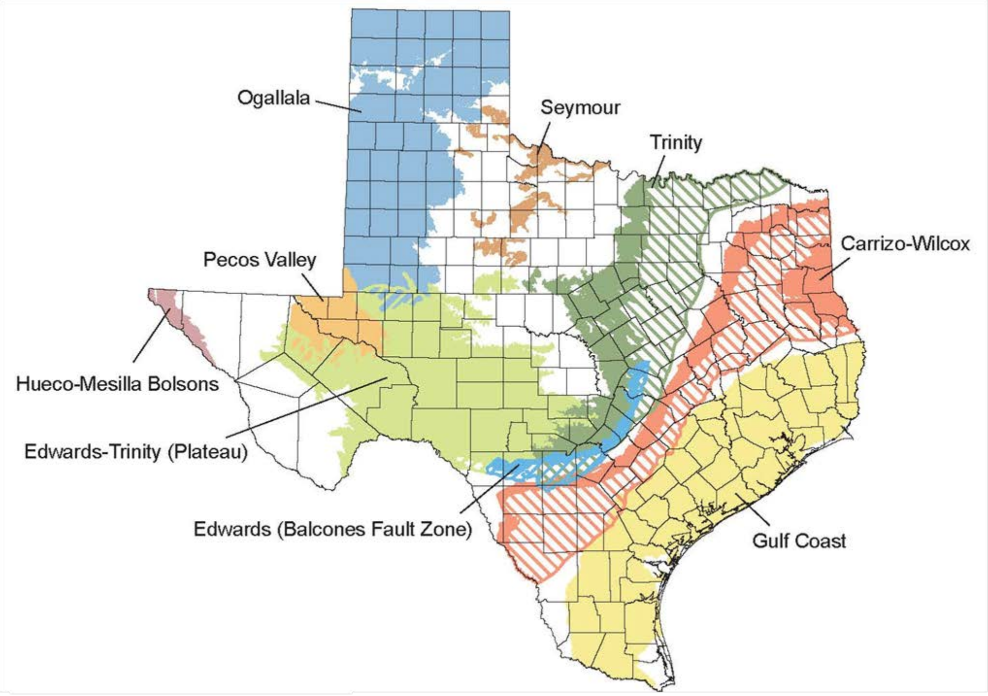
8 Groundwater Strategies

Aquifers have always been a vital source of water for Lubbock. The first municipal water system constructed in 1911 consisted of one Ogallala Aquifer well. The City of Lubbock (City) relied solely upon groundwater until 1968 when surface water from Lake Meredith was made available (see Figure 3.1).

8.1 Groundwater Sources

The Texas Water Development Board (TWDB) recognizes 30 major and minor aquifers in the State of Texas. Aquifers that supply large quantities of water over large areas of the state are defined as major aquifers. Aquifers that supply relatively small quantities of water over large areas of the state or supply large quantities of water over small areas of the state are defined as minor aquifers. Each aquifer has unique characteristics.[1] The major aquifers in Texas are shown in Figure 8.1, and the minor aquifers are shown in Figure 8.2. The Ogallala and Seymour Aquifers are the major aquifers in Lubbock's region. The Edwards-Trinity (High Plains) and the Dockum Aquifers are the minor aquifers in the Lubbock region.

Figure 8.1. Major Aquifers



(Map courtesy of TWDB)[2]

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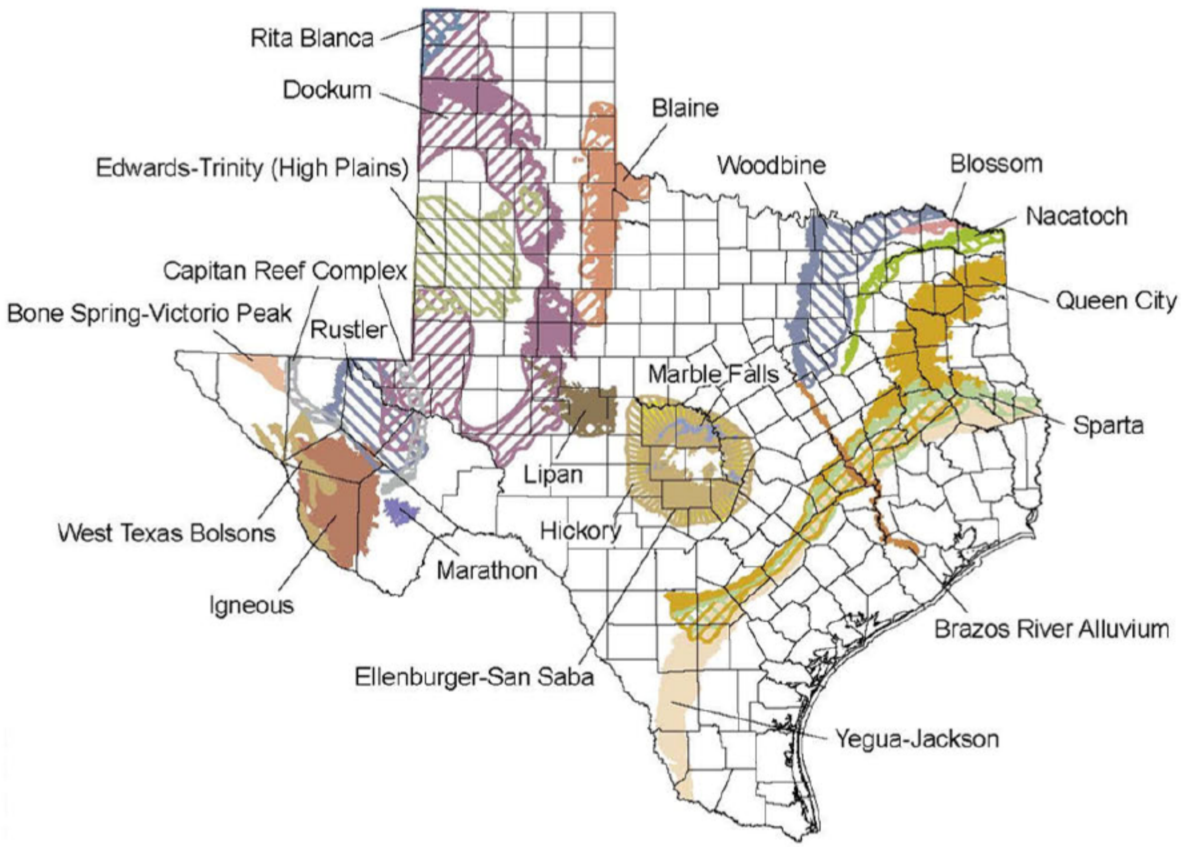
[1] Water for Texas: 2017 State Water Plan.

[2] Ewing, J.E. and others. October 2008. Final Report: Groundwater Availability Model for the Dockum Aquifer. Texas Water Development Board Report. October 2008: Figure 4.2.2.

Figure 8.2. Minor Aquifers



(Map courtesy of TWDB)[3]

8.1.1 Ogallala Aquifer

The High Plains of Texas lies above the largest groundwater formation in the State of Texas, known as the Ogallala Aquifer. The Ogallala Aquifer has been the main source of potable and agriculture water in the Lubbock region since the early 1900s. Most of the water is used for irrigating crops. Only 5% of the Ogallala Aquifer groundwater on the Southern High Plains is used for domestic purposes.[4] Because of the heavy agricultural pumping on the Southern High Plains for over 100 years, the saturated thickness levels have dropped significantly. Figure 8.3 shows the saturated thickness of the Ogallala Aquifer as of 2008, which is the latest map that is readily available. The figure demonstrates that the portion of the Ogallala Aquifer to the north of Lubbock near Amarillo contains the greatest volumes of groundwater in the Texas portion of the aquifer. Historically, groundwater use in this region has been minor, primarily for cattle operations with windmills pumping relatively small quantities of water into stock tanks.

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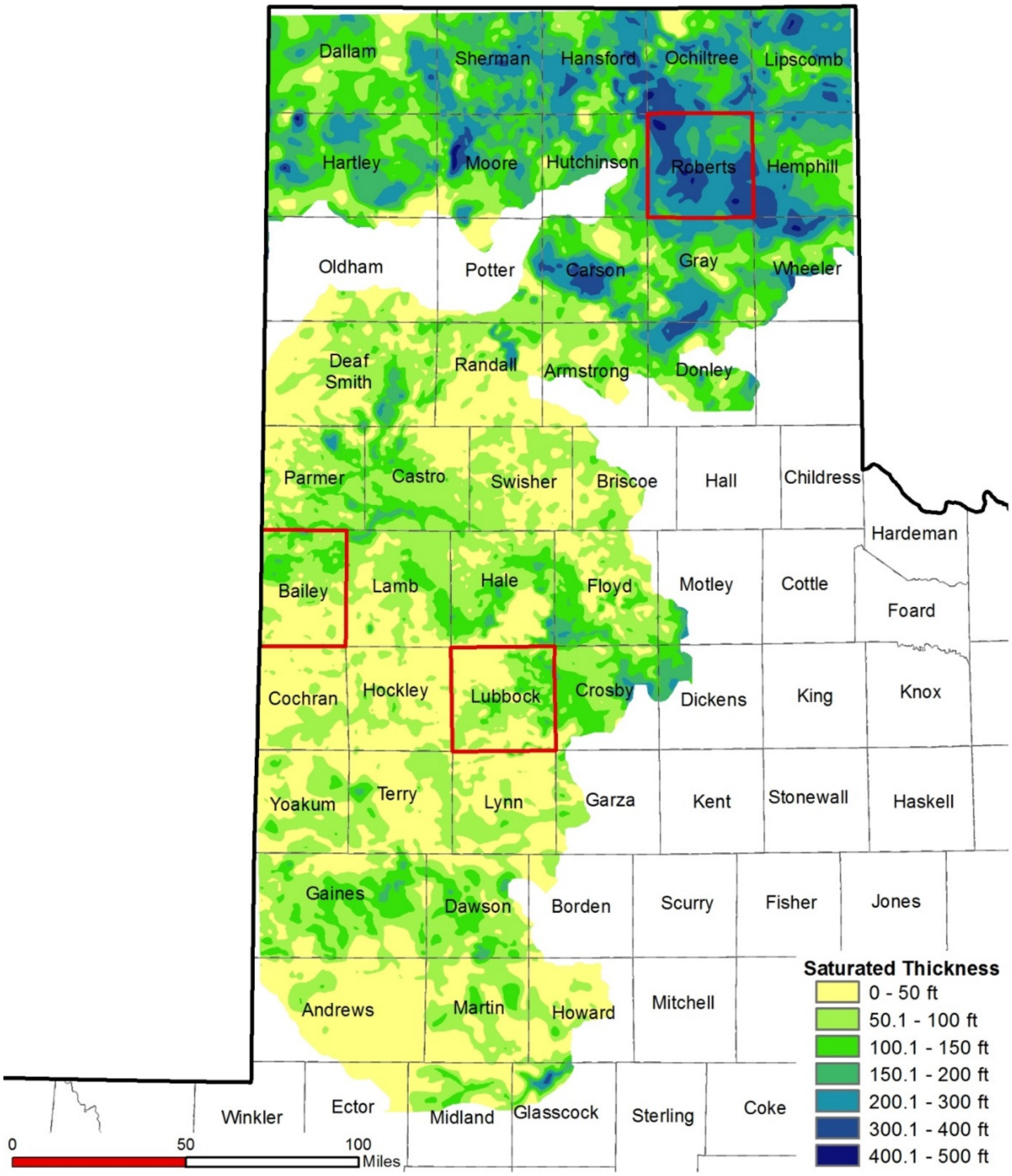
[3] Ewing, J.E. and others. October 2008. Final Report: Groundwater Availability Model for the Dockum Aquifer. Texas Water Development Board Report. October 2008: Figure 4.2.2.

[4] 2011 Llano Estacado Regional Water Plan. Llano Estacado Regional Water Planning Group. September 2010: 3-1.

Figure 8.3. Saturated Thickness of the Ogallala Aquifer



(Data courtesy of the Center for Geospatial Technology at Texas Tech University, 2008)[5]

Figure 8.4 shows the saturated thicknesses of groundwater in Lubbock County. Several studies have evaluated the potential for using the groundwater underlying the City and Lubbock County. However, the saturated thickness of the groundwater in in this area has declined greatly from heavy agricultural irrigation over the past 100 years, and wells in many areas of the county produce less than 30 gallons per minute (gpm). As a result, very little potential exists for long-term and significant development of local groundwater supplies.

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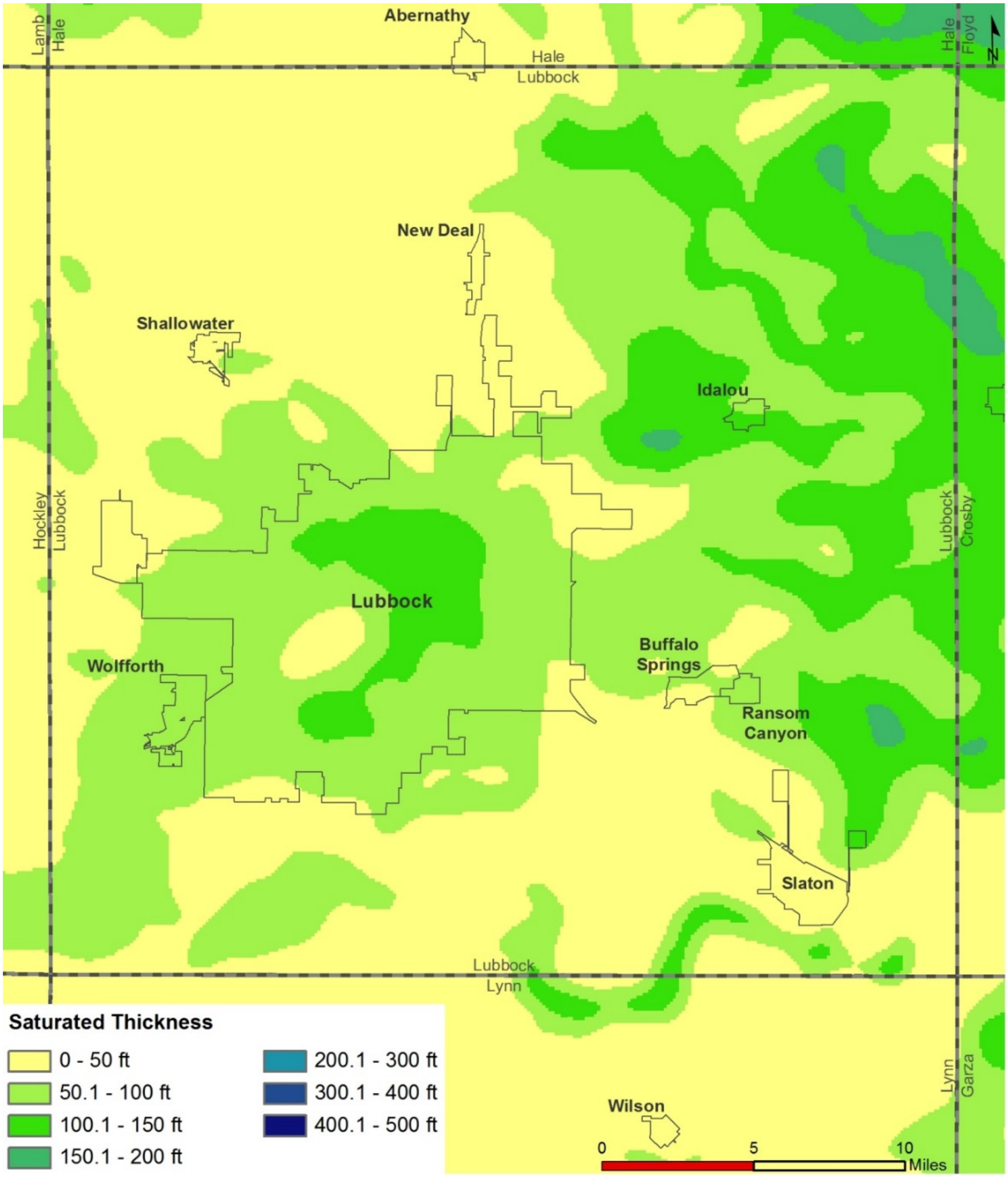
[5] Center for Geospatial Technology, Texas Tech University. 2008.

Figure 8.4 Saturated Thickness of the Ogallala Aquifer in Lubbock County



(Data courtesy of the Center for Geospatial Technology at Texas Tech University, 2008)[6]

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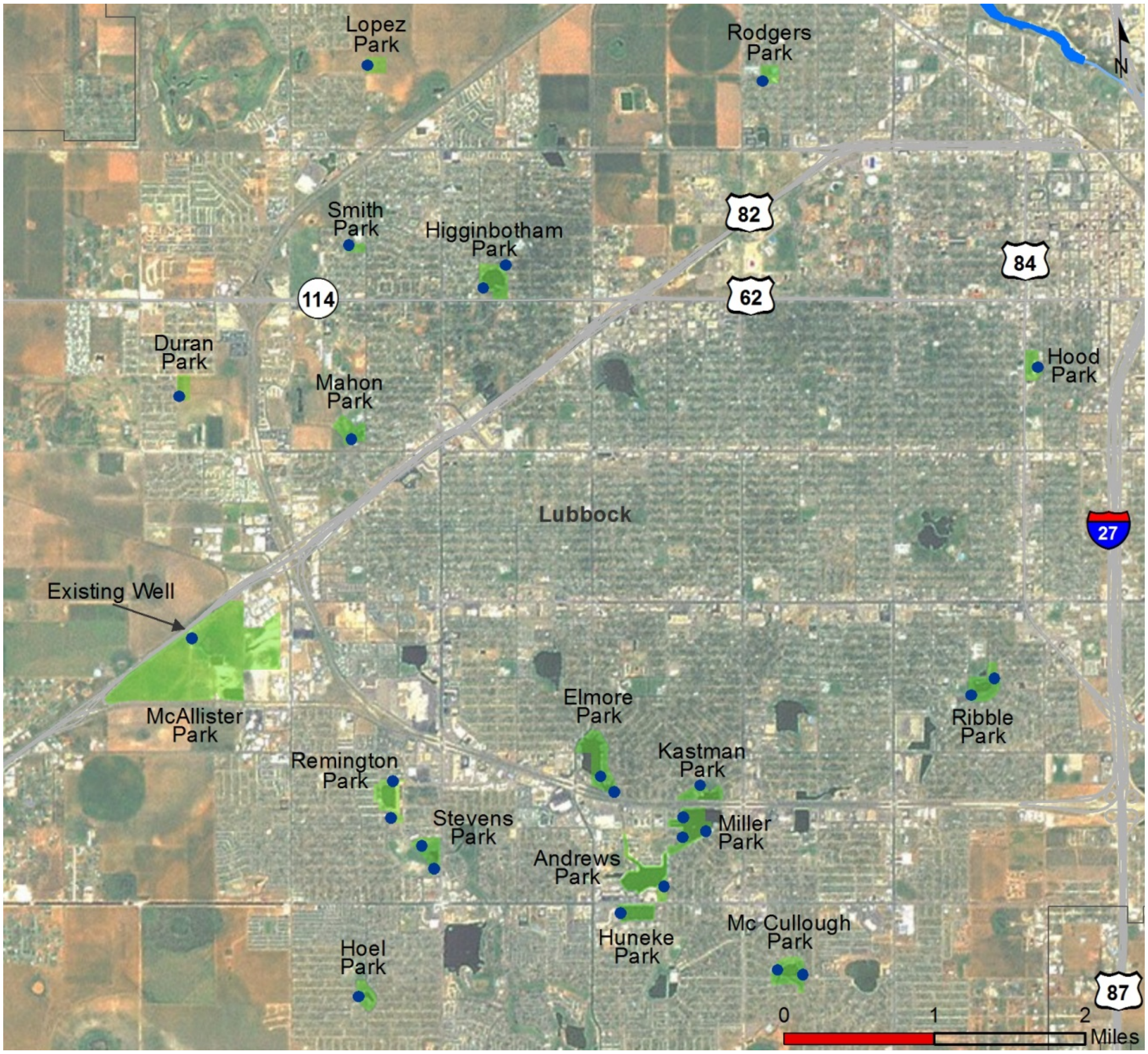
[6] Center for Geospatial Technology, Texas Tech University. 2008.

The Parks and Recreation Department has historically been among the City's top water users. In 2006, the City evaluated ways to reduce the amount of potable water used to irrigate its parks. Currently (2018), there are 78 City parks with an estimated total water demand of 1.356 billion gallons per year or 4,161 acre-feet per year (ac-ft/yr).[7] Water diverted from the Jim Bertram Lake System (Lake 1) is used to irrigate the Berl Huffman Soccer Complex, as discussed in Section 10.1. It is not feasible to irrigate from the Ogallala Aquifer in 20 of the 78 parks. From 2007 and 2008, 26 water wells were installed throughout 18 City-owned parks (encompassing 319 acres) as depicted in Figure 8.5.

Figure 8.5. Location of Parks with Groundwater Wells



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[7] 2007 Strategic Water Supply Plan, City of Lubbock, Section 9.

Due to the production rates of these wells and time-of-day irrigation restrictions at City parks, irrigation of the parks requires supplemental supply from the City's potable water system to operate properly. Over the last five years, this initiative has helped conserve roughly half of the potable water used to irrigate the 18 parks in which wells were installed. The total annual amount of water conserved represents less than 1% of the City's total potable water demand. Table 8.1 shows the volumes of water saved each year since 2008.

Table 8.1. Potable Water Conserved at City Parks

Year	Potable Water Conserved (Well Water Used, ac-ft/yr)	Percent of Total Annual Demand
2008	70.8	0.2%
2009	100.7	0.3%
2010	249.4	0.7%
2011	218.6	0.5%
2012	147.6	0.4%
2013	190.3	0.5%
2014	102.7	0.3%
2015	71.0	0.2%
2016	59.0	0.2%
2017	76.5	0.2%

Note: ac-ft/yr = acre-feet per year

8.1.2 Edwards-Trinity Aquifer

The Edwards-Trinity (High Plains) Aquifer is a Cretaceous-aged minor aquifer located on the Southern High Plains of Texas and New Mexico (see Figure 8.6). The Edwards-Trinity (High Plains) Aquifer spans approximately 9,000 square miles[8] and lies just underneath the Ogallala Aquifer and above the Dockum Aquifer. Approximately 95% of the water pumped from this aquifer is used for irrigation.[9]

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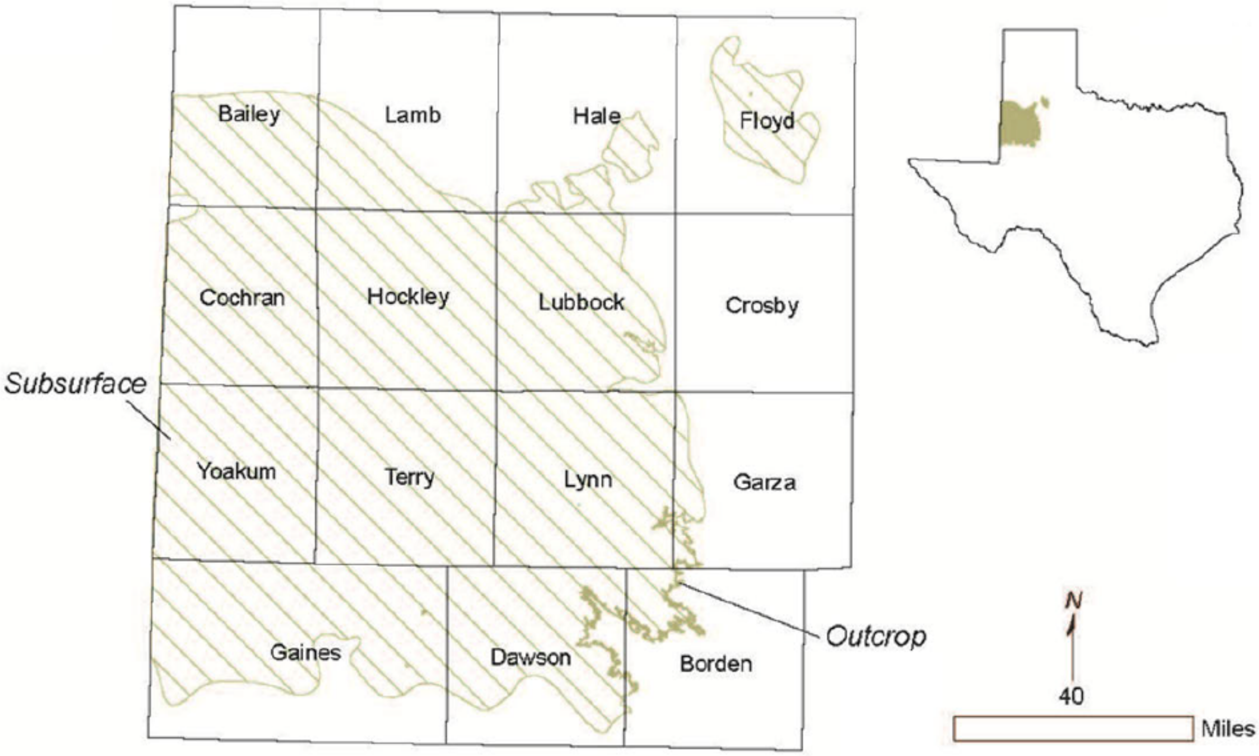
[8] George, P.G., R.E. Mace, and R. Petrossian. Aquifers of Texas. Texas Water Development Board: Report 380. 2011: 101.

[9] George, P.G., R.E. Mace, and R. Petrossian. Aquifers of Texas. Texas Water Development Board: Report 380. 2011: 101.

Figure 8.6. Edwards Trinity Aquifer



(Map courtesy of TWDB)[10]

Figure 8.7 shows a cross-section of the Southern High Plains. The Edwards-Trinity (High Plains) Aquifer is located within the blue Cretaceous layer (for reference, the Ogallala is yellow and the Dockum is purple). In certain locations where the soils are permeable and the dividing formations are thin, water will readily move between the Edwards-Trinity (High Plains) and the Ogallala Aquifers, constituting the main source of recharge for the Edwards-Trinity (High Plains) Aquifer.[11]

There is a limited quantity of water in the Edwards-Trinity (High Plains) Aquifer. The average yield for an Edwards-Trinity (High Plains) well is between 50-200 gpm, with maximum yields reported at over 1,000 gpm.[12] In 2010, the total estimated yield from the Edwards-Trinity (High Plains) was 4,160 ac-ft/yr. This is expected to diminish to 2,065 ac-ft/yr by 2060.[13]

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[10] Ewing, J.E. and others. October 2008. Final Report: Groundwater Availability Model for the Dockum Aquifer. Texas Water Development Board Report. October 2008: Figure 4.2.2.

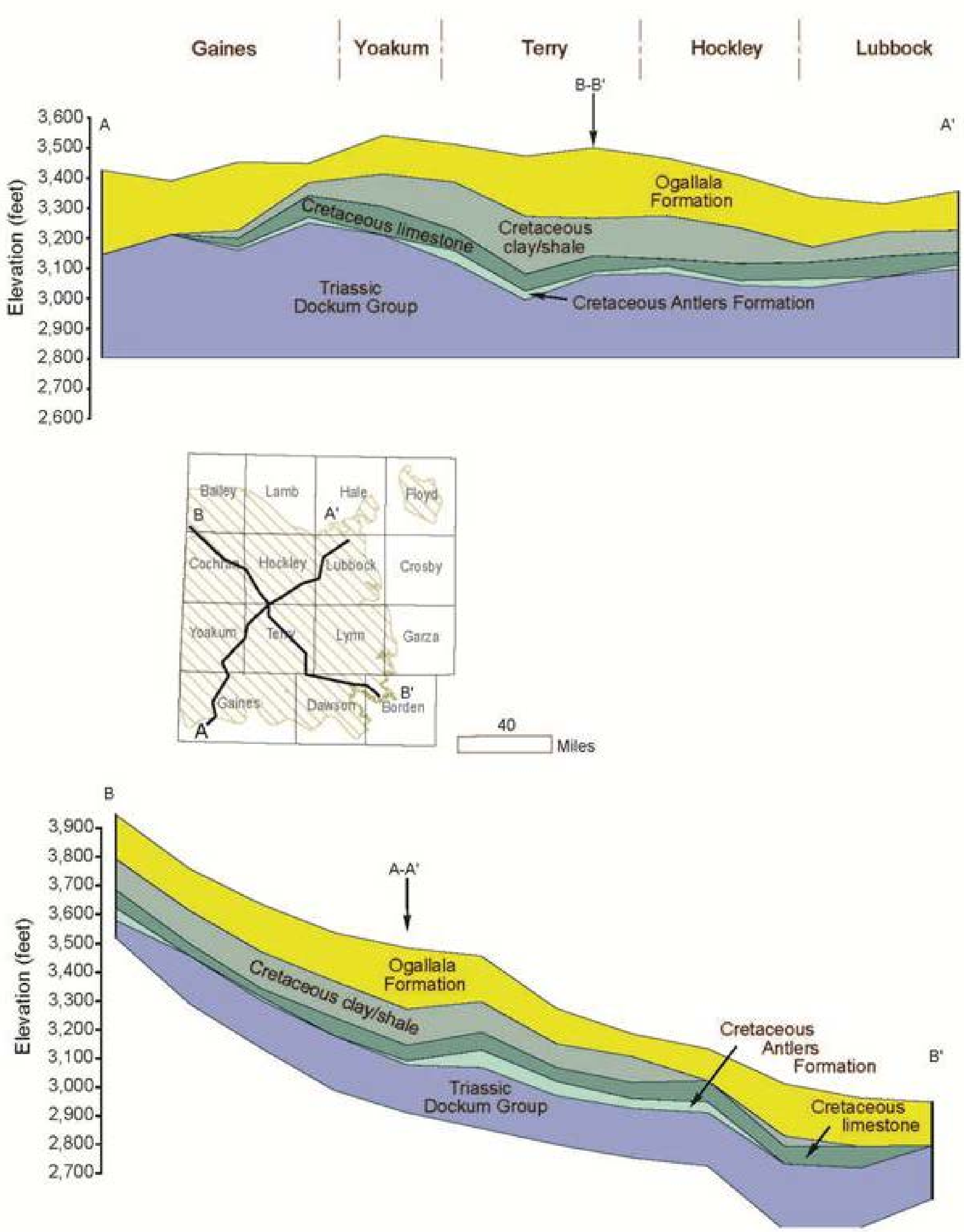
[11] Blanford, T.N., M. Kuchanur, A Standen, K.C. Calhun, P. Kirby, and G. Shah. Edwards-Trinity (High Plains) Groundwater Availability Model. Texas Water Development Board. 2008: 12-13.

[12] Brackish Groundwater Manual for Texas Regional Water Planning Groups. Texas Water Development Board. 2003: 91.

[13] Water for Texas: 2007 State Water Plan. 2007: 169.

Water quality in the Edwards-Trinity (High Plains) varies by location, ranging from fresh to slightly brackish. The typical range for total dissolved solids (TDS) is from 1,000 to 2,000 milligrams per liter (mg/L).[14] However, maximum TDS values can reach 20,000 mg/L in extremely low-quality areas.[15]

Figure 8.7. Cross-Sections of the Southern High Plains

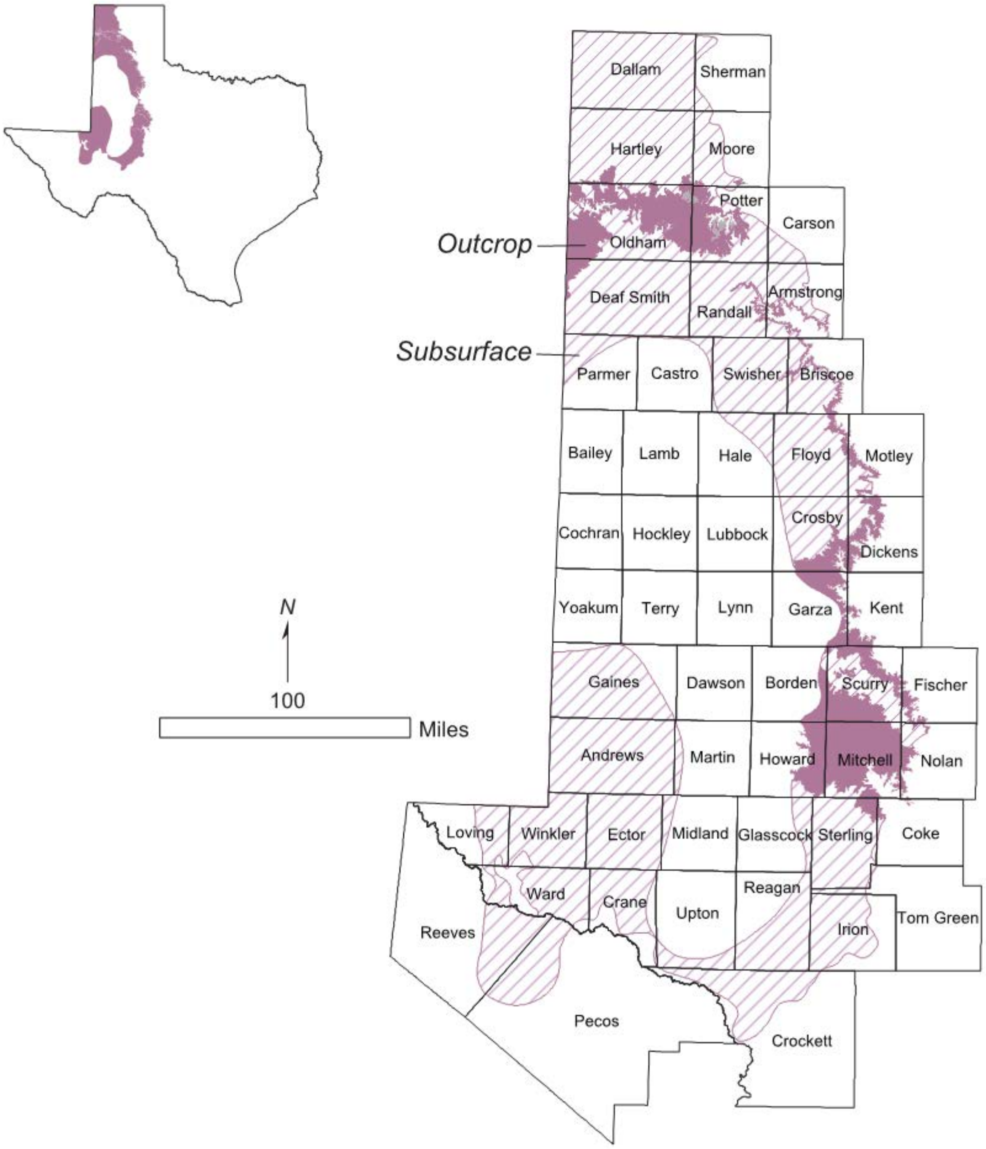


(Map courtesy of TWDB)[16]

8.1.3 Dockum Aquifer

The Dockum Aquifer is a minor aquifer found in the northwest part of Texas, as shown in Figure 8.8. The formation underlies all counties from Castro to Upton, including Bailey and Lubbock counties. However, the figure does not depict the formation under these two counties as being part of the Dockum Aquifer because water quality data shows that the TDS concentrations are greater than 25,000 mg/L. Water of this salinity is not considered to be a potential water supply for most uses.

Figure 8.8. Dockum Aquifer



(Map courtesy of TWDB)[17]

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[17] George, Peter G. and others. July 2011. Aquifers of Texas. Texas Water Development Board Report 380: 97.

This aquifer is defined stratigraphically as the Dockum Group and includes four formations (from oldest to youngest): the Santa Rosa, the Tecovas, the Trujillo Sandstone, and the Cooper Canyon. The highest groundwater yields come from the Santa Rosa sandstones, which is at the base of the Dockum. The City of Lubbock installed a Dockum test well during 2017 in efforts to further explore this formation as a potential drinking water supply. Data collected from the Dockum test well located at Lubbock's South Water Treatment Plant (SWTP) shows that the base of the aquifer is about 1,420 deep, potential well yields are about 60 gpm, and the concentration of TDS is about 45,000 mg/L. The TWDB's *Final Report: Groundwater Availability Model for the Dockum Aquifer* indicates that there "has not been widespread use of the Dockum Aquifer because of poor water quality, low yields, and deep pumping depth."[18] Because of low use of this aquifer, very little water quality and quantity data exist for the Lubbock region for this formation. Figure 8.9 depicts the base of the Dockum Aquifer, which was prepared during the development of a Groundwater Availability Model (GAM) for the Dockum Aquifer[xix] and is the latest available map.

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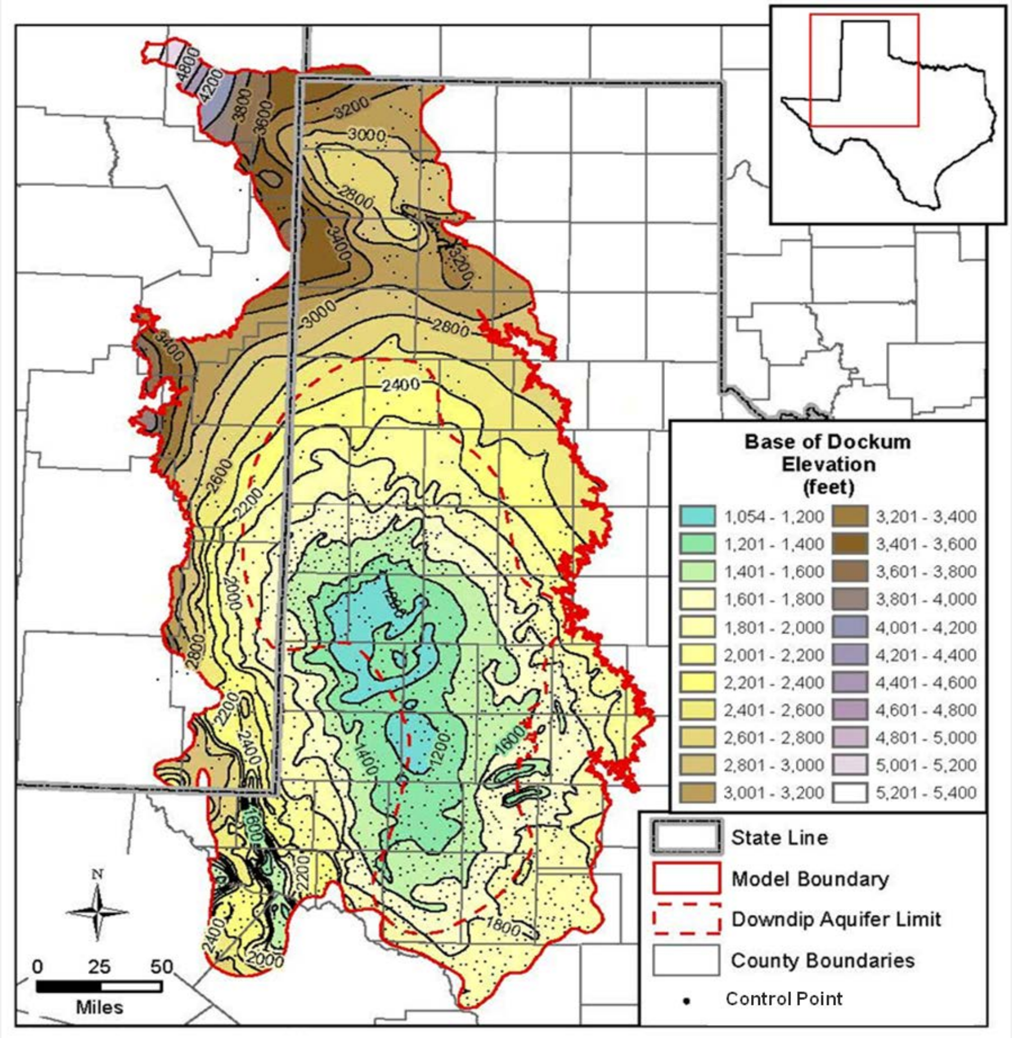
[18] Final Report: Groundwater Availability Model for the Dockum Aquifer. Texas Water Development Board. October 2008: 1-1.

Figure 8.9. Base of the Dockum Aquifer



(Map courtesy of TWDB)[19]

8.1.4 Seymour Aquifer

The Seymour Formation is one of the nine major aquifers in Texas, and as shown in Figure 8.10, the formation is located a considerable distance to the east of Lubbock. The water quality and yield of the Seymour Aquifer are inconsistent.

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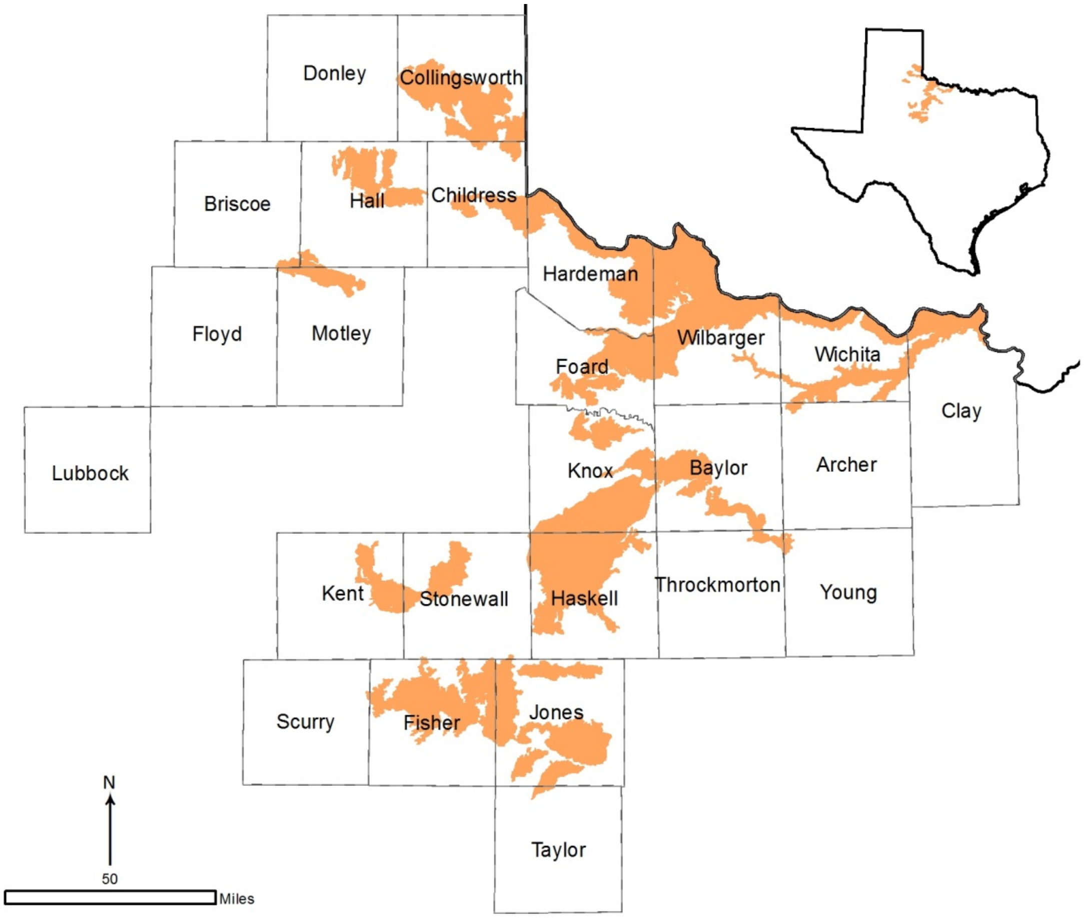
[19] Ewing, J.E. and others. October 2008. Final Report: Groundwater Availability Model for the Dockum Aquifer. Texas Water Development Board Report. October 2008: Figure 4.2.2.

Figure 8.10. Seymour Aquifer



(Map courtesy of TWDB)[20]

8.2 Groundwater Management

8.2.1 Groundwater Conservation Districts

In Texas, groundwater usage is legally recognized as a private property interest subject to the rule of capture and limited by regulation by local Groundwater Conservation Districts (GCDs). There are 98 GCDs in Texas, and GCDs cover nearly 70 percent of the area of the state, including 173 of the 254 Texas counties. Because of the size of many of the aquifers in Texas, numerous conservation districts manage the resources of a given aquifer. For example, Lubbock and Bailey Counties are part of the High Plains Underground Water Conservation District No. 1, while Roberts County is part of the Panhandle GCD.

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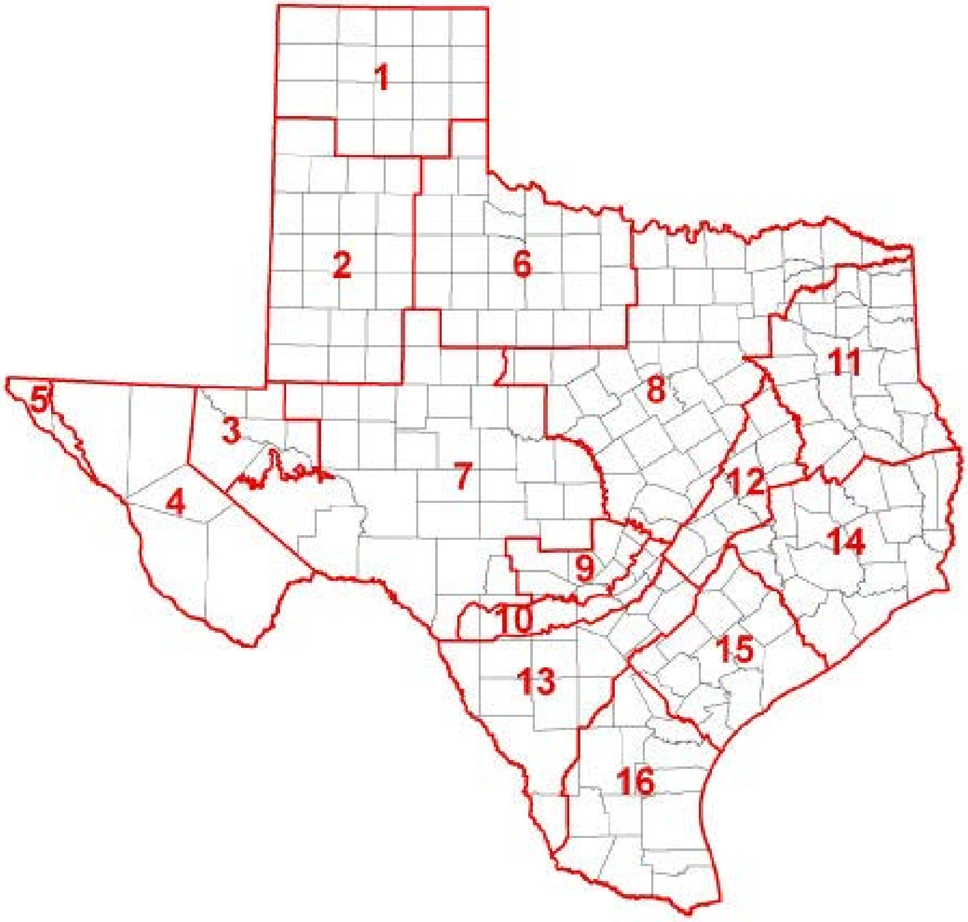
[20] George, P.G., R.E. Mace, and R. Petrossian. Aquifers of Texas. Texas Water Development Board: Report 380. 2011: 63.

8.2.2 Groundwater Management Areas

In 1995, Groundwater Management Areas (GMAs) were created "in order to provide for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions, consistent with the objectives of Section 59, Article XVI, Texas Constitution…" (Texas Water Code §35.001). Added by Acts 1995, 74th Leg., ch. 933, §2, eff. Sept. 1, 1995, GMAs made it feasible to establish common groundwater management goals among multiple GCDs. The TWDB was delegated responsibility to delineate GMAs, and subsequently divided Texas into 16 GMAs in 2002 (Figure 8.11). These areas correspond roughly to aquifer boundaries in the State and help State agencies regulate different aspects of groundwater usage.

Figure 8.11. Groundwater Management Areas in Texas



(Map courtesy of TWDB)[21]

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[21] Texas Water Development Board Groundwater Management Areas. Online: http://www.twdb.state.tx.us/groundwater/management_areas/

The Texas Legislature mandated that by September 1, 2010, GCDs must establish Desired Future Conditions (DFCs) for aquifers in each GMA. These DFCs may differ across GMAs and impact the amount of groundwater that can be pumped from a given aquifer on an annual basis. Most of Lubbock's current or potential groundwater supplies are located within GMA #1 or #2. In October 2016 GMA #2 officials adopted a DFC for the Ogallala and Edwards-Trinity (High Plains) Aquifers to be an average drawdown between 23 and 27 ft. The drawdown is calculated from the end of 2012 conditions to the year 2070. In Roberts County, GMA #1 officials adopted a DFC of "At least 50 percent of volume in storage remaining in 50 years, for the period 2012-2062".

8.3 Roberts County Well Field Capacity Maintenance Strategy

The Roberts County Well Field (RCWF) produces water from the Ogallala Aquifer. For operational sustainability and flexibility, Canadian River Municipal Water Authority (CRMWA) has a production capacity in the RCWF that is about 30% greater than the capacity of the transmission line from the RCWF to the main CRMWA Aqueduct. The capacity of the RCWF is 84 million gallons per day (mgd); and, the maximum capacity of the transmission line is 65 mgd. As is common in Ogallala well fields, the RCWF's capacity from existing wells declines over time with continued utilization. Eventually, replacement wells become necessary to maintain a given well field capacity.

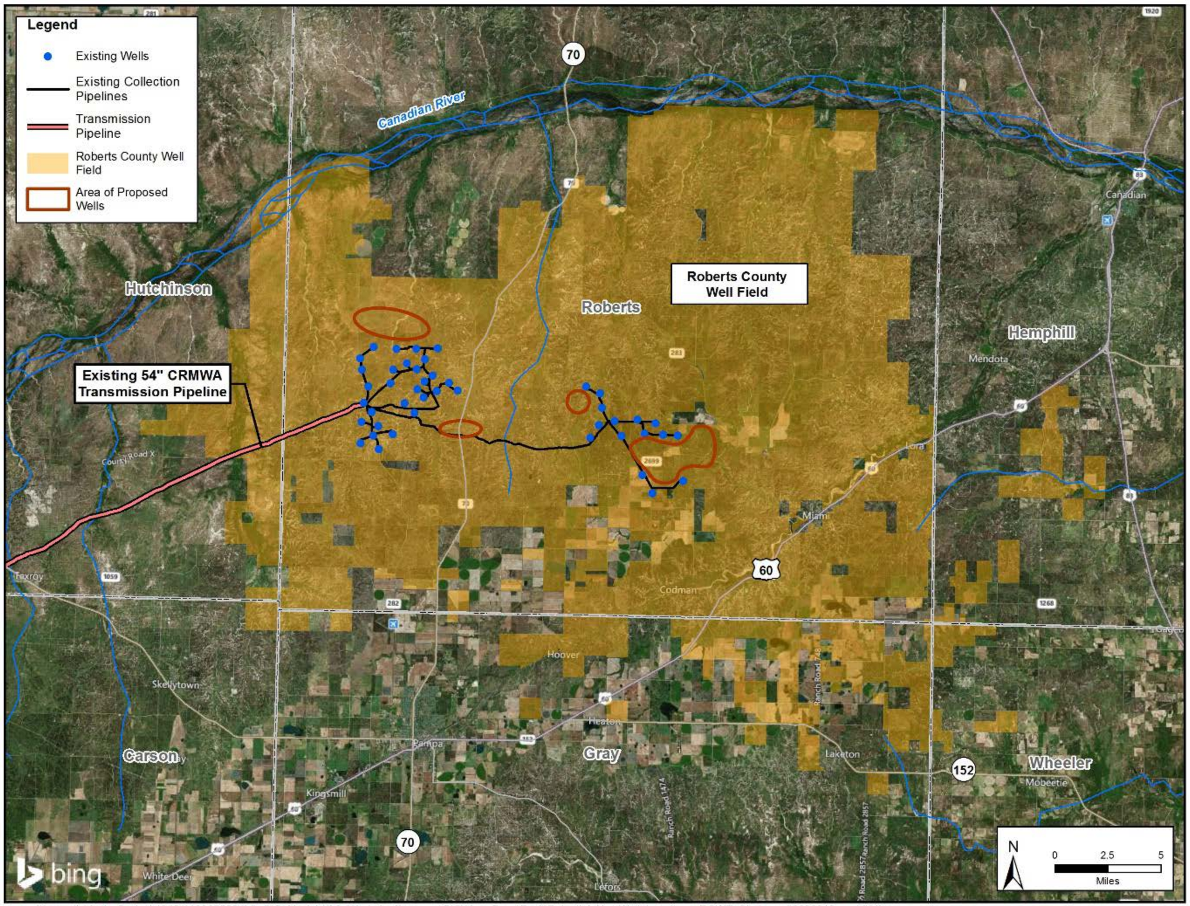
This RCWF Capacity Maintenance (CM) strategy is designed to maintain the RCWF's capacity at 84 mgd. Modeling by Lee Wilson & Associates (a consultant under contract with CRMWA) estimates that 11 replacement wells will be needed approximately every 30 years in order to sustain an average production of 65 mgd and maintain a RCWF peak production capacity of 84 mgd.

The major design features of this strategy include:

- Eleven new wells are constructed to the top of the Red Beds. Overall, they are expected to average about 950 feet deep;
- On average, each well will operate at 1,750 gpm;
- New wells will be located on property where CRMWA holds the interest in groundwater rights; and
- No additional treatment is included in the costs.

Figure 8.12 shows the relative locations of the well field and associated infrastructure needed.

Figure 8.12. Potential New Well Locations for the RCWF Capacity Maintenance Strategy



\\tx-austin\ActiveProjects\3291\10055566\7.0_GIS_Models\7.2_Work_In_Progress\GIS\Map_Docs\Draft\Potential_NewWell_Locations_RCWF_Strategy_08082018.mxd [KJ]

8.3.1 Quantity of Available Water

The RCWF CM strategy is designed to maintain the target RCWF production capacity of 84 mgd. Under this strategy, the City's allocation from CRMWA will remain at 25,570 ac-ft/yr and the transmission line from the RCWF to the CRMWA Aqueduct will remain near capacity (65 mgd) at all times. The wells in this strategy restore the diminished RCWF production capacity by 28 mgd (11 wells producing an average of 1,750 gpm each) before the end of the planning period.

8.3.2 Strategy Costs

Costs associated with this strategy are presented in Table 8.2. Assumptions and conditions associated with these costs include:

- City of Lubbock will pay for 37.058% of the costs for this project, which is the City's allocation of water from CRMWA;
- Engineering, legal, and contingency costs are 35% for facilities required by this strategy;
- Power is available at $0.09 per kilowatt-hour (kwh);

- Interest during construction is 4.0%, and a 1.0% return on investments; and
- The project will be financed for 20-years at a 5.5% interest rate.

As shown, the total project cost is estimated to be $23,603,000. Annual debt service is $1,975,000; and, annual operational cost, including power, is $1,608,000. This results in a total annual cost of $3,583,000. CRMWA project and operational costs are shared amongst the 11 member cities. Lubbock's share of the project is 37.058%, which will result in an annual cost estimated at $1,328,000 and 11,630 ac-ft/yr. This results in a unit cost of $114 per ac-ft, or $0.35 per 1,000 gallons.

8.3.3 Implementation Issues

Environmental Issues

The installation of wells and collection pipelines should be planned so that sensitive habitats, cultural resources, and other environmentally sensitive areas are avoided.

Permitting Issues

Currently, CRMWA owns the groundwater interests in over 450,000 acres of property. Wells will be drilled within this area. CRMWA will need to secure well drilling permits from the Panhandle GCD. The design and construction of public water supply wells and water transmission facilities must be approved by the Texas Commission on Environmental Quality (TCEQ).

Other

Wells will be placed on properties where CRWMA owns the water rights, which include the rights to surface improvements to extract and convey their groundwater.

Table 8.2. RCWF Capacity Maintenance Costs (January 2017 Prices)

Item	Estimated Costs for Facilities	City's portion (37.058%)
CAPITAL COST		
Well Field (11 Wells, Pumps and Piping)	$16,782,000	
TOTAL COST OF FACILITIES	**$16,782,000**	
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$5,874,000	
Environmental & Archaeology Studies and Mitigation	$133,000	
Land Acquisition and Surveying (6 acres)	$15,000	
Interest During Construction (4% for 1 years with a 1% ROI)	$799,000	
TOTAL COST OF PROJECT	**$23,603,000**	**$8,747,000**
ANNUAL COST		
Debt Service (5.5 percent, 20 years)	$1,975,000	$732,000
Operation and Maintenance		
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$168,000	$62,000
Pumping Energy Costs (15,998,442 kwh @ 0.09 $/kwh)	$1,440,000	$534,000
TOTAL ANNUAL COST	**$3,583,000**	**$1,328,000**
Available Project Yield (ac-ft/yr)	31,360	11,630
Annual Cost of Water ($/ac-ft), based on a Peak Factor of 1.0	$114	$114
Annual Cost of Water ($/1,000 gallons), based on a Peak Factor of 1.0	$0.35	$0.35

Notes: ROI = return on investment; kwh = kilowatt-hour; ac-ft/yr = acre-feet per year; $/ac-ft = dollars per acre-foot.

8.4 Bailey County Well Field Capacity Maintenance Strategy

The Bailey County Well Field (BCWF) produces water from the Ogallala Aquifer. The BCWF's production capacity has decreased sharply the last few years because the City has needed to produce more from the BCWF than desired in order to compensate for a reduction in supply originating through the CRMWA system. In 2010, the BCWF's production capacity was 50 mgd. By 2017, the well field's production capacity had dropped to about 30 mgd. The transmission line from the BCWF to the City's distribution system can deliver a peak flow of 40 mgd.

The City has two goals for the BCWF. The first goal is to maintain the 2017 BCWF capacity of 30 mgd. The City's second goal is to reserve the BCWF for meeting peak demand during summer months. In order to effectively meet these goals, it is recommended that the City produce no more than 5,000 ac-ft/yr on a long-term average.[22] The City plans to continually produce 2 mgd from the BCWF to keep the transmission line operational. Under this base load production amount, the City is able to use the BCWF full capacity of 30 mgd for 32 days to meet peaking demands during the summer without exceeding the annual maximum production target of 5,000 ac-ft.

The proposed BCWF CM strategy is intended to replace capacity that is expected to be lost in the future and assist the City in achieving its BCWF goals. It is anticipated that each CM phase will maintain the 30 mgd capacity for 6 years, after which time additional well field maintenance will be needed. The CM phase is based on an HDR analysis completed in 2017, which updated the results from a Daniel B. Stephens & Associates' (DBS&A) October 2012 modeling report.[23] Assuming that new wells will have a production capacity of 200 to 250 gpm, and based on the expected production decline curve from the DBS&A and HDR analyses, 10 replacement wells will be required every 6 years to maintain the production capacity in the BCWF while producing about 5,000 ac-ft/yr. This strategy considers only a 20-year project period for comparison to other strategies in this Plan.

The major design features of this strategy include:

- Construction of ten 200-gpm wells every 6 years;
- Wells are assumed to be constructed to a depth of 220 feet and operate at an average of 200 gpm;
- Wells are located on properties where the City holds existing water rights;
- No additional treatment is required;
- Approximately 5.3 miles of 6-inch to 16-inch diameter collection pipe is required for each CM phase; and Well pumps will be sized to deliver the water to terminal storage at the east end of the well field, with a delivery pressure of 30 pounds per square inch (psi) at the connection to the original well field.

Figure 8.13 shows the relative locations of the well field and associated infrastructure needed.

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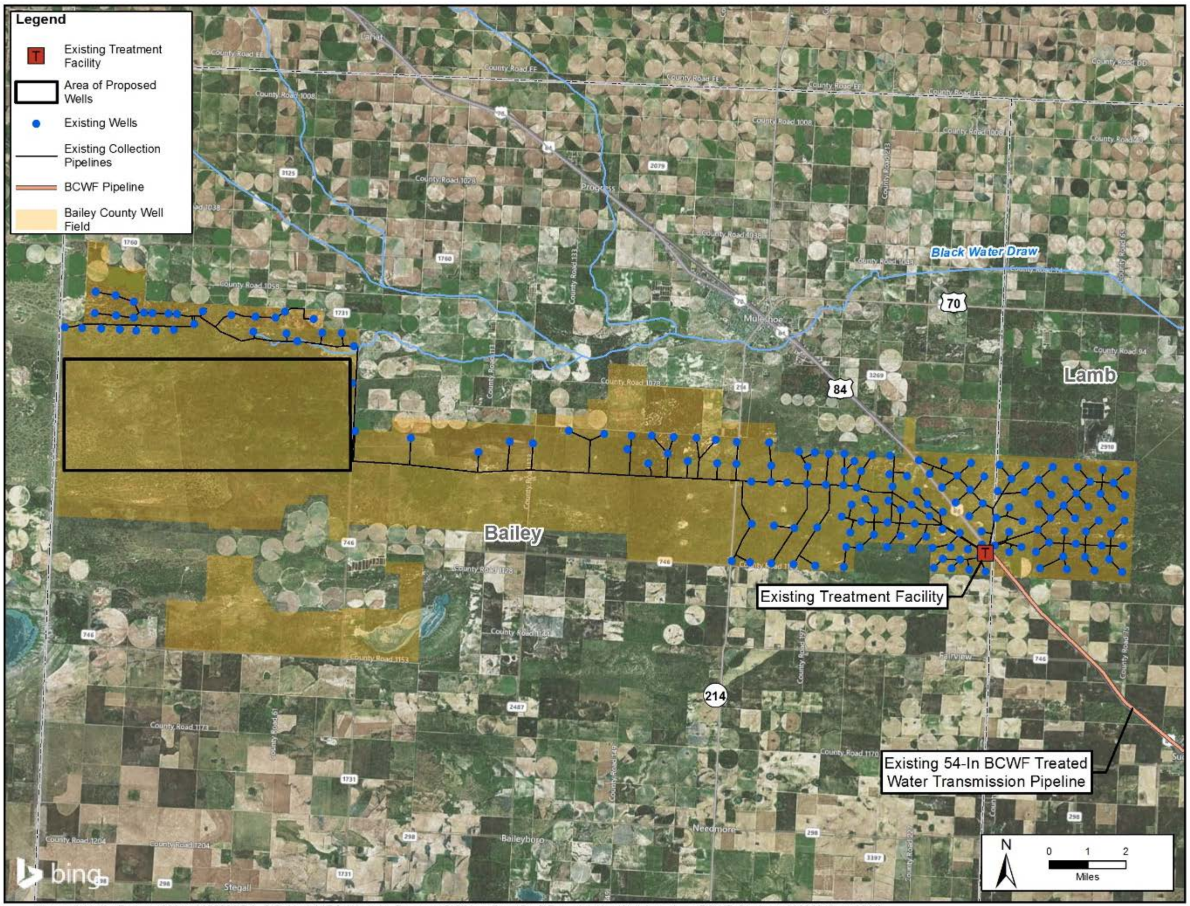
[22] Updated Bailey County Well Field Modeling Report, Daniel B. Stephens & Associates. September 2012: 6.

[23] Updated Bailey County Well Field Modeling Report, Daniel B. Stephens & Associates. September 2012: 7.

Figure 8.13. Potential New Well Locations for BCWF Capacity Maintenance Strategy



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8.4.1 Quantity of Available Water

The BCWF CM strategy is designed to maintain the current BCWF production capacity of 30 mgd. Under this strategy, the City will produce an average of 5,000 ac-ft/yr of water from the BCWF, consisting of 2 mgd base load throughout the year, and peaking supply of 30 mgd for about 30 days each year. Each CM phase will consist of installing 10 wells, providing 2.88 mgd (10 wells at approximately 200 gpm each) of capacity to offset overall capacity declines from the system. The current well field consists of 175 active wells. By cycling the wells and not overpumping any single well, an average of 28.6 ac-ft/yr can be considered to be supplied from each well. Assuming that some wells will go out of service as water levels decline, then the future supply made available by each new well can conservatively be estimated to be 28.6 ac-ft/yr. Therefore, each set of 10 new wells will provide an average supply of 286 ac-ft/yr.

8.4.2 Strategy Costs

Costs associated with this strategy are presented in Table 8.3. Assumptions and conditions associated with these costs include:

- Capital cost for wells and related infrastructure is based on estimates provided by Parkhill, Smith and Cooper engineer;
- Capital cost of collector pipelines is calculated by the unified costing model that is used for strategies in the Regional Water Plans;
- Engineering, legal, and contingency costs are 35% for facilities constructed for this strategy;
- Power is available at $0.09 per kwh;
- Interest during construction is estimated at 4.0%, and a 1% return on investments over a 2-year period; and
- The project will be financed for 20 years at a 5.5% annual interest rate.

As shown in Table 8.3, the total project costs every 6 years for CM is estimated to be $4,328,000. Annual debt service is $362,000; and, annual operational cost, including power, is $39,000, resulting in a total annual cost of $401,000 for the 6 wells. The unit cost for the 2.88 mgd peak capacity and 286 ac-ft/yr supply is estimated to be $1,402 per ac-ft, or $4.30 per 1,000 gallons.

Table 8.3. BCWF Capacity Maintenance Costs (January 2017 Prices)

Item	Estimated Costs for Facilities
CAPITAL COST	
Wells (10 Wells at 200 gpm)[1]	$1,821,000
Well Collection System (5.3 mi - 6, 8, 12, 16-in dia)	$1,065,000
TOTAL COST OF FACILITIES	**$2,886,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies	$1,010,000
Env & Archaeology Studies and Mitigation	$133,000
Easement and Surveying	$15,000
Interest During Construction (4% for 2 yrs 1% ROI)	$284,000
TOTAL COST OF PROJECT	**$4,328,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$362,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks	$29,000
Pumping Energy Costs (111,111 kwh @ 0.09 $/kwh)	$10,000
TOTAL ANNUAL COST	**$401,000**
Available Project Yield (ac-ft/yr)	286
Annual Cost of Water ($ per ac-ft)	$1,402
Annual Cost of Water ($ per 1,000 gallons)	$4.30

Notes: ROI = return on investment; kwh = kilowatt-hour; ac-ft/yr = acre-feet per year; $/ac-ft = dollars per acre-foot.

1. Unit cost for wells and related infrastructure is based on estimate provided by Parkhill, Smith and Cooper, Inc.

8.4.3 Implementation Issues

Environmental Issues

The installation of wells and collection pipelines should be planned and installed so that sensitive habitats, cultural resources, and other environmentally sensitive areas are avoided.

Permitting Issues

The City already owns groundwater rights on 83,305 acres of contiguous property, and wells will be drilled within this area. The City will need to acquire permits from the High Plains Underground Conservation District No. 1, and the design and construction of public water supply wells and water transmission facilities must be approved by the TCEQ.

Other

Wells will be placed on properties where the City owns the water rights, which include the rights to surface improvements to extract and convey the groundwater. The City will need to negotiate work with surface owners to accommodate the surface operations and plans. Future CMs (CM-1, CM-2, etc.) would be implemented every six years to maintain the BCWF capacity.

8.5 Roberts County Well Field - New Transmission Line to Aqueduct Strategy

CRMWA is planning to expand its groundwater supplies through expansion of the RCWF by expanding the well field and well field transmission pipeline capacity for delivery to the CRMWA Aqueduct. Currently a 54-inch diameter transmission line with a 65-mgd capacity delivers water from the RCWF west toward Borger and then south to Amarillo. The capacity of the CRMWA Aqueduct between Amarillo and Lubbock is 53 mgd. A proposed new 54-inch diameter transmission line is being planned using a new right-of-way to deliver water to the CRMWA Aqueduct on the north side of Amarillo. Additional wells will be necessary to increase the RCWF production capacity to fully utilize the increased pipeline capacity. Eventually, replacement wells will be necessary to maintain the proposed RCWF production capacity. For purposes of this strategy, Lee Wilson & Associates, a consultant under contract with CRMWA, states that 19 wells will initially be required; and, by 2045, an additional 17 wells in three increments will be required to maintain the target production capacity of 63,000 ac-ft/yr.

Two 54-inch diameter transmission lines (one existing and one planned) delivering water from the RCWF could deliver a peak supply of 130 mgd to the CRMWA Aqueduct (65 mgd from each pipeline). The City's portion would be 48.2 mgd (37.058% of the total CRMWA-produced water available). The City's current allocation is approximately 42 mgd.

The major design features of this strategy include:

- Thirty-six new Ogallala Aquifer wells constructed to the top of the Red Beds, which is estimated to average about 950 feet and operating at 1,750 gpm per well. Nineteen (19) wells will be drilled in the initial construction phase. Seventeen (17) wells will be added in three increments;
- Collector pipelines and ground storage tank at pump station to beginning of transmission pipeline;
- Approximately 67 miles of 54-inch diameter transmission pipeline; and
- A ground storage tank and pump station at the well field and at one booster pump station. Both are sized for 65 mgd.

Figure 8.14 depicts the relative locations of the well field, new wells, transmission lines, and associated infrastructure needed.

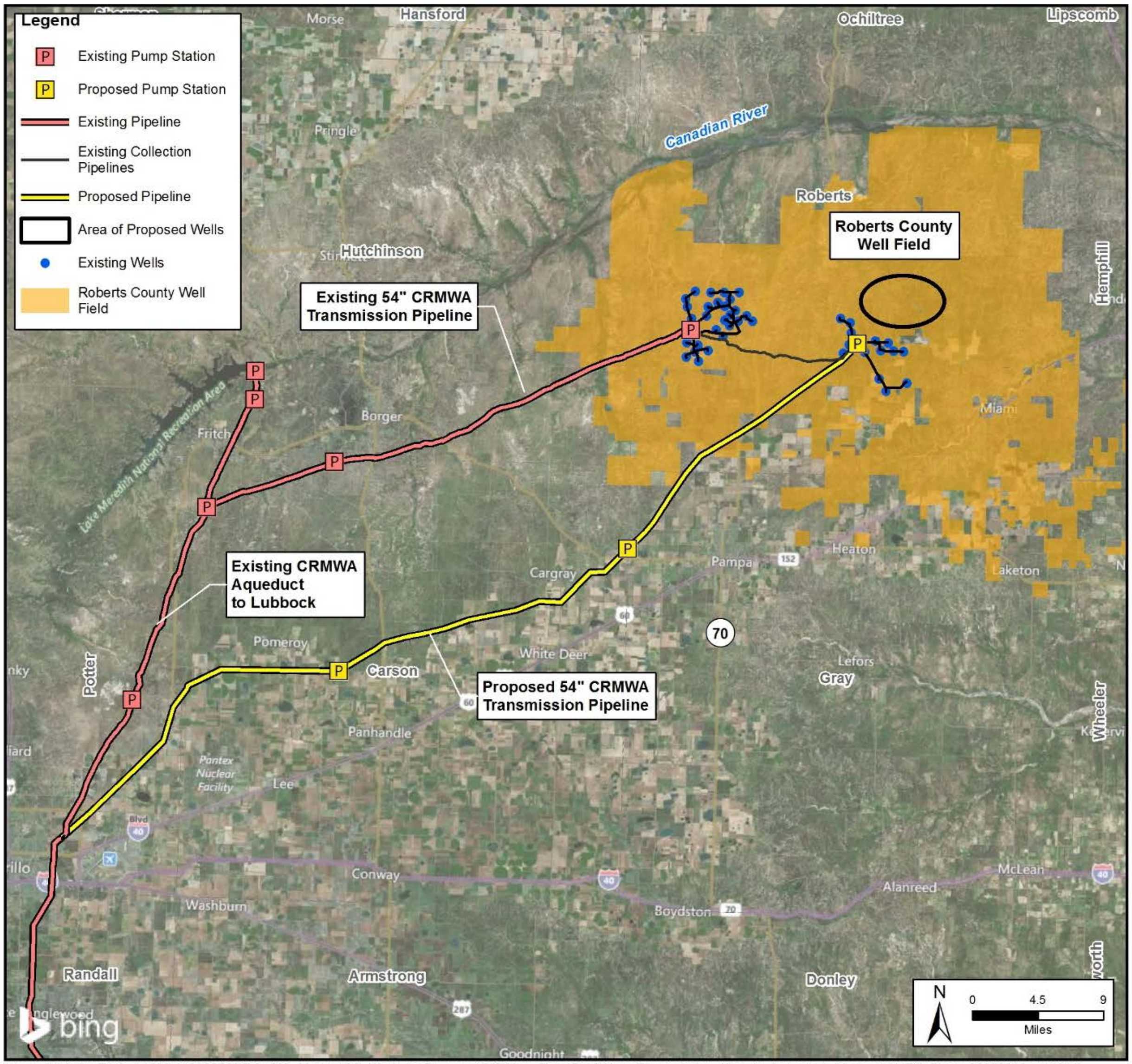
8.5.1 Quantity of Available Water

It is assumed that CRMWA will operate the new transmission line between RCWF and the CRMWA Aqueduct at 80% of its 65-mgd capacity (58,240 ac-ft/yr). Therefore, the City's incremental increase in annual allocation from CRMWA will be 21,583 ac-ft/yr (65 mgd x 1120 ac-ft/yr/mgd x 0.8 x 0.37058). The City's portion of the total CRMWA-produced water available is 37.058%. Consequently, the CRMWA Aqueduct between Plainview and Lubbock will be flowing near its peak capacity of 53 mgd with the City's portion of the peak capacity of 42 mgd. Under this strategy, Lubbock's total CRMWA allocations are as follows:

Lubbock's current CRMWA allocation:	24,088 ac-ft/yr
Additional supply with new transmission line:	21,583 ac-ft/yr
Lubbock's updated CRMWA supply:	45,671 ac-ft/yr

Maintaining the target quantity of water in the future will require a production CM program of adding new wells to account for reduced wells yields due to declining groundwater levels. For purposes of this strategy, estimated CM costs are included for a 50-year planning period.

Figure 8.14. RCWF – New Transmission Line to Aqueduct Strategy



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8.5.2 Strategy Costs

Costs associated with this strategy are presented in Table 8.4. Assumptions and conditions associated with these costs include:

- The City will pay for 37.058% of the costs for this project;
- Capital costs provided by CRMWA were used instead of the Unified Costing Model. A review of the capital costs indicates that they are very similar to those that would be developed by the Unified Costing Model.
- All new wells are located on property for which CRMWA owns the water rights, and the authority to build facilities on the surface to develop and transport the water;

- Engineering, legal, and contingency costs are 35% for facilities required by this strategy;
- Power is available at $0.09 per kwh;
- Interest during construction is 4.0%, and a 1.0% return on investments; and
- The project will be financed for 20-years at a 5.5% interest rate.

Table 8.4. RCWF New Transmission Line to Aqueduct Costs (Jan 2017 Prices)

Item	Estimated Costs for Facilities	City's portion (37.058%)
CAPITAL COST		
Pump Stations (65 mgd)	$34,696,000	
Transmission Pipeline (54 in dia.)	$137,924,000	
Transmission Storage Tank(s)	$4,283,000	
Well Fields (36 Wells, Pumps, and Piping)	$55,189,000	
TOTAL COST OF FACILITIES	**$232,092,000**	
Engineering Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$74,336,000	
Environmental & Archaeology Studies and Mitigation	$2,050,000	
Land Acquisition and Surveying (468 acres)	$1,242,000	
Interest During Construction (4% for 2 years with a 1% ROI)	$21,681,000	
TOTAL COST OF PROJECT	**$331,401,000**	**$122,811,000**
ANNUAL COST		
Debt Service (5.5 percent, 20 years)	$27,731,000	$10,277,000
Operation and Maintenance		
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,974,000	$732,000
Pump Stations (2.5% of Cost of Facilities)	$867,000	$321,000
Pumping Energy Costs (191,408,704 kwh @ 0.09 $/kwh)	$17,227,000	$6,384,000
TOTAL ANNUAL COST	**$47,799,000**	**$17,713,000**
Available Project Yield (ac-ft/yr)	58,240	21,583
Annual Cost of Water ($/ac-ft), based on a Peaking Factor of 1.0	$821	$821
Annual Cost of Water ($/1,000 gallons), based on a Peaking Factor of 1.0	$2.52	$2.52

Notes: mgd = million gallons per day; ROI = return on investment; kwh = kilowatt-hour; ac-ft/yr = acre-feet per year; $/ac-ft = dollars per acre-foot.

As shown, the total project cost is estimated to be $331,401,000 for facilities to provide the full capacity of 65 mgd. Annual debt service is $27,731,000, and annual operational cost, including power, is $20,068,000. This results in a total annual cost of $47,799,000. The unit cost for the average annual supply is $821/ac-ft or $2.52 per 1,000 gallons.

These costs are for delivery of water to Lubbock’s terminal storage reservoir and not for any subsequent treatment or transmission from the North Water Treatment Plant (NWTP). The supply and costs from this strategy will be shared by other CRMWA members. Lubbock’s annual cost will be $17,713,000.

8.5.3 Implementation Issues

Environmental Issues

The installation of wells and collection pipelines should be planned so that sensitive habitats, cultural resources, and other environmentally sensitive areas are avoided. CRMWA should seek to minimize environmental impact when planning the route for the new 54-inch transmission pipeline.

Permitting Issues

Currently, CRMWA owns the groundwater interests in over 450,000 acres of property and wells will be drilled within this area. CRMWA will need to secure permits from the Panhandle GCD and the design and construction of public water supply wells and water transmission facilities must be approved by the TCEQ.

Other

Wells will be placed on properties where CRWMA owns the water rights, which include the rights to surface improvements to extract and convey their groundwater. An easement is currently being acquired for the new transmission pipeline.

9 Aquifer Storage and Recovery

Aquifer storage and recovery (ASR) can generally be defined as increasing recharge into an aquifer system and subsequently recovering all or a portion of the amount recharged into the aquifer system at a later date. An effective ASR program requires a source of supply to be recharged and a compatible aquifer system in which to store the water. Sources of supply may include surface water, groundwater, or reclaimed water.

ASR is a water supply strategy that can be used to 1) work around seasonal bottlenecks in the delivery system; 2) protect surface water from high evaporation rates (water loss); and 3) provide an engineered buffer for potable reuse of reclaimed water. ASR can be used for long-term storage of water, with recovery occurring during times of drought to supplement or replace existing supplies, or it can be used for short-term storage and used to supplement existing supplies during peak demand periods.

The source water must be treated to a level so as not to impair the water quality of the receiving aquifer and to avoid subsequent fouling of ASR well screens and the subsurface formation of the receiving aquifer. The source water and receiving aquifer must also be chemically compatible to avoid unwanted chemical reactions. ASR typically is accomplished using dual-purpose wells, which both inject and recover the stored water, but can also be accomplished with a combination of injection and separate recovery wells depending on the goals of the system and the hydrogeologic setting.

9.1 CRMWA to Aquifer Storage & Recovery Strategy

This ASR strategy will store water purchased from Canadian River Municipal Water Authority (CRMWA) during the fall, winter, and spring in the Ogallala Aquifer and recover the water during summer months. The ASR project aids in balancing the CRMWA deliveries by increasing the deliveries during periods of relatively low winter demands and decreasing demands on the CRMWA system during the summer. The raw CRMWA water will be delivered to the North Water Treatment Plant (NWTP), treated, delivered, and injected into a new ASR well field about two miles east of the NWTP. Later, this water will be recovered and delivered to the NWTP site, disinfected, and blended with other treated water from CRMWA for distribution. The framework for this option follows a 2011 CDM Smith report titled *Canadian River Municipal Water Authority Aquifer Storage and Recovery Facility: Project Delivery Plan.*[1] The strategy is also discussed in detail in the City of Lubbock's (City's) 2015 *Aquifer Storage and Recovery (ASR) Evaluation*[2] report prepared by HDR.

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[1] Canadian River Municipal Water Authority Aquifer Storage and Recovery Facility: Project Delivery Plan. CDM Smith. 2011.

[2] HDR Engineering, 2015. Aquifer Storage and Recovery (ASR) Evaluation, Engineering Report for City of Lubbock.

The major design features of this strategy include:

- Raw water from CRMWA sources are treated at NWTP;
- A new pump station at the NTWP delivers treated water directly to ASR wells in the well field for injection;
- Installation of 45 Ogallala Aquifer ASR wells with an injection capacity of about 350 gallons per minute (gpm) and a production capacity of about 500 gpm. Six of the ASR wells are considered to be contingency or standby wells;
- Installation of 34 Ogallala Aquifer production wells with a capacity of about 500 gpm. Five of the production wells are considered to be contingency or standby wells;
- ASR and production wells spacing is about ¼ mile or greater;
- Distribution of ASR wells is more concentrated on west side of well field to compensate for the slight easterly downdip in aquifer storage zone;
- Well pumps delivering recovered water to the NWTP; and
- Recovered water is disinfected and blended with treated water from the CRMWA supply and pumped into the distribution system.

Figure 9.1shows the relative locations of the ASR and production wells and associated infrastructure. Figure 9.2 shows a schematic of the ASR system.

Figure 9.1. CRMWA to Aquifer Storage and Recovery Infrastructure

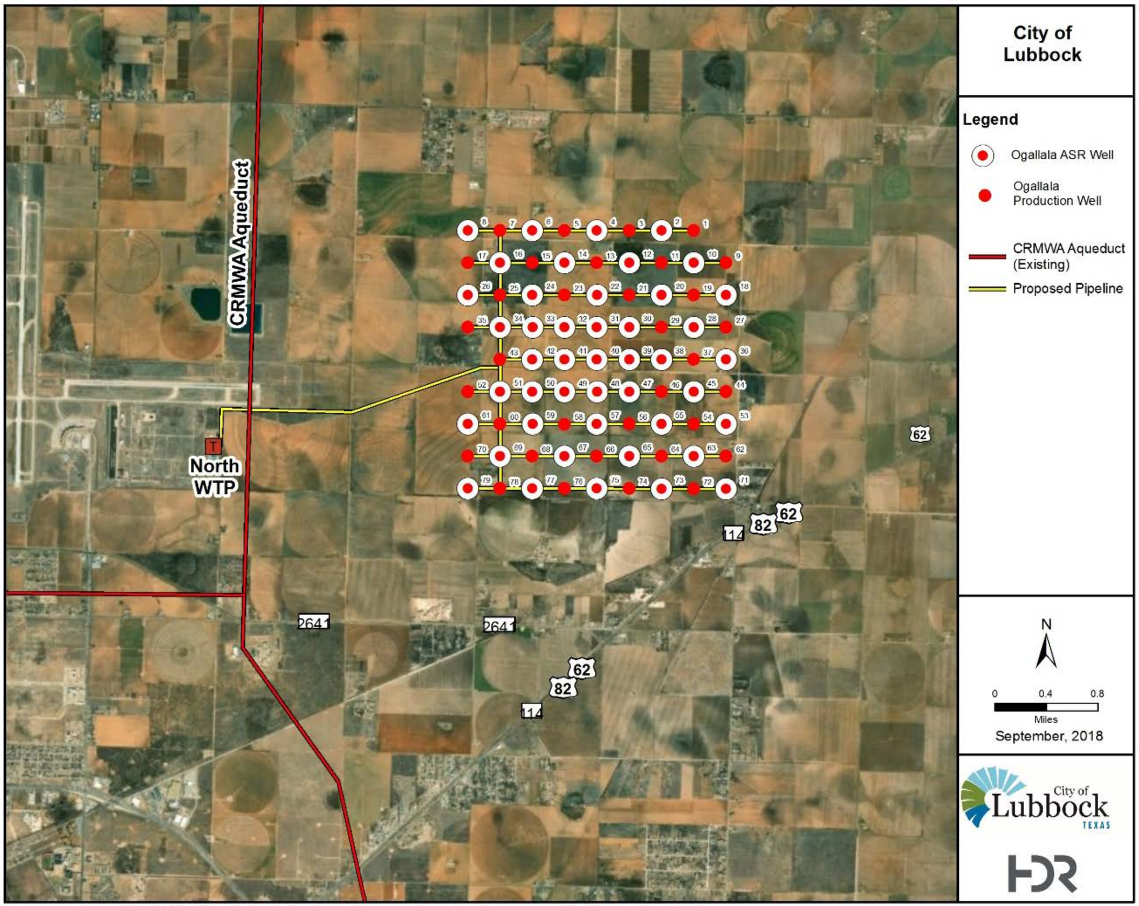

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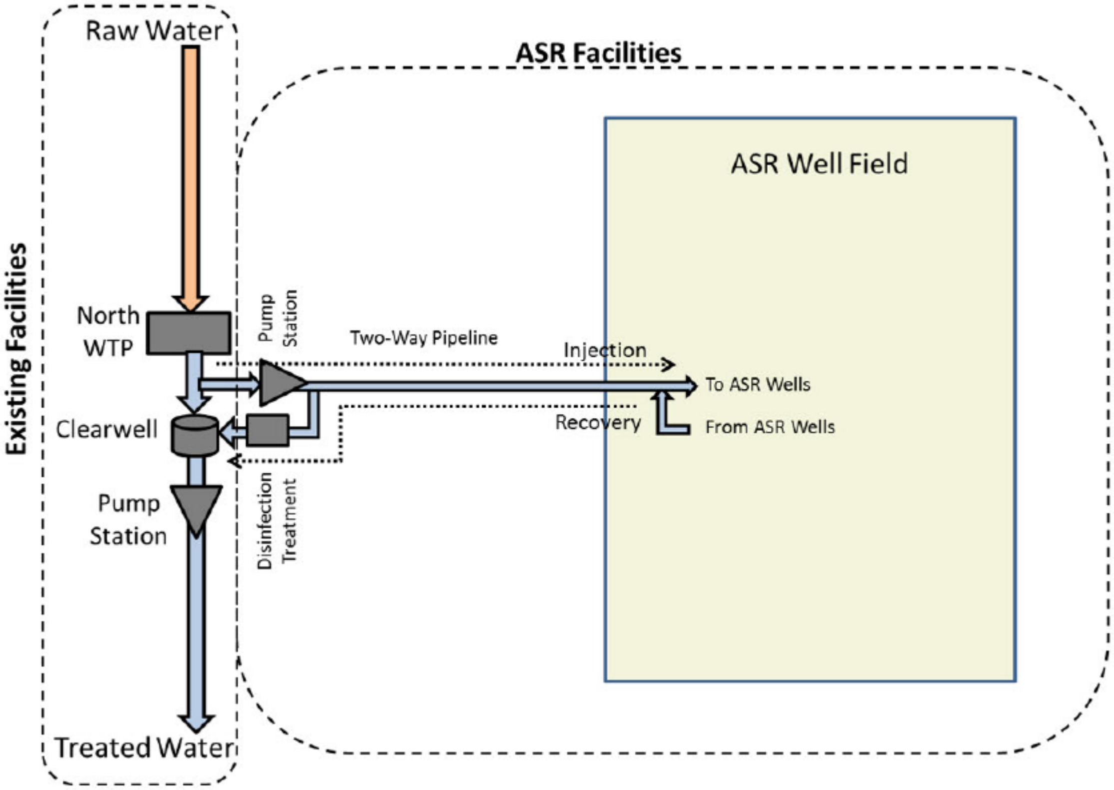
Figure 9.2. ASR System Schematic



9.1.1 Quantity of Available Water

The option assumes that the new transmission line from the Roberts County Well Field (RCWF) to the CRMWA Aqueduct will be built (see Section 8.5). It also assumes that Lubbock's average unused seasonal capacity in the CRMWA aqueduct is 19.5 million gallons per day (mgd). For evaluation purposes, the system is assumed to operate under recharge conditions for six months of the year (November through April), recovery conditions for 2.5 months (mid-June through August) and remain idle for the remaining time (May to mid-June, September and October). This results in an average of 10,920 acre-feet per year (ac-ft/yr) of water available for ASR storage. To recover this same amount in 2.5 months, a 48.8-mgd system would be designed and would be used to supplement the City's peak-day supplies. The assumptions used in this evaluation will need to be revisited during a more detailed project-specific feasibility study.

Depending on groundwater levels, nearby pumping, and stored volume, some of this stored supply may be lost to other wells; however, the option assumes recovery operations will pump the same total volume as recharge. As a result, there may be a minor blend of native groundwater and stored treated CRMWA supplies near the end of the recovery cycle. This assumption is based on native groundwater being suitable for a public supply.

At many ASR sites, forming and maintaining a buffer zone around an ASR well or well field has been found effective at controlling subsurface geochemical reactions so that recovered water quality is similar to injected water quality. Initial ASR well testing in the Lubbock area would determine whether the same beneficial results would be achieved locally, minimizing or avoiding the need for pre- or post-treatment of the water in ASR storage.

9.1.2 Strategy Costs

Costs associated with this strategy are presented in Table 9.1. Assumptions and conditions associated with these costs include:

- On average a high-capacity Ogallala Aquifer production well for the target area is expected to be able to produce about 500 gpm and have an injection capacity of about 350 gpm;
- The depth to the base of the Ogallala Aquifer is about 160 feet;
- CRMWA raw water treatment prior to ASR would occur during November to April when there is unused capacity in the NWTP;
- Property acquisition for the ASR well field will be approximately 3,200 acres;
- A new pump station at the NWTP will deliver the treated water to the ASR well field through a two-way transmission pipeline;
- The well field will include 45 Ogallala Aquifer ASR wells. Six of the wells are considered to be contingency or standby wells;
- The well field will include 34 Ogallala Aquifer production wells. Five of the production wells are considered to be contingency or standby wells;
- The well spacing is 1,320 feet or greater;
- Well pumps would deliver recovered water back to the NWTP through the two-way transmission pipeline;
- The recovered water would be disinfected and delivered to the NWTP clearwell for blending with treated water from the CRMWA supply. Then, the blended water would be pumped into the distribution system through the NWTP high service pump station;
- The ASR system would be operated with advanced Supervisory Control and Data Acquisition (SCADA) and variable speed well pumps. During peak recovery period, wells may be operated in rotation to maintain target groundwater levels in the well field;
- The well field will include 15 monitoring wells;
- The migration of the injected water is expected to be minimal;
- Costs for raw water treatment at the existing NWTP were not considered. Water will be treated and delivered from November through April when there is unused capacity in the NWTP;
- Property for the ASR well field can be purchased for $2,500 per acre (inclusive of water rights), which is twice the average of rural lands in this part of the state;
- Engineering, legal, and contingency costs is 30% of pipelines and 35% for other facilities;
- Power is available at $0.09 per kilowatt-hour (kwh);
- Interest during construction is 4.0%, and a 1.0% return on investments; and
- The project will be financed for 20-years at a 5.5% interest rate.

Table 9.1. CRMWA to Aquifer Storage and Recovery Costs (January 2017)

Item	Estimated Costs for Facilities
CAPITAL COST	
Pump Station at Water Treatment Plant (19.5 mgd)	$2,459,000
Transmission Pipeline (54 in dia., 2 miles)	$3,564,000
Well Field (48 Combination Wells, 31 Production Wells, Pumps, and Piping)	$46,266,000
Disinfection Treatment	$948,000
SCADA and Integration	$1,669,000
TOTAL COST OF FACILITIES	**$54,906,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$19,039,000
Environmental & Archaeology Studies and Mitigation	$8,662,000
Land Acquisition and Surveying (3,227 acres)	$8,860,000
Interest During Construction (4% for 2 years with a 1% ROI)	$6,403,000
TOTAL COST OF PROJECT	**$97,870,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$8,190,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$499,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$61,000
Water Treatment Plant	$569,000
Pumping Energy Costs (0.09 $/kwh)	$398,000
TOTAL ANNUAL COST	**$9,717,000**
Available Project Yield (ac-ft/yr)	10,920
Annual Cost of Water ($ per ac-ft), based on a Peaking Factor of 5.0	$890
Annual Cost of Water ($ per 1,000 gallons), based on a Peaking Factor of 5.0	$2.73

Notes: mgd = million gallons per day; SCADA = Supervisory Control and Data Acquisition; ROI = return on investment; kwh = kilowatt-hour; ac-ft/yr = acre-feet per year.

As shown, the total project cost is estimated to be $97,870,000. Annual debt service is $8,190,000; and, annual operational cost, including power, is $1,527,000. This results in a total annual cost of $9,717,000. The unit cost for a 10,920 ac-ft/yr peaking supply is estimated to be $890 per ac-ft, or $2.73 per 1,000 gallons. This cost does not include the cost of water from CRMWA nor the water treatment prior to storage in the ASR well field, because the NTWP will require no expansion to provide this treatment.

9.1.3 Implementation Issues

Environmental Issues

The installation of wells and collection pipelines should be planned and installed so that sensitive habitats, cultural resources, and other sensitive areas are avoided.

Permitting Issues

The High Plains Underground Water Conservation District No. 1 (HPUWCD) likely would have no permitting authority of the ASR injection or production wells as long as there is a net positive balance of recoverable water in the storage zone.

Other

The City does not own groundwater rights in this area. Groundwater rights will need to be purchased so that water within the recharge area can be controlled by the City.

9.2 Reclaimed Water Aquifer Storage and Recovery to North WTP Strategy

The Reclaimed Water ASR to NWTP Strategy will treat and transport reclaimed water from the Southeast Water Reclamation Plant (SEWRP) to an ASR facility located northeast of the City, near the NWTP. Treated supplies would be conveyed through a new 20-inch diameter, 7.3 mile pipeline to the ASR well field. The reclaimed water will then be injected into the Ogallala Aquifer and then recovered approximately 0.25 miles downgradient to the east. The recovered water will be delivered to the NWTP for disinfection and blending with other treated water from CRMWA for distribution to customers. Recharge into ASR is assumed to occur uniformly throughout the year. The injected water will be closely monitored as it migrates downgradient over 1-2 years to the recovery well field to allow for soil aquifer treatment and residence time.

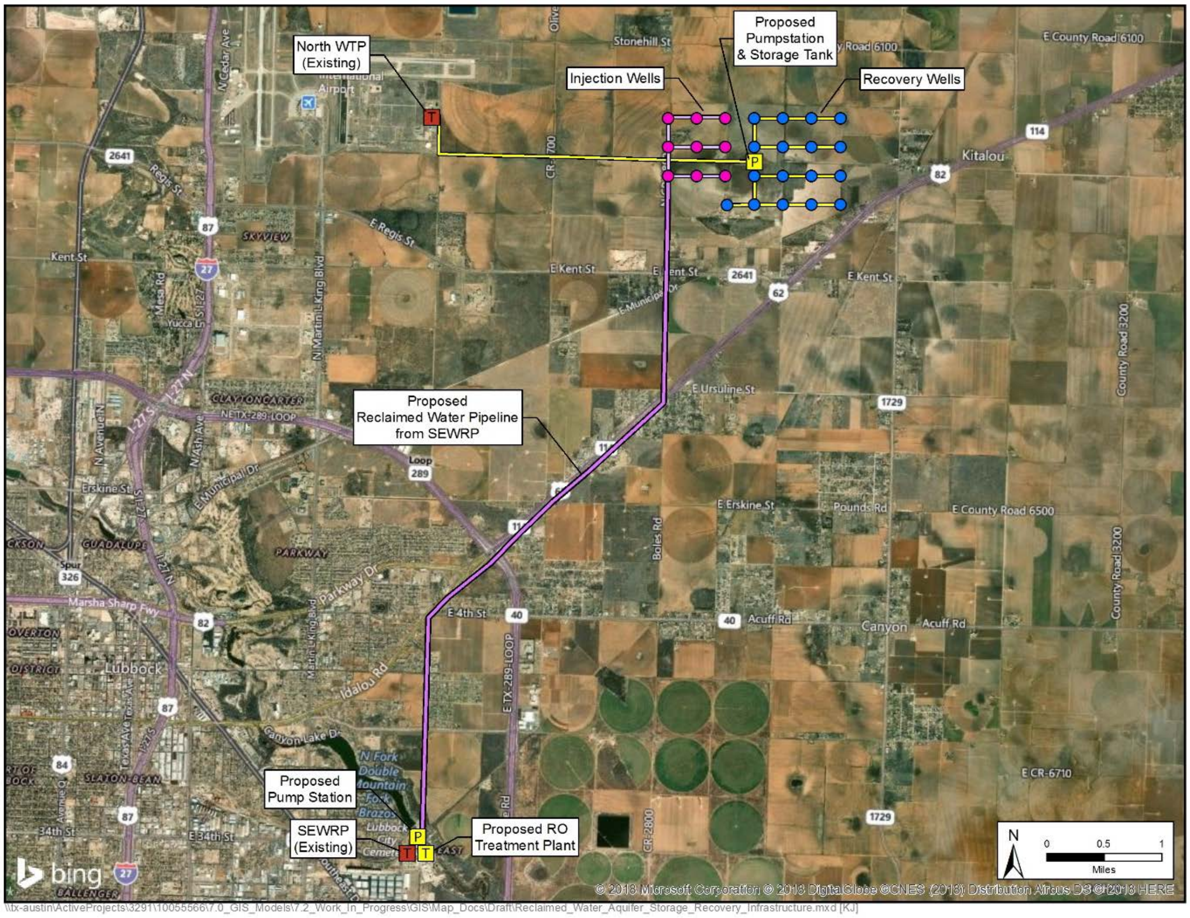
The major design features of this strategy include:

- Nine Ogallala ASR injection wells (500 gpm) with spacing of 1,320 feet or greater, including two contingency or standby wells;
- Seventeen 250 gpm ASR recovery wells constructed at about 160 feet deep with horizontal spacing of 1,320 feet or greater , including three contingency or standby wells;
- 7.3 mile pipeline from SEWRP to the ASR Well Field;
- A new 18-in, 2.5 mile pipeline to deliver the recovered water to the NWTP. A booster pump station and ground storage are included for delivery to the NWTP;
- An expansion of the NWTP is necessary for additional chlorine disinfection;
- Assume SEWRP upgrades for biological nutrient removal (BNR) have been completed;

- 3.5 mgd reverse osmosis (RO) treatment to reduce total dissolved solids (TDS) to less than 500 milligrams per liter (mg/L) from the SEWRP effluent prior to injection in the Ogallala;
- RO concentrate (0.5 mgd) will be stream discharged; and
- Requires a two year piloting program prior to Texas Commission on Environmental Quality (TCEQ) acceptance of the soil aquifer treatment. Piloting project will include treatment to reduce nitrate and TDS, one 500 gpm recharge well, one recovery well, and one monitoring well. The location of the recovery well will provide a travel time of 30 days to evaluate water quality through soil aquifer treatment.

Figure 9.3 depicts the relative locations of the Reclaimed Water ASR wells and associated infrastructure.

Figure 9.3. Reclaimed Water Aquifer Storage and Recovery to NWTP Infrastructure



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9.2.1 Quantity of Available Water

This Reclaimed Water ASR to NWTP Strategy assumes that up to 5 mgd of reclaimed water will be sent to the ASR and recovered. The final supply of 5 mgd (5,600 ac-ft/yr) will be blended and distributed at the NWTP.

9.2.2 Strategy Costs

Costs associated with this strategy are presented in Table 9.2. Assumptions and conditions associated with these costs include:

- Property for the well field can be purchased for $2,500 per acre, which is twice the average of rural lands in this part of the state;
- The depth to the base of the Ogallala Aquifer is about 160 feet;
- Additional costs for well field SCADA, valves and pump controls were included in the strategy costs;
- Engineering, legal, and contingency costs is 30% of pipelines and 35% for other facilities;
- Power is available at $0.09 per kwh;
- Interest during construction is 4%, and a 1% return on investments;
- The project will be financed for 20-years at a 5.5% interest rate; and
- The project is assumed to have a 2-year construction period.

As shown, the total cost is estimated to be $54,806,000. The pilot project costs for two years are estimated at $4,762,000. Annual debt service is $4,586,000; and, annual operational cost, including power, is $2,904,000. This results in a total annual cost of $7,490,000. The unit cost for 5,600 ac-ft/yr of supply at the NWTP is estimated to be $1,388 per ac-ft, or $4.10 per 1,000 gallons. This cost does not include the distribution of the potable water from the NWTP to potential customers.

Table 9.2. Reclaimed Water Aquifer Storage and Recovery to NWTP Costs

Item	Estimated Costs for Facilities
Pump Stations (5.3 mgd)	$4,309,000
Transmission Pipeline (20 in dia., 7 miles, and 18 in dia., 2.5 miles)	$5,749,000
Well Fields (Wells, Pumps, and Piping)	$10,314,000
RO Treatment (3.5 mgd) and Disinfection (5 mgd)	$10,766,000
SCADA and Integration	$714,000
TOTAL COST OF FACILITIES	**$31,852,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$10,884,000
Pilot Project (Infrastructure and Program costs)	$4,762,000
Environmental & Archaeology Studies and Mitigation	$2,070,000
Land Acquisition and Surveying (714 acres)	$1,964,000
Interest During Construction (4% for 2 years with a 1% ROI)	$3,274,000
TOTAL COST OF PROJECT	**$54,806,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$4,586,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$162,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$108,000
Water Treatment Plant	$2,065,000
Pumping Energy Costs (6316900 kwh @ 0.09 $/kwh)	$569,000
TOTAL ANNUAL COST	**$7,490,000**
Available Project Yield (ac-ft/yr)	5,600
Annual Cost of Water ($ per ac-ft), based on a Peaking Factor of 1	$1,338
Annual Cost of Water ($ per 1,000 gallons), based on a Peaking Factor of 1	$4.10

Notes: mgd = million gallons per day; SCADA = Supervisory Control and Data Acquisition; ROI = return on investment; kwh = kilowatt-hour; ac-ft/yr = acre-feet per year.

9.2.3 Implementation Issues

Environmental Issues

The installation of wells and collection pipelines should be planned and installed so that sensitive habitats, cultural resources, and other sensitive areas are avoided.

Permitting Issues

TCEQ requires a Direct Potable Reuse (DPR) process that provides 5.5, 6, and 8 log reduction for crypto, giardia, viruses,[3] respectively at the recharge wellhead. For the proposed ASR to be permitted, TCEQ will require a demonstration project to claim soil aquifer treatment credits. The recharge well will require an Experimental Class V injection well authorization for piloting the treatment effectiveness.

The recharge piloting would likely take 2 years to accumulate the operational and sampling data necessary to support a Class V ASR injection well permit for non-drinking water and for TCEQ approval to recover the water through water wells for treatment in the existing NWTP.

Because the recharge water would not reliably meet drinking water standards prior to injection, the ASR injection well would likely need an individual Class V authorization, which would require public notice and might require one or more public hearings. The HPUWCD would have no permitting authority of the ASR injection or production wells as long as there is a net positive balance of recoverable water in the storage zone.

The design and construction of public water supply wells and water transmission facilities must be approved by the TCEQ. There may also be permitting obligations pursuant to Texas Water Code depending upon regulatory characterization of the associated return flows.

9.3 Reclaimed ASR to SWTP

The Reclaimed Water ASR to South Water Treatment Plant (SWTP) Strategy will treat and transport reclaimed water from the SEWRP to an ASR facility located near the SWTP. Treated supplies would be conveyed through the existing transmission system to the Hancock Land Application Site (HLAS) after the site is decommissioned then delivered to the ASR well field. The reclaimed water will be injected into the Edwards-Trinity High Plains (ETHP) Aquifer and recovered approximately 1 mile downgradient to the east. The recovered water will be delivered to the SWTP for disinfection and blending with other treated water from Lake Alan Henry for distribution to customers. Recharge into ASR is assumed to occur uniformly throughout the year. Losses will be minimal and it is assumed that nearly all of the original 5 mgd of reclaimed supply could be recovered down gradient after 1-2 years of residence time in the aquifer.

The major design features of this strategy include:

- Seventeen ETHP ASR recharge wells with spacing of 700 feet or greater , including three contingency or standby wells;

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[3] TWDB, “Direct Potable Reuse Resource Document”. April 2015. 3-10

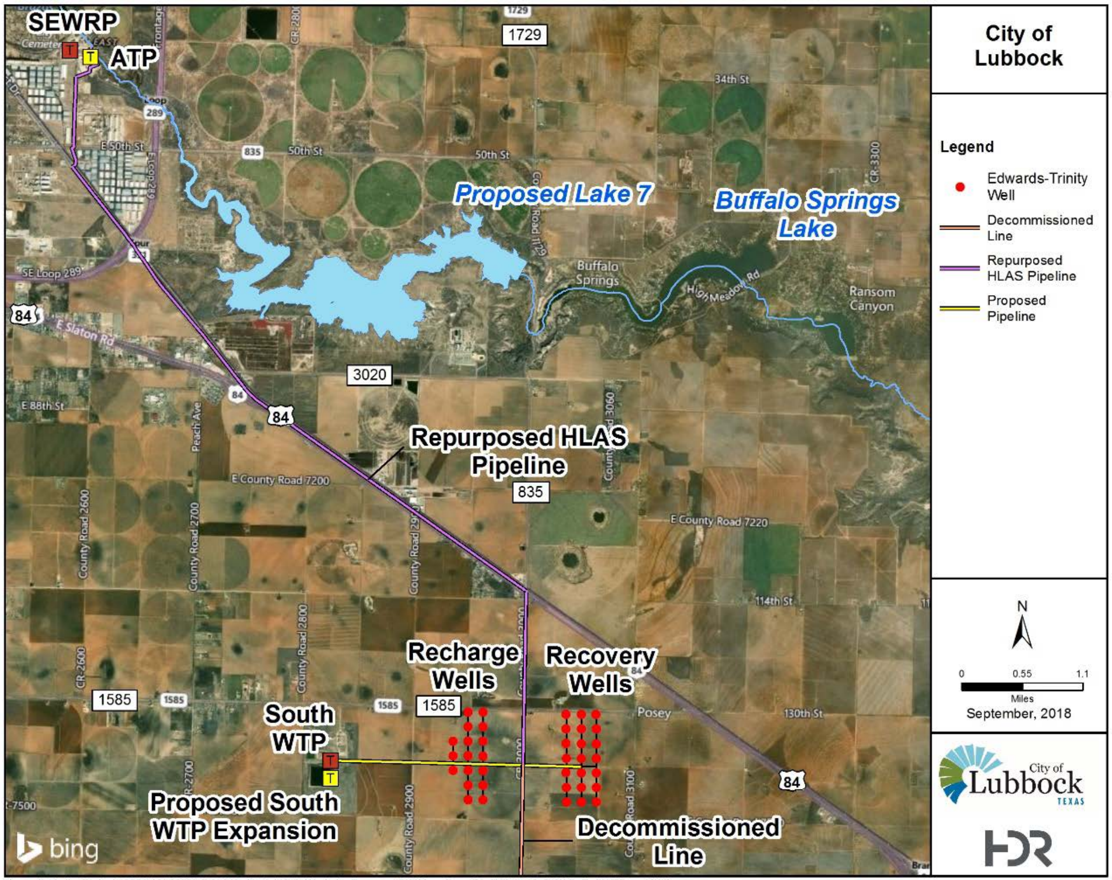
- Twenty-one ASR recovery wells with horizontal spacing of 700 feet or greater, including three contingency or standby wells;
- A total of 10 monitoring wells will be constructed within the recharge and recovery well fields;
- A 6 mgd advanced ATP at the Lubbock SEWRP with stream discharge of RO concentrate;
- A booster pump station to deliver the reclaimed water from the ground storage to ASR wells for injection;
- A new 18-in, 2mile pipeline to deliver the recovered water to the SWTP. Due to the relatively small quantity of water being recovered, a booster pump station and ground storage were not deemed necessary for delivery to the SWTP;
- A 5 mgd expansion of the SWTP and associated expansion of the high service pump station at the SWTP;
- A 4.5-mile, 30-in Low Head C Transmission pipeline to allow flow from the SWTP to reach Pumping Station (PS) 16 or Bailey County groundwater to flow to PS 14 (see Figure 4.11); and
- A 15 mgd Low Head C Pump Station to transfer water from the SWTP to PS 16.

Figure 9.4 depicts the relative locations of the Reclaimed Water ASR wells and associated infrastructure.

9.3.1 Quantity of Available Water

This Reclaimed Water ASR to SWTP Strategy assumes that up to 5 mgd (5,600 ac-ft/yr) of reclaimed water will be recovered from the ASR well field.

Figure 9.4. Reclaimed Water Aquifer Storage and Recovery to SWTP Infrastructure



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9.3.2 Strategy Costs

Costs associated with this strategy are presented in Table 9.3. Assumptions and conditions associated with these costs include:

- The existing transmission system for the decommissioned HLAS will be repurposed for delivery of purified water to the ASR project. This repurposed use is dependent on the future use of this line by Xcel Energy and for the existing outfall;
- Property for the well field can be purchased for $2,500 per acre, which is twice the average of rural lands in this part of the state;
- The depth to the base of the ETHP Aquifer is about 250 feet;
- Additional costs for well field SCADA, valves and pump controls were included in the strategy costs;
- Engineering, legal, and contingency costs is 30% of pipelines and 35% for other facilities;
- Power is available at $0.09 per kwh;
- Interest during construction is 4%, and a 1% return on investments;
- The project will be financed for 20-years at a 5.5% interest rate; and

- The project is assumed to have a 2-year construction period.

As shown, the total cost is estimated to be $133,592,000. Annual debt service is $11,179,000; and, annual operational cost, including power, is $3,847,000. This results in a total annual cost of $15,026,000. The unit cost for 5,600 ac-ft/yr of supply at the SWTP is estimated to be $2,683 per ac-ft, or $8.23 per 1,000 gallons.

Table 9.3. Reclaimed Water Aquifer Storage and Recovery to SWTP Costs (January 2017 Prices)

Item	Estimated Costs for Facilities
Transmission Pipeline (18 in dia., 2 miles)	$955,000
Low Head C Transmission Pipeline	$9,393,000
Low Head C Pump Station	$12,000,000
Well Fields (Wells, Pumps, and Piping)	$12,552,000
South Water Treatment Plant Expansion (5 mgd)	$12,058,000
Advanced Treatment Plant (5 mgd)	$41,443,000
SCADA and Integration	$1,751,000
TOTAL COST OF FACILITIES	**$90,152,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$31,036,000
Environmental & Archaeology Studies and Mitigation	$1,904,000
Land Acquisition and Surveying (663 acres)	$1,760,000
Interest During Construction (4% for 2 years with a 1% ROI)	$8,740,000
TOTAL COST OF PROJECT	**$133,592,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$11,179,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$230,000
Pump Stations (2.5% of Cost of Facilities)	$300,000
Water Treatment Plant	$2,506,000
Pumping Energy Costs (9007965 kwh @ 0.09 $/kwh)	$811,000
TOTAL ANNUAL COST	**$15,026,000**
Available Project Yield (ac-ft/yr)	5,600
Annual Cost of Water ($ per ac-ft), based on a Peaking Factor of 1	$2,683
Annual Cost of Water ($ per 1,000 gallons), based on a Peaking Factor of 1	$8.23

Notes: mgd = million gallons per day; SCADA = Supervisory Control and Data Acquisition; ROI = return on investment; kwh = kilowatt-hour; ac-ft/yr = acre-feet per year.

9.3.3 Implementation Issues

Environmental Issues

The installation of wells and collection pipelines should be planned and installed so that sensitive habitats, cultural resources, and other environmentally sensitive areas are avoided.

Permitting Issues

The City does not own the land or groundwater rights in the area of interest. Groundwater rights and/or land will need to be purchased so wells can be drilled within the proposed ASR area. The HPUWCD would have no permitting authority of the ASR injection or production wells as long as there is a net positive balance of recoverable water in the storage zone.

The City will need to acquire an ASR permit through TCEQ (rules still under development) and notice the HPUWCD. The design and construction of public water supply wells and water transmission facilities must be approved by the TCEQ. There may also be permitting obligations pursuant to Texas Water Code depending upon regulatory characterization of the associated return flows.

The drinking water produced for the project will meet or exceed all state and federal drinking water standards. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. TCEQ will require a pilot study prior to regulatory approval and for determining design values for the treatment technologies. Treatment requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Disposal of residuals from the project would meet all state and federal requirements for discharge of waste. A Texas Pollutant Discharge Elimination System (TPDES) permit will be required to discharge RO concentrate. The water quality for RO concentrate discharged into the North Fork of the Double Mountain Fork (NFDMF) of the Brazos River will meet or exceed the stream standards for that segment.[4]

Stream crossings would be subject to Section 404 of the Clean Water Act. Due to the minimal and temporary impacts associated with the pipeline installation, it is likely that most of the proposed project would be authorized by Nationwide Permit 12.

Monitoring is likely to include Cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on the U.S. Environmental Protection Agency (USEPA) Candidate Contaminate List (CCL), including Emerging Constituents of Concern (ECCs) and pharmaceuticals and personal care products (PPCPs).

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[4] City of Lubbock, “Potable Water Reuse Implementation Feasibility Study”. March 2017. 7-9.

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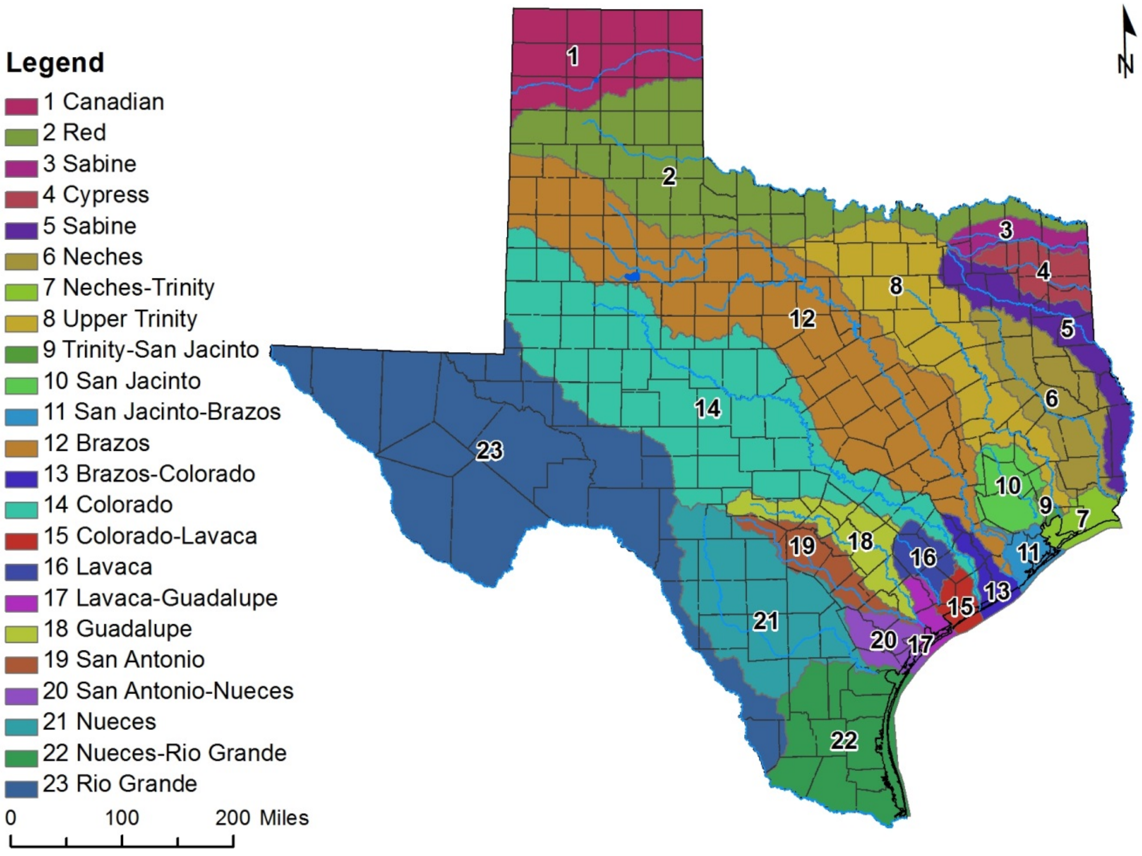
10 Surface Water Strategies

Surface water is an essential part of Lubbock's efforts to diversify its water supply portfolio in order to ensure a sustainable supply of water for the next 100 years. The State of Texas contains all or part of 23 river basins, as shown in Figure 10.1

Figure 10.1. River Basins in Texas



Four of the river basins are within practical reach of Lubbock, including the Canadian River, Red River, Brazos River, and Colorado River basins as depicted in Figure 10.2. On the semi-arid High Plains of Texas, the average annual rainfall for the Lubbock region is only 19 inches[1], thus limiting surface water supply opportunities as most streams only receive intermittent flow. However, periodic flood events combined with developed water make surface water strategies a viable option in some cases.

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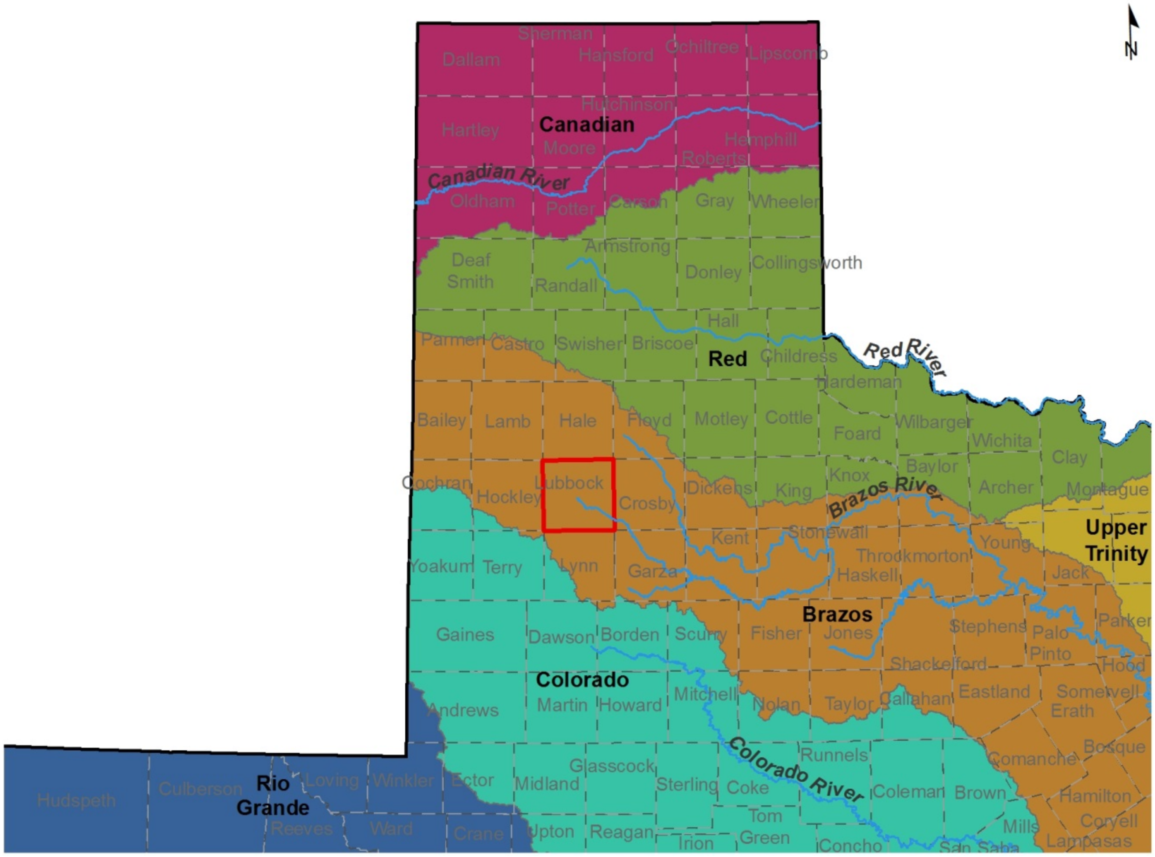
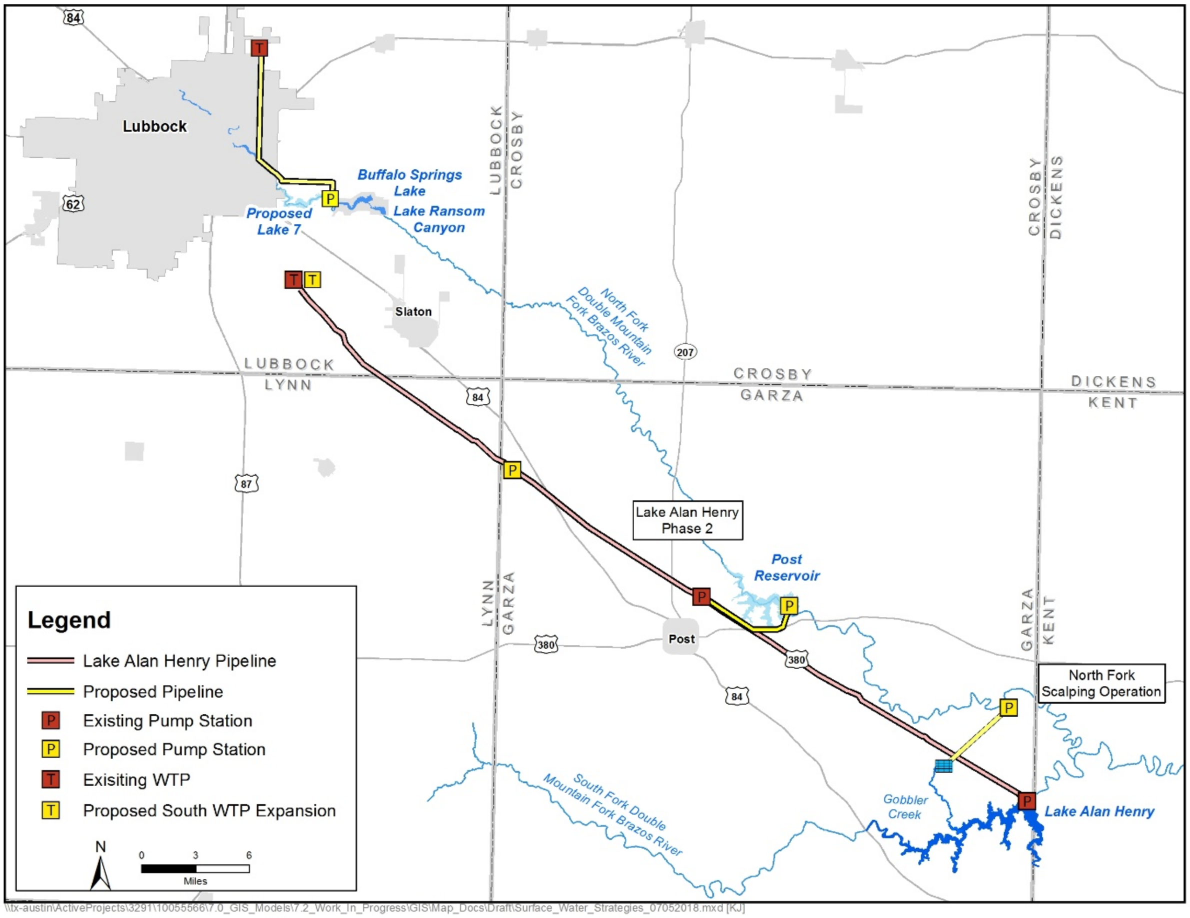
[1] Annual Water Highlights: Technical Summary. Brazos River Authority. 2000: III-6.

Figure 10.2. River Basins in the Lubbock Region



This section details the four surface water strategies identified that can potentially assist the City of Lubbock (City) in meeting its projected future water demand. These strategies include the expansion of the Lake Alan Henry (LAH) infrastructure (LAH Phase 2), Jim Bertram Lake 7, Post Reservoir, and the North Fork Scalping Operation. Figure 10.3 shows the location of the four surface water strategies in relation to Lubbock and its water treatment facilities.

Figure 10.3. Surface Water Strategies



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10.1 Developed Water – Supplements to Brazos River Basin

Since flows in the upper Brazos River Basin are limited, the addition of developed water is necessary to make new surface water projects viable. Developed water is defined as water that is non-native to the Brazos River Basin and includes groundwater, groundwater-based reclaimed water, and playa lake water. Developed water would not enter the Basin except for the City constructing facilities to convey the water to the Basin.

10.1.1 Supplemental Reclaimed Water

Reclaimed water that is treated to stream discharge standards and permitted to be discharged into a surface water body can become a supplemental component of a surface water strategy. Stand-alone reclaimed water supply strategies are described in Section 7.0. The Jim Bertram Lake 7 and Post Reservoir strategies, discussed in Sections 10.3 and 10.4, respectively, rely upon reclaimed water as a primary inflow component. The Northwest Water Reclamation Plant (NWWRP) is now operational and is discharging 1 to 1.5 million gallons per day (mgd) into Lake 1 under its Texas Pollutant Discharge Elimination System (TPDES) permit.

10.1.2 Supplemental Groundwater

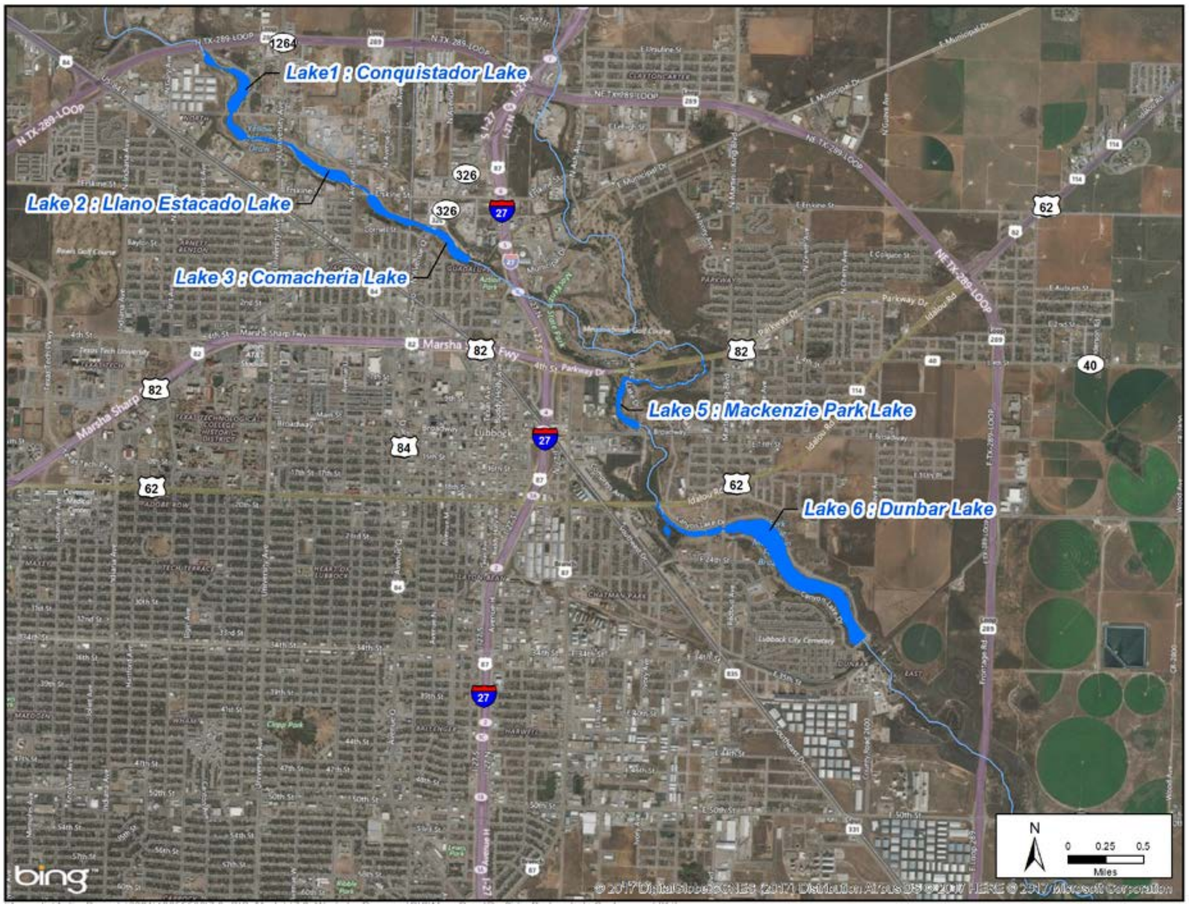
Yellow House Canyon and Blackwater Draw run through Lubbock and discharge into the North Fork. In 1969, the City hired a consultant to perform the initial planning for the Canyon Lakes Project, which consists of a series of eight dams and small reservoirs in the Yellow House Canyon. The City subsequently constructed a series of lakes in the Yellow House Canyon. These lakes were named as follows:

- Lake 1 Conquistador Lake
- Lake 2 Llano Estacado Lake
- Lake 3 Comacheria Lake
- Lake 4 Not Constructed
- Lake 5 Mackenzie Park Lake
- Lake 6 Dunbar Lake

This system of lakes was originally known as the Canyon Lake System but was later renamed the Jim Bertram Lake System (JBLS) and the City has developed a park system around these lakes. The JBLS is depicted in Figure 10.4.

These small lakes receive a constant flow of water each year from groundwater that is pumped from under the Lubbock Land Application Site (LLAS) just outside of East Loop 289 adjacent to the City. The pumping began in 1989 as part of an Agreed Order from the Texas Commission on Environmental Quality (TCEQ) to reduce a water mound and high levels of nitrate in the groundwater beneath the LLAS. TPDES Discharge Permit No. WQ00004599000, originally approved on December 31, 2003 (renewed March 32, 2014 with an expiration date on February 28, 2019), allows a maximum daily discharge of groundwater into Lake 1 of 4.3 mgd (4,817 acre-feet per year [ac-ft/yr]).

Figure 10.4. Jim Bertram Lake System



The City obtained a Certificate of Adjudication 12-3705 in February 1985, authorizing the impoundment of water in the JBLS for recreation purposes with no diversion authorization. Certificate 12-3705 was subsequently amended two times (12-7305A on February 28, 1997 and 12-7305B on May 11, 2007) to obtain the right to divert from Lakes 1, 2 and 6, and to gain more flexibility in using the water for agriculture, municipal, recreational, and industrial purposes in Lubbock and Lynn Counties. The maximum combined rate of the authorized diversion is 4.3 mgd (4,817 ac-ft/yr). However, the City can only divert the amount of groundwater that it discharges into the JBLS, less carriage losses. Currently, the City discharges an average of about 1.3 mgd (1,438 ac-ft/yr) into the JBLS. Groundwater production has declined over the past few years. The water discharged into Lake 1 is also diverted from Lake 1 to irrigate the Berl Huffman Soccer Complex. Before water is discharged into the JBLS, some of it is used to irrigate the City Cemetery. Until May 2018, the Meadowbrook Golf Course also used this water, but now relies upon two groundwater wells. Annual volumes of water used from the JBLS and pumped LLAS groundwater are shown in Table 10.1.

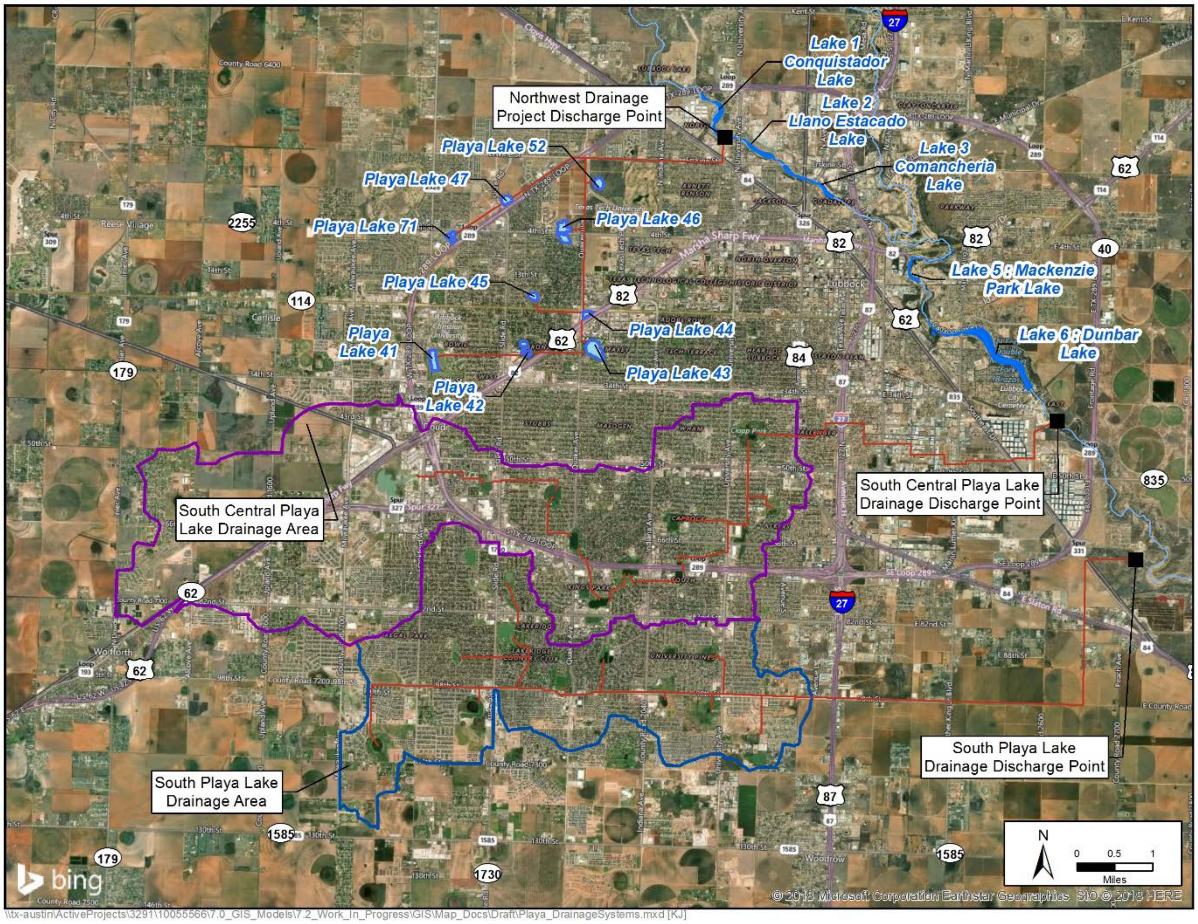
Table 10.1. JBLS and LLAS Pumped Groundwater Users

User	Annual Amount (acre-feet)
Berl Huffman Soccer Complex	155
City Cemetery	83
Total	**238**

10.1.3 Supplemental Playa Lake Water

Another source of surface water that supplements the natural flows of the Brazos River Basin is the water stored in playa lakes throughout the City. Storm water in the Lubbock area collects in playa lakes and can flood surrounding structures. Stormwater collected in these playas evaporates and percolates into local groundwater, but does not contribute flow naturally into the Brazos River Basin. Areas that drain to these playas are considered by the TCEQ to be "non-contributing" drainage areas within the Brazos River Basin. In an effort to reduce the potential for flooding around the playa lakes, the City completed the South Central Drainage System in 2003 and the South Drainage System in 2008, and has completed portions of the Northwest Drainage System, with several portions still under development. The South Central and South systems convey excess storm water into the Yellow House Canyon (a tributary to the North Fork) as shown in Figure 10.5, and the Northwest system collects stormwater from nine playa lakes and discharges into Llano Estacado Lake (Lake 2) of the JBLS. Stormwater discharges into the North Fork are authorized by the TCEQ pursuant to the City's Municipal Separate Storm Sewer System (MS4) TPDES permit no. WQ0004773000, which expires August 17, 2020.

Figure 10.5. Playa Lake Drainage Systems



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The quantity of water available from these systems will vary based on seasonal and annual rainfall events. According to a Municipal Precipitation Runoff study performed in October 2008 for the South Central and South systems[2] and an analysis by HDR based on data provided in a feasibility study of the Northwest system[3], the following volumes of storm water presented in Table 10.2 can be anticipated from the discharge points of the South Central, South and Northwest Playa Lake Drainage Systems.

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[2] Municipal Precipitation Runoff Contributions to the North Fork of the Double Mountain Fork of the Brazos River (City of Lubbock Discharge Points 30 & 31). Parkhill, Smith & Cooper, Inc. August 2008: 20, 47.

[3] Feasibility Study, Northwest Lubbock Drainage Improvements. Parkhill, Smith & Cooper, Inc. September 2013.

Table 10.2. Anticipated Storm Water Discharges from the Playa Lake Drainage Systems

Facility	Maximum Annual (acre-feet)	Average Annual (acre-feet)	Maximum Daily (cubic feet per second [cfs])
South Central System	14,857	4,932	2,545
South System	8,934	2,958	1,524
Northwest System	7,103	2,344	1,832
Total Discharge	**30,894**	**10,234**	**5,901**

The impoundment and diversion of the storm water after its discharge from the South Central, South and Northwest Playa Lake Drainage Systems will ultimately require water use permits. In May 2009, the City entered into an Interlocal Agreement with the Brazos River Authority (BRA) where the BRA acknowledged discharges from these drainage systems as the City's developed water.[4] This agreement ensures that the BRA will not contest any of Lubbock's applications or filings that seek to divert and use the playa lake storm water flows. The City has a pending application for Water Use Permit 5921 requesting the authorization to impound and divert treated effluent discharges and storm water from the South and South Central Playa Lake Drainage Systems in Lake 7, and has a pending application for an amendment to Water Use Permit 3985 which will authorize the City to use storm water from the Northwest Playa Lake Drainage System.

10.2 Lake Alan Henry Phase 2 Strategy

The LAH Phase 2 water supply strategy includes expanding the existing LAH infrastructure capacity to transport and treat an additional 15 mgd of raw water from the lake, thus increasing the total capacity to 30 mgd. As discussed in Section 4.3, Lubbock began using LAH as a water supply during the fall of 2012 and currently utilizes about 8,000 ac-ft/yr supply from this source. The existing LAH raw water supply pipeline (Phase 1) consists of:

- Two raw water pump stations—LAH Pump Station (LAHPS) and the Post Pump Station (PPS);
- The South Water Treatment Plant (SWTP);
- A 42-inch diameter raw water transmission pipeline from the LAHPS to the PPS;
- A 48-inch diameter raw water transmission pipeline from the PPS to the SWTP; and
- Treated water transmission lines that move water into three pump stations ([PS] #8, PS #10, and PS #14) within Lubbock's water distribution system.

Expansion of the existing infrastructure is necessary to supply water to the City at a greater daily rate. The major infrastructure components of the LAH Phase 2 strategy include:

- Construction of a Southland Pump Station (SLPS);
- Capacity expansion of equipment at the LAHPS and the PPS;

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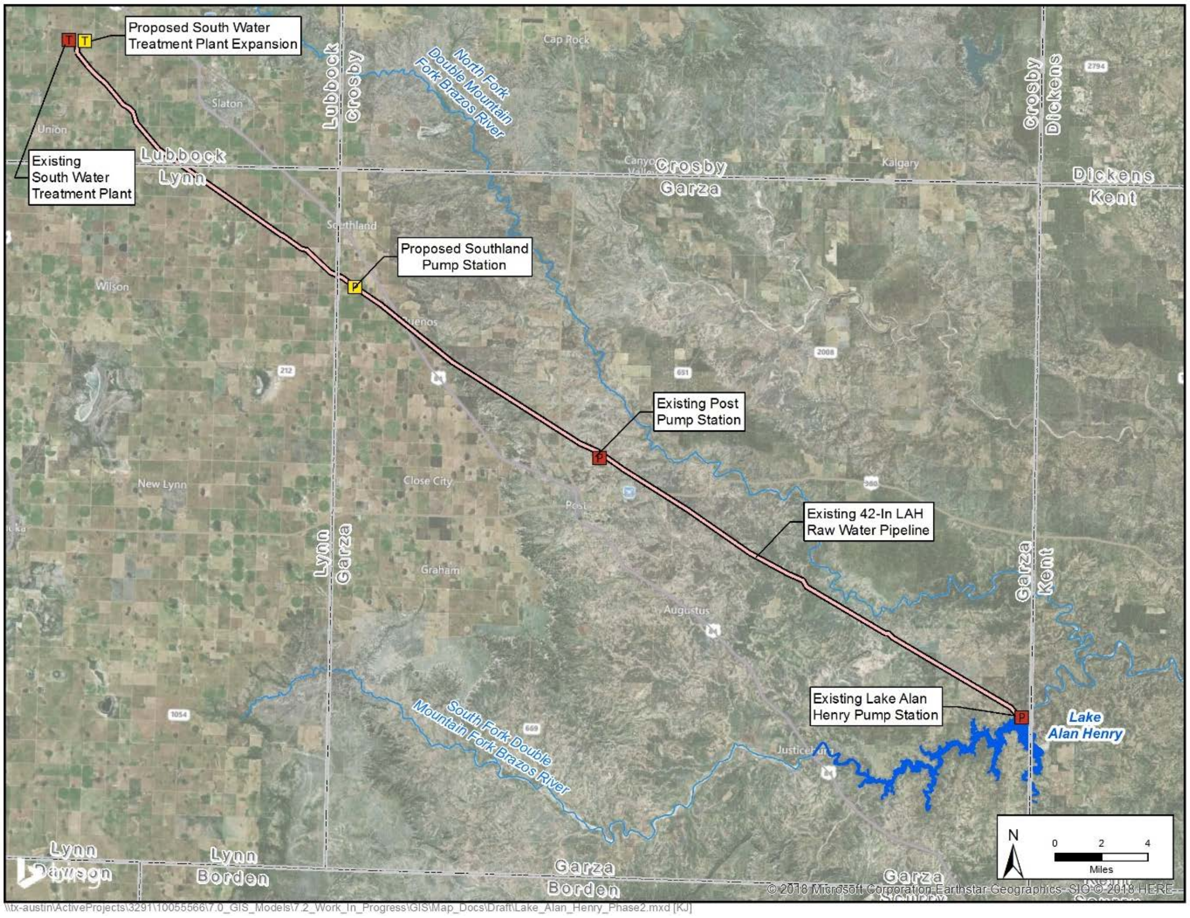
[4] Interlocal Agreement between the Brazos River Authority of Texas and the City of Lubbock, Texas. Resolution No. 2009-R0187. May 14, 2009.

- A 15 mgd expansion of the SWTP, which includes expansion of the high service pump station;
- A 4.5-mile, 30-in Low Head C Transmission pipeline to allow flow from the SWTP to reach PS 16 or Bailey County groundwater to flow to PS 14 (see Figure 4.11); and
- A 15 mgd Low Head C Pump Station to transfer water from the SWTP to PS 16.

Figure 10.6 shows the additional infrastructure required for this strategy.

Figure 10.6. Lake Alan Henry Phase 2



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10.2.1 Quantity of Available Water

The City intends to operate LAH near the 2-year safe yield of 12,875 ac-ft/yr.[5] The current water supply infrastructure will only deliver 8,000 ac-ft/yr with a peaking capacity of 15 mgd. Phase 2 will be constructed to increase the total deliverable water to 16,000 ac-ft/yr from LAH, an incremental increase of 8,000 ac-ft/yr. The pump stations and the SWTP will be modified to provide a peak capacity of 30 mgd. Additional raw water transmission lines will

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[5] Lake Alan Henry Current and Future Supply for 2018 Strategic Water Plan - Memo. HDR, Inc. July 12, 2017.

not be necessary since the existing pipelines were sized to handle up to 34 mgd[6] with the appropriate pumping capacity.

The additional capacity of the raw water transmission lines may be used if other water supply strategies are implemented, such as the North Fork Diversion to Lake Alan Henry Pump Station (NFD-LAHPS) (Section 7.8), the Post Reservoir (Section 10.4), or the North Fork Scalping Operation (Section 10.5).

10.2.2 Strategy Costs

Costs associated with this strategy are presented in Table 10.3. Assumptions and conditions associated with these costs include:

- Energy costs to transmit the additional water from the expansion through the LAHPS and pipeline are included. These costs are based on an average annual delivery of an additional 4.4 mgd (4,875 ac-ft/yr) through the upgraded system;
- Existing infrastructure will be used to transmit treated water from the SWTP into the City's water distribution system;
- Land for the new SLPS has already been purchased;
- Energy costs for the Low Head C Pump Station were not included in transmission pipeline costs;
- Engineering, legal, and contingency costs are 30% of pipeline construction and 35% of other facilities constructed;
- Power is available at $0.09 per kwh;
- Interest during construction is estimated at 4.0%, and a 1% return on investments over a 2-year period; and
- The project will be financed for 20 years at a 5.5% annual interest rate.

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[6] 2011 Llano Estacado Regional Water Plan. Llano Estacado Regional Water Planning Group. September 2010: 4-179.

Table 10.3. Lake Alan Henry Phase 2 Costs (January 2017 Prices)

Item	Estimated Cost for Facilities
Capital Costs	
LAH Pump Station Expansion (additional 15 mgd)	$6,150,000
Post Pump Station Expansion (additional 15 mgd)	$4,865,000
Southland Pump Station (30 mgd)	$9,147,000
Low Head C Transmission Pipeline	$9,393,000
Low Head C Pump Station	$12,000,000
Water Treatment Plant Expansion (additional 15 mgd)	$27,131,000
Total Capital Cost	**$68,686,000**
Engineering, Legal Costs, and Contingencies	$23,570,000
Environmental & Archaeology Studies and Mitigation	$0
Land Acquisition and Surveying (0 acres)	$0
Interest During Construction (2 years)	$6,458,000
Total Project Cost	**$98,714,000**
Annual Costs	
Debt Service (5.5%, 20 years)	$8,260,000
Operation and Maintenance	
Intake, Pipeline, Pump Station	$893,000
SWTP Expansion	$2,713,000
Pumping Energy Costs (0.09 $/kwh)	$861,000
Total Annual Cost	**$12,727,000**
Available Project Yield (ac-ft/yr)	4,875
Annual Cost of Water ($ per ac-ft)	$2,611
Annual Cost of Water ($ per 1,000 gallons)	$8.01

As shown, the total project cost is estimated to be $98,714,000. Annual debt service is $8,260,000; and, the annual operational cost, including power, is $4,467,000. This results in a total annual cost of $12,727,000. The unit cost for an additional annual supply of 4.4 mgd or 4,875 ac-ft/yr from LAH is estimated to be $2,611 per ac-ft, or $8.01 per 1,000 gallons.

10.2.3 Implementation Issues

Environmental

Environmental issues associated with this option should be minimal. The Texas Water Development Board (TWDB) approved an environmental assessment[7] for the overall Phase 1 project so the City could qualify for low interest loans administered through the TWDB. In addition, environmental assessments were performed at the locations of the proposed SLPS[8] and the SWTP[9] expansion. Therefore, no additional assessment should be necessary at these locations. The treated water transmission pipeline routes can be selected to avoid sensitive wildlife habitat and cultural resources.

Permitting

Raw water will be obtained from LAH, which is owned by the City of Lubbock. Water Use Permit No. 4146 allows for the annual diversion of 35,000 ac-ft; therefore, no additional permitting requirements are anticipated. The TCEQ will need to approve design modifications to the existing system.

Other Issues

The City owns property where the SLPS and the additional SWTP capacity will be constructed. The treated water transmission pipeline will be installed within the city limits and preferably within existing City street easements.

10.3 Jim Bertram Lake 7

The Jim Bertram Lake 7 strategy consists of a new 20,000 ac-ft reservoir immediately upstream of Buffalo Springs Lake on the North Fork. The new reservoir would impound reclaimed water, developed playa lake stormwater, and natural inflows. Diversions from the lake would be transported to the North Water Treatment Plant (NWTP) via a 12-mile, 36-in pipeline. Supplies from Lake 7 would be used to help meet annual and peak day demands and transmission facilities are sized with a 2.0 peaking factor. Figure 10.7 provides the location of the proposed Lake 7 and pipeline route to the NWTP.

This strategy includes advanced treatment to address water quality concerns. Wastewater effluent will constitute a large percentage of the volume in Lake 7 and the blended concentration of total dissolved solids (TDS) in the lake will increase as a result. Multiple treatment barriers will be required for direct potable reuse of the lake water since extended drought periods would decrease the detention time and concentrate the amount of treated wastewater in the lake.

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[7] Environmental Assessment for the City of Lubbock Lake Alan Henry Water Supply Project. Freese and Nichols, Inc.; June 2009

[8] Phase I Environmental Site Assessment, 4.82 Acre Tract, Southland, Garza County, Texas (Southland Pump Station Site), Prepared by V-Tech Environmental Services, January 8, 2008.

[9] Phase I Environmental Site Assessment, West half of Section 72, Block S, Lubbock County, Texas (South Water Treatment Plant Site), Prepared by the City of Lubbock, August 5, 2008.

The major infrastructure components of this strategy include:

- Construction of a 20,000 ac-ft, 774 acre reservoir;
- A new intake structure and pump station located at the reservoir site;
- A 12-mile, 36-in transmission pipeline to deliver water from Lake 7 to the NWTP; and
- A new 21.4 mgd advanced treatment plant adjacent to the NWTP.

10.3.1 Quantity of Available Water

According to the HDR technical memorandum dated 15 July 2015, Jim Bertram Lake 7 will supply a one-year safe yield of 11,550 ac-ft/yr of raw water without considering the Northwest Playa Lake System discharges. When this additional developed water is considered, the one-year safe yield would increase to 11,975 ac-ft/yr. The safe yield is contingent upon the availability of return flows discharged by the City and the availability of playa lake developed water. Natural inflows captured by Lake 7 were modeled subject to the instream flow requirements based on the Lyons Method. At the time of the yield analysis, environmental flow requirements pursuant to the Senate Bill 3 (SB3) process had not been adopted by the TCEQ and were not incorporated into the analysis. However, they are expected to have little effect on the yields because only State water (natural inflows) are affected by the instream flow criteria, and little State water is available to Lake 7. The individual contributions of the three sources of inflows to increase the yield of Lake 7 are presented in Table 10.4.

Figure 10.7. Jim Bertram Lake 7 Infrastructure

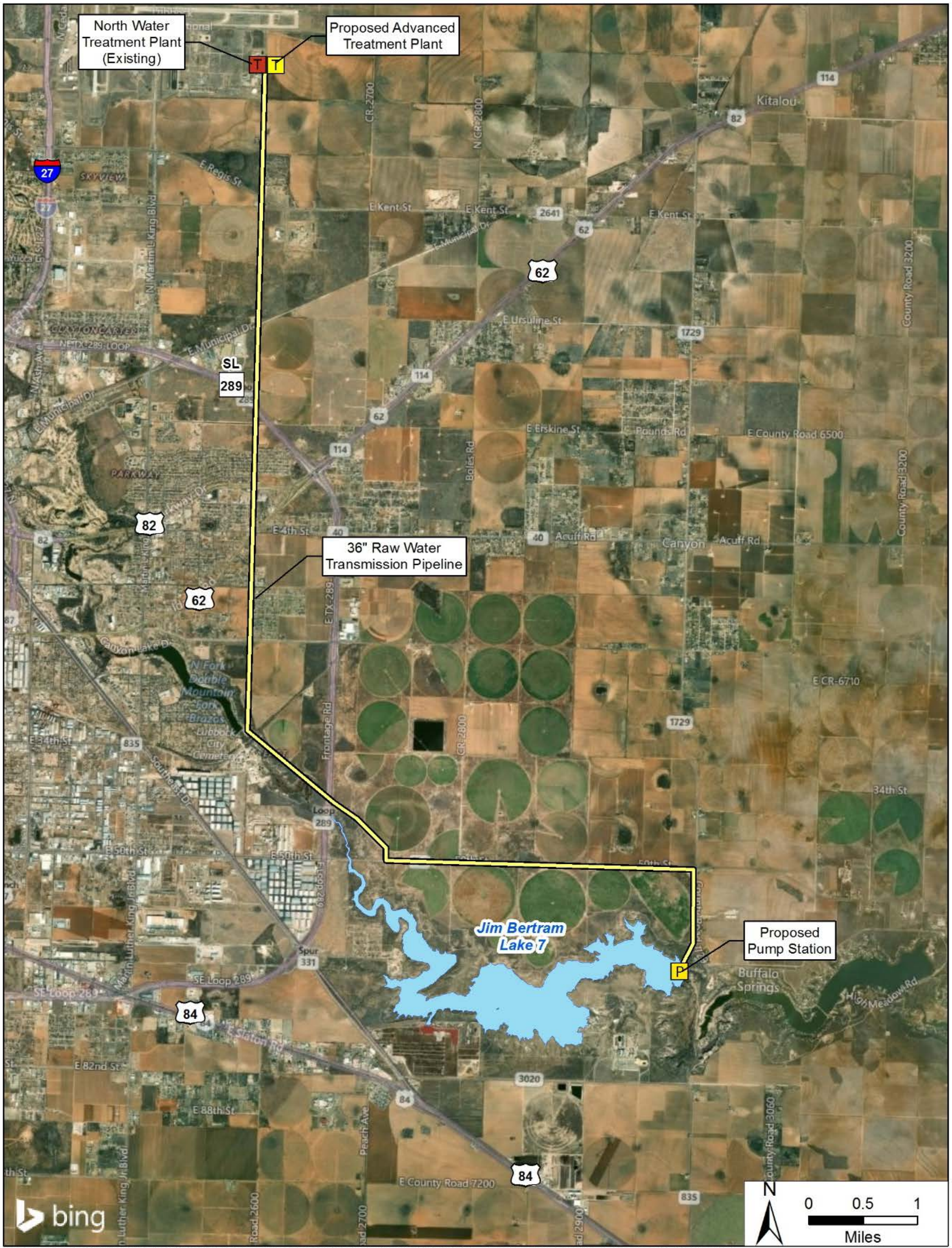

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Table 10.4. Lake 7 Yield Components

Yield Component	1-Year Safe Yield Amount (ac-ft/yr)
Reclaimed Water (8 mgd)	7,300
Playa Lake Developed Water	2,875
Natural Inflow (Unappropriated State Water)	1,800
Total	**11,975**

This safe yield amount is subject to the City obtaining sole rights to its developed water (playa lake storm water and reclaimed water).[10] Increases or decreases of the reclaimed water available will have an approximate one to one increase or decrease on the reservoir's safe yield. The reclaimed water will be discharged from Outfall 007 located near the Southeast Water Reclamation Plant (SEWRP), at Conquistador Lake (associated with the NWWRP), and at Llano Estacado Lake (associated with the Northwest Playa System outfall). The Lake 7 yield does not include any reductions attributed to potential horizontal leakage through the canyon walls. An analysis completed in 2014 projects that this leakage will be significant upon initial filling of the lake, but will rapidly diminish to a small, steady-state volume as reservoir and proximate groundwater levels balance.[11]

10.3.2 Strategy Costs

Costs associated with this strategy are presented in Table 10.5. Assumptions and conditions associated with these costs include:

- Flows used to design the intake, pump station, advanced treatment plant and transmission pipelines include an estimated 5% downtime and are sized for a 2.0 peaking factor;
- Engineering, legal, and contingency costs are 30% of pipeline construction and 35% of other facilities constructed;
- Power is available at $0.09 per kwh;
- Interest during construction is estimated at 4.0%, and a 1% return on investments over a 2-year period;
- The project will be financed for 20 years at a 5.5% annual interest rate; and
- Costs do not include the distribution of the potable water from the NWTP to potential customers.

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[10] Feasibility of Constructing the Proposed Lake 7, HDR, Inc., September 2011, p. 7-1.

[11] Estimated Groundwater Interaction with the Proposed Lake 7, HDR, Inc., April, 2014, p. 29.

Table 10.5. Jim Bertram Lake 7 Strategy Costs (January 2017 Prices)

Item	Estimated Costs for Facilities
Capital Costs	
Dam and Reservoir (20,000 ac-ft, 774 acres)	$28,775,000
Intake and Pump Station (21.4 mgd)	$11,577,000
Transmission Pipeline	
36 in dia., 12 miles	$19,275,000
Advanced Water Treatment Plant (21.4 mgd)	$81,290,000
Total Capital Cost	**$140,917,000**
Engineering, Legal Costs, and Contingencies	$48,357,000
Environmental & Archaeology Studies and Mitigation	$2,243,000
Land Acquisition and Surveying (803 acres)	$2,184,000
Interest During Construction (2 years)	$13,560,000
Total Project Cost	**$207,261,000**
Annual Costs	
Debt Service (5.5%, 20 years)	$13,515,000
Reservoir Debt Service (5.5%, 20 years)	$3,366,000
Operation and Maintenance	
Intake, Pipeline, Pump Station	$482,000
Dam and Reservoir	$432,000
Advanced WTP	$1,768,000
Pumping Energy Costs (0.09 $/kwh)	$781,000
Total Annual Cost	**$20,344,000**
Available Project Yield (ac-ft/yr)	11,975
Annual Cost of Water ($ per ac-ft)	$1,699
Annual Cost of Water ($ per 1,000 gallons)	$5.21

As shown the table, the total project cost is estimated to be $207,261,000. Annual debt service is $16,881,000; and, the annual operational cost, including power, is $3,463,000. This results in a total annual cost of $20,344,000. The unit cost for 11,975 ac-ft/yr supply is estimated to be $1,699 per acre-foot, or $5.21 per 1,000 gallons.

10.3.3 Implementation Issues

Environmental Issues

The primary environmental issue related to this strategy is the change in land use of 774 acres from ranchland to a reservoir site. In July 2011, the City provided an Environmental Information Document (EID) to the TCEQ which described the environment that will potentially be affected by the construction of Lake 7.[12] According to the EID, this project will have an impact on the environment, and a mitigation plan will be required to compensate for unavoidable impacts. Some of the issues identified in the EID include:

- No federal or state protected aquatic life has been found in the project reach,[13] although two listed species of minnow – the sharpnose shiner and the smalleye shiner – would potentially be impacted in the reach downstream from the reservoir;
- A baseline survey revealed that the Texas horned lizard (Texas listed threatened species) is thriving in the project vicinity. Additional evaluation and a management and mitigation plan will be necessary if the reservoir is built;[14] and
- A review of Texas Historical Commission and other records identified 17 archeological sites in or near the project area that will need to be assessed.[15]

The advanced treatment facilities would be constructed on property owned by Lubbock that is currently being used for similar purposes, and environmental issues should be minimal. The transmission line corridor that will convey the reclaimed water should be selected to avoid potentially sensitive areas.

Permitting Issues

The existing TPDES Permit No. 10353-002 authorizes the City to discharge up to 14.5 mgd (16,242 ac-ft/yr) of reclaimed water at the SEWRP into the North Fork at Outfall 007. In 2005, the City submitted Water Rights Application No. 5921 which, among other things, seeks the right to impound and divert water from the proposed Lake 7. Although the application was declared administratively complete in April 2006, the TCEQ's technical review is still on-going. The TCEQ has received eight requests for contested case hearings. It will most likely take several years before the permit may be issued to the City.

In addition, a United States Army Corps of Engineers (USACE) Section 404 permit will be required prior to commencing construction of Lake 7. This reservoir is large enough to require an individual permit. Mitigation plans for the project's environmental impacts must be developed and agreed upon by the USACE and other state and federal resource agencies.

The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. Treatment

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[12] Environmental Information Document in Support of Water Use permit Application No. 5921; City of Lubbock, July 2011.

[13] Feasibility of Constructing the Proposed Lake 7, HDR, Inc., September 2011, p. 5-4.

[14] Feasibility of Constructing the Proposed Lake 7, HDR, Inc., September 2011, p. 5-5.

[15] Feasibility of Constructing the Proposed Lake 7, HDR, Inc., September 2011, p. 5-7.

requirements for any reclaimed water as a drinking water source may consider the pretreatment program, influent wastewater quality, vulnerability assessment of the collection system, results of effluent quality sampling/monitoring data, and wastewater treatment process.

Monitoring is likely to include Cryptosporidium (or a surrogate organism), other regulated contaminants, and may include contaminants on the U.S. Environmental Protection Agency (USEPA) Candidate Contaminate List (CCL), including Emerging Constituents of Concern (ECCs) and pharmaceuticals and personal care products (PPCPs).

Other

Property will need to be acquired for the lake, dam, pump station, and mitigation area. In addition, pipeline utility easements will be necessary to construct a raw water transmission line to the NWTP.

The geological formation that the dam foundation will be constructed upon appears to be somewhat pervious. Extensive cut-off wall and grout curtains will need to be installed to avoid water seeping under the dam and around the abutments. In addition, there is the potential for considerable leakage from the reservoir conservation pool to the local groundwater aquifer system. The Comanche Peak formation could also allow vertical leakage from the reservoir through the valley floor.[16] A study commissioned by the City was completed in 2014 to investigate these geologic formation issues, and determined that such leakage can be controlled[17].

Wastewater effluent will constitute a large percentage of the volume in Lake 7 and the blended concentration of TDS in the lake will increase as a result. During drought conditions, the TDS concentration may become greater than the secondary drinking water standard requiring advanced treatment which should consider:

- Multiple treatment process barriers;
- redundancy and backup power sources;
- alternate storage or discharge locations to divert reclaimed water from the potable distribution system during an acute episode; and
- real time monitoring and regular sampling to ensure process performance and avoid any acute episode of pathogens in the reclaimed water.

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[16] Feasibility of Constructing the Proposed Lake 7, HDR, Inc., September 2011, p. 7-2.

[17] Estimated Groundwater Interaction with the Proposed Lake 7, HDR, Inc., April 2014, pp. 21-25.

10.4 Post Reservoir

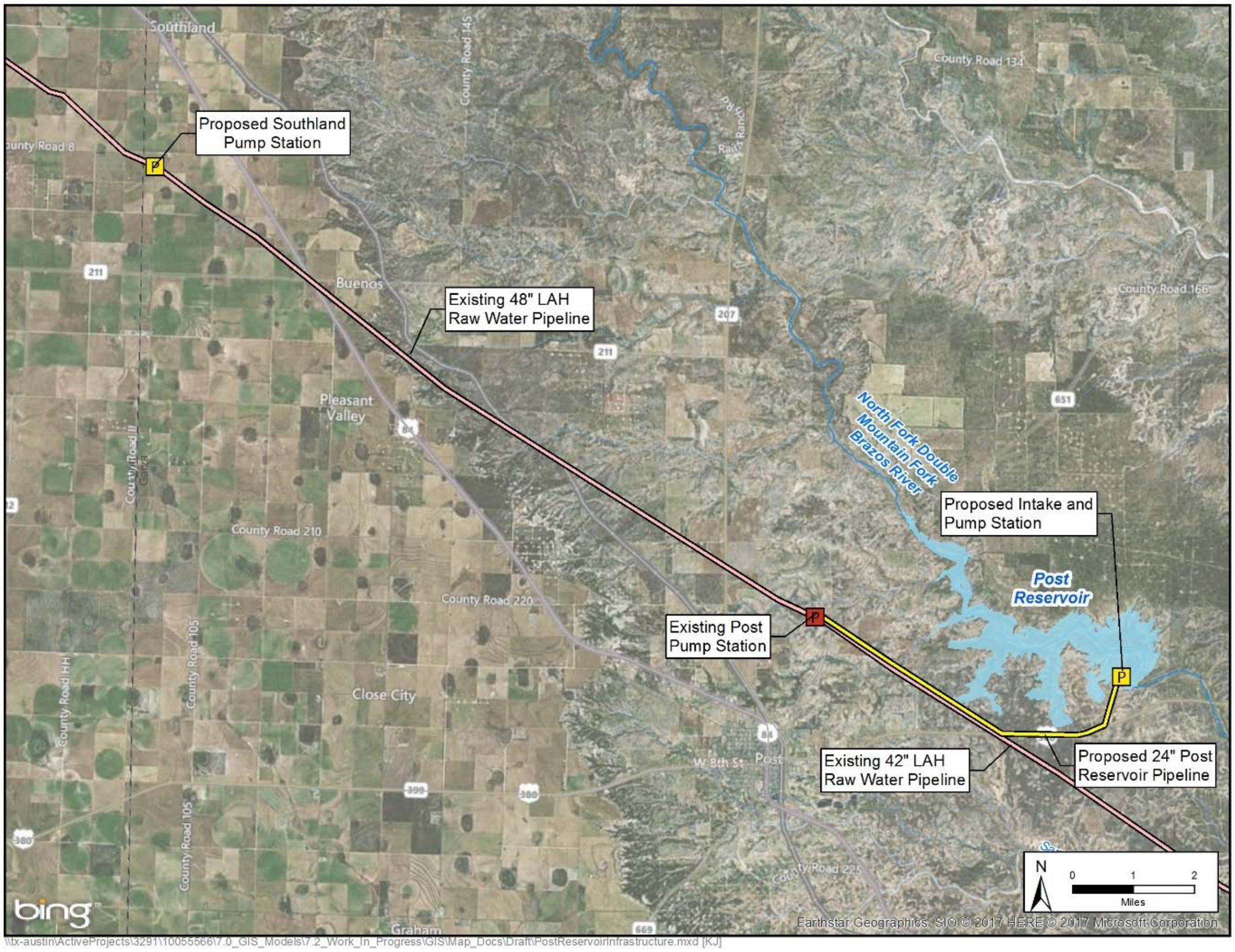
The Post Reservoir strategy consists of a new reservoir located immediately northeast of Post, Texas on the North Fork. Certificate of Adjudication No. 12-3711 authorizes the impoundment of 57,420 ac-ft of water and the diversion and use of up to 10,600 ac-ft of water per year. Under this strategy, water will be impounded and diverted from the reservoir and transported to the existing PPS that delivers water from LAH to Lubbock. The 48-inch diameter LAH raw water line is adequate to convey water from both Post Reservoir and LAH. However, an expansion of the SWTP will be necessary. Figure 10.8 provides the location of Post Reservoir and the proposed LAH pipeline connection route.

The major infrastructure components of this strategy include:

- Construction of a 57,420 ac-ft, 2,280 acre reservoir;
- A new intake structure and pump station located at the reservoir site;
- A 6-mile, 24-in transmission pipeline to deliver water from Post Reservoir to the PPS;
- Expansion of the PPS to transport raw water along the LAH pipeline system;
- The addition of the SLPS located on the LAH raw water pipeline.
- An 8 mgd expansion of the SWTP;
- A 4.5-mile, 30-in Low Head C Transmission pipeline to allow flow from the SWTP to reach PS 16 or Bailey County groundwater to flow to PS 14 (see Figure 4.11); and
- A 15 mgd Low Head C Pump Station to transfer water from the SWTP to PS 16.Quantity of Available Water.

Similar to the Lake 7 strategy, the yield of Post Reservoir relies heavily on inflows from developed playa stormwater and reclaimed water. Analyses using the TCEQ Water Availability Model (WAM) indicate a range of firm and safe yield supplies could be developed for this strategy, depending upon treatment of upstream return flows, sediment storage reserves, instream flow requirements and playa lake stormwater flows. For purposes of this analysis, it is assumed that 8,962 ac-ft/yr (8 mgd) of water is available for diversion from the Post Reservoir, assuming that Lake 7 would not be constructed upstream.

Figure 10.8. Post Reservoir Infrastructure



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10.4.1 Strategy Costs

Costs associated with this strategy are presented in Table 10.6, and are shown with and without the LAH pipeline expansion. Assumptions and conditions associated with these costs include:

- Flows used to design the intake, pump station, and transmission pipeline designs include an estimated 5% downtime;
- Expansion costs of the PPS is included;
- The construction of the SLPS is included;
- Land for the new SLPS has already been purchased;
- Energy costs to transmit water through the LAHPS and pipeline are included;
- Existing infrastructure will be used for transmission of treated water from the SWTP into the City’s water distribution system;
- Energy costs related to the Low Head C Pump Station were not included in transmission pipeline costs;
- Engineering, legal, and contingency costs are 30% of pipeline construction and 35% of other facilities constructed;
- Power is available at $0.09 per kwh;
- Interest during construction is estimated at 4.0%, and a 1% return on investments over a 2-year period; and
- The project will be financed for 20 years at a 5.5% annual interest rate.

Table 10.6. Post Reservoir Strategy Costs (January 2017 Prices)

Item	Estimated Costs for Facilities	Costs Including LAH Pipeline Expansion
Capital Costs		
Dam and Reservoir (57,420 ac-ft, 2,280 acres)	$25,164,000	$25,164,000
Intake and Pump Station	$6,056,000	$6,056,000
Transmission Pipeline (24 in dia., 6 miles)	$3,611,000	$3,611,000
Low Head C Transmission Pipeline	$9,393,000	$9,393,000
Low Head C Pump Station	12,000,000	12,000,000
SWTP Expansion (8.0 mgd)	$17,096,000	$17,096,000
LAH Pipeline Expansion		
Post Pump Station Expansion (additional 15 mgd)	$0	$4,865,000
Southland Pump Station (30 mgd)	$0	$9,147,000
Total Capital Cost	**$73,320,000**	**$87,332,000**
Engineering, Legal Costs, and Contingencies	$25,012,000	$29,916,000
Permitting Fees	$5,000,000	$5,000,000
Environmental & Archaeology Studies and Mitigation	$5,978,000	$5,978,000
Land Acquisition and Surveying	$5,928,000	$5,928,000
Interest During Construction (2 years)	$8,067,000	$9,391,000
Total Project Cost	**$123,305,000**	**$143,545,000**
Annual Costs		
Debt Service (5.5%, 20 years)	$5,895,000	$7,589,000
Reservoir Debt Service (5.5%, 20 years)	$3,889,000	$3,889,000
Operation and Maintenance		
Intake, Pipeline, Pump Station	$581,000	$932,000
Dam and Reservoir	$365,000	$365,000
SWTP Expansion	$1,710,000	$1,710,000
Post Pipeline Pumping Energy Costs (0.09 $/kwh)	$323,000	$323,000
LAH Pipeline Pumping Energy Costs (0.09 $/kwh)	$530,000	$530,000
Total Annual Cost	**$13,293,000**	**$15,338,000**
Available Project Yield (ac-ft/yr)	8,962	8,962
Annual Cost of Water ($ per ac-ft)	$1,483	$1,711
Annual Cost of Water ($ per 1,000 gallons)	$4.55	$5.25

As shown, the total project cost not including the LAH pipeline expansion is estimated to be $123,305,000. Annual debt service is $9,784,000; and annual operational cost, including power, is $3,509,000, resulting in a total annual cost of $13,293,000. The unit cost for 8,962 ac-ft/yr supply is estimated to be $1,483 per ac-ft, or $4.55 per 1,000 gallons. If the LAH pipeline expansion is included, the unit cost of the project is increased to $1,711 per ac-ft, or $5.25 per 1,000 gallons.

10.4.2 Implementation Issues

Environmental

The primary environmental issue related to this strategy is the change in land use of 2,280 acres from ranchland to a reservoir site. There will be a high impact on animal habitats that must be mitigated. It is anticipated that the construction of the reservoir will have a low to moderate impact related to these concerns.[18] Studies will be necessary to determine the actual impact to cultural resources, wetlands, and threatened and endangered species, although two listed species of minnow – the sharpnose shiner and the smalleye shiner – would potentially be impacted in the reaches upstream and downstream from the reservoir, which could preclude construction of this project.

Permitting

As discussed in Section 7.0, the existing TPDES Permit No. 10353-002 authorizes the City to discharge up to 14.5 mgd (16,242 ac-ft/yr) of reclaimed water at the SEWRP into the North Fork at Outfall 007, and up to 9.0 mgd (10,089 ac-ft/yr) at FM400 at Outfall 001. The White River Municipal Water District (WRMWD) holds Certificate of Adjudication No. 12-3711, which authorizes the Post Reservoir with a priority date of January 20, 1970. This Certificate authorizes impoundment of 57,420 ac-ft in the reservoir. It also authorizes diversion of 5,600 ac-ft/yr for municipal use, 1,000 ac-ft/yr for industrial use, and 4,000 ac-ft/yr for mining purposes. The City will need to obtain ownership of the water right in order to construct the reservoir. The certificate will need to be amended so the City can obtain authorization to divert and use the full 10,600 ac-ft/yr for municipal purposes and obtain clarification regarding 19,000 ac-ft of sediment reserve identified in the special conditions of the certificate. In addition, a USACE Section 404 permit will be required prior to commencing construction of the Post Reservoir. This lake is large enough to require an individual permit. Mitigation plans for the project's environmental impacts must be developed and agreed upon by the USACE and other interested state and federal resource agencies.

Other Issues

Property will need to be acquired for the lake, dam, pump station, and habitat mitigation area. In addition, pipeline utility easements will be necessary to construct a raw water transmission line to the PPS.

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[18] 2011 Llano Estacado Regional Water Plan. Llano Estacado Regional Water Planning Group. September 2010: p. 4-219-221.

10.5 North Fork Scalping Operation

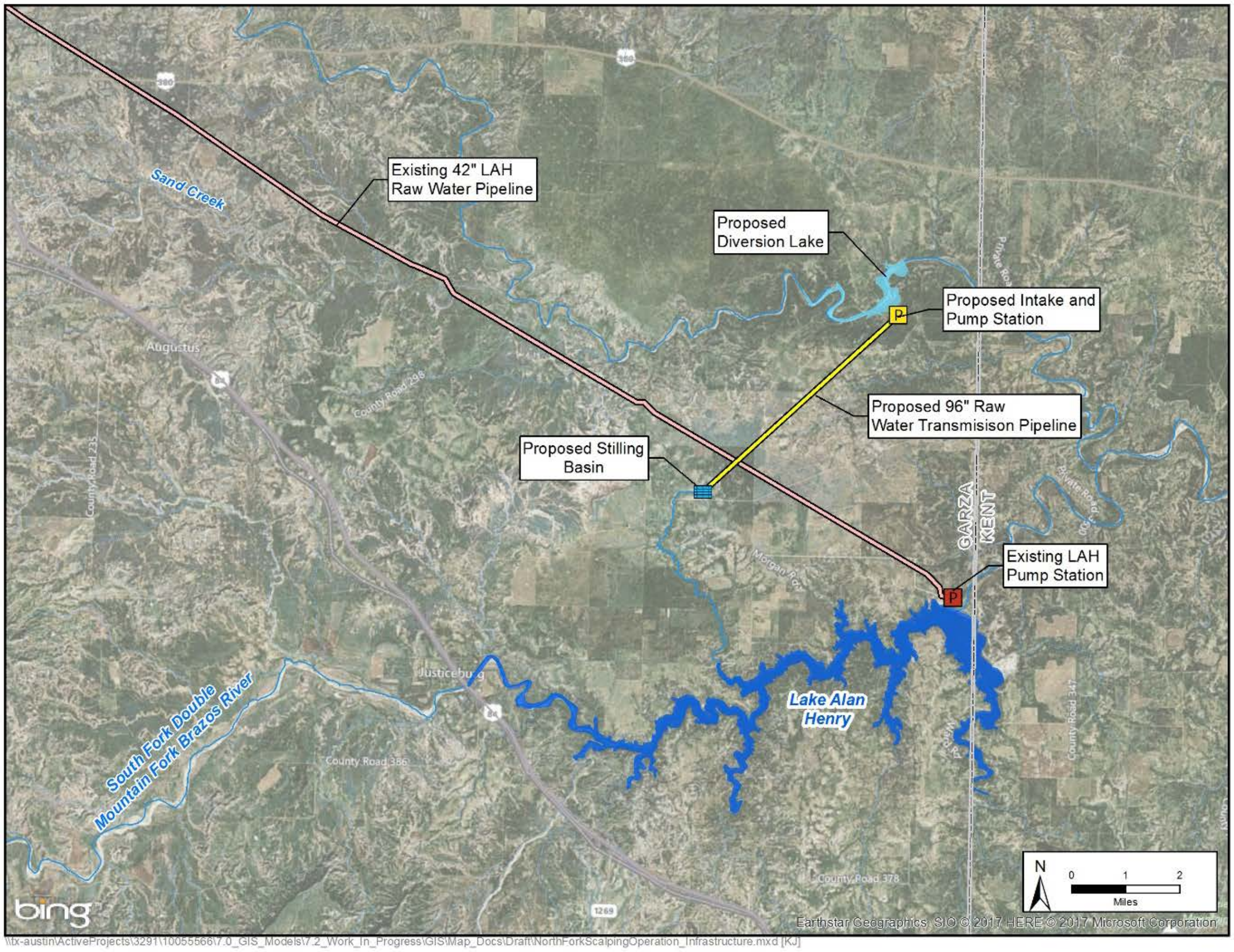
The North Fork Scalping Operation strategy is designed to increase the yield of LAH by collecting and re-directing storm water from the North Fork into the lake. To accomplish this, a diversion reservoir would need to be built on the North Fork in Garza County to capture stormwater flows and provide adequate pumping head for the intake pump station. The stormwater would be delivered to a point on Gobbler Creek upstream of LAH via a 5-mile, 96-inch pipeline. The intake, pump station, and pipeline would have a capacity of 162.4 mgd (251 cfs), making the transmission system capable of diverting large amounts of water during a short duration high flow event. A stilling basin would be necessary at the discharge location on Gobbler Creek to decrease the velocity of the scalped water and therefore reduce erosion. The water from the stilling basin would then flow through Gobbler Creek and naturally drain into LAH. Figure 10.9 provides the location of the diversion reservoir on the North Fork and transmission pipeline route to Gobbler Creek.

The major infrastructure components of this strategy include:

- A 1,000 ac-ft, 650 acre diversion reservoir on the North Fork to aid in the capture of high flows for scalping;
- A new 162 mgd intake structure and pump station at the diversion site;
- A 5-mile, 96-in transmission pipeline to deliver the scalped high flows from the North Fork to LAH;
- A stilling basin located at the discharge point located on Gobbler Creek;
- Construction of the SLPS and expansion of the LAH and PPSs;
- A 7.8 mgd expansion of the SWTP which includes expansion of the high service pump station at the SWTP;
- A 4.5-mile, 30-in Low Head C Transmission pipeline to allow flow from the SWTP to reach PS 16 or Bailey County groundwater to flow to PS 14 (see Figure 4.11); and
- A 15 mgd Low Head C Pump Station to transfer water from the SWTP to PS 16.

There is an opportunity to combine this strategy with the North Fork Diversion to LAHPS strategy (diverting reclaimed water) described in Section 7.8. By combining these strategies there is a possibility for cost savings since both strategies would share the expanded LAH infrastructure.

Figure 10.9. North Fork Scalping Operation Infrastructure



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10.5.1 Quantity of Available Water

The North Fork Scalping Operation will be an intermittent and unpredictable source of water because it is dependent upon local precipitation and storm events. However, analyses by HDR estimates that the North Fork Scalping Operation could increase the firm yield of LAH by as much as 7.8 mgd or 8,725 ac-ft/yr.[19] Based on a WAM analysis of 1940 through 1997, the North Fork Scalping Operation would operate in all but three years of the simulation – the drought years of 1951, 1952 and 1956.

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[19] 2011 Llano Estacado Regional Water Plan. Llano Estacado Regional Water Planning Group. September 2010: 4-202.

10.5.2 Strategy Costs

Costs associated with this strategy are presented in Table 10.7 and are provided with and without the inclusion of the LAH pipeline expansion. Assumptions and conditions associated with these costs include:

- Expansion costs of the LAH and PPSs;
- Construction of the SLPS;
- Land for the new SLPS has already been purchased;
- Energy costs to transmit the additional water through the LAH pipeline are included;
- Existing infrastructure will be used to transmit treated water from the SWTP into the City's water distribution system;
- Energy costs associated with the Low Head C Transmission Pipeline were not included in transmission pipeline costs;
- Engineering, legal, and contingency costs are 30% of pipeline construction and 35% of other facilities constructed;
- Power is available at $0.09 per kwh;
- Interest during construction is estimated at 4.0%, and a 1% return on investments over a 2-year period.; and
- The project will be financed for 20 years at a 5.5% annual interest rate.

Table 10.7. North Fork Scalping Operation Costs (January 2017 Prices)

Item	Estimated Costs for Facilities	Costs Including LAH Pipeline Expansion
Capital Costs		
Dam and Reservoir (Conservation Pool 1,000 ac-ft, 650 acres)	$2,935,000	$2,935,000
Intake and Pump Station (162.4 mgd)	$28,994,000	$28,994,000
Transmission Pipeline (96 in dia., 5 miles)	$21,988,000	$21,988,000
Low Head C Transmission Pipeline	$9,393,000	$9,393,000
Low Head C Pump Station	12,000,000	12,000,000
Stilling Basin	$756,000	$756,000
SWTP Expansion (7.8 mgd)	$16,760,000	$16,760,000
LAH Pipeline Expansion		
LAH Pump Station Expansion (additional 15 mgd)	$0	$6,150,000
Post Pump Station Expansion (additional 15 mgd)	$0	$4,865,000
Southland Pump Station (30 mgd)	$0	$9,147,000
Total Capital Cost	**$92,826,000**	**$112,988,000**
Engineering, Legal Costs, and Contingencies	$30,883,000	$37,939,000
Environmental & Archaeology Studies and Mitigation	$1,883,000	$1,883,000
Land Acquisition and Surveying (687 acres)	$1,758,000	$1,758,000
Interest During Construction (2 years)	$8,916,000	$10,821,000
Total Project Cost	**$136,266,000**	**$165,389,000**
Annual Costs		
Debt Service (5.5%, 20 years)	$10,754,000	$13,191,000
Reservoir Debt Service (5.5%, 20 years)	$570,000	$570,000
Operation and Maintenance		
Intake, Pipeline, Pump Station	$1,.346,000	$1,529,000
Dam and Reservoir	$44,000	$44,000
SWTP Expansion	$1,676,000	$1,676,000
Pumping Energy Costs (0.09 $/kwh)	$313,000	$313,000
LAH Pumping Energy Costs (0.09 $/kwh)	$1,238,000	$1,238,000
Total Annual Cost	**$15,941,000**	**$18,882,000**
Available Project Yield (ac-ft/yr)	8,725	8,725
Annual Cost of Water ($ per ac-ft)	$1,827	$2,164
Annual Cost of Water ($ per 1,000 gallons)	$5.61	$6.64

As shown, the total project cost not including the LAH pipeline expansion is estimated to be $136,266,000. Annual debt service is $11,324,000; and, the annual operational cost, including power, is $4,617,000. This results in a total annual cost of $15,941,000. The unit cost for 7.8 mgd or 8,725 ac-ft/yr supply is estimated to be $1,827 per acre-foot, or $5.61 per 1,000 gallons. If the LAH pipeline expansion is included, the unit cost of the project is increased to $2,164 per ac-ft or $6.64 per 1,000 gal.

10.5.3 Implementation Issues

Environmental Issues

This project should have a low to moderate impact on the environment, including habitats, cultural resources, wetlands, and threatened or endangered species.[20] Some concern exists that discharging storm water from the North Fork into LAH could encourage golden algae growth in LAH. Golden alga is an organism that is toxic to fish under certain conditions, and has been found in lakes along the North Fork.[21] The sharpnose shiner and smalleye shiner are listed as endangered species on the federal list. These fish have been found along this reach of the North Fork and could potentially be impacted by the diversion lake, although the diversion dam could be designed to mitigate those impacts by allowing passage of the shiners during all but high flow events. Additionally, increased flows into Gobbler Creek may change the size and configuration of the channel.[22]

Permitting Issues

A new water use permit from the TCEQ will be required for the impoundment and diversion of water from the North Fork and the conveyance of the diverted water into LAH. Diversions will be subject to instream flow requirements. A USACE Section 404 permit will be required prior to commencing construction of the diversion facilities. Mitigation plans for the project's environmental impacts must be developed and agreed upon by the USACE and other interested state and federal resource agencies. The TCEQ must review and approve construction of proposed facilities.

Other Issues

Property will need to be acquired for the diversion reservoir, dam, and pump station. In addition, pipeline utility easements will be necessary to construct a raw water transmission line to Gobbler Creek.

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[20] 2011 Llano Estacado Regional Water Plan. Llano Estacado Regional Water Planning Group. September 2010: p. 4-213.

[21] 2011 Llano Estacado Regional Water Plan. Llano Estacado Regional Water Planning Group. September 2010: p. 4-206.

[22] 2011 Llano Estacado Regional Water Plan. Llano Estacado Regional Water Planning Group. September 2010: p. 4-208, 210.

11 Other Strategies Considered

In addition to the water supply strategies that were fully evaluated and ranked, several strategies were considered that either:

- did not consist of enough data to be fully evaluated, or
- were evaluated in the past but found undesirable for various reasons.

These strategies include Jim Bertram Lake 8, a Jim Bertram Lakes well field, a linear well field along the Canadian River Municipal Water Authority (CRMWA) Aqueduct, the addition of a second CRMWA Aqueduct often referred to as CRMWA III, the South Lubbock Well Field, and the Brackish Well Field. These strategies are discussed in this section.

11.1 Jim Bertram Lake 8

This strategy was included in the 2006 Llano Estacado (Region O) Regional Water Plan. The concept behind this strategy was to construct both Jim Bertram Lake 7 and 8 simultaneously. These lakes were both included to provide a way to use Lubbock's developed water resources. Developed resources include storm water collected into playa lakes, groundwater pumped from under the Lubbock Land Application Site (LLAS), and treated wastewater discharged into the North Fork. Figure 11.1 depicts the proposed location of Lake 8 downstream of Lake Ransom Canyon.

Lake 8 would be built to capture, store, and divert water to the South Water Treatment Plant (SWTP) and subsequently pumped into Lubbock's water distribution system. Design includes: [1]

- A reservoir with 49,900 acre-feet of storage capacity;
- A 26.7 million gallons per day (mgd) capacity pump station and intake structure;
- A 90-inch diameter raw water transmission pipeline with a 26.7 mgd capacity to transfer water 7 miles to the SWTP; and
- Expansion of the SWTP to include an additional 21 mgd treatment capacity.

11.1.1 Quantity of Available Water

This strategy was estimated to provide an additional 17,720 acre-feet per year (ac-ft/yr) of annual water supply to Lubbock. This firm yield was determined in conjunction with a 3,500 ac-ft/yr yield for Lake 7 for a total system yield of 21,200 ac-ft/yr.[2] The yield estimate for these two lakes is based on 25,648 ac-ft/yr of available reclaimed water. Current projections indicate that by 2118 (in 100 years), 22.88 mgd (25,625 ac-ft/yr) of reclaimed water will be available for direct and/or indirect reuse (See Section 7.3).

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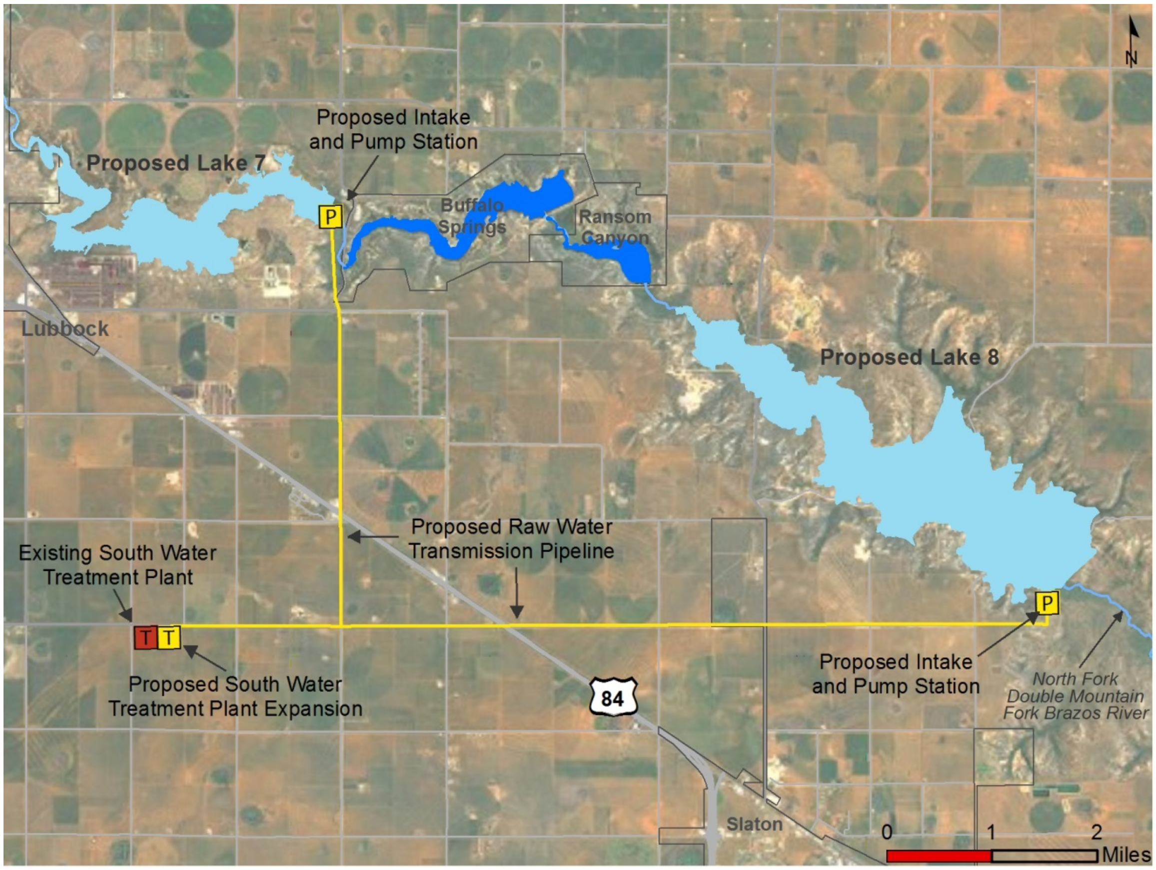
[1] 2006 Llano Estacado Regional Water Plan, HDR, p. 4-183

[2] 2006 Llano Estacado Regional Water Plan, HDR, p. 4-185

Figure 11.1. Location of Proposed Jim Bertram Lake 8



11.1.2 Implementation Issues

In 2005, the City of Lubbock (City) submitted Water Rights Application No. 5921, which, among other things, originally sought the right to impound and divert water from both Lakes 7 and 8. Although the application was declared administratively complete in April 2006, the Texas Commission on Environmental Quality (TCEQ's) technical review is still on-going. On March 4, 2008, a request was made by Lubbock to the TCEQ to remove Lake 8 from the permit application. This was due primarily to the number of existing structures and properties that Lake 8 would inundate if constructed. Lake 8 was subsequently deleted from the 2011 Region O Water Plan.

11.2 Jim Bertram Lakes Well Field

Another potential strategy consists of installing a series of shallow wells in close proximity to the Jim Bertram Lake System (JBLS). This lake system flows through east Lubbock as depicted in Figure 11.2. Wells would be installed on either side of the Lakes 1, 2 and 3. The water would be pumped to the surface, collected, and transported through a pipeline to the North Water Treatment Plant (NWTP) for treatment and distribution.

Data needed to further evaluate this strategy includes:

- The recommended distance between the “bed and banks” of the stream to the proposed wells;
- The hydraulic characteristics of the alluvial formation;
- The depth to the groundwater table and the base of the formation;
- The recommended number of wells;
- A determination of the amount of water that these wells can produce over a sustained period;
- A determination of whether the groundwater is under the influence of surface water;
- A determination of whether the groundwater is considered to be part of the “bed and banks” of the river system;
- Water rights or water use permits that will be required;
- The allowable spacing of the proposed wells;
- Evaluation of the 1970 tornado debris that is buried along the south side of the JBLS;
- The size and length of collection and transmission pipelines that will be needed;
- The type of pumping facilities that will be needed; and,
- The level of treatment that will be required.

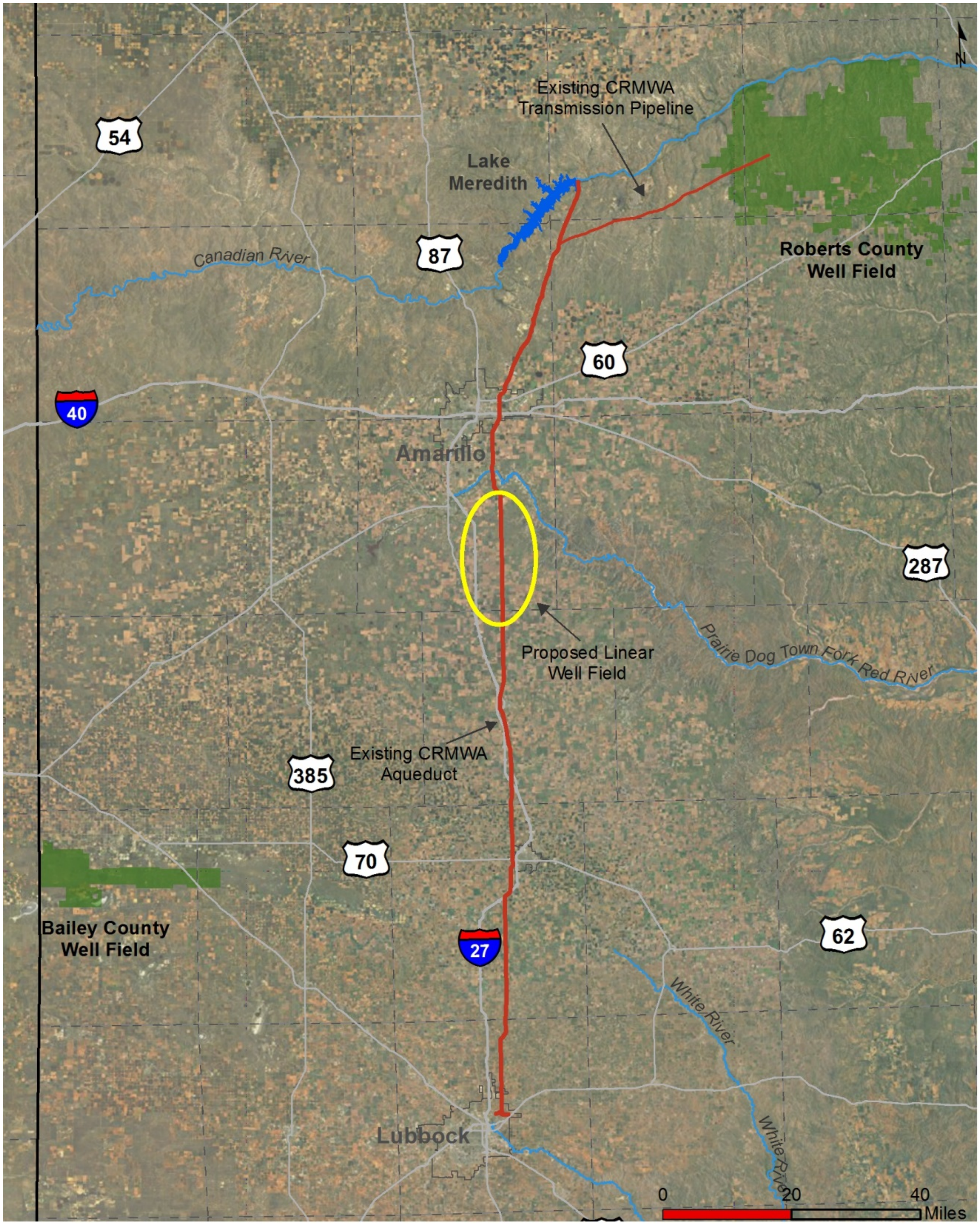
Figure 11.2. Jim Bertram Lakes Well Field

This strategy has been considered because installing a well field along the JBLS has the potential to be a sustainable supply of water since the water in the lakes is recharging into the surrounding water bearing formations. The Northwest Water Reclamation Plant (NWWRP) began discharging treated effluent into JBLS Lake 1 in April 2018. This discharge of water helps mitigate the uncertainty that most of the water found in the lake system has been supplied in the past by pumping groundwater from the LLAS and discharging it into Lake 1. This groundwater remediation project will not provide a long-term, reliable supply of water (beyond 30 years). When the remediation project is ended, the effluent from the NWWRP will be the main source of water discharged into the JBLS. Section 7.9 describes a potable reuse strategy utilizing the discharged groundwater and delivering it to an advanced treatment plant near the NWTP rather than into the JBLS.

11.3 Linear Well Field - CRMWA Aqueduct

This potential strategy consists of installing a series of wells into the Ogallala Aquifer at optimal locations near the existing CRMWA Aqueduct. The groundwater would be pumped to the surface, collected, and transported to the aqueduct for delivery to Lubbock's NWTP for treatment and distribution. This concept is depicted in Figure 11.3.

Figure 11.3. Linear Well Field – CRMWA Aqueduct



The proposed linear well field would be located in an optimal area (encircled in yellow on the figure) between Tulia and Amarillo along the CRMWA Aqueduct.

Data needed to further evaluate this strategy includes:

- Recommended areas along the aqueduct to install proposed wells;
- The hydraulic characteristics of the Ogallala formation in the areas of interest;
- The depth to the groundwater table and the base of the formation;
- The recommended number of wells;
- A determination of the amount of water the wells can produce over a sustained period;
- Water rights and/or water use permits that will be required;
- The allowable spacing of the proposed wells;
- The size and length of collection and transmission pipelines that will be needed;
- The type of pumping facilities that will be needed;
- The level of treatment that will be required.

This strategy has been considered because installing wells along the aqueduct could be a cost effective way to supplement the supply of water in the aqueduct. However, additional information is needed before the evaluation can be completed.

11.4 Additional CRMWA Aqueduct

When the Roberts County Well Field (RCWF) New Transmission Line (Section 8.5) is built, the current CRMWA Aqueduct will be near capacity delivering up to 43,728 ac-ft/yr to Lubbock. At that point, the only way to increase the allocation of water to CRMWA member cities will be to expand the capacity of the aqueduct system. This strategy proposes the construction of a new aqueduct that runs parallel to the existing CRMWA Aqueduct from an area north of Amarillo to Lubbock's NWTP. Since the long-term reliability of Lake Meredith is questionable and the two RCWF transmission lines will be at capacity, a third transmission line may be needed to convey greater quantities of water from the RCWF to the aqueducts in the future.

The existing aqueduct was originally built to transport surface water to member cities. The water must pass through two open top balancing reservoirs between the lake and Lubbock. Therefore, all of the raw water, including groundwater, is treated the same as surface water. If the second aqueduct is constructed, it could be built as a “groundwater only” pipeline and by-pass the balancing reservoirs. This would allow the groundwater to be chlorinated and by-pass Lubbock's NWTP, which is a conventional surface water treatment facility.

Data needed to further evaluate this strategy includes:

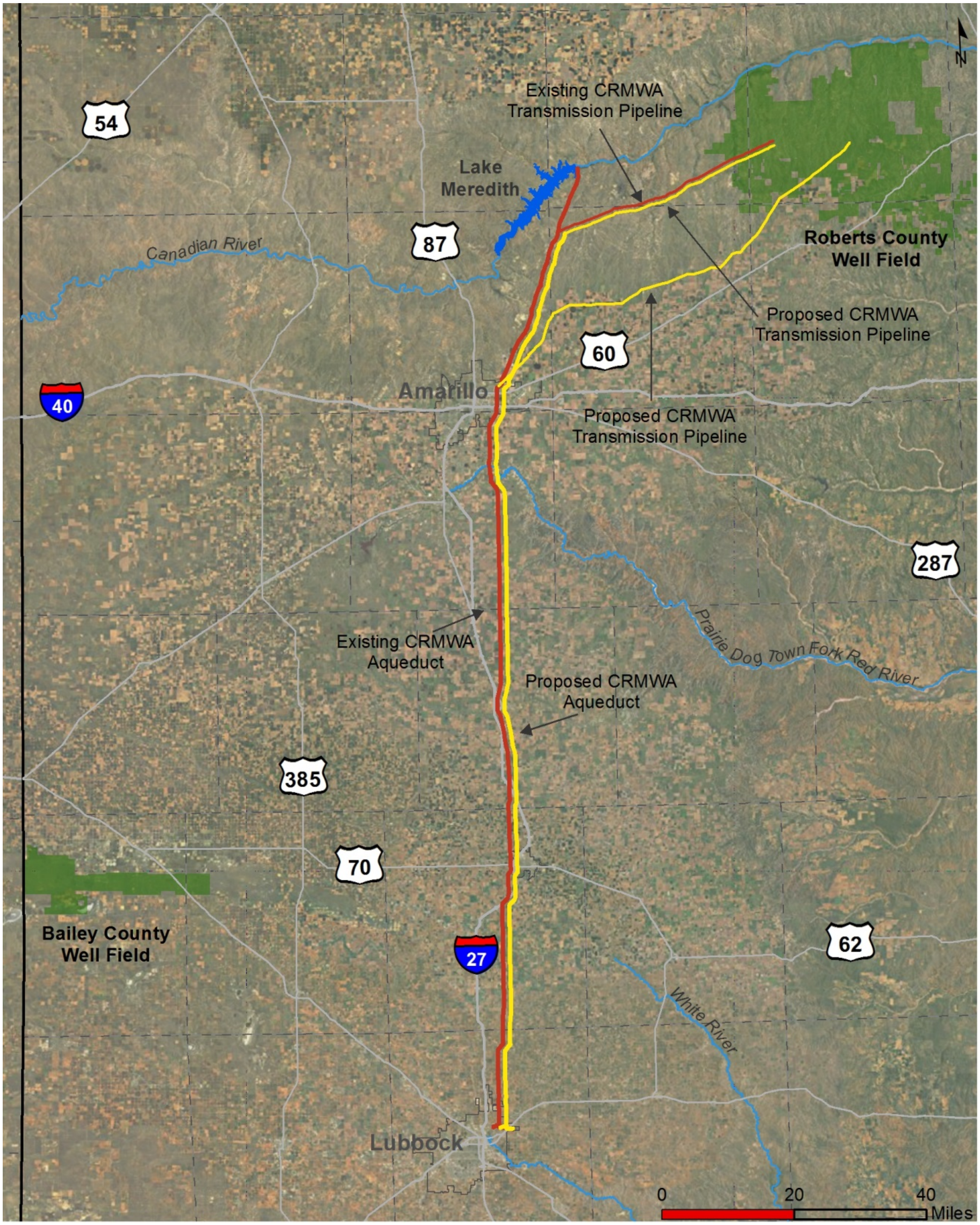
- The allowable RCWF field pumping capacity based on Panhandle Groundwater Conservation District rules;
- The optimal rate of RCWF production;
- The recommended size of the second CRMWA aqueduct;

- The recommended size of the third RCWF transmission line to the CRMWA aqueduct system;
- The length of aqueduct and transmission pipelines that will be needed; and,
- The type of pumping facilities that will be needed.

Figure 11.4 shows a schematic of the necessary infrastructure for the CRMWA Aqueduct Expansion.

This strategy has been considered because installing additional aqueduct and transmission lines in the CRMWA system could quadruple the amount of water allocated to Lubbock from the current CRMWA allocation of 24,088 ac-ft/yr to an allocation of approximately 90,000 ac-ft/yr. However, this means that the RCWF would be depleted at least four times faster than current depletion rates. Additional modeling of the RCWF would be necessary to determine its long-term viability at a much higher production rate. In addition, the cost of such a large and long aqueduct may not be as cost effective as other water supply strategies.

Figure 11.4. Additional CRMWA Aqueduct



11.5 South Lubbock Well Field Strategy

Although the City used over 60 Ogallala Aquifer wells located within the city limits from 1911 to 1970 for potable water supply, the wells and water collection systems have been decommissioned and abandoned. However, in 2006, the City initiated a study to evaluate the feasibility of creating a new well field in the southern part of the City where groundwater levels are relatively high and the saturated thickness is relatively large. The results of the evaluation are documented in the City's *Groundwater Treatment Plant Engineering Report* delivered by Parkhill, Smith & Cooper and Black & Veatch in May 2006[3] and the *Groundwater Utilization Study* delivered by Daniel B. Stephens & Associates (DBS&A) in March 2007.[4] The information in these reports was utilized to evaluate this strategy.

The South Lubbock Well Field Strategy includes the installation of wells on existing City-owned properties. Groundwater would be transported to a new water treatment plant at Pump Station #10, near the intersection of Memphis Avenue and 82nd Street. The raw groundwater will require advanced water treatment to overcome relatively high salinity and the possibility of the groundwater being influenced by hydraulic connection to surface water. The treated water will be discharged into the ground storage tank at Pump Station 10 for blending and distribution. However, there is not sufficient capacity in Pump Station 10 to accommodate this new water supply, and some of the water at Pump Station 10 would need to be diverted to Pump Station 14 for distribution to customers.

The major design features of this strategy include:

- Installation of 17 water supply wells (2 are standby wells);
- All wells are installed on City property and located to meet TCEQ's sanitary control easement requirements (The well locations are based on previous work by DBS&A.);
- Approximately 7 miles of 6- to18-inch diameter raw water collection pipeline;
- Well pumps will be sized to deliver the raw water directly to the new water treatment plant at Pump Station 10;
- A new water treatment plant will be constructed near Pump Station #10. The new treatment plant will provide microfiltration and reverse osmosis (RO) for desalination. The new treatment plant will produce finished water with salinity near the concentration of current potable water supplies;
- Treated water will be delivered to the existing ground storage tank at Pump Station #10 for blending and distribution;
- Since Pump Station 10 is at its designed capacity, some or all of the new water supply would be diverted to Pump Station 14 in order to accommodate the new supply at Pump Station 10;
- A 4-mile, 42-in Low Head C Transmission pipeline to allow flow from the SWTP to reach PS 16 or Bailey County groundwater to flow to PS 14 (see Figure 4.11);

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[3] Engineering Report: Groundwater Treatment Plant- Lubbock, Texas. Parkhill, Smith & Cooper, Inc. May 2006.

[4] City of Lubbock Groundwater Utilization Study. Daniel B. Stephens & Associates Inc. March 23, 2007.

- Desalination concentrate will be disposed of by injecting the concentrate into the Dockum Aquifer;
- The new treatment plant will be designed to produce desalination concentrate with a total dissolved solids (TDS) concentration that is less than or equal to the salinity of water in the Dockum Aquifer; and
- The concentrate disposal well will be located near the new treatment plant.

Figure 11.5 depicts the relative locations of the well field and associated infrastructure needed.

Figure 11.5. South Lubbock Well Field Infrastructure

11.5.1 Quantity of Available Water

This strategy is estimated to produce 7.2 mgd during the summer months (June - September) each year to assist the City in meeting its peak demand. The *Groundwater Utilization Study* report delivered by DBS&A in March 2007 state that this pumping schedule would contribute 2,613 ac-ft/yr to Lubbock's overall water supply.[5] Part of this 2007 study included analyzing a Pump Station #10 strategy with approximately the same yield and well locations as the strategy described here. Their modeling analysis showed 50-year

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[5] City of Lubbock Groundwater Utilization Study. Daniel B. Stephens & Associates, Inc. March 23, 2007: ES-3.

groundwater declines of about 20 to 40 ft in the new well field, which results in a minimum saturated thickness of about 40 ft.

11.5.2 Strategy Costs

Costs associated with this strategy are presented in Table 11.1. Assumptions and conditions associated with these costs include:

- A high-capacity Ogallala Aquifer production well can produce 325 gallons per minute (gpm) (0.47 mgd);
- The depth to the base of the Ogallala is averages approximately 135 feet;
- Sparse and relatively old data suggest TDS concentrations range from approximately 570 to over 1,600 milligrams per liter (mg/L). Assuming that the raw groundwater has TDS concentration of 1,250 mg/L, and 50% of the raw water goes to desalination, the resulting TDS concentration is about 625 mg/L;
- This part of the Ogallala Aquifer receives rather rapid and direct recharge from rainfall and possibly urban runoff and irrigation. Considering the likelihood of the water being slightly brackish and possibly influenced by surface water, advanced water treatment is planned. Advanced treatment will include microfiltration and RO;
- Based on a 2003 Texas Water Development Board (TWDB) report,[6] the depth to the base of the best Dockum sandstone is about 1,900 feet;
- Groundwater in the Dockum Aquifer at this location has an estimated TDS concentration of about 25,000 mg/L;
- Brine concentrate will be discharged into a new Dockum disposal well;
- For an operational capacity of 7.2 mgd of potable water, 7.6 mgd of raw water is required. The balance of 0.4 mgd becomes concentrate (50% bypass and 90% efficiency);
- Engineering, legal, and contingency costs is 35% for facilities required by this strategy;
- Power is available at $0.09 per kilowatt-hour (kwh);
- Interest during construction is 4.0%, and a 1.0% return on investments; and
- The project will be financed for 20-years at a 5.5 % interest rate.

As shown, the total project cost is estimated to be $41,888,000. Cost estimates include adjustment for construction in an urban setting. Annual debt service is $3,535,000 and, annual operational cost, including power, is $2,471,000. This results in a total annual cost of $6,006,000. The unit cost for a 2,613 ac-ft/yr supply is estimated to be $2,299 per ac-ft, or $7.05 per 1,000 gallons.

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[6] Bradley, R.G., and S. Kalaswad. December 2003. The groundwater resources of the Dockum Aquifer in Texas: TWDB Report 359.

Table 11.1. South Lubbock Well Field Costs (January 2017 Prices)

Item	Estimated Costs for Facilities
CAPITAL COST	
Low Head C Transmission Pipeline	$9,393,000
Low Head C Pump Station	$12,000,000
Well Fields (17 Wells with Pumps, and 6.5 mi of Collector Piping)	$9,579,000
Brackish Water Treatment Plant (4.0 mgd) with 1 Deep Disposal Well	$13,103,000
Integration, Relocations, & Other	$50,000
TOTAL COST OF FACILITIES	**$44,125,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$14,987,000
Environmental & Archaeology Studies and Mitigation	$293,000
Interest During Construction (4% for 1 year with a 1% ROI)	$2,092,000
TOTAL COST OF PROJECT	**$61,497,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$5,176,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$201,000
Water Treatment Plant	$2,235,000
Pumping Energy Costs (622,712 kwh @ 0.09 $/kwh)	$56,000
TOTAL ANNUAL COST	**$7,668,000**
Available Project Yield (ac-ft/yr)	2,613
Annual Cost of Water ($ per ac-ft)	$2,935
Annual Cost of Water ($ per 1,000 gallons)	$9.00

11.5.3 Implementation Issues

Environmental Issues

Environmental issues should be minimal since the new infrastructure would be installed in an urban area.

Permitting Issues

Water well permits from the High Plains Underground Water Conservation District No. 1 will be necessary. Design and construction of public water supply wells and water treatment facilities must be approved by the TCEQ. Authorization to construct and operate an injection well for concentrate disposal will also be required by the TCEQ.

Other

Wells will be placed on City owned properties. In addition, pipelines will be placed in City utility easements. However, pipeline construction under City streets is costly due to the surface infrastructure restoration necessary. Consideration will need to be made regarding a proximate landfill (Old Kingsgate Landfill) located east of Quaker and north of 78th Street. Depletion of groundwater may have a negative effect on existing private wells in the area.

11.6 Brackish Well Field Strategy

This strategy consists of installing wells in the Santa Rosa Formation of the Dockum Aquifer. Brackish water would be pumped to the surface and treated before being used for drinking water. The well system would be constructed on the City's existing 320-acre SWTP site. Desalination facilities will be required for proper treatment, and a concentrate disposal well discharging into the Permian formation will be necessary to dispose of the concentrate produced during treatment.

A recent test drilling study completed HDR for the City and summarized in the March 2017 *Brackish Groundwater Water Supply Evaluation* report provides documentation on local hydrogeologic conditions and updates previous estimates of potential well depths and yields, depth to water, and salinity.[7.]

The major design features of this strategy include:

- The installation of four Dockum production wells in the corners of the SWTP property. Because of the availability of other water sources, no contingency or standby wells are planned.
- The installation of one Permian Formation injection well. As with the supply wells, no contingency well is planned. Storage facilities will be located on the east side of the property;
- Approximately 10,400 feet of 6-inch diameter raw water collection pipeline;
- Approximately 1,000 feet of 6-inch diameter concentrate disposal pipeline;

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[7] HDR Engineering, 2017. Brackish Groundwater Water Supply Evaluation, Engineering Report for City of Lubbock.

- Pumps will deliver the raw water directly to the desalination water treatment plant;
- The desalination water treatment plant will use RO technology. It is assumed to have an efficiency of 85% and will require 98% of the raw water to be treated. The product water will have a TDS concentration of about 840 mg/L and the concentrate will have a TDS concentration of about 280,000 mg/L;
- Concentrate will be delivered to a ground storage tank near the desalination water treatment plant, which is sized to hold the amount of concentrate that is produced in a day;
- From the ground storage tank, concentrate will flow by gravity to the disposal well. No pump station is needed because the static water level in the Permian Formation is expected to be about 500 ft below land surface;
- For an operational capacity of 0.18 mgd of potable water, 0.21 mgd of raw water is required. The balance becomes concentrate; and
- Treated water will be delivered to the SWTP for final blending and distribution.

Figure 11.6 depicts the relative locations of the Brackish Well Field and associated infrastructure needed.

11.6.1 Quantity of Available Water

This strategy is designed for a dependable treated supply of 200 ac-ft/yr or 0.18 mgd. The required raw water supply will be about 235 ac-ft/yr or 0.21 mgd and will generate approximately 34 ac-ft/yr or 0.03 mgd of concentrate. Because the water supply will come from a deep aquifer, it is considered to be independent of drought conditions.

11.6.2 Strategy Costs

Costs associated with this strategy are presented in Table 11.2. Assumptions and conditions associated with these costs include:

- Based on information included in the March 2017 HDR report, a high-capacity Dockum Aquifer production well at this location is expected to produce about 60 gpm (0.09 mgd);
- Based on the March 2017 HDR report, the depth to the base of the best Dockum sandstone is about 1,420 feet;
- Data show that the water has an estimated TDS concentration of about 42,000 mg/L;
- A Permian injection well to a depth of about 5,000 feet provides for disposal of the brine concentrate;
- Engineering, legal, and contingency costs are 35% for the facilities required by this project;
- Power is available at $0.09 per kwh;
- Interest during construction is 4.0%, and a 1.0% return on investments; and
- The project will be financed for 20-years at a 5.5% interest rate.

Figure 11.6. Brackish Well Field Infrastructure

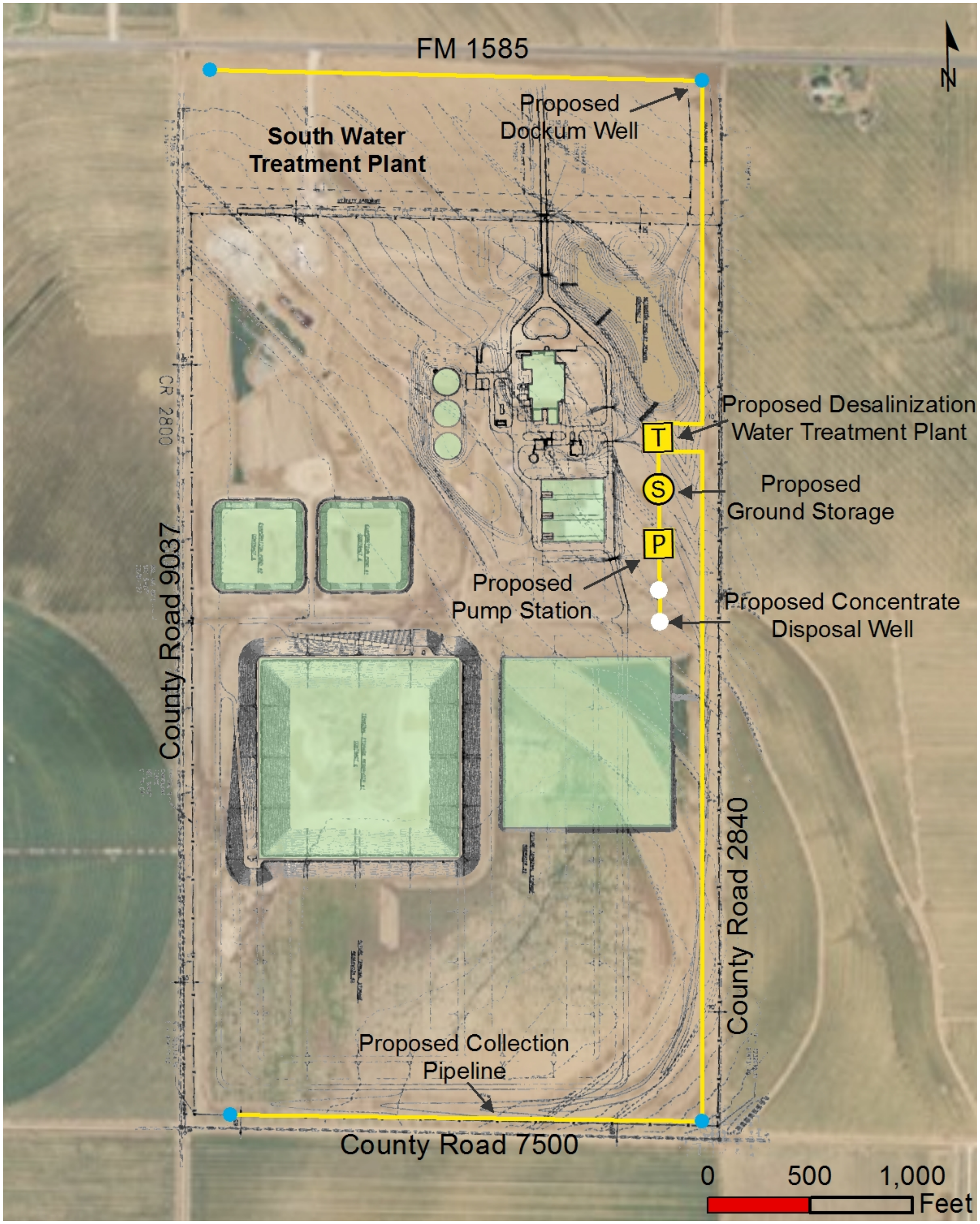

Table 11.2. Brackish Well Field Costs (January 2017 Prices)

Item	Estimated Costs for Facilities
CAPITAL COST	
Concentrate Storage Tank	$106,000
Production Well Field (4 Wells, Pumps, and Collector Piping)	$1,938,000
Disposal Well Field (1 Well and Piping)	$2,019,000
Water Treatment Plant (0.2 mgd)	$4,052,000
TOTAL COST OF FACILITIES	**$8,115,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,840,000
Environmental & Archaeology Studies and Mitigation	$54,000
Land Acquisition and Surveying (5 acres)	$0
Interest During Construction (4% for 1 years with a 1% ROI)	$386,000
TOTAL COST OF PROJECT	**$11,395,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$953,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$41,000
Water Treatment Plant	$391,000
Pumping Energy Costs (235,218 kwh @ 0.09 $/kwh)	$21,000
TOTAL ANNUAL COST	**$1,406,000**
Available Project Yield (ac-ft/yr)	200
Annual Cost of Water ($ per ac-ft)	$7,030
Annual Cost of Water ($ per 1,000 gallons)	$21.57

As shown, the total project cost is estimated to be $11,395,000. Annual debt service is $953,000; and, annual operational cost, including power, is $453,000. The total annual cost is $1,406,000. The unit cost for a 200 ac-ft/yr supply is estimated to be $7,030 per ac-ft, or $21.57 per 1,000 gallons.

11.6.3 Implementation Issues

Environmental Issues

Environmental issues should be minimal since the new infrastructure would be installed on existing City properties. No known wildlife habitat or cultural resources would be affected. An environmental assessment for the SWTP approved by the TWDB was prepared as part of the Lake Alan Henry (LAH) Phase 1 infrastructure project. In addition, environmental assessments were performed as part of the City's due diligence in purchasing the property for the SWTP.

Permitting Issues

Water well permits from the High Plains Underground Water Conservation District No. 1 will be necessary. Design and construction of public water supply wells and water treatment facilities must be approved by the TCEQ. Authorization to construct and operate an injection well for concentrate disposal will also be required by the TCEQ.

Other

Wells and collection pipelines will be placed on City-owned properties.

The target zone for brine disposal from oil and gas production in the area is about 5,000 feet deep in the Permian Formation. No other information is readily available to estimate its suitability for a concentrate disposal well. As a result, there is considerable uncertainty in the capacity of the Permian Formation to accept the required injection rate for an extended period of time.

Review of Feasibility for Locating Well Field to a More Favorable Area

A review of the potential yield for this strategy shows that a brackish groundwater supply from the Dockum Aquifer at the SWTP is not feasible because of very high unit cost, which is attributed to deep well depths, low well yields, and high salinity.

A cursory review the potential for more favorable locations in Lubbock County and in neighboring counties was undertaken by studying maps on the Santa Rosa Formation, including: (1) sand thickness, (2) formation thickness, (3) aquifer hydraulic conductivity, (4) total dissolved solids, and (5) depth to base of water bearing zone. Within Lubbock County, these maps show that the most favorable area is the extreme northeast part of the county. The improvement in aquifer properties over the SWTP site is mostly based on considerably lower concentrations of total dissolved solids. In this area, the estimated total dissolved solids concentration is expected to range between less than 1,000 to 5,000 mg/L instead of greater than 40,000 mg/L. In neighboring counties, the aquifer properties in Floyd County appears to be considerable better than those at the SWTP site and the northeast part of Lubbock County. This improvement is based on shallower wells, greater aquifer hydraulic conductivity, thicker sands, and much lower total dissolved solid concentrations. The aquifer properties in Crosby County are also much better than the SWTP site, but not quite as favorable as those in Floyd County.

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12 Supply Strategy Scoring

The potential water supply strategies developed and discussed in Sections 6, 7, 8, 9 and 10 are evaluated and ranked in this section. The objective of the evaluation is to determine which strategies appear to be the most feasible for the City of Lubbock (City) to implement. The scores do not factor in the volume of water produced by each strategy. Neither do the scores incorporate how long it will take for a project to be ready for implementation. These two factors are independently considered in the development of the water supply packages discussed in Section 13.

12.1 Strategy Scoring Criteria

All strategies were evaluated and scored based on a common set of eight criteria. The first three criteria – confidence, reliability/vulnerability, and sustainability consist of some level of subjectivity. Confidence was determined based on the total score of permitting ease, technical feasibility, political feasibility, dependence on others, and staff opinion. The last five criteria – quality, unit cost after debt service, project cost, energy efficiency and operational complexity – are objective. Strategies were assigned a ranking for each criterion on a scale from 1 to 5. The raw scores were then weighted based on the relative importance of each criterion as determined by City staff. The evaluation method provides a relatively objective framework for comparing the relative merits of these strategies. Descriptions of these criteria and associated weightings are presented in Table 12-1.

12.2 Individual Strategy Scoring

Detailed tables providing the rationale for the scoring of each strategy with respect to each criterion are shown in Tables 12.2 through 12.20. Strategy rankings are based on the current known political, regulatory, technological, and other conditions. Many supply strategies are interchangeable. The attractiveness of each strategy may change over time based on a variety of unforeseen circumstances. Rankings can be updated periodically as evaluation factors change in the future.

Table 12.1. Evaluation Criteria

Category	Weight	1 Low / Poor	2	3 Medium	4	5 High / Excellent
Confidence	2.0	The likely success of the potential project based on several factors (permitting, technical and political challenges; dependence on others; and overall staff opinion).				
Reliability/ Vulnerability	1.0	The likelihood that the water source is available 100% of the time. The likelihood that the water source is not at risk of being interrupted (pipeline breaks, contamination, drought susceptibility, etc.) 1: High risk of interrupted supply 5: Low risk of interrupted supply				
Sustainability	1.0	The likelihood that the supply will be available for a longer period than other strategies. 1: less than or equal to (≤) 20 yrs; 2: ≤ 40 yrs; 3: ≤ 60 yrs; 4: ≤ 80 years 5: greater than (>) 80 years				
Quality	0.5	The relative level of water treatment required for each strategy. 1: Advanced Treatment: RO + Other Techniques; 2: Advanced Treatment: RO only; 3: Conventional Treatment; 4: Filtration; 5: Chlorination Only				
Unit Cost after Debt Service (cost /1,000 gal)	1.5	The relative unit costs compared to other strategies after debt service is retired. 1: greater than (>) \$3.07; 2: less than or equal to (≤) \$3.07; 3: ≤ \$2.00; 4: ≤ \$1.38; 5: ≤ \$0.62				
Project Cost (\$ in millions)	1.0	The relative total project cost compared to other strategies. 1. greater than (>) \$125 M;2: less than or equal to (≤) \$125 M; 3: ≤ \$100 M; 4: ≤ \$60 M; 5: ≤ \$15 M				
Operational Complexity	0.5	The relative operational complexity compared to other strategies. 1: High complexity to operate 5: Low complexity to operate				
Energy Efficiency	1.5	The relative energy intensity compared to other strategies. 1: greater than (>) 5500 kwh/MG; 2: less than or equal to (≤) 5500 kWh/MG; 3: ≤ 4500 kWh/MG; 4: ≤ 3000 kWh/MG; 5: ≤ 1250 kWh/MG				

12.2.1 Conservation Strategies

Table 12.2. All Conservation Strategies Scored Together – Strategy Evaluation

Category	Score	Reason for Ranking
Confidence	5	Past experience has shown that the conservation savings can be achieved.
Reliability/ Vulnerability	5	Water saved is not subject to outside influences.
Sustainability	5	Most water savings can be continued indefinitely.
Quality	5	No change in water quality from existing sources.
Unit Cost after Debt Service (cost /1,000 gal)	4	Cost is reasonable for the water savings achieved.
Project Cost (\$ in millions)	5	Cost is reasonable for the water savings achieved.
Operational Complexity	3.4	Requires a variety of programs be implemented and maintained over time.
Energy Efficiency	5	Requires virtually no energy to implement.

12.2.2 Reclaimed Water Strategies

Table 12.3. North Fork at CR 7300 – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3	This supply strategy is within 15 miles of Lubbock. The City holds permits to discharge, transport, and divert the reclaimed water at CR 7300 on the North Fork. Sufficient reclaimed water will be needed to implement this strategy. Landowner opposition may be an issue at CR 7300. The City holds a permit to discharge up to 10,089 ac-ft/yr (9 mgd) of treated effluent at Outfall 001 into the North Fork. In addition, the impoundment and diversion permit at CR 7300 was issued in 2012. However, the City must still acquire the land for the diversion facility, easements for the pipelines, and authorization by the TCEQ to construct facilities.
Reliability/ Vulnerability	5	This strategy uses 100% reclaimed water. Reclaimed water availability is dependent on commitments to other users and operational decisions. The water supplied is interruptible.
Sustainability	5	Since water used for this strategy is 100% reclaimed water, it should be available for at least 60 years unless the City seeks to use the reclaimed water for another beneficial purpose.
Quality	1	This strategy consists of treated effluent that is discharged into the North Fork and transported downstream 2.7 miles where it will be diverted. Before entering the distribution system, this water will need to undergo advanced treatment that includes membrane barriers.
Unit Cost after Debt Service	3	The unit cost of water for this strategy after debt service is $1.62/1,000 gal.
Project Cost	1	The project cost for this strategy is $161,186,000.
Operational Complexity	1	This project required advanced treatment.
Energy Efficiency	3	The energy efficiency for this strategy is 3,567 kWh/MG produced.

Raw Score	22
Weighted Score	27

Table 12.4. Direct Potable Reuse to NWTP – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3.4	Public perception of direct potable reuse in Texas has improved some. Improvements in technology and drought conditions have stimulated increased desire in many communities to implement this type of strategy. Standards, rules, and regulations are still being developed. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. Future permits must comply with these "undeveloped" regulations
Reliability/ Vulnerability	5	This strategy uses 100% reclaimed water. Reclaimed water availability is dependent on commitments to other users and operational decisions. The water supplied is interruptible.
Sustainability	5	The water used by this strategy will be 100% reclaimed water. This supply should be available for at least 60 years unless the City seeks to use the reclaimed water for another beneficial purpose.
Quality	1	The water used by this strategy must be treated using RO plus other barriers during advanced treatment since it includes direct reuse of wastewater effluent.
Unit Cost after Debt Service	4	The unit cost of water for this strategy is $0.85/1,000 gal.
Project Cost	2	The project cost for this strategy is $117,104,000.
Operational Complexity	1	This project requires advanced treatment.
Energy Efficiency	4	The energy intensity for this strategy is 2,861 kWh/MG produced.

Raw Score	25.4
Weighted Score	31.8

Table 12.5. Direct Potable Reuse to SWTP – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3.2	Public perception of direct potable reuse in Texas has improved some. Improvements in technology and drought conditions have stimulated increased desire of many communities to implement this type of strategy. Standards, rules, and regulations are still being developed.
Reliability/ Vulnerability	5	This strategy uses 100% reclaimed water. Reclaimed water availability is dependent on commitments to other users and operational decisions. The water supplied is interruptible.
Sustainability	5	The water used by this strategy will be 100% reclaimed water. This supply should be available for at least 60 years unless the City seeks to use the reclaimed water for another beneficial purpose.
Quality	1	The water used by this strategy must be treated using RO plus other barriers during advanced treatment since it includes direct reuse of wastewater effluent.
Unit Cost after Debt Service	3	The unit cost of water for this strategy is $1.39/1,000 gal after debt service.
Project Cost	1	The project cost for this strategy is $147,519,000.
Operational Complexity	1	This project requires advanced treatment.
Energy Efficiency	4	The energy efficiency for this strategy is 2,422 kWh/MG produced.

Raw Score	23.2
Weighted Score	28.9

Table 12.6. South Fork Discharge to LAH Supplement – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3.0	Public concern exists about discharging reclaimed water into the South Fork that will be mixed with LAH water. Furthermore, high carriage losses (19%) make this strategy less attractive. The City's existing discharge permit (TPDES Permit WQ0010353002) will need to be amended to include an additional outfall on the South Fork. Also, although the City's current Water Right Permit No. 4146 for LAH authorizes a maximum annual withdrawal of 35,000 ac-ft/yr, the City needs to ensure that the return flow discharges on the South Fork can be diverted and used.
Reliability/ Vulnerability	4	This strategy uses 100% reclaimed water. The water supplied could be considered interruptible during dry times due to distance from City and interception by intervening users.
Sustainability	5	The water used by this strategy will be 100% reclaimed water. This supply should be available for at least 60 years unless the City seeks to use the reclaimed water for another beneficial purpose.
Quality	3	This water consists of treated effluent that is discharged, transported 36 miles down the South Fork, and impounded in LAH. The water will be blended into the lake water. Treatment will be advanced treatment with membranes.
Unit Cost after Debt Service	4	The unit cost of water for this strategy is $0.84/1,000 gal after debt service.
Project Cost	2	The project cost for this strategy is $82,852,000.
Operational Complexity	3	This project requires continued discharges and maintenance of facilities into a tributary of the South Fork that drains into LAH.
Energy Efficiency	2	The energy efficiency for this strategy is 4,703 kWh/MG produced.

Raw Score	26
Weighted Score	29

Table 12.7. North Fork Diversion to LAH Pump Station – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3.6	The diversion point for this strategy is over 50 miles from Lubbock. The City holds a permit to discharge the reclaimed water, but does not hold permits to transport, impound, and divert the reclaimed water at this location. Existing water rights holders and landowners may oppose an application for a permit. Sufficient reclaimed water will be needed to implement this strategy. Carriage losses are high. Water blended with the LAH raw water at the LAHPS could present treatment issues.
Reliability/ Vulnerability	3	This strategy uses 100% reclaimed water. The water supplied could be considered interruptible during dry times due to distance from City and interception by intervening users.
Sustainability	5	The water used by this strategy will be 100% reclaimed water. This supply should be available for at least 60 years unless the City seeks to use the reclaimed water for another beneficial purpose.
Quality	3	This water consists of treated effluent that is discharged into the North Fork and transported downstream 67 miles where it will be diverted. Before entering the distribution system, this water will need to undergo advanced treatment that includes membrane barriers.
Unit Cost after Debt Service	4	The unit cost of water for this strategy is $0.89/1,000 gal after debt service.
Project Cost	3	The project cost for this strategy is $75,480,000.
Operational Complexity	3	This project requires continued discharge of return flows into the North Fork, and monitoring to assure they reach the diversion location. Potential water quality differences between the North Fork and LAH supplies may increase operational complexity.
Energy Efficiency	4	The energy efficiency for this strategy is 2,934 kWh/MG produced.

Raw Score	28.6
Weighted Score	33.2

Table 12.8. DPR NWWRP to NWTP (Option 7B) – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3.6	Public perception of direct potable reuse in Texas has improved some. Improvements in technology and drought conditions have stimulated increased desire of many communities to implement this type of strategy. Standards, rules, and regulations are still being developed.
Reliability/ Vulnerability	5	This strategy uses 100% reclaimed water. Reclaimed water availability is dependent on commitments to other users and operational decisions. The water supplied is interruptible.
Sustainability	5	The water used by this strategy will be 100% reclaimed water. This supply should be available for at least 60 years unless the City seeks to use the reclaimed water for another beneficial purpose.
Quality	1	The water used by this strategy must be treated using RO plus other barriers during advanced treatment since it includes direct reuse of wastewater effluent.
Unit Cost after Debt Service	4	The unit cost of water for this strategy is $1.16/1,000 gal after debt service.
Project Cost	3	The project cost for this strategy is $74,886,000.
Operational Complexity	1	This project requires advanced treatment.
Energy Efficiency	3	The energy efficiency for this strategy is 3,679 kWh/MG produced.

Raw Score	25.6
Weighted Score	31.7

Table 12.9. DPR NWWRP to PS9 (Option 8) – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	2.4	Public perception of direct potable reuse in Texas has improved some. Improvements in technology and drought conditions have stimulated increased desire of many communities to implement this type of strategy. Standards, rules, and regulations are still being developed.
Reliability/ Vulnerability	5	This strategy uses 100% reclaimed water. Reclaimed water availability is dependent on commitments to other users and operational decisions. The water supplied is interruptible.
Sustainability	5	The water used by this strategy will be 100% reclaimed water. This supply should be available for at least 60 years unless the City seeks to use the reclaimed water for another beneficial purpose.
Quality	1	The water used by this strategy must be treated using RO plus other barriers during advanced treatment since it includes direct reuse of wastewater effluent.
Unit Cost after Debt Service	3	The unit cost of water for this strategy is $1.29/1,000 gal after debt service.
Project Cost	3	The project cost for this strategy is $81,728,000.
Operational Complexity	1	This project requires advanced treatment.
Energy Efficiency	3	The energy efficiency for this strategy is 3,679 kWh/MG produced.

Raw Score	23.4
Weighted Score	27.8

Table 12.10. LLAS Groundwater Potable Reuse – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3.8	Public perception of direct potable reuse in Texas has improved some. Improvements in technology and drought conditions have stimulated increased desire of many communities to implement this type of strategy. Standards, rules, and regulations are still being developed.
Reliability/ Vulnerability	5	This strategy uses 100% reclaimed water. Reclaimed water availability is dependent on commitments to other users and operational decisions. The water supplied is interruptible.
Sustainability	3	The water used by this strategy will be 100% reclaimed water. This supply should be available for less than 60 years assuming that the City is depleting the mounded groundwater under the LLAS.
Quality	1	The water used by this strategy must be treated using RO plus other barriers during advanced treatment since it includes direct reuse of wastewater effluent.
Unit Cost after Debt Service	4	The unit cost of water for this strategy is $0.65/1,000 gal after debt service.
Project Cost	4	The project cost for this strategy is $15,116,000.
Operational Complexity	1	This project requires advanced treatment.
Energy Efficiency	5	The energy efficiency for this strategy is 615 kWh/MG produced.

Raw Score	26.8
Weighted Score	34.1

12.2.3 Groundwater Strategies

Table 12.11. RCWF Capacity Maintenance – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	4.0	The likely success of this project is high since it maintains the capacity of an already existing water supply. All financial decisions for this strategy must be approved and implemented by the CRMWA board. Panhandle Groundwater Conservation District rules may change production strategies from the RCWF. Water well permits from the Panhandle Groundwater Conservation District will be necessary. Design and construction of public water supply wells and water transmission facilities must be approved by the TCEQ.
Reliability/ Vulnerability	5	This strategy relies on groundwater that should be available as needed.
Sustainability	3	Estimates vary as to the amount of available groundwater in the Ogallala Aquifer in Roberts County. Further data collection is needed to determine the exact saturated thickness. This water supply should last at least 60 years.
Quality	3	The groundwater from Roberts County is high quality. The only treatment typically required is chlorination. However, Lubbock must treat the groundwater like surface water since the groundwater must pass through two open topped balancing reservoirs before it reaches Lubbock.
Unit Cost after Debt Service	5	The unit cost of water for this strategy is $0.16/1,000 gal.
Project Cost	5	The project cost for this strategy is $8,747,000.
Operational Complexity	5	This project involves continued operation and expansion of existing facilities already well understood.
Energy Efficiency	4	The energy efficiency for this strategy is 1,566 kWh/MG produced.

Raw Score	34
Weighted Score	38.5

Table 12.12. BCWF Capacity Maintenance – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	4.2	The likely success of this project is high since it includes maintaining the capacity of an already existing water supply. This strategy has minimal legal/permitting issues, a relatively low unit/project/annual cost, and can be implemented quickly. Water well permits from the High Plains Underground Water Conservation District No. 1 will be necessary. Design and construction of public water supply wells and water transmission facilities must be approved by the TCEQ.
Reliability	3	This strategy relies on groundwater that should be available as needed.
Sustainability	1	With the estimated annual use of 5,000 ac-ft/yr, current modeling suggests that the BCWF should be sustainable for at least 40 years.
Quality	4	The groundwater from Bailey County is high quality. The only treatment required is chlorination.
Unit Cost	5	The unit cost of water for this strategy is $4.30/1,000 gal.
Project Cost	5	The project cost for this strategy is $4,328,000.
Operational Complexity	5	This project involves continued operation and expansion of existing facilities already well understood.
Energy Efficiency	5	The energy efficiency for this strategy is 1,225 kWh/MG produced.

Raw Score	32.2
Weighted Score	36.9

Table 12.13. RCWF New Transmission Line to Aqueduct – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3.8	Any decision regarding the RCWF requires the consent of all CRMWA member cities. Many of the cities have expressed interest in this project as the large incremental increase in water supply will assist with the cities' growing water demands. Water well permits from the Panhandle Groundwater Conservation District will be necessary. Design and construction of public water supply wells and water transmission facilities must be approved by the TCEQ. Furthermore, CRMWA must acquire easements for the new transmission line.
Reliability/ Vulnerability	5	This strategy relies on groundwater that should be available as needed.
Sustainability	3	Estimates vary as to the amount of water contained in the Ogallala Aquifer in Roberts County. Further data collection and aquifer modeling is needed to estimate saturated thickness and well field decline patterns.
Quality	3	The groundwater from Roberts County is high quality. The only treatment typically required is chlorination. However, Lubbock must treat the groundwater like surface water since the groundwater must pass through two open topped balancing reservoirs before it reaches Lubbock.
Unit Cost after Debt Service	4	The unit cost of water for this strategy is $1.06/1,000 gal.
Project Cost	2	Lubbock's portion of the project cost for this strategy is $122,811,000.
Operational Complexity	5	This project involves operation of a facility very similar to existing facilities by a party other than the City, i.e., CRMWA.
Energy Efficiency	1	The energy efficiency for this strategy is 7,048 kWh/MG produced.

Raw Score	26.8
Weighted Score	29.1

12.2.4 Surface Water Strategies

Table 12.14. Lake Alan Henry Phase 2 – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	5.0	Phase 1 of the LAH water supply is already complete. Phase 2 expands the treatment and pumping capacity. Staff is confident that Phase 2 can be implemented successfully. The permitting issues associated with this project were addressed in Phase 1. No additional permitting requirements are anticipated with Phase 2. Design and construction of public water supply and treatment facilities must be approved by the TCEQ.
Reliability/ Vulnerability	4	The water used for this strategy will be 100% surface water. Water from this strategy should be available at all times and useful for peaking capacity also.
Sustainability	5	If precipitation patterns, land use trends, and the City's usage from the lake do not change in the coming decades, LAH should be sustainable for more than 80 years.
Quality	3	Advanced treatment using membrane barriers was installed during Phase 1. Phase 2 will include the same type of treatment facilities.
Unit Cost after Debt Service	2	The unit cost of water for this strategy is $2.61/1,000 gal.
Project Cost	3	The project cost for this strategy is $77,907,000.
Operational Complexity	5	This project involves operation and expansion of an existing system
Energy Efficiency	2	The energy efficiency for this strategy is 5,470 kWh/MG produced.

Raw Score	29
Weighted Score	32

Table 12.15. Jim Bertram Lake 7 – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3.4	There is mixed public interest in this project. Some downstream water rights holders are opposed to the lake while others are in favor. Due to complex permitting issues, high project costs, and length of time required to plan and construct a reservoir, confidence levels are low. Water Rights Application No. 5921 associated with Lake 7 is under technical review by the TCEQ. In addition, the TCEQ has received several requests for a contested case hearing. It will take several more years before the permit can be issued. A USACE Section 404 permit will be required prior to commencing construction of Lake 7. Mitigation plans for the project's environmental impacts must be developed and agreed upon by the USACE and other state and federal agencies. The City must also acquire the property for the lake, dam, pump station, wildlife mitigation area, and pipeline easements.
Reliability/ Vulnerability	5	This strategy uses a combination of reclaimed water, state water/natural inflows, and playa lake developed water. Reclaimed water availability is dependent on City water usage and operational decisions at the wastewater treatment plant. State water/natural inflows and playa lake developed water are dependent upon precipitation.
Sustainability	5	This strategy relies heavily on City's reclaimed water to be viable. This supply should be available for at least 60 years unless the City seeks to use the reclaimed water for another beneficial purpose.
Quality	2	This strategy uses reclaimed water, state water/natural inflows, and playa lake developed water. Sufficient blending and detention time is available most years. However, advanced treatment may be necessary during extended drought periods. Costs include advanced treatment.
Unit Cost after Debt Service	4	The unit cost of water for this strategy is $0.89/1,000 gal.
Project Cost	1	The project cost for this strategy is $207,261,000.
Operational Complexity	2	This project will require advanced treatment due to the large proportion of reclaimed water that will be stored in the reservoir.
Energy Efficiency	4	The energy efficiency for this strategy is 2,224 kWh/MG produced.

Raw Score	26.4
Weighted Score	31.8

Table 12.16. Post Reservoir – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	1.8	There is mixed public interest for this project. Some existing water rights holders may be opposed to the lake while some elected officials may be interested in economic development in Garza County. Moreover, due to complex permitting issues, high project costs, and length of time required to plan and construct a reservoir, confidence levels are low. The City would need to obtain ownership of the TCEQ Certificate of Adjudication No. 3711 from the White River Municipal Water District in order to construct the reservoir. The permit will need to be amended so the City can divert sufficient water to make this strategy viable. In addition, a USACE Section 404 permit will be required prior to commencing construction of the Post Reservoir. The project would bifurcate existing habitat for the smalleye and sharpnose shiners, two minnow species recently added to the Endangered Species List. Mitigation plans for the project's environmental impacts must be developed and agreed upon by the USACE and other state and resource agencies. The City must also acquire the property for the lake, dam, pump station, wildlife mitigation area, and pipeline easements.
Reliability/ Vulnerability	3	This strategy uses a combination of reclaimed water, state water/natural inflows, and playa lake developed water. Reclaimed water availability is dependent on City water usage and operational decisions at the wastewater treatment plant. State water/natural inflows and playa lake developed water are dependent upon precipitation. Yield data requires additional studies to increase reliability score.
Sustainability	5	This strategy relies heavily on City's reclaimed water to be viable. This supply should be available for at least 80 years unless the City seeks to use the reclaimed water for another beneficial purpose.
Quality	3	This strategy uses reclaimed water, state water/natural inflows, and playa lake developed water. Advanced treatment with membrane barriers is necessary.
Unit Cost after Debt Service	3	The unit cost of water for this strategy is $0.78/1,000 gal.
Project Cost	1	The project cost for this strategy is $122,643,000.
Operational Complexity	3	This project would require coordinated operation with the existing LAH pipeline facilities, and differences in water quality may make also increase the project's operational complexity.
Energy Efficiency	4	The energy efficiency for this strategy is 2,102 kWh/MG produced.

Raw Score	23.8
Weighted Score	26.1

Table 12.17. North Fork Scalping Operation – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3.2	This strategy requires the City to file a new water rights permit application with the TCEQ. It is uncertain whether the TCEQ will grant any more permits on the North Fork. The water availability may be over allocated already. It is uncertain whether existing water rights holders would protest the application. A water use permit authorized by the TCEQ will be required for the impoundment and diversion of storm water. A USACE Section 404 permit will also be required. The City will need to acquire property for the diversion facilities and pump station. In addition, pipeline utility easements will be necessary to construct a raw water transmission line to Gobbler Creek.
Reliability	3	The water used for this strategy is storm water and is, therefore, dependent upon precipitation events. Consequently, this is not the most reliable source of water. It will help "firm up" LAH's yield.
Sustainability	5	If precipitation patterns, land use, and senior water rights usage trends do not change in the coming decades, this project should be sustainable for more than 80 years.
Quality	3	This strategy is comprised of storm water flows that flow into LAH. Advanced treatment with membrane barriers is necessary.
Unit Cost after Debt Service	3	The unit cost of water for this strategy is $1.08/1,000 gal.
Project Cost	1	The project cost for this strategy is $144,564,000.
Operational Complexity	3	This project requires intermittent operation of large facilities.
Energy Efficiency	3	The energy efficiency for this strategy is 3,889 kWh/MG produced.

Raw Score	24.2
Weighted Score	27.4

12.2.5 Aquifer Storage and Recovery Strategies

Table 12.18. Reclaimed Water ASR to NWTP– Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3.2	ASR has not been attempted in the Lubbock area of the Ogallala Aquifer. Due to the many uncertainties in reliability, sustainability, and water losses during storage, confidence in this strategy is low. Public perception of potable reuse in Texas has improved some. Improvements in technology and drought conditions have stimulated increased desire in many communities to implement this type of strategy. Standards, rules, and regulations are still being developed. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. Future permits must comply with these "undeveloped" regulations. Permits will also be needed from the Groundwater Conservation District for injection and extraction of groundwater.
Reliability/ Vulnerability	5	This strategy uses 100% reclaimed water. Reclaimed water availability is dependent on commitments to other users and operational decisions. The water supplied is interruptible. Also, some water is lost between injection into the aquifer and recovery from the aquifer.
Sustainability	5	The water used by this strategy will be 100% reclaimed water. This supply should be available for at least 60 years unless the City seeks to use the reclaimed water for another beneficial purpose.
Quality	2	The water used by this strategy must be treated using RO plus other barriers during advanced treatment since it includes direct reuse of wastewater effluent.
Unit Cost after Debt Service	3	The unit cost of water for this strategy is $1.59/1,000 gal after debt service
Project Cost	4	The project cost for this strategy is $54,806,000.
Operational Complexity	1	This project requires advanced treatment and operation of ASR facilities for which little experience is available.
Energy Efficiency	3	The energy efficiency for this strategy is 4,375 kWh/MG produced.

Raw Score	26.2
Weighted Score	30.9

Table 12.19. Reclaimed Water ASR to SWTP– Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3.4	ASR has not been attempted in the Lubbock area of the Ogallala Aquifer. Due to the many uncertainties in reliability, sustainability, and water losses during storage, confidence in this strategy is low. Public perception of potable reuse in Texas has improved some. Improvements in technology and drought conditions have stimulated increased desire in many communities to implement this type of strategy. Standards, rules, and regulations are still being developed. The TCEQ is currently developing potable reuse guidance requirements to be applied to proposed projects and to be used as the basis for reviewing permit applications. Future permits must comply with these "undeveloped" regulations. Permits will also be needed from the Groundwater Conservation District for injection and extraction of groundwater.
Reliability/ Vulnerability	5	This strategy uses 100% reclaimed water. Reclaimed water availability is dependent on commitments to other users and operational decisions. The water supplied is interruptible. Also, some water is lost between injection into the aquifer and recovery from the aquifer.
Sustainability	5	The water used by this strategy will be 100% reclaimed water. This supply should be available for at least 60 years unless the City seeks to use the reclaimed water for another beneficial purpose.
Quality	2	The water used by this strategy must be treated using RO plus other barriers during advanced treatment since it includes direct reuse of wastewater effluent.
Unit Cost after Debt Service	2	The unit cost of water for this strategy is $1.93/1,000 gal after debt service
Project Cost	1	The project cost for this strategy is $133,592,000.
Operational Complexity	1	This project requires advanced treatment and operation of ASR facilities for which little experience is available.
Energy Efficiency	1	The energy efficiency for this strategy is 5,850 kWh/MG produced.

Raw Score	19.5
Weighted Score	23.3

Table 12.20. CRMWA to Aquifer Storage & Recovery – Strategy Evaluation

Category	Raw Score	Reason for Score
Confidence	3.6	ASR has not been attempted in the Lubbock area of the Ogallala Aquifer. Due to the many uncertainties in reliability, sustainability, and water losses during storage, confidence in this strategy is low. It is uncertain when excess water will be available in the CRMWA Aqueduct to use for ASR. Both injection and recovery wells will need to be permitted by the High Plains Underground Water Conservation District No. 1. Design and construction of the public water supply transmission facilities must be approved by the TCEQ.
Reliability/ Vulnerability	3	This strategy seeks to store CRMWA water during the winter months so it can be used in the summer to meet peak demands. The amount of water available for storage is dependent upon the amount of excess capacity in the CRMWA Aqueduct.
Sustainability	4	Long-term sustainability of this strategy is dependent upon how CRMWA uses the capacity of the existing or future aqueducts that supply Lubbock with water. Important factors include member city allocations which are set annually and Lubbock's water demand/usage. These factors will likely change in future years creating some uncertainty.
Quality	3	Groundwater recovered from the Ogallala Aquifer is high quality. It should only require chlorination for treatment.
Unit Cost	5	The unit cost of water for this strategy is $0.43/1,000 gal.
Project Cost	3	The project cost for this strategy is $97,870,000.
Operational Complexity	1	This project requires operation of ASR facilities for which little experience is available.
Energy Efficiency	4	The energy efficiency for this strategy is 1,242 kWh/MG produced.

Raw Score	26.6
Weighted Score	32.7

12.3 Strategy Scoring

Based on the aggregate score for each strategy, the strategies were compared and ranked. Scores ranged from 27 to 38.5. The results of the scoring by type of water supply (reclaimed water, surface water, and groundwater) are presented in Table 12.21. From this table the following general observations can be made:

- The highest scoring reclaimed water strategy is the Lubbock Land Application Site (LLAS) Potable Reuse;
- The highest scoring groundwater strategy is the Roberts County Well Field (RCWF) Capacity Maintenance;
- The highest scoring surface water strategy is Lake Alan Henry (LAH) Phase 2;
- Strategies involving Ogallala groundwater generally have the highest scores of all categories; and

- Reclaimed water strategies demonstrated a wider range in scores than the other types of strategies.

Table 12.22 provides a list of the strategies sorted by their respective scores (highest to lowest). From this table the following general observations can be made:

- The two top ranked strategies – RCWF Capacity Maintenance and the Bailey County Well Field (BCWF) Capacity Maintenance are associated with existing Ogallala water supplies;
- The RCWF New Transmission Line provides the most incremental increase in water supply at 21,583 ac-ft/yr;
- The BCWF Capacity Maintenance provides the least incremental increase in water supply at 286 ac-ft/yr; and
- Four strategies have essentially the same score – Lake Alan Henry Phase 2, Jim Bertram Lake 7, Direct Potable Reuse (DPR) to North Water Treatment Plant (NWTP) from Southeast Water Reclamation Plant (SEWRP), and DPR Option 7B (Northwest Water Reclamation Plant [NWWRP] to NWTP).

Figure 12.1 provides a graphical representation of the ranking of the strategies and the amount of additional water each strategy will provide. This information is used to prepare the strategic supply packages presented in Section 13.

Table 12.21. Water Supply Strategy Scores by Supply Type

Lubbock Water Supply Strategies	2016 Region O Plan[3]	Additional Studies since 2013 SWSP	Incremental Capacity Increase (ac-ft/yr)	Reliability/ Vulnerability	Sustainability	Quality	Unit Cost after debt	Project Cost	Operational Complexity	Energy Efficiency	Confidence	Raw Score	Total Weight Score
Weight				1.0	1.0	0.5	1.5	1.0	0.5	1.5	2.0		
Reclaimed Water													
LLAS Groundwater Potable Reuse		yes	2,240	5	3	1	4	4	1	5	3.8	26.8	34.1
North Fork Diversion to LAH Pump Station	Alt	no	12,385	3	5	3	4	3	3	4	3.6	28.6	33.2
DPR to NWTP from SEWRP	Alt	yes	9,274	5	5	1	4	2	1	4	3.4	25.4	31.8
DPR Option 7B (NWWRP to NWTP)		yes	5,376	5	5	1	4	3	1	3	3.6	25.6	31.7
South Fork Discharge - LAH Supplement	Alt	no	13,058	4	5	3	4	2	3	2	3.0	26	29
DPR to SWTP from SEWRP	Alt	no	9,274	5	5	1	3	1	1	4	3.2	23.2	28.9
DPR Option 8 (NWWRP to PS9)		yes	5,376	5	5	1	3	3	1	3	2.4	23.4	27.8
North Fork Diversion - County Road 7300	Alt	yes	10,089	5	5	1	3	1	1	3	3	22	27
Groundwater													
RCWF - Capacity Maintenance		no	11,630	5	3	3	5	5	5	4	4	34	38.5
BCWF Capacity Maintenance	Rec	yes	286	3	1	4	5	5	5	5	4.2	32.2	36.9
RCWF - New Transmission Line[1]	Rec	no	21,583	5	3	3	4	2	5	1	3.8	26.8	29.1
Surface Water													
LAH - Phase 2	Rec	no	4,875	4	5	3	2	3	5	2	5	29	32
Jim Bertram Lake 7	Rec	yes	11,975	5	5	2	4	1	2	4	3.4	26.4	31.8
North Fork Scalping Operation	Rec	no	13,600	3	5	3	3	1	3	3	3.2	24.2	27.4
Post Reservoir	Alt	no	13,837	3	5	3	3	1	3	4	1.8	23.8	26.1
ASR Water													
CRMWA ASR[2]	Rec	yes	10,920	3	4	3	5	3	1	4	3.6	26.6	32.7
Reclaimed ASR to NWTP	Alt	yes	5,600	5	5	2	3	4	1	3	3.2	26.2	30.9
Reclaimed ASR to SWTP		yes	5,600	5	5	1	2	1	1	1	3.4	19.4	23.3

1 - Strategy is dependent on another for the full yield or full operation.

2 - Strategy would be activated if CRMWA Lake Meredith supplies are unavailable due to drought or water quality.

3 - "Alt" and "Rec" indicate alternative or recommended strategy in the 2016 Region O Plan.

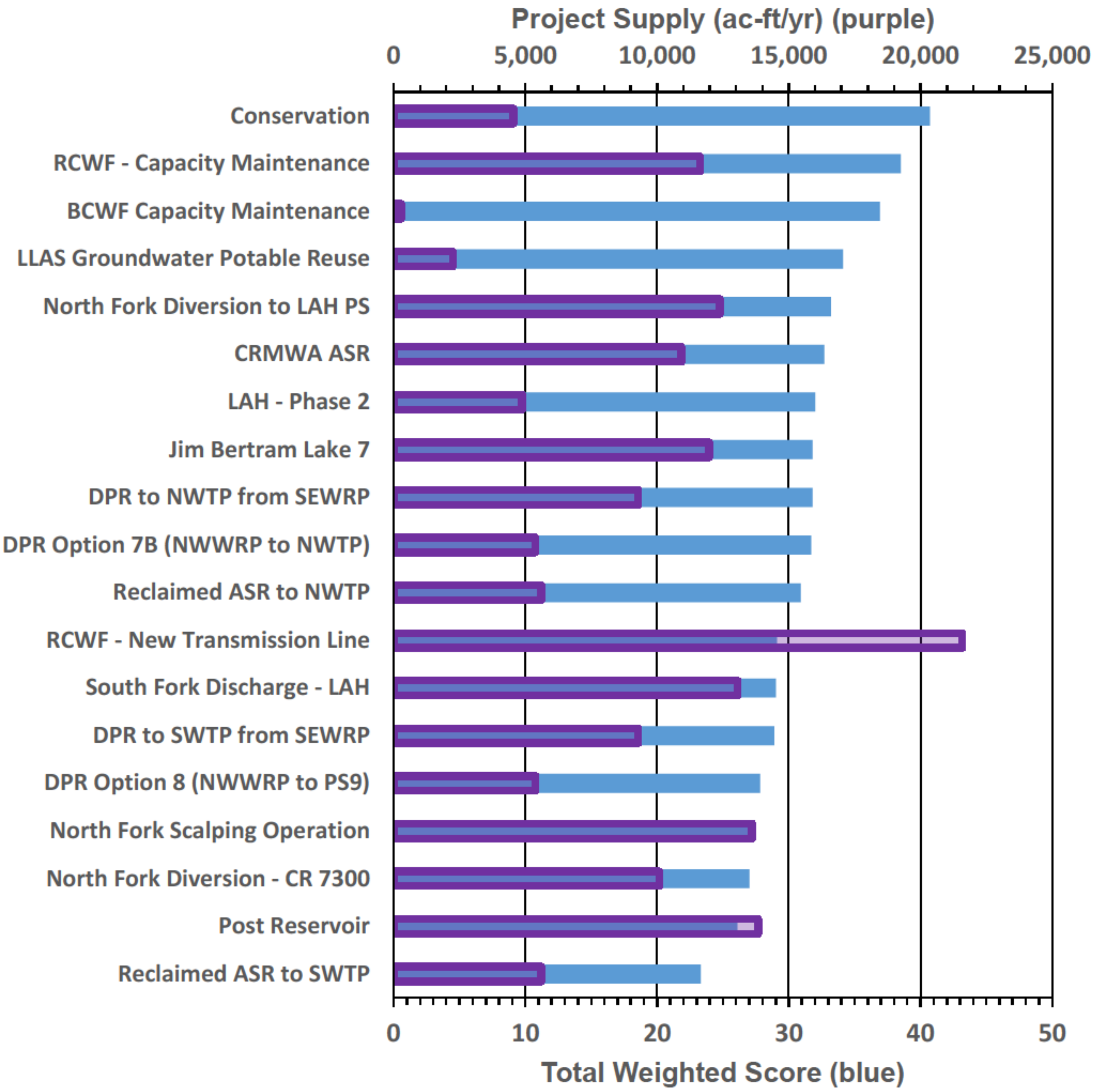
Table 12.22. Water Supply Strategy Scores from Highest to Lowest

Lubbock Water Supply Strategies	2016 Region O Plan	Additional Studies since 2013 SWSP	Incremental Capacity Increase (ac-ft/yr)	Reliability/ Vulnerability	Sustainability	Quality	Unit Cost after debt	Project Cost	Operational Complexity	Energy Efficiency	Confidence	Raw Score	Total Weight Score
Weight				1.0	1.0	0.5	1.5	1.0	0.5	1.5	2.0		
RCWF - Capacity Maintenance		no	11,630	5	3	3	5	5	5	4	4	34	38.5
BCWF Capacity Maintenance	Rec	yes	286	3	1	4	5	5	5	5	4.2	32.2	36.9
LLAS Groundwater Potable Reuse		yes	2,240	5	3	1	4	4	1	5	3.8	26.8	34.1
North Fork Diversion to LAH Pump Station	Alt	no	12,385	3	5	3	4	3	3	4	3.6	28.6	33.2
CRMWA ASR2	Rec	yes	10,920	3	4	3	5	3	1	4	3.6	26.6	32.7
LAH - Phase 2	Rec	no	4,875	4	5	3	2	3	5	2	5	29	32
DPR to NWTP from SEWRP	Alt	yes	9,274	5	5	1	4	2	1	4	3.4	25.4	31.8
Jim Bertram Lake 7	Rec	yes	11,975	5	5	2	4	1	2	4	3.4	26.4	31.8
DPR Option 7B (NWWRP to NWTP)		yes	5,376	5	5	1	4	3	1	3	3.6	25.6	31.7
Reclaimed ASR to NWTP	Alt	yes	5,600	5	5	2	3	4	1	3	3.2	26.2	30.9
RCWF - New Transmission Line1	Rec	no	21,583	5	3	3	4	2	5	1	3.8	26.8	29.1
South Fork Discharge - LAH Supplement	Alt	no	13,058	4	5	3	4	2	3	2	3	26	29
DPR to SWTP from SEWRP	Alt	no	9,274	5	5	1	3	1	1	4	3.2	23.2	28.9
DPR Option 8 (NWWRP to PS9)		yes	5,376	5	5	1	3	3	1	3	2.4	23.4	27.8
North Fork Scalping Operation	Rec	no	13,600	3	5	3	3	1	3	3	3.2	24.2	27.4
North Fork Diversion - County Road 7300	Alt	yes	10,089	5	5	1	3	1	1	3	3	22	27
Post Reservoir	Alt	no	13,837	3	5	3	3	1	3	4	1.8	23.8	26.1
Reclaimed ASR to SWTP		yes	5,600	5	5	1	2	1	1	1	3.4	19.4	23.3

1 - Strategy is dependent on another for the full yield or full operation.

2 - Strategy would be activated if CRMWA Lake Meredith supplies are unavailable due to drought or water quality.

Figure 12.1. Supply Strategy Scoring and Available Water



13 Water Supply Packages

In this section, various potential water supply strategies are combined with existing water supplies to create water supply package designed to meet the City of Lubbock (City's) projected water demand over the next 100 years. The supply packages were developed by:

- Meeting projected water demands for the 100 year planning period (through 2118);
- Incorporating existing water supplies discussed in Section 4;
- Basing the need for a new strategy on either the Annual Water Demand (AWD) projection or the Peak Day Demand (PDD) projection, whichever intersects with the projected supply line (associated with the demand) first. (Note that the peak day supply capacity is often the critical factor when deciding on when to implement strategies later in the planning timeline); and
- Providing a diverse set of supply packages for meeting the City's future demands.

Five different supply packages are presented and discussed in this section that depict a wide range of strategies that can be used to meet the Expected Drought, Conservation and/or Accelerated Growth Demands presented in Section 2.

13.1 Supply Package 1 – Early Diversification

The Early Diversification supply package is intended to continue diversifying the City's water supplies so that the City is not overly dependent on a single source of supply. The City enjoys a diverse set of water supplies relying on two separate groundwater sources and two separate surface water sources. The City's current sources of supply all originate and are transported from a relatively long distance from the City and are individually vulnerable to interruption due to a variety of factors including power outages, structural failures such as pipeline breaks, water quality contamination, natural phenomena such as extended drought and wildfires, and criminal activities. Just as it is wise financially to maintain diverse investment portfolios, it is wise for the City to continue to maintain the diversity of its water supply portfolio to meet its future water supply needs.

The Early Diversification supply package meets water demands under the Conservation demand scenario by maintaining and/or increasing supplies from the existing Roberts County and Bailey County Well Fields (RCWF and BCWF) and Lake Alan Henry (LAH), and also develops a new source of supply at a fairly early stage, Jim Bertram Lake 7. Because Lake 7 will utilize the City's reclaimed effluent as the primary portion of its yield, supply from Lake 7 will be relatively drought proof. Its proximate location to the City renders it somewhat less vulnerable to extended interruption than the City's existing supplies that are located much further away from Lubbock.

Figure 13.1compares the City's annual and PDDs with the supplies developed by the strategies in the package. Figure 13.2 presents a timeline for when the various strategies would be implemented.

Figure 13.1. Early Diversification Supply Package

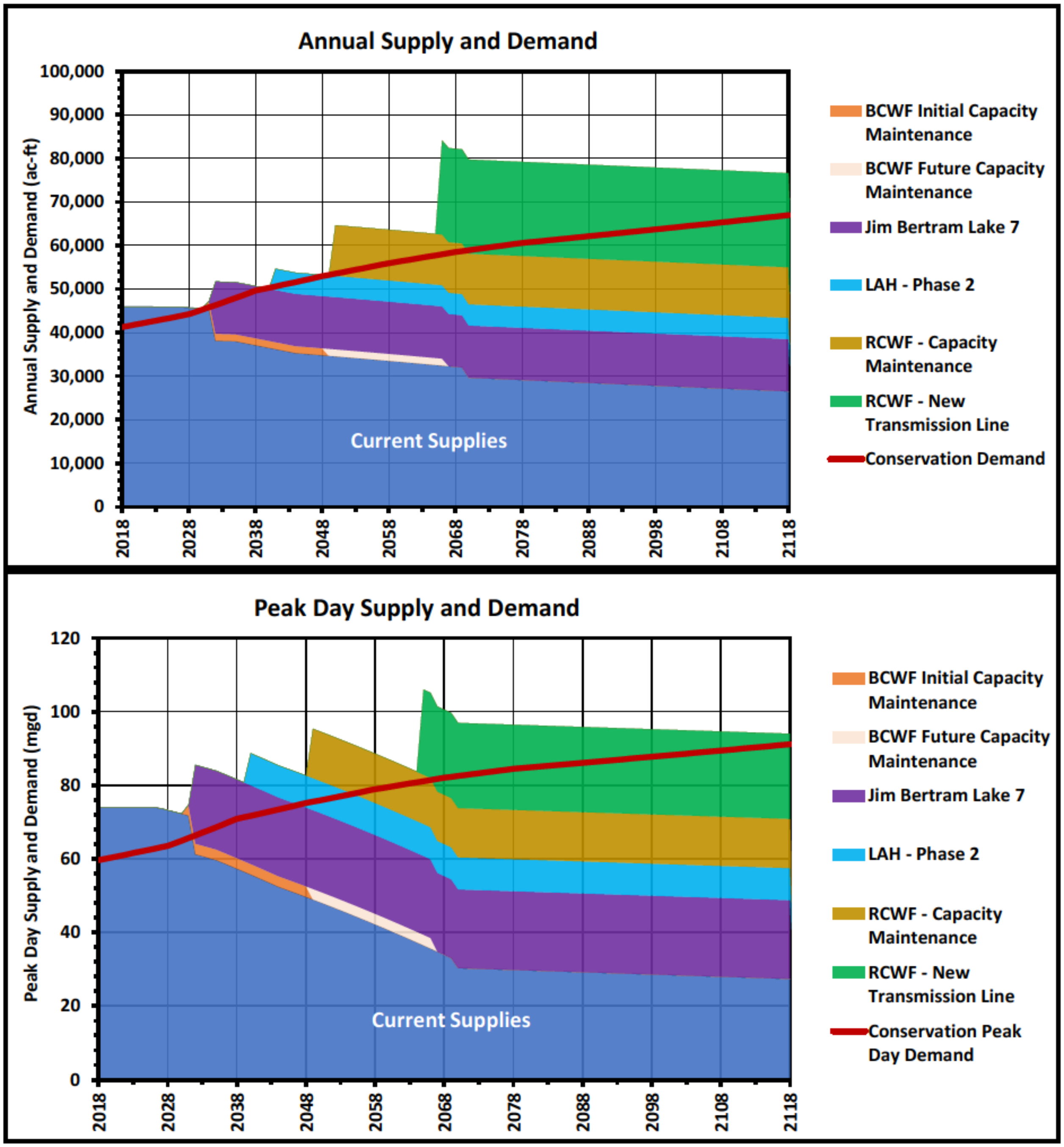
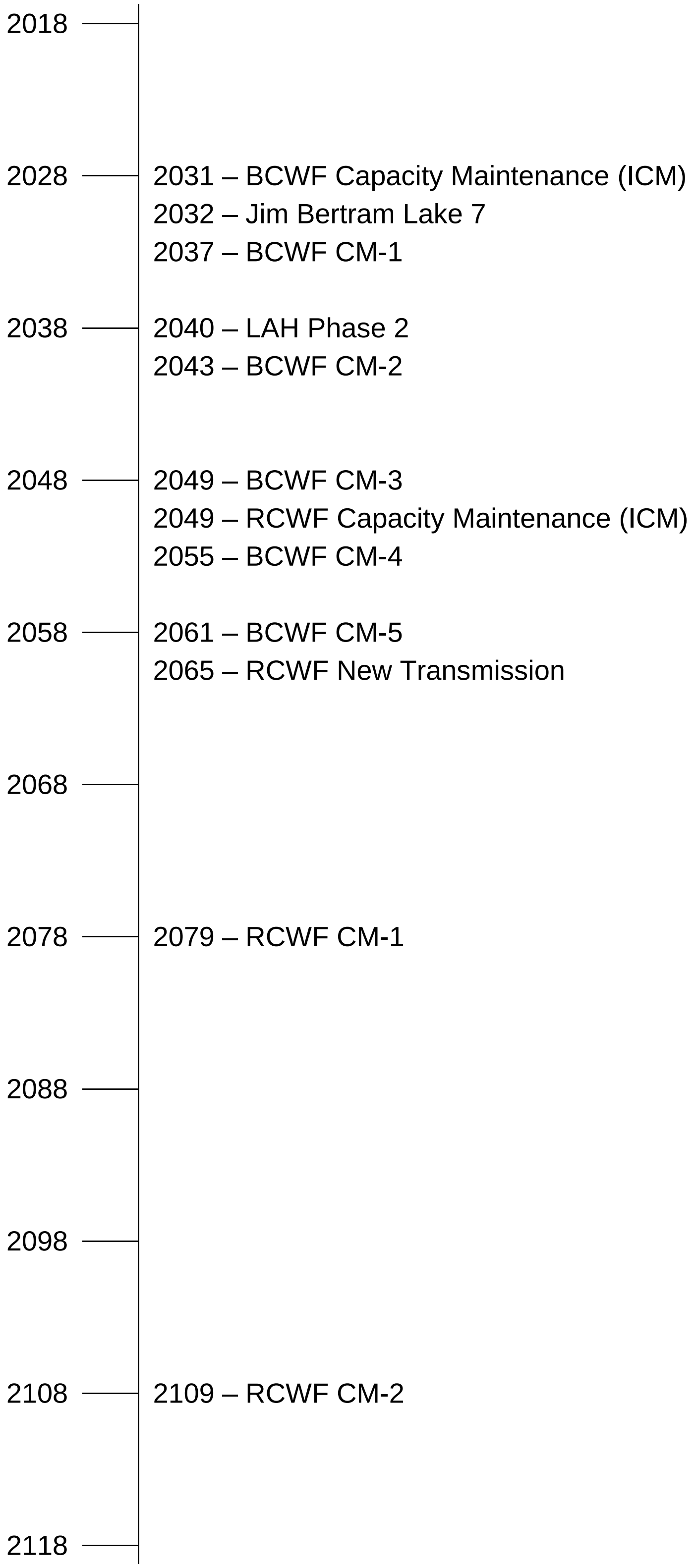


Figure 13.2. Timeline for Early Diversification Supply Package



2031 – BCWF Capacity Maintenance (ICM)
2032 – Jim Bertram Lake 7
2037 – BCWF CM-1
2040 – LAH Phase 2
2043 – BCWF CM-2
2049 – BCWF CM-3
2049 – RCWF Capacity Maintenance (ICM)
2055 – BCWF CM-4
2061 – BCWF CM-5
2065 – RCWF New Transmission
2079 – RCWF CM-1
2109 – RCWF CM-2

13.2 Supply Package 2 – Maximize RCWF

The Maximize RCWF supply package is intended to, as much as possible, increase reliance on supplies from the RCWF. The RCWF is a drought proof, dependable supply that is easily maintained and expanded and requires minimal water treatment. This supply package capitalizes on those characteristics early in the timeline. Expansion of surface water supplies (Lake 7 and LAH Phase 2) is delayed, and the BCWF is not maintained beyond its current configuration. Implementation of Lake 7 is needed by 2058 in order to meet PDDs, but could be delayed until almost 2088 if annual supplies were the only consideration.

Figure 13.3 compares the City's AWD and PDD with the supplies developed by the strategies in the package. Figure 13.4 presents a timeline for when the various strategies would be implemented.

Figure 13.3. Maximize RCWF Supply Package

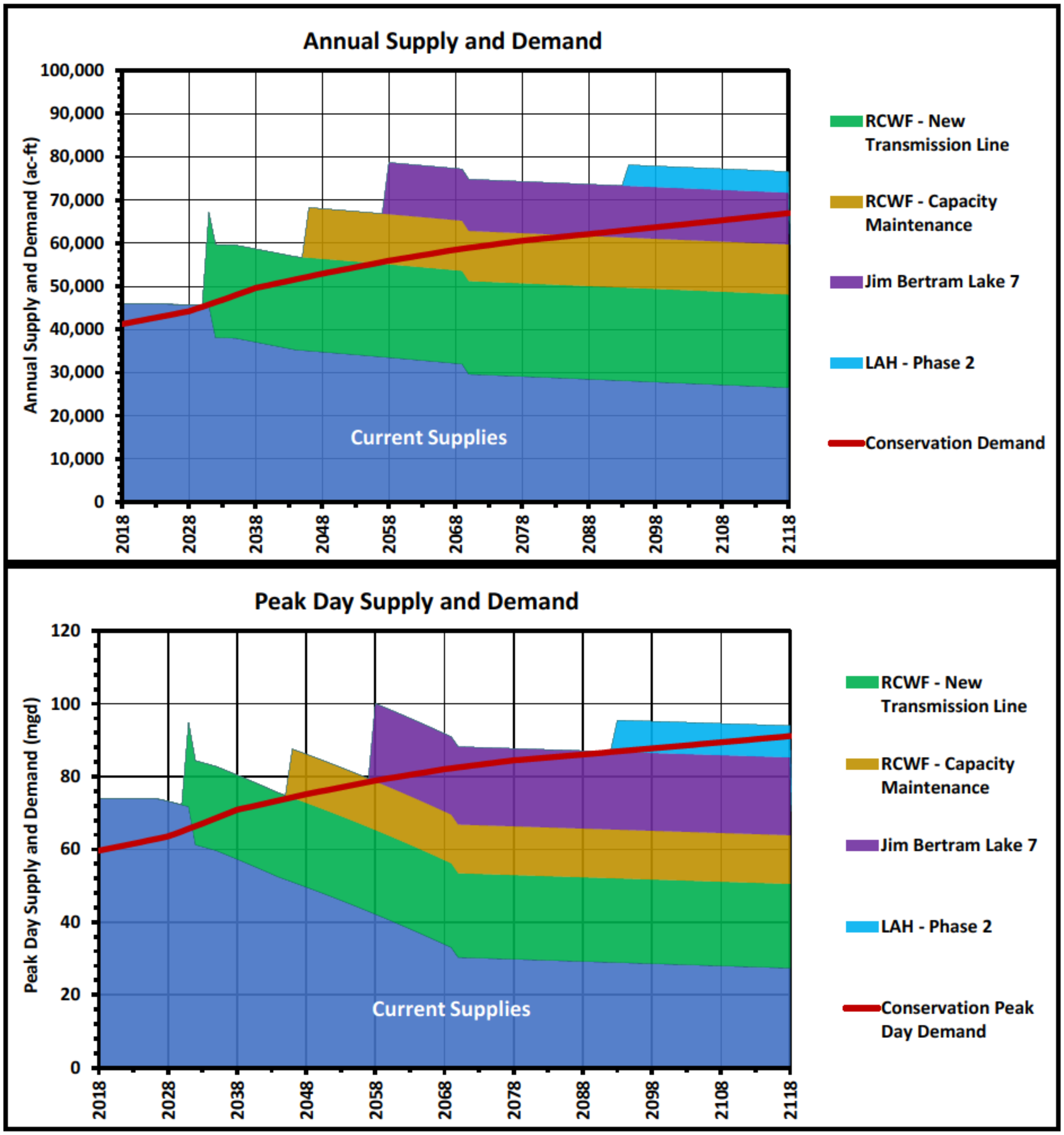
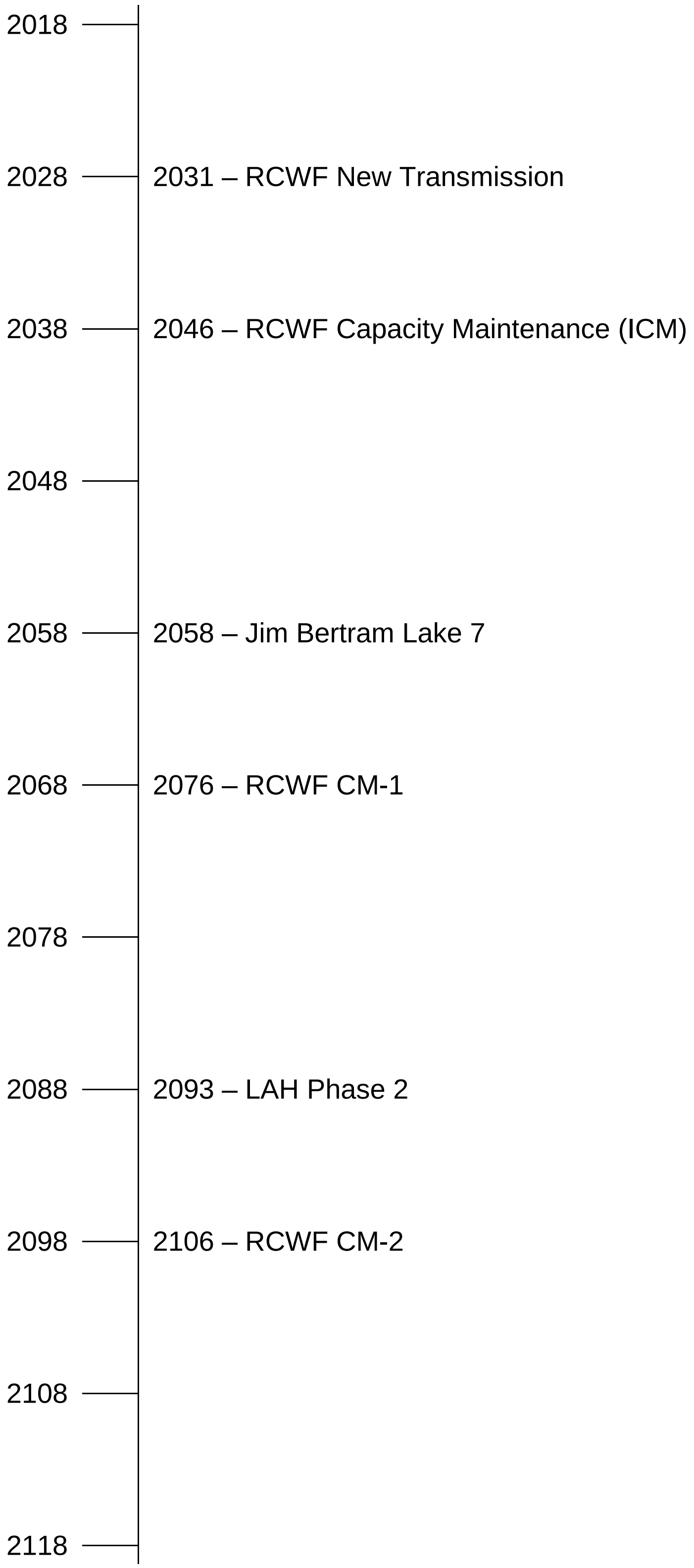


Figure 13.4. Timeline for Maximize RCWF Supply Package



13.3 Supply Package 3 – Maximize Groundwater

The Maximize Groundwater supply package is similar to the Maximize RCWF package, except that the BCWF continues to be expanded and maintained in order to retain its current 30 million gallons per day (mgd) peak day supply capacity, and the order in which the surface water supply projects (LAH Phase 2 and Lake 7) are implemented is reversed. This package delays the implementation of the RCWF strategies by one to three years. However, in order to meet PDDs in the 2060's, the Jim Bertram Lake 7 would need to be implemented soon after implementing LAH Phase 2.

Figure 13.5 compares the City's AWD and PDD with the supplies developed by the strategies in the package. Figure 13.6 presents a timeline for when the various strategies would be implemented.

Figure 13.5. Maximize Groundwater Supply Package

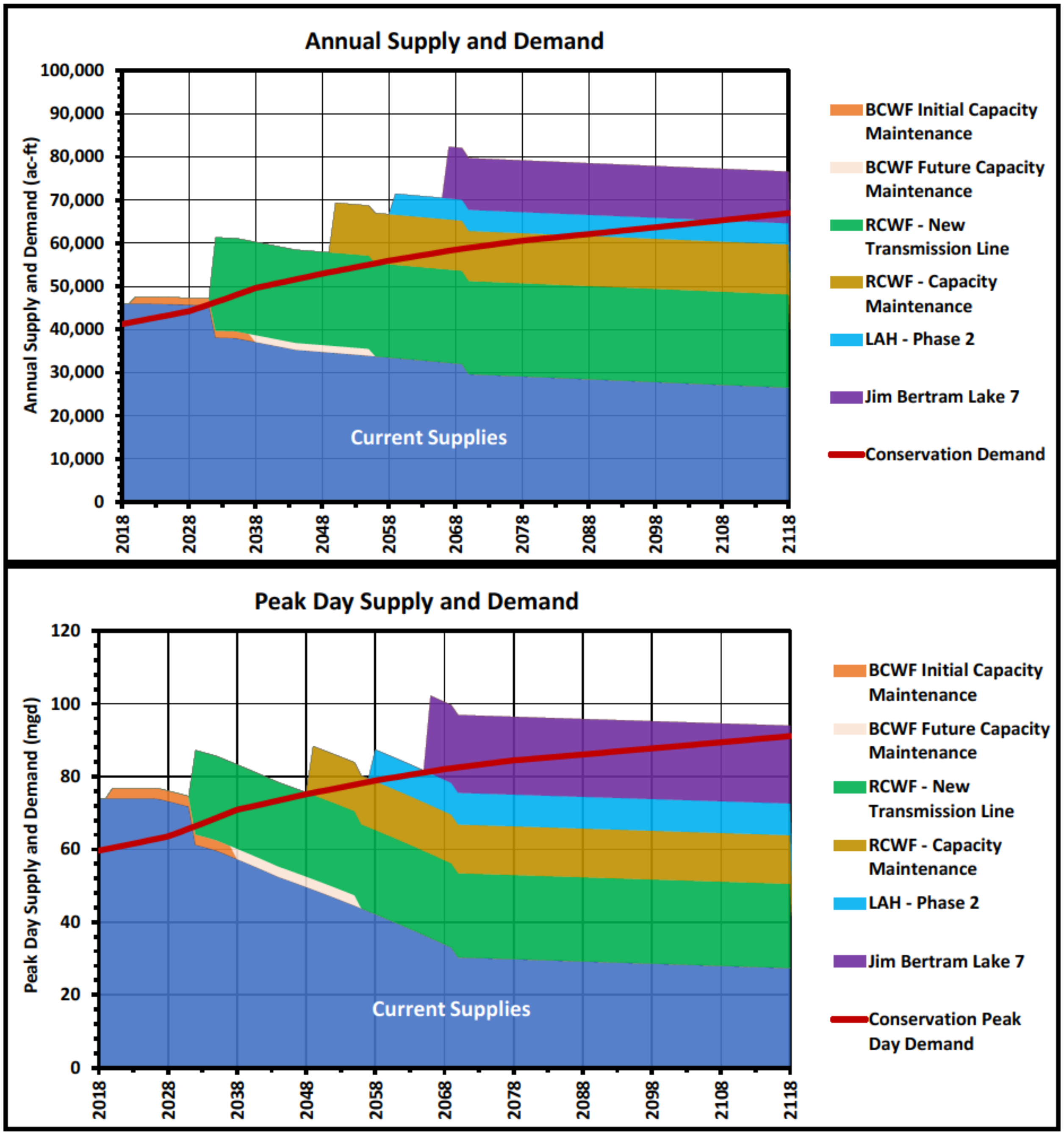


Figure 13.6. Timeline for Maximize Groundwater Supply Package

2018	2020 – BCWF Capacity Maintenance (ICM) 2026 – BCWF CM-1
2028	2032 – RCWF New Transmission 2032 – BCWF CM-2
2038	2038 – BCWF CM-3 2044 – BCWF CM-4
2048	2049 – RCWF Capacity Maintenance (ICM) 2050 – BCWF CM-5
2058	2058 – LAH Phase 2 2066 – Jim Bertram Lake 7
2068	
2078	2079 – RCWF CM-1
2088	
2098	
2108	2109 – RCWF CM-2
2118	

13.4 Supply Package 4 – Drought Demands

The Drought Demands supply package is intended to meet the larger demands under the Expected Demands scenario. Under the Expected Demands scenario, population growth follows the Expected progression, but water demands are not mitigated by successful conservation efforts and might be what would be expected under severe drought conditions. The Drought Demands supply package initiates water supply strategies sooner than the previous packages, and requires the implementation of the Canadian River Municipal Water Authority (CRMWA) Aquifer Storage and Recovery (ASR) strategy primarily to meet PDDs projected to occur by the 2060's. If these PDDs can be mitigated, then the CRMWA ASR project can be delayed or phased in more slowly over time. This supply package demonstrates the intensive water supply development that would be required if anticipated conservation savings cannot be realized.

Figure 13.7compares the City's AWD and PDD with the supplies developed by the strategies in the package. Figure 13.8 presents a timeline for when the various strategies would be implemented.

Figure 13.7. Drought Demands Supply Package

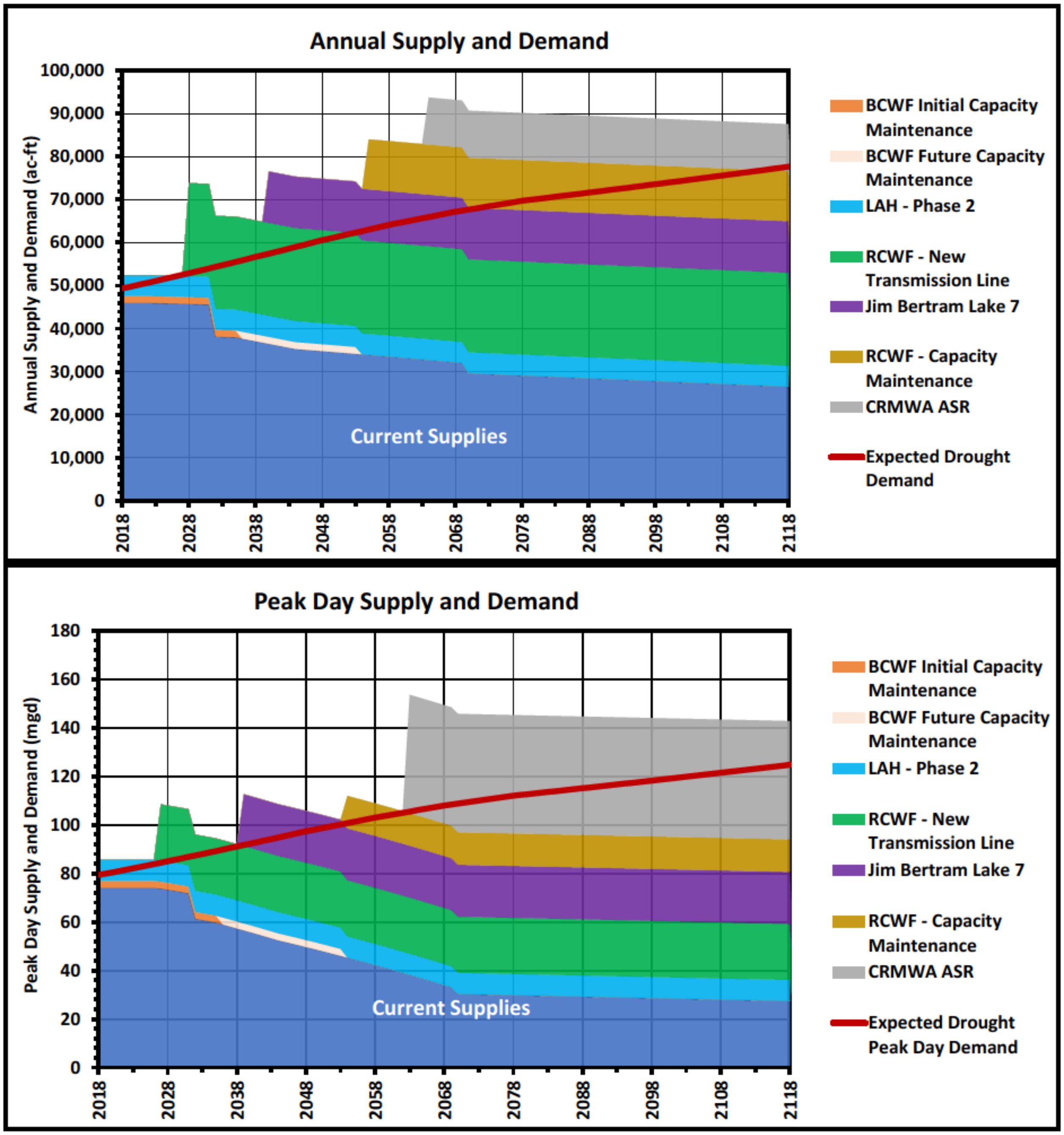


Figure 13.8. Timeline for Drought Demands Supply Package

2018	2018 – BCWF Capacity Maintenance (ICM) 2018 – LAH Phase 2 2024 – BCWF CM-1
2028	2027 – RCWF New Transmission 2030 – BCWF CM-2
2038	2036 – BCWF CM-3 2039 – Jim Bertram Lake 7 2042 – BCWF CM-4
2048	2048 – BCWF CM-5 2054 – RCWF Capacity Maintenance (ICM)
2058	2063 – CRMWA ASR
2068	
2078	2084 – RCWF CM-1
2088	
2098	
2108	2114 – RCWF CM-2
2118	

13.5 Supply Package 5 – Accelerated Population Growth

The Accelerated Population Growth supply package is designed to meet water demands under a combination of faster than expected population growth, but with annual water demands mitigated by conservation savings. Under the Accelerated Population Growth scenario, annual water demands are actually smaller than the Expected water demands met by the Drought Demands water supply package in early years of the timeline because it is assumed that the accelerated population growth would necessitate more immediate water conservation savings. However, this scenario assumes that peak day reduction efforts are not as effective, and the timing of most of this package is driven by the need to meet future PDDs.

Figure 13.9 compares the City's AWD and PDD with the supplies developed by the strategies in the package. Figure 13.10 presents a timeline for when the various strategies would be implemented.

13.6 Comparison of Supply Package Schedules

Table 13.1 provides a comparison of the five supply packages discussed in this section. General observations concerning this comparison include:

- Many supply strategies are interchangeable, and various combinations of strategies can be implemented to meet the future AWD and PDD. The attractiveness of each strategy may change over time. Implementation schedules may change based on a variety of unpredictable variables including climate conditions, population, per capita consumption, industry need, changes in regulatory environments, etc.
- Direct potable reuse strategies typically will not provide the peaking capacity needed because of the cost of oversizing the advanced treatment facilities and are not included in any of the packages;
- Continued conservation efforts will delay the need for many of the strategies identified;
- If accelerated growth occurs, several additional strategies will need to be implemented to meet the projected AWD and PDD in 2118.

Figure 13.9. Accelerated Population Growth Supply Package

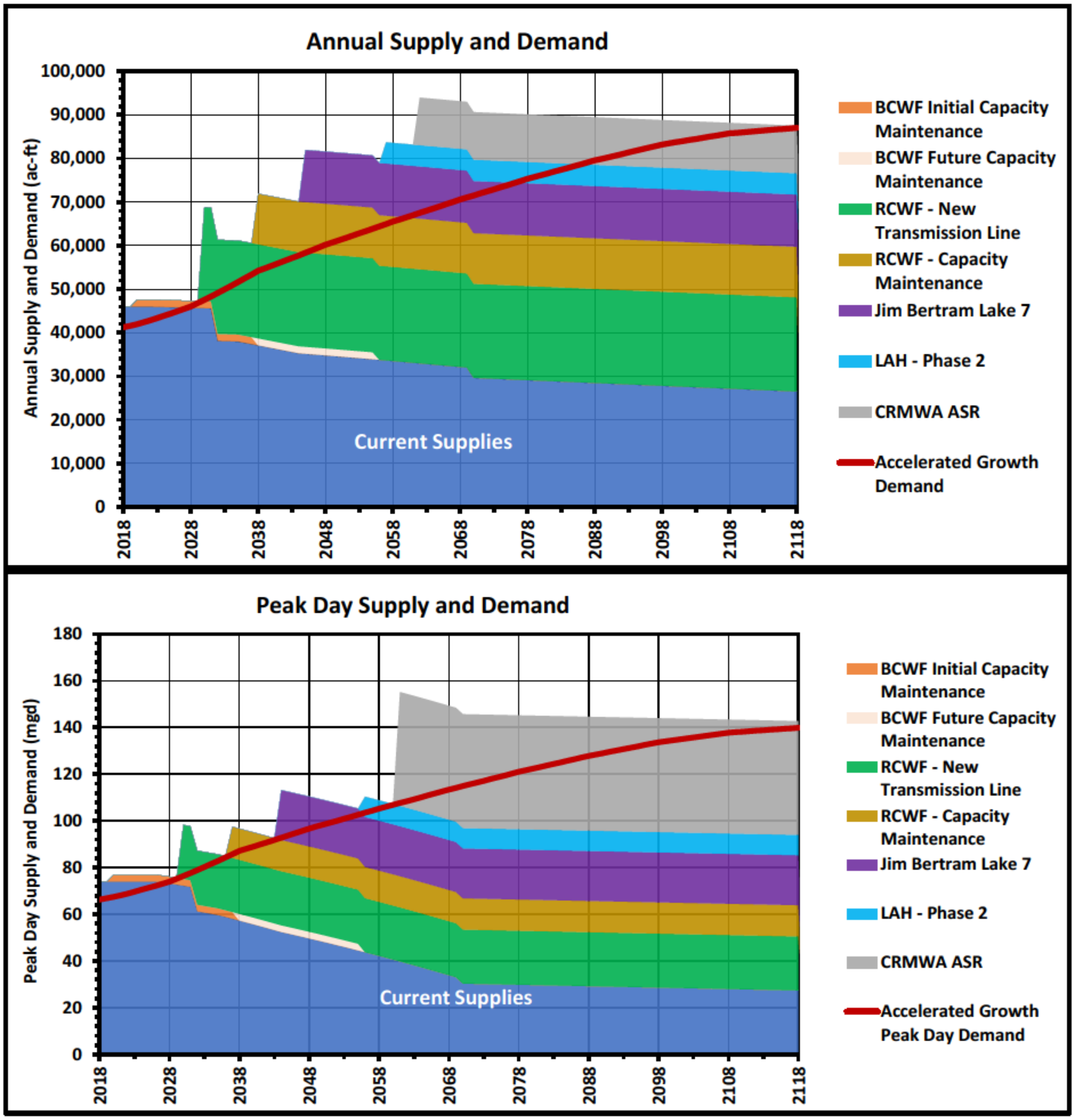


Figure 13.10. Timeline for Accelerated Population Growth Supply Package

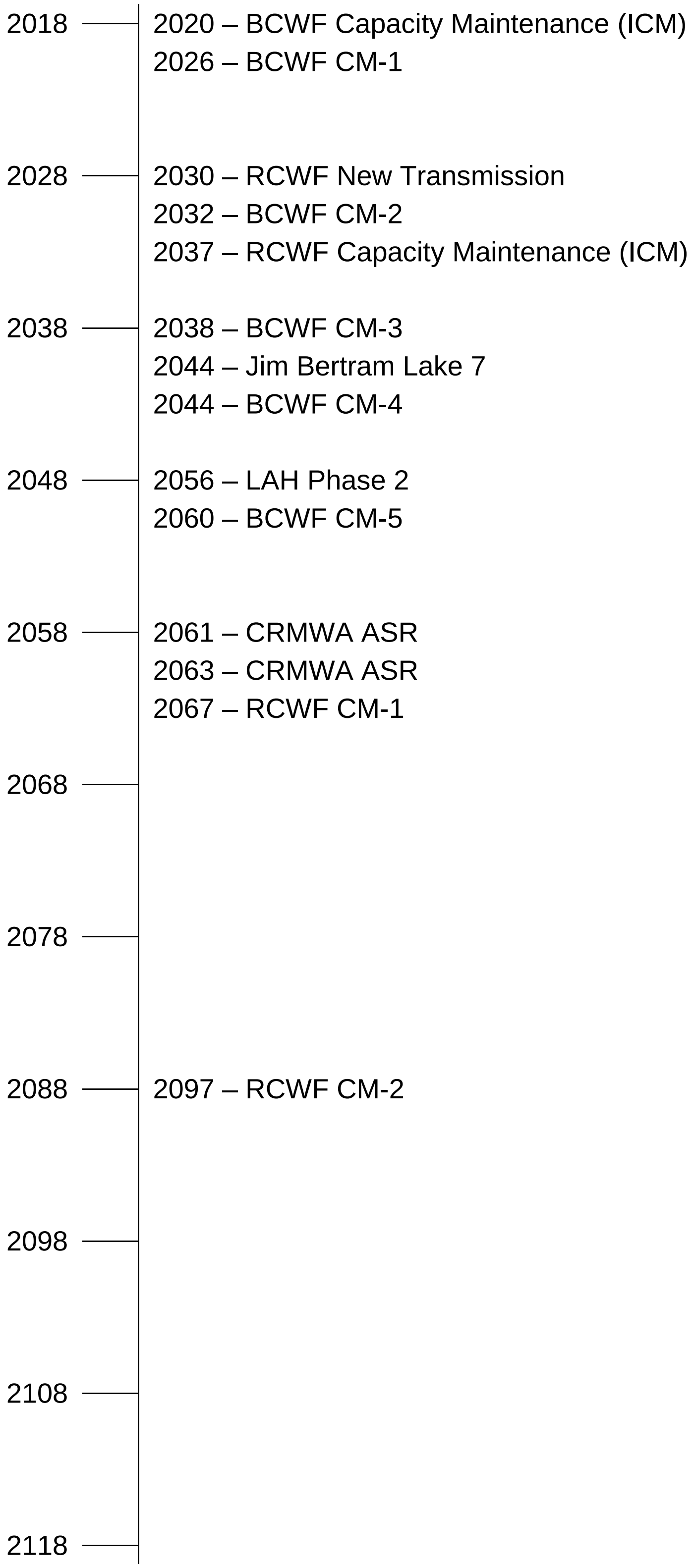


Table 13.1. Comparison of Supply Package Schedules

Supply Package 1 Early Diversification	Supply Package 2 Maximize RCWF	Supply Package 3 Maximize Groundwater	Supply Package 4 Drought Demands	Supply Package 5 Accelerated Population Growth
2018				
		2020: BCWF ICM 2026: BCWF CM-1	2018: BCWF ICM 2018: LAH Phase 2 2024: BCWF CM-1	2020: BCWF ICM 2026: BCWF CM-1
2028				
2031: BCWF ICM 2032: Jim Bertram Lake 7 2037: BCWF CM-1	2031: RCWF New Transmission	2032: RCWF New Transmission 2032: BCWF CM-2	2027: RCWF New Transmission 2030: BCWF CM-2	2032: BCWF CM-2 2030: RCWF New Transmission
2038				
2040: LAH Phase 2 2043: BCWF CM-2	2046: RCWF ICM	2038: BCWF CM-3 2044: BCWF CM-4	2036: BCWF CM-3 2039: Jim Bertram Lake 7 2042: BCWF CM-4	2037: RCWF ICM 2038: BCWF CM-3 2044: BCWF CM-4 2044: Jim Bertram Lake 7
2048				
2049: BCWF CM-3 2049: RCWF ICM 2055: BCWF CM-4		2049: RCWF ICM 2050: BCWF CM-5	2048: BCWF CM-5 2054: RCWF ICM	2050: BCWF CM-5 2056: LAH Phase 2
2058				
2061: BCWF CM-5 2065: RCWF New Transmission	2058: Jim Bertram Lake 7	2058: LAH Phase 2 2066: Jim Bertram Lake 7	2063: CRMWA ASR	2061: CRMWA ASR 2067: RCWF CM-1
2068				
	2076: RCWF CM-1			
2078				
2079: RCWF CM-1		2079: RCWF CM-1	2084: RCWF CM-1	
2088				
	2093: LAH Phase 2			2097: RCWF CM-2
2098				
	2106: RCWF CM-2			
2108				
2109: RCWF CM-2		2109: RCWF CM-2	2114: RCWF CM-2	
2118				

Note: ICM = Initial Capacity Maintenance, CM-1 = Capacity Maintenance-1, CM-2 = Capacity Maintenance-2, etc.

13.7 Financial Impact of the Water Supply Packages

The projects presented in each of the five water supply packages represent substantial capital investment by the City. The financial impact of each package will depend upon the actual timing of when specific projects are implemented. The net present value of each supply package was determined, in addition to a future debt service schedule, based upon the implementation schedule proposed for each package. The proposed implementation schedules can be adjusted to meet the City's needs, and the actual order in which projects are implemented can change based upon changes in the City's priorities, future water demands, and regulatory and other considerations.

A net present value (NPV) analysis was performed on each of the five water supply packages. As part of this analysis, assumptions were made regarding inflation rate, power cost inflation rate, discount rate, and the bond interest rate. These rates are summarizing in Table 13.2.

Table 13.2. Net Present Value Analysis – Assumed Rates Used in Calculations

Time Period	Inflation Rate	Power Cost Inflation Rate	Discount Rate	Bond Rate
2018 – 2042	3.2%	2.8%	2.0%	4.5%
2043 – 2067	3.5%	3.8%	2.1%	4.5%
2068 – 2092	3.8%	4.8%	2.2%	4.5%
2093 – 2117	4.1%	5.8%	2.3%	4.5%

13.7.1 Inflated Project Costs

Inflated project costs for each of the five water supply packages are shown in Table 13.3. These inflated costs account for estimated rates of inflation affecting future prices, using the rates shown in Table 13.2. Projects implemented later in the Plan have higher inflated costs than those implemented earlier. Table 13.3 lists the cost of projects if constructed today (Original Project Cost) and compares the inflated costs of those projects based upon their implementation date.

Table 13.3. Inflated Project Cost Comparison

		Package 1 Early Diversification		Package 2 Maximize RCWF		Package 3 Maximize Groundwater		Package 4 Drought Demands		Package 5 Accel. Population Growth	
Project Name	Original Project Cost (millions)	Year Financed	Inflated Project Cost (millions)	Year Financed	Inflated Project Cost (millions)	Year Financed	Inflated Project Cost (millions)	Year Financed	Inflated Project Cost (millions)	Year Financed	Inflated Project Cost (millions)
RCWF – CM (1)	$8.7	2047	$22.8	2044	$20.6	2047	$22.8	2052	$27.1	2035	$15.4
RCWF – CM (2)	$8.7	2077	$66.0	2074	$59.0	2077	$66.0	2082	$79.5	2065	$42.4
RCWF – CM (3)	$8.7	2107	$211.0	2104	$187.0	2107	$211.0	2112	$257.9	2095	$130.2
BCWF – CM (1)	$4.3	2029	$6.3			2018	$4.5	2018	$4.5	2018	$4.5
BCWF – CM (2)	$4.3	2035	$7.6			2024	$5.4	2022	$5.1	2024	$5.4
BCWF – CM (3)	$4.3	2041	$9.2			2030	$6.5	2028	$6.1	2030	$6.5
BCWF – CM (4)	$4.3	2047	$11.3			2036	$7.9	2034	$7.4	2036	$7.9
BCWF – CM (5)	$4.3	2053	$13.9			2042	$9.5	2040	$9.0	2042	$9.5
BCWF – CM (6)	$4.3	2059	$17.2			2048	$11.7	2046	$11.0	2048	$11.7
RCWF – New Transmission Line	$122.8	2063	$555.9	2029	$179.2	2030	$185.0	2025	$158.0	2028	$173.7
LAH – Phase 2	$98.7	2038	$191.3	2091	$1,255.2	2056	$351.2	2018	$101.9	2054	$327.8
Jim Bertram Lake 7	$207.3	2030	$312.1	2056	$737.4	2064	$971.0	2037	$389.1	2042	$455.5
CRMWA ASR	$97.9							2061	$413.6	2059	$386.1

Note: CM-1 = Capacity Maintenance-1, CM-2 Capacity Maintenance-2, etc.

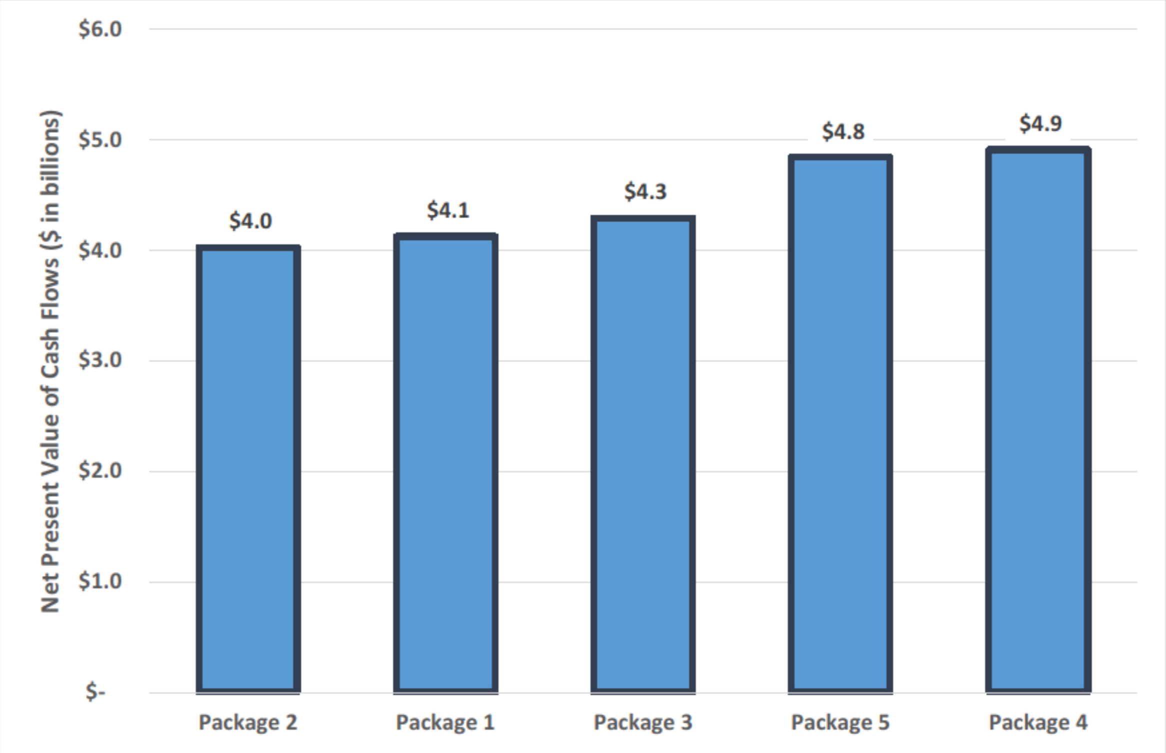
13.7.2 Net Present Value

A summary of the NPV Analysis is shown in Table 13.4 and Figure 13.11. Based on this analysis, the NPV of all five supply packages falls between $3.9 billion and $4.9 billion over the 100-year planning period.

Table 13.4. Net Present Value Analysis Summary (million dollars)

Package	Total Package Cost (Current Dollars)	Total Package Cost (Inflated Dollars)	Total Cash Flow (Inflated Dollars)	Net PV of Cash Flow
Package 1	$481	$1,424	$18,977	$4,127
Package 2	$455	$2,438	$19,522	$4,031
Package 3	$481	$1,852	$19,750	$4,294
Package 4	$579	$1,470	$20,955	$4,911
Package 5	$579	$1,577	$21,450	$4,844

Figure 13.11. Net Present Value Comparison of Supply Packages



As expected, Supply Package 2 is the least expensive alternative since it relies heavily on additional groundwater development (a less expensive alternative than surface water development). Similarly, Supply Package 4 is the most expensive alternative since it requires the implementation of more water supply strategies in order to meet the Drought Demand projections.

13.7.3 Future Debt Service

Figures 13.12 – 13.16 illustrate the timing of projected total debt to be financed for each water supply package, and the estimated debt payments, based upon the inflated project costs developed for the Net Present Value Analyses. The debt service for each project is based on a 20-year payout schedule. The cumulative debt and debt payments are superimposed on the graphs illustrating the timing of the various strategies included in each water supply package. Increases in cumulative debt or debt payments correspond with financing and implementation of each new water management strategy in a water supply package.

Figure 13.12. Debt Schedule for the Early Diversification Supply Package

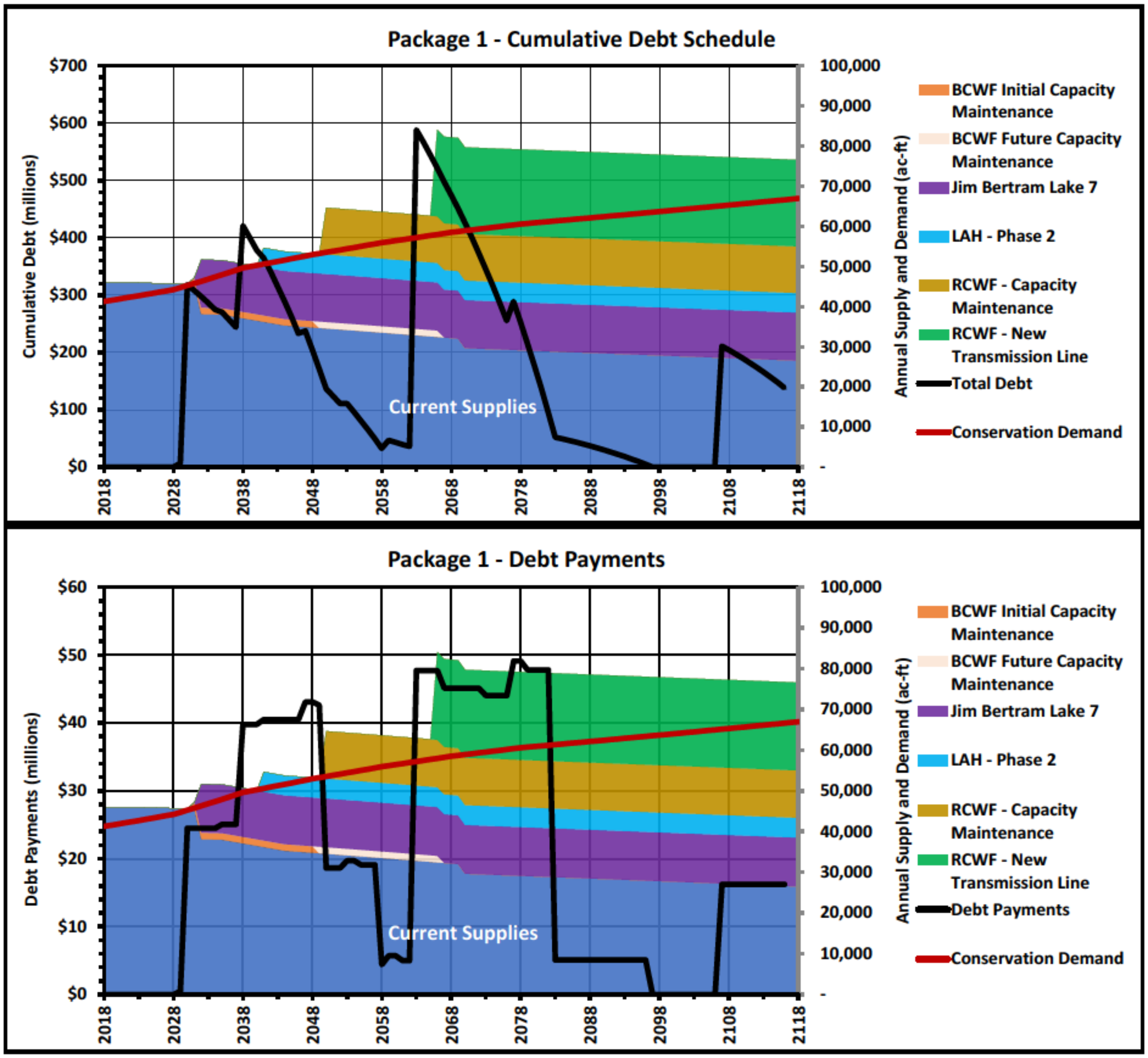


Figure 13.13. Debt Schedule for the Maximize RCWF Supply Package

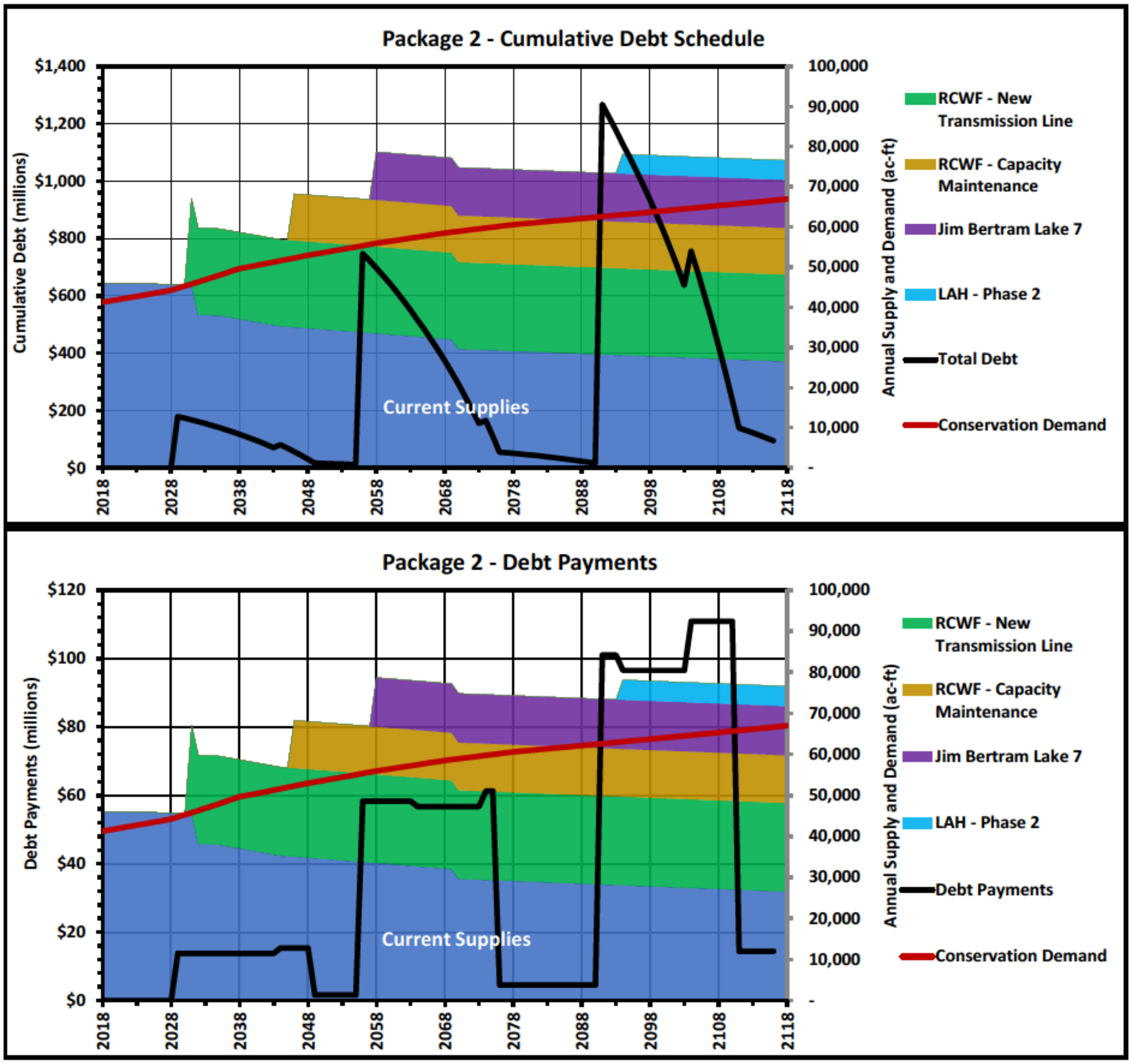


Figure 13.14. Debt Schedule for the Maximize Groundwater Supply Package

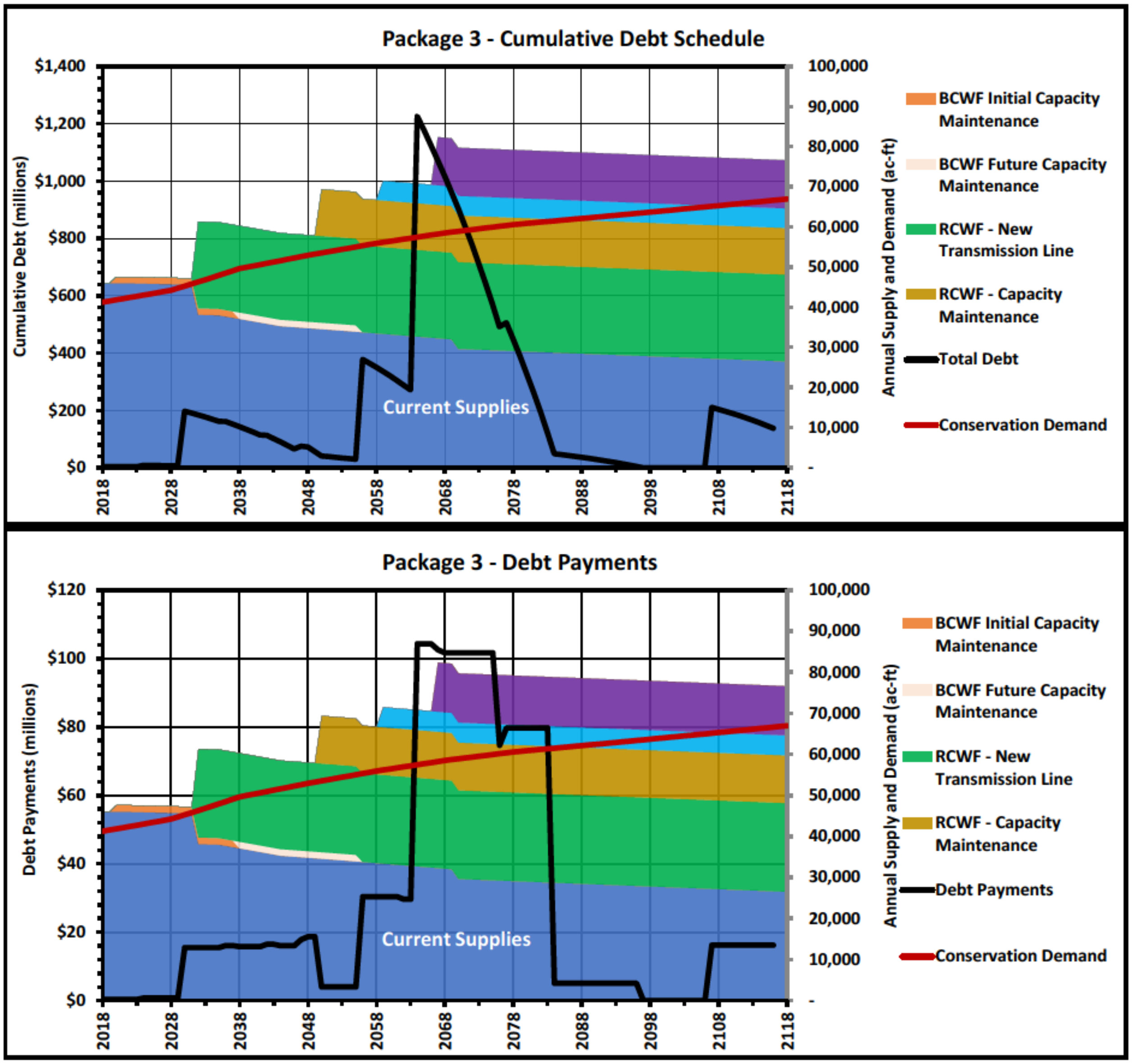


Figure 13.15. Debt Schedule for the Drought Demands Supply Package

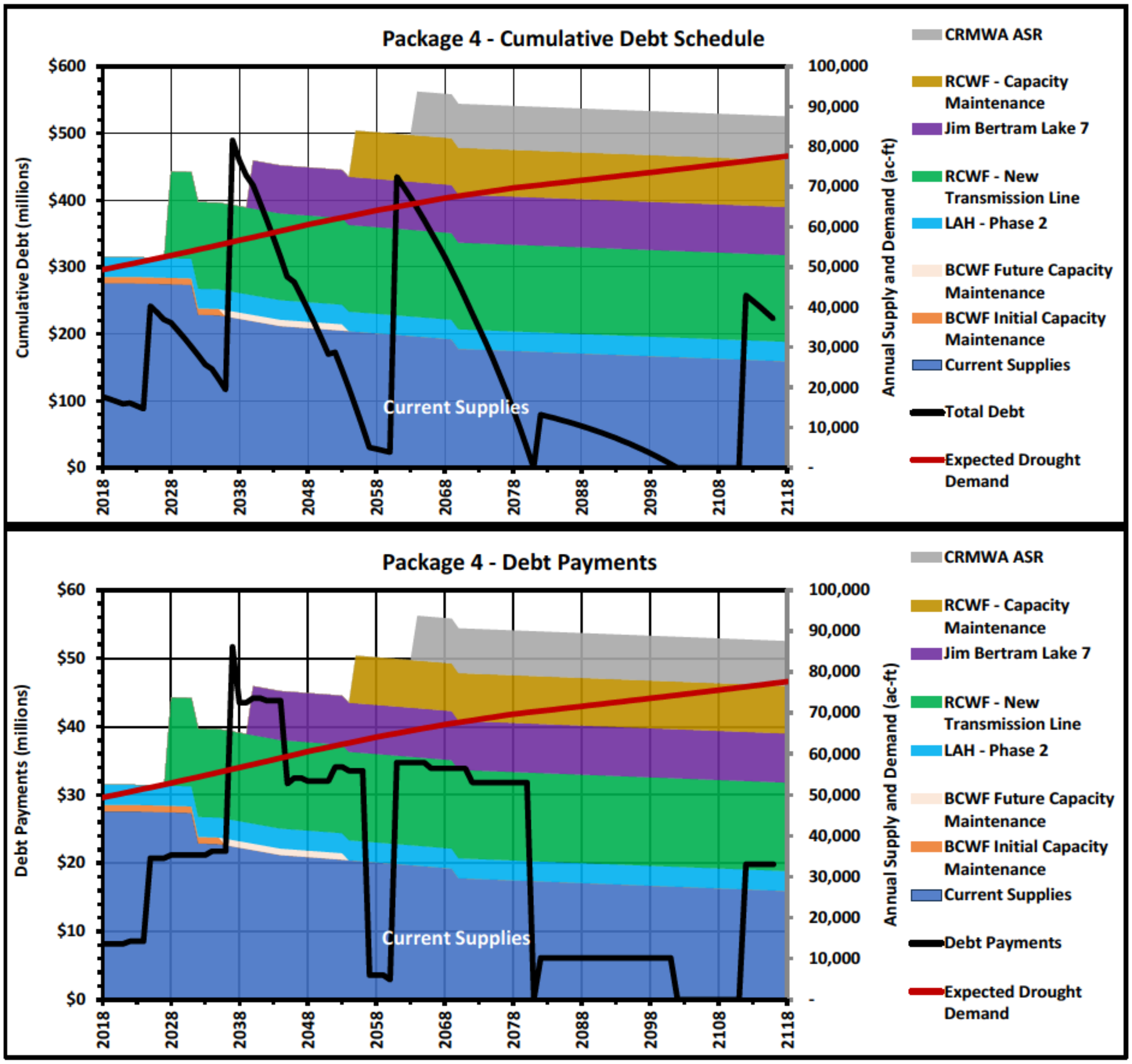
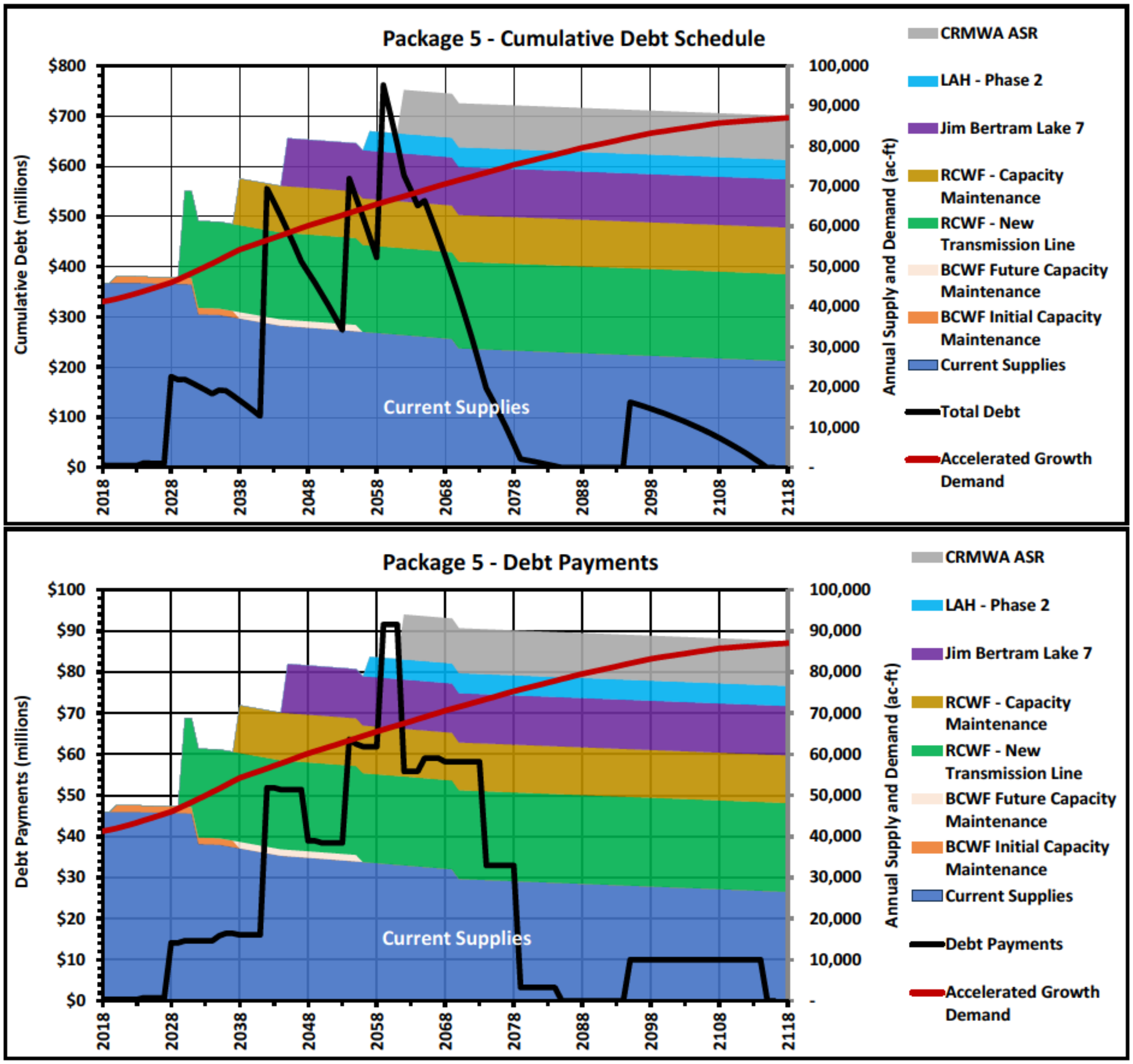


Figure 13.16. Debt Schedule for the Accelerated Population Growth Supply Package



A

Historic and Projected Water Demands

Appendix A.1

Historic Data for the City of Lubbock

Year	Population (Cenus Data)	Growth Rate (Percent)	Gallons per Capita per Day (gpcd)	Water Demand (ac-ft/yr)	Peak Day Demand (mgd)	Average Annual Day (mg)	Peaking Factor
Data by Decade							
1910	1,938	n/a	.	.	.	.	.
1920	4,051	109.03	.	.	.	.	.
1930	20,520	406.54	91	2,092	.	1.87	.
1940	31,853	55.23	135	4,820	.	4.30	.
1950	71,747	125.25	130	10,424	.	9.31	.
1960	128,691	79.37	142	20,486	.	18.29	.
1970	149,101	15.86	187	31,200	.	27.85	.
1980	173,979	16.69	206	40,205	70.85	35.89	1.97
1990	186,206	7.03	192	40,086	79.00	35.79	2.21
2000	199,564	7.17	199	44,375	67.82	39.62	1.71
2010	229,573	15.04	141	36,275	50.40	32.38	1.56
Data by Year							
1910	1,938	8.54	.	.	.	.	.
1911	2,104	4.02	.	.	.	.	.
1912	2,188	4.35	.	.	.	.	.
1913	2,283	8.54	.	.	.	.	.
1914	2,478	8.54	.	.	.	.	.
1915	2,690	8.54	.	.	.	.	.
1916	2,920	8.54	.	.	.	.	.
1917	3,169	8.54	.	.	.	.	.
1918	3,440	8.54	.	.	.	.	.
1919	3,733	8.51	.	.	.	.	.
1920	4,051	17.62	.	.	.	.	.
1921	4,765	17.62	.	.	.	.	.
1922	5,604	17.62	.	.	.	.	.
1923	6,591	17.62	.	.	.	.	.
1924	7,753	17.62	.	.	.	.	.
1925	9,118	17.62	.	.	.	.	.
1926	10,725	17.62	.	.	.	.	.
1927	12,614	17.62	.	.	.	.	.
1928	14,836	17.62	.	.	.	.	.
1929	17,450	17.59	.	.	.	.	.
1930	20,520	4.50	91	2,092	.	1.87	.
1931	21,443	4.50	93	2,242	.	2.00	.
1932	22,407	4.50	95	2,391	.	2.13	.
1933	23,414	4.50	97	2,541	.	2.27	.
1934	24,467	4.50	98	2,690	.	2.40	.
1935	25,567	4.50	99	2,840	.	2.54	.
1936	26,716	4.50	100	2,989	.	2.67	.
1937	27,917	4.50	100	3,139	.	2.80	.
1938	29,173	4.50	113	3,699	.	3.30	.
1939	30,484	4.49	125	4,259	.	3.80	.
1940	31,853	8.46	135	4,820	.	4.30	.
1941	34,547	8.46	139	5,380	.	4.80	.
1942	37,470	8.46	142	5,941	.	5.30	.
1943	40,639	8.46	143	6,501	.	5.80	.
1944	44,077	8.46	143	7,062	.	6.30	.
1945	47,806	8.46	142	7,622	.	6.80	.
1946	51,849	8.46	141	8,183	.	7.31	.
1947	56,235	8.46	139	8,743	.	7.81	.
1948	60,992	8.46	136	9,304	.	8.31	.
1949	66,152	8.46	133	9,864	.	8.81	.
1950	71,747	6.02	130	10,424	.	9.31	.
1951	76,064	6.02	136	11,576	.	10.33	.
1952	80,641	6.02	141	12,727	.	11.36	.
1953	85,493	6.02	145	13,879	.	12.39	.
1954	90,638	6.02	148	15,031	.	13.42	.
1955	96,091	6.02	150	16,182	.	14.45	.
1956	101,873	6.02	168	19,145	.	17.09	.
1957	108,003	6.02	135	16,374	.	14.62	.
1958	114,501	6.02	143	18,278	.	16.32	.
1959	121,391	6.01	144	19,618	.	17.51	.
1960	128,691	1.48	142	20,486	.	18.29	.
1961	130,599	1.48	137	20,020	.	17.87	.

Appendix A.1

Historic Data for the City of Lubbock

Year	Population (Cenus Data)	Growth Rate (Percent)	Gallons per Capita per Day (gpcd)	Water Demand (ac-ft/yr)	Peak Day Demand (mgd)	Average Annual Day (mg)	Peaking Factor
1962	132,536	1.48	155	22,955	.	20.49	.
1963	134,502	1.48	171	25,744	.	22.98	.
1964	136,496	1.48	181	27,674	.	24.71	.
1965	138,521	1.48	184	28,528	.	25.47	.
1966	140,575	1.48	173	27,243	.	24.32	.
1967	142,660	1.48	158	25,322	.	22.61	.
1968	144,775	1.48	161	26,187	.	23.38	.
1969	146,922	1.48	185	30,365	.	27.11	.
1970	149,101	1.55	187	31,200	.	27.85	.
1971	151,420	1.55	180	30,460	.	27.19	.
1972	153,774	1.55	187	32,242	.	28.78	.
1973	156,165	1.55	181	31,588	.	28.20	.
1974	158,593	1.55	194	34,428	.	30.74	.
1975	161,059	1.55	174	31,318	.	27.96	.
1976	163,564	1.55	181	33,098	.	29.55	.
1977	166,107	1.55	193	35,928	.	32.07	.
1978	168,690	1.55	222	42,027	.	37.52	.
1979	171,313	1.56	197	37,862	.	33.80	.
1980	173,979	0.30	206	40,205	70.85	35.89	1.97
1981	174,508	0.30	184	35,928	68.48	32.07	2.13
1982	175,038	0.30	178	34,841	58.69	31.10	1.89
1983	175,569	0.30	208	40,835	n/a	36.46	n/a
1984	176,103	2.19	195	38,385	n/a	34.27	n/a
1985	179,953	0.34	180	36,305	65.18	32.41	2.01
1986	180,561	0.23	170	34,395	65.71	30.71	2.14
1987	180,973	0.70	168	34,057	57.01	30.40	1.87
1988	182,243	0.73	183	37,417	60.40	33.40	1.81
1989	183,573	1.43	196	40,233	69.12	35.92	1.92
1990	186,206	0.50	192	40,086	79.00	35.79	2.21
1991	187,137	0.19	176	36,930	67.38	32.97	2.04
1992	187,493	0.26	167	34,971	55.50	31.22	1.78
1993	187,981	1.09	181	38,096	58.35	34.01	1.72
1994	190,038	0.52	197	41,929	74.98	37.43	2.00
1995	191,020	1.07	213	45,491	79.54	40.61	1.96
1996	193,064	1.19	204	44,178	66.71	39.44	1.69
1997	195,367	0.67	185	40,408	63.37	36.07	1.76
1998	196,679	0.22	224	49,299	84.17	44.01	1.91
1999	197,117	1.24	188	41,429	68.93	36.99	1.86
2000	199,564	0.83	199	44,375	67.82	39.62	1.71
2001	201,217	0.39	191	43,078	73.09	38.46	1.90
2002	202,000	1.35	182	41,080	63.91	36.67	1.74
2003	204,737	0.76	190	43,626	73.61	38.95	1.89
2004	206,290	1.37	161	37,121	59.94	33.14	1.81
2005	209,120	0.99	168	39,302	62.54	35.09	1.78
2006	211,187	0.56	177	41,874	68.77	37.38	1.84
2007	212,365	1.17	136	32,456	47.30	28.97	1.63
2008	214,847	1.62	148	35,671	53.66	31.85	1.69
2009	218,327	5.15	145	35,434	54.23	31.63	1.71
2010	229,573	1.03	141	36,275	50.40	32.38	1.56
2011	231,937	0.74	178	46,205	64.12	41.25	1.55
2012	233,651	1.16	152	39,869	58.07	35.59	1.63
2013	236,362	0.99	154	40,892	57.96	36.51	1.59
2014	238,706	1.10	141	37,811	50.04	33.76	1.48
2015	241,322	4.63	131	35,298	49.56	31.51	1.57
2016	252,506	0.82	132	37,286	58.37	33.29	1.75
2017	254,565		127	36,108	49.94	32.24	1.55

Appendix A.2

Population and Growth Rate Projections

Year	Population					Growth Rate (Percent)				
	Expected Growth	Accelerated Growth	2021 Region O Plan	2013 SWSP Probable	2013 SWSP Accelerated	Expected Growth	Accelerated Growth	2021 Region O Plan	2013 SWSP Probable	2013 SWSP Accelerated
Data by Decade										
2018	257,620	257,620	249,900	255,349	259,155	1.20	1.30	1.07	1.20	1.70
2028	290,258	301,934	277,688	287,700	306,739	1.20	1.70	1.06	1.20	1.70
2038	327,031	357,373	306,134	317,793	354,223	1.20	1.70	0.96	0.80	1.20
2048	354,156	402,649	336,078	342,448	395,172	0.80	1.20	0.93	0.70	1.00
2058	379,743	444,775	365,364	365,369	434,359	0.70	1.00	0.80	0.60	0.90
2068	403,152	486,466	393,998	385,969	472,724	0.60	0.90	0.74	0.50	0.80
2078	423,770	526,814	n/a	403,693	509,398	0.50	0.80	n/a	0.40	0.70
2088	441,029	564,875	n/a	420,134	543,494	0.40	0.70	n/a	0.40	0.60
2098	458,991	599,697	n/a	437,246	572,709	0.40	0.60	n/a	0.40	0.45
2108	477,685	627,237	n/a	455,054	594,550	0.40	0.45	n/a	0.40	0.30
2118	497,140	646,310	n/a	n/a	n/a	0.40	0.30	n/a	n/a	n/a
Data by Year										
2018	257,620	257,620	249,900	255,349	259,155	1.20	1.30	1.07	1.20	1.70
2019	260,711	260,969	252,564	258,413	263,561	1.20	1.40	1.07	1.20	1.70
2020	263,840	264,622	255,257	261,514	268,041	1.20	1.50	1.06	1.20	1.70
2021	267,006	268,592	257,959	264,652	272,598	1.20	1.60	1.06	1.20	1.70
2022	270,210	272,889	260,689	267,828	277,232	1.20	1.70	1.06	1.20	1.70
2023	273,452	277,528	263,448	271,042	281,945	1.20	1.70	1.06	1.20	1.70
2024	276,734	282,246	266,236	274,295	286,738	1.20	1.70	1.06	1.20	1.70
2025	280,055	287,044	269,054	277,586	291,613	1.20	1.70	1.06	1.20	1.70
2026	283,415	291,924	271,902	280,917	296,570	1.20	1.70	1.06	1.20	1.70
2027	286,816	296,887	274,779	284,288	301,612	1.20	1.70	1.06	1.20	1.70
2028	290,258	301,934	277,688	287,700	306,739	1.20	1.70	1.06	1.20	1.70
2029	293,741	307,067	280,627	291,152	311,954	1.20	1.70	1.06	1.20	1.70
2030	297,266	312,287	283,597	294,646	317,257	1.20	1.70	0.96	1.20	1.70
2031	300,833	317,596	286,321	298,182	322,650	1.20	1.70	0.96	1.20	1.70
2032	304,443	322,995	289,071	301,760	328,136	1.20	1.70	0.96	1.20	1.70
2033	308,097	328,486	291,847	305,381	333,714	1.20	1.70	0.96	1.20	1.70
2034	311,794	334,070	294,650	307,824	337,718	1.20	1.70	0.96	0.80	1.20
2035	315,535	339,749	297,480	310,287	341,771	1.20	1.70	0.96	0.80	1.20
2036	319,322	345,525	300,337	312,769	345,872	1.20	1.70	0.96	0.80	1.20
2037	323,154	351,399	303,222	315,271	350,023	1.20	1.70	0.96	0.80	1.20
2038	327,031	357,373	306,134	317,793	354,223	1.20	1.70	0.96	0.80	1.20
2039	329,648	361,661	309,074	320,336	358,474	0.80	1.20	0.96	0.80	1.20
2040	332,285	366,001	312,043	322,898	362,775	0.80	1.20	0.93	0.80	1.20
2041	334,943	370,393	314,951	325,482	367,129	0.80	1.20	0.93	0.80	1.20
2042	337,623	374,838	317,886	328,085	371,534	0.80	1.20	0.93	0.80	1.20
2043	340,324	379,336	320,848	330,710	375,993	0.80	1.20	0.93	0.80	1.20
2044	343,046	383,888	323,838	333,025	379,753	0.80	1.20	0.93	0.70	1.00
2045	345,791	388,495	326,855	335,356	383,550	0.80	1.20	0.93	0.70	1.00
2046	348,557	393,157	329,901	337,704	387,386	0.80	1.20	0.93	0.70	1.00
2047	351,345	397,875	332,976	340,068	391,259	0.80	1.20	0.93	0.70	1.00
2048	354,156	402,649	336,078	342,448	395,172	0.80	1.20	0.93	0.70	1.00
2049	356,635	406,676	339,210	344,845	399,124	0.70	1.00	0.93	0.70	1.00
2050	359,132	410,742	342,371	347,259	403,115	0.70	1.00	0.93	0.70	1.00
2051	361,646	414,850	345,562	349,690	407,146	0.70	1.00	0.80	0.70	1.00
2052	364,177	418,998	348,323	352,138	411,218	0.70	1.00	0.80	0.70	1.00
2053	366,726	423,188	351,107	354,603	415,330	0.70	1.00	0.80	0.70	1.00
2054	369,293	427,420	353,913	356,730	419,068	0.70	1.00	0.80	0.60	0.90
2055	371,878	431,694	356,742	358,871	422,839	0.70	1.00	0.80	0.60	0.90
2056	374,482	436,011	359,593	361,024	426,645	0.70	1.00	0.80	0.60	0.90
2057	377,103	440,371	362,467	363,190	430,485	0.70	1.00	0.80	0.60	0.90
2058	379,743	444,775	365,364	365,369	434,359	0.70	1.00	0.80	0.60	0.90
2059	382,021	448,778	368,284	367,561	438,268	0.60	0.90	0.80	0.60	0.90
2060	384,313	452,817	371,227	369,767	442,213	0.60	0.90	0.80	0.60	0.90
2061	386,619	456,892	374,194	371,985	446,193	0.60	0.90	0.74	0.60	0.90
2062	388,939	461,004	376,961	374,217	450,208	0.60	0.90	0.74	0.60	0.90
2063	391,273	465,154	379,748	376,463	454,260	0.60	0.90	0.74	0.60	0.90
2064	393,620	469,340	382,556	378,345	457,894	0.60	0.90	0.74	0.50	0.80
2065	395,982	473,564	385,385	380,237	461,558	0.60	0.90	0.74	0.50	0.80
2066	398,358	477,826	388,235	382,138	465,250	0.60	0.90	0.74	0.50	0.80

Appendix A.2

Population and Growth Rate Projections

Year	Population					Growth Rate (Percent)				
	Expected Growth	Accelerated Growth	2021 Region O Plan	2013 SWSP Probable	2013 SWSP Accelerated	Expected Growth	Accelerated Growth	2021 Region O Plan	2013 SWSP Probable	2013 SWSP Accelerated
2067	400,748	482,126	391,106	384,049	468,972	0.60	0.90	0.74	0.50	0.80
2068	403,152	486,466	393,998	385,969	472,724	0.60	0.90	0.74	0.50	0.80
2069	405,168	490,357	396,911	387,899	476,506	0.50	0.80	0.74	0.50	0.80
2070	407,194	494,280	399,846	389,838	480,318	0.50	0.80	0.74	0.50	0.80
2071	409,230	498,234	n/a	391,787	484,160	0.50	0.80	n/a	0.50	0.80
2072	411,276	502,220	n/a	393,746	488,033	0.50	0.80	n/a	0.50	0.80
2073	413,333	506,238	n/a	395,715	491,938	0.50	0.80	n/a	0.50	0.80
2074	415,399	510,288	n/a	397,298	495,381	0.50	0.80	n/a	0.40	0.70
2075	417,476	514,370	n/a	398,887	498,849	0.50	0.80	n/a	0.40	0.70
2076	419,564	518,485	n/a	400,483	502,341	0.50	0.80	n/a	0.40	0.70
2077	421,661	522,633	n/a	402,085	505,857	0.50	0.80	n/a	0.40	0.70
2078	423,770	526,814	n/a	403,693	509,398	0.50	0.80	n/a	0.40	0.70
2079	425,465	530,502	n/a	405,308	512,964	0.40	0.70	n/a	0.40	0.70
2080	427,167	534,215	n/a	406,929	516,555	0.40	0.70	n/a	0.40	0.70
2081	428,875	537,955	n/a	408,557	520,171	0.40	0.70	n/a	0.40	0.70
2082	430,591	541,721	n/a	410,191	523,812	0.40	0.70	n/a	0.40	0.70
2083	432,313	545,513	n/a	411,832	527,479	0.40	0.70	n/a	0.40	0.70
2084	434,042	549,331	n/a	413,479	530,643	0.40	0.70	n/a	0.40	0.60
2085	435,779	553,177	n/a	415,133	533,827	0.40	0.70	n/a	0.40	0.60
2086	437,522	557,049	n/a	416,793	537,030	0.40	0.70	n/a	0.40	0.60
2087	439,272	560,948	n/a	418,461	540,252	0.40	0.70	n/a	0.40	0.60
2088	441,029	564,875	n/a	420,134	543,494	0.40	0.70	n/a	0.40	0.60
2089	442,793	568,264	n/a	421,815	546,755	0.40	0.60	n/a	0.40	0.60
2090	444,564	571,674	n/a	423,502	550,035	0.40	0.60	n/a	0.40	0.60
2091	446,342	575,104	n/a	425,196	553,336	0.40	0.60	n/a	0.40	0.60
2092	448,128	578,554	n/a	426,897	556,656	0.40	0.60	n/a	0.40	0.60
2093	449,920	582,026	n/a	428,605	559,996	0.40	0.60	n/a	0.40	0.60
2094	451,720	585,518	n/a	430,319	562,516	0.40	0.60	n/a	0.40	0.45
2095	453,527	589,031	n/a	432,040	565,047	0.40	0.60	n/a	0.40	0.45
2096	455,341	592,565	n/a	433,768	567,590	0.40	0.60	n/a	0.40	0.45
2097	457,162	596,120	n/a	435,504	570,144	0.40	0.60	n/a	0.40	0.45
2098	458,991	599,697	n/a	437,246	572,709	0.40	0.60	n/a	0.40	0.45
2099	460,827	602,396	n/a	438,994	575,287	0.40	0.45	n/a	0.40	0.45
2100	462,670	605,107	n/a	440,750	577,875	0.40	0.45	n/a	0.40	0.45
2101	464,521	607,830	n/a	442,513	580,476	0.40	0.45	n/a	0.40	0.45
2102	466,379	610,565	n/a	444,284	583,088	0.40	0.45	n/a	0.40	0.45
2103	468,245	613,312	n/a	446,061	585,712	0.40	0.45	n/a	0.40	0.45
2104	470,118	616,072	n/a	447,845	587,469	0.40	0.45	n/a	0.40	0.30
2105	471,998	618,845	n/a	449,636	589,231	0.40	0.45	n/a	0.40	0.30
2106	473,886	621,629	n/a	451,435	590,999	0.40	0.45	n/a	0.40	0.30
2107	475,782	624,427	n/a	453,241	592,772	0.40	0.45	n/a	0.40	0.30
2108	477,685	627,237	n/a	455,054	594,550	0.40	0.45	n/a	0.40	0.30
2109	479,595	629,118	n/a	456,874	596,334	0.40	0.30	n/a	0.40	0.30
2110	481,514	631,006	n/a	458,701	598,123	0.40	0.30	n/a	0.40	0.30
2111	483,440	632,899	n/a	460,536	599,917	0.40	0.30	n/a	0.40	0.30
2112	485,374	634,797	n/a	462,378	601,717	0.40	0.30	n/a	0.40	0.30
2113	487,315	636,702	n/a	464,228	603,522	0.40	0.30	n/a	0.40	0.30
2114	489,264	638,612	n/a	n/a	n/a	0.40	0.30	n/a	n/a	n/a
2115	491,221	640,528	n/a	n/a	n/a	0.40	0.30	n/a	n/a	n/a
2116	493,186	642,449	n/a	n/a	n/a	0.40	0.30	n/a	n/a	n/a
2117	495,159	644,377	n/a	n/a	n/a	0.40	0.30	n/a	n/a	n/a
2118	497,140	646,310	n/a	n/a	n/a	0.40	0.30	n/a	n/a	n/a

Appendix A.3

Per Capita Consumption and Water Demand Projections

Year	Gallons per Capita per Day (gpcd)					Water Demand (ac-ft/yr)						
	Conservation Consumption	Drought Consumption	2021 Region O Plan	2013 SWSP Drought	2013 SWSP Conserv.	Conservation	Expected Drought	Accelerated Growth	2021 Region O Plan	2013 SWSP Probable	2013 SWSP Accelerated Growth	2013 SWSP Conservation
Data by Decade												
2018	143	171	162	173	148	41,266	49,344	41,266	n/a	49,553	50,292	42,289
2028	136	163	157	164	142	44,221	52,878	45,999	48,664	52,888	56,388	45,922
2038	135	155	154	158	139	49,624	56,664	54,228	52,634	56,401	62,866	49,397
2048	133	153	152	156	136	52,945	60,571	60,194	57,178	59,799	69,006	52,227
2058	131	151	151	153	134	55,929	64,108	65,508	61,931	62,776	74,629	54,673
2068	130	149	151	151	131	58,498	67,180	70,587	66,740	65,248	79,914	56,667
2078	128	147	n/a	148	129	60,580	69,703	75,311	n/a	67,147	84,729	58,153
2088	126	145	n/a	146	126	62,114	71,604	79,556	n/a	68,758	88,947	59,381
2098	124	143	n/a	144	124	63,687	73,558	83,211	n/a	70,408	92,221	60,635
2108	122	141	n/a	141	121	65,300	75,564	85,744	n/a	72,097	94,198	61,916
2118	120	139	n/a	n/a	n/a	66,954	77,625	87,044	n/a	n/a	n/a	n/a
Data by Year												
2018	143	171	162	173	148	41,266	49,344	41,266	n/a	49,553	50,292	42,289
2019	142	170	161	172	147	41,552	49,687	41,593	n/a	49,877	50,870	42,591
2020	142	169	160	171	146	41,840	50,032	41,964	45,622	50,203	51,456	42,896
2021	141	168	160	170	146	42,131	50,379	42,381	46,003	50,531	52,048	43,263
2022	140	168	159	170	145	42,423	50,729	42,844	46,383	50,861	52,647	43,633
2023	139	167	159	169	145	42,718	51,081	43,354	46,763	51,193	53,253	44,006
2024	139	166	158	168	144	43,014	51,435	43,871	47,143	51,528	53,866	44,383
2025	138	165	158	167	144	43,313	51,792	44,394	47,524	51,865	54,486	44,763
2026	137	164	158	166	143	43,613	52,151	44,923	47,904	52,204	55,113	45,146
2027	137	163	157	165	143	43,916	52,513	45,458	48,284	52,545	55,747	45,533
2028	136	163	157	164	142	44,221	52,878	45,999	48,664	52,888	56,388	45,922
2029	136	162	156	163	142	44,733	53,245	46,763	49,044	53,234	57,037	46,315
2030	136	161	156	162	142	45,252	53,614	47,539	49,423	53,582	57,694	46,712
2031	136	160	156	161	141	45,777	53,986	48,327	49,825	53,932	58,358	47,112
2032	136	159	155	161	141	46,308	54,361	49,129	50,227	54,284	59,029	47,515
2033	136	159	155	160	140	46,844	54,738	49,945	50,628	54,639	59,709	47,921
2034	136	158	155	159	140	47,388	55,118	50,773	51,029	54,987	60,327	48,213
2035	136	157	155	159	140	47,937	55,501	51,616	51,431	55,337	60,952	48,506
2036	136	156	154	159	139	48,493	55,886	52,472	51,832	55,690	61,584	48,802
2037	136	155	154	159	139	49,055	56,274	53,343	52,233	56,044	62,222	49,099
2038	135	155	154	158	139	49,624	56,664	54,228	52,634	56,401	62,866	49,397
2039	135	154	153	158	139	49,946	57,043	54,797	53,036	56,760	63,518	49,698
2040	135	154	153	158	138	50,271	57,425	55,372	53,437	57,121	64,176	50,000
2041	135	154	153	158	138	50,598	57,809	55,953	53,905	57,485	64,841	50,304
2042	135	154	153	157	138	50,926	58,196	56,540	54,372	57,851	65,512	50,611
2043	134	154	153	157	137	51,257	58,585	57,133	54,840	58,220	66,191	50,919
2044	134	153	153	157	137	51,590	58,977	57,733	55,307	58,532	66,745	51,178
2045	134	153	153	157	137	51,926	59,372	58,338	55,775	58,846	67,303	51,438
2046	134	153	152	156	137	52,263	59,769	58,951	56,243	59,162	67,866	51,700
2047	134	153	152	156	136	52,603	60,169	59,569	56,710	59,480	68,434	51,962
2048	133	153	152	156	136	52,945	60,571	60,194	57,178	59,799	69,006	52,227
2049	133	152	152	156	136	53,236	60,916	60,705	57,645	60,120	69,583	52,492
2050	133	152	152	155	136	53,529	61,262	61,221	58,112	60,443	70,165	52,759
2051	133	152	152	155	135	53,823	61,611	61,741	58,590	60,767	70,752	53,028
2052	133	152	152	155	135	54,119	61,962	62,266	59,068	61,094	71,344	53,298
2053	132	152	152	155	135	54,417	62,314	62,795	59,545	61,422	71,940	53,569
2054	132	151	152	154	135	54,716	62,669	63,328	60,022	61,690	72,470	53,788
2055	132	151	152	154	134	55,017	63,026	63,866	60,500	61,960	73,004	54,008
2056	132	151	151	154	134	55,319	63,384	64,409	60,977	62,231	73,542	54,228
2057	132	151	151	154	134	55,624	63,745	64,956	61,454	62,502	74,083	54,450
2058	131	151	151	153	134	55,929	64,108	65,508	61,931	62,776	74,629	54,673
2059	131	151	151	153	133	56,181	64,409	65,999	62,409	63,050	75,179	54,896
2060	131	150	151	153	133	56,434	64,711	66,493	62,886	63,326	75,732	55,121
2061	131	150	151	153	133	56,688	65,014	66,992	63,368	63,602	76,290	55,346
2062	131	150	151	152	133	56,943	65,319	67,494	63,849	63,880	76,852	55,572
2063	131	150	151	152	132	57,200	65,626	68,000	64,331	64,159	77,418	55,800
2064	130	150	151	152	132	57,457	65,934	68,510	64,813	64,376	77,911	55,972
2065	130	149	151	152	132	57,716	66,243	69,023	65,295	64,593	78,407	56,145
2066	130	149	151	151	132	57,975	66,554	69,541	65,776	64,811	78,906	56,319
2067	130	149	151	151	131	58,236	66,866	70,062	66,258	65,029	79,409	56,493
2068	130	149	151	151	131	58,498	67,180	70,587	66,740	65,248	79,914	56,667
2069	129	149	151	151	131	58,703	67,428	71,046	67,221	65,468	80,423	56,842
2070	129	148	151	150	131	58,909	67,677	71,508	67,702	65,689	80,935	57,018
2071	129	148	n/a	150	130	59,115	67,927	71,972	n/a	65,911	81,451	57,194
2072	129	148	n/a	150	130	59,322	68,178	72,440	n/a	66,133	81,969	57,371
2073	129	148	n/a	150	130	59,530	68,430	72,911	n/a	66,356	82,491	57,548
2074	128	148	n/a	149	130	59,739	68,683	73,385	n/a	66,513	82,934	57,669
2075	128	147	n/a	149	129	59,948	68,936	73,861	n/a	66,671	83,379	57,789
2076	128	147	n/a	149	129	60,158	69,191	74,341	n/a	66,830	83,827	57,910
2077	128	147	n/a	149	129	60,369	69,447	74,824	n/a	66,988	84,277	58,031
2078	128	147	n/a	148	129	60,580	69,703	75,311	n/a	67,147	84,729	58,153
2079	127	147	n/a	148	128	60,732	69,891	75,725	n/a	67,307	85,184	58,275
2080	127	146	n/a	148	128	60,884	70,079	76,141	n/a	67,466	85,642	58,397

Appendix A.3

Per Capita Consumption and Water Demand Projections

Year	Gallons per Capita per Day (gpcd)					Water Demand (ac-ft/yr)						
	Conservation Consumption	Drought Consumption	2021 Region O Plan	2013 SWSP Drought	2013 SWSP Conserv.	Conservation	Expected Drought	Accelerated Growth	2021 Region O Plan	2013 SWSP Probable	2013 SWSP Accelerated Growth	2013 SWSP Conservation
2081	127	146	n/a	148	128	61,036	70,268	76,560	n/a	67,626	86,101	58,519
2082	127	146	n/a	148	128	61,189	70,457	76,981	n/a	67,787	86,564	58,641
2083	127	146	n/a	147	127	61,342	70,647	77,404	n/a	67,948	87,028	58,764
2084	126	146	n/a	147	127	61,496	70,838	77,830	n/a	68,109	87,409	58,887
2085	126	146	n/a	147	127	61,650	71,029	78,258	n/a	68,271	87,791	59,010
2086	126	145	n/a	147	127	61,804	71,220	78,689	n/a	68,433	88,174	59,133
2087	126	145	n/a	146	126	61,959	71,412	79,121	n/a	68,595	88,560	59,257
2088	126	145	n/a	146	126	62,114	71,604	79,556	n/a	68,758	88,947	59,381
2089	126	145	n/a	146	126	62,270	71,797	79,915	n/a	68,921	89,335	59,505
2090	125	145	n/a	146	126	62,426	71,991	80,274	n/a	69,085	89,726	59,630
2091	125	144	n/a	145	125	62,582	72,185	80,636	n/a	69,249	90,118	59,755
2092	125	144	n/a	145	125	62,739	72,379	80,999	n/a	69,413	90,512	59,880
2093	125	144	n/a	145	125	62,896	72,574	81,363	n/a	69,578	90,907	60,005
2094	125	144	n/a	145	125	63,053	72,770	81,729	n/a	69,743	91,169	60,131
2095	124	144	n/a	144	125	63,211	72,966	82,097	n/a	69,909	91,430	60,256
2096	124	143	n/a	144	124	63,369	73,163	82,467	n/a	70,075	91,693	60,383
2097	124	143	n/a	144	124	63,528	73,360	82,838	n/a	70,241	91,957	60,509
2098	124	143	n/a	144	124	63,687	73,558	83,211	n/a	70,408	92,221	60,635
2099	124	143	n/a	144	124	63,847	73,756	83,461	n/a	70,575	92,486	60,762
2100	124	143	n/a	143	123	64,007	73,955	83,711	n/a	70,742	92,751	60,889
2101	123	143	n/a	143	123	64,167	74,154	83,963	n/a	70,910	93,018	61,017
2102	123	142	n/a	143	123	64,327	74,354	84,215	n/a	71,078	93,285	61,145
2103	123	142	n/a	143	123	64,489	74,554	84,468	n/a	71,247	93,553	61,273
2104	123	142	n/a	142	122	64,650	74,755	84,722	n/a	71,416	93,682	61,401
2105	123	142	n/a	142	122	64,812	74,956	84,976	n/a	71,586	93,810	61,529
2106	122	142	n/a	142	122	64,974	75,158	85,231	n/a	71,756	93,939	61,658
2107	122	141	n/a	142	122	65,137	75,361	85,487	n/a	71,926	94,069	61,787
2108	122	141	n/a	141	121	65,300	75,564	85,744	n/a	72,097	94,198	61,916
2109	122	141	n/a	141	121	65,464	75,768	85,873	n/a	72,268	94,327	62,046
2110	122	141	n/a	141	121	65,627	75,972	86,002	n/a	72,439	94,457	62,176
2111	121	141	n/a	141	121	65,792	76,177	86,132	n/a	72,611	94,587	62,306
2112	121	140	n/a	141	121	65,957	76,382	86,261	n/a	72,784	94,717	62,436
2113	121	140	n/a	140	120	66,122	76,588	86,391	n/a	72,956	94,847	62,567
2114	121	140	n/a	n/a	n/a	66,287	76,794	86,521	n/a	n/a	n/a	n/a
2115	121	140	n/a	n/a	n/a	66,453	77,001	86,652	n/a	n/a	n/a	n/a
2116	121	140	n/a	n/a	n/a	66,620	77,208	86,782	n/a	n/a	n/a	n/a
2117	120	140	n/a	n/a	n/a	66,786	77,417	86,913	n/a	n/a	n/a	n/a
2118	120	139	n/a	n/a	n/a	66,954	77,625	87,044	n/a	n/a	n/a	n/a

Appendix A.4

Peaking Factor, Average Annual Day, and Peak Day Demand

Year	Peaking Factor		Average Annual Day - AAD (mgd)			Peak Day Demand - PDD (mgd)					
	Conservation	Expected	Conservation	Expected Drought	Accelerated Growth	Conservation	Expected Drought	Accelerated Growth	2013 SWSP Probable Peak	2013 SWSP Accelerated Peak	2013 SWSP Conservation Peak
Data by Decade											
2018	1.62	1.80	36.84	44.05	36.84	59.68	79.29	66.31	79.63	80.82	67.66
2028	1.61	1.80	39.48	47.21	41.07	63.57	84.97	73.92	84.99	90.61	72.84
2038	1.60	1.80	44.30	50.59	48.41	70.91	91.06	87.14	90.63	101.02	77.67
2048	1.59	1.80	47.27	54.07	53.74	75.20	97.33	96.73	96.09	110.89	81.41
2058	1.58	1.80	49.93	57.23	58.48	78.97	103.02	105.27	100.88	119.92	84.48
2068	1.57	1.80	52.22	59.97	63.02	82.10	107.95	113.43	104.85	128.42	86.80
2078	1.56	1.80	54.08	62.23	67.23	84.51	112.01	121.02	107.90	136.15	88.31
2088	1.55	1.80	55.45	63.92	71.02	86.14	115.06	127.84	110.49	142.93	89.39
2098	1.54	1.80	56.86	65.67	74.29	87.79	118.20	133.71	113.14	148.19	90.49
2108	1.53	1.80	58.30	67.46	76.55	89.47	121.43	137.79	115.85	151.37	91.60
2118	1.53	1.80	59.77	69.30	77.71	91.19	124.74	139.87	n/a	n/a	n/a
Data by Year											
2018	1.62	1.80	36.84	44.05	36.84	59.68	79.29	66.31	79.63	80.82	67.66
2019	1.62	1.80	37.10	44.36	37.13	60.06	79.84	66.84	80.15	81.75	68.09
2020	1.62	1.80	37.35	44.67	37.46	60.44	80.40	67.43	80.67	82.69	68.51
2021	1.62	1.80	37.61	44.98	37.84	60.82	80.96	68.10	81.20	83.64	69.04
2022	1.62	1.80	37.87	45.29	38.25	61.21	81.52	68.85	81.73	84.60	69.57
2023	1.62	1.80	38.14	45.60	38.70	61.59	82.08	69.67	82.26	85.57	70.10
2024	1.61	1.80	38.40	45.92	39.17	61.99	82.65	70.50	82.80	86.56	70.64
2025	1.61	1.80	38.67	46.24	39.63	62.38	83.23	71.34	83.34	87.55	71.18
2026	1.61	1.80	38.94	46.56	40.10	62.77	83.80	72.19	83.89	88.56	71.73
2027	1.61	1.80	39.21	46.88	40.58	63.17	84.39	73.05	84.44	89.58	72.28
2028	1.61	1.80	39.48	47.21	41.07	63.57	84.97	73.92	84.99	90.61	72.84
2029	1.61	1.80	39.94	47.53	41.75	64.27	85.56	75.14	85.54	91.66	73.40
2030	1.61	1.80	40.40	47.86	42.44	64.98	86.15	76.39	86.10	92.71	73.96
2031	1.61	1.80	40.87	48.20	43.14	65.69	86.75	77.66	86.67	93.78	74.53
2032	1.61	1.80	41.34	48.53	43.86	66.41	87.35	78.95	87.23	94.86	75.10
2033	1.61	1.80	41.82	48.87	44.59	67.14	87.96	80.26	87.80	95.95	75.68
2034	1.60	1.80	42.30	49.21	45.33	67.88	88.57	81.59	88.36	96.94	76.07
2035	1.60	1.80	42.80	49.55	46.08	68.62	89.19	82.94	88.92	97.95	76.47
2036	1.60	1.80	43.29	49.89	46.84	69.38	89.81	84.32	89.49	98.96	76.87
2037	1.60	1.80	43.79	50.24	47.62	70.14	90.43	85.72	90.06	99.99	77.27
2038	1.60	1.80	44.30	50.59	48.41	70.91	91.06	87.14	90.63	101.02	77.67
2039	1.60	1.80	44.59	50.93	48.92	71.33	91.67	88.06	91.21	102.07	78.07
2040	1.60	1.80	44.88	51.27	49.43	71.75	92.28	88.98	91.79	103.13	78.48
2041	1.60	1.80	45.17	51.61	49.95	72.17	92.90	89.91	92.38	104.20	78.89
2042	1.60	1.80	45.46	51.95	50.48	72.60	93.52	90.86	92.96	105.27	79.30
2043	1.60	1.80	45.76	52.30	51.01	73.03	94.14	91.81	93.56	106.37	79.71
2044	1.59	1.80	46.06	52.65	51.54	73.46	94.77	92.77	94.06	107.25	80.05
2045	1.59	1.80	46.36	53.00	52.08	73.89	95.41	93.75	94.56	108.15	80.39
2046	1.59	1.80	46.66	53.36	52.63	74.33	96.04	94.73	95.07	109.06	80.73
2047	1.59	1.80	46.96	53.72	53.18	74.76	96.69	95.72	95.58	109.97	81.07
2048	1.59	1.80	47.27	54.07	53.74	75.20	97.33	96.73	96.09	110.89	81.41
2049	1.59	1.80	47.53	54.38	54.19	75.57	97.89	97.55	96.61	111.82	81.75
2050	1.59	1.80	47.79	54.69	54.65	75.94	98.44	98.38	97.13	112.75	82.09
2051	1.59	1.80	48.05	55.00	55.12	76.31	99.01	99.21	97.65	113.69	82.44
2052	1.59	1.80	48.31	55.32	55.59	76.69	99.57	100.06	98.17	114.64	82.79
2053	1.59	1.80	48.58	55.63	56.06	77.06	100.14	100.91	98.70	115.60	83.14
2054	1.59	1.80	48.85	55.95	56.54	77.44	100.71	101.76	99.13	116.46	83.40
2055	1.58	1.80	49.12	56.27	57.02	77.82	101.28	102.63	99.57	117.31	83.67
2056	1.58	1.80	49.39	56.59	57.50	78.20	101.85	103.50	100.00	118.18	83.94
2057	1.58	1.80	49.66	56.91	57.99	78.58	102.43	104.38	100.44	119.05	84.21
2058	1.58	1.80	49.93	57.23	58.48	78.97	103.02	105.27	100.88	119.92	84.48
2059	1.58	1.80	50.16	57.50	58.92	79.28	103.50	106.06	101.32	120.81	84.75
2060	1.58	1.80	50.38	57.77	59.36	79.59	103.99	106.85	101.76	121.70	85.03
2061	1.58	1.80	50.61	58.04	59.81	79.90	104.47	107.65	102.20	122.59	85.30
2062	1.58	1.80	50.84	58.31	60.25	80.21	104.96	108.46	102.65	123.50	85.57
2063	1.58	1.80	51.06	58.59	60.71	80.52	105.46	109.27	103.10	124.41	85.85
2064	1.58	1.80	51.29	58.86	61.16	80.83	105.95	110.09	103.45	125.20	86.04
2065	1.57	1.80	51.53	59.14	61.62	81.15	106.45	110.92	103.80	126.00	86.23
2066	1.57	1.80	51.76	59.42	62.08	81.47	106.95	111.75	104.15	126.80	86.42
2067	1.57	1.80	51.99	59.69	62.55	81.78	107.45	112.59	104.50	127.61	86.61
2068	1.57	1.80	52.22	59.97	63.02	82.10	107.95	113.43	104.85	128.42	86.80
2069	1.57	1.80	52.41	60.20	63.43	82.34	108.35	114.17	105.20	129.24	87.00
2070	1.57	1.80	52.59	60.42	63.84	82.58	108.75	114.91	105.56	130.06	87.19
2071	1.57	1.80	52.77	60.64	64.25	82.82	109.15	115.66	105.91	130.89	87.38
2072	1.57	1.80	52.96	60.87	64.67	83.06	109.56	116.41	106.27	131.72	87.58
2073	1.57	1.80	53.15	61.09	65.09	83.30	109.96	117.16	106.63	132.56	87.77
2074	1.57	1.80	53.33	61.32	65.51	83.54	110.37	117.92	106.88	133.27	87.88

Appendix A.4

Peaking Factor, Average Annual Day, and Peak Day Demand

Year	Peaking Factor		Average Annual Day - AAD (mgd)			Peak Day Demand - PDD (mgd)					
	Conservation	Expected	Conservation	Expected Drought	Accelerated Growth	Conservation	Expected Drought	Accelerated Growth	2013 SWSP Probable Peak	2013 SWSP Accelerated Peak	2013 SWSP Conservation Peak
2075	1.57	1.80	53.52	61.54	65.94	83.78	110.78	118.69	107.14	133.99	87.99
2076	1.56	1.80	53.71	61.77	66.37	84.03	111.19	119.46	107.39	134.70	88.09
2077	1.56	1.80	53.89	62.00	66.80	84.27	111.60	120.24	107.65	135.43	88.20
2078	1.56	1.80	54.08	62.23	67.23	84.51	112.01	121.02	107.90	136.15	88.31
2079	1.56	1.80	54.22	62.39	67.60	84.68	112.31	121.69	108.16	136.89	88.42
2080	1.56	1.80	54.35	62.56	67.97	84.84	112.61	122.35	108.41	137.62	88.52
2081	1.56	1.80	54.49	62.73	68.35	85.00	112.92	123.03	108.67	138.36	88.63
2082	1.56	1.80	54.63	62.90	68.72	85.16	113.22	123.70	108.93	139.10	88.74
2083	1.56	1.80	54.76	63.07	69.10	85.32	113.53	124.38	109.19	139.85	88.85
2084	1.56	1.80	54.90	63.24	69.48	85.48	113.83	125.07	109.45	140.46	88.96
2085	1.56	1.80	55.04	63.41	69.86	85.65	114.14	125.76	109.71	141.07	89.07
2086	1.56	1.80	55.18	63.58	70.25	85.81	114.45	126.45	109.97	141.69	89.17
2087	1.55	1.80	55.31	63.75	70.64	85.97	114.75	127.14	110.23	142.31	89.28
2088	1.55	1.80	55.45	63.92	71.02	86.14	115.06	127.84	110.49	142.93	89.39
2089	1.55	1.80	55.59	64.10	71.34	86.30	115.37	128.42	110.75	143.56	89.50
2090	1.55	1.80	55.73	64.27	71.66	86.46	115.68	129.00	111.02	144.18	89.61
2091	1.55	1.80	55.87	64.44	71.99	86.63	116.00	129.58	111.28	144.81	89.72
2092	1.55	1.80	56.01	64.62	72.31	86.79	116.31	130.16	111.54	145.45	89.83
2093	1.55	1.80	56.15	64.79	72.64	86.96	116.62	130.75	111.81	146.08	89.94
2094	1.55	1.80	56.29	64.96	72.96	87.12	116.94	131.33	112.07	146.50	90.05
2095	1.55	1.80	56.43	65.14	73.29	87.29	117.25	131.93	112.34	146.92	90.16
2096	1.55	1.80	56.57	65.32	73.62	87.46	117.57	132.52	112.61	147.35	90.27
2097	1.54	1.80	56.71	65.49	73.95	87.62	117.88	133.12	112.87	147.77	90.38
2098	1.54	1.80	56.86	65.67	74.29	87.79	118.20	133.71	113.14	148.19	90.49
2099	1.54	1.80	57.00	65.84	74.51	87.96	118.52	134.12	113.41	148.62	90.60
2100	1.54	1.80	57.14	66.02	74.73	88.12	118.84	134.52	113.68	149.05	90.71
2101	1.54	1.80	57.28	66.20	74.96	88.29	119.16	134.92	113.95	149.47	90.82
2102	1.54	1.80	57.43	66.38	75.18	88.46	119.48	135.33	114.22	149.90	90.93
2103	1.54	1.80	57.57	66.56	75.41	88.63	119.80	135.73	114.49	150.33	91.04
2104	1.54	1.80	57.72	66.74	75.63	88.80	120.13	136.14	114.76	150.54	91.15
2105	1.54	1.80	57.86	66.92	75.86	88.97	120.45	136.55	115.03	150.75	91.27
2106	1.54	1.80	58.01	67.10	76.09	89.13	120.77	136.96	115.31	150.95	91.38
2107	1.54	1.80	58.15	67.28	76.32	89.30	121.10	137.37	115.58	151.16	91.49
2108	1.53	1.80	58.30	67.46	76.55	89.47	121.43	137.79	115.85	151.37	91.60
2109	1.53	1.80	58.44	67.64	76.66	89.64	121.75	137.99	116.13	151.58	91.71
2110	1.53	1.80	58.59	67.82	76.78	89.81	122.08	138.20	116.41	151.79	91.82
2111	1.53	1.80	58.74	68.01	76.89	89.99	122.41	138.41	116.68	152.00	91.94
2112	1.53	1.80	58.88	68.19	77.01	90.16	122.74	138.62	116.96	152.20	92.05
2113	1.53	1.80	59.03	68.37	77.13	90.33	123.07	138.83	117.24	152.41	92.16
2114	1.53	1.80	59.18	68.56	77.24	90.50	123.40	139.03	n/a	n/a	n/a
2115	1.53	1.80	59.33	68.74	77.36	90.67	123.74	139.24	n/a	n/a	n/a
2116	1.53	1.80	59.47	68.93	77.47	90.84	124.07	139.45	n/a	n/a	n/a
2117	1.53	1.80	59.62	69.11	77.59	91.02	124.40	139.66	n/a	n/a	n/a
2118	1.53	1.80	59.77	69.30	77.71	91.19	124.74	139.87	n/a	n/a	n/a

B

Current Water Supplies, Demands and Net Supplies

Appendix B.1

Current Annual and Peak Day Water Supply Projections

Year	Current Annual Supplies (ac-ft/yr)				Total Annual Water Supply (ac-ft/yr)	Current Peak Day Supplies (mgd)				Total Peak Day Supply (mgd)
	Lake Meredith	Roberts County Well Field	Bailey County Well Field	Lake Alan Henry		Lake Meredith	Roberts County Well Field	Bailey County Well Field	Lake Alan Henry	
Data by Decade										
2018	7,412	25,570	5,000	8,000	45,982	10.00	24.00	30.00	10.00	74.00
2028	7,412	25,570	4,748	8,000	45,730	10.00	24.00	29.24	10.00	73.24
2038	0	24,829	4,268	8,000	37,097	0.00	23.30	24.03	10.00	57.33
2048	0	23,087	3,713	8,000	34,800	0.00	21.67	18.00	10.00	49.67
2058	0	22,437	3,082	8,000	33,519	0.00	21.06	11.15	10.00	42.21
2068	0	21,780	2,376	8,000	32,156	0.00	20.44	3.48	10.00	33.92
2078	0	21,130	0	8,000	29,130	0.00	19.83	0.00	10.00	29.83
2088	0	20,480	0	8,000	28,480	0.00	19.22	0.00	10.00	29.22
2098	0	19,830	0	8,000	27,830	0.00	18.61	0.00	10.00	28.61
2108	0	19,180	0	8,000	27,180	0.00	18.00	0.00	10.00	28.00
2118	0	18,530	0	8,000	26,530	0.00	17.39	0.00	10.00	27.39
Data by Year										
2018	7,412	25,570	5,000	8,000	45,982	10.00	24.00	30.00	10.00	74.00
2019	7,412	25,570	5,000	8,000	45,982	10.00	24.00	30.00	10.00	74.00
2020	7,412	25,570	5,000	8,000	45,982	10.00	24.00	30.00	10.00	74.00
2021	7,412	25,570	5,000	8,000	45,982	10.00	24.00	30.00	10.00	74.00
2022	7,412	25,570	5,000	8,000	45,982	10.00	24.00	30.00	10.00	74.00
2023	7,412	25,570	4,960	8,000	45,942	10.00	24.00	30.00	10.00	74.00
2024	7,412	25,570	4,919	8,000	45,901	10.00	24.00	30.00	10.00	74.00
2025	7,412	25,570	4,877	8,000	45,859	10.00	24.00	30.00	10.00	74.00
2026	7,412	25,570	4,835	8,000	45,817	10.00	24.00	30.00	10.00	74.00
2027	7,412	25,570	4,792	8,000	45,774	10.00	24.00	29.72	10.00	73.72
2028	7,412	25,570	4,748	8,000	45,730	10.00	24.00	29.24	10.00	73.24
2029	7,412	25,570	4,704	8,000	45,686	10.00	24.00	28.76	10.00	72.76
2030	7,412	25,570	4,658	8,000	45,640	10.00	24.00	28.27	10.00	72.27
2031	7,412	25,570	4,612	8,000	45,594	10.00	24.00	27.76	10.00	71.76
2032	0	25,570	4,565	8,000	38,135	0.00	24.00	27.26	10.00	61.26
2033	0	25,570	4,518	8,000	38,088	0.00	24.00	26.74	10.00	60.74
2034	0	25,570	4,469	8,000	38,039	0.00	24.00	26.21	10.00	60.21
2035	0	25,570	4,420	8,000	37,990	0.00	24.00	25.68	10.00	59.68
2036	0	25,323	4,370	8,000	37,693	0.00	23.77	25.14	10.00	58.91
2037	0	25,076	4,320	8,000	37,396	0.00	23.54	24.59	10.00	58.13
2038	0	24,829	4,268	8,000	37,097	0.00	23.30	24.03	10.00	57.33
2039	0	24,582	4,216	8,000	36,798	0.00	23.07	23.46	10.00	56.53
2040	0	24,335	4,163	8,000	36,498	0.00	22.84	22.89	10.00	55.73
2041	0	24,088	4,110	8,000	36,198	0.00	22.61	22.31	10.00	54.92
2042	0	23,841	4,055	8,000	35,896	0.00	22.38	21.72	10.00	54.10
2043	0	23,594	4,000	8,000	35,594	0.00	22.14	21.12	10.00	53.26
2044	0	23,347	3,944	8,000	35,291	0.00	21.91	20.51	10.00	52.42
2045	0	23,282	3,887	8,000	35,169	0.00	21.85	19.89	10.00	51.74
2046	0	23,217	3,830	8,000	35,047	0.00	21.79	19.27	10.00	51.06
2047	0	23,152	3,772	8,000	34,924	0.00	21.73	18.64	10.00	50.37
2048	0	23,087	3,713	8,000	34,800	0.00	21.67	18.00	10.00	49.67
2049	0	23,022	3,653	8,000	34,675	0.00	21.61	17.35	10.00	48.96
2050	0	22,957	3,593	8,000	34,550	0.00	21.55	16.69	10.00	48.24
2051	0	22,892	3,532	8,000	34,424	0.00	21.49	16.03	10.00	47.52
2052	0	22,827	3,470	8,000	34,297	0.00	21.42	15.36	10.00	46.78
2053	0	22,762	3,407	8,000	34,169	0.00	21.36	14.68	10.00	46.04
2054	0	22,697	3,344	8,000	34,041	0.00	21.30	13.99	10.00	45.29
2055	0	22,632	3,279	8,000	33,911	0.00	21.24	13.29	10.00	44.53
2056	0	22,567	3,214	8,000	33,781	0.00	21.18	12.58	10.00	43.76
2057	0	22,502	3,149	8,000	33,651	0.00	21.12	11.87	10.00	42.99
2058	0	22,437	3,082	8,000	33,519	0.00	21.06	11.15	10.00	42.21
2059	0	22,372	3,015	8,000	33,387	0.00	21.00	10.42	10.00	41.42
2060	0	22,307	2,947	8,000	33,254	0.00	20.94	9.68	10.00	40.62
2061	0	22,235	2,878	8,000	33,113	0.00	20.87	8.93	10.00	39.80
2062	0	22,170	2,809	8,000	32,979	0.00	20.81	8.18	10.00	38.99
2063	0	22,105	2,739	8,000	32,844	0.00	20.75	7.42	10.00	38.17
2064	0	22,040	2,668	8,000	32,708	0.00	20.69	6.65	10.00	37.34
2065	0	21,975	2,596	8,000	32,571	0.00	20.63	5.87	10.00	36.50
2066	0	21,910	2,524	8,000	32,434	0.00	20.56	5.08	10.00	35.64
2067	0	21,845	2,450	8,000	32,295	0.00	20.50	4.29	10.00	34.79
2068	0	21,780	2,376	8,000	32,156	0.00	20.44	3.48	10.00	33.92
2069	0	21,715	2,302	8,000	32,017	0.00	20.38	2.67	10.00	33.05
2070	0	21,650	0	8,000	29,650	0.00	20.32	0.00	10.00	30.32
2071	0	21,585	0	8,000	29,585	0.00	20.26	0.00	10.00	30.26
2072	0	21,520	0	8,000	29,520	0.00	20.20	0.00	10.00	30.20
2073	0	21,455	0	8,000	29,455	0.00	20.14	0.00	10.00	30.14
2074	0	21,390	0	8,000	29,390	0.00	20.08	0.00	10.00	30.08
2075	0	21,325	0	8,000	29,325	0.00	20.02	0.00	10.00	30.02
2076	0	21,260	0	8,000	29,260	0.00	19.95	0.00	10.00	29.95
2077	0	21,195	0	8,000	29,195	0.00	19.89	0.00	10.00	29.89
2078	0	21,130	0	8,000	29,130	0.00	19.83	0.00	10.00	29.83
2079	0	21,065	0	8,000	29,065	0.00	19.77	0.00	10.00	29.77
2080	0	21,000	0	8,000	29,000	0.00	19.71	0.00	10.00	29.71
2081	0	20,935	0	8,000	28,935	0.00	19.65	0.00	10.00	29.65
2082	0	20,870	0	8,000	28,870	0.00	19.59	0.00	10.00	29.59
2083	0	20,805	0	8,000	28,805	0.00	19.53	0.00	10.00	29.53

Appendix B.1

Current Annual and Peak Day Water Supply Projections

Year	Current Annual Supplies (ac-ft/yr)				Total Annual Water Supply (ac-ft/yr)	Current Peak Day Supplies (mgd)				Total Peak Day Supply (mgd)
	Lake Meredith	Roberts County Well Field	Bailey County Well Field	Lake Alan Henry		Lake Meredith	Roberts County Well Field	Bailey County Well Field	Lake Alan Henry	
2084	0	20,740	0	8,000	28,740	0.00	19.47	0.00	10.00	29.47
2085	0	20,675	0	8,000	28,675	0.00	19.40	0.00	10.00	29.40
2086	0	20,610	0	8,000	28,610	0.00	19.34	0.00	10.00	29.34
2087	0	20,545	0	8,000	28,545	0.00	19.28	0.00	10.00	29.28
2088	0	20,480	0	8,000	28,480	0.00	19.22	0.00	10.00	29.22
2089	0	20,415	0	8,000	28,415	0.00	19.16	0.00	10.00	29.16
2090	0	20,350	0	8,000	28,350	0.00	19.10	0.00	10.00	29.10
2091	0	20,285	0	8,000	28,285	0.00	19.04	0.00	10.00	29.04
2092	0	20,220	0	8,000	28,220	0.00	18.98	0.00	10.00	28.98
2093	0	20,155	0	8,000	28,155	0.00	18.92	0.00	10.00	28.92
2094	0	20,090	0	8,000	28,090	0.00	18.86	0.00	10.00	28.86
2095	0	20,025	0	8,000	28,025	0.00	18.79	0.00	10.00	28.79
2096	0	19,960	0	8,000	27,960	0.00	18.73	0.00	10.00	28.73
2097	0	19,895	0	8,000	27,895	0.00	18.67	0.00	10.00	28.67
2098	0	19,830	0	8,000	27,830	0.00	18.61	0.00	10.00	28.61
2099	0	19,765	0	8,000	27,765	0.00	18.55	0.00	10.00	28.55
2100	0	19,700	0	8,000	27,700	0.00	18.49	0.00	10.00	28.49
2101	0	19,635	0	8,000	27,635	0.00	18.43	0.00	10.00	28.43
2102	0	19,570	0	8,000	27,570	0.00	18.37	0.00	10.00	28.37
2103	0	19,505	0	8,000	27,505	0.00	18.31	0.00	10.00	28.31
2104	0	19,440	0	8,000	27,440	0.00	18.25	0.00	10.00	28.25
2105	0	19,375	0	8,000	27,375	0.00	18.18	0.00	10.00	28.18
2106	0	19,310	0	8,000	27,310	0.00	18.12	0.00	10.00	28.12
2107	0	19,245	0	8,000	27,245	0.00	18.06	0.00	10.00	28.06
2108	0	19,180	0	8,000	27,180	0.00	18.00	0.00	10.00	28.00
2109	0	19,115	0	8,000	27,115	0.00	17.94	0.00	10.00	27.94
2110	0	19,050	0	8,000	27,050	0.00	17.88	0.00	10.00	27.88
2111	0	18,985	0	8,000	26,985	0.00	17.82	0.00	10.00	27.82
2112	0	18,920	0	8,000	26,920	0.00	17.76	0.00	10.00	27.76
2113	0	18,855	0	8,000	26,855	0.00	17.70	0.00	10.00	27.70
2114	0	18,790	0	8,000	26,790	0.00	17.64	0.00	10.00	27.64
2115	0	18,725	0	8,000	26,725	0.00	17.57	0.00	10.00	27.57
2116	0	18,660	0	8,000	26,660	0.00	17.51	0.00	10.00	27.51
2117	0	18,595	0	8,000	26,595	0.00	17.45	0.00	10.00	27.45
2118	0	18,530	0	8,000	26,530	0.00	17.39	0.00	10.00	27.39

Appendix B.2
Current Annual Water Demand, Supply, and Net

Year	Annual Water Demand (ac-ft/yr)			Total Annual Water Supply (ac-ft/yr) (for details see Appendix B.1)	Annual Shortages/Surplus (ac-ft/yr)		
	Conservation	Expected Drought	Accelerated Growth		Conservation	Expected Drought	Accelerated Growth
Data by Decade							
2018	41,266	49,344	41,266	45,982	4,716	-3,362	4,716
2028	44,221	52,878	45,999	45,730	1,510	-7,148	-269
2038	49,624	56,664	54,228	37,097	-12,527	-19,567	-17,131
2048	52,945	60,571	60,194	34,800	-18,145	-25,771	-25,394
2058	55,929	64,108	65,508	33,519	-22,410	-30,588	-31,988
2068	58,498	67,180	70,587	32,156	-26,342	-35,024	-38,431
2078	60,580	69,703	75,311	29,130	-31,450	-40,573	-46,181
2088	62,114	71,604	79,556	28,480	-33,634	-43,124	-51,076
2098	63,687	73,558	83,211	27,830	-35,857	-45,728	-55,381
2108	65,300	75,564	85,744	27,180	-38,120	-48,384	-58,564
2118	66,954	77,625	87,044	26,530	-40,424	-51,095	-60,514

Data by Year							
2018	41,266	49,344	41,266	45,982	4,716	-3,362	4,716
2019	41,552	49,687	41,593	45,982	4,430	-3,705	4,389
2020	41,840	50,032	41,964	45,982	4,142	-4,050	4,018
2021	42,131	50,379	42,381	45,982	3,851	-4,397	3,601
2022	42,423	50,729	42,844	45,982	3,559	-4,747	3,138
2023	42,718	51,081	43,354	45,942	3,224	-5,139	2,588
2024	43,014	51,435	43,871	45,901	2,887	-5,534	2,030
2025	43,313	51,792	44,394	45,859	2,547	-5,933	1,466
2026	43,613	52,151	44,923	45,817	2,204	-6,334	895
2027	43,916	52,513	45,458	45,774	1,858	-6,739	316
2028	44,221	52,878	45,999	45,730	1,510	-7,148	-269
2029	44,733	53,245	46,763	45,686	952	-7,559	-1,077
2030	45,252	53,614	47,539	45,640	388	-7,974	-1,898
2031	45,777	53,986	48,327	45,594	-183	-8,392	-2,733
2032	46,308	54,361	49,129	38,135	-8,172	-16,226	-10,994
2033	46,844	54,738	49,945	38,088	-8,757	-16,651	-11,857
2034	47,388	55,118	50,773	38,039	-9,348	-17,079	-12,734
2035	47,937	55,501	51,616	37,990	-9,947	-17,511	-13,626
2036	48,493	55,886	52,472	37,693	-10,800	-18,193	-14,779
2037	49,055	56,274	53,343	37,396	-11,660	-18,878	-15,947
2038	49,624	56,664	54,228	37,097	-12,527	-19,567	-17,131
2039	49,946	57,043	54,797	36,798	-13,148	-20,245	-17,999
2040	50,271	57,425	55,372	36,498	-13,773	-20,927	-18,874
2041	50,598	57,809	55,953	36,198	-14,400	-21,612	-19,755
2042	50,926	58,196	56,540	35,896	-15,030	-22,300	-20,644
2043	51,257	58,585	57,133	35,594	-15,663	-22,991	-21,539
2044	51,590	58,977	57,733	35,291	-16,299	-23,686	-22,442
2045	51,926	59,372	58,338	35,169	-16,756	-24,202	-23,169
2046	52,263	59,769	58,951	35,047	-17,216	-24,722	-23,904
2047	52,603	60,169	59,569	34,924	-17,679	-25,245	-24,645
2048	52,945	60,571	60,194	34,800	-18,145	-25,771	-25,394
2049	53,236	60,916	60,705	34,675	-18,561	-26,241	-26,030
2050	53,529	61,262	61,221	34,550	-18,979	-26,713	-26,671
2051	53,823	61,611	61,741	34,424	-19,399	-27,187	-27,318
2052	54,119	61,962	62,266	34,297	-19,822	-27,665	-27,969
2053	54,417	62,314	62,795	34,169	-20,248	-28,145	-28,626
2054	54,716	62,669	63,328	34,041	-20,675	-28,628	-29,287
2055	55,017	63,026	63,866	33,911	-21,105	-29,114	-29,955
2056	55,319	63,384	64,409	33,781	-21,538	-29,603	-30,627
2057	55,624	63,745	64,956	33,651	-21,973	-30,094	-31,305
2058	55,929	64,108	65,508	33,519	-22,410	-30,588	-31,988
2059	56,181	64,409	65,999	33,387	-22,794	-31,021	-32,612
2060	56,434	64,711	66,493	33,254	-23,180	-31,457	-33,239
2061	56,688	65,014	66,992	33,113	-23,575	-31,901	-33,878
2062	56,943	65,319	67,494	32,979	-23,964	-32,340	-34,515
2063	57,200	65,626	68,000	32,844	-24,356	-32,782	-35,156
2064	57,457	65,934	68,510	32,708	-24,749	-33,226	-35,802
2065	57,716	66,243	69,023	32,571	-25,145	-33,672	-36,452

Appendix B.2

Current Annual Water Demand, Supply, and Net

Year	Annual Water Demand (ac-ft/yr)			Total Annual Water Supply (ac-ft/yr) (for details see Appendix B.1)	Annual Shortages/Surplus (ac-ft/yr)		
	Conservation	Expected Drought	Accelerated Growth		Conservation	Expected Drought	Accelerated Growth
2066	57,975	66,554	69,541	32,434	-25,542	-34,120	-37,107
2067	58,236	66,866	70,062	32,295	-25,941	-34,571	-37,767
2068	58,498	67,180	70,587	32,156	-26,342	-35,024	-38,431
2069	58,703	67,428	71,046	32,017	-26,687	-35,412	-39,029
2070	58,909	67,677	71,508	29,650	-29,259	-38,027	-41,858
2071	59,115	67,927	71,972	29,585	-29,530	-38,342	-42,387
2072	59,322	68,178	72,440	29,520	-29,802	-38,658	-42,920
2073	59,530	68,430	72,911	29,455	-30,075	-38,975	-43,456
2074	59,739	68,683	73,385	29,390	-30,349	-39,293	-43,995
2075	59,948	68,936	73,861	29,325	-30,623	-39,611	-44,536
2076	60,158	69,191	74,341	29,260	-30,898	-39,931	-45,081
2077	60,369	69,447	74,824	29,195	-31,174	-40,252	-45,629
2078	60,580	69,703	75,311	29,130	-31,450	-40,573	-46,181
2079	60,732	69,891	75,725	29,065	-31,667	-40,826	-46,660
2080	60,884	70,079	76,141	29,000	-31,884	-41,079	-47,141
2081	61,036	70,268	76,560	28,935	-32,101	-41,333	-47,625
2082	61,189	70,457	76,981	28,870	-32,319	-41,587	-48,111
2083	61,342	70,647	77,404	28,805	-32,537	-41,842	-48,599
2084	61,496	70,838	77,830	28,740	-32,756	-42,098	-49,090
2085	61,650	71,029	78,258	28,675	-32,975	-42,354	-49,583
2086	61,804	71,220	78,689	28,610	-33,194	-42,610	-50,079
2087	61,959	71,412	79,121	28,545	-33,414	-42,867	-50,576
2088	62,114	71,604	79,556	28,480	-33,634	-43,124	-51,076
2089	62,270	71,797	79,915	28,415	-33,855	-43,382	-51,500
2090	62,426	71,991	80,274	28,350	-34,076	-43,641	-51,924
2091	62,582	72,185	80,636	28,285	-34,297	-43,900	-52,351
2092	62,739	72,379	80,999	28,220	-34,519	-44,159	-52,779
2093	62,896	72,574	81,363	28,155	-34,741	-44,419	-53,208
2094	63,053	72,770	81,729	28,090	-34,963	-44,680	-53,639
2095	63,211	72,966	82,097	28,025	-35,186	-44,941	-54,072
2096	63,369	73,163	82,467	27,960	-35,409	-45,203	-54,507
2097	63,528	73,360	82,838	27,895	-35,633	-45,465	-54,943
2098	63,687	73,558	83,211	27,830	-35,857	-45,728	-55,381
2099	63,847	73,756	83,461	27,765	-36,082	-45,991	-55,696
2100	64,007	73,955	83,711	27,700	-36,307	-46,255	-56,011
2101	64,167	74,154	83,963	27,635	-36,532	-46,519	-56,328
2102	64,327	74,354	84,215	27,570	-36,757	-46,784	-56,645
2103	64,489	74,554	84,468	27,505	-36,984	-47,049	-56,963
2104	64,650	74,755	84,722	27,440	-37,210	-47,315	-57,282
2105	64,812	74,956	84,976	27,375	-37,437	-47,581	-57,601
2106	64,974	75,158	85,231	27,310	-37,664	-47,848	-57,921
2107	65,137	75,361	85,487	27,245	-37,892	-48,116	-58,242
2108	65,300	75,564	85,744	27,180	-38,120	-48,384	-58,564
2109	65,464	75,768	85,873	27,115	-38,349	-48,653	-58,758
2110	65,627	75,972	86,002	27,050	-38,577	-48,922	-58,952
2111	65,792	76,177	86,132	26,985	-38,807	-49,192	-59,147
2112	65,957	76,382	86,261	26,920	-39,037	-49,462	-59,341
2113	66,122	76,588	86,391	26,855	-39,267	-49,733	-59,536
2114	66,287	76,794	86,521	26,790	-39,497	-50,004	-59,731
2115	66,453	77,001	86,652	26,725	-39,728	-50,276	-59,927
2116	66,620	77,208	86,782	26,660	-39,960	-50,548	-60,122
2117	66,786	77,417	86,913	26,595	-40,191	-50,822	-60,318
2118	66,954	77,625	87,044	26,530	-40,424	-51,095	-60,514

Appendix B.3
Current Peak Day Demand, Supply, and Net

Year	Peak Day Demand (mgd)			Peak Day Supply (mgd) (for details see Appendix B.1)	Peak Day Shortages/Surpluses (mgd)		
	Conservation	Expected Drought	Accelerated Growth		Conservation	Expected Drought	Accelerated Growth
Data by Decade							
2018	59.68	79.29	66.31	74.00	14.32	-5.29	7.69
2028	63.57	84.97	73.92	73.24	9.67	-11.73	-0.68
2038	70.91	91.06	87.14	57.33	-13.58	-33.73	-29.81
2048	75.20	97.33	96.73	49.67	-25.54	-47.67	-47.06
2058	78.97	103.02	105.27	42.21	-36.76	-60.81	-63.06
2068	82.10	107.95	113.43	33.92	-48.18	-74.03	-79.51
2078	84.51	112.01	121.02	29.83	-54.68	-82.18	-91.19
2088	86.14	115.06	127.84	29.22	-56.92	-85.84	-98.62
2098	87.79	118.20	133.71	28.61	-59.18	-89.59	-105.10
2108	89.47	121.43	137.79	28.00	-61.47	-93.43	-109.79
2118	91.19	124.74	139.87	27.39	-63.80	-97.35	-112.48

Data by Year							
2018	59.68	79.29	66.31	74.00	14.32	-5.29	7.69
2019	60.06	79.84	66.84	74.00	13.94	-5.84	7.16
2020	60.44	80.40	67.43	74.00	13.56	-6.40	6.57
2021	60.82	80.96	68.10	74.00	13.18	-6.96	5.90
2022	61.21	81.52	68.85	74.00	12.79	-7.52	5.15
2023	61.59	82.08	69.67	74.00	12.41	-8.08	4.33
2024	61.99	82.65	70.50	74.00	12.01	-8.65	3.50
2025	62.38	83.23	71.34	74.00	11.62	-9.23	2.66
2026	62.77	83.80	72.19	74.00	11.23	-9.80	1.81
2027	63.17	84.39	73.05	73.72	10.55	-10.67	0.67
2028	63.57	84.97	73.92	73.24	9.67	-11.73	-0.68
2029	64.27	85.56	75.14	72.76	8.49	-12.80	-2.39
2030	64.98	86.15	76.39	72.27	7.29	-13.89	-4.13
2031	65.69	86.75	77.66	71.76	6.08	-14.99	-5.89
2032	66.41	87.35	78.95	61.26	-5.16	-26.10	-17.69
2033	67.14	87.96	80.26	60.74	-6.40	-27.22	-19.52
2034	67.88	88.57	81.59	60.21	-7.67	-28.36	-21.38
2035	68.62	89.19	82.94	59.68	-8.95	-29.51	-23.26
2036	69.38	89.81	84.32	58.91	-10.47	-30.90	-25.41
2037	70.14	90.43	85.72	58.13	-12.01	-32.30	-27.59
2038	70.91	91.06	87.14	57.33	-13.58	-33.73	-29.81
2039	71.33	91.67	88.06	56.53	-14.80	-35.13	-31.52
2040	71.75	92.28	88.98	55.73	-16.02	-36.55	-33.25
2041	72.17	92.90	89.91	54.92	-17.26	-37.98	-35.00
2042	72.60	93.52	90.86	54.10	-18.50	-39.42	-36.76
2043	73.03	94.14	91.81	53.26	-19.77	-40.89	-38.55
2044	73.46	94.77	92.77	52.42	-21.04	-42.35	-40.35
2045	73.89	95.41	93.75	51.74	-22.15	-43.66	-42.00
2046	74.33	96.04	94.73	51.06	-23.27	-44.98	-43.67
2047	74.76	96.69	95.72	50.37	-24.40	-46.32	-45.36
2048	75.20	97.33	96.73	49.67	-25.54	-47.67	-47.06
2049	75.57	97.89	97.55	48.96	-26.61	-48.93	-48.59
2050	75.94	98.44	98.38	48.24	-27.70	-50.20	-50.13
2051	76.31	99.01	99.21	47.52	-28.80	-51.49	-51.69
2052	76.69	99.57	100.06	46.78	-29.91	-52.79	-53.28
2053	77.06	100.14	100.91	46.04	-31.03	-54.10	-54.87
2054	77.44	100.71	101.76	45.29	-32.15	-55.42	-56.48
2055	77.82	101.28	102.63	44.53	-33.29	-56.75	-58.10
2056	78.20	101.85	103.50	43.76	-34.44	-58.09	-59.74
2057	78.58	102.43	104.38	42.99	-35.59	-59.44	-61.39
2058	78.97	103.02	105.27	42.21	-36.76	-60.81	-63.06
2059	79.28	103.50	106.06	41.42	-37.86	-62.08	-64.64
2060	79.59	103.99	106.85	40.62	-38.96	-63.37	-66.23
2061	79.90	104.47	107.65	39.80	-40.09	-64.67	-67.85
2062	80.21	104.96	108.46	38.99	-41.22	-65.97	-69.47
2063	80.52	105.46	109.27	38.17	-42.35	-67.29	-71.10
2064	80.83	105.95	110.09	37.34	-43.50	-68.62	-72.75
2065	81.15	106.45	110.92	36.50	-44.65	-69.95	-74.42

Appendix B.3
Current Peak Day Demand, Supply, and Net

Year	Peak Day Demand (mgd)			Peak Day Supply (mgd) (for details see Appendix B.1)	Peak Day Shortages/Surpluses (mgd)		
	Conservation	Expected Drought	Accelerated Growth		Conservation	Expected Drought	Accelerated Growth
2066	81.47	106.95	111.75	35.64	-45.83	-71.31	-76.11
2067	81.78	107.45	112.59	34.79	-47.00	-72.67	-77.80
2068	82.10	107.95	113.43	33.92	-48.18	-74.03	-79.51
2069	82.34	108.35	114.17	33.05	-49.29	-75.30	-81.12
2070	82.58	108.75	114.91	30.32	-52.26	-78.43	-84.59
2071	82.82	109.15	115.66	30.26	-52.56	-78.89	-85.40
2072	83.06	109.56	116.41	30.20	-52.86	-79.36	-86.21
2073	83.30	109.96	117.16	30.14	-53.16	-79.82	-87.02
2074	83.54	110.37	117.92	30.08	-53.46	-80.29	-87.84
2075	83.78	110.78	118.69	30.02	-53.76	-80.76	-88.67
2076	84.03	111.19	119.46	29.95	-54.08	-81.24	-89.51
2077	84.27	111.60	120.24	29.89	-54.38	-81.71	-90.35
2078	84.51	112.01	121.02	29.83	-54.68	-82.18	-91.19
2079	84.68	112.31	121.69	29.77	-54.91	-82.54	-91.92
2080	84.84	112.61	122.35	29.71	-55.13	-82.90	-92.64
2081	85.00	112.92	123.03	29.65	-55.35	-83.27	-93.38
2082	85.16	113.22	123.70	29.59	-55.57	-83.63	-94.11
2083	85.32	113.53	124.38	29.53	-55.79	-84.00	-94.85
2084	85.48	113.83	125.07	29.47	-56.01	-84.36	-95.60
2085	85.65	114.14	125.76	29.40	-56.25	-84.74	-96.36
2086	85.81	114.45	126.45	29.34	-56.47	-85.11	-97.11
2087	85.97	114.75	127.14	29.28	-56.69	-85.47	-97.86
2088	86.14	115.06	127.84	29.22	-56.92	-85.84	-98.62
2089	86.30	115.37	128.42	29.16	-57.14	-86.21	-99.26
2090	86.46	115.68	129.00	29.10	-57.36	-86.58	-99.90
2091	86.63	116.00	129.58	29.04	-57.59	-86.96	-100.54
2092	86.79	116.31	130.16	28.98	-57.81	-87.33	-101.18
2093	86.96	116.62	130.75	28.92	-58.04	-87.70	-101.83
2094	87.12	116.94	131.33	28.86	-58.26	-88.08	-102.47
2095	87.29	117.25	131.93	28.79	-58.50	-88.46	-103.14
2096	87.46	117.57	132.52	28.73	-58.73	-88.84	-103.79
2097	87.62	117.88	133.12	28.67	-58.95	-89.21	-104.45
2098	87.79	118.20	133.71	28.61	-59.18	-89.59	-105.10
2099	87.96	118.52	134.12	28.55	-59.41	-89.97	-105.57
2100	88.12	118.84	134.52	28.49	-59.63	-90.35	-106.03
2101	88.29	119.16	134.92	28.43	-59.86	-90.73	-106.49
2102	88.46	119.48	135.33	28.37	-60.09	-91.11	-106.96
2103	88.63	119.80	135.73	28.31	-60.32	-91.49	-107.42
2104	88.80	120.13	136.14	28.25	-60.55	-91.88	-107.89
2105	88.97	120.45	136.55	28.18	-60.79	-92.27	-108.37
2106	89.13	120.77	136.96	28.12	-61.01	-92.65	-108.84
2107	89.30	121.10	137.37	28.06	-61.24	-93.04	-109.31
2108	89.47	121.43	137.79	28.00	-61.47	-93.43	-109.79
2109	89.64	121.75	137.99	27.94	-61.70	-93.81	-110.05
2110	89.81	122.08	138.20	27.88	-61.93	-94.20	-110.32
2111	89.99	122.41	138.41	27.82	-62.17	-94.59	-110.59
2112	90.16	122.74	138.62	27.76	-62.40	-94.98	-110.86
2113	90.33	123.07	138.83	27.70	-62.63	-95.37	-111.13
2114	90.50	123.40	139.03	27.64	-62.86	-95.76	-111.39
2115	90.67	123.74	139.24	27.57	-63.10	-96.17	-111.67
2116	90.84	124.07	139.45	27.51	-63.33	-96.56	-111.94
2117	91.02	124.40	139.66	27.45	-63.57	-96.95	-112.21
2118	91.19	124.74	139.87	27.39	-63.80	-97.35	-112.48

C

Conservation Information

Appendix C.1

Lubbock Water Rate Structure, 1980-2018

Decreasing Block Rate Structure

Effective Dates		Base Rate + first 1,000 Gallons	2,000 - 49,000 Gallons Water Rate per 1,000 Gallons	50,000 - 250,000 Gallons Water Rate per 1,000 Gallons	> 250,000 Gallons Water Rate per 1,000 Gallons
Start	End				
1980	1983	4.50	0.93	0.80	0.75
1983	1987	5.46	1.13	0.97	0.91
1987	1989	6.21	1.13	0.97	0.91
1989	1990	6.76	1.28	1.12	1.06
1990	1992	7.31	1.53	1.37	1.31

Uniform Rate Structure

Effective Dates		Base Rate for 3/4" Meter	Base Rate for 1" Meter	Single-Family Water Rate per 1,000 Gallons	Commercial Water Rate per 1,000 Gallons	Irrigation Water Rate per 1,000 Gallons
Start	End					
1992	1993	7.31	9.31	1.34	1.23	1.68
1993	1994	7.68	9.78	1.41	1.29	1.76
1994	1999	8.06	10.26	1.48	1.36	1.85
1999	2000	8.30	10.57	1.52	1.40	1.85
2000	2001	8.63	10.99	1.58	1.46	1.85
2001	2002	8.89	11.32	1.63	1.50	1.91
2002	2003	9.16	11.66	1.68	1.55	1.96
2003	2004	9.43	12.01	1.73	1.60	2.02
2004	2005	10.01	12.74	1.83	1.69	2.14
2005	2006	11.11	14.14	2.03	1.88	2.38

Conservation Block Rate Structure

Effective Dates		Base Rate for 3/4" Meter	Base Rate for 1" Meter	Block 1 (0 - AWC) Water Rate per 1,000 Gallons	Block 2 (AWC - 40,000) Water Rate per 1,000 Gallons	Block 3 (AWC + 40,000) & Up Water Rate per 1,000 Gallons
Start	End					
2007	2008	7.66	12.79	2.09	2.61	3.61
2008	2009	8.89	14.84	2.42	3.03	4.19
2009	2011	18.00	30.05	2.67	4.29	5.93
2011	2012	24.00	40.06	2.67	4.29	5.93
2012	2013	28.00	46.74	2.67	4.29	5.93
2013	2014	21.00	35.06	4.00	5.46	6.55
2014	2015	18.00	30.05	4.31	5.88	7.06
2015	2016	18.00	30.05	4.53	6.18	7.41
2016	2017	16.00	26.71	4.76	6.50	7.79
2017	2018	16.00	26.71	4.76	6.50	7.79

Conservation Block Rate Structure Residential

Effective Dates		Base Rate for 3/4" Meter	Base Rate for 1" Meter	Block 1 (0 - 1000) Water Rate per	Block 2 (1001 - 5,000) Water Rate per	Block 3 (5001 - 10,000) Water Rate per	Block 4 (10,001 - 30,000)	Block 5 (30,001) & Up Water Rate per
Start	End							
2018	-	18.00	30.06	0.00	4.03	6.97	8.36	8.57

Conservation Block Rate Structure Commercial

Effective Dates		Base Rate for 3/4" Meter	Base Rate for 1" Meter	Block 1 (0 - AWC) Water Rate per	Block 2 (AWC - AWC * 50%)	Block 3 (AWC + (AWC*50%) & Up Water
Start	End					
2018	-	18.00	30.06	4.76	6.50	7.79

Appendix C.2
Residential Water Bill Comparison for Major Texas Cities During May 2018 for 5/8" or 3/4" Meters

	City	**Water Used (gallons)**						
		0	**5,000**	**10,000**	**20,000**	**30,000**	**40,000**	**50,000**
Monthly Residential Water Bill ($)	**Amarillo**	13.91	18.87	31.27	63.76	96.26	144.36	192.46
	Arlington	9.00	21.41	35.36	79.41	127.31	186.70	246.10
	Austin(R)	13.00	38.41	83.60	229.34	374.04	518.74	663.44
	Brownsville	12.06	22.38	33.84	66.36	107.16	147.96	188.76
	Corpus Christi	12.70	31.75	67.30	143.55	223.05	302.55	382.05
	Dallas(R)	7.40	19.42	41.12	115.85	203.35	290.85	378.35
	El Paso`	7.16	11.48	29.63	97.15	170.15	243.15	316.15
	Fort Worth(R)*	12.35	23.38	38.23	73.29	117.00	162.60	208.20
	Garland(R)	26.80	52.89	82.34	157.89	250.09	342.29	434.49
	Grand Prairie	14.18	22.28	41.63	80.33	149.63	218.93	288.23
	Houston	5.39	29.57	55.74	127.70	215.30	302.90	390.50
	Irving(S)	11.38	20.06	41.76	88.56	138.56	188.56	238.56
	Laredo	9.82	15.71	25.96	47.16	69.66	93.66	118.76
	Lubbock	18.00	34.12	68.97	152.57	236.17	321.87	407.57
	Pasadena	10.97	20.15	36.47	85.43	136.43	192.53	248.63
	Plano	23.35	25.95	43.60	78.90	149.50	220.10	305.60
	San Antonio(R)	16.97	21.98	32.73	63.12	110.93	159.03	207.13
	Median Value	12.35	22.28	41.12	85.43	149.50	218.93	288.23
	Lowest Value	5.39	11.48	25.96	47.16	69.66	93.66	118.76
	Highest Value	26.80	52.89	83.60	229.34	374.04	518.74	663.44
	Monthly Water Bill Range	21.41	41.41	57.64	182.18	304.38	425.08	544.68

R = City has 5/8" *and* 3/4" meters - 3/4" rate used in calculations * = AWC of 7,000 gal S = summer rates

Appendix C.3

Public-School Program Lessons

Lesson Title	Grade(s)	Description
Listen to the Rain	PK-2	Learn about rain in its many forms and sounds through creating rain sticks. The students will create rain sticks using craft roles, fabric, cotton balls, foil, & dried pasta, rice, beans, and rock salt.
The Watermelon Seed	PK-2	Learn about the parts of a plant, different kinds of seeds, what seeds need to grow, and attempt to grow a watermelon seedling in a plastic bag.
Birdfeeders: Sustaining Lubbock 6R's	PK-2	Students will learn about reusing objects to help the environment; students will make bird feeders from used plastic bottles
The Tiny Seed	1-3	Students explore the parts of a plant and life cycle through the seasons as they use watercolors to depict Eric Carle's timeless story.
Water Warriors	1-3	Explore the world's water resources, discover very little is consumable; create water necklace; become water warriors by discussing ways to conserve our water. Discuss the stages of the water cycle and importance; create bracelets to represent each component.
The Adventures of Fred the Fish	2-12	Travel with Fred the Fish as he swims in a polluted river; explore the water treatment process for the City of Lubbock; create a filtering system.
What Goes In Must Come Out	4-12	Explore the world of wastewater; discuss ways in which people add waste into our water system; explore the wastewater treatment process for the City of Lubbock.
Outbreak! Viruses in Our Water	9-12	Explore viruses, bacteria, and how Lubbock's water is cleaned.
Water Careers	K-12	A position in the treatment, distribution, or protection of drinking water is a career, not a job. In the Water and Stormwater industries, there will always be a demand for workers. Students can learn about the diversity in careers available, education needed, and job outlook.

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D

Reclaimed Water Projections

Appendix D.1

Gross Reclaimed Water Projections

Year	Reclaimed Water Population			Reclaimed Water Gallons per Capita per Day (gpcd)			Effluent Flows (mgd)		
	Expected Growth (for details see Section 7.3.1)	2013 SWSP	2009 Wastewater Master Plan	Expected	2013 SWSP	2009 Wastewater Master Plan	Expected	2013 SWSP	2009 Wastewater Master Plan
Data by Decade									
2018	253,061	250,990	243,917	78	79	95	19.70	19.88	23.17
2028	285,122	282,788	267,109	77	78	95	21.81	21.99	25.38
2038	321,244	312,368	292,118	75	76	95	24.15	23.84	27.75
2048	347,889	336,602	319,471	74	75	95	25.69	25.20	30.35
2058	373,023	359,132	349,388	73	73	95	27.07	26.36	33.19
2068	396,018	379,380	.	71	72	.	28.24	27.29	.
2078	416,271	396,801	.	70	70	.	29.16	27.97	.
2088	433,224	412,962	.	69	69	.	29.82	28.51	.
2098	450,869	429,781	.	68	68	.	30.49	29.04	.
2108	469,231	447,285	.	66	66	.	31.18	29.58	.
2118	488,342	.	.	65	.	.	31.88	.	.
Historic Data									
1995	191,020	191,020	191,020	109			20.80		
1996	193,064	193,064	193,064	102			19.67		
1997	195,367	195,367	195,367	96			18.83		
1998	196,679	196,679	196,679	103			20.22		
1999	197,117	197,117	197,117	94			18.59		
2000	199,564	199,564	199,864	106			21.06		
2001	201,217	201,217	201,217	99			19.91		
2002	202,000	202,000	202,000	98			19.82		
2003	204,737	204,737	204,737	89			18.27		
2004	206,290	206,290	206,290	97			20.06		
2005	209,120	209,120	209,120	95			19.93		
2006	211,187	211,187	211,487	97			20.40		
2007	212,365	212,365	215,015	92			19.56		
2008	214,847	214,847	218,542	91			19.65		
2009	218,327	218,327	222,070	87			19.06		
2010	229,573	229,573	225,597	85			19.53		
2011	231,937	231,938	227,887	80			18.47		
2012	233,651	234,327	230,177	80			18.72		
2013	236,362	236,740	232,467	76			17.90		
2014	238,706	239,179	234,757	77			18.28		
2015	241,322	241,642	237,047	79			19.00		
2016	247,095	244,131	239,337	78			19.19		
Data by Year									
2015	241,322	242,167	237,047	79	80	95	19.00	19.29	22.52
2016	247,095	245,073	239,337	78	80	95	19.19	19.49	22.74
2017	250,060	248,014	241,627	78	79	95	19.50	19.68	22.95
2018	253,061	250,990	243,917	78	79	95	19.70	19.88	23.17
2019	256,098	254,002	246,207	78	79	95	19.91	20.08	23.39
2020	259,171	257,050	248,497	78	79	95	20.11	20.29	23.61
2021	262,281	260,134	250,824	77	79	95	20.31	20.49	23.83
2022	265,428	263,256	253,150	77	79	95	20.52	20.70	24.05
2023	268,613	266,415	255,477	77	78	95	20.73	20.91	24.27
2024	271,837	269,612	257,803	77	78	95	20.94	21.12	24.49
2025	275,099	272,847	260,130	77	78	95	21.16	21.34	24.71
2026	278,400	276,122	262,456	77	78	95	21.37	21.55	24.93
2027	281,741	279,435	264,783	77	78	95	21.59	21.77	25.15
2028	285,122	282,788	267,109	77	78	95	21.81	21.99	25.38
2029	288,543	286,182	269,436	76	78	95	22.04	22.21	25.60

Appendix D.1

Gross Reclaimed Water Projections

Year	Reclaimed Water Population			Reclaimed Water Gallons per Capita per Day (gpcd)			Effluent Flows (mgd)		
	Expected Growth (for details see Section 7.3.1)	2013 SWSP	2009 Wastewater Master Plan	Expected	2013 SWSP	2009 Wastewater Master Plan	Expected	2013 SWSP	2009 Wastewater Master Plan
2030	292,006	289,616	271,762	76	77	95	22.26	22.44	25.82
2031	295,510	293,091	274,307	76	77	95	22.49	22.66	26.06
2032	299,056	296,608	276,851	76	77	95	22.72	22.89	26.30
2033	302,644	300,168	279,396	76	77	95	22.95	23.12	26.54
2034	306,276	302,569	281,940	76	77	95	23.18	23.26	26.78
2035	309,951	304,990	284,485	76	77	95	23.42	23.41	27.03
2036	313,671	307,429	287,029	75	77	95	23.66	23.55	27.27
2037	317,435	309,889	289,574	75	76	95	23.90	23.69	27.51
2038	321,244	312,368	292,118	75	76	95	24.15	23.84	27.75
2039	323,814	314,867	294,663	75	76	95	24.30	23.98	27.99
2040	326,405	317,386	297,207	75	76	95	24.45	24.13	28.23
2041	329,016	319,925	299,990	75	76	95	24.60	24.27	28.50
2042	331,648	322,484	302,773	75	76	95	24.75	24.42	28.76
2043	334,301	325,064	305,556	75	76	95	24.91	24.57	29.03
2044	336,976	327,340	308,339	74	75	95	25.06	24.69	29.29
2045	339,671	329,631	311,122	74	75	95	25.22	24.82	29.56
2046	342,389	331,938	313,905	74	75	95	25.38	24.94	29.82
2047	345,128	334,262	316,688	74	75	95	25.53	25.07	30.09
2048	347,889	336,602	319,471	74	75	95	25.69	25.20	30.35
2049	350,324	338,958	322,254	74	75	95	25.83	25.32	30.61
2050	352,776	341,331	325,037	74	75	95	25.96	25.45	30.88
2051	355,246	343,720	328,081	73	74	95	26.10	25.58	31.17
2052	357,733	346,126	331,125	73	74	95	26.23	25.71	31.46
2053	360,237	348,549	334,169	73	74	95	26.37	25.84	31.75
2054	362,758	350,640	337,213	73	74	95	26.51	25.94	32.04
2055	365,298	352,744	340,257	73	74	95	26.65	26.04	32.32
2056	367,855	354,861	343,300	73	74	95	26.79	26.15	32.61
2057	370,430	356,990	346,344	73	74	95	26.93	26.25	32.90
2058	373,023	359,132	349,388	73	73	95	27.07	26.36	33.19
2059	375,261	361,287	352,432	72	73	95	27.18	26.47	33.48
2060	377,512	363,454	355,476	72	73	95	27.30	26.57	33.77
2061	379,777	365,635	.	72	73	.	27.41	26.68	.
2062	382,056	367,829	.	72	73	.	27.53	26.78	.
2063	384,348	370,036	.	72	73	.	27.65	26.89	.
2064	386,655	371,886	.	72	73	.	27.76	26.97	.
2065	388,974	373,745	.	72	72	.	27.88	27.05	.
2066	391,308	375,614	.	72	72	.	28.00	27.13	.
2067	393,656	377,492	.	71	72	.	28.12	27.21	.
2068	396,018	379,380	.	71	72	.	28.24	27.29	.
2069	397,998	381,277	.	71	72	.	28.33	27.37	.
2070	399,988	383,183	.	71	72	.	28.42	27.46	.
2071	401,988	385,099	.	71	72	.	28.51	27.54	.
2072	403,998	387,024	.	71	71	.	28.60	27.62	.
2073	406,018	388,959	.	71	71	.	28.69	27.70	.
2074	408,048	390,515	.	71	71	.	28.79	27.75	.
2075	410,088	392,077	.	70	71	.	28.88	27.81	.
2076	412,139	393,646	.	70	71	.	28.97	27.86	.
2077	414,200	395,220	.	70	71	.	29.07	27.92	.
2078	416,271	396,801	.	70	70	.	29.16	27.97	.
2079	417,936	398,388	.	70	70	.	29.23	28.02	.
2080	419,607	399,982	.	70	70	.	29.29	28.08	.

Appendix D.1

Gross Reclaimed Water Projections

Year	Reclaimed Water Population			Reclaimed Water Gallons per Capita per Day (gpcd)			Effluent Flows (mgd)		
	Expected Growth (for details see Section 7.3.1)	2013 SWSP	2009 Wastewater Master Plan	Expected	2013 SWSP	2009 Wastewater Master Plan	Expected	2013 SWSP	2009 Wastewater Master Plan
2081	421,286	401,582	.	70	70	.	29.36	28.13	.
2082	422,971	403,188	.	70	70	.	29.42	28.19	.
2083	424,663	404,801	.	69	70	.	29.49	28.24	.
2084	426,361	406,420	.	69	70	.	29.55	28.29	.
2085	428,067	408,046	.	69	69	.	29.62	28.35	.
2086	429,779	409,678	.	69	69	.	29.69	28.40	.
2087	431,498	411,317	.	69	69	.	29.75	28.45	.
2088	433,224	412,962	.	69	69	.	29.82	28.51	.
2089	434,957	414,614	.	69	69	.	29.89	28.56	.
2090	436,697	416,272	.	69	69	.	29.95	28.62	.
2091	438,444	417,937	.	68	69	.	30.02	28.67	.
2092	440,198	419,609	.	68	68	.	30.09	28.72	.
2093	441,958	421,288	.	68	68	.	30.15	28.78	.
2094	443,726	422,973	.	68	68	.	30.22	28.83	.
2095	445,501	424,665	.	68	68	.	30.29	28.88	.
2096	447,283	426,363	.	68	68	.	30.36	28.94	.
2097	449,072	428,069	.	68	68	.	30.42	28.99	.
2098	450,869	429,781	.	68	68	.	30.49	29.04	.
2099	452,672	431,500	.	68	67	.	30.56	29.10	.
2100	454,483	433,226	.	67	67	.	30.63	29.15	.
2101	456,301	434,959	.	67	67	.	30.70	29.20	.
2102	458,126	436,699	.	67	67	.	30.76	29.26	.
2103	459,958	438,446	.	67	67	.	30.83	29.31	.
2104	461,798	440,199	.	67	67	.	30.90	29.36	.
2105	463,645	441,960	.	67	67	.	30.97	29.42	.
2106	465,500	443,728	.	67	66	.	31.04	29.47	.
2107	467,362	445,503	.	67	66	.	31.11	29.52	.
2108	469,231	447,285	.	66	66	.	31.18	29.58	.
2109	471,108	449,074	.	66	66	.	31.25	29.63	.
2110	472,993	450,870	.	66	66	.	31.32	29.68	.
2111	474,885	452,674	.	66	66	.	31.39	29.73	.
2112	476,784	454,485	.	66	66	.	31.46	29.79	.
2113	478,691	456,302	.	66	65	.	31.53	29.84	.
2114	480,606	.	.	66	.	.	31.60	.	.
2115	482,529	.	.	66	.	.	31.67	.	.
2116	484,459	.	.	66	.	.	31.74	.	.
2117	486,397	.	.	65	.	.	31.81	.	.
2118	488,342	.	.	65	.	.	31.88	.	.

Appendix D.2

Net Reclaimed Water Projections

Year	Reclaimed Water Projections (mgd)					
	Expected Gross Effluent Flows	Contractual		Operational		Expected Net Effluent Flows
		Xcel	Private Cotton Farmers	LLAS	HLAS	
Data by Decade						
2018	19.70	9.00	0	4.00	4.00	2.70
2028	21.81	9.00	0	2.00	0.00	10.81
2038	24.15	9.00	0	2.00	0.00	13.15
2048	25.69	7.00	0	2.00	0.00	16.69
2058	27.07	7.00	0	2.00	0.00	18.07
2068	28.24	7.00	0	2.00	0.00	19.24
2078	29.16	7.00	0	2.00	0.00	20.16
2088	29.82	7.00	0	2.00	0.00	20.82
2098	30.49	7.00	0	2.00	0.00	21.49
2108	31.18	7.00	0	2.00	0.00	22.18
2118	31.88	7.00	0	2.00	0.00	22.88

Data by Year						
2015	19.00	9.00	0	4.00	4.00	2.00
2016	19.19	9.00	0	4.00	4.00	2.19
2017	19.50	9.00	0	4.00	4.00	2.50
2018	19.70	9.00	0	4.00	4.00	2.70
2019	19.91	9.00	0	4.00	4.00	2.91
2020	20.11	9.00	0	4.00	4.00	3.11
2021	20.31	9.00	0	4.00	4.00	3.31
2022	20.52	9.00	0	4.00	4.00	3.52
2023	20.73	9.00	0	4.00	4.00	3.73
2024	20.94	9.00	0	4.00	4.00	3.94
2025	21.16	9.00	0	2.00	0.00	10.16
2026	21.37	9.00	0	2.00	0.00	10.37
2027	21.59	9.00	0	2.00	0.00	10.59
2028	21.81	9.00	0	2.00	0.00	10.81
2029	22.04	9.00	0	2.00	0.00	11.04
2030	22.26	9.00	0	2.00	0.00	11.26
2031	22.49	9.00	0	2.00	0.00	11.49
2032	22.72	9.00	0	2.00	0.00	11.72
2033	22.95	9.00	0	2.00	0.00	11.95
2034	23.18	9.00	0	2.00	0.00	12.18
2035	23.42	9.00	0	2.00	0.00	12.42
2036	23.66	9.00	0	2.00	0.00	12.66
2037	23.90	9.00	0	2.00	0.00	12.90
2038	24.15	9.00	0	2.00	0.00	13.15
2039	24.30	9.00	0	2.00	0.00	13.30
2040	24.45	9.00	0	2.00	0.00	13.45
2041	24.60	9.00	0	2.00	0.00	13.60
2042	24.75	9.00	0	2.00	0.00	13.75
2043	24.91	9.00	0	2.00	0.00	13.91
2044	25.06	9.00	0	2.00	0.00	14.06
2045	25.22	9.00	0	2.00	0.00	14.22
2046	25.38	7.00	0	2.00	0.00	16.38
2047	25.53	7.00	0	2.00	0.00	16.53
2048	25.69	7.00	0	2.00	0.00	16.69
2049	25.83	7.00	0	2.00	0.00	16.83
2050	25.96	7.00	0	2.00	0.00	16.96
2051	26.10	7.00	0	2.00	0.00	17.10
2052	26.23	7.00	0	2.00	0.00	17.23
2053	26.37	7.00	0	2.00	0.00	17.37
2054	26.51	7.00	0	2.00	0.00	17.51

Appendix D.2

Net Reclaimed Water Projections

Year	Reclaimed Water Projections (mgd)					
	Expected Gross Effluent Flows	Contractual		Operational		Expected Net Effluent Flows
		Xcel	Private Cotton Farmers	LLAS	HLAS	
2055	26.65	7.00	0	2.00	0.00	17.65
2056	26.79	7.00	0	2.00	0.00	17.79
2057	26.93	7.00	0	2.00	0.00	17.93
2058	27.07	7.00	0	2.00	0.00	18.07
2059	27.18	7.00	0	2.00	0.00	18.18
2060	27.30	7.00	0	2.00	0.00	18.30
2061	27.41	7.00	0	2.00	0.00	18.41
2062	27.53	7.00	0	2.00	0.00	18.53
2063	27.65	7.00	0	2.00	0.00	18.65
2064	27.76	7.00	0	2.00	0.00	18.76
2065	27.88	7.00	0	2.00	0.00	18.88
2066	28.00	7.00	0	2.00	0.00	19.00
2067	28.12	7.00	0	2.00	0.00	19.12
2068	28.24	7.00	0	2.00	0.00	19.24
2069	28.33	7.00	0	2.00	0.00	19.33
2070	28.42	7.00	0	2.00	0.00	19.42
2071	28.51	7.00	0	2.00	0.00	19.51
2072	28.60	7.00	0	2.00	0.00	19.60
2073	28.69	7.00	0	2.00	0.00	19.69
2074	28.79	7.00	0	2.00	0.00	19.79
2075	28.88	7.00	0	2.00	0.00	19.88
2076	28.97	7.00	0	2.00	0.00	19.97
2077	29.07	7.00	0	2.00	0.00	20.07
2078	29.16	7.00	0	2.00	0.00	20.16
2079	29.23	7.00	0	2.00	0.00	20.23
2080	29.29	7.00	0	2.00	0.00	20.29
2081	29.36	7.00	0	2.00	0.00	20.36
2082	29.42	7.00	0	2.00	0.00	20.42
2083	29.49	7.00	0	2.00	0.00	20.49
2084	29.55	7.00	0	2.00	0.00	20.55
2085	29.62	7.00	0	2.00	0.00	20.62
2086	29.69	7.00	0	2.00	0.00	20.69
2087	29.75	7.00	0	2.00	0.00	20.75
2088	29.82	7.00	0	2.00	0.00	20.82
2089	29.89	7.00	0	2.00	0.00	20.89
2090	29.95	7.00	0	2.00	0.00	20.95
2091	30.02	7.00	0	2.00	0.00	21.02
2092	30.09	7.00	0	2.00	0.00	21.09
2093	30.15	7.00	0	2.00	0.00	21.15
2094	30.22	7.00	0	2.00	0.00	21.22
2095	30.29	7.00	0	2.00	0.00	21.29
2096	30.36	7.00	0	2.00	0.00	21.36
2097	30.42	7.00	0	2.00	0.00	21.42
2098	30.49	7.00	0	2.00	0.00	21.49
2099	30.56	7.00	0	2.00	0.00	21.56
2100	30.63	7.00	0	2.00	0.00	21.63
2101	30.70	7.00	0	2.00	0.00	21.70
2102	30.76	7.00	0	2.00	0.00	21.76
2103	30.83	7.00	0	2.00	0.00	21.83
2104	30.90	7.00	0	2.00	0.00	21.90
2105	30.97	7.00	0	2.00	0.00	21.97
2106	31.04	7.00	0	2.00	0.00	22.04
2107	31.11	7.00	0	2.00	0.00	22.11
2108	31.18	7.00	0	2.00	0.00	22.18

Appendix D.2

Net Reclaimed Water Projections

Year	Reclaimed Water Projections (mgd)					
	Expected Gross Effluent Flows	Contractual		Operational		Expected Net Effluent Flows
		Xcel	Private Cotton Farmers	LLAS	HLAS	
2109	31.25	7.00	0	2.00	0.00	22.25
2110	31.32	7.00	0	2.00	0.00	22.32
2111	31.39	7.00	0	2.00	0.00	22.39
2112	31.46	7.00	0	2.00	0.00	22.46
2113	31.53	7.00	0	2.00	0.00	22.53
2114	31.60	7.00	0	2.00	0.00	22.60
2115	31.67	7.00	0	2.00	0.00	22.67
2116	31.74	7.00	0	2.00	0.00	22.74
2117	31.81	7.00	0	2.00	0.00	22.81
2118	31.88	7.00	0	2.00	0.00	22.88

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512.912.5100

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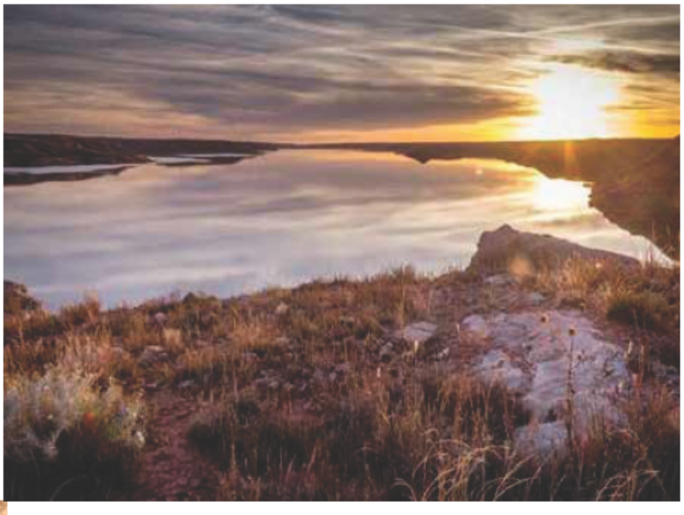
We practice increased use of sustainable materials and reduction of material use.



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Mr. Castleberry's Direct Line: (512) [redacted]
Email: [redacted]

RECEIVED
2016 AUG 16 A 10: 23
WATER AVAILABILITY DIV.

August 15, 2016

Mr. Chris Kozlowski
Water Rights Permitting Team (MC 160)
Water Rights Permitting and Availability Section
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

VIA FIRST-CLASS MAIL AND ELECTRONIC MAIL

Re: Additional Response to Request for Information dated June 14, 2016
City of Lubbock; WRPERM 5921; CN600130736
Application No. 5921 for a Water Use Permit
Texas Water Code §11.121, Requiring Published and Mailed Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties (2020-2)

Dear Chris:

This letter is submitted on behalf of my client, the City of Lubbock (the "City"), as an additional response to the Request for Information (the "RFI") that we received from the Texas Commission on Environmental Quality dated June 14, 2016, in connection with the above-referenced application (the "Application"). On July 27, 2016, Lori Hamilton granted the City's request for an extension of time to provide an additional response to the RFI.

Response to Request No. 1:

Provide an accounting plan for Application 5921 that accounts for all sources of water that will be impounded in or diverted from Lake 7, including rainfall-derived streamflow, return flows authorized under Water Use Permit 3985, and any other water sources. The accounting plan must also include calculations demonstrating compliance with the Senate Bill 3 environmental flow standards. The accounting plan should consist of a text file describing the information in the plan and a spreadsheet with the calculations.

Enclosed herewith as **Attachment A**, please find a compact disc that contains an electronic version of the requested accounting plan. Also included with this letter is **Attachment B**, which is a narrative describing the information in the accounting plan. Those files will also be sent to you electronically with the copy of the letter emailed to you today.

The City appreciates the opportunity to provide this additional information. If you have any questions regarding this response or the Application, please feel free to call me or Ashleigh Acevedo (512) 322-5891 at your earliest convenience.

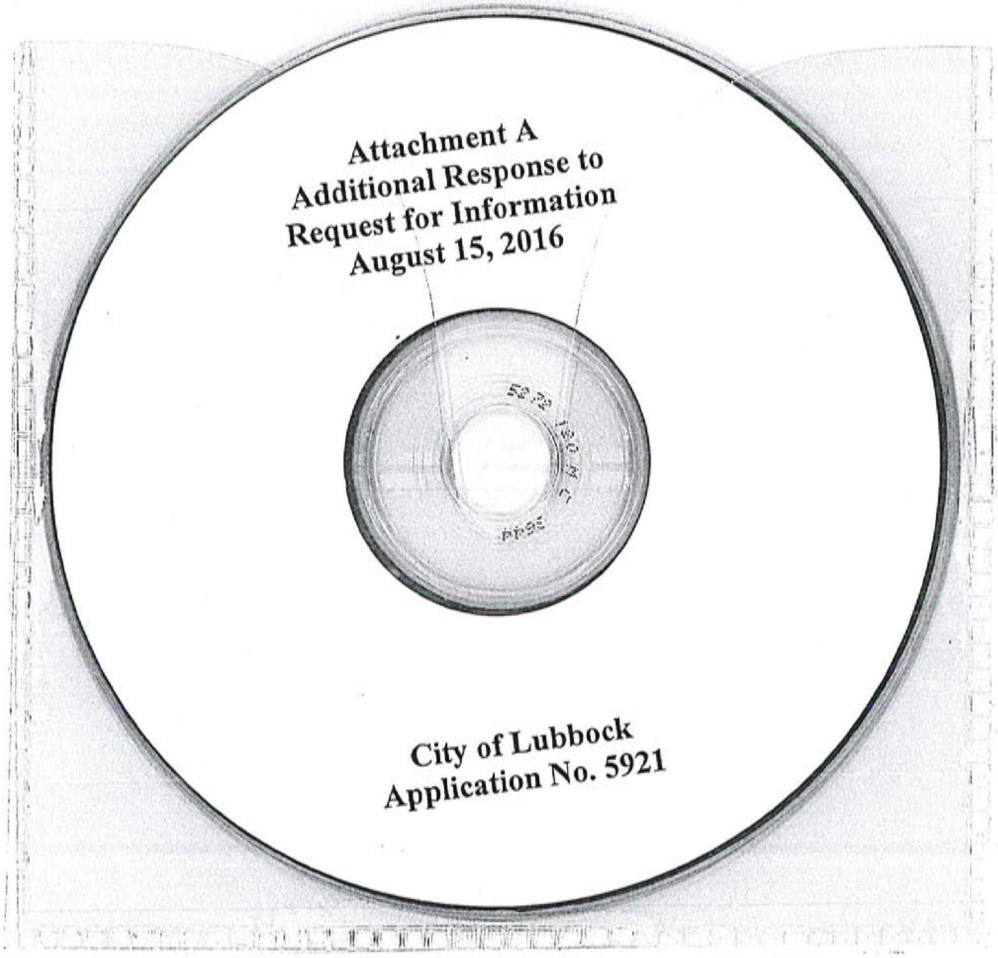
Sincerely,

Brad Castleberry with permission PLH

Brad B. Castleberry

BBC/ldp
7148339
Enclosure

cc: (*without enclosure*)
Mr. Aubrey Spear
Mr. David Dunn
Ms. Ashleigh Acevedo



Attachment A
Additional Response to
Request for Information
August 15, 2016

City of Lubbock
Application No. 5921

Attachment B

-DRAFT-

City of Lubbock
Accounting Plan for Permit Application No. 5921
Lake 7

Background

The City of Lubbock (the "City") has developed an accounting plan to track impoundment of water in the City's proposed Jim Bertram Lake 7 ("Lake 7") on the North Fork of the Double Mountain Fork of the Brazos River (the "North Fork"), under Permit Application No. 5921. The purpose of this accounting plan is to differentiate State Water from other sources of water available to the City for impoundment in Lake 7. Other sources of water include Developed Playa Lake Water and return flows. Use of return flows has been authorized by the Texas Commission on Environmental Quality ("TCEQ") under Permit No. 12-3985, Certification of Adjudication ("CA") No. 12-3705 and CA No. 12-4146. This document outlines the principles used to develop the plan.

Definitions

State Water – water naturally flowing in the North Fork and its tributaries that is subject to appropriation and use by downstream senior and superior water rights.

City Water – water discharged into the North Fork by the City that is not subject to appropriation and use by downstream senior and superior water rights. This water would not enter the North Fork but for the actions of the City and is considered to be "developed water." City Water includes discharges of playa lake water from the City's South Lubbock Drainage System ("SLDS") and South-Central Lubbock Drainage System ("SCLDS"), wastewater effluent derived from groundwater sources owned by the City (including water pumped from underneath the City's land application site and authorized for use by CA 12-3705) and wastewater effluent derived from groundwater and surface water sources purchased from the Canadian River Municipal Water Authority ("CRMWA"). For purposes of this accounting plan, return flows originating from Lake Alan Henry are considered City Water because those return flows originate from water previously stored in Lake Alan Henry and would not have contributed to downstream flows. Differentiation of water originating from Lake Alan Henry from other sources of City Water is accomplished in the accounting plan for Water Right Permit No 3985.

Permit Application No. 5921 – water right permit application filed by the City to authorize impoundment of water in and diversion from the proposed Lake 7 on the North Fork.

CA No. 12-3705 – The City pumps groundwater underlying a wastewater effluent land application site and discharges these flows into the North Fork upstream of the Jim Bertram Lake (JBL) System, pursuant to TPDES Permit No. 04599. CA 12-3705 authorizes the subsequent diversion of these discharges from the perimeters of Lakes 1, 2 and 6 of the JBL System. A special condition in the permit stipulates that these diversions "will not be subject to call by senior and superior water rights holders."

Permit No. 12-3985 (as amended) – water use permit authorizing the diversion of return flows from the North Fork.

CA No. 12-4146 – water right authorizing impoundment of water in and diversion from the existing Lake Alan Henry located on the South Fork of the Double Mountain Fork of the Brazos River. CA 12-4146 also authorizes reuse of effluent originating from Lake Alan Henry.

Accounting Plan Framework

The accounting plan will be based on direct measurement of City Water flows discharged to the North Fork, diversions by the City and flows in the North Fork consisting of combined City Water and State Water. All unmeasured inflows into the North Fork will be considered State Water. Inflows of return flows or reclaimed water by entities other than the City will be considered State Water unless the City enters into a contract to reuse the water and obtains permission to reuse such flows from the TCEQ, in which event these return flows will be accounted for as City Water.

Streamflows in, and City Water discharged to, the North Fork shall be measured by the City using continuous recording devices. For this accounting plan, flows will be measured or computed at the following locations:

- All existing and future wastewater effluent outfalls from which the City has a right to reuse effluent;
- Outfalls of the SLDS and SCLDS;
- A point on the North Fork above Lake 7 (the "Upper Gage");
- Intervening State Water between the Upper Gage and Lake 7, estimated using contributing drainage area ratio; and
- Outflows from Lake 7, which will be based on established rating curves of the reservoir's outlet works.

Channel delivery/loss factors are extrapolated from the TCEQ Brazos WAM and are applied to all City Water and State Water. The relatively short reach does not require application of lag times.

State Water inflows to Lake 7 are computed as State Water flows passing the Upper Gage plus intervening flows to be computed using a drainage area ratio applied to the Lake 7 dam location. Inflows of City Water into Lake 7 will be determined based on the measured discharges of City Water, less losses and diversions of City Water by the City.

The City will pass inflows of State Water through Lake 7:

1. When Possum Kingdom Lake is below elevation 1,000 feet mean sea level and inflows of State Water exceed 5 cfs, per agreement between the City and the Brazos River Authority;
2. To meet subsistence and base flow standards translated from the Aspermont Gage by contributing drainage area ratio to the Lake 7 dam site. This translation is computed as Standard x (Lake 7 DA)/(Aspermont DA) = Standard x 243.13/1,891.25 = Standard x 0.1286; and
3. To meet seasonal pulse standards translated from the Aspermont Gage. Pulse flows will be translated as follows:
   a. The trigger flows will be scaled using the ratio of the mean annual WAM naturalized flows for the two locations.
   b. The durations will be scaled using the $(R)^e$, where R is the naturalized flow ratio calculated above. The exponent e is a duration exponent obtained from a power law relationship between pulse volumes and trigger flows, and is equal to 0.105. The scaled duration will be rounded to an integer number of days.
   c. The pulse volumes will be related such that the pulse ratio, QD/V, where Q is the pulse flow trigger level, D is the duration in days, and V is the pulse volume, is the same at the two locations.

The City has developed and will maintain an Excel spreadsheet recording on a daily basis the above information. In the event that Possum Kingdom Reservoir fills during the course of a day, the City will cease passing State Water inflows through Lake 7 for that purpose.

Accounting Plan Spreadsheet

Organization of Spreadsheet

The Accounting Plan spreadsheet contains fifteen separate tabs to organize input data, calculations and monthly summaries. The following are descriptions of each tab.

- **Instructions** – This tab provides supplemental instructions to those found in this document and provides the location for the user to input the accounting year. This tab also provides the constants used in calculation for drainage area ratios and carriage losses.
- **Summary Table** - This tab provides a summary of monthly diversions from Lake 7 under CoA 12-XXXX.
- **JAN-DEC** – These monthly tabs contain the daily user input and resulting calculations.
- **EFR** – This tab contains the TCEQ environmental flow regime (EFR) for the State Water inflows into Lake 7.

Instructions for Use of Spreadsheet

INSTRUCTIONS TAB

Cell I13: Accounting Year – This cell is the location for the user to input the accounting year. It is imperative that the user input a value because all logic pertaining to dates and leap years depends upon this value.

Cell I14: Inflow Release Balance from Previous Year – This cell is used to carry forward the balance of the required inflow releases from the previous year, if any exists. Only zero or negative numbers should be entered.

SUMMARY TABLE TAB

Column B: Month – The month of the year.

Column C: Lake 7 Diversions (acft) – This column summarizes the total water diverted from Lake 7 under CA 12-XXXX.

JAN-DEC TABS

Columns headings are identical for all of the monthly tabs. Columns B-J require user input when cells are highlighted tan.

Column A: Date (mm/dd/yyyy) – This column represents the date. This column will automatically be populated once the user enters the accounting year in the Instructions Tab.

Column B: Developed Stormwater Outfall 30 (MGD) – This column represents the daily developed stormwater discharged at Outfall 30 and recorded from the gage operated by the City.

Column C: Developed Stormwater Outfall 31 (MGD) – This column represents the daily developed stormwater discharged at Outfall 31 and recorded from the gage operated by the City.

Column D: NWWRP Return Flow (MGD) – This column represents the recorded daily discharge from the City's Northwest Water Reclamation Plant.

Column E: SEWRP Return Flow (MGD) – This column represents the recorded daily discharge from the City's Southeast Water Reclamation Plant.

Column F: Streamflow "Upper Gage" (cfs) – This column represents the average daily streamflow recorded at the "Upper Gage" (USGS Gate No. XXXXXXXX).

Column G: Lake 7 Diversion (MGD) – This column represents the daily diversion from Lake 7.

Column H: Lake 7 Outflow (cfs) – This column represents the daily flow released through the Lake 7 outlet works.

Column I: Possum Kingdom Reservoir WSEL (ft-msl) – This column represents the daily water surface elevation of Possum Kingdom Reservoir as recorded by USGS Gage 08088500.

Column J: PHDI (High Plains Zone) (no units) – This column represents the Palmer Hydrological Drought Index (PHDI), which monitors long-term drought and wet conditions. PHDI values range from +7 to -7. The TCEQ has determined that the PHDI values should be updated on the last day of the month before the start of a new season. Preliminary PHDI values are published by the National Climatic Data Center (NCDC) on a weekly basis. Column J must be updated with the weekly PHDI value that is published during the week in which the last day of the month before the start of a new season occurs. When the NCDC published the final values, the user must enter these values in place of the preliminary values if they differ from the preliminary values.

Conditional formatting has been applied to Column B to denote the days on which the PHDI needs to be updated (tan shading). If a cell is shaded gray, then the PHDI does not need to be updated for that day. For December 31st of the previous accounting year (Tab: JAN, Cell J4), the PHDI value from October 31st of the previous accounting year must be entered to designate the current drought conditions for the winter season beginning on November 1st of the previous year and ending on the last day of February in the current accounting year. The links below provide background information on the PHDI and the location of text files containing the weekly published preliminary values. Lake 7 is located in the Texas High Plains Zone and has a lookup value of 4101 in the text files.\

http://ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers.php

http://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers/phd-20160723.csv

Column K: Developed Stormwater Inflow (cfs) – This column calculates the developed stormwater that enters Lake 7 and accounts for the carriage losses that occur in the reach from stormwater outfalls 30 & 31 to Lake 7.

Column L: Return Flow Inflow (cfs) – This column calculates the return flow that enters Lake 7 and accounts for the carriage losses that occur in the reach from the NWWRP outfall to Lake 7. The SEWRP outfall is located at the upper end of the Lake 7 conservation pool; therefore, carriage losses for return flows discharged from the SEWRP outfall are negligible and assumed to be zero.

Column M: Natural Inflow (cfs) – This column calculates the natural inflow originating in the North Fork and its tributaries that is subject to appropriation and use by downstream senior and superior water rights and is subject to environmental flow criteria.

The natural inflow is calculated by first removing the developed stormwater and return flow components from the recorded flow at the upper gage to calculate the natural flow passing the gage site. The natural flow passing the gage site is then adjusted for differences in drainage area with Lake 7 to account for the additional natural inflow originating downstream of the gage and upstream of the Lake 7 dam. The plan currently assumes that the gage will be located downstream of Outfalls 30 and 31. If the gage is located upstream, the formulas will need to be changed accordingly.

If the entered data cause the calculated natural inflow to be zero or negative while flows are measured at the Upper Gage, the value is set to zero and conditional formatting is used to indicate to the user that the values entered for that day require inspection.

Column N: Hydrologic Condition (none) – This column calculates the hydrologic condition used to identify dry, average, or wet conditions in the environmental flow regime and is based on the PHDI value entered by the user in Column J. Dry conditions are defined as a PHDI value less than -1.78, average conditions between -1.78 and +2.18, and wet conditions greater than +2.18.

Column O: Required Subsistence/Base Flow Release (cfs) – This column calculates the required release of natural inflows that must be made to satisfy the subsistence and base flow environmental flow targets.

Column P: Pulse Trigger (cfs) – This column retrieves the seasonal high flow pulse trigger rate as established for each season.

Column Q: Pulse Volume (acft) – This column retrieves the seasonal high flow pulse volume target necessary to end a pulse event.

Column R: Pulse Duration (days) – This column retrieves the seasonal high flow duration target necessary to end a pulse event.

Column S: Pulse Frequency (per season) – This column retrieves the seasonal frequency target of high flow pulse events.

Column T: Pulse Trigger Met (yes/no) – This column designates whether the pulse flow trigger target is met by natural inflow into Lake 7. For the pulse trigger to bet met, natural inflow must be increasing from the previous day (indicating the beginning of a pulse) and be greater than or equal to the seasonal pulse trigger set in Column P.

Column U: Days Since Last Pulse Start (days) – This column keeps track of the number of days since the start of the last required pulse event. A subsequent required pulse event cannot start until after the seasonal high flow duration target has lapsed (Column R).

Column V: Pulse Event (yes/no) – This column indicates whether a required pulse event is occurring. A required pulse event will occur if the pulse trigger is met in Column T, the target pulse frequency (Column S) has not been met for the season, and sufficient days have passed since the start of the last required pulse event. The pulse event will continue until the target duration or volume has been met.

Column W: Seasonal Pulse Counter (none) – This column counts the number of required high flow pulse events that have occurred in a season. The counter is reset to zero at the beginning of each season.

Column X: Pulse Duration Counter (days) – This column counts the number of days a given required pulse event has been occurring.

Column Y: Cumulative Pulse Volume (acft) – This column calculates the cumulative pulse volume.

Column Z: Turn Off Pulse (yes/no) – This determines whether a required pulse event has reached the target volume or duration and will return a value of 1 to signify that the pulse event has ended.

Column AA: Required Pulse Flow Release (cfs) – This column calculates the required release of natural inflow to satisfy the high flow pulse component of the environmental flow criteria.

Column AB: Required Inflow Release (cfs) – This column calculates the total required release of natural inflows. If the Possum Kingdom Reservoir water surface elevation is below 1,000 ft-msl, then all natural inflows are to be released if the natural inflow is greater than 5 cfs, per agreement with the Brazos River Authority. If the Possum Kingdom Reservoir water surface elevation is equal to or greater than 1,000 ft-msl, then the required natural inflow release is the maximum of the required base or subsistence release (Column O) and the required pulse flow release (Column AA).

Column AC: Balance of Required Inflow Release (acft) – This column calculates the balance of environmental flow release deficits from the current and previous days. Deficit values are carried over from one day to the next until they are satisfied with additional releases greater than the minimum required environmental flow release. Cells in Column AC are conditionally formatted to show deficits with red shading. When no deficits are occurring, the cells are shaded green.

EFR TAB

The EFR tab provides the Lake 7 environmental flow regime (EFR) targets as translated and rounded to the nearest integer from the environmental flow standards located at the Double Mountain Fork near Aspermont Gage (USGS 0808055). The EFR contains three seasons; Winter (Nov-Feb), Spring (Mar-Jun) and Summer (Jul-Oct), and three hydrologic conditions; Dry, Average and Wet. Note that the winter season does contain a high flow pulse requirement; therefore, these cells are highlighted gray along with the columns containing the pulse requirement calculations (Columns P-AA) in the JAN, FEB, NOV and DEC tabs.

From:	Paige Hamilton <[redacted]>
Sent:	Monday, August 15, 2016 1:29 PM
To:	Chris Kozlowski
Cc:	Brad Castleberry; Ashleigh Acevedo
Subject:	Lubbock - Additional Response to RFI Lubbock Permit 5921 (2020-2)
Attachments:	BBC to TCEQ, C Kozlowski, Add_l Resp to RFI dated 2016.06.14 App for Permit 5921 2016.08.15.PDF; Attachment A - Lubbock Accounting Plan Narrative Permit 5921 2016.08.15.xlsm

Hi Chris,

Please find attached a copy of the City of Lubbock's additional response to the TCEQ RFI dated June 14, 2016 pursuant to the City's application for Water Use Permit No. 5921.

Also attached is an electronic version of the letter's Attachment A. A compact disc with this information is being provided to you with the hard-copy of the letter that we are mailing to you today.

Please don't hesitate to let us know if you have any questions.

Paige

Paige L. Hamilton, Paralegal
Lloyd Gosselink Rochelle & Townsend, P.C.
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Austin, Texas 78701
Direct Line: (512) 322-5828
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Mr. Castleberry's Direct Line: (512) [redacted]
Email: [redacted]

August 15, 2016

Mr. Chris Kozlowski
Water Rights Permitting Team (MC 160)
Water Rights Permitting and Availability Section
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

VIA FIRST-CLASS MAIL
AND ELECTRONIC MAIL

Re: Additional Response to Request for Information dated June 14, 2016
City of Lubbock; WRPERM 5921; CN600130736
Application No. 5921 for a Water Use Permit
Texas Water Code §11.121, Requiring Published and Mailed Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties (2020-2)

Dear Chris:

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Sincerely,

Brad Castleberry with permission HH

Brad B. Castleberry

BBC/ldp
7148339
Enclosure

cc: (*without enclosure*)
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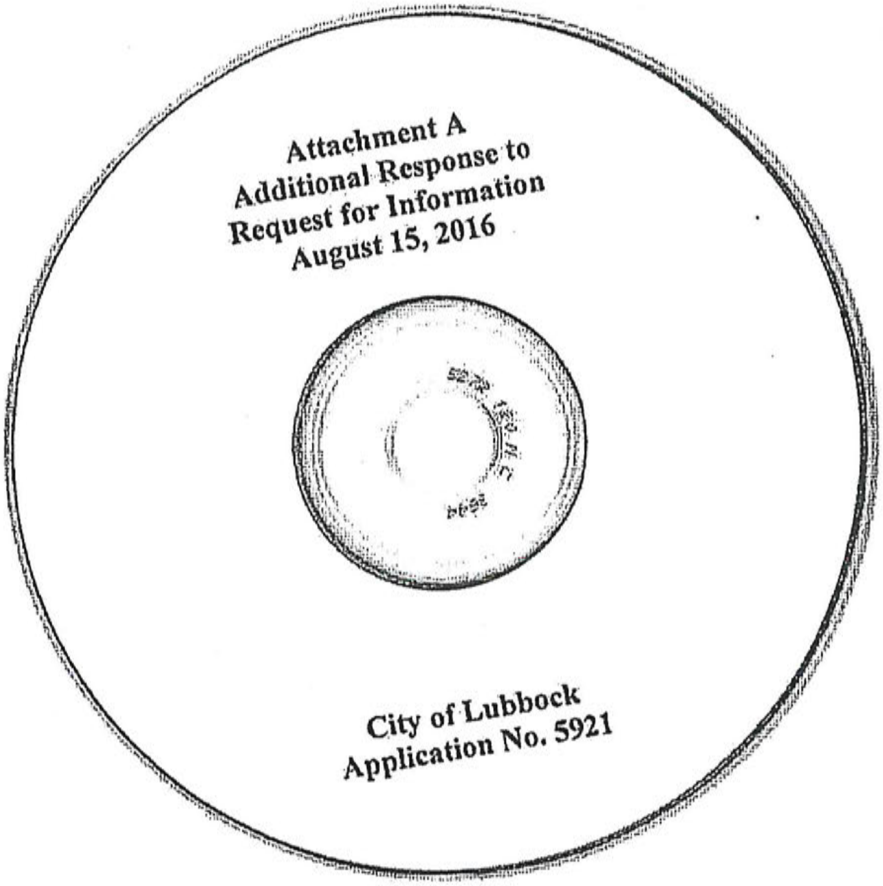
Mr. David Dunn
Ms. Ashleigh Acevedo



Attachment A
Additional Response to
Request for Information
August 15, 2016

City of Lubbock
Application No. 5921

Attachment B

-DRAFT-

City of Lubbock
Accounting Plan for Permit Application No. 5921
Lake 7

Background

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Definitions

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Accounting Plan Framework

The accounting plan will be based on direct measurement of City Water flows discharged to the North Fork, diversions by the City and flows in the North Fork consisting of combined City Water and State Water. All unmeasured inflows into the North Fork will be considered State Water. Inflows of return flows or reclaimed water by entities other than the City will be considered State Water unless the City enters into a contract to reuse the water and obtains permission to reuse such flows from the TCEQ, in which event these return flows will be accounted for as City Water.

Streamflows in, and City Water discharged to, the North Fork shall be measured by the City using continuous recording devices. For this accounting plan, flows will be measured or computed at the following locations:

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- Intervening State Water between the Upper Gage and Lake 7, estimated using contributing drainage area ratio; and
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State Water inflows to Lake 7 are computed as State Water flows passing the Upper Gage plus intervening flows to be computed using a drainage area ratio applied to the Lake 7 dam location. Inflows of City Water into Lake 7 will be determined based on the measured discharges of City Water, less losses and diversions of City Water by the City.

The City will pass inflows of State Water through Lake 7:

1. When Possum Kingdom Lake is below elevation 1,000 feet mean sea level and inflows of State Water exceed 5 cfs, per agreement between the City and the Brazos River Authority;
2. To meet subsistence and base flow standards translated from the Aspermont Gage by contributing drainage area ratio to the Lake 7 dam site. This translation is computed as Standard x (Lake 7 DA)/(Aspermont DA) = Standard x 243.13/1,891.25 = Standard x 0.1286; and
3. To meet seasonal pulse standards translated from the Aspermont Gage. Pulse flows will be translated as follows:
    a. The trigger flows will be scaled using the ratio of the mean annual WAM naturalized flows for the two locations.
    b. The durations will be scaled using the $(R)^e$, where R is the naturalized flow ratio calculated above. The exponent e is a duration exponent obtained from a power law relationship between pulse volumes and trigger flows, and is equal to 0.105. The scaled duration will be rounded to an integer number of days.
    c. The pulse volumes will be related such that the pulse ratio, QD/V, where Q is the pulse flow trigger level, D is the duration in days, and V is the pulse volume, is the same at the two locations.

The City has developed and will maintain an Excel spreadsheet recording on a daily basis the above information. In the event that Possum Kingdom Reservoir fills during the course of a day, the City will cease passing State Water inflows through Lake 7 for that purpose.

Accounting Plan Spreadsheet

Organization of Spreadsheet

The Accounting Plan spreadsheet contains fifteen separate tabs to organize input data, calculations and monthly summaries. The following are descriptions of each tab.

- **Instructions** – This tab provides supplemental instructions to those found in this document and provides the location for the user to input the accounting year. This tab also provides the constants used in calculation for drainage area ratios and carriage losses.
- **Summary Table** - This tab provides a summary of monthly diversions from Lake 7 under CoA 12-XXXX.
- **JAN-DEC** – These monthly tabs contain the daily user input and resulting calculations.
- **EFR** – This tab contains the TCEQ environmental flow regime (EFR) for the State Water inflows into Lake 7.

Instructions for Use of Spreadsheet

INSTRUCTIONS TAB

Cell I13: Accounting Year – This cell is the location for the user to input the accounting year. It is imperative that the user input a value because all logic pertaining to dates and leap years depends upon this value.

Cell I14: Inflow Release Balance from Previous Year – This cell is used to carry forward the balance of the required inflow releases from the previous year, if any exists. Only zero or negative numbers should be entered.

SUMMARY TABLE TAB

Column B: Month – The month of the year.

Column C: Lake 7 Diversions (acft) – This column summarizes the total water diverted from Lake 7 under CA 12-XXXX.

JAN-DEC TABS

Columns headings are identical for all of the monthly tabs. Columns B-J require user input when cells are highlighted tan.

Column A: Date (mm/dd/yyyy) – This column represents the date. This column will automatically be populated once the user enters the accounting year in the Instructions Tab.

Column B: Developed Stormwater Outfall 30 (MGD) – This column represents the daily developed stormwater discharged at Outfall 30 and recorded from the gage operated by the City.

Column C: Developed Stormwater Outfall 31 (MGD) – This column represents the daily developed stormwater discharged at Outfall 31 and recorded from the gage operated by the City.

Column D: NWWRP Return Flow (MGD) – This column represents the recorded daily discharge from the City's Northwest Water Reclamation Plant.

Column E: SEWRP Return Flow (MGD) – This column represents the recorded daily discharge from the City's Southeast Water Reclamation Plant.

Column F: Streamflow "Upper Gage" (cfs) – This column represents the average daily streamflow recorded at the "Upper Gage" (USGS Gate No. XXXXXXXX).

Column G: Lake 7 Diversion (MGD) – This column represents the daily diversion from Lake 7.

Column H: Lake 7 Outflow (cfs) – This column represents the daily flow released through the Lake 7 outlet works.

Column I: Possum Kingdom Reservoir WSEL (ft-msl) – This column represents the daily water surface elevation of Possum Kingdom Reservoir as recorded by USGS Gage 08088500.

Column J: PHDI (High Plains Zone) (no units) – This column represents the Palmer Hydrological Drought Index (PHDI), which monitors long-term drought and wet conditions. PHDI values range from +7 to -7. The TCEQ has determined that the PHDI values should be updated on the last day of the month before the start of a new season. Preliminary PHDI values are published by the National Climatic Data Center (NCDC) on a weekly basis. Column J must be updated with the weekly PHDI value that is published during the week in which the last day of the month before the start of a new season occurs. When the NCDC published the final values, the user must enter these values in place of the preliminary values if they differ from the preliminary values.

Conditional formatting has been applied to Column B to denote the days on which the PHDI needs to be updated (tan shading). If a cell is shaded gray, then the PHDI does not need to be updated for that day. For December 31st of the previous accounting year (Tab: JAN, Cell J4), the PHDI value from October 31st of the previous accounting year must be entered to designate the current drought conditions for the winter season beginning on November 1st of the previous year and ending on the last day of February in the current accounting year. The links below provide background information on the PHDI and the location of text files containing the weekly published preliminary values. Lake 7 is located in the Texas High Plains Zone and has a lookup value of 4101 in the text files.\

http://ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers.php

http://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers/phd-20160723.csv

Column K: Developed Stormwater Inflow (cfs) – This column calculates the developed stormwater that enters Lake 7 and accounts for the carriage losses that occur in the reach from stormwater outfalls 30 & 31 to Lake 7.

Column L: Return Flow Inflow (cfs) – This column calculates the return flow that enters Lake 7 and accounts for the carriage losses that occur in the reach from the NWWRP outfall to Lake 7. The SEWRP outfall is located at the upper end of the Lake 7 conservation pool; therefore, carriage losses for return flows discharged from the SEWRP outfall are negligible and assumed to be zero.

Column M: Natural Inflow (cfs) – This column calculates the natural inflow originating in the North Fork and its tributaries that is subject to appropriation and use by downstream senior and superior water rights and is subject to environmental flow criteria.

The natural inflow is calculated by first removing the developed stormwater and return flow components from the recorded flow at the upper gage to calculate the natural flow passing the gage site. The natural flow passing the gage site is then adjusted for differences in drainage area with Lake 7 to account for the additional natural inflow originating downstream of the gage and upstream of the Lake 7 dam. The plan currently assumes that the gage will be located downstream of Outfalls 30 and 31. If the gage is located upstream, the formulas will need to be changed accordingly.

If the entered data cause the calculated natural inflow to be zero or negative while flows are measured at the Upper Gage, the value is set to zero and conditional formatting is used to indicate to the user that the values entered for that day require inspection.

Column N: Hydrologic Condition (none) – This column calculates the hydrologic condition used to identify dry, average, or wet conditions in the environmental flow regime and is based on the PHDI value entered by the user in Column J. Dry conditions are defined as a PHDI value less than -1.78, average conditions between -1.78 and +2.18, and wet conditions greater than +2.18.

Column O: Required Subsistence/Base Flow Release (cfs) – This column calculates the required release of natural inflows that must be made to satisfy the subsistence and base flow environmental flow targets.

Column P: Pulse Trigger (cfs) – This column retrieves the seasonal high flow pulse trigger rate as established for each season.

Column Q: Pulse Volume (acft) – This column retrieves the seasonal high flow pulse volume target necessary to end a pulse event.

Column R: Pulse Duration (days) – This column retrieves the seasonal high flow duration target necessary to end a pulse event.

Column S: Pulse Frequency (per season) – This column retrieves the seasonal frequency target of high flow pulse events.

Column T: Pulse Trigger Met (yes/no) – This column designates whether the pulse flow trigger target is met by natural inflow into Lake 7. For the pulse trigger to bet met, natural inflow must be increasing from the previous day (indicating the beginning of a pulse) and be greater than or equal to the seasonal pulse trigger set in Column P.

Column U: Days Since Last Pulse Start (days) – This column keeps track of the number of days since the start of the last required pulse event. A subsequent required pulse event cannot start until after the seasonal high flow duration target has lapsed (Column R).

Column V: Pulse Event (yes/no) – This column indicates whether a required pulse event is occurring. A required pulse event will occur if the pulse trigger is met in Column T, the target pulse frequency (Column S) has not been met for the season, and sufficient days have passed since the start of the last required pulse event. The pulse event will continue until the target duration or volume has been met.

Column W: Seasonal Pulse Counter (none) – This column counts the number of required high flow pulse events that have occurred in a season. The counter is reset to zero at the beginning of each season.

Column X: Pulse Duration Counter (days) – This column counts the number of days a given required pulse event has been occurring.

Column Y: Cumulative Pulse Volume (acft) – This column calculates the cumulative pulse volume.

Column Z: Turn Off Pulse (yes/no) – This determines whether a required pulse event has reached the target volume or duration and will return a value of 1 to signify that the pulse event has ended.

Column AA: Required Pulse Flow Release (cfs) – This column calculates the required release of natural inflow to satisfy the high flow pulse component of the environmental flow criteria.

Column AB: Required Inflow Release (cfs) – This column calculates the total required release of natural inflows. If the Possum Kingdom Reservoir water surface elevation is below 1,000 ft-msl, then all natural inflows are to be released if the natural inflow is greater than 5 cfs, per agreement with the Brazos River Authority. If the Possum Kingdom Reservoir water surface elevation is equal to or greater than 1,000 ft-msl, then the required natural inflow release is the maximum of the required base or subsistence release (Column O) and the required pulse flow release (Column AA).

Column AC: Balance of Required Inflow Release (acft) – This column calculates the balance of environmental flow release deficits from the current and previous days. Deficit values are carried over from one day to the next until they are satisfied with additional releases greater than the minimum required environmental flow release. Cells in Column AC are conditionally formatted to show deficits with red shading. When no deficits are occurring, the cells are shaded green.

EFR TAB

The EFR tab provides the Lake 7 environmental flow regime (EFR) targets as translated and rounded to the nearest integer from the environmental flow standards located at the Double Mountain Fork near Aspermont Gage (USGS 0808055). The EFR contains three seasons; Winter (Nov-Feb), Spring (Mar-Jun) and Summer (Jul-Oct), and three hydrologic conditions; Dry, Average and Wet. Note that the winter season does contain a high flow pulse requirement; therefore, these cells are highlighted gray along with the columns containing the pulse requirement calculations (Columns P-AA) in the JAN, FEB, NOV and DEC tabs.

Bryan W. Shaw, Ph.D., P.E., *Chairman*
Toby Baker, *Commissioner*
Jon Niermann, *Commissioner*
Richard A. Hyde, P.E., *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
Protecting Texas by Reducing and Preventing Pollution

July 27, 2016

Mr. Martin Rochelle
Lloyd Gosselink Blevins Rochelle & Townsend, P.C.
816 Congress Avenue, Suite 1900
Austin, TX 78701

CERTIFIED MAIL

91 7199 9991 7033 2772 0803

RE: City of Lubbock
WRPERM 5921
CN600130736
Application No. 5921 for a Water Use Permit
Texas Water Code § 11.121, Requiring Published and Mailed Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

Dear Mr. Rochelle:

This acknowledges receipt, on July 14, 2016 of the applicant's request for a 30 day extension of time to respond to the Texas Commission on Environmental Quality letter, dated June 14, 2016.

A 30 day extension is granted until August 15, 2016 and after that date the application may be returned pursuant to Title 30 Texas Administrative Code § 281.18. No further extensions will be granted associated with this request for information.

If you have any questions concerning the application, please contact Mr. Chris Kozlowski via e-mail at chris.kozlowski@tceq.texas.gov or by telephone at (512) 239-1801.

Sincerely,

Lori Hamilton

Lori Hamilton, Manager
Water Rights Permitting & Availability Section
Water Availability Division

Lloyd
Gosselink
ATTORNEYS AT LAW

816 Congress Avenue, Suite 1900
Austin, Texas 78701
Telephone: (512) 322-5800
Facsimile: (512) 472-0532
www.lglawfirm.com

Mr. Castleberry's Direct Line: (512) [redacted]
Email: [redacted]

RECEIVED
2016 JUL 18 A 11: 53
WATER AVAILABILITY DIV.

July 14, 2016

Mr. Chris Kozlowski
Water Rights Permitting Team (MC 160)
Water Rights Permitting and Availability Section
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

VIA FIRST-CLASS MAIL
AND ELECTRONIC MAIL

Re: Response to Request for Information dated June 14, 2016
City of Lubbock; WRPERM 5921; CN600130736
Application No. 5921 for a Water Use Permit
Texas Water Code §11.121, Requiring Published and Mailed Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties (2020-2)

Dear Chris:

This letter is submitted on behalf of my client, the City of Lubbock (the "City" or the "Applicant"), in response to the Request for Information (the "RFI") that we received from the Texas Commission on Environmental Quality dated June 14, 2016, in connection with the above-referenced application (the "Application").

Response to Request No. 1:

Provide an accounting plan for Application 5921 that accounts for all sources of water that will be impounded in or diverted from Lake 7, including rainfall-derived streamflow, return flows authorized under Water Use Permit 3985, and any other water sources. The accounting plan must also include calculations demonstrating compliance with the Senate Bill 3 environmental flow standards. The accounting plan should consist of a text file describing the information in the plan and a spreadsheet with the calculations.

Due to the need for the advanced technical work required to develop the requested accounting plan, the City requests a 30-day extension to provide you with the response for RFI Request No. 1. The City hereby commits to provide you with an electronic version of the accounting plan as well as the requested text file, or narrative, no later than Monday, August 15, 2016.

Response to Request No. 2:

Provide any updated water availability modeling conducted for the application in electronic format. Staff acknowledges the information received on July 20, 2015; however, the recently adopted Senate Bill 3 environmental flow standards were not considered in the information provided and an electronic version of the water availability model was not provided.

Enclosed herewith as **Attachment A**, please find a compact disc that contains an electronic version of the updated water availability model("WAM") that takes into consideration the requirements of Senate Bill 3, as well as **Attachment B**, a memorandum (with attachment) explaining the data files. Those files will also be sent to you electronically with the copy of the letter emailed to you today.

The City appreciates the opportunity to provide this additional information. If you have any questions regarding this response or the Application, please feel free to call me or Ashleigh Acevedo (512) 322-5891 at your earliest convenience.

Sincerely,

Brad B. Castleberry

BBC/ldp
7130059
Enclosure

cc: (*without enclosure*)
Mr. Aubrey Spear
Mr. David Dunn
Ms. Ashleigh Acevedo

Attachment A
Response to Request for Information
July 14, 2016

City of Lubbock
Application No. 5921

Attachment B

FDR

Memorandum

Date: Wednesday, July 13, 2016

Project: City of Lubbock Water Right Application No. 5921 (Lake 7)

To: Brad Castleberry

From: David Dunn, PE

Subject: Initial response to TCEQ Request for Information dated June 14, 2016

The attached data files are in partial response to the Request for Information (RFI) received from the Texas Commission on Environmental Quality (TCEQ) regarding Water Right Application No. 5921, dated June 14, 2016. In that RFI, TCEQ requests the Brazos Basin Water Availability Model (Brazos WAM) input files that were used to determine the safe yields presented in our memorandum dated July 15, 2015 (also attached).

After discussion with TCEQ staff, we have utilized the latest Brazos WAM input files obtained from the TCEQ, which now incorporate the adopted environmental flows standards for the Brazos Basin. Our previous analysis was completed prior to adoption of the environmental flow standards. We inserted the additional input records necessary to model the City of Lubbock Lake 7 safe yield, specifically Scenario 6 identified in the memorandum. Scenario 6 includes water available from unappropriated natural flows, developed playa lake stormwater discharges and the City's wastewater effluent discharged upstream of Lake 7.

Note that the effluent and playa lake discharge volumes are adjusted within the model by BWAM channel loss factors extrapolated from the reach between the Buffalo Springs and Aspermont control points.

The only substantive difference between the records we are transmitting and those used to compute the safe yield under Scenario 6 is we have included the full 6 million gallons per day (mgd) (6,725 acft/yr) of return flows authorized in the TPDES permit for the City's Northwest Water Reclamation Facility. Our previous analysis utilized 3.96 mgd (4,438 acft/yr) discharged at this location. This increases the computed 1-year safe yield of Lake 7 to 18,400 acft/yr[1].

I met on July 12, 2016 with Dr. Kathy Alexander of the TCEQ regarding the accounting plan for Application No. 5921, which is the other item requested in the RFI. We discussed the structure and principles behind the accounting plan, and reached agreement on its technical aspects. Please request a 30-day extension for our full response to the RFI to allow time to complete the requested accounting plan.

---

[1] The previous analysis using 3.96 mgd from the Northwest Plant computed a 1-year safe yield of 17,900 acft/yr.

Bryan W. Shaw, Ph.D., P.E., *Chairman*
Toby Baker, *Commissioner*
Jon Niermann, *Commissioner*
Richard A. Hyde, P.E., *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
Protecting Texas by Reducing and Preventing Pollution

June 14, 2016

Mr. Martin Rochelle
Lloyd Gosselink Blevins Rochelle & Townsend, P.C.
816 Congress Avenue, Suite 1900
Austin, TX 78701

CERTIFIED MAIL

91 7199 9991 7033 2842 6490

RE: City of Lubbock
WRPERM 5921
CN600130736
Application No. 5921 for a Water Use Permit
Texas Water Code § 11.121, Requiring Published and Mailed Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

Dear Mr. Rochelle:

Additional information will be required in order to complete technical review of the application:

1. Provide an accounting plan for Application 5921 that accounts for all sources of water that will be impounded in or diverted from Lake 7, including rainfall-derived streamflow, return flows authorized under Water Use Permit 3985, and any other water sources. The accounting plan must also include calculations demonstrating compliance with the Senate Bill 3 environmental flow standards. The accounting plan should consist of a text file describing the information in the plan and a spreadsheet with the calculations.
2. Provide any updated water availability modeling conducted for the application in electronic format. Staff acknowledges the information received on July 20, 2015; however, the recently adopted Senate Bill 3 environmental flow standards were not considered in the information provided and an electronic version of the water availability model was not provided.

Provide the requested information by July 14, 2016, or the application may be returned pursuant to Title 30 Texas Administrative Code § 281.19. Alternatively, you may have the question of the necessity of the requested data (or the sufficiency of the information already submitted) referred to the commission for a decision. To be considered, a request for a referral must be provided by July 14, 2016.

If you have any questions concerning this matter please contact me via email at chris.kozlowski@tceq.texas.gov or by telephone at (512) 239-1801.

Sincerely,

Chris Kozlowski, Work Leader
Water Rights Permitting Team
Water Rights Permitting and Availability Section

Lloyd
Gosselink
ATTORNEYS AT LAW

816 Congress Avenue, Suite 1900
Austin, Texas 78701
Telephone: (512) 322-5800
Facsimile: (512) 472-0532
www.lglawfirm.com

Mr. Castleberry's Direct Line: (512) [redacted]
Email: [redacted]

July 20, 2015

Mr. Michael Gill (MC 160)
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

VIA ELECTRONIC MAIL
AND FIRST-CLASS MAIL

Re: City of Lubbock WRPERM 5921 CN 600130736
Application No. 5921 for a Water Use Permit
TWC § 11.121, Requiring Published and Mailed Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

Dear Michael:

This letter is submitted on behalf of the City of Lubbock pursuant to the above-referenced application for a water use permit (the "Application").

Please find enclosed as a supplement to the Application a technical memorandum prepared by HDR Engineering, Inc. (**Attachment A**) that provides information about the availability of water to support the pending Application.

Do not hesitate to contact me at [redacted] if you have questions.

Sincerely,

Brad B. Castleberry

BBC/plh
4819415
ENCLOSURE

cc: Mr. Aubrey Spear
Mr. David Dunn
Mr. Martin C. Rochelle

RECEIVED
TCEQ
WATER SUPPLY DIV.
2015 JUL 21 AM 10 53

Attachment A

Technical Memorandum

Date: July 15, 2015
Project: City of Lubbock – Water Rights Support
To: Aubrey Spear, PE
From: David Dunn, PE
Paula Jo Lemonds, PE, PG

Subject: **Summary of Lake 7 Yield Analyses**

This memorandum describes the yield analyses completed for the City of Lubbock's (City) proposed Lake 7 project. This memorandum explains the analysis of available water from the North Fork (North Fork) of the Double Mountain Fork of the Brazos River and developed water sources to develop the yield of proposed Lake 7. The analyses used the Brazos Basin Water Availability Model (Brazos WAM) developed and maintained by the Texas Commission on Environmental Quality (TCEQ).

Future analyses of the project likely will have different results depending on alternative assumptions, and future changes in the WAM data sets and the WRAP model. However, the results presented in this report provide a foundation upon which to base any future analyses.

North Fork Water Availability

The assumptions used in the modeling effort are described below and organized by general modeling assumptions, including treatment of developed water supplies (effluent and playa lake discharges) and environmental flow assumptions.

General Assumptions Used in Analyses

Water availability modeling assumptions used in the Lake 7 yield analyses include the following.

1. Brazos Basin Water Availability Model (Brazos WAM) Run 3 with the Brazos River Authority's (BRA's) System Operations Model included, as originally applied for, using the "Gulf Diversion" scenario. Basin-wide year 2060 return flows as originally submitted with the BRA System Operations application are included.
2. Hydrologic period of record of 1940 to 1997. The Brazos WAM does not contain the recent drought experienced since 1997.
3. No subordination of BRA rights to Lubbock water supplies for the analyses of Lake 7.
4. Developed water (playa lake water and return flows) are available only to City water supplies and are not subject to call by downstream rights. City return flows in 2070 are projected in the 2013 Strategic Water Supply Plan to total 30,755 acre-feet per year (27.46 MGD).
5. As-permitted reservoir capacities and storage-area relationships for all reservoirs are utilized in the model.
6. One-year safe yields were determined. A reservoir's one-year safe yield is defined as the annual quantity of water that could be withdrawn from the reservoir during the historical drought of record such that a volume equal to approximately one year of supply remains in storage during

the critical month of the drought. Other formulations of safe yield have been utilized in Texas, including 6-month and 2-year safe yields. For purposes of this memorandum, all references to "safe yield" will mean "one-year safe yield."

7. Instream flow requirements have been based on the Lyons Method for the yield analyses presented. At the time of the analysis, environmental flow requirements pursuant to the Senate Bill 3 (SB3) process had not been adopted by the TCEQ and are not incorporated into these analyses. They are expected to have little effect on the yields presented herein, because only State water (natural inflows) are affected by the instream flow criteria, and little State water is available to Lake 7.

Developed Water Sources

The City's return flows and playa lake stormwater flows are considered to be "developed" water, in that they would not have been present in the North Fork except for the actions of the City. These developed water supplies are considered to be available only to the City for its water supply projects. Development of those supplies is described in the following sections.

RETURN FLOWS

Until 2011, all of the City's return flows (treated wastewater effluent discharges) originated from groundwater sources or surface water supplied through an interbasin transfer from the Canadian River Basin. In 2011, the City began operation of the Lake Alan Henry pipeline, delivering raw water from Lake Alan Henry. With the addition of the supply from Lake Alan Henry, the City's effluent now includes in-basin water from Lake Alan Henry. However, all effluent volumes considered in these analyses are based on the City having unrestricted access to all effluent volumes as if they are developed-water sources because no senior North Fork water rights would have had the capability to call upon any of the Lake Alan Henry flows if they had remained in the South Fork where Lake Alan Henry is located.

Effluent from the City has historically been land applied for irrigation, and has not been discharged into the North Fork. The City was recently granted a water right permit (Water Right Permit No. 3985A), issued by TCEQ for indirect reuse of City return flows up to 32,991 acre-feet per year (ac-ft/yr). For purposes of these analyses, volumes of return flows potentially available to the City were estimated to be 30,755 ac-ft/yr (27.46 MGD). In this current analysis, up to 10,080 ac-ft/yr (9 MGD) would be discharged at Outfall 001, which is the outfall location permitted by TPDES Permit No. 10353-002, near where FM 400 crosses the North Fork; up to 16,240 ac-ft/yr (14.5 MGD) would be discharged at Outfall 007, which is upstream of the proposed Lake 7; and the balance of 4,435 ac-ft/yr (3.96) MGD discharged further upstream at the location of the outfall proposed for the Northwest Water Reclamation Plant (NWWRP). Specific discharge amounts and locations are identified in the descriptions of the various scenarios evaluated for this study.

HDR estimated channel losses (from existing Brazos WAM data) between the outfalls to Lake 7 in order to determine the quantity of return flows that would be delivered from the two upstream discharge locations to the reservoir. These estimated return flows were incorporated into the Brazos WAM and were made available for use by the projects prior to other water rights in the basin having access.

PLAYA LAKE DISCHARGES

Stormwater flows have been historically captured by the natural playa lake system and never discharged to the North Fork. The City has recently completed the South Central Lubbock and

South Lubbock Drainage Systems (SCLDS and SLDS) to discharge to the North Fork stormwater captured in the playa lakes.

Volumes of stormwater discharged to the North Fork from the drainage improvement projects vary with rainfall. Estimates of water generated and discharged to the North Fork due to operation of the City's playa lake system were developed by Parkhill, Smith & Cooper, Inc. (PSC) for the City and provided to HDR (PSC, 2008). These estimates include total storm runoff volumes for the 2-, 5-, 10-, 25-, 50-, and 100-year 24-hour design storms, discharged at outfall locations 30 and 31. In addition, PSC provided runoff volumes for five rainfall depths less than the 2-year design storm in order to obtain an extended relationship between rainfall depth and runoff volume. The five additional rainfall depths include the 0.5-, 1.0-, 1.5-, 2.0-, and 2.5-inch 24-hour precipitation events. PSC provided these data considering Natural Resources Conservation Service (NRCS) Antecedent Moisture Conditions (AMC) II and III, with AMC II conditions considering the playa lake storage to be, alternatively, empty or full. AMC III conditions considered the playa lake storage to be full. When playa lake storage is full, playa lake inflows ultimately are discharged to the North Fork through the drainage systems.

Relationships were developed between storm event runoff volume discharged into the North Fork and 24-hour rainfall depth for the two playa lake system outfalls. These relationships are a function of antecedent conditions – both overall watershed moisture and storage retained in the playa lakes. Five-day running totals of rainfall were used to determine if conditions were consistent with AMC II or III, and the amount of storage retained in the playa lakes. Relationships for the drainage areas associated with Outfall 30 (SCLDS) and Outfall 31 (SDS) are shown in Figures 1 and 2. These relationships and daily rainfall data monitored at Lubbock International Airport were used to estimate monthly volumes of playa lake stormwater discharges for the 1940 to 1997 period of record covered by the Brazos WAM. Areas drained by these outfalls are outside the areas that TCEQ has determined to naturally contribute flows to the North Fork. These areas contribute to North Fork flows solely due to construction of the City's SCLDS and SLDS systems. Monthly and annual flow volumes are presented in Table 1, with annual volumes shown in Figure 3.

HDR estimated channel losses (from existing Brazos WAM data) between the two outfalls and Lake 7 in order to estimate the portion of the water generated by the City's SCLDS and SLDS that would be delivered to the proposed reservoir. These estimates of developed playa flows were incorporated into the Brazos WAM and were made available for use by the project prior to other water rights in the basin having access.

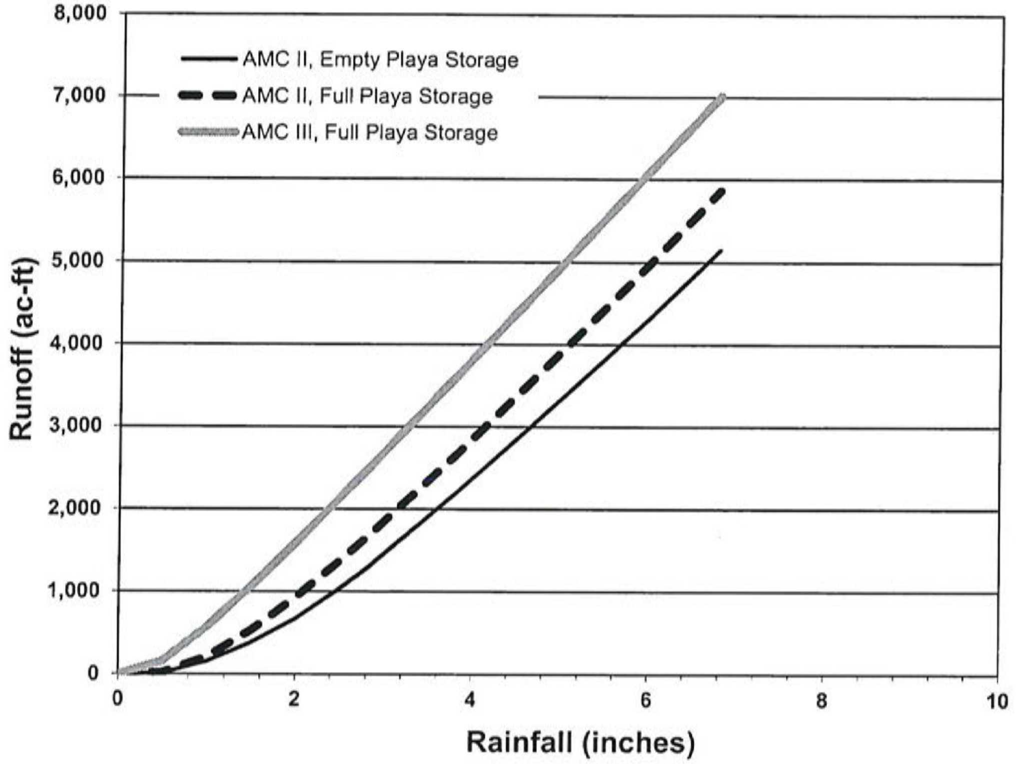

Figure 1. Runoff Volumes Discharged by the SCLDS (Outfall 30) from a 24-hour Storm

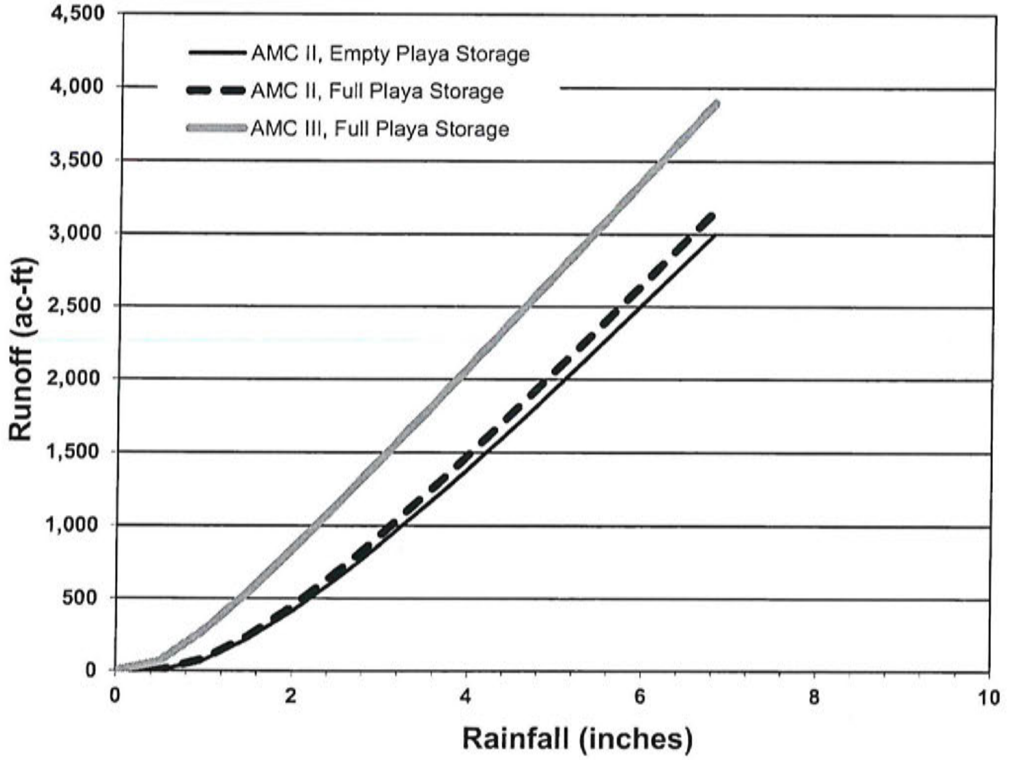

Figure 2. Runoff Volumes Discharged by the SLDS (Outfall 31) from a 24-hour Storm

Table 1. Monthly and Annual Total Combined Playa Flows from the SLDS and SCLDS Discharged into the North Fork (acre-feet)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1940	1	894	-	1,246	674	675	-	39	57	13	879	1	4,479
1941	5	14	2,331	619	12,577	1,389	2,383	68	2,514	1,859	1	29	23,790
1942	-	1	15	1,917	3	104	449	3,164	6,155	1,688	-	1,473	14,968
1943	-	-	2	23	1,581	333	1,224	-	164	-	66	343	3,737
1944	128	134	285	104	1,536	893	1,564	299	2,769	112	327	689	8,840
1945	10	3	-	11	7	8	1,318	1,413	675	861	4	4	4,314
1946	89	-	14	-	111	1,837	13	4,005	1,934	3,890	3	121	12,016
1947	14	-	18	26	4,591	11	146	-	-	8	208	12	5,033
1948	-	37	-	5	743	223	494	3	659	105	-	-	2,270
1949	1,317	2	20	296	6,997	2,326	65	942	2,881	36	-	3	14,885
1950	5	2	-	17	2,026	14	608	465	1,484	1	-	-	4,620
1951	6	13	66	7	1,368	3,076	1,217	1,564	16	56	-	-	7,389
1952	41	-	-	119	30	922	1,776	745	139	-	45	-	3,817
1953	7	1	28	11	495	11	32	751	-	3,119	1	-	4,455
1954	-	-	-	1,150	2,138	4	1	1,017	-	2,044	-	59	6,413
1955	17	-	-	2	837	57	1,149	7	1,205	3,876	-	-	7,150
1956	-	278	-	2	157	882	8	121	-	559	-	5	2,012
1957	-	9	20	898	3,997	3,779	1,161	-	13	2,717	27	-	12,621
1958	78	3	165	778	1,720	11	1,180	3	1,452	14	6	-	5,410
1959	-	-	-	332	455	5,937	52	29	21	66	-	345	7,238
1960	13	17	12	4	81	3,717	3,382	-	3	5,010	-	28	12,268
1961	13	2,212	100	-	660	2,978	822	44	-	8	46	2	6,885
1962	2	-	-	250	-	318	1,785	88	2,182	493	4	16	5,140
1963	-	3	18	2	5,388	192	3	1,106	233	9	233	-	7,187
1964	9	-	16	1	841	3,732	150	270	591	3	9	19	5,641
1965	-	4	1	2	169	37	531	8	5,001	165	-	5	5,923
1966	12	-	1	1,783	16	927	9	7,669	1,069	-	-	-	11,487
1967	-	-	546	179	2,325	9,242	1,915	7	19	8	-	6	14,247
1968	24	11	1,202	10	581	831	860	503	12	24	1,409	7	5,476
1969	-	21	220	193	1,372	1,029	2,833	2,168	2,500	6,199	53	15	16,602
1970	-	-	223	2	3,957	153	-	278	78	293	-	-	4,983
1971	-	75	3	339	1,592	287	10	1,238	3,870	498	4	17	7,934
1972	-	1	-	7	1,743	3,484	2,626	3,874	467	121	18	3	12,345
1973	26	32	117	31	7	5	1,863	41	19	17	-	-	2,158
1974	-	-	516	22	268	129	1,031	3,394	4,573	1,313	20	2	11,269
1975	2	77	-	4	179	171	2,046	1,166	512	-	169	5	4,330
1976	-	-	3	289	222	2,437	3,844	296	1,938	31	8	-	9,068
1977	-	1	68	1,009	1,114	656	194	2,953	9	64	-	-	6,068
1978	8	609	-	3	1,641	669	1	1	1,107	150	54	1	4,244
1979	1	100	1,493	19	3,696	1,385	267	1,384	-	53	-	383	8,782
1980	10	4	1	28	2,361	1,328	2	276	2,361	2	1,120	13	7,506
1981	4	11	31	304	156	21	2,198	4,294	226	4,239	14	2	11,500
1982	-	2	9	2,231	1,976	1,816	282	225	115	9	80	46	6,790
1983	1,088	6	36	12	70	295	8	2	4	10,855	5	2	12,384
1984	-	2	1	1	5	2,390	6	1,937	-	69	375	109	4,895
1985	1	2	95	7	1,269	2,389	3,060	8	3,336	2,841	3	1	13,013
1986	-	20	4	9	49	2,804	163	280	6,700	1,415	1,101	28	12,574
1987	9	27	8	-	1,379	574	3,357	461	855	71	-	23	6,763
1988	3	8	15	140	494	26	1,168	35	754	-	1	12	2,655
1989	8	73	9	-	4	3,229	1	410	2,664	-	-	-	6,398
1990	6	890	17	87	198	-	1,750	409	40	1,368	58	6	4,828
1991	68	10	-	-	248	2,820	794	509	4,420	13	147	210	9,240
1992	22	784	143	27	3,391	2,159	130	228	52	-	550	28	7,514
1993	33	2	-	848	900	3,542	11	248	2	10	4	4	5,603
1994	3	-	-	1,011	2,813	8	1,167	1	27	7	49	-	5,085
1995	5	1	4	108	277	1,153	17	836	7,503	23	-	12	9,940
1996	2	-	-	-	1,328	1,137	126	2,143	9	4	5	-	4,754
1997	3	131	-	3,978	1,002	1,501	746	179	426	17	12	320	8,315

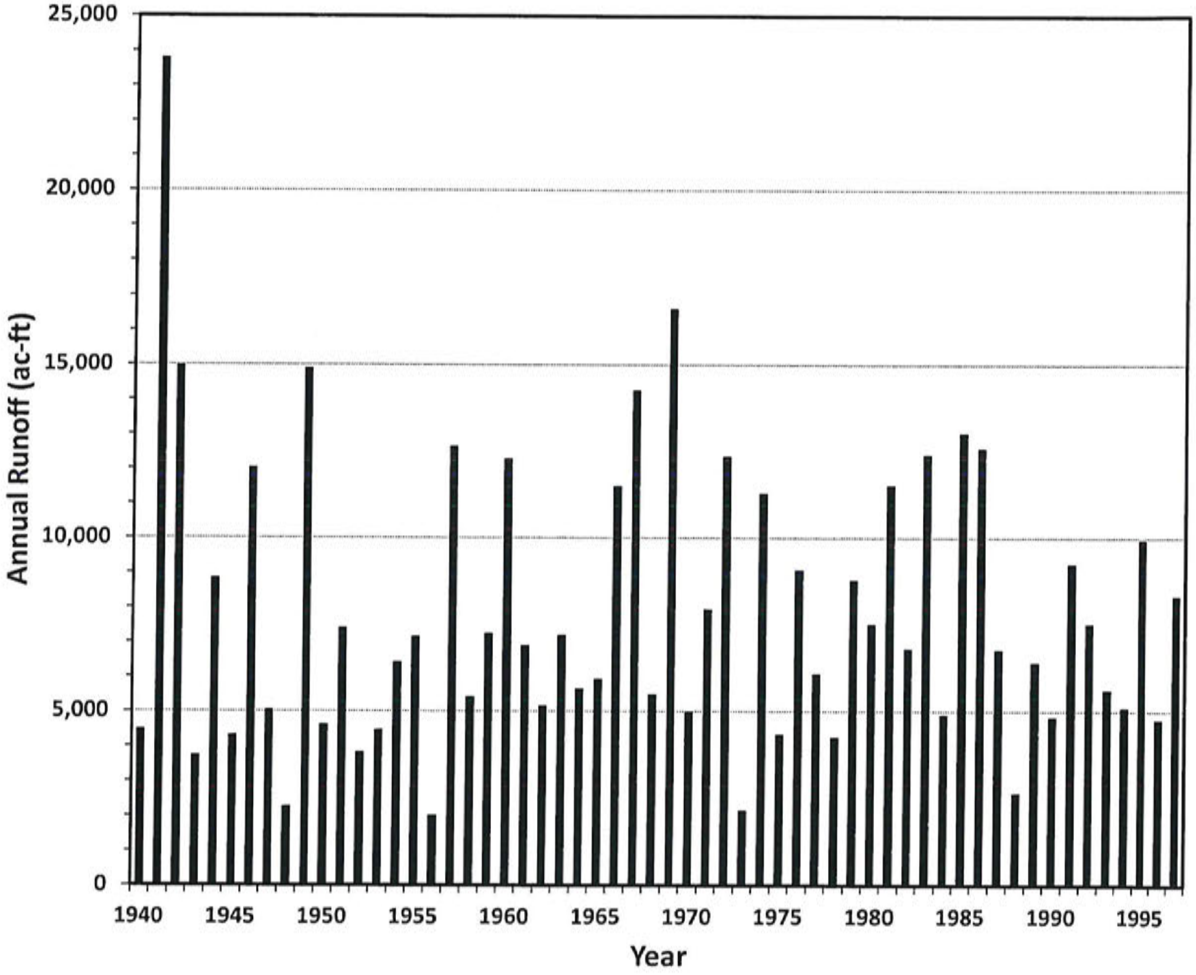

Figure 3. Annual Combined Playa Flows from the SLDS and SCLDS Discharged into the North Fork

Stand-alone Yield of Lake 7

Alternative Scenarios

Safe yield estimates for Lake 7 were calculated using the assumptions described above. Various safe yield estimates for Lake 7 assume the following alternative sources of water available, as described in the following scenarios. These scenarios assume that 9 MGD of return flows will continue to be discharged at Outfall 001 (downstream of Lake 7) or utilized for power generation if not discharged.

1. Unappropriated State water only;
2. Unappropriated State water plus approximately 8,962 ac-ft/yr (8 MGD) of return flows discharged at Outfall 007 located upstream of Lake 7;
3. Unappropriated State water plus 16,240 ac-ft/yr (14.5 MGD) of return flows discharged at Outfall 007 and 4,435 ac-ft/yr (3.96 MGD) discharged further upstream at the outfall proposed for the NWWRP;
4. Item 1 plus developed playa lake water;
5. Item 2 plus developed playa lake water; and
6. Item 3 plus developed playa lake water.

Yield of Lake 7 under Six Scenarios

The results of the WAM yield analysis are shown in Table 2. Utilizing unappropriated flows only, the safe yield of Lake 7 is 1,800 ac-ft/yr. When 8 MGD of return flows are added to the analysis, the safe yield increases to 9,100 ac-ft/yr, and when the 20,675 ac-ft/yr of wastewater discharges are included in the analysis, the safe yield of Lake 7 increases to 16,600 ac-ft/yr. The effect of greater levels of return flows on the safe yield diminishes as those return flows begin to approach or exceed the storage capacity of the reservoir.

Accounting for the playa lake flows increases the yield of Lake 7 by 3,825 ac-ft/yr; 2,450 ac-ft/yr; and 1,300 ac-ft/yr, respectfully, over the yields of Scenarios 1, 2 and 3.

Scenario 5 represents most closely the analysis resulting in the safe yield for Lake 7 that is referenced in the City's 2013 Strategic Water Supply Plan (City of Lubbock, February 2013). In that feasibility analysis, the yield of Lake 7 is identified as being 11,300 ac-ft/yr, compared to the yield reported in Table 1 of 11,550 ac-ft/yr for Scenario 5. The 250 ac-ft/yr difference in yield is within the precision of the yield analyses documented here.

Table 2. Lake 7 Safe Yield Analysis Results

Scenario	Description	Safe Yield (ac-ft/yr)
1	Unappropriated flows only	1,800
2	Unappropriated flows plus 8,962 ac-ft/yr discharged upstream of Lake 7	9,100
3	Unappropriated flows plus 20,675 ac-ft/yr discharged upstream of Lake 7 at 2 locations	16,600
4	Scenario 1 plus playa lake flows	5,625
5	Scenario 2 plus playa lake flows	11,550
6	Scenario 3 plus playa lake flows	17,900

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Mr. Rochelle's Direct Line:
[redacted]

September 28, 2011

Mr. Ron Ellis (MC 160)
Water Supply Division
Water Rights Team
Texas Commission on Environmental Quality
Bldg. F, Room 3101
Austin, Texas 78711-3087

VIA HAND DELIVERY

Re: City of Lubbock
Application for Water Use Permit No. 5921

RECEIVED
TCEQ
WATER SUPPLY DIV.
2011 SEP 28 PM 12

Dear Mr. Ellis:

This letter is submitted on behalf of my client, the City of Lubbock (the "City"), in response to your Request for Information ("RFI") dated June 23, 2008, and in connection with the above-referenced application (the "Application"). The following responses are numbered in accordance with the RFI inquiries included in your June 23, 2008 letter. In addition to this letter, please find enclosed a revised Environmental Information Document in Support of Water Use Permit Application No. 5921 ("EID").

Response to Question No. 8:

Provide an updated "Environmental Information Document in Support of Water Use Permit Application No. 5921". The original document was submitted January 31, 2006, and supplemental information was received on September 6, 2006. The information submitted in January and September of 2006 addresses items 7, 8, and 10 of TCEQ's request for information letter dated December 1, 2005. An update is needed since the City requested on March 4, 2008, that Lake 8 be removed from the application. The updated information should reflect the amended application. Specific comments are provided below based on the original document and the September 6, 2006, supplemental information. Staff needs clarification of these issues and the comments should be addressed in the updated version of the Environmental Information Document.

a. Section 2.3.1, Terrestrial Habitats and Communities (p 2-4): The habitat types within Lake 7 are provided as percentages of the total area. Provide the delineation of habitat types in acres. Include this as part of the Vegetation, Habitats, and Wildlife studies described in the supplemental information received on September 6, 2006.

8a. Table 2-1 (page 5) of the EID provides a delineation of the vegetation types within the project area in acres and percentage of total project area.

b. Section 2.3.1, Terrestrial Habitats and Communities (p 2-5): On September 6, 2006 the City indicated that additional wetland delineations, based on actual field surveys, would be provided. When will the updated information be available?

8b. The wetland delineation results are summarized in Section 2.3.1.3 (page 9) of the EID, and the complete results of the survey are provided in Appendix C to the EID.

c. Section 2.3.2, Aquatic Habitats and Communities (p 2-6): Identify adverse affects that are expected by the construction and operation of the proposed reservoir, i.e. reduced populations due to migratory barriers of dams and increasing salinities in instream water quality conditions.

8c. Text was added to clarify potential effects in Lotic Community Impacts, which is Section 3.2.3 (page 36) of the EID.

d. Section 2.3.3, Important Species (p 2-8): The document identifies several threatened or endangered species that may potentially utilize the habitats in or around the project area on either a temporary or permanent basis. The City proposes a methodology to determine the presence or absence of suitable habitat types for these species and/or their utilization. In the information submitted on September 6, 2006, the City proposes the use of Rapid Biological Assessment (RBA) procedures to evaluate aquatic habitats and fish communities. The RBA procedures alone are not adequate to evaluate the effect on aquatic communities. Staff recommends that the City consider the use of a more comprehensive evaluation technique such as Habitat Evaluation Procedure (HEP), Wildlife Habitat Appraisal Procedure (WHAP), or the U.S. Army Corps of Engineers' Hydrogeomorphic (HGM) assessment model to further evaluation the functions and values of existing habitats.

8d. The WHAP method was used, and the results of this assessment are provided in Section 2.3.1.1 (page 5) of the EID and Appendix B to the EID.

e. Section 4.1, Effects of Project Construction and Reservoir Impoundment (pp 4-1. 4-3): This section describes in very general terms the number of acres and frequencies of inundation within proposed Lake 7. Indicate whether the analysis included the areas affected by construction of the actual dam and explain what the City will propose as mitigation for these impacts.

8e. The dam for the proposed project is currently anticipated to occupy approximately 10 acres. Of this total, the reservoir footprint includes approximately 5.5 acres; the remaining 4.5 acres would be on the downstream side of the dam. Although these additional impacts represent less than 1% of the reservoir footprint, they will be included in the final impact calculations associated with the Section 404/401 permitting process and will be mitigated based on coordination with the appropriate agencies.

f. Section 4.1.3, Important Species (p.4-4): How did the City determine that no significant impact to horned lizard populations is expected to occur?

8f. The potential effects to the Texas horned lizard are addressed in greater detail in Section 4.1.4 of the EID and Appendix E (survey results) to the EID.

g. Section 4.2.2, Downstream Water Quantity and Quality (p.4-5): The City utilizes the Consensus Criteria for Environmental Flow Needs to determine downstream instream flows. While this method can be used for general planning purposes, it is usually not used in the permitting process to determine instream flow needs. The flow recommendations generated by this method do not account for any site specific biological considerations. For a project of this magnitude, staff recommends using and/or developing site specific information to address the environmental flow requirements. Indicate how the City will develop site specific information and use that information in the determination of downstream instream flow needs.

8g. Please note that Section 4.2.2 is now numbered as Section 3.2.2 (page 32) in the EID, and that no changes were made to the document text. The City realizes that the CCEFN is not typically used in the permitting process to determine instream flow needs, and that the trend has been to stipulate a more complex combination of subsistence, base and pulse flow requirements that are intended to provide variability in the hydrologic flow regime to maintain species and habitat diversity. However, for this project, the City believes it is appropriate to use a more simplified approach such as the CCEFN in lieu of more complex requirements for the following reasons:

1. There is a short distance of only 0.8 river miles between the proposed Lake 7 dam site and the headwaters of Buffalo Springs Lake. No biologically sensitive species occur in that reach.
2. The North Fork is a naturally ephemeral stream, and the stream goes dry frequently and for prolonged periods under natural conditions. There are no natural subsistence or base flows to maintain. The CCEFN requirements, in combination with flows passed to honor downstream senior water rights, will sufficiently maintain instream flows.
3. There is no natural stream morphology in the short reach between Lake 7 and Buffalo Springs Lake that might maintain pulse flow release requirements because the stream is already fragmented and disturbed by a small channel dam and by a highway crossing. A set of instream flow requirements more complex than the CCEFN requirements are unnecessary.

4. The presence of Buffalo Springs Lake and Lake Ransom Canyon immediately downstream will preclude any flow effects of Lake 7 being continued downstream.

j. Section 4.2.2, Downstream Water Quantity and Quality (p 4-7): Describe in detail the operations (i.e. frequency, duration, and magnitude of releases) of the proposed reservoir as well as the intended outlet structures design for Lake 7. Explain how the outlet works will mitigate water quality effects since the application indicates that the reservoir will function as a sediment and nutrient sink.

8j. It is not anticipated that releases of stored water would be made downstream. Any flows released from the reservoir will be inflows passed through to meet the requirements of downstream senior water rights and instream flow requirements. Water used from the project is expected to be diverted from the reservoir pool. Water released downstream to honor downstream senior water rights and meet environmental flow requirements will be through a tower outlet designed with multiple stages. These multiple stages will allow releases from within the top 20 feet of the conservation pool as it varies up and down. This is noted on page 33 of the EID in the paragraph immediately beneath Table 3-1. This tower outlet configuration will allow the more oxygenated water near the reservoir surface to be passed downstream when honoring downstream senior water rights and meeting the proposed instream flow requirements. In addition, the outlet works stilling basin will aerate and increase dissolved oxygen levels in those waters released from the reservoir.

The reservoir will mitigate water quality effects by functioning as a sediment sink as it traps sediments and organic matter that will not be passed downstream through the outlet works. These materials will settle to the bottom of the reservoir, and this will decrease nutrient loads passed downstream. Often, this will also result in an anaerobic condition in the lower levels of the reservoir, so the multiple stage outlet works will allow only the top, more oxygenated portion of the water column to be released downstream.

Attached to this letter is a memorandum, noted as Attachment A, prepared by HDR Engineering, Inc. that describes the frequency of Lake 7 storage and the regulated flows downstream from the project under a firm yield operation.

k. Section 4.2.2, Downstream Water Quantity and Quality (p 4-7): The report states that other effects of the project include fragmentation of stream habitat, as well as the trapping of sediment, organic material and nutrients in the reservoir. The reservoir would function as a sink for materials and nutrients and result in reduced oxygen demand, nutrient and sediment loads downstream. While the report claims that the reduced oxygen demand

and nutrient loads would be beneficial to the North Fork downstream, it does not address the stream fragmentation and reduced sediment load issues except for stating that these types of adverse impacts have already occurred due to existing structures and this project would not exacerbate these impacts. Provide an evaluation of the extent of water quality impacts including the sediment reduction and the associated erosion/stream downcutting. Stream habitat fragmentation would be an unavoidable impact if the project proceeds as proposed. Indicate the type of mitigation the City proposes to address stream habitat fragmentation.

8k. Because of the six lakes known as the Canyon Lakes that are located upstream of proposed Lake 7, and because of the proximity of Lake 7 to the headwaters of Buffalo Springs Lake, impacts to sediment loads and potential erosion/stream downcutting will be minimal. In addition, stream habitat fragmentation is not anticipated to be substantially increased by the proposed Lake 7 given that the portion of the North Fork to be inundated by Lake 7 has been fragmented in the past with several small dams located within the footprint of Lake 7. These previous small impoundments are shown on the available USGS 7.5-minute quadrangle map, but several have since been breached or otherwise no longer impound water. Starting from just downstream of the dam site for the proposed Lake 7, continuing upstream, the status of these impoundments is described below:

- Arnett Lake – a small channel dam located immediately downstream of the proposed Lake 7 dam site forms a small impoundment identified as Arnett Lake. This impoundment exists and separates the North Fork from the short reach downstream that leads to the headwaters of Buffalo Springs Lake.

- Benson Lake – a remnant of the dam remains, but the channel has shifted to the north around the original dam and no lake remains.

- Blake Lake – a remnant of the dam remains, but the southern portion of the dam appears to have been breached or washed out and the channel has shifted to the south. The remainder of the dam has formed a riffle/small waterfall. No lake remains except for a small pool upstream of the existing riffle/falls.

- Unnamed lake – this impoundment is shown on the USGS map immediately upstream of the former Blake Lake and may have been a portion of the original Blake Lake. The channel has shifted to the south and now bisects the southern portion of the impoundment. No lake remains, although the original water body appears to hold water periodically from overbank flows.

- Unnamed lake – a long, narrow impoundment formed by a small dam is shown on the USGS map. The southern portion of the dam appears to have been breached or washed out and the channel has shifted from the northern edge of the dam to the southern edge. No lake remains.

l. Section 4.2.3, Lotic Community Impacts (p 4-10): Explain the City's determination that expected changes in water quality due to the project operation would not result in significant impact to the downstream biota.

8l. As noted, the proposed dam for Lake 7 is 0.8 miles upstream of the headwater of Buffalo Springs Lake, which is why the City expects insignificant changes to water quality. The 4th paragraph in Section 3.2.3 of the EID has been revised as follows (page 36): "The existing biota already experience wide variation in water quantity and quality due to natural hydrologic variation. The proposed Lake 7 dam will be located near the upper end of Buffalo Springs Lake. Changes in water quality as a result of project operation are not expected to have significant adverse impacts on downstream biotic communities. Natural hydrology varies by orders of magnitude and existing biota has already demonstrated a tolerance for this large variation."

m. Section 4.2.3, Lotic Community Impacts (p. 4-10): The original report indicates that Lake 8 would be operated to allow a naturalized flow regime downstream. A naturalized flow regime would include medium to high pulse flows needed for periodic channel scout as well as other channel maintenance functions. Since the City requested that Lake 8 be removed from the application, would Lake 7 be operated to allow for a naturalized flow regime downstream? Indicate what the City would consider to be a naturalized flow regime.

8m. Lake 7 would not be operated to provide a naturalized flow regime downstream as it would not be possible to provide such through Buffalo Springs Lake and Lake Ransom Canyon.

n. Section 5.1, Field Study and Mitigation Planning Requirements (p. 5-1): This section of the report explains the additional field work and other evaluations that need to be performed to evaluate the project impacts and appropriate mitigation requirements. The City has engaged in some discussion with staff in these regards, but further discussion is needed if the project is to proceed as proposed.

8n. In the updated EID, the Mitigation Planning Section is now numbered 4.2, and it contains detailed information on the studies that have been completed to date. A combination of habitat enhancement and preservation measures that will compensate for unavoidable losses of habitat functions will be developed in consultation with TCEQ, TPWD, USACE and USFWS personnel during the Section 404 permitting process.

In closing, it is important to note that this document supersedes the document previously submitted, dated January 2006, and by this letter, we withdraw that document from consideration as part of the application.

The City appreciates the opportunity to provide this additional information, and looks forward to working with the Commission on this project. Should you have any questions regarding these responses, please feel free to call either Brad Castleberry [redacted] or me at your earliest convenience.

Sincerely,

Martin C. Rochelle

MCR/ldp
1348327_5.doc
ENCLOSURES

cc: (w/o enclosures)
Mr. Aubrey Spear
Mr. David D. Dunn
Mr. Brad B. Castleberry

ONE COMPANY
Many Solutions℠

Memo

To:	Martin Rochelle		
From:	David D. Dunn, P.E. (Texas 82630)	Project:	City of Lubbock, Lake 7
CC:	Aubrey Spear, P.E.		
Date:	August 9, 2011	Job No:	100815

RE: Frequency Analysis for Lake 7

Based on Brazos WAM modeling of the proposed Lake 7, a frequency analysis was performed on Lake 7 Lake levels, and on regulated and naturalized flows below Lake 7 under a firm yield demand. Assumptions regarding the firm yield analysis include the following:

- TCEQ Brazos WAM, Run 3;
- BRA System Operations modeled as per the latest draft permit. This includes both a total firm diversion from the BRA system (existing rights plus new supply) of 858,660 acft/yr at Richmond and an interruptible supply of 670,000 acft/yr at Richmond;
- Naturalized inflows to Lake 7 are subject to priority calls by downstream senior water rights, including the BRA System Operations Permit, and are subject to Consensus Criteria for Environmental Flow Needs (CCEFN);
- Developed playa lake inflows from the two Lubbock Drainage Improvement Projects are available to Lake 7 only and are not subject to downstream senior right priority calls or instream flow requirements;
- Developed return flows from the Lubbock Southeast Water Reclamation Plant of 8 MGD are available to Lake 7 only and are not subject to downstream senior right priority calls or instream flow requirements;
- Unused portions of the developed playa lake inflows and City return flows are left in the stream and allowed to flow (spill) downstream;
- Lake 7 is modeled at a firm yield demand of 14,450 acft/yr with a conservation capacity of 20,006 acft at elevation 3,100 feet.

Lake 7 storage over the 1940 – 1997 historical period of record is presented in Figure 1. A frequency analysis of Lake 7 storage is presented in Figure 2. Naturalized and regulated flow frequencies are compared in Figure 3.

Regulated flows under the scenario described above generally are equal to or greater than naturalized flows over the range of frequencies due to several factors:

1. During high flow conditions when Lake 7 is full, the developed playa lake stormwater flows, which are not included in the naturalized flows, are spilled downstream, as are the 8 MGD of return flows discharged upstream of Lake 7. During high flow periods, flows in the North Fork of the Double Mountain Fork (North Fork) generally are greater than under natural conditions because of the presence of the developed playa lake stormwater flows and the City's return flows.
2. During high flow conditions when Lake 7 is not full, natural flows are often passed downstream to meet priority calls by downstream senior water rights.
3. During low flow periods, the developed playa lake inflows generally are not present because they occur only during large precipitation events. During these times, no natural flows are

available to Lake 7 due to priority calls by downstream senior water rights in combination with the CCEFN instream flow requirements. The natural flows are therefore passed downstream and flows under this scenario are essentially identical to naturalized flows during low flow periods.

4. The City's 8 MGD of return flows are present during both dry and wet conditions. During dry conditions, however, they are utilized by the City's firm yield diversion and to maintain storage in Lake 7.

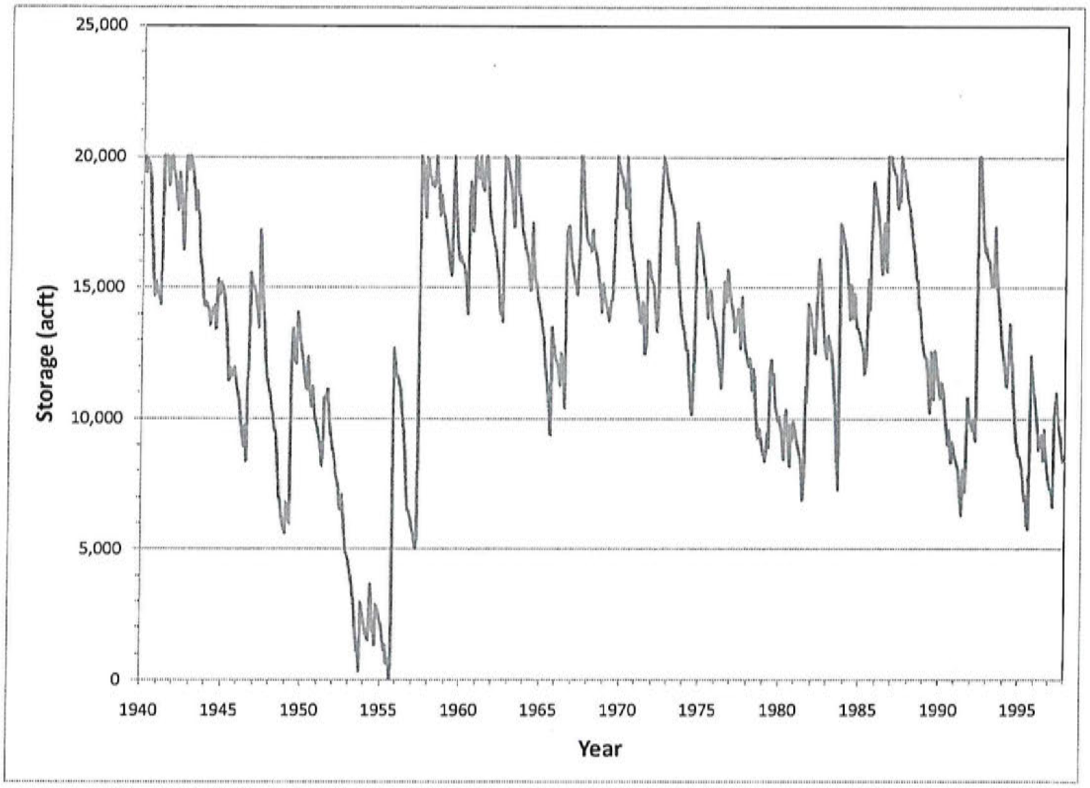

Figure 1. Lake 7 Storage Trace under a Firm Yield Demand of 14,450 acft/yr

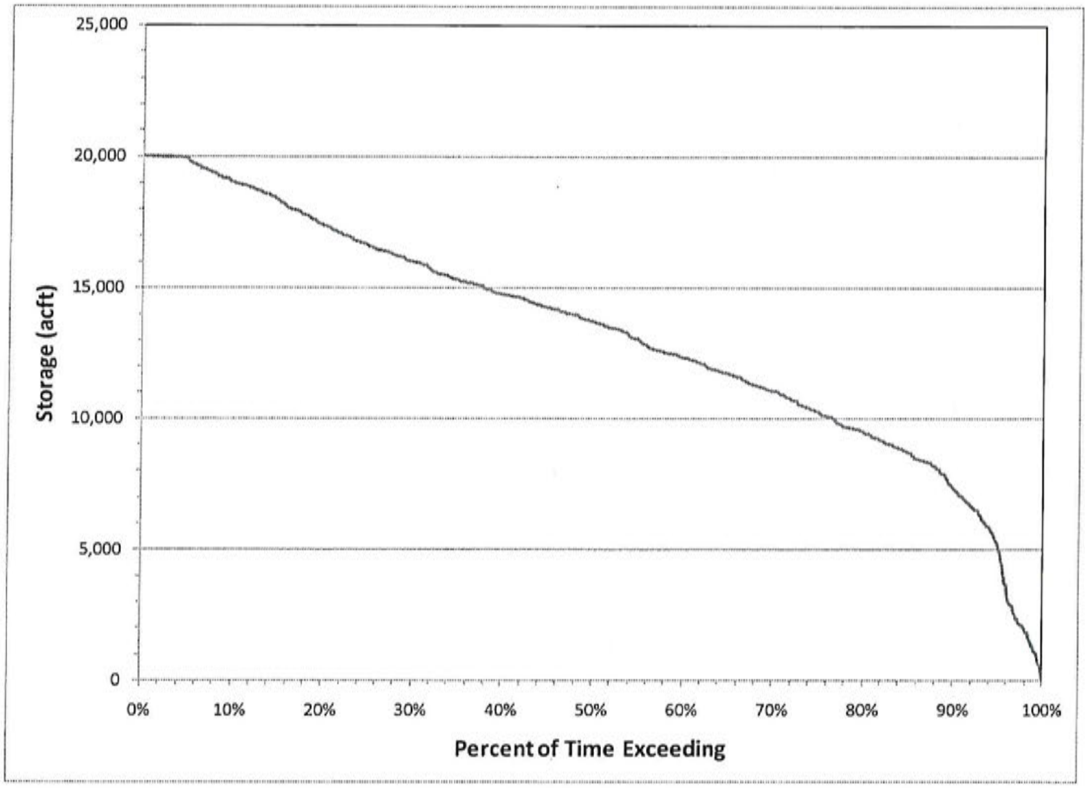

Figure 2. Lake 7 Storage Frequency under a Firm Yield Demand of 14,450 acft/yr

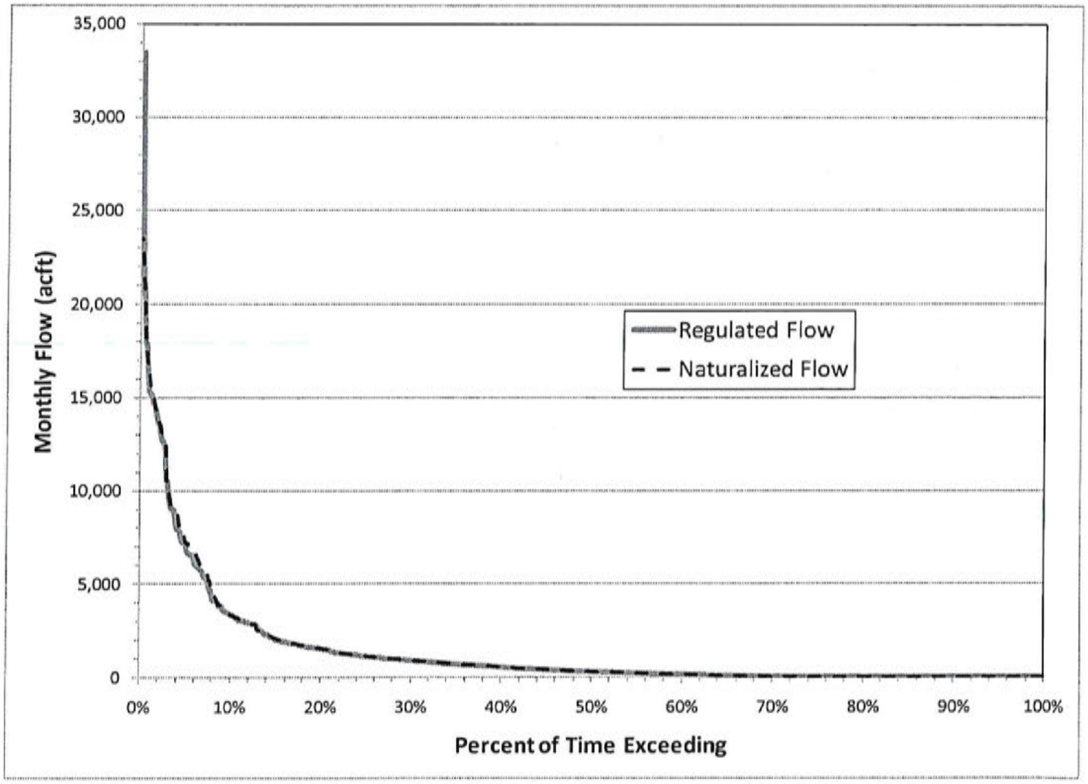

Figure 3. Frequencies of Naturalized and Regulated Flows Downstream of Lake 7

Environmental Information Document in Support of Water Use Permit Application No. 5921
Prepared in Response to
TCEQ RFI Dated 06/23/2008

Prepared for:

city of lubbock
TEXAS

Prepared by:

HDR | ONE COMPANY
*Many Solutions*SM

June 2011

Environmental Information Document in Support of Water Use Permit Application No. 5921 Prepared in Response to TCEQ RFI Dated 06/23/2008

Prepared for:

city of lubbock
TEXAS

Prepared by:

HDR | **ONE COMPANY**
Many Solutions℠

STATE OF TEXAS
DAVID D. DUNN
82630
REGISTERED
PROFESSIONAL ENGINEER

6/7/11

June 2011

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1.0 INTRODUCTION

This Environmental Information Document (EID) was developed to support Water Use Permit Application No. 5921 by the City of Lubbock (City) to construct a Storm Water and Reclaimed Water System Project. The proposed project involves construction of an impoundment (Lake 7) on the North Fork Double Mountain Fork Brazos River (North Fork) to capture and store treated wastewater, stormwater discharges, and other developed-water sources, and unappropriated run of river water for subsequent use.

1.1 Project Location

The construction of the dam for Lake 7 will impound an approximately 6.0-mile reach of the North Fork located immediately upstream of an existing, large impoundment, Buffalo Springs Lake (Figure 1-1). The proposed location of the dam for Lake 7 (at the centerline of the North Fork channel) is 33° 29' 33.27" N, 101° 37' 23.75" W. The preliminary conservation pool boundary was based on USGS 7.5 minute topographic maps, which yielded a storage volume of 20,921 acre-feet with an area of 795 acres. Lake 7 is located on the Buffalo Springs and Lubbock East United States Geological Survey (USGS) 7.5 Minute Quadrangle Maps.

1.2 Purpose and Need for the Project

The principal purpose of the proposed Lake 7 will be to store developed water in the form of reclaimed wastewater and storm water, and available unappropriated flows for subsequent use. Although the six small impoundments already constructed upstream of the proposed reservoir location form the core of a municipal park which stretches for approximately 8 miles through the southeast quadrant of the City, no recreational use is currently planned for the Lake 7 Reservoir. The major water sources for the proposed impoundment include unappropriated stream flows, which are generally infrequent and irregular in this area, wastewater return flows, and developed water-based stormwater discharges.

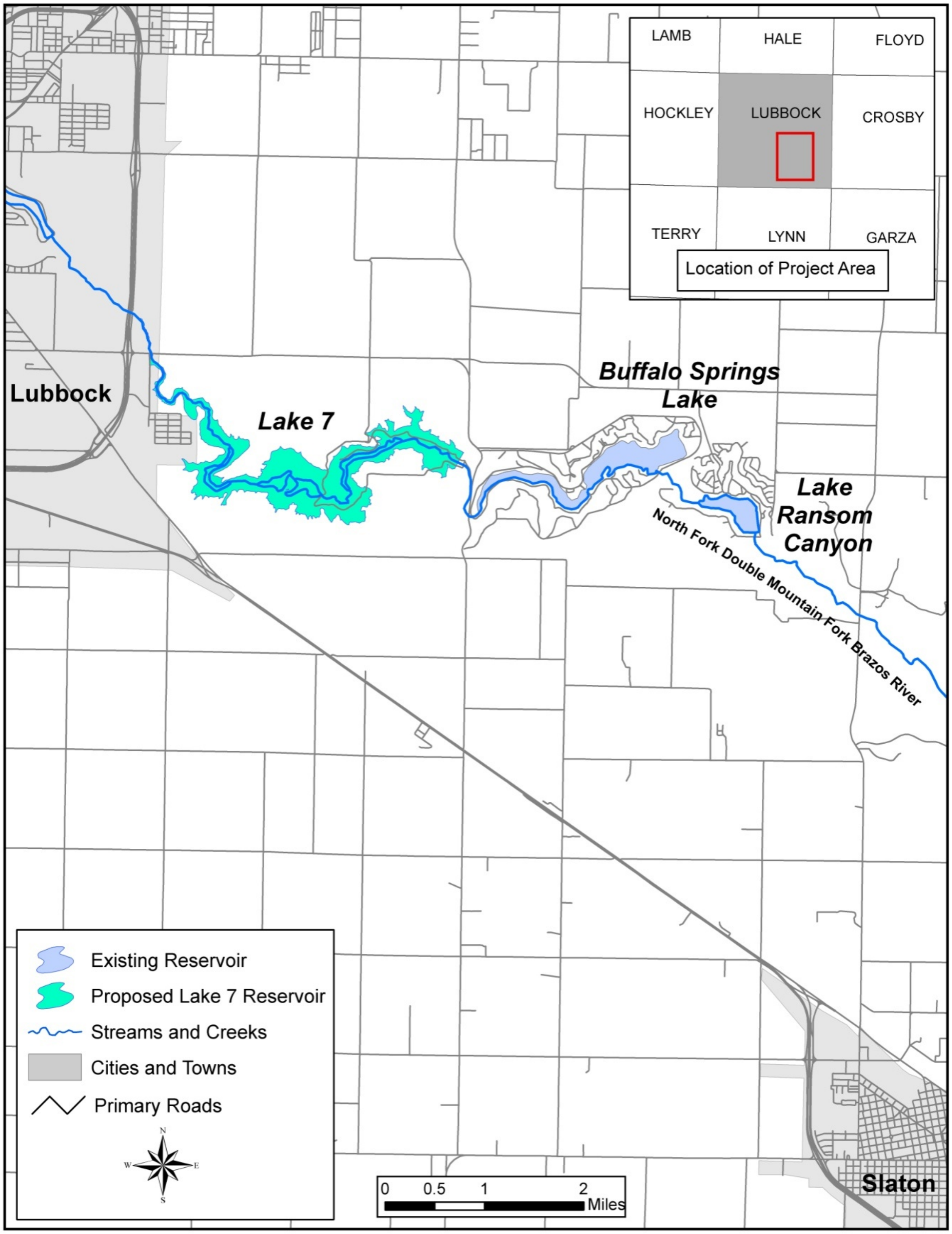

Figure 1-1. Lake 7 Project Vicinity

2.0 AFFECTED ENVIRONMENT

The environmental resources of the proposed project area include the physical habitat and the plant and animal populations resident within, adjacent to and downstream of the reach of the North Fork proposed for impoundment and inundation. Cultural resources include the archaeological and historic remains present in areas that would be disturbed as a result of the proposed reservoir project.

A comprehensive environmental Literature Review of the project area (Literature Review) was performed in order to identify the endangered, threatened, or species of concern which may exist within the upper Brazos River Basin or along the North Fork within the area of the proposed Lake 7 impoundment (Appendix A). Based on the information gathered during this Literature Review, appropriate survey methodologies were developed for each recognized listed species that could occur in the project area.

2.1 Regional Setting

The proposed project area, designated as Lake 7, is located on the North Fork, in Lubbock County, southeast of the City. The North Fork originates at the confluence of Yellow House and Blackwater Creeks on the northern edge of Lubbock, and flows southeastward, cutting a deep canyon in the eastern margin of the Caprock escarpment. This erosional feature, steeply incised into the surrounding, flat farmland of the Panhandle Plains, is known locally as Yellow House Canyon. Upland areas which flank the river are found north and south of the proposed reservoir site. These uplands are flat, dominated by row-crop agriculture, and thickly dotted with shallow, enclosed intermittently flooded small lakes known as playas.

Lubbock County is located in the High Plains Ecoregion[1], the High Plains vegetational area of Texas[2], and the Kansan biotic province[3]. The High Plains Ecoregion is a nearly level elevated plain surrounded by escarpments on three sides. It was once covered with a shortgrass prairie which included an interdependent web of species such as bison, black-tailed prairie dogs, black-footed ferrets, snakes, ferruginous hawks, coyotes, swift fox, deer, pronghorn antelope, mountain lions and gray wolves. Although this area now contains largely agricultural areas, it was originally dominated by native grasses, the major species including buffalo grass (*Buchloe dactyloides*), blue grama (*Bouteloua gracilis*), and sideoats grama (*Bouteloua curtipendula*). Annual and perennial forbs, legumes and woody species such as beargrass (*Nolina texana*) and cholla cactus (*Opuntia fulgida*) occasionally invade this grassland region. In zones with loamy soils, honey mesquite (*Prosopis glandulosa*) and yucca (*Yucca* spp.) have invaded large areas.

Faunal species in the region include those suited to a semi-arid environment. Riparian zones along the Brazos River and its tributaries contain wildlife habitat that supports populations of white-tailed deer (*Odocoileus virginianus)* and Rio Grande turkey (*Meleagris gallopavo intermedia).* Bobwhite quail (*Colinus virginianus)*, scaled quail (*Callipepla squamata*), mourning dove (*Zenaida macroura*), and a variety of song birds, small mammals, waterfowl, shorebirds, reptiles, and

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[1] Griffith, G.E., Bryce, S.A., Omernik, J.M., Comstock, J.A., Rogers, A.C., Harrison, B., Hatch, S.L., and Bezanson, D., , Ecoregions of Texas, U.S. Environmental Protection Agency, Corvallis, OR. 2004

[2] Gould, F.W., “The Grasses of Texas,” Texas A&M University Press, Texas Agricultural Experiment Station, College Station, Texas, 1962.

[3] Blair, W.F., “The Biotic Provinces of Texas, “Tex. J. Sci. 2:93-117, 1950.

amphibians are also found in this region. Large to medium-size mammals include the coyote (*Canis latrans),* striped skunk (*Mephitis mephitis),* and bobcat (*Lynx rufus).* Typical smaller herbivores include eastern cottontail (*Sylvilagus floridanus*), hispid pocket mouse (*Chaetodipus hispidus),* Ord's kangaroo rat (*Dipodomys ordii),* plains harvest mouse (*Reithrodontomys montanus*), desert shrew (*Notiosorex crawfordi),* and black-tailed prairie dog (*Cynomys ludovicianus).* Bison (*Bos bison),* and the black-footed ferret (*Mustela nigripes)* are two additional species historically associated with this area.

2.2 Water Resources

The North Fork (Segment 1241A) is considered perennial from its confluence with the Double Mountain Fork Brazos River (Double Mountain Fork) in Kent County to the dam impounding Lake Ransom Canyon, approximately 100 river miles upstream. Although this segment is considered perennial, it periodically ceases flowing, and surface water is confined to isolated pools. Alan Henry Reservoir was constructed on the Double Mountain Fork about 6 miles above its confluence with the North Fork as a water supply source for the City.

The North Fork is ungaged; the nearest station providing stream flow monitoring is USGS Gage No.08080500, located below the confluence with the Double Mountain Fork Brazos River near Aspermont in Stonewall County over 100 river miles downstream of the proposed project. At that location, the long-term median daily discharge is 27.0 cubic feet per second (cfs); however, zero flow has been recorded during 16.3% of the 1924-2009 period of record for the gage. Stream flow in the Double Mountain Fork at Justiceburg (USGS Gage No. 08079600) above the confluence exhibits a long-term median daily discharge of only 0.01 cfs.[4] Much of the base flow of the North Fork presently originates as stormwater and groundwater pumped from below the Lubbock Land Application Site (LLAS), which are discharged into the chain of small lakes located upstream of the proposed Lake 7, and wastewater return flow from the City discharged below Lake Ransom Canyon.

Segment 1241 waters are typically high in dissolved solids, with Texas Commission on Environmental Quality (TCEQ) segment standards for chloride and sulfate of 2500 mg/L and 2400 mg/L, respectively. Segment 1241A is on the Draft 2010 303(d) list for excessive bacterial concentrations[5], and is listed in the 2008 Texas Water Quality Inventory (305(b) list) for *E. coli* bacteria concerns. Data listed for this parameter indicates that the mean of the *E. coli* samples assessed was 201 Most Probable Number (MPN)/100ml, which is above the established screening criteria of 126 MPN/100ml. Additional data and information will be collected by the TCEQ before a Total Maximum Daily Load (TMDL) study is scheduled for this segment. There are no Ecologically Significant River and Stream Segments, either nominated by Texas Parks and Wildlife Department (TPWD), Water Resources Branch, or the Llano Estacado Regional Water Planning Group (Region O), or designated by Texas Legislature within the project area.

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[4] USGS. National Water Information System Real Time Data. Accessed at http://waterdata.usgs.gov/tx/nwis/current/?type=flow&group_key=huc_cd&search_site_no_station_nm=08080500, May 6, 2010.

[5] TCEQ. Draft 2010 Texas 303(d) List (February 5, 2010). Accessed at http://www.tceq.state.tx.us/assets/public/compliance/monops/water/10twqi/2010_303d.pdf, May 6, 2010.

2.3 Biological Resources

2.3.1 Terrestrial Habitats and Communities

In contrast to the intensive agricultural development of the surrounding High Plains, the prevalent land uses within Yellow House Canyon are rangeland, suburban residential, and recreational, including substantial development around Buffalo Springs Lake and Lake Ransom Canyon. TPWD has mapped the dominant vegetation type within the area of Lake 7 as Mesquite-Lotebush-Brush (99%) and Crops (0.1%).[6] Table 2-1 presents the approximate acreage of each vegetation type found within the proposed Lake 7 conservation pool, as designated by USGS Land Use Land Cover classification data.[7]

Table 2-1. Vegetation Types within the Conservation Pool

Vegetation Type	***Approximate Acreage***	***Percentage of Total Conservation Pool***
Mixed rangeland	297.9	37.5%
Non-forested wetlands	469.0	59.0%
Existing Reservoir	18.9	2.4%
Gravel pits	6.4	0.8%
Confined feeding operations	1.5	0.2%
Cropland/Pasture	0.9	0.1%
Total	**794.6**	**100**

Source: USGS, 1990.

2.3.1.1 Vegetation and Wildlife Habitat Appraisal Procedure (WHAP) Surveys

To further evaluate the functions and values of existing habitats within the project area, a vegetation survey was performed in concurrence with a comprehensive evaluation technique developed by TPWD known as a Wildlife Habitat Appraisal Procedure (WHAP). Discussion of the survey methods utilized and the results obtained with the WHAP procedure are included in the following subsections. Vegetation data, representative photographs, and a vegetation map of the project area are included in Appendix B.

2.3.1.1.1 Vegetation

A general vegetation survey was conducted for the proposed Lake 7 project area on November 11 and 12, 2009 and April 29, 2010 in conjunction with sampling the site using the WHAP. Prior to the vegetation survey, aerial photographs were used to delineate vegetation types based on the WHAP physiognomic classes (i.e., cover types). Sampling sites were located within each cover type to collect data on vegetation species. All sapling, shrub, and tree species within a circular sampling plot with an 80-foot radius around the sample site (approximately 0.5-acre plot) were identified and recorded. Herbaceous species within a nested 1m^2 plot were also documented. In addition to recording the species present, the absolute cover of each vegetation species was recorded. Table 2-2 contains the estimated

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[6] TPWD. 1984. The Vegetation Types of Texas. Austin, Texas.

[7] U. S. Geological Survey, 1990. Land Use Land Cover Classification Data. Reston, Virginia.

acreages and percentages for each of the vegetation cover types, as well as the water and urban areas, within the conservation pool.

Based on the general vegetation survey, the proposed conservation pool contained eight principal vegetation types: (1) shrub, (2) grasses, (3) brush, (4) forest, (5) parks, (6) marsh, (7) woods, and (8) wooded swamp (see Figure 1 in Appendix B).

Table 2-2. Estimated Acres and Percentages of All Vegetation Types Present within the Lake 7 Conservation Pool*

Vegetation Type	*Estimated Acres*	*Estimated Percentage of Conservation Pool*
Shrub	381	47.9
Grasses	261	32.8
Brush	40	5.0
Forest	28	3.5
Parks	21	2.6
Marsh	22	2.8
Woods	19	1.9
Water	15	2.4
Wooded Swamp	8	1.0
Urban	0.1	0.01
Total	**795**	**100**

*Based on field survey data collected by HDR Engineering, Inc.

The shrub areas were comprised of scattered individual woody plants including honey mesquite and netleaf hackberry (*Celtis laevigata* var. *reticulata*) with an understory of herbaceous species including composite dropseed (*Sporobolus compositus*), blue grama, sideoats grama, and broom snakeweed (*Gutierrezia sarothrae*).

Areas of grasses were dominated by grasses, forbs, and other grass-like plants where woody vegetation was absent or nearly so. These areas largely consisted of sand dropseed (*S. cryptandrus)*, but also contained common sunflower (*Helianthus annuus*), composite dropseed, silverleaf nightshade (*Solanum elaeagnifolium*), and Canada wildrye (*Elymus canadensis*). Some areas classified as grasses also consisted entirely of extremely dense stands of introduced burningbush (*Bassia scoparia*), also known as kochia.

Brush areas consisted primarily of small (less than 9 feet) dominant woody plants growing as randomly or evenly spaced individuals, small clusters, or closed stands with greater than 10% canopy cover. Woody species found in brush areas included honey mesquite, netleaf hackberry, and tamarisk (*Tamarix* sp.), also known as saltcedar. Herbaceous species in brush areas included Cuman ragweed (*Ambrosia psilostachya*), great ragweed (*A. trifida*), composite dropseed, and burningbush.

Forested areas were defined as those areas containing dominant deciduous or evergreen trees greater than 30 feet tall with 71 to 100% canopy cover. Dominant over- and midstory vegetation consisted primarily of Siberian elm (*Ulmus pumila*) and netleaf hackberry.

Parks were classified as those areas containing woody plants mostly equal to or greater than 9 feet tall and growing as scattered individuals or small clusters within a continuous grass or forb understory. Park vegetation included woody species such as Siberian elm, netleaf hackberry, and honey mesquite with an understory containing sand dropseed, Bermudagrass, and burningbush.

Marsh areas consisted of inundated or saturated areas dominated by emergent herbaceous plants with 10% or less canopy cover from woody vegetation. Vegetation included in these areas consisted of common threesquare (*Schoenoplectus pungens*), common spikerush (*Eleocharis palustris*), curlytop knotweed (*Polygonum lapathifolium*), broadleaf cattail (*Typha latifolia*), and rough cocklebur (*Xanthium strumarium*).

Woods were defined as those areas containing woody plants generally 9 to 30 feet tall with 71 to 100% canopy cover. Dominant woody vegetation in areas classified as woods consisted of netleaf hackberry, Siberian elm, western soapberry (*Sapindus saponaria* var. *drummondii*), black willow (*Salix nigra*), tamarisk, and skunkbush sumac (*Rhus trilobata* var. *trilobata*).

Finally, areas classified as Wooded Swamp consisted of inundated or saturated areas with woody plants mostly between 9 and 30 feet tall with 71 to 100% canopy cover within inundated sites. Woody vegetation in these areas consisted of black willow, tamarisk, and Siberian elm. Herbaceous vegetation within wooded swamps consisted primarily of great ragweed and Canada wildrye, but also included broadleaf cattail and curlytop knotweed.

2.3.1.1.2 Wildlife Habitat Appraisal Procedure (WHAP)

The TPWD developed the WHAP to allow for the quantitative evaluation of wildlife habitat for specific tracts of land within the state. This appraisal procedure assumes that vegetation alone is sufficient to define habitat suitability for wildlife, that a positive relationship exists between vegetation diversity and wildlife species diversity, and that vegetation composition and primary productivity directly influence the population density of wildlife species. Data from the WHAP evaluation are included in Appendix B.

The WHAP includes three primary sections. Section 1 is designed to measure key components contributing to the ecological condition of the evaluated tract and resulting overall suitability for wildlife. Observations and data collected during the general vegetation survey were used to develop Section 1. As noted in the vegetation section, the vegetation types were based on the cover types used in the WHAP, and the WHAP biological habitat components were evaluated at each vegetation sampling site (see Figure 2 in Appendix B). The resulting Average Habitat Quality Score for all sites located within each cover type was then multiplied by the corresponding acreage value to generate available Habitat Units (HU). HU values are used to determine the extent of projected impacts and are used to estimate the amount of habitat required to compensate for unavoidable adverse impacts.

Section 2 of the WHAP focuses on the degree of presence or absence of protected plants and animals. Information on protected plant and animal species within the project area is included in Section 2.3.3.

Section 3 of the WHAP concentrates on factors to determine if the project area is suitable for acquisition for wildlife habitat conservation or management. Section 3 is not applicable to this project and was not used.

The WHAP was designed to be used to evaluate impacts upon wildlife populations from specific projects, to establish baseline data prior to changes in habitat conditions, to compare tracts of land proposed for land acquisition or mitigation, and to evaluate the general habitat quality and wildlife management potential of tracts of land within large geographical areas. However, this procedure was not designed to evaluate habitat quality in relation to specific wildlife species. The product of the WHAP is the Wildlife Habitat Appraisal Summary for the proposed conservation pool (Table 2-3). For the proposed conservation pool, the WHAP estimates that 247 HU would be affected by the construction of the proposed Lake 7 Reservoir.

Table 2-3. Wildlife Habitat Appraisal Summary for the Proposed Conservation Pool

Cover Type Category	***Average Habitat Quality Score***	***Estimated Total Acres Of Cover Type***	***Habitat Units***
Shrub	0.21	381	80
Grasses	0.35	261	91
Brush	0.54	40	22
Forest	0.63	28	18
Parks	0.40	21	8
Marsh	0.60	22	13
Woods	0.55	19	10
Wooded Swamp	0.59	8	5
Urban	0	0.1	0
Water	0	15	0
Total Habitat Units =			**247**

The WHAP may be used to quantitatively evaluate the wildlife habitat impacts for a proposed project and the appropriate wildlife habitat mitigation measures. The WHAP specifies that proposed project activities may require wildlife habitat mitigation measures that (1) minimize the impact of the project by changing the project location, design, or operation plan; (2) rectify the impact by repairing or rehabilitating the affected environment; (3) reduce or eliminate the impact over a period of time; or (4) compensate for any net wildlife losses created as a result of the impact. The first three measures help to reduce net losses; the fourth provides a means to replace resource losses that cannot be avoided.

2.3.1.2 Soils

Within the proposed lake site, the Soil Survey Report for Lubbock County shows that the North Fork is primarily flanked by banks of Berda loam, and Berda-Potter Association soils which make up approximately 59% of the reservoir area.[8] The Berda series soils consist of very deep, well drained, moderately permeable soils formed in loamy alluvial and colluvial sediments. These soils are normally found on very gently sloping valley flats or gently sloping to very steep valley sides or scarps. The Potter series soils consist of very deep, well drained, moderately slowly permeable soils that formed in calcareous sediments of fractured and highly weathered calcrete. Potter soils are found on very gently sloping to steep draws, scarps, or valley sides. Slopes range from 1 to 30%. In

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[8] SCS, 1975. Soil Survey of Lubbock County, Texas, USDA Soil Conservation Service.

the Berda-Potter Association, Berda soils comprise approximately 60% of the association, Potter soils comprise approximately 30%, and other soils comprising the remaining 10%.

Approximately 26% of the conservation pool contains Bippus clay loam, frequently flooded soils which consist of very deep, well drained, moderately permeable soils that formed in loamy alluvial sediments. Bippus soils are found on nearly level to very gently sloping floodplains or draws, and include slopes which range from 0 to 2%. The remaining areas include 12% Potter-Berda Association soils, and five additional soil types which total less than 3% of the proposed conservation pool. In the Potter-Berda Association, Potter soils typically make up about 55% of the association, Berda soils make up about 35%, and other soils make up the remaining 10%.

2.3.1.3 Wetlands

National Wetland Inventory (NWI) mapping, which includes those portions of the proposed reservoir site encompassed by the Lubbock East, and Buffalo Springs Lake 7.5 minute quad maps, shows wetland features that include primarily Palustrine (floodplain and terrace) shrubland and intermittent emergent wetland areas in addition to small areas of Riverine and Lacustrine wetlands.[9]

Potential waters of the U.S., including wetlands, were delineated on-site on November 11-12, 2009 and April 29, 2010 by experienced environmental scientists. Results of this survey are included as Appendix C. The survey was conducted in accordance with the U.S. Army Corps of Engineers (USACE) 1987 Wetlands Delineation Manual and the interim regional supplement for the Great Plains Region. The delineation will be verified and a Jurisdictional Determination will be issued by the USACE during the Section 404 permitting process.

Potential waters of the U.S., including wetlands, within the conservation pool consisted of the North Fork Double Mountain Fork Brazos River and eight intermittent tributaries (16.6 acres), 22 non-forested wetlands (21.1 acres), and one forested wetland (7.6 acres). Approximately 4.1 acres of the non-forested wetlands occur on the northern face of the canyon and are primarily the result of upslope land application of treated wastewater. Wetlands (emergent and forested) in the valley alluvium have formed primarily as the result of previously constructed impoundments (i.e., stock ponds) that have breached or filled with sediment. The waters of the U.S., including wetlands, total 45.30 acres within the proposed conservation pool. Section 404 of the Clean Water Act requires authorization by the USACE for the release of dredged or fill material into waters of the U.S.

2.3.2 Aquatic Habitats and Communities

There are six existing, smaller impoundments in the upper reaches of the Yellow House Canyon above the proposed Lake 7 location, and two larger lakes, Buffalo Springs Lake and Lake Ransom Canyon, below it. The existing chain of six small lakes form the core of an extensive urban park system (Jim Bertram Lake System) and are designated by TPWD to be Texas Community fishing lakes. Fishing activities in these lakes are supported by the TPWD which manages fisheries for largemouth bass, channel catfish and rainbow trout, and occasionally stocks these lakes. Buffalo Springs Lake and Lake Ransom Canyon are regional recreational centers that appear to be

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[9] USFWS. 1994. National Wetland Inventory Map of the Lubbock East, and Buffalo Springs Lake, 7.5 minute Quad Maps. US Fish and Wildlife Service, Reston, VA.

supporting fisheries. TPWD currently reports fair fishing for channel catfish, sunfish, crappie, largemouth and stripped bass in Buffalo Springs Lake.[10]

Until the present study, the fish assemblages in the North Fork have been most recently sampled at three locations near Post, Texas in Garza County by TPWD during a 1988-92 study.[11] Wilde and Ostrand collected fish from the Double Mountain Fork above Lake Alan Henry, which was constructed about 6 miles above the confluence with the North Fork, in the late 1990s.[12] The list of fish species present in the upper Brazos River Drainage (i.e., the Salt and Double Mountain Forks) shown in Table 2-4 consists of relatively few species that tend to be typical of the relatively harsh environments of prairie streams. Prairie streams tend to exhibit wide ranges in temperature, dissolved oxygen (DO) and dissolved solids (salinity), and their typical fish assemblages tend to be dominated by species with tolerance for wide ranges of physical and chemical conditions that fluctuate widely.[13] This is particularly the case in headwater areas like the North Fork, where flow may cease seasonally and aquatic habitats are restricted to isolated pools. These same species tend to be poor competitors in less stressed environments, especially with regard to dissolved solids concentrations, and are thought to be limited in their downstream distributions by the presence of species populations less tolerant of high salinities.[14]

Table 2-4. Fish Species Reported from the Upper Brazos River Drainage

Common Name	**Scientific Name**
Longnose gar	*Lepisosteus osseus*
Gizzard shad	*Dorosoma cepedianum*
Central stoneroller	*Campostoma anomolum*
Common carp	*Cyprinus carpio*
Red shiner*	*Cyprinella lutrensis*
Blacktail shiner	*Cyprinella venusta*
Plains minnow*	*Hybognathus placitus*
Smalleye shiner*	*Notropis buccula*
Sharpnose shiner*	*Notropis oxyrhynchus*
Speckled chub	*Macrhybopsis aestivalis*
Suckermouth minnow	*Phenocobius mirabilis*
Bullhead minnow	*Pimephales vigilax*
River carpsucker	*Carpiodes carpio*
Channel catfish	*Ictalurus punctatus*
Plains killifish*	*Fundulus zebrinus*

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[10] TPWD. 2010. http://www.tpwd.state.tx.us/fishboat/fish/recreational/lakes/buffalo_springs. Accessed May 19, 2010.

[11] Moss, R.E. and K. B. Mayes. 1993. Current Status of *Notropis buccula* and *Notropis oxyrhyncus* in Texas. River Studies Report No. 8. Resource Protection Division, TPWD, Austin, Texas.

[12] Wilde, G.R. and K.G. Ostrand. 1999. Changes in the fish assemblage of an intermittent prairie stream upstream of a Texas impoundment. Texas Journal of Science 51: 203-210.

[13] Matthews, W.J. 1987. Physiochemical tolerance and selectivity of stream fish related to their geographic ranges and local distributions. *In* Community and Evolutionary Ecology of North American Stream Fishes, Matthews and Heins, *eds.* University of Oklahoma Press, Norman.

[14] Echelle, A.A., A.F. Echelle and L.G. Hill. 1972. Interspecific interactions and limiting factors of abundance and distribution in the Red River Pupfish, *Cyprinodon rubrofluviatalis.* American Midland Naturalist 88(1): 109-130.

Common Name	***Scientific Name***
Red River pupfish	*Cyprinodon rubrofluviatilis*
Western mosquitofish*	*Gambusia affinis*
Inland silverside	*Menidia beryllina*
White bass	*Morone chrysops*
Largemouth bass	*Micropterus salmoides*
Spotted bass	*Micropterus punctulatus*
Warmouth	*Lepomis gulosus*
Bluegill	*Lepomis macrochirus*
Longear sunfish	*Lepomis megalotis*
Redear sunfish	*Lepomis microlophus*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Dusky darter	*Percina sciera*
Freshwater drum	*Applodinotus grunniens*
*Species collected (by seine only) from the North Fork	

Wilde and Ostrand reported that the fish assemblage in the river reach above Lake Alan Henry had changed substantially, presumably in response to the reservoir construction. A subsequent physiology study of the dominant species in that assemblage indicated that those changes are most likely the result of an inability of the cyprinids to repopulate the river above Alan Henry Lake following episodes when aquatic habitats are reduced to isolated pools. The plains minnow (*Hybognathus placitus*), smalleye shiner (*Notropis buccula*) and the sharpnose shiner (*N. oxyrhynchus*), whose populations were much reduced in the late 1990s in the Double Mountain Fork Brazos River, were found to be eliminated from pool habitats by increasing salinities as evaporation proceeded, but that the dominant cyprinodontids (Red River pupfish and Plains killifish, *Fundulus zebrinus*) were sufficiently tolerant of high salinities to survive in isolated pools until stream flow resumed. The cyprinids, on the other hand, could not repopulate the river when flow resumed because of the migratory barrier imposed by Lake Alan Henry.[15]

As previously mentioned, historical information on the fishes of the North Fork is generally inadequate. While there is considerable information already available for the Salt Fork Brazos River and Double Mountain Fork Brazos River watersheds, very little information regarding fish assemblages is available for the North Fork Double Mountain Fork Brazos River drainage downstream of Buffalo Springs Lake and no recognized pre- and post-impoundment fisheries information is available for the length of river upstream of this reservoir.[16,17] The intent of this study

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[15] Ostrand, K.G. and G.R. Wilde. 2001. Temperature, dissolved oxygen, and salinity tolerances of five prairie stream fishes and their role in explaining fish assemblage patterns. Transactions of the American Fisheries Society 130(5): 742-749.

[16] Wilde, G.R. 2009. Professor of Fish Ecology, Department of Biological Sciences, Texas Tech University, Lubbock, Texas. Email communication with D. Thomas (HDR) on 19 October 2009.

[17] Munger, C. 2009. District Management Supervisor, Texas Parks and Wildlife Division, Inland Fisheries Division, District 1-A, Canyon, Texas. Personal communication with D. Thomas (HDR) on 13 November 2009.

in support of the proposed project was to determine the current species composition of the fish community in the section of the North Fork proposed for impoundment.

2.3.2.1 Habitat Inventory Assessment and Aquatic Life Monitoring

The proposed Lake 7 Reservoir is located southeast (downstream) of Lubbock, a major urban area. Land-use in the North Fork river basin surrounding Lake 7 supports intense agricultural activities, including irrigated row crops, rangeland, and confined animal feeding operations (CAFOs). To characterize the stream proposed to be inundated, site-specific baseline information on water quality, habitat quality, and biological integrity was collected to determine existing aquatic conditions at four locations along Segment 1241A of the Brazos River between FM 835 near Loop 289 to a point immediately at and downstream of the current proposed new dam as a prerequisite for the construction of the proposed reservoir site (Appendix D).

Evaluation of stream physio-chemical conditions, stream habitat, characterization of stream flow, and the assessment of the fish and macroinvertebrate community on the North Fork was conducted during the non-critical (index) period on June 23–24, 2009 and the critical period on September 22-23, 2009. A total of four sample locations within Lubbock County were selected for Aquatic Life Monitoring (ALM) to provide an accurate and detailed description of the existing aquatic environment by identifying and documenting the aquatic communities residing within the section of North Fork proposed for impoundment. The methods and materials for the ALM work performed followed the guidelines of the TCEQ's Surface Water Monitoring Procedures Manuals[18,19] and the TCEQ *Biological Monitoring Fact Sheet* on Aquatic Life Monitoring.[20]

The North Fork within the project area southeast of the City is a low gradient, third-order stream that flows through rural, predominately unmanaged floodplain characterized by turbid water, stream bank erosion, and low overhanging black willow (*Salix nigra*), salt cedar (*Tamarix ramosissima*), and American elm trees. Riparian vegetation is sparse along the central portion of the channel but is densely forested in the upper and lower sections of the river which were investigated. The floodplain area within and adjacent to the conservation pool is generally utilized for farming and ranching while substantial urban development occurs downstream around Buffalo Springs Lake and Lake Ransom Canyon. Except during periods of heavy rainfall the river flows slowly, the result of a highly variable stream discharge which is strongly influenced by precipitation and the resulting surface runoff.

Aquatic habitats found in this region include playa lakes, perennial river habitats, and intermittent tributary streams. Typical of prairie streams, the North Fork experiences large variations in discharge, exhibiting an annual pattern of prolonged periods of low flow punctuated by high flow events. Although the river may be subject to large variations in discharge, it is characteristically a

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[18] Texas Commission on Environmental Quality (TCEQ). 2008. *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue.* Document No. RG-415. Monitoring Operations Division, Texas Commission on Environmental Quality, Austin, Texas.

[19] TCEQ. 2007. *Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data.* Document No. RG-416. Monitoring Operations Division, Texas Commission on Environmental Quality, Austin, Texas.

[20] TCEQ. 2006. *Biological Monitoring Fact Sheets.* TCEQ Procedures for Biological and Habitat Monitoring Effective May 17, 2006.

continuously flowing system containing species characteristic of, and in some cases restricted to, small riverine systems. At each of the four locations described below and shown in Appendix D, three individual habitat types representing available habitat were identified: riffles, pools, and runs. Each habitat has characteristic species assemblages which depend on or are regulated by temperature, pH, current velocity, light, nutrients, and turbidity.

Station 1, the uppermost river access selected for monitoring, is found approximately 0.15 mile downstream of the FM 835 crossing near Loop 289 on private property at 33°32’43.115” N latitude, 101°46’54.521” W longitude. Both banks were heavily wooded, providing a closed canopy with light undergrowth. There was no emergent or submergent aquatic vegetation.

Station 2 was established about 1.9 river miles downstream of Station 1 at the upper river crossing, and is located on private property at 33°31’48.009” N latitude, 101°46’24.174” W longitude. Sampling was conducted upstream of the river crossing that is heavily utilized as a watering place for crossing livestock. Pool habitat dominated the entire sample area, comprising at least 85% coverage of the total surface area.

Station 3 is located approximately 2.0 river miles downstream of Station 2 at the middle river crossing on private property at 33°31’46.726” N latitude, 101°44’58.458” W longitude. The length of river upstream and downstream of the stream crossing represents a highly sinuous aquatic environment that is characterized with very little riparian cover or tree canopy. Deep pools limited accessibility for habitat inventory and biological assessment. This location did not have a developed riparian border, although some shading was provided over the river at various times of the day.

Station 4 was located on the river approximately 1.5 miles downstream of Station 3, directly south of a private homestead, situated at and immediately downstream of the area proposed for the current dam structure at 33°32’.105” N latitude, 101°43’44.021” W longitude. A deep and wide man-made impoundment created by a concrete crossing structure was located in the upper portion of the sample zone. Two existing corrugated metal pipes allow water and fish passage to the narrower and shallower downstream section of the river.

In June 2009, sampling was conducted under somewhat higher flow rates after weather-induced runoff resulting from a storm system that passed through the area prior to the summer survey. Stream flow characteristics did not change significantly after localized heavy storm events prior to and during the September survey. Overall habitat and biological integrity for the four stations sampled in the North Fork between Loop 289 and Buffalo Springs Lake were predominately in the Intermediate category (Table 2-5).

Table 2-5. Summary of Aquatic Life Monitoring Results for Habitat, Benthic Macroinvertebrates, and Fish June 23–24, 2009 and September 22–23, 2009

Station	Habitat Total Score Aquatic Life Use Rating*		Benthic Macroinvertebrate Total Score Aquatic Life Use Rating**		Fish Total Score Aquatic Life Use Rating***	
	June	September	June	September	June	September
1	19.5	19.5	22.0	24.0	28.0	30.0
	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
2	19.0	19.0	28.0	16.0	30.0	30.0
	Intermediate	Intermediate	Intermediate	Limited	Intermediate	Intermediate
3	21.0	21.5	26.0	25.0	34.0	36.0
	High	High	Intermediate	Intermediate	High	Exceptional
4	22.5	22.5	26.0	24.0	34.0	36.0
	High	High	Intermediate	Intermediate	High	Exceptional
* Habitat Aquatic Life Use Point Score Ranges: Exceptional: 26–31 High: 20–25 Intermediate: 14–19 Limited: < 13			** Benthic Macroinvertebrate Aquatic Life Use Point Score Ranges: Exceptional:>36 High:29–36 Intermediate: 22–28 Limited: < 22		***Nekton Aquatic Life Use Point Score Ranges: Exceptional: ≥ 36 High: 34-35 Intermediate: 24-33 Limited: < 24	

2.3.2.1.1 Benthic Macroinvertebrates

The density and diversity of the benthic fauna of this region is influenced by water quality, substrate character (including organic content of the substrate), persistence of water, and predator-prey relationships. The dominant substrates along the evaluated reaches of the North Fork consisted of soft, clayey mud bottoms in the deeper pool areas, firm scoured clay in run habitats and loose, small to large gravel, with scattered cobble in the short and shallow fast-flowing riffle habitats. Instream riparian cover usually composed of variable amounts of dead woody debris such as leaves, logs, branches, and roots along the stream edge was rather limited. Therefore, substrate diversity was fairly homogenous, a condition that decreases the stability of available aquatic habitat for macroinvertebrate colonization.

Qualitative benthic macroinvertebrate sampling was conducted on June 23-24, 2009 and September 22–23, 2009. Table 2-6 presents a checklist of the benthic macroinvertebrate assemblages collected by station during the two survey periods. A total of 1,773 individuals representing 27 taxa were collected and identified to the lowest practical taxonomic level, using standard taxonomic references (Appendix D). Mayflies (Ephemeroptera) and caddisflies (Trichoptera), two major groups widely considered to be representative of exceptional aquatic integrity, were poorly represented as only two taxa from each group were present. All river collections had relatively high densities of midge larvae (Chironomidae), a group which has the tendency to proliferate in waters exhibiting less than optimal conditions. These larvae are usually an indication of poor water quality and degraded habitat conditions most other invertebrates tend to avoid.

Benthic macroinvertebrate community composition and structure for the four sites are shown in Table 2-7. The TCEQ-based Index of Biotic Integrity (IBI) indicates the macroinvertebrate community of the river reach to be impounded by the proposed project is not well diversified and is comprised of those taxa which favor more compromised conditions. Typical samples in this assessment had relatively low diversity, balanced trophic structure, and imbalanced benthic communities indicative of a relatively simple and low quality ecosystem. Seven of the 8 samples collected reflected an Intermediate overall aquatic life use rating; Station 3 rated Limited in September. Fewer pollution intolerant macroinvertebrates, such as mayflies, stoneflies, and caddisflies, and more pollution tolerant species, particularly chironomid midges, were found.

Although many physical and chemical parameters indicate a healthy stream, the waterway's potential is limited by the effects of bank erosion, scour, limited suitable substrates, stormwater and wastewater diversions, and other stressors. Low biodiversities at all sites demonstrate the aquatic invertebrate communities in the North Fork are somewhat unstable.

During each survey, cattle were either grazing along the banks or actively crossing the river to another area. Grazing by livestock not only reduces the amount of vegetation biomass at the stream edge available for aquatic insects to perch and emerge as winged adults, but may also have harmful impacts on water quality, including increases in nutrient concentrations through the introduction of livestock waste material into the river, and increases in temperature, sediment, and turbidity due to trampling and bank alteration.

Table 2-6. Checklist of Benthic Macroinvertebrates Collected by Kicknet June 23-24, 2009 and September 22–23, 2009

TAXA				***North Fork Double Mountain Fork Brazos River***			
				Station			
Phylum	***Class***	***Order***	***Genus***	***1***	***2***	***3***	***4***
Platyhelminthes	Turbellaria	Tricladida	Dugesia	X	X	X	
Mollusca	Gastropoda	Basommatophora	Physella	X	X	X	X
Annelida	Oligochaeta*			X	X	X	X
	Ostracoda*				X		
Arthropoda	Malacostraca	Decapoda	Cambaridae*		X		
			Palaemonetes	X	X	X	X
		Amphipoda	Hyalella	X	X	X	X
	Insecta	Diptera	Chironomidae*	X	X	X	X
			Bezzia		X		
			Simulium	X	X	X	X
			Hemerodromia	X			X
		Coleoptera	Stenelmis	X	X	X	X
			Agabus		X		
			Liodessus			X	
			Berosus			X	
			Scirtes				X
		Ephemeroptera	Callibaetis		X	X	X
			Fallceon quilleri	X	X	X	X
		Hemiptera	Trichocorixa			X	
			Ranatra			X	
		Odonata	Erpetogomphus			X	
			Ischnura			X	X
			Argia	X	X	X	X
			Enallagma	X	X	X	X
			Haeterina	X	X	X	X
		Trichoptera	Cheumatopsyche	X	X	X	X
			Hydroptila		X	X	

Table 2-7. Metrics and Scoring Criteria for Benthic Macroinvertebrate Kick Net Samples — 2009 Index and Critical Periods[1]

Metric	***North Fork Double Mountain Fork Brazos River***															
	Station 1				***Station 2***				***Station 3***				***Station 4***			
	Index		***Critical***		***Index***		***Critical***		***Index***		***Critical***		***Index***		***Critical***	
	Value	***Score***	***Value***	***Score***	***Value***	***Score***	***Value***	***Score***	***Value***	***Score***	***Value***	***Score***	***Value***	***Score***	***Value***	***Score***
1. Taxa Richness	14	2	10	2	15	3	14	2	20	3	9	2	16	3	9	2
2. EPT Taxa Abundance	2	1	2	1	4	2	2	1	4	2	2	1	3	1	2	1
3. Hilsenhoff Biotic Index	6.52	1	5.26	2	6.24	1	6.59	1	6.25	1	5.48	1	6.09	1	5.41	1
4. Percent Chironomidae	19.31	1	20.85	1	26.02	1	39.67	1	10.13	2	9.84	2	18.68	1	27.23	1
5. Percent Dominant Taxon	39.38	2	45.5	1	27.55	3	39.67	2	42.29	1	36.61	2	18.68	4	32.67	2
6. Percent Dominant Functional Feeding Group	69.18	1	35.62	4	40.82	3	46.69	2	46.11	2	34.38	4	44.14	3	35.56	4
7. Percent Predators	13.77	4	17.14	3	23.98	3	29.13	2	13.73	4	9.19	4	44.14	1	14.03	4
8. Ratio of Intolerant: Tolerant Species	0.01	1	0.87	1	0.10	1	0.02	1	0.11	1	0.59	1	0.30	1	0.64	1
9. Percent Trichoptera as Hydropsychidae	100.0	1	100.0	1	94.74	1	100.0	1	96.0	1	100.0	1	100.0	1	100.0	1
10. Number of Non-insect Taxa	5	3	3	2	5	3	6	4	5	3	2	2	5	3	2	2
11. Percent Collector-Gatherers	69.18	1	35.62	2	25.26	3	46.69	1	25.4	3	32.02	2	27.66	3	35.56	2
12. Percent of Total Number as Elmidae	1.16	4	3.79	4	3.57	4	0.41	1	10.57	3	12.20	3	8.79	4	13.37	3
Total Score	22		24		28		19		26		25		26		24	
Aquatic Life Use*	Intermediate		Intermediate		Intermediate		Limited		Intermediate		Intermediate		Intermediate		Intermediate	

[1] Index Period (23-24 June 2009); Critical Period (22-23 August 2009)

*Exceptional (≥36); High (34-35): Intermediate (24-33); Limited (< 24)

2.3.2.1.2 Fish

The geographic range of roughly 89 species of freshwater fish found in the Brazos River Basin[21] includes the immediate project area and surrounding area, although based on size and habitat suitability, not all of these species would occur in each area.

Since water conductivities were greater than those feasible for backpack electrofishing, fish populations were collected at each sampling location in a downstream to upstream direction using a 20-foot minnow seine. Sampling was conducted on a qualitative basis to obtain relative abundance and species composition of the fish community. Table 2-8 presents a checklist of fish species collected during this study.

A total of 4,417 individuals of fish represented by 7 families, 15 species, and one hybrid sunfish species were collected during the two sampling events (Appendix D). The representative fish found in the seine collections consisted of smaller forage fish populations that included the red shiner (*Cyprinella lutrensis*), inland silverside (*Menidia beryllina*), fathead minnow (*Pimephales promelas*), western mosquitofish (*Gambusia affinis*), and gizzard shad (*Dorosoma cepedianum*). The sunfish family (Centrarchidae) was represented by only six species. Pools were the most commonly encountered mesohabitat type. The fish community appears to be restricted to less sensitive species (i.e., tolerant) which are able to withstand wide fluctuations in stream conditions.

Table 2-8. Checklist of Fish Species Collected by Seine at Four Stations June 23-24, 2009 and September 22–23, 2009

Common Name	***Scientific Name***
Gizzard shad	*Dorosoma cepedianum*
Red shiner	*Cyprinella lutrensis*
Golden shiner	*Notemigonus crysoleucas*
Common carp	*Cyprinus carpio*
Fathead minnow	*Pimephales promelas*
Black bullhead	*Ameiurus melas*
Western mosquitofish	*Gambusia affinis*
Inland silverside	*Menidia beryllina*
Striped bass	*Morone saxatilis*
Green sunfish	*Lepomis cyanellus*
Bluegill	*Lepomis macrochirus*
Longear sunfish	*Lepomis megalotis*
Largemouth bass	*Micropterus salmoides*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Hybrid sunfish	*L. macrochirus x L. cyanellus*

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[21] Linam, G. W. and L.J. Kleinsasser. 1998. *Classification of Texas Freshwater Fishes into Trophic and Tolerance Groups*. Texas Parks and Wildlife Department, River Studies Report No. 14, Austin. 8 pp.

The most numerous species collected in order of decreasing relative abundance were the red shiner, fathead minnow, western mosquitofish, and bluegill (*Lepomis macrochirus*) (Appendix D). These four species comprised almost 95% of the total catch. The red shiner was the most common fish species taken in the ALM study area comprising approximately 59% of the total catch with 2,613 individuals. This species was taken in large numbers mostly from the shallow pool habitat areas prevalent at each of the four stations. Its extremely high tolerance to a wide range of sometime harsh ecological conditions including high turbidity and siltation, allow them to be highly competitive with other fishes. The fathead minnow is another highly tolerant species that was more dominant in terms of numbers in the June samples. This species can be very abundant locally in the small pools and quiet backwater areas of the river, thriving in warm turbid waters of high temperatures and low oxygen levels. Western mosquitofish, introduced world wide for mosquito larvae control, are very tolerant of warm temperatures and low DO conditions. Sunfish, including the bluegill, were mostly collected in very low numbers from backwater areas in generally low velocity habitats frequently having large woody debris.

Station 4 ranked first in total numbers collected with 2,290 individuals representing 14 species. Station 3 produced 1,139 individuals and 12 species. Station 2 yielded 582 individuals and 10 species and Station 1 was represented by 404 individuals and 9 species.

To assess stream health Karr et al.[22] proposed an IBI based on fish community attributes. The IBI is used to determine the relative biological "health" of a stream by examining particular characteristics of a fish assemblage.[23] For the biological evaluation, all fish collected by seine were treated identically. Because watershed characteristics and fish communities from the North Fork differ from those for Midwestern headwater streams originally used by Karr et al.,[24] the community trophic structure status and intolerance/tolerance data as described by Linam and Kleinsasser[25] along with a regionalized adaptation of the IBI developed by Linam et al.[26] for representative Texas streams in Ecoregions 25 and 26 (Western High Plains and Southwestern Tablelands) was calculated to provide a fish aquatic life use rating for each station. Application of the IBI scoring and evaluation criteria is presented in Table 2-9.

Average Aquatic Life Use (ALU) scores calculated for the fish communities of the North Fork reflect the characteristics typical of Intermediate to Exceptional quality stream habitat. The June and September collections at Stations 1 and 2 exhibited a qualitative biological score of either a 28 or 30. The June collection at Stations 3 and 4 scored a

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[22] Karr, J.R., K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.J. Schlosser. 1986. *Assessing Biological Integrity in Running Waters: a Method and its Rationale*. Illinois Natural History Survey Special Publication 5, Urbana Illinois.

[23] Ibid.

[24] Ibid.

[25] Linam, G. W. and L.J. Kleinsasser. 1998. *Classification of Texas Freshwater Fishes into Trophic and Tolerance Groups*. Texas Parks and Wildlife Department, River Studies Report No. 14, Austin. 8 pp.

[26] Linam, G.W., L.J. Kleinsasser, and K.B. Mayes. 2002. *Regionalization of the Index of Biotic Integrity for Texas Streams (River Studies Report No. 17)*. Texas Parks and Wildlife Department. Austin, Texas.

High rating of 34 and an Exceptional rating of 36 in September. Minor variations of species observed between the two surveys probably indicate differences in seasonality, individual collection performance and chance rather than changes in species occurrence. Very few species were indicators of a particular mesohabitat type, as the study length of the North Fork contains mostly generalist forage species that use a variety of habitats. Many of the species present are among the more common species for the state and are typical of perennial stream habitats. Nothing unusual was noted concerning the condition of collected fish. No incidence of parasites or disease was detected.

No federal or state protected aquatic species were found at the four sampling locations. Neither the smalleye shiner (*Notropis buccula*) nor the sharpnose shiner (*Notropis oxyrhynchus*), each a candidate for federal protection (discussed in Section 2.3.3), was collected. The probability of these species inhabiting the North Fork is very low. The construction of the two existing on-channel impoundments, Buffalo Springs Lake and Ransom Canyon Lake, has created a barrier to fish movement in the North Fork watershed. Therefore, the section of river upstream of these lakes could essentially be considered functionally fragmented from the existing downstream smalleye and sharpnose shiner populations.

Table 2-9. Metrics and Scoring Criteria for Fish Samples Based on Ecoregions 25 and 26 Criteria Index and Critical Periods [1]

Metric	***North Fork Double Mountain Fork Brazos River***															
	Station 1				***Station 2***				***Station 3***				***Station 4***			
	Index		***Critical***		***Index***		***Critical***		***Index***		***Critical***		***Index***		***Critical***	
	Value	***Score***	***Value***	***Score***	***Value***	***Score***	***Value***	***Score***	***Value***	***Score***	***Value***	***Score***	***Value***	***Score***	***Value***	***Score***
1. Total number of fish species	8	5	9	5	8	5	9	5	10	5	10	5	13	5	12	5
2. Number of native cyprinid species	2	3	2	3	2	3	2	3	2	3	2	3	3	5	2	3
3. Number of sunfish species	2	5	2	5	3	5	3	5	4	5	3	5	5	5	4	5
4. Percentage of individuals as omnivores	57.5	1	19.1	1	50.7	1	16.7	1	18.7	1	11.6	3	35.0	1	5.8	5
5. Percentage of individuals as invertivores	39.4	3	78.7	5	40.8	3	78.2	5	80.2	5	87.3	5	60.8	3	93.8	5
6. Number of individuals/seine haul	18.4	1	15.3	1	35.5	3	13.0	1	50.4	5	44.7	5	77.3	5	113.5	5
7. Percentage of individuals as Non-native species	0.0	5	0.0	5	0.0	5	1.3	5	0.3	5	0.4	5	0.4	5	2.1	3
8. Percentage of individuals with disease or anomalies	0.0	5	0.0	5	0.0	5	0.0	5	0.0	5	0.0	5	0.0	5	0.0	5
Total Score	**28**		**30**		**30**		**30**		**34**		**36**		**34**		**36**	
Aquatic Life Use*	**Intermediate**		**Intermediate**		**Intermediate**		**Intermediate**		**High**		**Exceptional**		**High**		**Exceptional**	

[1] Index Period (23-24 June 2009); Critical Period (22-23 August 2009)

*Exceptional (≥36); High (34-35): Intermediate (24-33); Limited (< 24)

2.3.3 Protected Species

Plant and animal species listed by U.S. Fish and Wildlife Service (USFWS), and TPWD, as endangered, threatened, or species of concern with potential habitat in Lubbock County are listed in Table 2-10.

Table 2-10. Threatened, Endangered and Species of Concern in Lubbock County, Texas

Species Name		***Occurrence in County***	***Federal Status***	***State Status***
BIRDS				
Peregrine falcon (*Falco peregrinus*)	American peregrine falcon (*Falco peregrinus anatum*)	Year round resident and local breeder in west Texas.	DL	T
	Arctic peregrine falcon (*Falco peregrinus tundrius*)	Potential migrant.	DL	---
Baird's sparrow (*Ammodramus bairdii*)		Found in shortgrass prairie with scattered low bushes and matted vegetation.	---	---
Bald eagle (*Haliaeetus leucocephalus*)		Found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts in winter.	DL	T
Ferruginous hawk (*Buteo regalis*)		Lives in open country, primarily prairies, plains, and badlands; nests in tall trees along streams or on steep slopes, cliff ledges, river-cut banks, hillsides, power line towers.	---	---
Mountain plover (*Charadrius montanus*)		Breeding species: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous.	---	---
Prairie falcon (*Falco mexicanus*)		Found in open, mountainous areas, plains and prairie, nesting on cliffs.	---	---
Snowy plover (*Charadrius alexandrinus*)		Formerly an uncommon breeder in the Panhandle; potential migrant.	---	---
Western burrowing owl (*Athene cunicularia hypugaea*)		Open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows and man-made structures.	---	---
Western snowy plover (*Charadrius alexandrines nivosus*)		Uncommon breeder in the Panhandle; potential migrant which winters along the coast.	---	---

Species Name	***Occurrence in County***	***Federal Status***	***State Status***
Whooping crane (*Grus americana*)	Potential migrant; winters in and around Aransas National Wildlife Refuge and migrates to Canada for breeding.	LE	E
MAMMALS			
Big free-tailed bat (*Nyctinomops macrotis*)	Prefers to roost in crevices and cracks in high canyon walls, but will use buildings. May hibernate in the Trans-Pecos.	---	---
Black-footed ferret (*Mustela nigripes*)	Extirpated in Texas; former inhabitant of prairie dog towns in the general area.	LE	---
Black-tailed prairie dog (*Cynomys ludovicianus*)	Prefers dry, flat, short grasslands with low, relatively sparse vegetation, including areas overgrazed by cattle; lives in large family groups.	---	---
Cave myotis bat (*Myotis velifer*)	Roosts colonially in caves, rock crevices, old buildings, carports, under bridges, nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum caves of Panhandle during winter; opportunistic insectivore.	---	---
Gray wolf (*Canis lupus*)	Extirpated; formerly known throughout the western two-thirds of the state.	LE	E
Pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*)	Roosts in caves, abandoned mine tunnels and old buildings, hibernates in groups during winter.	---	---
Plains spotted skunk (*Spilogale putorius interrupta*)	Catholic in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie.	---	---
Swift fox (*Vulpes velox*)	Restricted to current and historic shortgrass prairie; western and northern portions of Panhandle.	---	---
REPTILES			
Texas horned lizard (*Phrynosoma cornutum*)	Open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky.	---	T
Status Key: LE = Federal Endangered LT= Federal Threatened DL= Federal Delisted C = Federal Candidate Species E = State Endangered T = State Threatened -- = Rare, but with no regulatory listing status Source: TPWD, Lubbock County Species List revised 6/25/2009, and USFWS listed species.			

There are three species federally listed as endangered in Lubbock County; the whooping crane (*Gus Americana*), gray wolf (*Canis lupus*), and black-footed ferret (*Mustela nigripes*). Two of these species, the gray wolf, and black-footed ferret are listed as extirpated within Texas and subsequently would not be expected to occur within the project area. The State of Texas also lists the whooping crane and gray wolf as endangered. In addition there are three threatened species which are state-listed within Lubbock County, the American peregrine falcon (*Falco peregrinus anatum*), bald eagle (*Haliaeetus leucocephalus*), and Texas horned lizard (*Phrynosoma cornutum*). Information available from the TPWD Natural Diversity Database[27] indicates that the Texas horned lizard, a state threatened species, and the swift fox (*Vulpes velox*) a species of interest but without official protection, have been reported in the vicinity of the proposed project area.

2.3.3.1 Whooping Crane, Bald Eagle, and American Peregrine Falcon

The whooping crane and bald eagle are potential migrants to Lubbock County that may temporarily use habitats in the area during migration. Although they may occasionally occur within the project area, surveys of the project area did not reveal any areas of habitat preferred by these migratory species, and no effect to these species is anticipated from the proposed project. The American peregrine falcon, a state threatened species, is found in a wide range of vegetation types, including the sand shinnery oak communities of Texas and Oklahoma.[28] Because of their ability to successfully utilize a variety of habitat types, no adverse effects to this species from the Lake 7 project are anticipated.

2.3.3.2 Black-footed Ferret

The black-footed ferret was historically found in areas occupied by prairie dogs, usually dry, flat short grasslands including land overgrazed by cattle. Although this species is being reintroduced into the wild in an attempt to reestablish it within its original range, no individuals have been released within Texas. Similarly the gray wolf, although once prevalent throughout the state, is now considered to be extirpated in Texas. No effect to either of these species is anticipated from this project.

2.3.3.3 Texas Horned Lizard

The Texas horned lizard generally prefers open, arid areas with sparse vegetation. Appropriate habitat for this species occurs within the project area. A baseline survey for the Texas horned lizard was conducted from July 23–24, 2009, within the preliminary conservation pool boundary of the proposed Lake 7. This survey was conducted to assess the potential habitat and occurrence of the state threatened Texas horned lizard within the conservation pool. Detailed results of this survey are included as Appendix E.

Potentially suitable Texas horned lizard habitat within and surrounding the proposed reservoir site was initially remotely delineated using aerial photography (1-m resolution). The delineated habitat within the conservation pool was then verified for accuracy during an on-the-ground field

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[27] Texas Parks and Wildlife Department. Natural Diversity Database Data for Lubbock County. Received 10/5/2009.

[28] USFWS. Species Database. Accessed June 4, 2010 at http://www fs.fed.us/database/feis/animals/bird/fape/all html#GeneralDistribution.

evaluation. The field surveys for Texas horned lizard consisted of walking along and adjacent to dirt roads which were identified as bisecting potentially suitable Texas horned lizard habitat. Ground and vegetative cover was visually searched for the Texas horned lizard, its scat (i.e., fecal pellets), harvester ant mounds (the primary prey of Texas horned lizards), and fire ant beds.[29] [30] Lizards observed within these areas were captured by hand, measured, sexed, and released.

Approximately 240 acres within the proposed conservation pool were remotely delineated as potentially suitable habitat for Texas horned lizards. All suitable habitat located within the conservation pool and studied during the field evaluation was situated along the eastern (i.e., downstream) half of the conservation pool. During the two-day horned lizard survey approximately 12 man-hours were spent intensively surveying approximately 3.55 miles of linear transects. Seven Texas horned lizards were observed (5 hatchlings, 2 sub-adults/adults) during the field surveys. Additionally, six Texas horned lizard scats were observed along three transects and lizards were captured along two of these transects.

While this survey represents a rapid assessment of Texas horned lizard habitat and occurrence within the conservation pool boundary, it demonstrates that this species inhabits portions of the area to be inundated by the proposed reservoir project.

2.3.3.4 Smalleye and Sharpnose Shiners

The North Fork is in the geographic range of historical distribution and potential fish habitat for the smalleye shiner and sharpnose shiner, candidate species which have been proposed for federal protection; however, neither fish has been reported to occur within Lubbock County. These two fish species, endemic to the Brazos River and once present throughout the Basin, are now thought to be restricted to waters above Possum Kingdom Reservoir.

Both of these species require fairly shallow water in broad, open sandy channels with moderate current and have been documented at three locations in the North Fork in Garza County (See Section 2.3.2). Since no pre-impoundment fisheries information exists for the North Fork it is unknown if the two species inhabited the upper limits of this river prior to construction of Buffalo Springs Lake and Lake Ransom Canyon. The HDR collections were taken upstream of these two impoundments, and no individuals of smalleye or sharpnose shiner were captured during the 2009 ALM survey (Appendix D).

The effects of existing on-channel river impoundments have created a migration barrier for these two cyprinid species and function as major obstacles to their migration routes. Therefore, the North Fork upstream of the two physical barriers could essentially be considered functionally fragmented from the existing downstream smalleye and sharpnose shiner populations. No effects to these two candidate fish species are anticipated as a result of the proposed project.

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[29] Henke, S. E., and W. S. Fair. 1998. Management of Texas horned lizards. Caesar Kleberg Wildlife Research Institute, Texas A&M University – Kingsville. Management Bulletin No. 2.

[30] Texas Parks and Wildlife Department. 2008. Texas horned lizard Watch monitoring packet. Texas Parks and Wildlife Department, Austin. <http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_w7000_0038.pdf>. Accessed 25 August 2009.

2.4 Cultural Resources

HDR conducted a pre-field cultural resource investigation including an archaeological site files search and Literature Review and a geologic and soils map review for the proposed project. These initial analyses, summarized below, will guide the development of a Phase 1 survey, when required.

2.4.1 Previous Archaeological Surveys

Three cultural resource surveys have been conducted within the Area of Potential Effect (APE), which was preliminarily identified as the conservation pool boundary. Conducted in 1974, 1979, and 2004, the three projects are the only cultural resource surveys that have been conducted within 2 miles of the project area (Table 2-11). These three cultural resource surveys resulted in identification of 17 archaeological sites within the APE or in close proximity to the project area.

Table 2-11. Previous Archaeological Surveys

Date	***Recorder***	***Project Name***	***No. of Sites Identified within 2 Miles of the Project Area***
1974	Elain Bernreuther	Project name could not be found*	13
1979	Jack T. Hughs	*An Assessment of the Cultural Resources of the Gray and Hancock Farms*	2
2004	Dr. Eileen Johnson	*Lubbock Lake Landmark Regional Research Program*	2
*Preliminary research could not identify the project name or the agency that conducted the research for this 1974 survey.			

2.4.2 Previously Identified Archaeological Sites

The aforementioned archaeological surveys identified a total of 17 sites within or near the proposed APE for the Lake 7 conservation pool. Site information and the sites' relationship to the APE are provided below (Table 2-12). Additional details for each of these sites are provided in the *Phase I Survey Protocol for the Proposed Lubbock Lake No. 7 Project Lubbock County, Texas*.[31]

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[31] HDR|e²M, 2010. *Phase I Survey Protocol for The Proposed Lubbock Lake No. 7 Project Lubbock County, Texas*. September 2010.

Table 2-12.
Previously Recorded Archaeological Sites within 2 Miles of the Project Area

Site No.	*Cultural Affiliation/Site Type*	*NRHP Eligibility Recommendation*
41LU7	Unknown prehistoric/campsite	Not evaluated
41LU8	Unknown prehistoric/campsite	Not evaluated
41LU9	Unknown prehistoric/campsite	Not evaluated
41LU10	Unknown prehistoric/campsite	Not evaluated
41LU11	Unknown prehistoric/campsite	Not evaluated
41LU12	Unknown prehistoric/campsite	Not evaluated
41LU13	Unknown prehistoric/campsite	Not evaluated
41LU14	Unknown prehistoric/campsite	Not evaluated
41LU15	Unknown prehistoric/campsite	Not evaluated
41LU16	Unknown prehistoric/campsite	Not evaluated
41LU17	Unknown prehistoric/campsite	Not evaluated
41LU18	Unknown prehistoric/campsite	Not evaluated
41LU19	Unknown prehistoric/campsite	Not evaluated
41LU48	Unknown historic/stone wall	Eligible
41LU49	Unknown prehistoric/lithic artifact scatter	Not eligible
41LU129	Prehistoric Archaic, Proto-historic/campsite	Eligible
41LU132	Prehistoric Archaic, Proto-historic/campsite	Eligible

2.4.3 NRHP Properties/Historic-Age Properties

There are no previously recorded NRHP eligible properties within the project APE. However, there is one historic-age property that will be directly impacted by the proposed project. The property is currently the residence of John Wheeler, a tenant and current Ranch Manager for the V-8 Ranch owned by Sam Arnett III, Abby F. Quinn, and William A. Flygare. The building that Mr. Wheeler occupies is within the footprint of the project's proposed dam, spillway, and water outlet sources. Mr. Wheeler reports that the building was constructed in the 1890s and may be one of the oldest houses in Lubbock County (John Wheeler, personal communication 2010).[32]

2.4.4 Predictive Model for Further Phase I Investigations

When the APE is separated into areas of low, medium, and high probability based on landscape features and previously recorded archaeological site location, the acreage of each section within the 795-acre conservation pool can be estimated. High probability areas account for 44% of the

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[32] HDR|e²M, 2010. *Phase I Survey Protocol for The Proposed Lubbock Lake No. 7 Project Lubbock County, Texas*. September 2010.

conservation pool, or roughly 352 acres. Medium probability areas account for 43% of the conservation pool, or roughly 342 acres. Low probability areas account for 13% of the conservation pool, or roughly 101 acres (Figure 2-1).

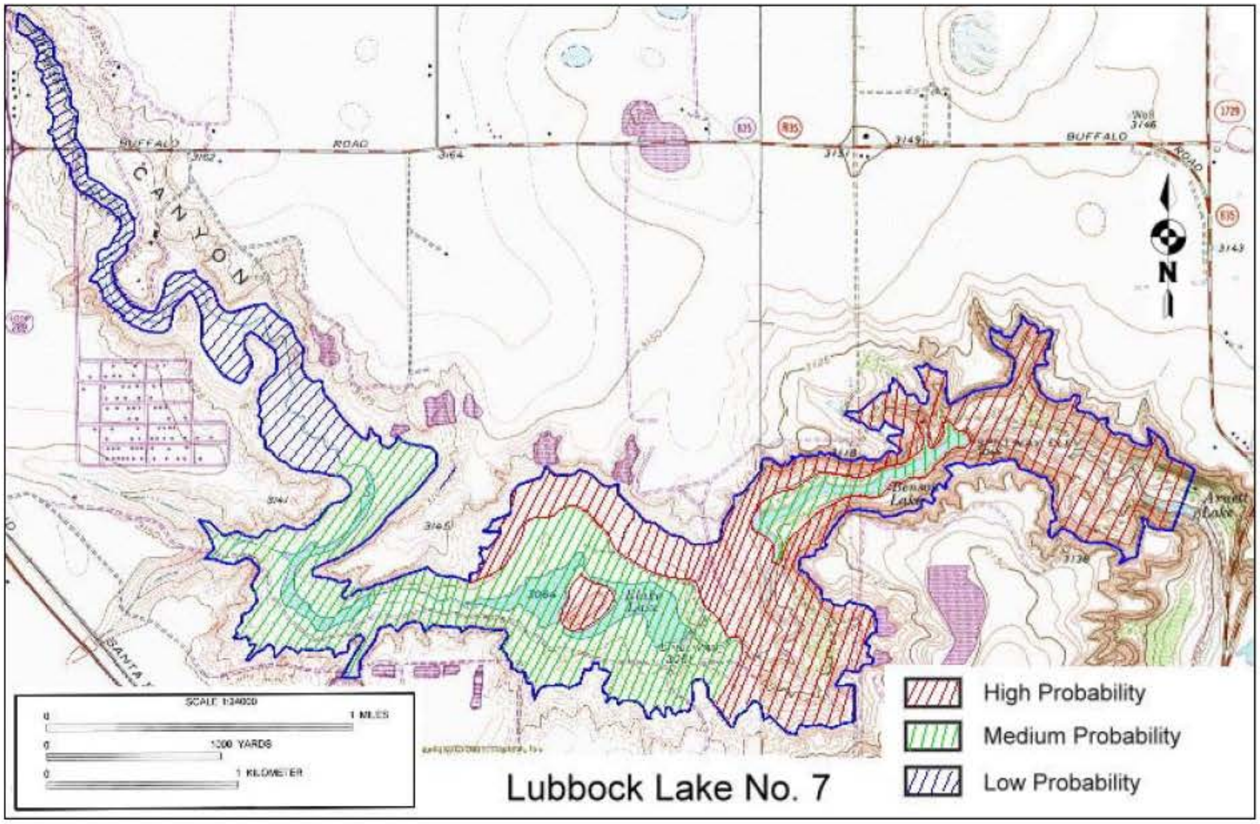

Figure 2-1. Buffalo Springs Lake USGS 7.5-minute Quad Map (1975) Illustrating Areas of High, Medium, and Low Probability for Cultural Resources within the Proposed Conservation Pool of the Proposed Lake 7

3.0 POTENTIAL IMPACTS

As part of the permitting process, potential direct and indirect impacts to aquatic and upland habitats of the reservoir site, and of downstream areas potentially affected by changes in flow regime must be considered. The effects on protected species, water quality, cultural resources, and other issues that may be raised by interested parties must also be considered. The following assessments are offered as our interpretation of the available information regarding the project area and the expected results of construction and operation of a dam and water supply reservoir. Additionally, the Clean Water Act, Section 404/401 permitting process will require evaluation of impacts and compensatory mitigation for unavoidable impacts to waters of the U.S.

3.1 Effects of Project Construction and Reservoir Impoundment

Primary, immediate impacts that will result from construction of the proposed reservoir would include conversion of existing habitats and land uses within the conservation pool to open water. Figures 3-1 and 3-2 illustrate the simulated Lake 7 storage levels for the 1940 to 1997 historical period, with annual diversions of 17,650 acft/yr. Figure 3-1 also illustrates that operation of the proposed Lake 7 would be above its 50% capacity elevation more than 75% of the time, resulting in the permanent inundation of 514 acres of brush – invaded grassland habitat and its conversion to a lacustrine (open water) environment in which an aquatic community will develop.

With respect to aquatic communities, the fish assemblages and other components of the aquatic biota of Lake 7 are expected to be comparable to those now present in the existing Yellow House Canyon impoundments, absent substantial changes in water quality.

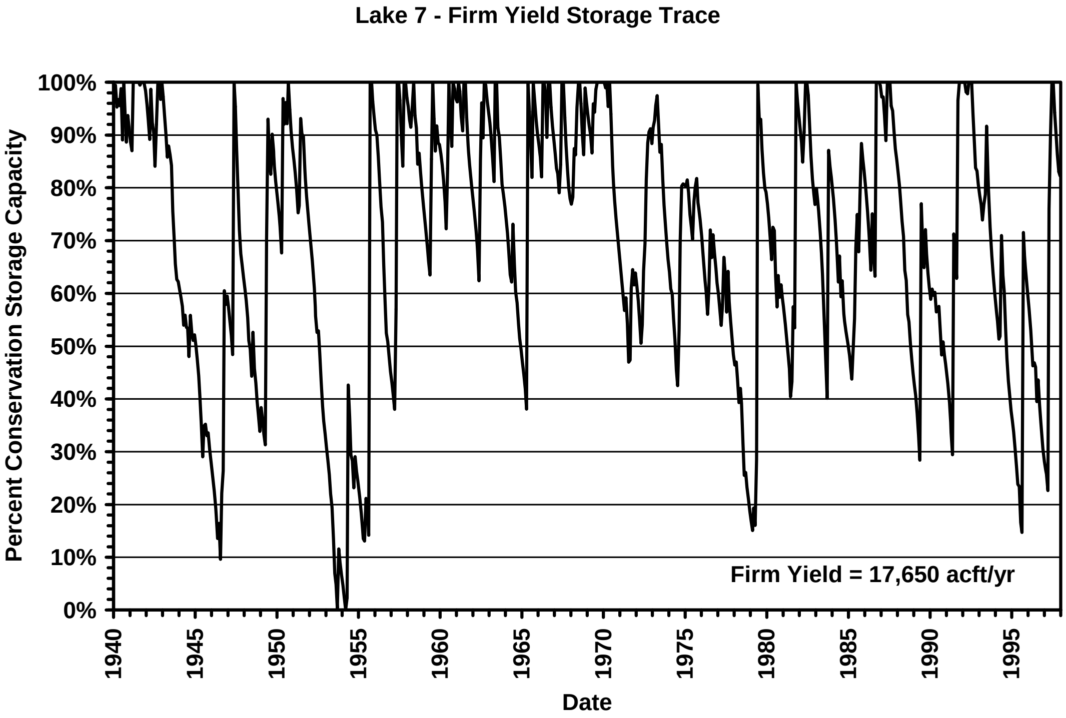

Figure 3-1. Lake 7 Reservoir Storage Considerations, Firm Yield Storage Trace

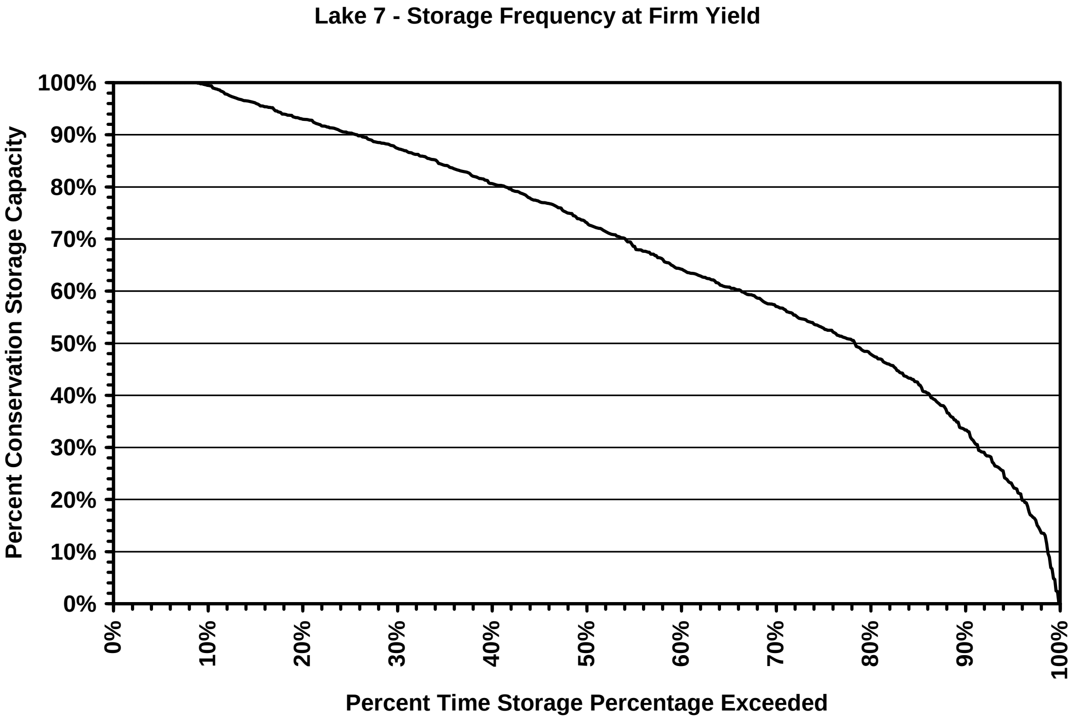

Figure 3-2. Lake 7 Reservoir Storage Considerations, Storage Frequency at Firm Yield

3.1.1 Terrestrial Habitats and Communities

3.1.1.1 Vegetation and Wildlife Habitat

Based on the vegetation and WHAP surveys described in Section 2.3.1.1 and Appendix B, it is anticipated that construction of the Lake 7 Reservoir would impact approximately 247 HU (Table 2-3) including both upland and aquatic habitat.

3.1.1.2 Waters of the U.S., Including Wetlands

As discussed in Section 2.3.1.2, waters of the U.S., including wetlands, within the conservation pool consisted of the North Fork and eight intermittent tributaries (16.6 acres), 22 non-forested wetlands (21.1 acres), and one forested wetland (7.6 acres). Approximately 4.1 acres of the non-forested wetlands considered waters of the U.S. occur on the northern face of the canyon and are primarily the result of upslope land application of treated wastewater. The waters of the U.S., including wetlands, total 45.30 acres within the proposed conservation pool. The *Delineation and Proposed Jurisdictional Determination of Waters of the U.S. Report* is included as Appendix C, and the anticipated impacts to waters of the U.S. will be finalized upon coordination with the USACE. It is anticipated that wetlands will form in shallow portions of the lake dominated by similar species as the existing wetlands. Stream habitats will be converted to open water.

3.1.2 Aquatic Habitats and Communities

Potential impacts to the aquatic habitats and communities are discussed in Section 3.2.3, Lotic Community Impacts.

3.1.3 Protected Species

State or federally listed endangered or threatened species potentially affected by reservoir construction appear to be limited to the Texas horned lizard. A baseline field survey was conducted over a 2-day period in July 2009 within the conservation pool of the proposed Lake 7 to assess the potential habitat and occurrence of this state threatened species within the proposed reservoir's area of impact. The eastern (i.e., downstream) half of the proposed reservoir contains suitable habitat for the Texas horned lizard. HDR documented at total of 7 individuals among 3.55 miles of linear transects, including 5 hatchlings. The findings from this rapid assessment survey effort confirm the presence of this species within portions of the area to be inundated by the proposed reservoir project. A complete discussion of the survey is included in Appendix E.

The presence of hatchlings indicates that the population is reproducing. Approximately 619 acres of potentially suitable Texas horned lizard habitat has been identified adjacent to and above the proposed Lake 7 conservation pool. Presently, it is unknown whether these areas support an existing lizard population or if these areas could effectively support the addition of lizards emigrating from the terrestrial habitat examined below the conservation pool boundary.

The following actions are recommended to determine the degree to which this area and adjacent areas above the conservation pool are inhabited by the Texas horned lizard:

1. Conduct additional surveys within the conservation pool boundary and within areas adjacent to and above the conservation pool of the proposed reservoir to estimate current Texas horned lizard densities and determine habitat suitability.
2. Evaluate off-site areas in the vicinity of the proposed reservoir for their potential as eventual relocation sites for Texas horned lizards.
3. Develop a Preliminary Management Plan detailing alternatives to mitigate impacts to Texas horned lizards due to habitat inundation from reservoir construction. Measures could include: (a) relocation of lizards to adjacent habitat above the proposed reservoir's conservation pool, or (b) relocation of lizards to other suitable habitat sites in the vicinity of the project area.
4. Coordinate with TCEQ/TPWD staff to determine the feasibility of appropriate mitigation alternatives to ensure no injury or damage to this sensitive reptile species.

3.1.4 Cultural Resources

Considering the proximity of the project area to the archaeological deposits at Lubbock Lake and the use of Yellow House Canyon as an east-west thoroughfare of great antiquity, there is a high probability that cultural resources are present within the area to be affected by reservoir. However, the number, quality and potential for damage cannot be determined without a detailed archaeological field survey.

The Texas Historical Commission (THC) and the USACE will require an intensive archeological survey of the dam site and the maximum flood pool area. The archaeological survey would have to include the evaluation of historic-age standing structures as well as buried archaeological sites for NRHP eligibility. USACE permit to construct a reservoir on the North Fork would have to be consistent with the requirements of Section 106 of the NHPA. Furthermore, if the project sponsor is a political subdivision of the State of Texas (i.e. county, municipality, etc.) and owns or controls the project lands, compliance with the Antiquities Code of Texas is also required. These laws and their implementing regulations generally require a pedestrian survey to identify cultural deposits, testing to determine the significance of identified sites, and where impacts to significant resources cannot be avoided, some form of mitigation, such as data recovery prior to site destruction, is usually required.

As previously discussed, there is one historic-age property that would be directly impacted by the proposed project (V-8 Ranch). As part of the permitting phase, the eligibility of the V-8 Ranch will be evaluated for listing on the NRHP, and the results and appropriate mitigation measures, if necessary, will be coordinated with the THC and USACE.

3.2 Effects of Project Operation

3.2.1 Reservoir Water Quality

Water quality concerns for the proposed Lake 7 include bacteria and other pollutants from storm runoff and treated wastewater. Storm runoff, particularly from urban areas, will likely be a source of coli form bacteria, oxygen demanding materials, nutrients and other materials (e.g., oil and grease, metals, household chemicals) potentially affecting water quality. This condition is common in streams and impoundments receiving urban runoff, and, in some cases, has proved to be a water quality issue. Water quality in the existing Yellow House Canyon reservoirs shows the effects of the adjacent urban area of Lubbock, but that quality remains sufficient to maintain acceptable aquatic life uses in those water bodies. Water quality conditions in the existing impoundments, which are not expected to change substantially as a result of the proposed project, are the best predictors of conditions most likely to develop in the proposed Lake 7 reservoir.

3.2.2 Downstream Water Quantity and Quality

Hydrologic effects of operating the proposed reservoir system on a firm yield basis have been preliminarily evaluated using the TCEQ Brazos Basin Water Availability Model (Brazos WAM). The model utilizes a January 1940 through December 1997 hydrologic period of record to compute the stream flow available from the North Fork without causing increased shortages to existing downstream rights. Firm yield was computed subject to the reservoir having to pass natural inflows to meet Consensus Criteria for Environmental Flow Needs in-stream flow requirements. Naturalized stream flow statistics used to determine the Consensus Criteria pass-through requirements and potential effects on stream flows below Lake 7 are shown in Table 3-1. In-stream flow requirements were not applied to the developed water sources, which would not be required to meet the Consensus Criteria flow requirements.

Table 3-1.
Daily Natural Stream Flow Statistics for Lake 7

Month	*Median Flows – Zone 1 Pass-Through Requirements (cfs)*	*25th Percentile Flows – Zone 2 Pass-Through Requirements (cfs)*
January	0.2	0.0
February	0.2	0.0
March	0.1	0.0
April	0.2	0.0
May	3.4	0.1
June	5.1	0.5
July	1.5	0.0
August	0.6	0.0
September	1.3	0.0
October	0.9	0.0
November	0.6	0.0
December	0.4	0.0
Zone 3 (7Q2) Pass-Through Requirement (cfs):		0

A detailed operational plan cannot be developed until environmental flow requirements are determined for the proposed project. The outlet structure will consist of a tower-type inlet with gated openings located at multiple elevations. This multi-stage outlet will allow water to be passed through the reservoir and released from multiple depths within the reservoir pool. The capability of releasing from multiple depths within the reservoir pool will allow water quality considerations to factor into release decisions. The reservoir will function as a sediment sink by trapping sediments and other organic matter that will not be passed downstream through the outlet works.

The existing six dams in the Jim Bertram Lake System, Buffalo Springs Lake and Lake Ransom Canyon already trap sediment and have fragmented the stream. The Lake 7 dam is located near the upper end of Buffalo Springs Lake, and as such, no increased levels of erosion/stream downcutting are expected to occur. The City has not yet identified mitigation strategies. This will occur in the future after further impact analyses have been completed and in consultation with TCEQ, TPWD and the USACE.

The treated wastewater originates from groundwater and from Canadian River water purchased from the Canadian River Municipal Water Authority (CRMWA). These return flows are in excess of the 9 million gallons per day (MGD) for which the City has recently applied to the TCEQ for reuse authorization. The 22.9 MGD (25,648 acft/yr) of return flows considered here were input into the Brazos WAM and used in conjunction with available unappropriated flows to develop the firm yield estimates for Lake 7. These return flows are not yet discharged to the North Fork upstream of the Lake 7 site.

Figures 3-3 and 3-4 indicate that operation of Lake 7 would not change the frequencies of low to normal stream flows (i.e., at and below naturalized median monthly flows). However, stream flows in the North Fork are presently dominated by "developed water" discharges whose use is the target of the proposed reservoir. Modest reductions in flood flows will occur as the reservoir captures these infrequent events; however, reservoir storage will not be sufficient to alter flood flow regimes for events exceeding a longer peak discharge.

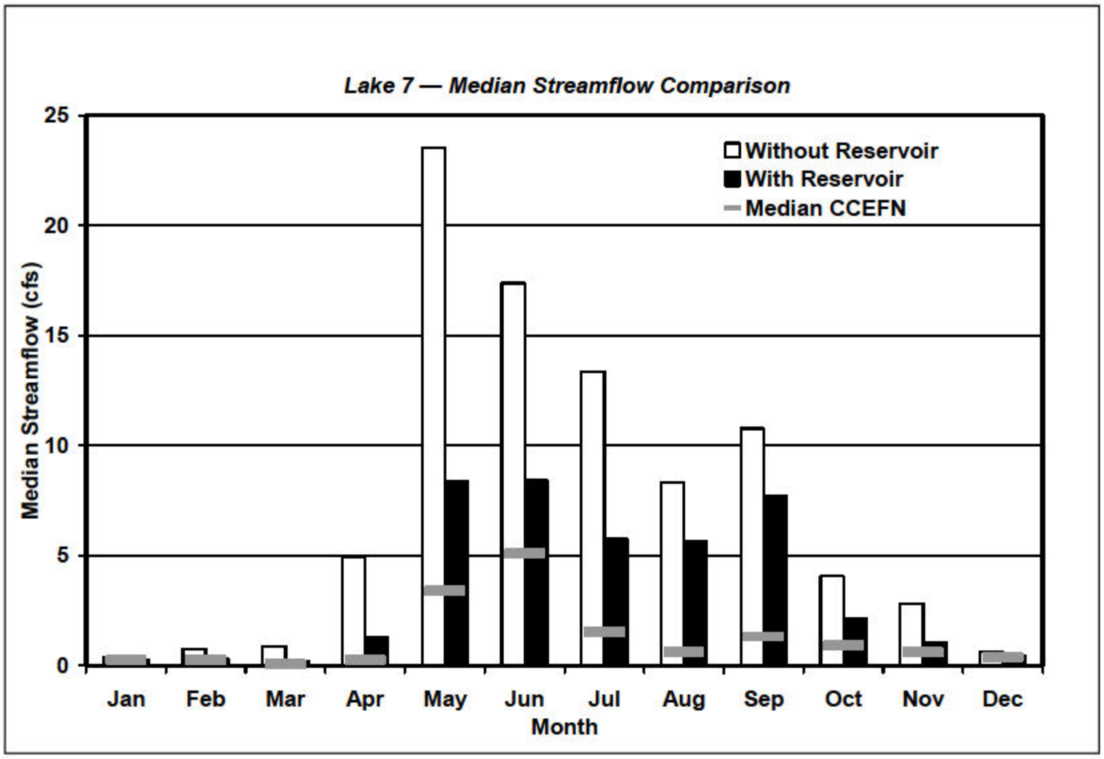

Figure 3-3. Lake 7 — Median Stream Flow Comparison

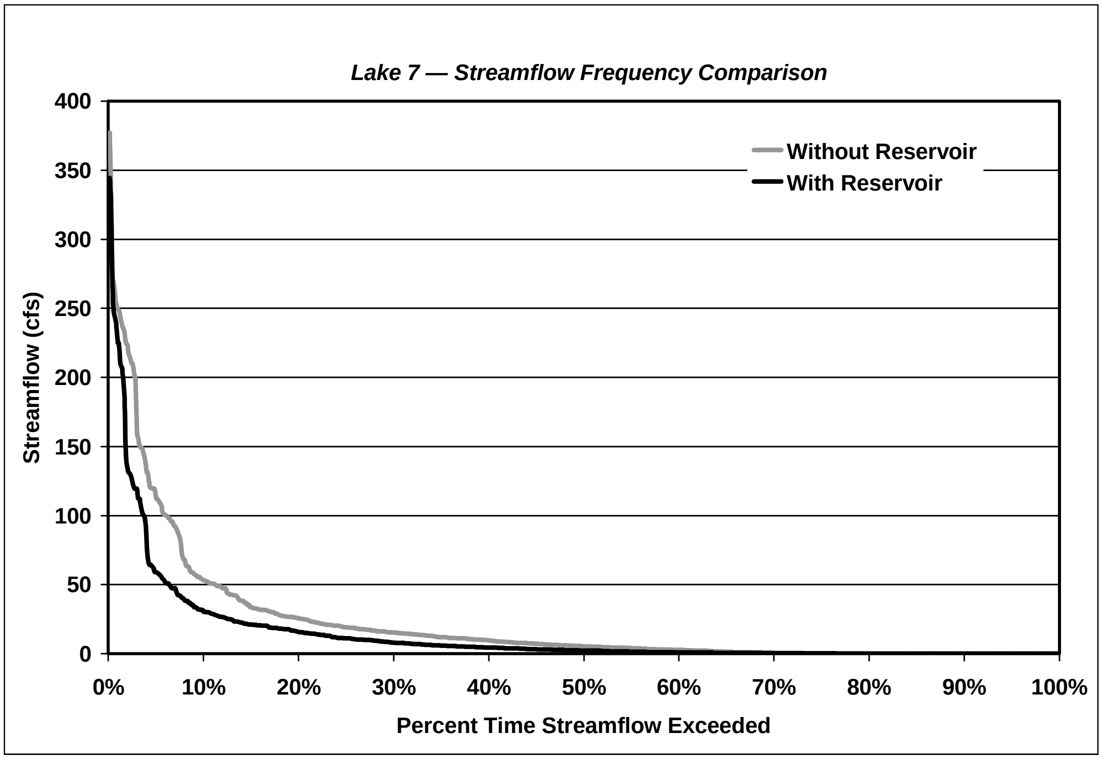

Figure 3-4. Lake 7 — Stream Flow Frequency Comparison

Existing impoundments are already exerting the same kinds of downstream water quality changes that will occur below Lake 7. These changes include temperatures in the tailwater that are warmer in winter than the unimpounded stream would exhibit, and cooler summer water temperatures. Bottom water releases from the dams may exhibit reduced DO concentrations, particularly during summer conditions when stratification occurs. Given the abundance of sulfate in stream waters here, very low DO concentrations (<1 mg/L) may be accompanied by substantial levels of hydrogen sulfide, which can be toxic to fish if persistent at sufficient levels. However, it is anticipated that a principal spillway tower with gated inlets at various elevations would be constructed, and bottom water releases would be managed appropriately. Other effects of impoundment include fragmentation of stream habitat, and the trapping of sediment, organic material and nutrients in the reservoir, which results in reduced oxygen demand, nutrient and sediment loads downstream of the dam.

While reduced oxygen demand and nutrient loads would be beneficial in the North Fork, reduction of sediment loads could result in increased erosion below the dam. However, all of these conditions are presently occurring in the North Fork as a result of the existing reservoir system and would not be exacerbated by the proposed project, other than serving to further polish the water flowing through them (i.e., detention in standing waters allows time for algal and microbial growth to remove dissolved nutrients and organic material from the water column while sedimentation removes those organisms as well as detrital and mineral particles).

3.2.3 Lotic Community Impacts

The entire lotic ecological community within the conservation pool is highly dependent on the flow characteristics of the upper North Fork. The stream flow in this area is highly variable among seasons and the sampling portions of river that exhibited appreciable flows during the time of the survey may exhibit low to no flows during dry periods. Upstream, the existing six dams in the Jim Bertram Lake System coupled with the two downstream impoundments, Buffalo Springs Lake and Lake Ransom Canyon, have already fragmented the stream and created migratory barriers. The harshness of hydrologically variable prairie streams usually limits colonization and species continuance that can invariably result in an aquatic system represented by more tolerant species and trophic generalists. Stability of these hardy assemblages might be the result of resistance, withstanding disturbance, or adjustment stability (i.e., the ability for rapid recovery).

Nine of the 15 fish species collected during the 2009 ALM survey (Section 2.3.3.2; Appendix D) are tolerant of wide ranges in abiotic habitat parameters (e.g., temperature, DO concentration, salinity) that occur during periodic episodes of zero stream flow and isolation in channel pools and conversely during flooding events. Macroinvertebrate assemblages, being relatively immobile, are believed to integrate the effects of multiple stressors including habitat quality (e.g., temperature, flow, erosion, sedimentation); chemical quality (e.g., contaminants in water and /or sediment) and climatic factors.

Further, benthic macroinvertebrates may reveal the impacts of chronic stressors that may be overlooked by the short-term “snapshot” view provided by ambient chemical sampling. The species that can utilize this section of stream are restricted either to species having some adaptation to surviving dry periods (e.g., resting eggs in some crustacean species) or to those adapted to rapidly recolonizing disturbed habitats. These species have developed strategies for surviving and often require periodic hydrologic extremes caused by floods and droughts that exceed the normal annual highs or lows in flows, temperature, and other factors.

The existing biota already experience wide variation in water quantity and quality due to natural hydrologic variation. The proposed Lake 7 dam will be located near the upper end of Buffalo Springs Lake. Expected changes in water quality as a result of project operation are not expected to have substantive adverse impacts on downstream biotic communities. Natural hydrology varies by orders of magnitude and existing biota has already demonstrated a tolerance for this large variation.

One of the main issues confronting the West Texas region is the scarcity of water. Population growth has greatly increased municipal and industrial use. When unregulated, river inflows have extreme variability ranging from drought stage to flooding which resulted in a direct contribution of freshwater into Buffalo Springs Lake. Since construction of Buffalo Springs Lake and Lake Ransom Canyon, the direct influence of the river (i.e., downstream flow) has been limited but nonetheless has some influence on providing freshwater inflow to the downstream reach. As noted above, the upper North Fork system is subject to changes in physical and chemical characteristics, and factors such as temperature and DO can influence the assemblage, distribution and abundance of aquatic biota**.** Operation of the proposed reservoir is not anticipated to result in increased saline content. No additional sources of salinity would drain into the portion of the North Fork that would be encompassed by the proposed Lake 7.

While in-stream flows have been a subject of research in Texas for several decades, there are still limited data and understanding of the hydrologic and ecological linkages. Understanding the goals of the Texas statutes for environmental flows and the various legislative implementation mechanisms can enhance communication among interested parties toward water allocation and management. Depending on a reservoir operation plan that would be developed based on final in-stream flow requirements, construction of Lake 7 would potentially provide stored water that would be available to provide better sustained base flows below Lake 7 and through Buffalo Springs Lake and Lake Ransom Canyon.

3.3 Downstream Geomorphic Impacts of Reservoir Operations

Reservoir construction and operation has been shown to modify downstream hydrology by reducing the magnitude of peak flows, attenuating flood hydrographs, and increasing base flows through low-flow releases. In addition, reservoirs trap inflowing sediment (both bed and suspended loads), and release clear-water discharges that are essentially free of appreciable quantities of sediment. The sediment-carrying capacity is often compensated for through erosion of the channel and banks immediately downstream of the reservoir as the downstream channel adjusts to the revised hydrologic regime. These channel adjustments can modify stream and riparian habitats.

Expected channel responses vary considerably amongst reservoir sites, and are a function of the natural hydrology, sediment loads in the stream prior to reservoir construction and other changes to the natural hydrology that pre-date reservoir construction. The stream channel in any specific location can be considered to be in a constant state of disequilibrium, as channel forms continually adjust to changes in the hydrologic regime, both man-induced as well as meteorological. The expected effects at any specific project cannot be generalized, and should be determined through site-specific analyses of natural hydrology, pre-existing man-induced changes to natural hydrology, and site-specific channel hydraulic and sediment transport analyses.

The proposed Lake 7 is located immediately upstream of the headwaters of the existing Buffalo Springs Lake, and downstream of six existing channel dams which form the Jim Bertram Lake System. Construction and operation of the proposed Lake 7 will have little effect on stream geomorphology, as the upstream reservoirs effectively control much of the existing sediment supply that would enter the Lake 7 stream reach, and the downstream Buffalo Springs Lake (and Lake Ransom Canyon immediately downstream of Buffalo Springs Lake) already effectively capture any sediment that is discharged currently from the Lake 7 reach (portion of the North Fork to be impounded). Lake 7 would be built principally for water supply and is not expected to mitigate downstream flooding for events having annual exceedance probabilities less than 50% (e.g., the approximate 2-year peak discharge and greater).

Based on stream flows at the Aspermont gage, translated upstream to the Lake 7 dam site using a drainage area ratio of 13%, the 2-year recurrence interval discharge at the Lake 7 site is approximately 2,070 cfs. Review of daily flow records at the Aspermont gage indicate that flood events with peak values of approximately 2,000 cfs (as translated upstream to Lake 7) have an average volume of about 3,300 acre-feet. This is 16% of the preliminary conservation pool capacity of Lake 7. Larger flood events would have even greater volumes and would overwhelm the storage capacity of Lake 7, eliminating any effective mitigation of downstream flood flows.

Combined with the attenuating effects of Buffalo Springs Lake and Lake Ransom Canyon, Lake 7 will have very little impact on flood discharges downstream of Lake Ransom Canyon.

4.0 MEASURES TO AVOID OR MINIMIZE ADVERSE IMPACTS, AND COMPENSATION FOR UNAVOIDABLE IMPACTS

Mitigation planning for the proposed Lake 7 project will include the development and execution of site-specific studies designed to adequately quantify potential impacts to environmental and cultural resources. The resulting data will be used to explore available alternatives for the avoidance or minimization of possible impacts. Planning that addresses compensation for unavoidable environmental impacts may require additional field work to characterize those areas found outside of the reservoir footprint suitable for appropriate management. These areas could generate the necessary additional habitat value needed to compensate for areas lost through the project implementation. Compensation for impacts to significant cultural resources generally involves the recovery of data and artifacts from the affected sites. Where appropriate, this action may also include some type of public informational display.

4.1 Field Study and Mitigation Planning Requirements

The work described in the following subsections is consistent with the provisions of the Texas Administrative Code governing Water Rights applications before the TCEQ, and is intended to address those areas in which our site-specific information of the proposed project was supplemented by additional field work and analyses. Assessments of possible environmental effects, specifically with respect to habitat impacts and mitigation, water quality, estuarine considerations, and in-stream uses (TAC 297.53-56), were conducted as part of the application process. The City consulted with TCEQ staff concerning the requirements, scopes of work, and analysis methodologies prior to commencing the work described herein.

4.1.1 Terrestrial Habitats and Communities

A field survey and recent aerial photography were used to delineate vegetational cover, land use and habitats within the conservation pool of Lake 7, and to develop maps of those resources. Based on the results of the initial vegetation/habitat mapping, a suitable quantitative method of terrestrial habitat assessment, the WHAP developed by TPWD, was used to evaluate probable impacts over the life of the project and to guide mitigation planning. A summary of the results of the vegetation and WHAP surveys is contained within Section 2.3.1 and datasheets and resulting maps are included in Appendix B. Coordination with TCEQ occurred prior to planning and conducting the field work to obtain general agreement on the basic approach, assumptions and habitat scoring of this effort. For USACE, USFWS or other federal personnel to participate, an application for a USACE permit pursuant to Section 404 of the Clean Water Act will have to be filed with the USACE Fort Worth District.

4.1.2 Wetland Delineation

The presence, nature and actual locations of jurisdictional wetlands potentially affected by reservoir construction were determined by a site survey which occurred preparatory to application for a USACE permit required by Section 404 of the Clean Water Act. A summary of the wetland delineation survey and results is contained within Section 2.3.1.3 of this document and the complete report is included as Appendix C. This wetland delineation was conducted according to the guidelines established in the USACE 1987 Wetland Delineation Manual. A mitigation plan will be developed during the Section 404/401 coordination process and will include an alternatives analysis and proposed measures to avoid, minimize, and compensate for impacts to waters of the U.S.

4.1.3 Aquatic Habitats and Communities

Aquatic habitats and fish communities in the North Fork were characterized at four locations, using the TCEQ's procedures for conducting physical habitat assessments and biological monitoring in wadeable freshwater streams outlined in *SWQM Procedures Manual Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data* (TCEQ RG-416). Because of the low diversity of the resident fish assemblage and the tolerant, generalist nature of the component species, the need for an elaborate in-stream flow study is considered unnecessary for the proposed project. Results of the fish and benthic surveys of the Lake 7 site are summarized in Section 2.3.2.1 of this document and a copy of the complete study is included as Appendix D.

4.1.4 Important Species

Field survey personnel assessed the potential for the presence of protected species on the proposed reservoir site based on their known distributions and habitat requirements. Only one listed species, the Texas horned lizard was thought to be suitable for additional species specific field surveys. Because occurrence probability for the Texas horned lizard was judged to be high, a targeted species survey was conducted for this reptile. A discussion of the findings of this survey was included in Section 2.3.3 of this document, and a copy of the full report is included as Appendix E.

4.1.5 Cultural Resources, Phase I Survey

All Phase I surveys must be done in accordance with state and federal laws promulgated by the NHPA, the THC, and the Council of Texas Archaeologists. These standards and guidelines detail survey protocols and evaluation methods for archaeological sites and the recording and documentation methods necessary. During the Phase I Survey for the proposed project, land within the project boundary or APE should be intensively inspected for cultural resources by a combination of pedestrian surface inspection, shovel testing, and backhoe trenching as described below. Any cultural materials encountered should be evaluated as sites or isolated occurrences and recorded accordingly. The *Phase I Survey Protocol for the Proposed Lubbock Lake No. 7 Project, Lubbock County, Texas* also includes a detailed discussion of evaluation methods for cultural resources[33].

At the completion of the Phase I component of the cultural resource survey, archaeologists will submit a report to the THC including site forms for all newly recorded and revisited archaeological sites encountered. Decisions will be made in accordance with consultation with the THC on the treatment of all threatened archaeological sites and future work that would be necessary at a minimum to determine NRHP eligibility for all archaeological sites encountered, and to determine recommendations for the protection and/or mitigation of these resources. Recommendations or estimates to determine any necessary future work can be made only after consultation with the THC following completion of the Phase I survey. Because a federal

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[33] HDR|e²M, 2010. Phase I Survey Protocol for The Proposed Lubbock Lake No. 7 Project Lubbock County, Texas. September 2010.

(USACE) permit would be required for the proposed project, the cultural resources investigation, significance testing and mitigation planning must also be coordinated with the USACE archaeologist to insure compliance with Section 106 of the NHPA.

In addition to an archaeological survey, an architectural survey should be conducted to identify whether the V-8 Ranch house may be eligible for listing in the NRHP. The ranch house and all other surveyed architectural resources should be evaluated for NRHP eligibility using the NRHP evaluation criteria.

4.2 Mitigation Planning

A mitigation plan includes a summary of potential adverse environmental and cultural resources impacts, delineates those impacts that are avoided or minimized by project features and operation, and presents a plan to compensate for unavoidable (net) impacts. Demonstrations of avoidance or minimization may include (for example) management planning for project lands or flowage easements above the conservation elevation to restrict certain land uses, thereby avoiding additional upland habitat loss due to lakeside development, and operational plans to allow for periodic flushing flow releases. In addition, channel restoration projects in other locations may be considered for mitigation of impacts on downstream channel morphology, if determined to be caused by Lake 7.

The results of the vegetation mapping, wetland delineation, habitat evaluation and in-stream flow assessment studies have been used to define the habitat functions or values affected by reservoir construction and operation. Additional, offsite surveys may be required to identify and evaluate potential areas to acquire and manage to achieve compensation for loss of habitat values. At this time, we anticipate that wetlands and wooded riparian areas would be a high priority for mitigation, given the generally ephemeral nature of regional surface waters and the degree of agricultural development characterizing the surrounding uplands.

A combination of habitat enhancement, restoration, and/or preservation measures that will compensate for unavoidable losses of habitat functions would be developed in consultation with TCEQ, TPWD, USACE and USFWS personnel during the Section 404 permitting process. This is typically an iterative process in which differences in interpretations of habitat values, impact severity, necessity for compensation and methods of achieving increases in habitat value are resolved through negotiation and consensus building.

Appendix A
Lubbock Lake 7 Environmental Literature Review

Table of Contents

A.1 Introduction

This comprehensive literature review was performed in order to identify all species of concern which may exist within the upper Brazos River Basin (Figure 1) or along the North Fork Double Mountain Fork Brazos River within the area of the proposed Lake 7 impoundment (Figure 2) and establish an appropriate survey methodology for each recognized species that could occur in the project area.

The proposed project involves construction of an impoundment (Lake 7) on the North Fork Double Mountain Fork Brazos River to capture and store treated wastewater, stormwater discharges and other developed-water sources, and available unappropriated stream flows for subsequent use. The proposed Lake 7 is located on the Buffalo Springs and Lubbock East 7.5 minute United States Geological Survey (USGS) quadrangle maps. There are six existing, smaller impoundments along the North Fork Double Mountain Fork Brazos River in the upper reaches above the proposed Lake 7 location, and two larger lakes, Buffalo Springs Lake and Lake Ransom Canyon downstream of Lake 7. Construction of the dam for this reservoir will impound an approximately 6.2-mile reach of the North Fork Double Mountain Fork Brazos River located immediately upstream of Buffalo Springs Lake (Figure 1). The proposed location for the Lake 7 dam is 33° 29’ 33.27” N, 101° 37’ 23.75” W.

A.2 Project Vicinity

The headwaters of the Brazos River form in the extensive plateau of the Southern High Plains, also known as the Llano Estacado, in eastern New Mexico and northwestern Texas. Surface water resources of this region are isolated hydrologically as playa lakes (enclosed intermittently flooded basins) and draws. The City of Lubbock is located near two major draws: Yellowhouse Draw and Blackwater Draw. These upland watershed areas drain in the direction of the North Fork Double Mountain Fork Brazos River of the upper Brazos River Basin, which is the primary perennial surface water source in the study area. Yellowhouse Draw originates in southeast Bailey County and cuts through the eastern edge of the Caprock Escarpment through Yellow House Canyon for over 35 miles in Lubbock and Crosby counties. As this drainage reaches central Lubbock County, the canyon is more visible just north of Lubbock. It continues

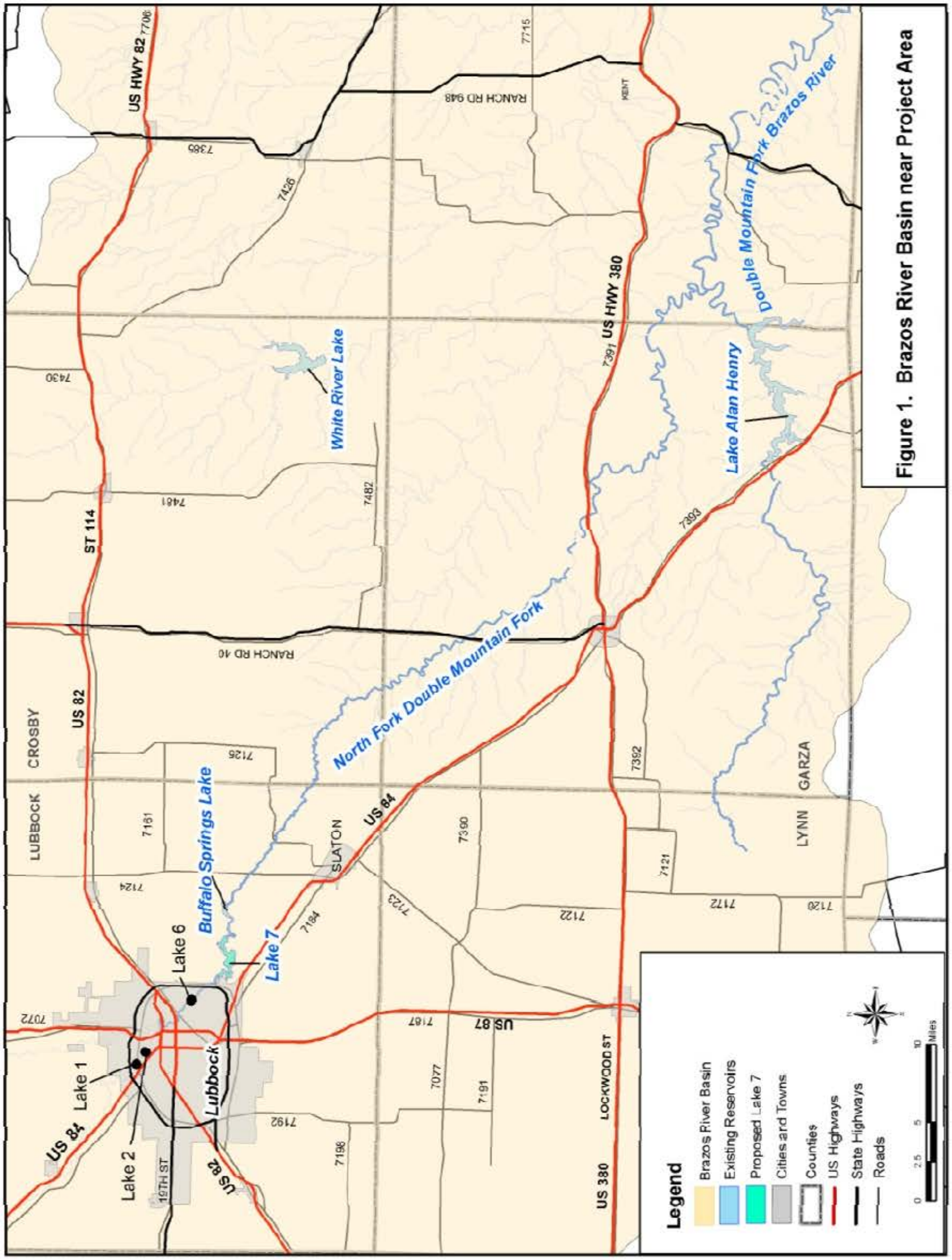

Figure 1. Brazos River Basin near Project Area

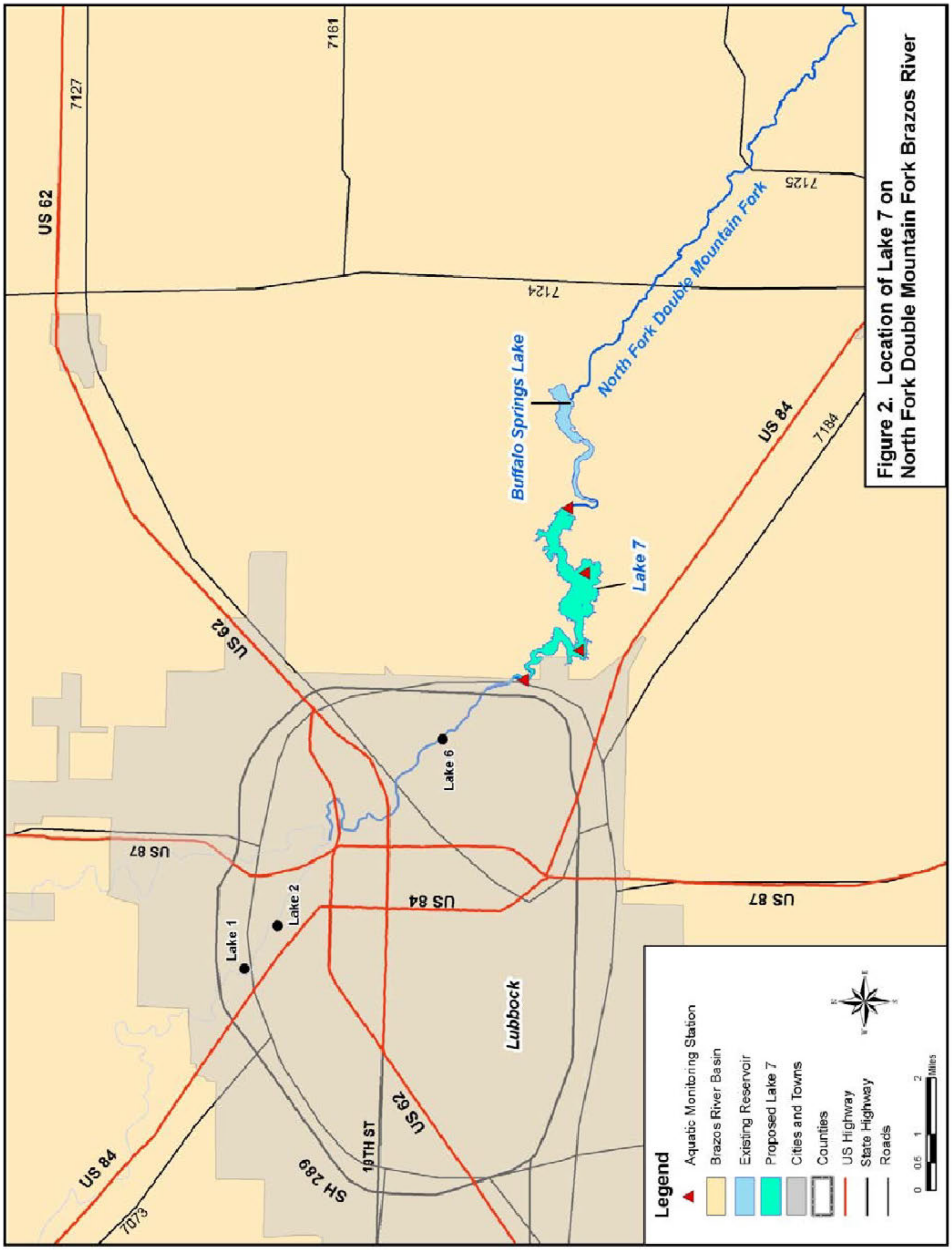

Figure 2. Location of Lake 7 on North Fork Double Mountain Fork Brazos River

to the southeast through the northern and eastern sections of the city and terminates at its confluence with Blackwater Draw. Blackwater Draw, upstream of its confluence with Yellowhouse Draw in Mackenzie Park in northeast Lubbock, flows southeast for approximately 63 miles from its headwaters in northwest Bailey County through a range of low-lying sand hills across Lamb, Hale and the northern section of Lubbock County. The North Fork Double Mountain Fork Brazos River starts where these two upper tributaries merge and flows southeast for about 75 miles through Crosby and Garza counties to its convergence with the Double Mountain Fork Brazos River southwest of Clairemont in western Kent County.

The proposed Lake 7 reservoir is located in Lubbock County, southeast of the City of Lubbock on the North Fork Double Mountain Fork Brazos River. The uplands adjacent to the river near the proposed reservoir are flat, dominated by row-crop agriculture and contain shallow playas.

The proposed project area is located in the High Plains ecoregion (Griffith et al, 2004), the High Plains vegetational area of Texas (Gould, 1962), and the Kansan biotic province (Blair, 1950). It is characterized by extensive areas of open plains on a distinct elevated plateau. Elevation within this area ranges from 2200 to 3800 feet (BEG, 1996). The average annual precipitation in this area is 16 to 22 inches, fluctuating widely from year to year. Most of the rainfall occurs as high-intensity, thunderstorms during late spring and early fall. The average annual temperature is 55° to 63° Fahrenheit (F) (13° to 17° Celsius). The freeze-free period averages 225 days and ranges from 195 to 255 days, increasing in length from north to south (NRCS, 2009).

Section 7.0 includes vegetation information for the project area. Faunal species in this ecoregion include those suited to a semi-arid environment. Riparian zones along the Brazos River and streams and their tributaries contain important wildlife habitat for the region and support populations of white-tailed deer (*Odocoileus virginianus*) and Rio Grande turkeys (*Meleagris gallopavo intermedia*). Bobwhites (*Colinus virginianus*), scaled quail (*Callipepla squamata*), mourning dove (*Zenaida macroura*), and a variety of song birds, small mammals, waterfowl, shorebirds, reptiles, and amphibians. Large to medium-size mammals include the coyote (*Canis latrans*), ringtail (*Bassariscus astusus*), and long-tailed weasel (*Mustela frenata*). Typical smaller herbivores include desert cottontail (*Sylvilagus auduboni*), Mexican ground squirrel (*Spermophilus mexicanus*), black-tailed prairie dog (*Cynomys ludovicianus*), plains pocket mouse (*Perognathus flavescens*), Ord's kangaroo rat (*Dipodomys ordii*), and plains harvest mouse (*Reithrodontomys montanus*). Bison (*Bos bison*), and black-footed ferrets (*Mustela nigripes*) are historically associated with this area (Davis and Schmidly, 1994).

A.2.1 Lake 7 Site

In contrast to the intensive agricultural development of the surrounding High Plains, the prevalent land uses within Yellow House Canyon are rangeland, suburban residential, and recreational facilities, including substantial development around Buffalo Springs Lake and Lake Ransom Canyon. The proposed Lake 7 project area landuse has been mapped by the USGS as primarily containing mixed rangeland and nonforested wetlands, with additional smaller areas including gravel pits, confined feeding operations, cropland or pasture, and reservoirs (USGS, 1990). However, Texas Parks and Wildlife Department (TPWD) has mapped the dominant vegetation type within the area of Lake 7 as Mesquite-Lotebush-Brush (McMahan et al. 1984). The mesquite-lotebush-brush cover in the vegetation type mapping does not include any wetland areas, and the proportion of the reservoir footprint designated as wetlands in the USGS mapping seems high for typical regional conditions.

Within the proposed Lake 7 footprint, the Soil Survey Report for Lubbock County (NRCS, 1975) shows that the North Fork Double Mountain Fork Brazos River primarily contains Berda loam 3-5 % slopes, Bippus Clay Loam, frequently flooded, Potter-Berda Association steep soils and Berda-Potter Association soils which are hilly soils. Berda, Bippus and Potter soils belong to the Potter-Berda-Bippus Series found on bottomlands and uplands that include very shallow, shallow, or deep soils located on nearly level to steep slopes. Two of these soil types are found on gently sloping to steep slopes, and include Potter soils which are found on uplands and Berda soils which are generally found on foot slopes. Slopes of areas containing these soils are generally found to be 1 to 45 percent. Bippus soils are found on nearly level areas (less than 1 percent slopes) on frequently flooded bottom lands, and should include any wetland areas in the reservoir sites. However, with respect to wildlife habitat potential, the Soil Survey Report rates Bippus soils *very poor* in their capabilities to support wetland plants and shallow water habitats because of periodic drying.

A.3 Protected Species

Plant and animal species listed by U.S. Fish and Wildlife Service (USFWS) and the TPWD as endangered or threatened with potential habitat in Lubbock County are listed in Table 1.

There are three species listed as federally endangered within Lubbock County, the whooping crane (*Gus Americana*), black-footed ferret (*Mustela nigripes*), and gray wolf (*Canis lupus*). The whooping crane and gray wolf are also listed as endangered by the State. In addition there are three threatened species which are state-listed within the county, the American peregrine falcon (*Falco peregrinus anatum*), bald eagle (*Haliaeetus leucocephalus*), and Texas horned lizard (*Phrynosoma cornutum*). Information available from the TPWD Natural Diversity Database indicates that the swift fox (*Vulpes velox*) and cylinder spikesedge (*Eleocharis cylindrica*), both species of interest but without official protection, have been reported in the vicinity of the proposed reservoir.

The whooping crane, American peregrine falcon, and bald eagle are potential migrants to Lubbock County which may use habitats in the area during migration. The black-footed ferret and gray wolf are both considered extirpated within the State. The black-footed ferret was historically found in areas occupied by prairie dogs, usually dry, flat short grasslands including land overgrazed by cattle. The Texas horned lizard generally prefers open, arid areas with sparse vegetation and might be found within the mixed rangeland portions of the proposed project area.

The presence or absence of potential habitat does not confirm the presence or absence of a listed species. Surveys for protected species should be conducted within the proposed construction corridors where preliminary evidence indicates their existence. No species specific surveys were conducted in the project area for this literature review.

A.4 Fishes

HDR personnel reviewed the existing literature sources available for the Upper Brazos River Basin in an attempt to find information relevant to the fishery resources of the Double Mountain Fork Brazos River watershed upstream of its confluence with the Salt Fork Brazos

Table 1.
Threatened, Endangered and Rare Species of Lubbock County, Texas

Species Name		***Occurrence in County***	***Federal Status***	***State Status***
BIRDS				
Peregrine Falcon **(*Falco peregrinus*)**	**American Peregrine Falcon** **(*Falco peregrinus anatum*)**	Year round resident and local breeder in west Texas.	DL	T
	Arctic Peregrine Falcon **(*Falco peregrinus tundrius*)**	Potential migrant.	DL	---
Baird's Sparrow **(*Ammodramus bairdii*)**		Found in shortgrass prairie with scattered low bushes and matted vegetation.	---	---
Bald Eagle **(*Haliaeetus leucocephalus*)**		Found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts in winter.	DL	T
Ferruginous Hawk **(*Buteo regalis*)**		Lives in open country, primarily prairies, plains, and badlands; nests in tall trees along streams or on steep slopes, cliff ledges, river-cut banks, hillsides, power line towers.	---	---
Mountain Plover **(*Charadrius montanus*)**		Breeding species: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous.	---	---
Prairie Falcon **(*Falco mexicanus*)**		Found in open, mountainous areas, plains and prairie, nesting on cliffs**.**	---	---
Snowy Plover **(*Charadrius alexandrinus*)**		Formerly an uncommon breeder in the Panhandle; potential migrant.	---	---
Western Burrowing Owl **(*Athene cunicularia hypugaea*)**		Open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows and man-made structures.	---	---
Western Snowy Plover **(*Charadrius alexandrines nivosus*)**		Uncommon breeder in the Panhandle; potential migrant which winters along the coast.	---	---
Whooping Crane **(*Grus americana*)**		Potential migrant; winters in and around Aransas National Wildlife Refuge and migrates to Canada for breeding.	LE	E

Table 1.
Threatened, Endangered and Rare Species of Lubbock County, Texas (Concluded)

Species Name	*Occurrence in County*	*Federal Status*	*State Status*
MAMMALS			
Big Free-tailed Bat **(*Nyctinomops macrotis*)**	Prefers to roost in crevices and cracks in high canyon walls, but will use buildings. May hibernate in the Trans-Pecos.	---	---
Black-footed Ferret **(*Mustela nigripes*)**	Extirpated in Texas; former inhabitant of prairie dog towns in the general area.	LE	---
Black-tailed Prairie Dog **(*Cynomys ludovicianus*)**	Prefers dry, flat, short grasslands with low, relatively sparse vegetation, including areas overgrazed by cattle; lives in large family groups.	---	---
Cave Myotis Bat **(*Myotis velifer*)**	Roosts colonially in caves, rock crevices, old buildings, carports, under bridges, nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum caves of Panhandle during winter; opportunistic insectivore.	---	---
Gray Wolf **(*Canis lupus*)**	Extirpated; formerly known throughout the western two-thirds of the state.	LE	E
Pale Townsend's big-eared bat **(*Corynorhinus townsendii pallescens*)**	Roosts in caves, abandoned mine tunnels and old buildings, hibernates in groups during winter.	---	---
Plains Spotted Skunk **(*Spilogale putorius interrupta*)**	Catholic in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie.	---	---
Swift Fox **(*Vulpes velox*)**	Restricted to current and historic shortgrass prairie; western and northern portions of Panhandle.	---	---
REPTILES			
Texas Horned Lizard **(*Phrynosoma cornutum*)**	Open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky.	---	T

Status Key: LE Federal Endangered LT Federal Threatened DL Federal Delisted C Federal Candidate Species
E State Endangered T State Threatened -- Rare, but with no regulatory listing status
Lubbock County Species List revised by TPWD 6/25/2009.

River. HDR searched the TPWD, the Texas Commission on Environmental Quality (TCEQ), and Texas Water Development Board (TWDB) websites for sources of data or reports pertinent to the fisheries of the upper Brazos River with emphasis on the distribution and relative abundance of smalleye shiner (*Notropis buccula*) and sharpnose shiner (*Notropis oxyrhynchus*) populations in the North Fork Double Mountain Fork Brazos River. These two fish species, both endemic and once present throughout the Brazos River Basin and now apparently restricted to the upper Brazos River watershed above Possum Kingdom Reservoir, are candidates for federal listing.

The University of Texas at Austin and the Texas Tech University at Lubbock library systems were utilized to review all available publications of *Copeia*, *Texas Journal of Science*, *Southwestern Naturalist*, *Transactions of the American Fisheries Society*, *Ecology* and *Hydrobiologica*. While there is considerable information already available for the Salt Fork Brazos River and Double Mountain Fork Brazos River watersheds, very little information regarding fish assemblages is available for the North Fork Double Mountain Fork Brazos River drainage downstream of Buffalo Springs Lake, and no recognized pre- and post-impoundment fisheries information is available for the length of river upstream of this reservoir (Wilde, 2009; Munger, 2009).

A.4.1 Sampling Program Recommendations[1]

A.4.1.1 Characterization of Water Quality

The North Fork Double Mountain Fork Brazos River is considered perennial from its confluence with the Double Mountain Fork Brazos River in Kent County to the dam impounding Lake Ransom Canyon, approximately 100 river miles upstream. The majority of base flow to the North Fork Double Mountain Fork Brazos River includes runoff from natural rainfall, which is generally infrequent and irregular in this area, releases of cooling water from the municipal power plant, springs associated with the irrigation of adjoining farm lands, effluent from the main Lubbock Sewer Treatment Plant, and runoff from the City's storm sewer system. Although

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[1] Due to parallel project task timelines, some of the sampling programs recommended in this document will have already commenced or be completed at the time of publication, i.e. Texas horned lizard survey.

the North Fork is considered perennial, flow periodically ceases, and its perennial surface waters are confined to isolated pools.

Currently, stormwater from the City of Lubbock and groundwater pumped from underneath the Lubbock Land Application Site is discharged into a series of six impoundments located upstream of the proposed Lake 7. The quantity and quality of water received by Lake 7 would be dependant on direct discharges from these upper lakes and overland surface runoff from upstream areas. The principal function of the proposed Lake 7 will be to store and reuse reclaimed water and stormwater, and to provide additional recreation opportunities. In addition, it has been proposed that all the wastewater treatment plant output that is not needed to satisfy the upper lakes and associated demands be released into Lake 7.

A review of USGS and other records was conducted in an attempt to locate continuous recording streamflow gages within or nearby the vicinity of the proposed Lake 7 study area. No active streamflow gauge stations are located on the North Fork Double Mountain Fork Brazos River (USGS, 2009)[2]. The nearest active USGS stream gauging station for the Brazos River watershed is No. 08080500 on the Double Mountain Fork Brazos River located downstream of the U.S. Highway 83 (US 83) bridge, 10 miles from Aspermont in Stonewall County. The drainage area for this station is 8,796 square miles.

Overall water quality in the Brazos River Basin is relatively good. Elevated bacteria levels are the most common problem, which is generally caused by several factors such as wastewater treatment plants, agricultural and urban runoff, and animal feeding operations (TCEQ, 2009; BRA, 2007). Elevated levels of nitrogen, phosphorus, nutrients, total dissolved solids, chloride, and sulfate are found in many locations within the basin. High nutrient levels combined with high TDS have been identified as a potential causative factor of golden algal blooms which result in low DO levels and release of toxins detrimental to several fish species. Golden algal blooms have been linked to large fish kills within this area in the past (BRA, 2007; TPWD, 2005).

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[2] The USGS operated a stream gage at Lubbock (North Fork Double Mountain Fork Brazos River, at Lubbock, Tx, 08079500) from 1939 to 1949 and a second stream gage downstream (North Fork Double Mountain Fork Brazos River near Post, TX, 08079575) from 1983-1993.

The 2008 Texas Water Quality Inventory and 303(d) List promulgated by TCEQ (2008) identifies water bodies that do not meet, or are not expected to meet, applicable water quality standards. The TCEQ identifies surface water quality standards and appropriate water uses for each classified river segment in Texas. The following information, based on the most recent seven years of data, provides an assessment of water quality results in the TCEQ-defined Segment 1241 of the Brazos River Basin (Double Mountain Fork Brazos River). Segment 1241 extends from the confluence with the Salt Fork Brazos River in Stonewall County to the confluence of the North Fork Double Mountain Fork Brazos. Data analyses continue to show elevated levels of chlorides, as the geologic formations that underlie this watershed contain a very high salt content. Based on long-term data collections, the TCEQ is currently proposing to the EPA an increase of the chloride default criteria value from the current 2,500 mg/L to 3,270 mg/L. It is anticipated that this segment will be removed from the 2010 303(d) list for chloride impairment upon EPA approval of this increase (BRA, 2007).

Relevant to the study area, the area of land drained by the length of the North Fork Double Mountain Fork Brazos River is considered to be an unclassified stream assigned to Sub-Segment 1241A. This watershed is predominantly undeveloped, flowing southeasterly through an area containing primarily agricultural farming and rangeland for cattle. This sub-segment is listed for not supporting its water quality standard for *E. coli* and has concern for ammonia, nitrate and chlorophyll a. Potential sources of bacteria and nutrients within this watershed include stormwater runoff from urban and suburban areas, wildlife and livestock wastes and municipal discharges (BRA, 2007).

Surface water quality monitoring is currently being conducted by the TCEQ Regions 2 and 3 staff at six locations in Segment 1241. Water monitoring, data collection and analysis on Segment 1241 of the Brazos River are being conducted near the study area on the North Fork at Farm-to-Market Road (FM) 835 immediately downstream of the proposed dam (TCEQ Station 11534) and Buffalo Springs Lake (TCEQ Station 11529). Two locations on the North Fork downstream of Buffalo Springs Lake near Slaton at State Highway (SH) 400 (TCEQ Station 11527) and SH 207 north of Post (TCEQ Station 11525). Two additional stations, Double Mountain Fork at US 83 south of Aspermont (TCEQ Station 12029) and Lake Alan Henry (TCEQ Station 18414), are being monitored during Fiscal Year 2010 (TCEQ, 2009).

There are no Ecologically Significant River and Stream Segments, either nominated by TPWD or by the Llano Estacado Regional Water Planning Group (TWDB, 2007) or designated by the Texas Legislature near the proposed project.

A.4.1.2 Characterization of the Fish Community

A total of 24 community fishing lakes are found in Lubbock County (TPWD, 2009). Community fishing lakes as defined by the TPWD are public impoundments 75 acres or less found completely within a city limits, public or state park. Six of these 24 small impoundments are found in the upper reaches of the North Fork Double Mountain Fork Brazos River canyon upstream of the proposed Lake 7, and two much larger lake systems, Buffalo Springs Lake and Lake Ransom Canyon exist downstream of the proposed Lake 7. These six community lakes comprise the core of an extensive urban park system, known as the Jim Bertram Lake System, where boating and fishing are permitted. The TPWD manages the fisheries through the stocking of largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*) and rainbow trout (*Oncorhynchus mykiss*). Buffalo Springs Lake and Lake Ransom Canyon are regional recreational centers which appear to be maintaining stable fisheries, however, a significant fish kill caused by blooms of golden algae (*Prymnesium parvum*) during 2003 and a smaller kill event in 2005 have had an impact on the reservoir fishery (TPWD, 2005). Important sport fish include largemouth bass, channel catfish, sunfish (*Lepomis* spp.), white crappie (*Pomoxis annularis*), white bass (*Morone chrysops*), and striped bass (*Morone saxatilis*).

The fish assemblages in the North Fork Double Mountain Fork Brazos River have been most recently sampled at three locations in Garza County by TPWD during a 1988-1992 study (Moss and Mayes, 1993). Wilde and Ostrand (1999) collected fish from the Double Mountain Fork above Alan Henry Reservoir, impounded in 1993 approximately six miles upstream of its confluence with the North Fork Double Mountain Fork Brazos River. The list of fish species present in the upper Brazos River drainage (i.e., the Salt and Double Mountain Forks) shown in Table 2 consists of relatively few species that tend to be typical of the relatively harsh environments of prairie streams. Prairie streams tend to exhibit wide ranges in temperature, dissolved oxygen and dissolved solids (salinity), and their typical fish assemblages tend to be

Table 2
Fish Species Reported from the Upper Brazos River Drainage

Scientific Name	*Common Name*	*TPWD*[1]
Lepisosteus oculatus	Spotted gar	
Lepisosteus osseus	Longnose gar	
Dorosoma cepedianum	Gizzard shad	
Campostoma anomalum	Central stoneroller	
Cyprinella lutrensis	Red shiner	✓
Cyprinella venusta	Blacktail shiner	
Cyprinus carpio	Common carp	
Hybognathus placitus	Plains minnow	✓
Macrhybopsis aestivalis	Speckled chub	✓
Notropis buccula	Smalleye shiner	✓
Notropis oxyrhynchus	Sharpnose shiner	✓
Phenocobius mirabilis	Suckermouth minnow	
Pimephales vigilax	Bullhead minnow	
Carpiodes carpio	River carpsucker	
Ictalurus punctatus	Channel catfish	
Fundulus zebrinus	Plains killifish	✓
Cyprinodon rubrofluviatilis	Red River pupfish	
Gambusia affinis	Western mosquitofish	✓
Menidia beryllina	Inland silverside	
Morone chrysops	White bass	
Lepomis gulosus	Warmouth	
Lepomis macrochirus	Bluegill	
Lepomis megalotis	Longear sunfish	
Lepomis microlophus	Redear sunfish	
Micropterus punctulatus	Spotted bas	
Micropterus salmoides	Largemouth bass	
Pomoxis annularis	White crappie	
Pomoxis nigromaculatus	Black crappie	
Percina sciera	Dusky darter	
Aplodinotus grunniens	Freshwater drum	

[1] Collected by seine in the North Fork Double Mountain Fork Brazos River by Moss and Mayes (1993)

dominated by species with tolerance for wide ranges of physical and chemical conditions that fluctuate widely (Mathews, 1987). This is particularly the case in headwater areas like the North Fork Double Mountain Fork Brazos River, where flow may cease seasonally and aquatic habitats are restricted to isolated pools. These same species tend to be poor competitors in less stressed environments, especially with regard to dissolved solids concentrations, and are thought to be limited in their downstream distributions by the presence of species populations less tolerant of high salinities.

Alan Henry Reservoir was constructed on the Double Mountain Fork as a water supply source for the City of Lubbock. Ostrand and Wilde (2001) reported that the fish assemblage in the river reach upstream of this impoundment had changed substantially, presumably in response to construction of the dam and reservoir. A subsequent physiology study of the dominant species in that assemblage indicated that those changes are most likely the result of an inability of cyprinid species to repopulate the river above Alan Henry Reservoir following episodes of intermittency when aquatic habitats are reduced to isolated pools. The plains minnow (*Hybognathus placitus*), smalleye shiner and the sharpnose shiner, whose populations were greatly reduced in the late 1990s in the Double Mountain Fork Brazos River, were found to be eliminated from pool habitats by increasing salinities as evaporation proceeded, but that the dominant cyprinodontids, Red River pupfish (*Cyprinodon rubrofluviatilis*) and plains killifish (*Fundulus zebrinus*), were sufficiently tolerant of high salinities to survive in isolated pools until streamflow resumed. Conversely, the cyprinids were not able to repopulate the river when flowing conditions resumed because of the migratory barrier imposed by Alan Henry Reservoir (Wilde and Ostrand, 1999).

Some fish species migrate to survive, having the natural ability to move across various aquatic ecosystems without bottlenecks or barriers. This trait is vital to the maintenance of a healthy and stable population of these species. The term potomodromus refers to those fish species that migrate entirely within freshwater searching for food and spawning grounds. The North Fork is in the geographic range of historical distribution and potential fish habitat for the smalleye and sharpnose shiners, species which have been proposed for listing, however, neither species has been reported to occur within Lubbock County. Both of these species require fairly shallow water in broad, open sandy channels with moderate current. Since no pre-impoundment fisheries information exists for the North Fork it is unknown if the two species inhabited the upper limits of this river prior to construction of Buffalo Springs Lake and Lake Ransom Canyon. The effects of on-channel river impoundment have created a migration barrier for these two shiners and function as major obstacles to their migration routes. Therefore, the North

Fork upstream of the two physical barriers could essentially be considered functionally fragmented from the existing downstream smalleye and sharpnose shiner populations.

A.4.1.3 Sampling Procedures

Based on an analysis of the available literature and historical datasets, a detailed work plan has been developed to establish a monitoring framework involving four sampling locations with a detailed methodology for sampling and analytical measurement in a manner consistent with well-established regulatory protocols for both physical/chemical measurements and bioassessment of aquatic systems (Attachment A1).

A.5 Mussels

Freshwater mussels (Family Unionidae) are members of one of several families of freshwater bivalve mollusks that occur in fresh waters, with over 50 species reported in Texas (Howells et al., 1996). They are important elements of aquatic ecosystems where they may be the major biomass component of some waters (Negus, 1966), contribute to nutrient storage and release (Nedeau et al., undated), impact water quality by their water-filtering activities (Strayer et al., 1999, 2004; Nedeau et al., 2000; Lyons et al., 2007), contribute to substrate turn-over, support numerous associated commensal and parasitic organisms, and provide a forage base for other mollusk-eating predators (Howells et al., 1996).

Freshwater mussels are sensitive barometers of environmental quality. When terrestrial or aquatic ecological conditions degrade or are modified, unionid mussels are often the first organisms to decline or vanish. Subsequently, unionids are the most rapidly declining faunal group in North America (Bogan, 1996; Strayer et al., 2004), with estimates of 50-80% of the U.S. species being extinct, endangered, threatened, or that will be very soon. Among the approximately 300 North American species, 25% have already been federally listed as threatened or endangered, with another 50% considered species of special concern (Williams et al., 1993; Williams et al., 2008).

As a result of the catastrophic declines in freshwater mussel assemblages seen throughout North America, including Texas, potential influences on their continued secure survival have become subject to greater attention in recent decades. Dam and bridge building activities, water management practices, and general construction projects may need to evaluate their impacts, if any, on local mussel populations. Although some such activities may have significant impacts on unionid survival, others may have little or no influence, and still others may occur in areas where mussel populations have already declined.

In Texas, Howells (2009a) listed conservation status concerns for 27 Texas species (about half of the total number of species reported from Texas waters). On 5 November 2009, the Texas Parks and Wildlife Commission adopted an amendment to Chapter 57, Subchapter B, 31TAC §57.157 of the *Texas Register*, concerning Mussels and Clams, without changes to the proposed text as published in the 2 October 2009 issue (Texas Register, 2010). This amendment added a total of 15 freshwater mussel species known to occur in Texas waters to the State list of threatened species: false spike (*Quadrula mitchelli*), golden orb (*Quadrula aurea), Louisiana pigtoe (Pleurobema ridellii), Mexican fawnsfoot (Truncilla cognate), Salina mucket (Potamilus metnecktayi), sandbank pocketbook (Lampsilis satura), smooth pimpleback (Quadrula houstonensis), southern hickorynut (Obovaria jacksoniana), Texas fatmucket (Lampsilis bracteata), Texas fawnsfoot (Truncilla macrodon), Texas heelsplitter (Potamilus amphichaenus), Texas hornshell (Popenaias popeii), Texas pigtoe (Fusconaia askewi), Texas pimpleback (Quadrula petrina), and triangle pigtoe (Fusconaia lananensis).* However, none of these now protected species *has been added to the TPWD's Annotated County Lists of Rare Species for Lubbock County, Texas (TPWD, 2010).*

Thus, no threatened or endangered unionid mussel species (listed or proposed for listing) are known to occur in the Panhandle Plains Region, and none would be expected to occur (Howells, 2009b).

A.5.1 Sampling Program Recommendations

A.5.1.1 Characterization of the Mussel Community

Mr. Bob Howells, a recognized expert on freshwater mussels in Texas, was consulted concerning the Lake 7 project after a review of existing freshwater mussel data determined that no freshwater mussel survey activities had occurred within the project study area prior to HDR efforts initiated in 2009. Among the various mussel studies and collections made in Texas, relatively few have focused on the Brazos River and none were directed specifically at the North Fork Double Mountain Fork Brazos River. Only very limited freshwater mussel surveys had been conducted in the North Fork Double Mountain Fork Brazos River watershed (Howells, 2009b). Shallow water examinations were conducted on 20 April 1999 at two locations on Buffalo Springs Lake but no bivalves were present (Howells, 2000). Cursory inspections of three Lubbock community lakes by Howells also failed to produce any freshwater mussels (including no invasive Asian clams (*Corbicula* spp.). Mussel diversity and abundance is expected to be low in this region due to the lack of appreciable amounts of permanent water.

Many of the mussel species expected to inhabit the waters of this area tend to be habitat generalists which can survive in a wide variety of habitats. These species may include the giant floater (*Pyganodon grandis*), paper pondshell (*Utterbackia imbecillis*), lilliputs (*Toxolasma* spp.), and pondhorns (*Uniomerus* spp.).

No live freshwater mussels, recent or older shell was observed in the study area during the various studies conducted within the study area boundary.

A.5.1.2 Sampling Procedures

Based on the absence of living mussels or Asian clams during the initial reconnaissance and several subsequent surveys of the study area, no labor-intensive, quantitative mussel sampling program in the Lake 7 project area appears necessary at this time. It is suggested that the presence of mussels in the study area should continue to be monitored during ongoing ecological, chemical, and engineering work on a qualitative basis as these other field efforts are conducted. Mussel sampling protocols can be reevaluated if confirmations of dense or diverse mussel assemblages or rare species are actually located within the study area.

A.6 Reptiles

The Texas horned lizard (*Phrynosoma cornutum*) is classified as Threatened by the TPWD and is the only reptile within the proposed Lake 7 reservoir boundary that is listed as state or federally threatened, endangered, or as a species of conservation concern. Horned lizards (Genus: *Phrynosoma*) occur only in the arid grasslands and deserts of central and western North America (Pianka and Parker, 1975) and current taxonomy recognizes nine separate species (Collins and Taggart, 2009). Three species of horned lizards occur within the state of Texas; these include the mountain short-horned lizard (*P. hernandesi*), roundtail horned lizard (*P. modestum*), and the Texas horned lizard (Conant and Collins, 1998). Of those horned lizards that occur in Texas, both the roundtail horned lizard and the Texas horned lizard inhabit Lubbock County and may occur within the Lake 7 project area.

Historically, Texas horned lizards were considered to be common and abundant across the state of Texas, with exception to far eastern Texas (Henke, 2003). Today, however, due to widespread population declines Texas horned lizards have been eliminated from the eastern third of the state, and only small isolated populations exist east of an imaginary line extending from Fort Worth south to Corpus Christi, Texas (Donaldson et al., 1994). Several potential factors have been attributed to the decline of Texas horned lizards across the state; the most common being conversion of natural habitats to agricultural lands, urbanization, widespread pesticide use, commercial exploitation for the pet trade, and the introduction and spread of the red imported fire ant (*Solenopsis invicta*) (Bigony, 1981; Donaldson et al., 1994; Henke and Fair, 1998).

While Texas horned lizards occur in a variety of habitats including shortgrass prairie, mesquite grasslands, shrublands, desert scrub, and desert grasslands (Price, 1990; Donaldson et al., 1994), they typically inhabit relatively flat, open areas lacking dense ground vegetation (Whiting et al., 1993; Fair and Henke, 1998; Henke and Fair, 1998; Endriss, 2006). Texas horned lizards can be found at elevations from sea level to approximately 6,000 feet (Conant and Collins, 1998) on a variety of soil types (Price, 1990); however, Texas horned lizards prefer soils that facilitate easy excavation such as sandy loams and loamy sands (Fair, 1995). Preferred habitats also support an ample population of ants, particularly harvester ants (Genus: *Pogonomyrmex*). While harvester ants make up the main component of the Texas horned lizard’s diet (Pianka and Parker, 1975), these lizards will also feed on other small arthropods (Milne and Milne, 1950). Generally, Texas horned lizards are active from early spring through mid to late fall (Fair, 1995; Henry, 2009). During winter months Texas horned lizards bury into the soil to hibernate (Potter and Glass, 1931). Furthermore, during the active season the daily activity patterns of Texas horned lizards vary depending on ambient air temperatures (Henke and Fair, 1998). During the cooler periods of spring and fall Texas horned lizards exhibit a unimodal activity pattern, that is, lizards remain active throughout the day. During the warmer months of summer activity patterns of Texas horned lizards are bimodal, with peaks of activity occurring in mid-morning and late afternoon (Montgomery and MacKessey, 2003). Finally, Texas horned lizards begin breeding from shortly after emerging in the spring until summer (Milne and Milne, 1950). Gravid females will excavate small nest chambers, deposit an average of 17–29 eggs in multiple layers (Ballinger, 1974; Endriss et al., 2007), and refill the hole before leaving the site (Sherbrook, 2003). Hatchlings emerge at the end of summer (Montgomery and MacKessy, 2003; Endriss et al., 2007).

A.6.1 Sampling Program Recommendations

A.6.1.1 Characterization of Texas Horned Lizard Habitat

Prior to conducting on-site surveys for Texas horned lizards, current aerial photography should be examined and potentially suitable Texas horned lizard habitat delineated based on the presence of favorable Texas horned lizard habitat characteristics (i.e., flat open areas with sparse vegetation). Ground-truthing of delineated habitat within the project area should be conducted to confirm the presence of suitable habitat prior to conducting field surveys for Texas horned lizards.

A.6.1.2 Sampling Procedures

To identify the presence/absence of Texas horned lizards within the proposed Lake 7 reservoir, surveys for this state threatened lizard should follow the methodology described by Henke and Fair (1998). Surveys should be conducted during the mid-morning hours between May 1 and September 1 on clear days when temperatures are above 75°F. Surveys should consist of walking transects along and adjacent to dirt roads identified to bisect potentially suitable Texas horned lizard habitat and visually searching the ground and vegetative cover for lizards, their scat (i.e., fecal pellets), harvester ant mounds, and fire ant beds.

A.7 Vegetation

The project area lies in the Llano Estacado portion of the High Plains ecological region. This ecological region was historically shortgrass prairie composed primarily of buffalograss (*Buchloe dactyloides*), blue grama (*Bouteloua gracilis*), sideoats grama (*Bouteloua curtipendula*), and little bluestem (*Schizachyrium scoparium*). However, approximately 97% of this ecological region has been tilled for agriculture (Griffith et al., 2004).

As previously mentioned, the project area lies within the High Plains vegetational area (Hatch et al. 1990). The High Plains is part of the southern Great Plains and is separated from the Rolling Plains by the Llano Estacado Escarpment and dissected by the Canadian River Breaks in the northern part. This relatively level plateau contains many shallow depressions, or playa lakes, which can support unique vegetation communities. Upland soils consist of clay and clay loams in the north to sandy loams and sands in the south. Caliche is also a common component of many soils found within this area.

The original vegetation of the High Plains could be classified as mixed prairie, shortgrass prairie, and on the deep, sandy soils as tallgrass prairie. Blue grama, buffalograss, and galleta (*Hilaria jamesii*) are the principal vegetation on the clay and clay loam sites, whereas sandy loam sites contain little bluestem, western wheatgrass (*Elytrigia smithii*), sideoats grama, and sand dropseed (*Sporobolus cryptandrus*). Shinnery oak (*Quercus harvardii*) and sand sagebrush (*Artemsia filifolia*) are confined to the sandy soil types along with several species of dropseeds (*Sporobolus* spp.). Although the High Plains are characteristically free of trees or brush, mesquite (*Prosopis glandulosa*), sand sagebrush, pricklypear (*Opuntia* spp.), and yucca (*Yucca* spp.) have invaded the sandy loam sites. The playa lakes can support aquatic species such as curltop smartweed (*Polygonum lapathifolim*). Common forbs include slimleaf scurfpea (*Psoralea tenuiflora*), prairie coneflower (*Ratibida columnifera*), croton (*Croton* sp.), fineleaf woollywhite (*Hymenopappus filifolius* var. *cinereus*), woolly loco (*Astragalus mollissimus* var. *mollissimus*), plains beebalm (*Monarda pectinata*), and tallowweed (*Plantago patagonia*).

Cotton, corn, sorghum, wheat, vegetables, and sugar beets are major crops produced in the High Plains vegetational area where 60% of the area is used as cropland. Winter cereals support the prevalent feedlot operations in the region. The remaining 40% of the area is used for livestock grazing.

The Vegetation Types of Texas, Including Cropland (McMahan et al., 1984), describes the vegetation types that occur within the study area as mesquite-lotebush brush and crops. The mesquite-lotebush brush vegetation type is located primarily in the uplands of the northwestern Edwards Plateau, northeastern Trans-Pecos east of the Pecos River, Rolling Plains, and western Cross Timbers and Prairies. Commonly associated plants in this community type include mesquite, lotebush (*Zizyphus obtusifolia*), yucca, skunkbush sumac (*Rhus aromatica* var. *flabelliformis*), agarito (*Mahonia trifoliolata*), elbowbush (*Forestiera pubescens*), juniper (*Juniperus* spp.), tasajillo (*Opuntia leptocaulis*), cane bluestem (*Bothriochloa barbinodis* var. *barbinodis*), silver bluestem (*Bothriochloa laguroides*), little bluestem, sand dropseed, Texas grama (*Bouteloua rigidiseta*), sideoats grama, hairy grama (*Bouteloua hirsuta*), red grama (*Bouteloua trifida*), tobosa (*Hilaria mutica*), buffalograss, Texas wintergrass (*Stipa leucotricha*), purple three-awn (*Aristida purpurea*), Engelmann daisy (*Engelmannia pinnatifida*), broom snakeweed (*Gutierrezia sarothrae*), and bitterweed (*Hymenoxys odorata*) (McMahan et al., 1984). The crops vegetation type occurs statewide and consists of cultivated cover crops or row crops that provide food and/or fiber for either man or domestic animals. This type may also portray grassland associated with crop rotations.

No federal or state threatened or endangered plants are listed for Lubbock County based on lists from TPWD (TPWD, 2009b) and USFWS (USFWS, 2009).

A.7.1 Sampling Program Recommendations

Various sampling methods can be utilized to characterize the vegetation communities in the study area. Since no protected species are anticipated to occur in the study area, the vegetation sampling plan should focus on describing the species composition and structure of the vegetation communities and where these communities are located within the study area. Since it is a generally acknowledged concept that the vegetation community determines the suitability of an area as wildlife habitat, the sampling program should include a method that incorporates this concept so that baseline wildlife habitat conditions can be characterized as well as vegetation communities.

The recommended method of sampling and data collection for the study area is the Wildlife Habitat Appraisal Procedure (WHAP) developed by the TPWD (Frye, 1995). This method would provide a holistic evaluation of the study area without excessive expense in field time or data compilation. The advantages of using the WHAP methodology include documentation of baseline vegetation and habitat conditions prior to anticipated or proposed changes, ability to evaluate impacts on vegetation and habitat from development alternatives, and comparing tracts of land.

A.7.1.1 Characterization of the Vegetation Community

Prior to initiating vegetation data collection, a review of the most current aerial photographs would be conducted to delineate preliminary cover types in the study area. A field reconnaissance of the study area would then be conducted to confirm and refine the mapped cover types. During the field reconnaissance, potential sampling points within each cover type would be identified based on the perceived representative character of the site and accessibility.

A.7.1.2 Sampling Procedures

For the purposes of this study, the baseline data collected with this methodology would be limited to the Biological Habitat Components Evaluation section of the WHAP. The

Significance of Protected Flora and Fauna evaluation component in the WHAP procedure does not require field data collection, but rather an evaluation of a species distributional range and potential for occurrence in an area. The Management Components Evaluation in WHAP is not applicable to this study because the land in the study area is privately owned and not subject to management decisions by the TPWD.

The WHAP procedure requires the assigning of value scores for several biological components including: (1) site potential, (2) temporal development of the existing successional stage, (3) uniqueness and relative abundance, (4) vegetation species diversity, (5) vertical vegetation structure, (6) other structural diversity components, and (7) condition/health of the vegetation. These components would be scored in the field.

The collection of vegetation species composition (diversity) would be done with circular sampling plots with an 80-foot radius, yielding an approximate 0.5-acre plot. All sapling, shrub, and tree species within the sampling plot would be recorded. Herbaceous species within a nested 1 m^2 plot would also be recorded. In addition to the recording of species present, absolute cover of vegetation would also be recorded.

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Attachment A1

Proposed Work Plan

Aquatic Life Monitoring

Attachment A1

Proposed Work Plan

Proposed Lake 7 Reservoir Project Site

Aquatic Life Monitoring

Water Chemistry, Habitat Evaluation, and Biological Collection

North Fork Double Mountain Fork Brazos River

Prepared for:

city of lubbock
TEXAS

Prepared by:

HDR | ONE COMPANY
*Many Solutions*SM

November 2009

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A1.1 Introduction

A fisheries data review and literature search was conducted by HDR Engineering, Inc. (HDR) in September, October, and November 2009 to document the existing fish assemblages of the upper Brazos River including the North Fork Double Mountain Fork Brazos River based on distribution records from available sources. Additionally, this task was undertaken to identify current and recent research regarding population distribution and life history research being conducted for the sharpnose shiner (*Notropis buccula*) and the smalleye shiner (*Notropis oxyrhynchus*), whose current geographic range includes the North Fork Double Mountain Fork Brazos River watershed in Garza County (Moss and Mayes, 1993). To facilitate recognition of potential habitat for the shiner species in the North Fork, a one-day field reconnaissance was conducted at two locations of known shiner habitat on the North Fork Double Mountain Fork and one location on the Double Mountain Fork Brazos River on 25 June 2009 (Supplement 1).

A field reconnaissance was conducted by HDR aquatics staff during 22-25 June 2009 to document existing environmental conditions on the North Fork Double Mountain Fork Brazos River. Several properties with river frontage extending downstream from FM 835 east of Loop 289 to FM 835 north of FM 3020 near at the upper end of Buffalo Springs Lake were inspected during the morning excursion. Specific information was gathered by each crew member to develop work plans for future data surveys, interpretation, ecological value assessments, and mitigation planning. Also, the information will be used to plan for documentation of watershed activities, land use, and disturbances found along the riparian corridor. Specifically, the aquatic biologists collected the following types of information to allow formulation of a sampling and monitoring plan:

- Photo documentation;
- Global-positioning system (GPS) coordinate data;
- Potential habitat for the Texas horned lizard;
- Identification of biological monitoring locations for fish, benthic invertebrates and the Texas horned lizard; and
- Potential habitat for smalleye shiner, sharpnose shiner, and freshwater mussels.

The primary purpose of the aquatic aspect of the field reconnaissance was to identify (1) selection of potential sampling locations for Aquatic Life Monitoring (ALM); (2) determine the feasibility of the use of a backpack electroshocker based on conductivity; (3) potential smalleye and sharpnose shiner habitat; and (4) potential Texas horned lizard habitat.

A1.2 Scope of Work

The sampling program will be consistent with the field data methods and procedural requirements described in the Texas Commission on Environmental Quality (TCEQ) *Surface Water Quality Monitoring (SWQM) Procedures Manual, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue* and *Surface Water Quality Monitoring Procedures Manual, Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data* (TCEQ, 2008; 2007). In accordance with the standardized stream characteristics forms and the SWQM field sampling manual, stream habitat evaluations, flow characteristics, and fish and benthic macroinvertebrate populations will be assessed two times during the calendar year 2009, with one event scheduled during the index period (15 March – 15 October) and one event during the critical period (1 July - 30 September). Standard field parameters and stream flow will be recorded during each sampling event. Fieldwork will be initiated to allow sufficient time for data analyses and report preparation. HDR will be responsible for coordinating, conducting and managing all activities with the field investigations, and preparation of all biological monitoring reports to be submitted to the regulatory agencies in support of necessary permits and approvals.

The field reconnaissance effort was designed to evaluate all aquatic habitat aspects at each of the potential survey locations to improve the efficiency of the sampling efforts on factors expected to constitute a complete habitat and biological assessment. Field collection trips will be scheduled during May through October. Biological monitoring will be conducted under normal flow conditions (e.g. defined by length of time since a significant rainfall event according to TCEQ sampling protocol).

A1.3 Water Quality

Much of the base flow of the North Fork Double Mountain Brazos River presently originates as groundwater pumped from underneath the Lubbock Land Application Site and discharged into a chain of small lakes located upstream of the proposed Lake 7 Reservoir, in addition to wastewater from the Cities of Lubbock and Ransom Canyon discharged downstream of Lake Ransom Canyon. Water quality of the North Fork Double Mountain Brazos River is characterized as having high dissolved solids and conductivity levels. Conductivity levels greater than 800 µS/cm in freshwater is considered high.

Standard stream field parameter measurements, of dissolved oxygen concentration and saturation, pH, conductivity, water temperature, water odor and color will be documented concurrent with the biological collections using a Yellow Springs Instrument (YSI) Model 600XLM Minilogger and Model 650-03 display with high memory and barometer. The data sonde will be calibrated according to the TCEQ and manufacturer's recommendations prior to field use and post-calibrated upon return to the office. Instantaneous stream flow measurements will be obtained with a Marsh-McBirney electronic flow meter during each aquatic life assessment. The field parameters to be sampled and recommended TCEQ methodology for water analysis by constituent are listed in Table A1-1.

Table A1-1.
Water Quality Monitoring Proposed at Four Stations
Lake 7 Reservoir Project
Lubbock County, Texas

PARAMETER	***UNIT***	***METHOD****	***STORET CODE***
FIELD PARAMETERS			
WATER TEMPERATURE	° Celsius	SM 2550 B and TCEQ SOP, V1	00010
DISSOLVED OXYGEN	mg/L	SM 4500-O G and TCEQ SOP, V1	00300
CONDUCTIVITY	uS/cm	EPA 120.1 and TCEQ SOP, V1	00094
pH	Standard Units	EPA 150.1 and TCEQ SOP, V1	00400
SECCHI DEPTH	Meters	TCEQ SOP, V1	00078
TOTAL WATER DEPTH	Meters	TCEQ SOP, V2	82903
FLOW	cfs	TCEQ SOP, V1	00061
FLOW SEVERITY	**	TCEQ SOP, V1	01351
DAYS SINCE LAST RAINFALL	days	TCEQ SOP, V1	72053

*TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue. 2008 (RG-415). TCEQ SOP, V2 - TCEQ Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data, 2007 (RG-416).

**1-no flow; 2-low 3-normal; 4-flood 5-high; 6-dry

Turbidity will be measured using a 20-cm diameter black-and-white Secchi disc. The disc will be lowered into the water column on a cable or rope, and the greatest depth (cm) at which the disc can be observed will be recorded.

A1.4 Instantaneous Flow Measurement

When feasible, channel cross-section information will be collected from one fixed transect at each of the four locations during each aquatic life use assessment. Hydraulic measurements will include physical stream dimensions of width and depth and the total flow (discharge) will be determined with a Marsh-McBirney electronic flow meter. Instantaneous flow measurements will follow protocol specified in Chapter 3 of the TCEQ SWQM Procedures Manual, Volume 1 (TCEQ, 2008).

A1.5 Physical Habitat Assessment

The riparian vegetation and physical characteristics during each of the two ALM sampling efforts during 2009 will be documented with a series of cross sections and associated habitat evaluations. Using the field information and measurements taken during each survey, general characteristics will be determined and placed into the Physical Characteristics of Water Body data sheets. From these evaluations, a Habitat Quality Index (HQI) will be prepared as described in the Volume 1 of the TCEQ SWQM Procedures Manual, (TCEQ, 2008). The parameters for habitat characterization will include instream cover, habitat type, stream depth and width, pool depths, bank stability, percentage of riparian canopy cover, channel flow status, channel sinuosity, bottom substrate type, and aesthetics of each study reach. A checklist of riparian vegetation including the presence or absence of rooted aquatic vegetation will be recorded during the each biological monitoring event. The percentage of tree canopy will be determined using a concave spherical densiometer. A Suunto clinometer will be used to determine the left and right bank slopes in degrees. The percentage of the dominant riparian vegetation types along the left and right shoreline margins at each transect station will be made by visual estimation. Photographs will be taken for descriptive purposes and each location will be recorded with a global-positioning system (GPS) unit so that these areas, if needed, could be easily and accurately relocated. A comprehensive list of physical habitat parameters is presented in Table A1-2.

Table A1-2.
Stream Physical Habitat Assessment Parameters Proposed at Four Stations
Lake 7 Reservoir Project
Lubbock County, Texas

PARAMETER	***UNIT***	***STORET CODE***
Streambed slope over evaluated reach	N/A	72052
Approximate drainage area above the most downstream transect from USGS map	km^2	89859
Stream order	#	84161
Length of stream	km	89860
Lateral transects made	#	89832
Average stream width	meters	89861
Average stream depth	meters	89862
Instantaneous stream flow	cfs	00061
Flow measurement method	2 = electric	89835
Channel flow status	1 = no flow 2 = low 3 = moderate 4 = weir/flume	
Maximum pool width at time of study	meters	89864
Maximum pool depth in study area	meters	89865
Total stream bends	#	89839
Well-defined stream bends	#	89840
Moderately defined stream bends	#	89841
Poorly defined stream bends	#	89842
Riffles	#	89843
Dominant substrate	1=clay, 2=silt, 3=sand, 4=gravel, 5=cobble, 6=boulder, 7=bedrock, 8=other	89844
Avg. % of substrate gravel > 2 mm	%	89845
Avg. % instream cover	%	84159
Steam Cover Types	#	89929
Avg. % stream bank erosion potential	%	89846
Avg. stream bank angle	degrees	89847
Avg. width natural riparian vegetation	meters	89866
Avg. % trees as riparian vegetation	%	89849
Avg. % shrubs as riparian vegetation	%	89850
Avg. % grasses & forbs as riparian vegetation	%	89851
Avg. % cultivated fields as riparian vegetation	%	89852
Avg. % other as riparian vegetation	%	89853
Avg. % tree canopy coverage	%	89854
Overall Aesthetics	1=wilderness, 2=natural, 3=moderate, 4=offensive	89867
Texas Ecoregion Code	#	89961
Land development impact	1=unimpacted, 2=low, 3=moderate, 4=high	89867

TCEQ SOP, V2 - TCEQ Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data, 2007 (RG-416)

A1.6 Biological Assessment

Macroinvertebrate and fish community integrity will be assessed on two separate occasions using the sample requirement procedures outlined in Volume 2 of the TCEQ SWQM Procedures Manual (TCEQ, 2007) and the TCEQ *Biological Monitoring Fact Sheet* effective on May 17, 2006. A list of TCEQ monitoring parameters for benthic macroinvertebrates and fish are presented in Table A1-3.

A1.6.1 Benthic Macroinvertebrate Community

Concurrent with fish collections, qualitative benthic macroinvertebrate sampling will be conducted at each river location using field methods consistent with the 2007 TCEQ SWQM protocols (TCEQ, 2007). Since stream substrate may vary between bedrock, boulder, cobble, gravel, sand, and silt, no one established method or sampling device can be used for all sampling. When permitted by waterbody characteristics, the preferred methodology will involve kicknet samples from riffle areas, if present, or vegetative areas using a rectangular frame (500 x 500 micron mesh) dip net.

Riffle areas with fast currents and cobble and gravel substrates generally provide the most diverse macroinvertebrate community. Sampling along each stream reach for a minimum of five minutes will be conducted in a “zig-zag” pattern from downstream to upstream through all available microhabitats in order to best represent the longitudinal and cross sectional areas. Dip net samples will be collected by placing the framed net on the streambed facing upstream and using the foot or hand to disturb the bottom substrate allowing dislodged material to flow into the net.

Field processing of the dip net samples will be accomplished by thoroughly washing the sample in the dip net then placing appropriate sample aliquots in a shallow white pan. The sample will be stirred in the pan to disperse the contents as evenly as possible and individual specimens were removed by forceps. This process will be repeated until a minimum of 150 individuals are picked. Organisms will be placed into 70% ethanol and returned to the HDR’s laboratory in Austin, Texas for taxonomic identification and enumeration. Each sample bottle will be labeled using waterproof ink in the field with the field collector initials, station number, date, and time of collection. A chain of custody (COC) inventory form will be kept to ensure precise laboratory sample tracking and integrity.

Table A1-3.
Biological Community Monitoring Parameters Proposed at Four Stations Lake 7 Reservoir Project Lubbock County, Texas

PARAMETER	UNIT	STORET CODE
Biological Data Reporting Units	1=number of individuals from sub-sample; 2=number of individual/ft^2, 3=number of individuals/m^2, 4= total number in kicknet	89899
Kicknet Effort, area kicked	m^2	89903
Kicknet Effort, minutes kicked	minutes	89904
Snags and Shoreline sampling effort, minutes picked	minutes	89905
Number of individuals in benthic RBA sub-sample (±100)	#	89906
Benthic Sampler	1=Surber, 2=Ekman, 3=kicknet, 4=Peterson, 5=Hester-Dendy	89950
Undercut bank at sample point	%	89921
Overhanging brush at sample point	%	89922
Gravel substrate at sample point	%	89923
Sand substrate at sample point	%	89924
Soft bottom at sample point	%	89925
Macrophyte bed at sample point	%	89926
Snags and brush at sample point	%	89927
Bedrock at sample point	%	89928
Benthic Organisms, None Present	%	90005
Mesh Size, any net or sieve, average bar for benthic collection	%	89946
Total Taxa Richness, Benthos	#	90055
EPT Index, Abundance	#	90008
Biotic Index (HBI)	N/A	90007
Chironomidae	%	90062
Dominant Taxon, Benthos	%	90042
Dominant FFG	%	90010
Predators	%	90036
Ratio of Intolrerant: Tolerant taxa	N/A	90050
Total Trichoptera as Hydropsychidae	%	90069
Non-insect taxa	#	90052
Collector - gatherers	%	90025
Total number as Elmidae	%	90054
Nekton, none captured	N/A	98005
Electrofishing effort, duration of shocking*	Seconds	89944

Table A1-3.
Biological Community Monitoring Parameters Proposed at Four Stations
Lake 7 Reservoir Project
Lubbock County, Texas
(Concluded)

PARAMETER	UNIT	STORET CODE
Seining effort	# of hauls	89947
Combined length of hauls	meters	89948
Seining effort duration	minutes	89949
Seine Minimum Mesh Size	inches	89930
Seine Maximum Mesh Size	inches	89931
Net length	meters	89941
Electrofishing method*	backpack	89943
Area seined	M^2	89976
Total number fish species	#	98003
Total darter species	#	98004
Total sunfish (except bass)	#	98008
Total sucker species	#	98009
Total intolerant fish species	%	98010
Tolerant fish species	%	98016
Omnivore individuals, fish	%	98017
Insectivore individuals, fish	%	98021
Piscivore individuals, fish	%	98022
Total individuals, fish	%	98023
Hybrid individuals	%	98024
Individuals w/ disease/anaomalies	%	98030

TCEQ SOP, V2 - TCEQ Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data, 2007 (RG-416).

*Only applies if electrofishing is implemented into the sampling plan

A1.6.2 Fish Community

Fish collection efforts at determined sites will be conducted using the techniques and equipment best suited for sampling that waterbody. The collection of fish usually involves the combination of two collection methods, seine and electrofishing, to obtain a representative fish collection. However, high water conductivities (e.g., 1,000-3,000 uS/cm) cause the use of the backpack electrofishing to become less effective for accurately depicting fish populations

Seining is one of the most common gear types used in all types of aquatic environments. Its use is most effective in open water habitat such as runs or pools and other slow moving water areas with little or no aquatic vegetation over even and or firm substrate. The representative habitats within each reach selected for sampling will be thoroughly sampled and the same level of effort will be expended at each reach location. Between 10 and 12 seine hauls will be taken covering a minimum of 186 square meters ($m^{2)}$ at each stream reach. The number of seine hauls per site will be determined by the field team leader and will continue until all habitats within the site have been sampled if it is determined that conductivity levels are too high (i.e. >800 uS/cm).

If conditions are deemed suitable for electrofishing, the collector carrying a Smith-Root Model LR-24 24 V 400W battery-powered backpack electrofisher will proceed in a downstream to upstream direction, to eliminate the effects of turbidity caused by disturbing bottom sediment, with a 3/8" mesh net while accompanied by a second person also netting to capture all fish stunned by the electrode. Each electrofishing sample will consist of a minimum of 15 minutes of actual shock time or until no new species is captured after 15 minutes, sufficiently covering accessible areas of the sample reach. Sampling effort will concentrate on brushy areas, small backwater areas, debris piles, deep depressional areas along undercut banks along with occasional sweeps through open water areas.

All fish that can be identified with 100 percent assurance will be measured to the nearest 1.0 inch and released. All other fish specimens will be preserved in 10 percent formalin in the field and returned to the laboratory, where they will be rinsed in water, identified to the lowest practical level (LPTL), measured and enumerated, and then stored in 70 percent ethanol. All fish collected will be visually examined for obvious diseases, parasites and other abnormalities.

A1.7 Statistical Data Analyses and Report Preparation

The field investigation results will be compiled, organized and arranged into a report that includes the raw survey results, a complete set of quality assurance documentation, and a historical review of water quality and biological work performed in the study area for comparative purposes, in order to evaluate the observed stream conditions in the appropriate local and regional context.

Benthic macroinvertebrate data will be evaluated using metric criteria developed by the TCEQ for assessing aquatic life use (TCEQ, 2007). This procedure incorporates a total of 12 metrics that examine the different levels of the benthic community to assess biotic integrity (Table A1-4). A common metric is taxa richness, which is the total number of benthic macroinvertebrate taxa collected from a site. Taxa richness usually decreases as biotic integrity decreases. Values for each of the 12 metrics are summed to make an overall evaluation of the benthic macroinvertebrate community.

Table A1-4.
TCEQ Rapid Bioassessment Protocol Metric Evaluation Protocol for Benthic Macroinvertebrate Kicknet Samples

METRIC	SCORING CRITERIA			
	4	3	2	1
Taxa richness	> 21	15-21	8-14	< 8
EPT taxa abundance	> 9	7-9	4-6	< 4
Biotic index (HBI)	< 3.77	3.77-4.52	4.53-5.27	>5.27
% Chironomidae	0.79-4.10	4.11-9.48	9.49-16.19	< 0.79 or >16.19
% Dominant taxon	< 22.15	22.15-31.01	31.02-39.88	> 39.88
% Dominant FFG	< 36.50	36.50-45.30	45.31-54.12	> 54.12
% Predators	4.73-15.20	15.21-25.67	25.68-36.14	< 4.73 or >36.14
Ratio of intolerant:tolerant taxa	> 4.79	3.21-4.79	1.63-3.20	< 1.63
% of total Trichoptera as Hydropsychidae	< 25.50	25.51-50.50	50.51-75.50	> 75.50 or no Trichoptera
# of non-insect taxa	> 5	4-5	2-3	< 2
% Collector-gatherers	8.00-19.23	19.24-30.46	30.47-41.68	< 8.00 or >41.68
% of total number as Elmidae	0.88-10.04	10.05-20.08	20.09-30.12	< 0.88 or >30.12
Aquatic life use point score ranges:	Exceptional: > 36; High: 29-36; Intermediate: 22-28; Limited: < 22			

For the biological evaluation, all fish collected by seine will be combined in the data set and treated identically Because watershed characteristics and fish communities from the North Fork Double Mountain Fork Brazos River differ from those for midwestern headwater streams originally used by Karr et al (1986), the community trophic structure status and intolerance/tolerance data as described by Linam and Kleinsasser (1998) along with a regionalized adaptation of the Index of Biotic Integrity (IBI) developed by Linam et al. (2002) for representative Texas streams in Ecoregions 25 and 26 (Western High Plains and Southwestern Tablelands) will be calculated to provide a fish aquatic life use rating for each station. The cumulative score of this index consisting of 8 separate metrics (Table A1-5), based on seine collections only, will provide a baseline evaluation of the overall condition of the fish community residing in the four stream reaches of the North Fork Double Mountain Fork Brazos River.

Table A1-5.
Scoring Criteria for Assessment of Stream Fish Assemblages
Western High Plains and Southwestern Tablelands (Ecoregions 25 and 26)

Metric Category	***Metric Name***	***Score***		
		5	***3***	***1***
Species Richness and Composition	1. Total number of fish species	*	*	*
	2. Number of native cyprinid species	>2	2	<2
	3. Number of sunfish species	>1	1	0
Trophic Composition	4. Percentage of individuals as omnivores	<9%	9-16%	<16%
	5. Percentage of individuals as invertivores	> 65%	33-65%	< 33%
Fish Abundance and Condition	6. Number of individuals/seine haul	>41.7	20.9-41.7	<20.9
	7. Percentage of individuals as non-native species	<1.4%	1.4-2.7%	>2.7%
	8. Percentage of individuals with disease or other anomaly	< 0.6	0.6-1.0%	> 1.0%
Fish Species:	*Fish species richness based on drainage basin size (km^2); see Linam et al. (2002)			
Aquatic Life Use: **Exceptional**: ≥ 36; **High:** 34-35; **Intermediate:** 24-33; **Limited: <** 24				

A1.8 References

Karr, J.R., K.D. Fausch, P.L. Angermeier, P.R.Yant, and I.J. Schlosser. 1986. *Assessing biological integrity in running waters, a method and its rationale*. Special Publication 5. Illinois Natural History Survey, Champaign, Illinois. 28 pp.

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Linam, G.W., L.J. Kleinsasser, and K.B. Mayes. 2002. *Regionalization of the Index of Biotic Integrity for Texas Streams (River Studies Report No. 17)*. Texas Parks and Wildlife Department. Austin, Texas.

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Supplement 1

Habitat Field Reconnaissance at Three Known Areas of Smalleye and Sharpnose Shiner Populations Collected by Texas Parks and Wildlife Department (TPWD) in August 1991 and May 1992

ONE COMPANY
Many Solutions℠

Trip Report

To:	David Dunn		
From:	David Thomas	Project:	Lake 7 Reservoir Project
CC:	James Thomas		
Date:	13 July 2009	Job No:	115321-001

RE: Habitat Field Reconnaissance at Three Known Areas of Smalleye and Sharpnose Shiner Populations Collected by Texas Parks and Wildlife Department (TPWD) in August 1991 and May 1992

A field reconnaissance of two of the three known locations supporting populations of the smalleye shiner (*Notropis buccula*) and the sharpnose shiner (*Notropis oxyrhynchus*) in the North Fork Double Mountain Fork Brazos River watershed was conducted by HDR biologist David Thomas on 25 June 2009. These locations, identified during our literature research, were selected based on specific site information documented by the TPWD (Moss and Mayes, 1993).

The following three locations on the North Fork Double Mountain Fork Brazos River were investigated on 21 August 1991 and 14 May 1992 by TPWD with the first two listed examined by HDR:

- FM 651 northeast of Post in Garza County
- U.S. 380 east of Post in Garza County
- S.H. 207 north of Post in Garza County

A fourth location that yielded 21 individuals of smalleye shiner in the 1992 TPWD collection on 14 May 1992 was also inspected at:

- Double Mountain Fork Brazos River at S.H. 84 near Justiceburg in Garza County

Photo documentation of the streambed and adjacent shoreline at each location was assisted by still digital photography. Visual observations were made immediately upstream and downstream of each bridge structure. Water temperature (°C), dissolved oxygen (DO) (mg/L) and oxygen saturation (%), conductivity (µS/cm), and pH (standard units) were measured in the field at the first two North Fork locations using a YSI Model 650-04 display with high memory and barometer connected to a Model 600 XLM-M data sonde. Table 1 presents the measurements taken from the four study area stations situated upstream of Buffalo Springs Lake and the two river locations near Post. All measurements were taken from 1.0 ft below the water surface. A brief description of the habitat encountered at each of the three locations observed follows.

North Fork Double Mountain Fork Brazos River at FM 651 and U.S. 380

Each location was accessed from the public roadway and involved walking and crossing several fence lines to reach the river channel. Figures 1 and 2 show the North Fork Double Mountain Fork Brazos River at FM 651 and at U.S. 380 near Post in Garza County, respectively. The substrate and morphology of the river channel at each site are similar to the section of river that flows through the V8 Ranch (Figure 3). However, the stream banks in the lower reach do not appear to be as extensively grazed by livestock and the tree canopy is more developed. Flows in the study reach ranged from 6.71 to 24.15 cfs compared with estimated flows of 30-35 cfs at the two downstream locations. Localized rainfall occurred in the region during this week. Channel widths at all sites ranged from 10-30 feet.

Table 1.
Water Quality Parameters by River Location
Lake 7 Reservoir Project
June 2009

Station	***Date***	***Time***	***Water Temperature (°C)***	***Dissolved Oxygen (mg/L)***	***Percent Saturation (%)***	***Conductivity (µS/cm)***	***pH (S.U.)***	***Secchi Depth (m)***
1	24 June	11:14	25.05	4.47	54.4	1083	7.93	0.41
2	23 June	08:15	23.85	5.24	62.2	949	8.04	0.46
3	23 June	12:46	26.25	8.24	102.4	1223	8.21	0.30
4	23 June	17:01	27.14	8.75	110.2	1012	8.56	0.49
	24 June	08:05	24.37	6.27	75.2	1106	8.08	0.15
FM 651	25 June	08:09	24.36	6.83	82.2	1684	8.55	--
U.S. 380	25 June	08:41	23.16	7.63	89.7	1542	8.66	--

Figure 1 North Fork Double Mountain Fork Brazos River at FM 651

Figure 2 North Fork Double Mountain Fork Brazos River at U.S. 380

Figure 3 North Fork Double Mountain Fork Brazos River at Station 3 (V8 Ranch)

Double Mountain Fork downstream of S.H. 84 near Justiceburg

The Double Mountain Fork Brazos River is crossed by two separate two-lane concrete bridges at U.S. 84 near Justiceburg (Figure 4) and is located upstream of Lake Alan Henry. This reach of river consisted of a straight channel approximately 100 feet wide. There was no flowing water and the channel bed was flat with no significant pool/riffle morphology observed. Nearly all of the channel substrate is composed of sand with occasional patches of small gravel. Low, ill-defined banks consisting of small sandy dunes occupies both banks in the upper and lower stream reaches including an occasional rock ledge outcrop adjacent to the river downstream of the bridge crossing. Dominant streamside cover is restricted to herbaceous species and grasses with an occasional shrub or tree composed mostly of salt cedar that provide little shade and terrestrial food input for aquatic organisms. No emergent aquatic vegetation, filamentous algae or algal mats were observed within the stream channel. This area is easily accessible by foot and small vehicles.

Figure 4. Double Mountain Fork downstream of S.H. 84 near Justiceburg

Common habitat characteristics identified at each site on the upper and lower reaches of the North Fork Double Mountain Fork Brazos River include the following:

- Each river segment flows through relatively undeveloped land.
- The substrate and morphology of the river channel at each site are similar.
- There is a continuous defined bed and bank present throughout the length of the stream channel.

- Predominately clay bedded pool channels with occasional rocky/gravelly riffle areas.
- Flooding has helped to keep the main river channel free from many obstructions that would hinder the flow of water; the major obstructions observed downstream were the bridge piers.
- The major limiting factors for area aquatic habitats are drought; perennial pools were observed at each location.
- Buffalo Springs Lake and Ransom Canyon Lake are artificial barriers that prohibit longitudinal fish movement and dispersal between the upper and lower reaches of the river channel.
- While there is suitable habitat and similar water quality characteristics in the river investigated upstream of Buffalo Springs Lake/ Ransom Canyon Lake, any movement by the two cyprinid species between the two aquatic systems is prevented by the dam.

Based on the physical aquatic habitat characteristics I examined on the North Fork Double Mountain Fork Brazos River upstream and downstream of Buffalo Springs Lake during the HDR survey conducted in June 2009, the two downstream areas are more similar to the aquatic habitat features I observed in the study area than witnessed on the Double Mountain Fork Brazos River. The river at U.S. 84 is intermittent with a broad sandy streambed.

References

Moss, R.E. and K. B. Mayes. 1993. *Current status of* Notropis buccula *and* Notropis oxyrhyncus *in Texas*. River Studies Report No. 8. Resource Protection Division, Texas Parks and Wildlife Department, Austin, Texas.

Appendix B
Vegetation and Wildlife Habitat Appraisal Procedure (WHAP) Survey Data

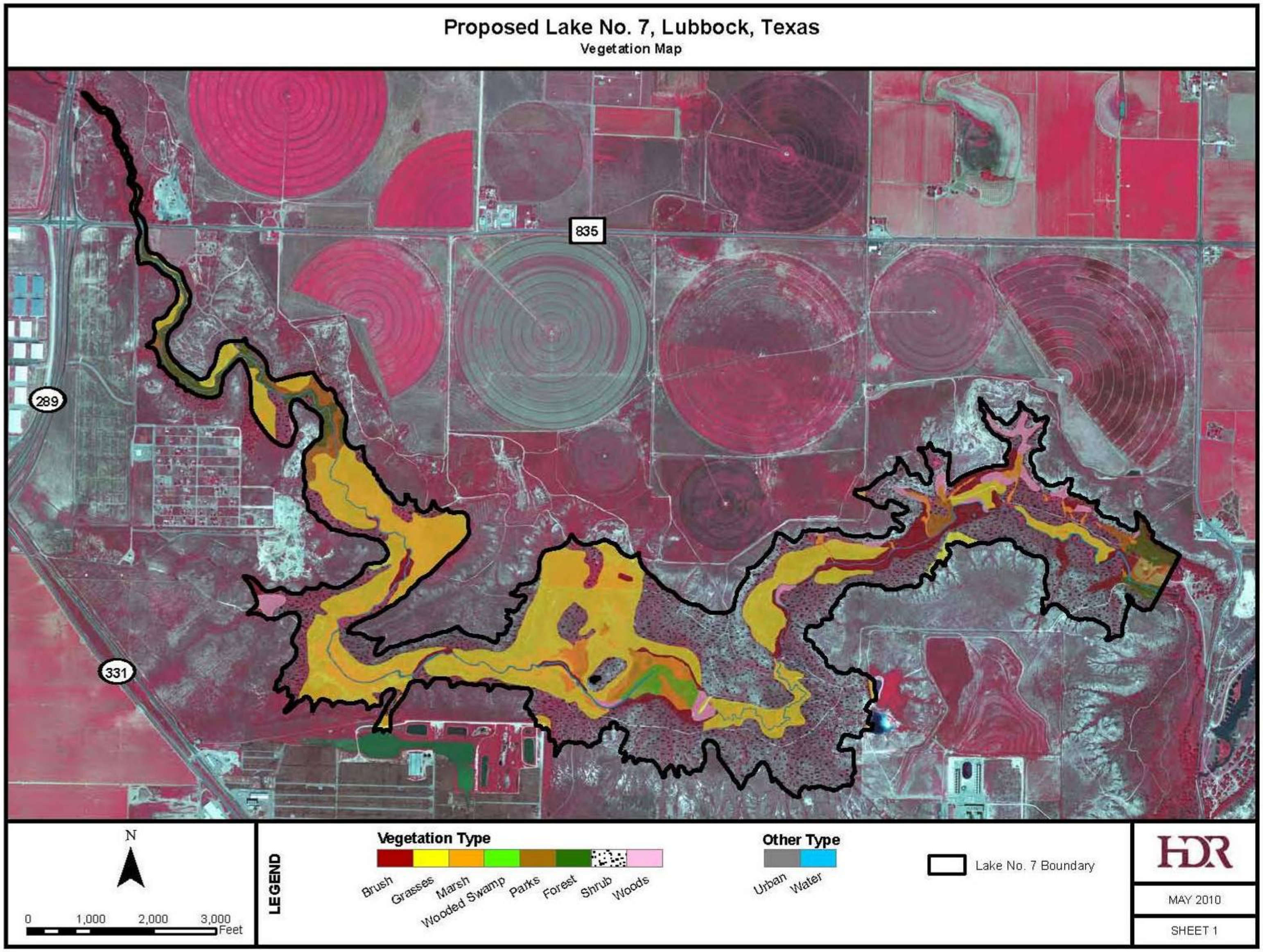

Figure 1. Location of Vegetation Types within the Lake 7 Project Area

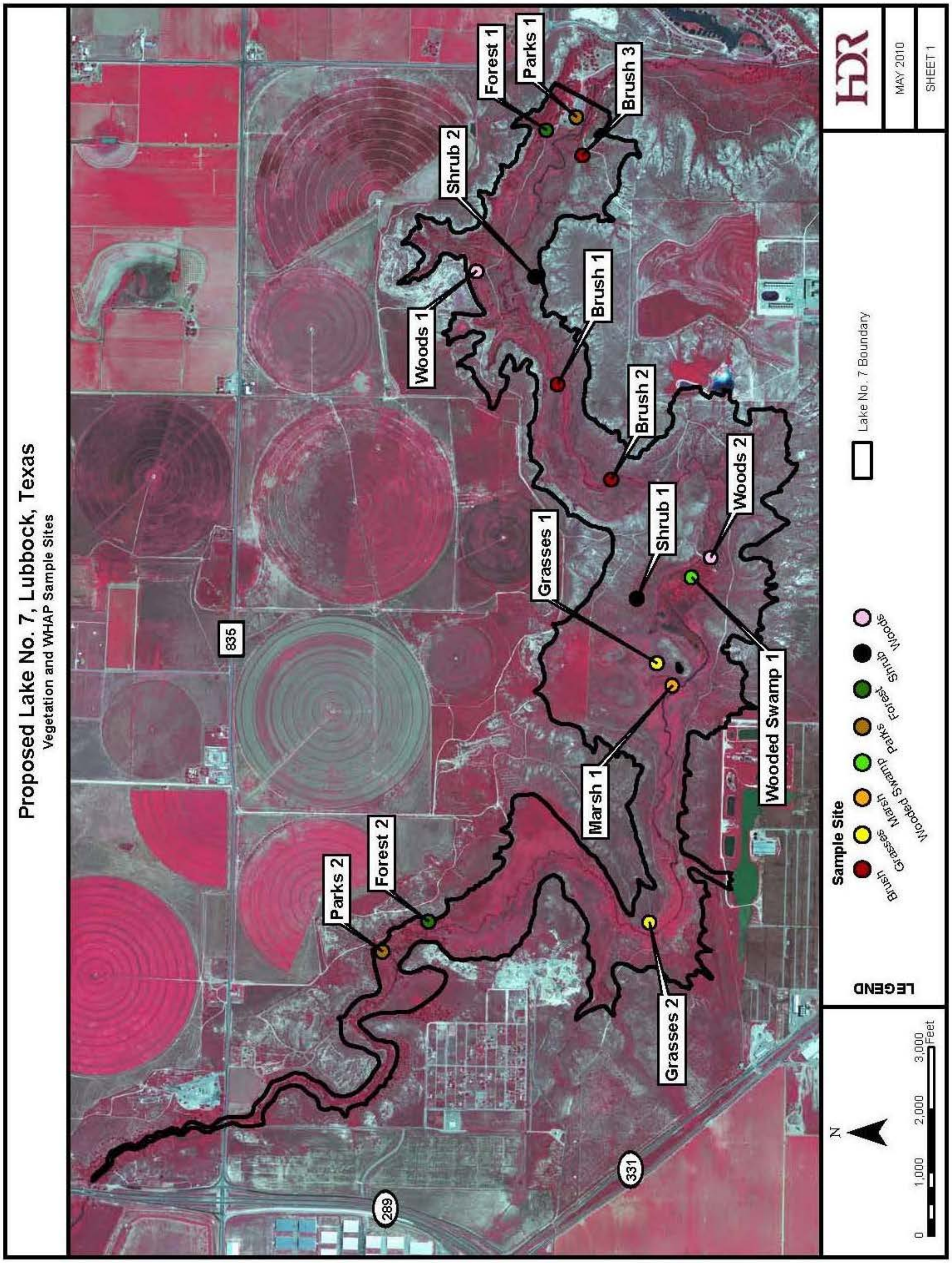

Figure 2. Location of WHAP Sampling Points within the Lake 7 Project Area

Lake 7 Vegetation Survey Species List

Stratum	***Common Name***	***Scientific Name***
Shrub #1		
Tree Stratum	None	
Sapling/Shrub Stratum	honey mesquite	*Prosopis glandulosa*
	Buckley’s yucca	*Yucca constricta*
	sand sagebrush	*Artemisia filifolia*
	catclaw acacia	*Acacia greggii*
Herb Stratum	composite dropseed	*Sporobolus compositus*
	curlycup gumweed	*Grindelia squarrosa*
	thistle	*Cirsium* sp.
	blue grama	*Bouteloua gracilis*
	Cuman ragweed	*Ambrosia psilostachya*
Shrub #2		
Tree Stratum	None	
Sapling/Shrub Stratum	netleaf hackberry	*Celtis laevigata* var. *reticulata*
	honey mesquite	*Prosopis glandulosa*
	western soapberry	*Sapindus saponaria* var. *drummondii*
	Buckley’s yucca	*Yucca constricta*
	sand sagebrush	*Artemisia filifolia*
	twistspine pricklypear	*Opuntia macrorhiza*
	catclaw acacia	*Acacia greggii*
Herb Stratum	composite dropseed	*Sporobolus compositus*
	sideoats grama	*Bouteloua curtipendula*
	blue grama	*Bouteloua gracilis*
	thistle	*Cirsium* sp.
	Cuman ragweed	*Ambrosia psilostachya*
	broom snakeweed	*Guitierrezia sarothrae*
Grasses #1		
Tree Stratum	None	
Sapling/Shrub Stratum	honey mesquite	*Prosopis glandulosa*
Herb Stratum	sand dropseed	*Sporobolus cryptandrus*
Grasses #2		
Tree Stratum	None	
Sapling/Shrub Stratum	honey mesquite	*Prosopis glandulosa*
	tamarisk	*Tamarix* sp.
Herb Stratum	burningbush	*Bassia scoparia*
Brush #1		
Tree Stratum	None	
Sapling/Shrub Stratum	tamarisk	*Tamarix* sp.
	netleaf hackberry	*Celtis laevigata* var. *reticulata*
	black willow	*Salix nigra*

Lake 7 Vegetation Survey Species List (Continued)

Stratum	***Common Name***	***Scientific Name***
Herb Stratum	Cuman ragweed	*Ambrosia psilostachya*
	composite dropseed	*Sporobolus compositus*
	burningbush	*Bassia scoparia*
	silverleaf nightshade	*Solanum elaeagnifolium*
	Brush #2	
Tree Stratum	tamarisk	*Tamarix* sp.
	black willow	*Salix nigra*
	Siberian elm	*Ulmus pumila*
Sapling/Shrub Stratum	tamarisk	*Tamarix* sp.
	netleaf hackberry	*Celtis laevigata* var. *reticulata*
Herb Stratum	great ragweed	*Ambrosia trifida*
	burningbush	*Bassia scoparia*
	composite dropseed	*Sporobolus compositus*
	Brush #3	
Tree Stratum	honey mesquite	*Prosopis glandulosa*
	netleaf hackberry	*Celtis laevigata* var. *reticulata*
	Siberian elm	*Ulmus pumila*
Sapling/Shrub Stratum	Buckley’s yucca	*Yucca constricta*
	netleaf hackberry	*Celtis laevigata* var. *reticulata*
	honey mesquite	*Prosopis glandulosa*
	prairie sumac	*Rhus lanceolata*
	clapweed	*Ephedra antisyphilitica*
	sand sagebrush	*Artemisia filifolia*
Herb Stratum	common sunflower	*Helianthus annuus*
	composite dropseed	*Sporobolus compositus*
	Forest #1	
Tree Stratum	Siberian elm	*Ulmus pumila*
	netleaf hackberry	*Celtis laevigata* var. *reticulata*
	black willow	*Salix nigra*
Sapling/Shrub Stratum	netleaf hackberry	*Celtis laevigata* var. *reticulata*
	Siberian elm	*Ulmus pumila*
	honey mesquite	*Prosopis glandulosa*
	skunkbush sumac	*Rhus trilobata* var. *trilobata*
Herb Stratum	None	

Lake 7 Vegetation Survey Species List (Continued)

Stratum	***Common Name***	***Scientific Name***
	Forest #2	
Tree Stratum	Siberian elm	*Ulmus pumila*
Sapling/Shrub Stratum	Siberian elm	*Ulmus pumila*
	netleaf hackberry	*Celtis laevigata* var. *reticulata*
Herb Stratum	None	
	Parks #1	
Tree Stratum	Siberian elm	*Ulmus pumila*
Sapling/Shrub Stratum	None	
Herb Stratum	sand dropseed	*Sporobolus cryptandrus*
	Bermudagrass	*Cynodon dactylon*
	Parks #2	
Tree Stratum	Siberian elm	*Ulmus pumila*
Sapling/Shrub Stratum	netleaf hackberry	*Celtis laevigata* var. *reticulata*
	honey mesquite	*Prosopis glandulosa*
Herb Stratum	burningbush	*Bassia scoparia*
	Bermudagrass	*Cynodon dactylon*
	Marsh #1	
Tree Stratum	None	
Sapling/Shrub Stratum	tamarisk	*Tamarix* sp.
Herb Stratum	common threesquare	*Schoenoplectus pungens*
	Woods #1	
Tree Stratum		
	netleaf hackberry	*Celtis laevigata* var. *reticulata*
	Siberian elm	*Ulmus pumila*
	black willow	*Salix nigra*
Sapling/Shrub Stratum	netleaf hackberry	*Celtis laevigata* var. *reticulata*
	skunkbush sumac	*Rhus trilobata* var. *trilobata*
	Buckley's yucca	*Yucca constricta*
	muscadine	*Vitis rotundifolia*
Herb Stratum	None	
	Woods #2	
Tree Stratum	black willow	*Salix nigra*
	honeylocust	*Gleditsia triacanthos*
	tree of heaven	*Ailanthus altissima*
Sapling/Shrub Stratum	tamarisk	*Tamarix* sp.
	tree of heaven	*Ailanthus altissima*
	netleaf hackberry	*Celtis laevigata* var. *reticulata*

Lake 7 Vegetation Survey Species List (Concluded)

Stratum	***Common Name***	***Scientific Name***
Herb Stratum	great ragweed	*Ambrosia trifida*
	curly dock	*Rumex crispus*
	Canada wildrye	*Elymus canadensis*
Wooded Swamp #1		
Tree Stratum	black willow	*Salix nigra*
	tamarisk	*Tamarix* sp.
	Siberian elm	*Ulmus pumila*
Sapling/Shrub Stratum	tamarisk	*Tamarix* sp.
Herb Stratum	great ragweed	*Ambrosia trifida*
	Canada wildrye	*Elymus canadensis*

Representative Photographs
Vegetation Survey and WHAP
Lubbock Lake No. 7
Pictures Taken November 11–12, 2009 and April 29, 2010

Photo 1. Representative shrub vegetation cover type.

Photo 2. Representative grasses vegetation cover type.

Photo 3. Representative brush vegetation cover type.

Photo 4. Representative forest vegetation cover type.

Photo 5. Representative parks vegetation cover type.

Photo 6. Representative marsh vegetation cover type.

Photo 7. Representative woods vegetation cover type.

Photo 8. Representative wooded swamp vegetation cover type.

Wildlife Habitat Appraisal Procedure
Biological Components Field Evaluation

Project: Lake 7 Reservoir Date: April 29, 2010

Cover Type or Plant Association: Brush

Habitat Components	Component Points (from Key)							
Site No.	1	2	3	4	5	6	7	**Total**
1. Site Potential	20	20	12					52
2. Temporal Development								
Criteria A	6	6	6					18
Criteria B (Marsh Wetlands Only)	-	-	-					-
3. Uniqueness and Relative Abundance	10	10	10					30
4. Vegetation Species Diversity								
Criteria A	2	3	6					11
Criteria B	1	1	3					5
Criteria C (Swamps Only)	-	-	-					-
Criteria D (Marsh Wetlands Only)	-	-	-					-
5. Vertical Stratification	4	5	4					13
6. Additional Structural Diversity Components	3	3	3					9
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	5	5	3					13
Criteria B (Herbaceous Vegetation)	3	3	5					11
Criteria C (Croplands Only)	-	-	-					-
Criteria D (Marsh Wetlands Only)	-	-	-					-

Average Habitat Quality Score for all Sites within this cover type = $\frac{Total\ Points}{Total\ Number\ of\ Sites} \times \frac{1}{100} = 0.54$

Wildlife Habitat Appraisal Procedure

Species Diversity Worksheet

Project: Lake 7 Reservoir

Cover Type: Brush

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Berry/Drupe					
netleaf hackberry	netleaf hackberry	netleaf hackberry			
	muscadine grape	prairie sumac			
Legume/Pod					
		honey mesquite			
Acorn					
Nut/Nutlike					
		clapweed			

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Samara					
	Siberian elm	Siberian elm			
Cone					
Achene					
		sand sagebrush			
All Others					
tamarisk	tamarisk	Buckley's yucca			
black willow	black willow				

Wildlife Habitat Appraisal Procedure

Biological Components Field Evaluation

Project: Lake 7 Reservoir Date: November 11-12, 2009

Cover Type or Plant Association: Forest

Habitat Components	**Component Points (from Key)**							
Site No.	1	2	3	4	5	6	7	**Total**
1. Site Potential	20	20						40
2. Temporal Development								
Criteria A	12	12						24
Criteria B (Marsh Wetlands Only)	-	-						-
3. Uniqueness and Relative Abundance	15	15						30
4. Vegetation Species Diversity								
Criteria A	3	2						5
Criteria B	3	1						4
Criteria C (Swamps Only)	-	-						-
Criteria D (Marsh Wetlands Only)	-	-						-
5. Vertical Stratification	5	3						8
6. Additional Structural Diversity Components	3	3						6
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	3	3						6
Criteria B (Herbaceous Vegetation)	3	0						3
Criteria C (Croplands Only)	-	-						-
Criteria D (Marsh Wetlands Only)	-	-						-

Average Habitat Quality Score for all Sites within this cover type =

$$\frac{Total\ Points}{Total\ Number\ of\ Sites} \times \frac{1}{100} = 0.63$$

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Wildlife Habitat Appraisal Procedure

Species Diversity Worksheet

Project: Lake 7 Reservoir

Cover Type: Forest

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Berry/Drupe					
netleaf hackberry	netleaf hackberry				
skunkbush sumac					
Legume/Pod					
honey mesquite					
Acorn					
Nut/Nutlike					

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
		Samara			
Siberian elm	Siberian elm				
		Cone			
		Achene			
		All Others			
black willow					

Wildlife Habitat Appraisal Procedure

Biological Components Field Evaluation

Project: Lake 7 Reservoir

Date: November 11-12, 2009

Cover Type or Plant Association: Grasses

Habitat Components	**Component Points (from Key)**							
Site No.	1	2	3	4	5	6	7	**Total**
1. Site Potential	12	12						24
2. Temporal Development								
Criteria A	5	1						6
Criteria B (Marsh Wetlands Only)	-	-						-
3. Uniqueness and Relative Abundance	5	0						5
4. Vegetation Species Diversity								
Criteria A	1	2						3
Criteria B	1	1						2
Criteria C (Swamps Only)	-	-						-
Criteria D (Marsh Wetlands Only)	-	-						-
5. Vertical Stratification	3	4						7
6. Additional Structural Diversity Components	3	3						6
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	5	5						10
Criteria B (Herbaceous Vegetation)	3	3						6
Criteria C (Croplands Only)	-	-						-
Criteria D (Marsh Wetlands Only)	-	-						-

Average Habitat Quality Score for all Sites within this cover type =

$$\frac{Total\ Points}{Total\ Number\ of\ Sites} \times \frac{1}{100} = 0.35$$

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Wildlife Habitat Appraisal Procedure

Species Diversity Worksheet

Project: Lake 7 Reservoir

Cover Type: Grasses

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
		Berry/Drupe			
		Legume/Pod			
honey mesquite	honey mesquite				
		Acorn			
		Nut/Nutlike			

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Samara					
Cone					
Achene					
All Others					
	tamarisk				

Wildlife Habitat Appraisal Procedure

Biological Components Field Evaluation

Project: Lake 7 Reservoir Date: November 11, 2009

Cover Type or Plant Association: Marsh

Habitat Components	**Component Points (from Key)**							
Site No.	1	2	3	4	5	6	7	**Total**
1. Site Potential	25							25
2. Temporal Development								
Criteria A	-							-
Criteria B (Marsh Wetlands Only)	5							5
3. Uniqueness and Relative Abundance	10							10
4. Vegetation Species Diversity								
Criteria A	1							1
Criteria B	1							1
Criteria C (Swamps Only)	-							-
Criteria D (Marsh Wetlands Only)	5							5
5. Vertical Stratification	4							4
6. Additional Structural Diversity Components	3							3
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	5							5
Criteria B (Herbaceous Vegetation)	-							-
Criteria C (Croplands Only)	-							-
Criteria D (Marsh Wetlands Only)	1							1

Average Habitat Quality Score for all Sites within this cover type =

$$\frac{Total\ Points}{Total\ Number\ of\ Sites} \times \frac{1}{100} = 0.60$$

TEXAS PARKS & WILDLIFE

Wildlife Habitat Appraisal Procedure

Species Diversity Worksheet

Project: Lake 7 Reservoir

Cover Type: Marsh

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Berry/Drupe					
Legume/Pod					
Acorn					
Nut/Nutlike					

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Samara					
Cone					
Achene					
All Others					
tamarisk					

Wildlife Habitat Appraisal Procedure

Biological Components Field Evaluation

Project: Lake 7 Reservoir Date: November 11-12, 2009

Cover Type or Plant Association: Parks

Habitat Components	**Component Points (from Key)**							
Site No.	1	2	3	4	5	6	7	**Total**
1. Site Potential	12	12						24
2. Temporal Development								
Criteria A	12	3						15
Criteria B (Marsh Wetlands Only)	-	-						-
3. Uniqueness and Relative Abundance	5	5						10
4. Vegetation Species Diversity								
Criteria A	1	3						4
Criteria B	1	1						2
Criteria C (Swamps Only)	-	-						-
Criteria D (Marsh Wetlands Only)	-	-						-
5. Vertical Stratification	4	3						7
6. Additional Structural Diversity Components	0	3						3
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	5	3						8
Criteria B (Herbaceous Vegetation)	3	3						6
Criteria C (Croplands Only)	-	-						-
Criteria D (Marsh Wetlands Only)	-	-						-

Average Habitat Quality Score for all Sites within this cover type =

$$\frac{Total\ Points}{Total\ Number\ of\ Sites} \times \frac{1}{100} = 0.40$$

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Wildlife Habitat Appraisal Procedure

Species Diversity Worksheet

Project: Lake 7 Reservoir
Cover Type: Parks

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
		Berry/Drupe			
	netleaf hackberry				
		Legume/Pod			
	honey mesquite				
		Acorn			
		Nut/Nutlike			

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Samara					
Siberian elm	Siberian elm				
Cone					
Achene					
All Others					

Wildlife Habitat Appraisal Procedure

Biological Components Field Evaluation

Project: Lake 7 Reservoir

Date: November 11-12, 2009

Cover Type or Plant Association: Shrub

Habitat Components	**Component Points (from Key)**							
Site No.	1	2	3	4	5	6	7	**Total**
1. Site Potential	12	7						19
2. Temporal Development								
Criteria A	3	5						8
Criteria B (Marsh Wetlands Only)	-	-						-
3. Uniqueness and Relative Abundance	5	10						15
4. Vegetation Species Diversity								
Criteria A	2	4						6
Criteria B	1	3						4
Criteria C (Swamps Only)	-	-						-
Criteria D (Marsh Wetlands Only)	-	-						-
5. Vertical Stratification	4	4						8
6. Additional Structural Diversity Components	3	3						6
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	5	3						8
Criteria B (Herbaceous Vegetation)	5	3						8
Criteria C (Croplands Only)	-	-						-
Criteria D (Marsh Wetlands Only)	-	-						-

Average Habitat Quality Score for all Sites within this cover type =

$$\frac{Total\ Points}{Total\ Number\ of\ Sites} \times \frac{1}{100} = 0.21$$

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Wildlife Habitat Appraisal Procedure

Species Diversity Worksheet

Project: Lake 7 Reservoir

Cover Type: Shrub

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Berry/Drupe					
	netleaf hackberry				
	western soapberry				
Legume/Pod					
honey mesquite	honey mesquite				
catclaw acacia	catclaw acacia				
Acorn					
Nut/Nutlike					

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Samara					
Cone					
Achene					
sand sagebrush	sand sagebrush				
All Others					
Buckley's yucca	Buckley's yucca				
	twistspine pricklypear				

Wildlife Habitat Appraisal Procedure

Biological Components Field Evaluation

Project: Lake 7 Reservoir Date: November 11, 2009

Cover Type or Plant Association: Wooded Swamp

Habitat Components	**Component Points (from Key)**							
Site No.	1	2	3	4	5	6	7	**Total**
1. Site Potential	20							20
2. Temporal Development								
Criteria A	6							6
Criteria B (Marsh Wetlands Only)	-							-
3. Uniqueness and Relative Abundance	10							10
4. Vegetation Species Diversity								
Criteria A	2							2
Criteria B	1							1
Criteria C (Swamps Only)	6							6
Criteria D (Marsh Wetlands Only)	-							-
5. Vertical Stratification	5							5
6. Additional Structural Diversity Components	3							3
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	3							3
Criteria B (Herbaceous Vegetation)	3							3
Criteria C (Croplands Only)	-							-
Criteria D (Marsh Wetlands Only)	-							-

Average Habitat Quality Score for all Sites within this cover type =

$$\frac{Total\ Points}{Total\ Number\ of\ Sites}\times\frac{1}{100}=0.59$$

TEXAS PARKS & WILDLIFE

Wildlife Habitat Appraisal Procedure

Species Diversity Worksheet

Project: Lake 7 Reservoir
Cover Type: Wooded Swamp

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
		Berry/Drupe			
		Legume/Pod			
		Acorn			
		Nut/Nutlike			

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Samara					
Siberian elm					
Cone					
Achene					
All Others					
tamarisk					
black willow					

Wildlife Habitat Appraisal Procedure

Biological Components Field Evaluation

Project: Lake 7 Reservoir Date: November 12, 2009 & April 29, 2010

Cover Type or Plant Association: Woods

Habitat Components	**Component Points (from Key)**							
Site No.	1	2	3	4	5	6	7	**Total**
1. Site Potential	12	20						32
2. Temporal Development								
Criteria A	6	6						12
Criteria B (Marsh Wetlands Only)	-	-						-
3. Uniqueness and Relative Abundance	15	10						25
4. Vegetation Species Diversity								
Criteria A	3	3						6
Criteria B	3	3						6
Criteria C (Swamps Only)	-	-						-
Criteria D (Marsh Wetlands Only)	-	-						-
5. Vertical Stratification	4	5						9
6. Additional Structural Diversity Components	3	3						6
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	3	5						8
Criteria B (Herbaceous Vegetation)	3	3						6
Criteria C (Croplands Only)	-	-						-
Criteria D (Marsh Wetlands Only)	-	-						-

Average Habitat Quality Score for all Sites within this cover type =

$$\frac{Total\ Points}{Total\ Number\ of\ Sites} \times \frac{1}{100} = 0.55$$

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Wildlife Habitat Appraisal Procedure

Species Diversity Worksheet

Project: Lake 7 Reservoir
Cover Type: Woods

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Berry/Drupe					
netleaf hackberry	netleaf hackberry				
skunkbush sumac					
muscadine grape					
Legume/Pod					
	honeylocust				
Acorn					
Nut/Nutlike					

Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
		Samara			
Siberian elm					
		Cone			
		Achene			
		All Others			
black willow	tamarisk				
Buckley's yucca	tree of heaven				
	Black willow				

Appendix C
Delineation and Proposed Jurisdictional Determination of Waters of the U.S.

Appendix C
Delineation and Proposed Jurisdictional Determination of Waters of the U.S.

Lubbock Lake No. 7
Lubbock County, Texas

Prepared for:

city of lubbock
TEXAS

Prepared by:

HDR | ONE COMPANY
*Many Solutions*SM

May 2010

Table of Contents

Section **Page**

Table of Contents (Concluded)

Attachments

C.1 Introduction

C.1.1 Background

This report presents the results of a delineation and proposed jurisdictional determination of waters of the United States (U.S.), including wetlands, performed on an approximately 800-acre (ac) study area in Lubbock County, Texas. In addition, a larger area was evaluated to identify any surface hydrologic connection to a water of the U.S. outside the study area to determine the jurisdictional status of any features within the study area. The study area follows the proposed flood pool and construction area of the proposed Lake 7 in Lubbock County, Texas (Attachment C1, Figure 1).

The City of Lubbock (City) is proposing to construct Lake 7 along the North Fork Double Mountain Fork Brazos River immediately upstream of the existing Buffalo Springs Lake. The project is a water supply alternative for the City to meet projected future water supply demands of the area.

The proposed jurisdictional determination for waters of the U.S., including wetlands was conducted by HDR Engineering, Inc. (HDR) for the City in support of the requirements of Section 404 of the Clean Water Act (CWA). A field survey for the following determination was conducted in November 2009 in accordance with the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory, 1987) and the interim regional supplement for the Great Plains region (U.S. Army Corps of Engineers, 2008a). HDR also evaluated the potential for federal jurisdiction under Section 404 of the CWA over aquatic features in the study area based on U.S. Army Corps of Engineers (USACE) revised guidance published December 2, 2008. The guidance was issued pursuant to the U.S. Supreme Court findings in the consolidated cases of Rapanos v. United States and Carabell v. United States (126 S. Ct. 2208 [2006]), and is herein referred to as the “Rapanos Guidance” (USACE, 2008b). The results are followed by a discussion of potential permitting requirements and recommendations based on the findings. The determination within this report is subject to review and approval by the Fort Worth District of the USACE, and the final jurisdictional determination is within the regulatory authority of the USACE.

C.1.2 Report Organization

The report is organized as follows:

- **Section 1** provides an introduction and overview of report organization
- **Section 2** describes the study area
- **Section 3** provides information pertaining to the regulatory authority and legal definitions
- **Section 4** presents methodologies and results of the jurisdictional determination
- **Section 5** provides a summary of the findings and recommendations for permitting
- **Section 6** contains a list of references used for report preparation

C.2 Study Area Description

The study area is located in Lubbock County, Texas (Attachment C1, Figure 1). The predominant land uses in the vicinity of the study area are agriculture, industrial, rural and suburban residence, and undeveloped. The study area lies immediately southeast of the City of Lubbock, between Texas Highway Loop 289 and Farm-to-Market Road 835, and generally follows the North Fork Double Mountain Fork Brazos River. From the study area, the North Fork Double Mountain Fork Brazos River flows directly into Buffalo Springs Lake, and from there into Ransom Canyon Lake. Approximately 49 aerial miles southeast of Ransom Canyon Lake the North Fork Double Mountain Fork Brazos River reaches its confluence with the Double Mountain Fork of the Brazos River in Kent County, the nearest downstream traditional navigable water (TNW).

Most of the study area has been subjected to agricultural and rangeland uses during the recent past while the immediate surrounding area has primarily been subjected to cultivated agricultural use. Additionally, at least 4 small dams have been built along the North Fork Double Mountain Fork Brazos River within and immediately downstream of the study area during the recent past. Today, however, only a single small dam/concrete crossing immediately downstream of the study area remains intact. Furthermore, the North Fork Double Mountain Fork Brazos River has been modified by several small to medium sized water development projects both up- and downstream of the study area, and many of these are present today.

C.2.1 Soils in the Study Area

Physiographically, the study area lies in the High Plains, a nearly flat region interspersed with many shallow rain-fed depressions known as playa lakes. Windblown sands and silts form rich soils and headwaters of major rivers have deeply notched the caprock of the High Plains (Bureau of Economic Geology, 1996). The soil association mapped within the study area is the Potter-Berda-Bippus association (Soil Conservation Service [SCS], 1979).

Soils of the Potter-Berda-Bippus association are very shallow, shallow, and deep, nearly level to steep, moderately permeable loamy soils on uplands and bottomlands.

The primary soils within the study area are (Natural Resources Conservation Service [NRCS], 2009a):

- Berta loam, 3 to 5 percent slopes; and
- Bippus clay loam, frequently flooded.

Berta loam, 3 to 5 percent slopes, is a deep, well-drained, gently sloping soil with medium permeability found on the sides of draws. The water erosion hazard of the soil is severe. This soil is used primarily as cropland and range and has a medium potential for wildlife habitat.

Bippus clay loam, frequently flooded, is a deep, well-drained, nearly level soil found in drainageways and on adjacent outwash fans. The soil is frequently flooded and has moderate permeability. This soil is used entirely as range and has medium potential for wildlife habitat.

Other soils within the study area include:

- Potter-Berda association, steep;
- Berda-Potter association, hilly;
- Berda loam, 1 to 3 percent slopes;
- Mobeetie fine sandy loam, 5 to 8 percent slopes;
- Mobeetie fine sandy loam, 3 to 5 percent slopes;
- Arents and Pits;
- Mobeetie fine sandy loam, 1 to 3 percent slopes;
- Amarillo fine sandy loam, 1 to 3 percent slopes;
- Friona loam, 0 to 1 percent slopes; and
- Potter loam, 2 to 12 percent slopes.

C.2.2 Hydric Soils in the Study Area

Soils in the study area listed on the National Hydric Soil List (NRCS, 2009b) as supporting hydric inclusions include:

- Bippus clay loam, frequently flooded.

The hydric soil inclusions represent approximately 1 percent of the map units and occur as sloughs within the study area. Within the study area this soil occurs in the floodplain of the North Fork Double Mountain Fork Brazos River.

- Plant Communities in the Study Area.

The study area is located within the High Plains vegetational area of Texas (Hatch et al., 1990) and is part of the Southern Great Plains. The High Plains consist of a relatively flat plateau containing many playa lakes (Hatch et al., 1990). Climax vegetation of the High Plains is typified by blue grama (*Bouteloua gracilis*), buffalograss (*Buchloe dactyloides*), galleta (*Hilaria jamesii*), little bluestem (*Schizachyrium scoparium*), western wheatgrass (*Elytrigia smithii*), sideoats grama (*B. curtipendula*), and sand dropseed (*Sporobolus cryptandrus*) (Hatch et al., 1990). Tree and brush species including mesquite (*Prosopis glandulosa*), sand sagebrush (*Artemisia filifolia*), pricklypear (*Opuntia* spp.), and yucca (*Yucca* spp.) have invaded certain areas (Hatch et al., 1990).The Lake 7 study area experiences an average growing season of 233 days a year (NOAA, 2004). Average annual precipitation at the study area is 18.69 inches (in), with the greatest amounts falling during the month of June (NOAA, 2004). Elevation of the study area ranges from approximately 3,025 to 3,100 feet (ft) above mean sea level.

The Vegetation Types of Texas, Including Cropland (McMahan et al. 1984), describes the vegetation types that occur within the study area as mesquite-lotebush (*Ziziphus obtusifolia*) brush and crops. The mesquite-lotebush brush vegetation type is located primarily in the uplands of the northwestern Edwards Plateau, northeastern Trans-Pecos east of the Pecos River, Rolling Plains, and western Cross Timbers and Prairies. Commonly associated plants in this community type include mesquite, lotebush, yucca, skunkbush sumac (*Rhus aromatica* var. *flabelliformis*), agarito (*Mahonia trifoliolata*), elbowbush (*Forestiera pubescens*), juniper (*Juniperus* spp.), tasajillo (*Opuntia leptocaulis*), cane bluestem (*Bothriochloa barbinodis* var. *barbinodis*), silver bluestem (*B. laguroides*), little bluestem, sand dropseed, Texas grama (*Bouteloua rigidiseta*), sideoats grama, hairy grama (*B. hirsuta*), red grama (*B. trifida*), tobosa (*Hilaria mutica*), buffalograss, Texas wintergrass (*Stipa leucotricha*), purple threeawn (*Aristida purpurea*), Engelmann daisy (*Engelmannia pinnatifida*), broom snakeweed (*Gutierrezia sarothrae*), and bitterweed (*Hymenoxys odorata*) (McMahan et al. 1984). The crops vegetation type occurs statewide and consists of cultivated cover crops or row crops that provide food and/or fiber for either man or domestic animals. This type may also portray grassland associated with crop rotations.

Based on field surveys and interpretation of aerial imagery, the study area was found to consist of 8 principal vegetation types: 1) shrub, 2) grasses, 3) brush, 4) forest, 5) parks, 6) marsh, 7) woods, and 8) wooded swamp. The shrub areas were comprised of scattered individual woody plants including mesquite, hackberry (*Celtis laevigata* var. *reticulata*), western soapberry (*Sapindus saponaria*), yucca, and sand sagebrush with an understory of herbaceous species including tall dropseed (*S. asper*), blue grama (*B. gracilis*), sideoats grama, broom snakeweed, clasping daisy (*Grindelia squarrosa*), thistle (*Cirsum* spp.), and western ragweed (*Ambrosia psilostachya*). Areas of grasses were dominated by grasses, forbs, and other grass-like plants where woody vegetation was absent or nearly so. These areas largely consisted of sand dropseed, but also contained sunflower (*Helianthus annuus*), tall dropseed, giant ragweed (*A. trifida*), nightshade (*Solanum elaeagnifolium*), and Canadian wildrye (*Elymus canadensis*) interspersed with widely scattered and shrubby mesquite and saltcedar (*Tamarix* spp). Some areas classified as grasses also consisted entirely of extremely dense stands of introduced kochia (*Kochia scoparia*). Brush areas within the study site consisted primarily of small (less than nine ft) dominant woody plants growing as randomly or evenly spaced individuals, small clusters, or closed stands with greater than 10 percent canopy cover. Woody species found in brushy areas included mesquite, hackberry, and saltcedar, and herbaceous species included western ragweed, giant ragweed, tall dropseed, and kochia. Areas of forest were defined as those areas containing dominant deciduous or evergreen trees greater than 30 ft tall with 71 to 100 percent canopy cover. Dominant over- and midstory vegetation consisted of Siberian elm (*Ulmus pumila*), hackberry, black willow (*Salix nigra*), mesquite, and skunkbush sumac, and dominant understory vegetation consisted of barnyardgrass (*Echinochloa colonum*), switchgrass (*Panicum virgatum*), Texas croton (*Croton texensis*), and Canadian wildrye. Parks were classified as those areas containing woody plants mostly equal to or greater than 9 ft tall and growing as scattered individuals or small clusters within a continuous grass or forb understory. Within the study area Park vegetation included woody species such as Siberian elm, hackberry, and mesquite with an understory containing sand dropseed, bermudagrass (*Cynodon dactylon*), and kochia. Marsh areas consisted of areas dominated by emergent herbaceous plants with 10 percent or less canopy cover from woody vegetation. Vegetation included in these areas consisted of saltcedar, common threesquare (*Schoenoplectus pungens*), smartweed (*Polygonum lapathifolium*), cattail (*Typha latifolia*), and cocklebur (*Xanthium strumarium*). Within the study area woods were defined as those areas containing woody plants generally 9 to 30 ft tall with 71 to 100 percent canopy cover. Dominant woody vegetation in areas classified as woods consisted of hackberry, Siberian elm, black willow, western soapberry, skunkbush sumac, yucca, and grape (Vitis spp.), and herbaceous vegetation consisted of bristlegrass (*Setaria leucopila*), sunflower, thistle, western ragweed, and switchgrass. Finally, areas classified as wooded swamp consisted of areas with woody plants mostly between 9 and 30 ft tall with 71 to 100 percent canopy cover within inundated sites. Woody vegetation in these areas consisted of black willow, saltcedar, and American elm. Herbaceous vegetation within wooded swamps consisted of giant ragweed, Canadian wildrye, sunflower, cattail, threesquare, smartweed, and curly dock (*Rumex crispus*).

C.3 Regulatory Background

Agencies that regulate impacts to the nation’s surface water resources within Texas include the USACE, U.S. Environmental Protection Agency (EPA), and Texas Commission on Environmental Quality (TCEQ). Waters of the U.S. are protected under Sections 401 and 404 of the CWA, and Executive Order 11990 (Protection of Wetlands). The USACE has the primary regulatory authority for enforcing Section 404 requirements for waters of the U.S., including wetlands.

The stated objective of the CWA is “to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” Section 404 of the Act requires the issuance of a permit by the USACE for the release of dredged or fill material into “Waters of the United States.”

C.3.1 Definitions

The Code of Federal Regulations (33 CFR 328.3), defines waters of the U.S. as:

- All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
- All interstate waters including interstate wetlands;
- All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters:
  - Which are, or could be, used by interstate or foreign travelers for recreational or other purposes; or
  - From which fish or shellfish are, or could be, taken and sold in interstate or foreign commerce; or
  - Which are used, or could be used, for industrial purposes by industries in interstate commerce;
- All impoundments of waters otherwise defined as waters of the U.S. under the definition;
- Tributaries of waters of the U.S. identified above;
- The territorial seas;
- Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in the paragraphs above. The term “adjacent” means bordering, contiguous,

> or neighboring. Wetlands separated from other waters of the U.S. by manmade dikes or barriers, natural river berms, beach dunes, and the like are "adjacent wetlands."

C.3.1.1 Streams

The jurisdictional extent of streams is generally defined by the ordinary high water mark (OHWM) which is defined as the line on the shore/bank established by flowing and/or standing water, marked by characteristics such as a clear, natural line impressed on the bank, erosion shelving, changes in the character of soil, destruction of terrestrial vegetation, presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

C.3.1.2 Wetlands

Wetlands are a category of waters of the U.S. and are defined by 33 CFR part 328.3 as areas that are "inundated or saturated by surface or ground water at a frequency and duration sufficient to support—and that under normal circumstances do support—a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." However, temporarily or seasonally flooded depressions that receive overland storm runoff or overbank floodwaters can meet the three criteria to be considered wetlands. This is often due to the slowly permeable soils and relatively long growing season resulting in anaerobic, hydric soils after just 11 to 12 consecutive days in the north-west Texas region.

C.3.1.3 Constructed Ponds

The jurisdictional status of constructed ponds depends on whether they were constructed as an impoundment of a jurisdictional stream, or if they were constructed in uplands, away from waters of the U.S. However, the jurisdictional status of constructed ponds also depends on whether they have a surface hydrological connection to a water of the U.S. under present normal conditions. If a constructed pond lacks a drainage pipe (or other means) that provides flow sufficient to establish an OHWM directly downstream to a water of the U.S., then this pond may be considered a non-jurisdictional aquatic feature.

C.3.1.4 Non-Jurisdictional Aquatic or Drainage Features

In general, ponds constructed in uplands, hydrologically disconnected wetlands, and remnant channels (e.g., erosional features) are not considered to be waters of the U.S. when they: (1) do not have a surface hydrologic connection to a water of the U.S.; (2) are not adjacent to a water of the U.S.; (3) are not used for, never were in the past, and likely never would be used for interstate commerce; or (4) are not interstate waters. These non-jurisdictional aquatic and drainage features are common in areas with low to moderate rainfall and historically altered land uses (e.g., crops to rangeland), and are referred to in this report as features that are not waters of the U.S. The acreages associated with non-jurisdictional features are not included in total acreages for a proposed jurisdictional determination.

C.3.2 Guidance Based on Supreme Court Rulings

In January 2003 the USACE issued guidance in response to the U.S. Supreme Court's findings in the case of the Solid Waste Agency of Northern Cook County (SWANCC) v. USACE (531 U.S. 159 [2001]) that limited the jurisdiction over non-tidal isolated waters, including wetlands and open water areas excavated in uplands. In general, only wetlands that have a direct hydrological connection to waters of the U.S., or are within their floodplains, are considered potentially jurisdictional under Section 404.

On December 2, 2008 the USACE and the EPA issued the Rapanos Guidance (USACE, 2008b), a revision to the joint guidance for Jurisdictional Determinations implementing the U.S. Supreme Court's findings in the Rapanos and Carabell cases (126 S. Ct. 2208 [2006]). The guidance generally does not allow for the agencies to assert jurisdiction over ephemeral features, including erosional features, swales, small washes characterized by low volume, infrequent, or short duration flow; and ditches excavated wholly in, and draining only, uplands and that do not carry a relatively permanent flow of water. Jurisdiction over water resources that are not TNWs or wetlands adjacent to a TNW is generally based on meeting one of the following two standards: 1) if a water body is relatively permanent, or if the water body is a wetland that "directly abuts" a relatively permanent water (RPW); or 2) if a water body, in combination with all wetlands adjacent to that water body, has a "significant nexus" to a TNW. For non-navigable waters that are not relatively permanent and wetlands not directly abutting a RPW to be considered waters of the U.S., a significant nexus must exist with a measurable hydrologic, biological, or chemical connection to a TNW. Factors used in determining a significant nexus would include: 1) hydrologic conditions, such as volume, duration and frequency of flow; 2) ecological factors, such as aquatic habitat that supports the biological functions of a TNW; and 3) chemical factors, such as maintenance of water quality in the TNW.

C.4 Waters of the U.S. Delineation

C.4.1 Methods

A recent topographic map of the study area and one-meter resolution digital color infrared aerial photography (TNRIS, 2004) were used to identify potential locations for waters of the U.S. and areas prone to wetland development. Waters of the U.S., including wetlands, were delineated and evaluated on November 11–12, 2009 by experienced HDR Environmental Scientists Ricky Wilson and Dustin McBride and on April 29, 2010 by Ricky Wilson and Peggy Jones. The survey was conducted in accordance with the USACE 1987 Wetlands Delineation Manual (Environmental Laboratory, 1987) and the interim regional supplement for the Great Plains region (USACE, 2008a). The delineation was also performed to reflect guidance from the USACE in accordance with the U.S. Supreme Court rulings in the SWANCC and Rapanos cases.

Based on the review of topographic and aerial maps, areas potentially containing waters of the U.S. (e.g., stream corridors, impoundments, etc.) and wetlands (areas adjacent to streams or with little slope and depressional areas) were evaluated using a combination of aerial photograph interpretation and routine on-site delineation methods. The on-site delineations were recorded using a sub-meter Geo XT Global Positioning System (GPS) unit and mapped as a data layer using ArcGIS 9.3.1.

C.4.1.1 Waters of the U.S. (Streams and Open Water)

Jurisdictional boundaries for streams and open waters were delineated at the OHWM (as described in section 3.2.1) using a combination of aerial photograph interpretation and field verification. Methods used to determine the category of each stream (e.g., perennial, intermittent, or ephemeral) include characterizing the type of substrate, evidence of groundwater seepage, percentage of reaches with gain and loss, type of vegetation, and evidence of flow volume. Data were also collected on the apparent functions of each stream reach such as water quality improvement, flood water storage, sediment transport, vegetation diversity, aquatic and terrestrial habitat, organic carbon production, and nutrient transfer.

The jurisdictional status of constructed ponds depends on whether they were constructed as an impoundment of a jurisdictional stream or if they were constructed in uplands, away from waters of the U.S. However, the jurisdictional status of constructed ponds also depends on whether they have a surface hydrological connection to a water of the U.S. under present normal conditions. If a pond lacks a drainage pipe (or other means) that provides flow sufficient to establish an OHWM directly downstream to a water of the U.S., then it may be considered a non-jurisdictional aquatic feature.

C.4.1.2 Wetlands

Wetland determinations were performed on-site using the methodology of the USACE Wetland Delineation Manual (Environmental Laboratory, 1987) and the interim regional supplement for the Great Plains region (USACE, 2008a). The presence of wetlands is determined by the positive indication of three criteria: hydrophytic vegetation, hydrology, and hydric soils. When evidence of the three criteria is found, a Wetland Determination Data Form is completed for the site.

Recorded information includes the dominant plant species in each vegetation layer (i.e., tree, sapling/shrub, herbaceous, and vine). The indicator status of each recorded plant species is determined from the *National List of Plant Species That Occur in Wetlands: 1988 National Summary* (Reed, 1988). Greater than 50 percent of the dominant plant species must have an indicator status of facultative (FAC, 34 to 66 percent probability of occurring in wetlands), facultative wetland (FACW, 67 to 99 percent probability), or obligate wetland (OBL, greater than 99 percent probability).

The determination of wetland hydrology is based on the presence of at least one primary or two secondary indicators of a prolonged hydroperiod (i.e., period of inundation/saturation). Primary indicators include surface water, high water table, saturation, water marks, sediment deposits, drift deposits, algal mat or crust, iron deposits, inundation visible on aerial imagery, water-stained leaves, salt crust, aquatic invertebrates, hydrogen sulfide odor, dry-season water table, oxidized rhizospheres on living roots (where not tilled), presence of reduced iron, and thin muck surface. Secondary indicators include surface soil cracks, sparsely vegetated concave surface, drainage patterns, oxidized rhizospheres on living roots (where tilled), crayfish burrows, saturation visible on aerial imagery, geomorphic position, and FAC-neutral test.

Hydric soils are defined as soils which are flooded, ponded, or saturated long enough during the growing season to develop anaerobic conditions in the upper part of the soil profile. The determination of hydric soils is generally based on the presence of indicators of an aquic moisture regime and hydric conditions. Aquic moisture regimes occur under anaerobic conditions and could develop from continuous saturation for at least five percent of the growing season. At least one positive hydric soil indicator at each site is required to classify the soil as hydric. For example, soils in prolonged anaerobic conditions undergo chemical reduction of iron and manganese, thereby producing low-chroma soil colors. Additionally, if reduced iron and manganese in inundated or saturated soil is exposed to oxygen in other areas of the soil ped (e.g., root pores and ped faces), areas of concentrated high-chroma mottles develop that are referred to as redoximorphic features. During the field survey, colors of the soil profile matrix and mottles are identified using Munsell® soil color charts. Additional characteristics of soil profile, texture, color, topography, and field indicators of hydrology are also considered in determining the presence of hydric soil.

C.4.1.3 Significant Nexus Evaluation

Based on the Rapanos Guidance (USACE, 2008b), each non-RPW stream and each wetland that is not adjacent to a TNW or directly abutting an RPW requires an evaluation for a significant nexus to a TNW, in this case the Double Mountain Fork of the Brazos River. Data collected on the functions of each potential water of the U.S. were used to determine if the hydrologic and ecologic impact of that resource would measurably affect the chemical, physical, and biological integrity of the downstream TNW.

C.4.2 Results

C.4.2.1 Waters of the U.S.

Waters of the U.S., including wetlands, within the study area are summarized in Table C-1 and subsequent sections. Delineation maps for waters of the U.S. within the study area are provided in Attachment C1, Figures 2 to 13. Site photographs and photograph location maps are provided in Attachment C2. Stream data sheets and wetland determination data forms are provided in Attachment C3.

Waters of the U.S., including wetlands, within the study area consist of 9 stream channels, 22 non-forested wetlands, and 1 forested wetland (Table C-2).

Table C-1.
Summary of Areal Extent of Waters of the U.S. within the Study Area

Categories of Waters of the U.S.	*Study Area Acreage*
Forested Wetlands	7.60
Non-Forested Wetlands	21.06
Open Water (On-channel Impoundments)	0.00
Streams	16.64
Total	**45.30**

Table C-2.
Individual Waters of the U.S. within the Study Area

Resource ID	*Description*	*OHWM (ft)*	*Classification*	*Linear Feet Within Study Area*	*Acreage Within Study Area*
S-1	Perennial Stream	20	Perennial RPW	35,122	16.13
S-2	Intermittent Stream	10	Seasonal RPW	1,642	0.38
S-3	Intermittent Stream	5	Seasonal RPW	107	0.01
S-4	Intermittent Stream	5	Seasonal RPW	192	0.02
S-5	Intermittent Stream	8	Seasonal RPW	148	0.03
S-6	Intermittent Stream	3	Seasonal RPW	185	0.01
S-7	Intermittent Stream	1	Seasonal RPW	155	0.01
S-8	Intermittent Stream	2	Seasonal RPW	169	0.01
S-9	Intermittent Stream	4	Seasonal RPW	432	0.04
W-1	Non-Forested Wetland	-	Adjacent*	-	0.07
W-2	Non-Forested Wetland	-	Adjacent*	-	0.01
W-3	Non-Forested Wetland	-	Abutting	-	1.05
W-4	Non-Forested Wetland	-	Adjacent*	-	3.92
W-5	Non-Forested Wetland	-	Abutting	-	0.62
W-6	Non-Forested Wetland	-	Adjacent*	-	0.39
W-7	Non-Forested Wetland	-	Adjacent*	-	0.08
W-8	Non-Forested Wetland	-	Abutting	-	10.39
W-9	Forested Wetland	-	Abutting	-	7.60
W-10	Non-Forested Wetland	-	Abutting	-	0.07

Table C-2.
Individual Waters of the U.S. within the Study Area (Concluded)

Resource ID	Description	OHWM (ft)	Classification	Linear Feet Within Study Area	Acreage Within Study Area
W-11	Non-Forested Wetland	-	Adjacent*	-	0.04
W-12	Non-Forested Wetland	-	Abutting	-	0.49
W-13	Non-Forested Wetland	-	Abutting	-	0.12
W-14	Non-Forested Wetland	-	Abutting	-	1.08
W-15	Non-Forested Wetland	-	Abutting	-	0.48
W-16	Non-Forested Wetland	-	Abutting	-	1.73
W-17	Non-Forested Wetland	-	Adjacent*	-	0.13
W-18	Non-Forested Wetland	-	Abutting	-	0.02
W-19	Non-Forested Wetland	-	Adjacent*	-	0.02
W-20	Non-Forested Wetland	-	Adjacent*	-	0.16
W-21	Non-Forested Wetland	-	Abutting	-	0.16
W-22	Non-Forested Wetland	-	Adjacent*	-	0.02
W-23	Non-Forested Wetland	-	Abutting	-	0.01
TOTAL				**38,152**	**45.30**
* Adjacent RPW with Significant Nexus to TNW					

C.4.2.2 Streams

The study area has a total of 38,152 linear feet (LF) (16.64 ac) of stream channels that include 35,122 LF of perennial (perennial RPW) stream and 3,030 LF of intermittent (seasonal RPW) stream (Table C-2).

Eight intermittent streams are within the study area and they have an OHWM width that varies from 1 ft to 10 ft wide (Table C-2). These streams have gently to steeply sloping banks that average 3 in to 10 ft high and widths that average 5 ft to 25 ft wide. Stream S-2 has a riparian corridor approximately 50 ft wide consisting of brush, woods, shrubs, and grass vegetation types. Stream S-4 is a side channel to S-1 that is surrounded by woods. The remaining intermittent streams are short and narrow channel segments connecting wetlands to the North Fork Double Mountain Fork Brazos River that do not have distinct riparian corridors. Erosion in these intermittent stream channels is slight to moderate and the substrate is composed primarily of either bedrock and silt/clay or silt/clay and organic matter.

The North Fork Double Mountain Fork Brazos River (S-1) is a perennial stream that has an average OHWM width of approximately 20 ft (Table C-2). On average, the banks are 25 ft wide and 10 ft in height. Erosion within the North Fork Double Mountain Fork Brazos River is moderate and the substrate of the creek is comprised of a silt/clay mix interspersed with small sections of gravel. Aquatic habitat of the North Fork Double Mountain Fork Brazos River consists primarily of undercut banks and log debris and brush, in addition to lesser amounts of gravel riffles, deep pools, and overhanging vegetation. The riparian corridor consists of scrub/shrub and pasture habitats and has an average width of 100 ft.

C.4.2.3 Wetlands

The study area contains 22 non-forested wetlands totaling 21.06 ac, and 1 forested wetland that is 7.60 ac in size, and these wetlands are considered waters of the U.S. (Table C-2).

The non-forested wetlands within the study area primarily support emergent herbaceous or marsh vegetation. Wetlands W-1 and W-2 occur south of and adjacent to stream S-1 near the middle of the study area. Wetland W-3 abuts to and occurs south of S-1, directly across the river from wetland W-4, which occurs north of and adjacent to S-1 near the middle of the study area. Wetland W-5 abuts to and occurs south of S-1 near the middle of the study area. Wetlands W-6 and W-7 occur adjacent to S-1 between wetlands W-4 and W-8. Wetland W-8 is located on both sides of S-1 near the middle of the study area and is bisected by a forested wetland (W-9). Wetland W-10 occurs in the scour pool formed at the outlet from a previously existing impoundment, and abuts stream S-5 which connects to S-1. Based on interpretation of historic aerial imagery of the study area (Attachment C4), wetlands W-1, W-2, W-3, W-4, W-5, W-6, W-7, W-8, W-9, and W-10 appear to be a result of human-induced hydrology alterations caused by previously existing dams and impoundments in the vicinity of the existing wetlands. Wetland W-11 occurs west of and adjacent to S-1 near the middle of the study area. Wetlands W-12, W-13, W-14, W-15, W-16, W-18, and W-23 occur north of and abut to S-1 near the downstream (east) end of the study area. Wetlands W-17, W-19, and W-22 also occur north of S-1 near the downstream end of the study area but are adjacent to S-1. Wetland W-20 occurs north of S-1 and lies adjacent to intermittent stream S-9 at the downstream end of the study area. Wetland W-21 occurs south of and abutting to S-1 near the downstream end of the study area. Wetlands W-11, W-17, W-18, W-19, W-21, W-22, and W-23 appear to result from depressions that receive and hold floodwaters from S-1, whereas wetlands W-12, W-13, W-14, W-15, W-16, and W-20 appear to be a result of groundwater seepage from the northern face of the canyon upslope of

S-1. This groundwater seepage primarily results from the upslope land application of treated wastewater.

The study area also contains 1 forested wetland totaling 7.60 ac (Table C-2). Wetland W-9 abuts both banks of stream S-1 near the middle of the study area and bisects non-forested wetland W-8. The river channel is poorly defined within this wetland and braids through the wetland as many small diffuse channels. The occurrence of W-9 appears to be a result of human-induced hydrology alterations caused by a previously existing dam and impoundments in the vicinity of the existing wetland (see Attachment C4). In addition, stream S-1 appears to be head-cutting into wetland W-9 at the southeast end, and may alter the hydrology and reduce the size of this wetland in the future.

C.4.3 Significant Nexus Discussion

Based on the Rapanos Guidance, 10 waters of the U.S. in the study area (W-1, W-2, W-4, W-6, W-7, W-11, W-17, W-19, W-20, and W-22) require a significant nexus evaluation because they do not directly abut to a RPW, yet they exhibit a significant nexus to a TNW (see sections 3.3 and 4.1.3). A discussion of the significant nexus of these waters of the U.S. is presented below.

Factors used in determining a significant nexus include: 1) hydrologic conditions, such as volume, duration, and frequency of flow; 2) ecological factors, such as aquatic habitat that supports the biological functions of a TNW; and 3) chemical factors, such as maintenance of water quality in the TNW.

Wetland W-1 is adjacent to RPW stream S-1. This wetland can reduce the amount of pollutants reaching the Double Mountain Fork of the Brazos River by capturing overflow from S-1 during high runoff events. Although this wetland may not provide habitat for many of the aquatic organisms within the Double Mountain Fork of the Brazos River, it does provide seasonal habitat for amphibians, wading birds, invertebrates, and other wildlife that are integral parts of the riparian ecosystem. During high runoff events, this wetland can transfer nutrients and organic carbon to downstream foodwebs (i.e., the Double Mountain Fork of the Brazos River). Based on the hydrologic and ecologic functions of wetland W-1, it was determined that W-1 has a significant nexus to the Double Mountain Fork of the Brazos River.

Wetland W-2 is adjacent to RPW stream S-1. This wetland can reduce the amount of pollutants reaching the Double Mountain Fork of the Brazos River by capturing overflow from S-1 during high runoff events. Although this wetland may not provide habitat for many of the aquatic organisms within the Double Mountain Fork of the Brazos River, it does provide seasonal habitat for amphibians, wading birds, invertebrates, and other wildlife that are integral parts of the riparian ecosystem. During high runoff events, this wetland can transfer nutrients and organic carbon to downstream foodwebs (i.e., the Double Mountain Fork of the Brazos River). Based on the hydrologic and ecologic functions of wetland W-2, it was determined that W-2 has a significant nexus to the Double Mountain Fork of the Brazos River.

Wetland W-4 is adjacent to RPW stream S-1. This wetland can reduce the amount of pollutants reaching the Double Mountain Fork of the Brazos River by capturing overflow from S-1 during high runoff events. Although this wetland may not provide habitat for many of the aquatic organisms within the Double Mountain Fork of the Brazos River, it does provide seasonal habitat for amphibians, wading birds, invertebrates, and other wildlife that are integral parts of the riparian ecosystem. During high runoff events, this wetland can transfer nutrients and organic carbon to downstream foodwebs (i.e., the Double Mountain Fork of the Brazos River). Based on the hydrologic and ecologic functions of wetland W-4, it was determined that W-4 has a significant nexus to the Double Mountain Fork of the Brazos River.

Wetland W-6 is adjacent to RPW stream S-1. This wetland can reduce the amount of pollutants reaching the Double Mountain Fork of the Brazos River by capturing overflow from S-1 during high runoff events. Although this wetland may not provide habitat for many of the aquatic organisms within the Double Mountain Fork of the Brazos River, it does provide seasonal habitat for amphibians, wading birds, invertebrates, and other wildlife that are integral parts of the riparian ecosystem. During high runoff events, this wetland can transfer nutrients and organic carbon to downstream foodwebs (i.e., the Double Mountain Fork of the Brazos River). Based on the hydrologic and ecologic functions of wetland W-6, it was determined that W-6 has a significant nexus to the Double Mountain Fork of the Brazos River.

Wetland W-7 is adjacent to RPW stream S-1. This wetland can reduce the amount of pollutants reaching the Double Mountain Fork of the Brazos River by capturing overflow from S-1 during high runoff events. Although this wetland may not provide habitat for many of the aquatic organisms within the Double Mountain Fork of the Brazos River, it does provide seasonal habitat for amphibians, wading birds, invertebrates, and other wildlife that are integral parts of the riparian ecosystem. During high runoff events, this wetland can transfer nutrients and organic carbon to downstream foodwebs (i.e., the Double Mountain Fork of the Brazos River). Based on the hydrologic and ecologic functions of wetland W-7, it was determined that W-7 has a significant nexus to the Double Mountain Fork of the Brazos River.

Wetland W-11 is adjacent to RPW stream S-1. This wetland can reduce the amount of pollutants reaching the Double Mountain Fork of the Brazos River by capturing overflow from S-1 during high runoff events. Although this wetland may not provide habitat for many of the aquatic organisms within the Double Mountain Fork of the Brazos River, it does provide seasonal habitat for amphibians, wading birds, invertebrates, and other wildlife that are integral parts of the riparian ecosystem. During high runoff events, this wetland can transfer nutrients and organic carbon to downstream foodwebs (i.e., the Double Mountain Fork of the Brazos River). Based on the hydrologic and ecologic functions of wetland W-11, it was determined that W-11 has a significant nexus to the Double Mountain Fork of the Brazos River.

Wetland W-17 is adjacent to RPW stream S-1. This wetland can reduce the amount of pollutants reaching the Double Mountain Fork of the Brazos River by capturing overflow from S-1 during high runoff events. Although this wetland may not provide habitat for many of the aquatic organisms within the Double Mountain Fork of the Brazos River, it does provide seasonal habitat for amphibians, wading birds, invertebrates, and other wildlife that are integral parts of the riparian ecosystem. During high runoff events, this wetland can transfer nutrients and organic carbon to downstream foodwebs (i.e., the Double Mountain Fork of the Brazos River). Based on the hydrologic and ecologic functions of wetland W-17, it was determined that W-17 has a significant nexus to the Double Mountain Fork of the Brazos River.

Wetland W-19 is adjacent to RPW stream S-1. This wetland can reduce the amount of pollutants reaching the Double Mountain Fork of the Brazos River by capturing overflow from S-1 during high runoff events. Although this wetland may not provide habitat for many of the aquatic organisms within the Double Mountain Fork of the Brazos River, it does provide seasonal habitat for amphibians, wading birds, invertebrates, and other wildlife that are integral parts of the riparian ecosystem. During high runoff events, this wetland can transfer nutrients and organic carbon to downstream foodwebs (i.e., the Double Mountain Fork of the Brazos River). Based on the hydrologic and ecologic functions of wetland W-19, it was determined that W-19 has a significant nexus to the Double Mountain Fork of the Brazos River.

Wetland W-20 is adjacent to RPW stream S-9. This wetland can reduce the amount of pollutants reaching the Double Mountain Fork of the Brazos River by capturing overflow from S-9 during high runoff events. Although this wetland may not provide habitat for many of the aquatic organisms within the Double Mountain Fork of the Brazos River, it does provide seasonal habitat for amphibians, wading birds, invertebrates, and other wildlife that are integral parts of the riparian ecosystem. During high runoff events, this wetland can transfer nutrients and organic carbon to downstream foodwebs (i.e., the Double Mountain Fork of the Brazos River). Based on the hydrologic and ecologic functions of wetland W-20, it was determined that W-20 has a significant nexus to the Double Mountain Fork of the Brazos River.

Wetland W-22 is adjacent to RPW stream S-1. This wetland can reduce the amount of pollutants reaching the Double Mountain Fork of the Brazos River by capturing overflow from S-1 during high runoff events. Although this wetland may not provide habitat for many of the aquatic organisms within the Double Mountain Fork of the Brazos River, it does provide seasonal habitat for amphibians, wading birds, invertebrates, and other wildlife that are integral parts of the riparian ecosystem. During high runoff events, this wetland can transfer nutrients and organic carbon to downstream foodwebs (i.e., the Double Mountain Fork of the Brazos River). Based on the hydrologic and ecologic functions of wetland W-22, it was determined that W-22 has a significant nexus to the Double Mountain Fork of the Brazos River.

C.4.4 Non-Jurisdictional Aquatic or Drainage Features

Within the study area, ponds constructed in uplands and non-jurisdictional wetlands are not considered to be waters of the U.S. when they: 1) do not have a surface hydrologic connection to a water of the U.S.; 2) are not adjacent to a water of the U.S.; 3) are not used for, never were in the past, and likely never would be used for interstate commerce; or 4) are not interstate waters. In addition, swales, erosional features, and ditches excavated wholly in and draining only uplands that do not carry a relatively permanent flow of water are not considered to be waters of the U.S. because they are not tributaries and do not have a significant nexus to a downstream TNW (USACE, 2008b). These non-jurisdictional aquatic and drainage features are identified in **Attachment C1, Figures 2 to 13,** and are referred to in this report as features that are not waters of the U.S. The acreages associated with these non-jurisdictional features are not included in total acreages for the delineation and proposed jurisdictional determination.

A single (1) upland pond exists within the study area (Attachment C1, Figure 13) that appears to have formed in a scour pool directly below an outlet pipe of an old dam and impoundment on the North Fork Double Mountain Fork Brazos River. Examination of historic aerial imagery (**Attachment C4**) indicated that the impoundment (Benson Lake) was present in 1978 but had breached its earthen dam by 1996. Breaching of the dam appears to have resulted in the establishment of a new river channel approximately 200 ft north of the upland pond. As a result of the river's rechannelization the upland pond appears to only capture overland flow in its present condition and does not appear to have an outlet to a water of the U.S., as evident by stagnant water conditions and a lack of a definitive OHWM connecting this aquatic feature to a water of the U.S. Therefore, it was determined that this upland pond is not a water of the U.S.

Non-jurisdictional wetlands have developed in the study area where groundwater seeps out of the northern face of the canyon, but then dissipates/infiltrates into the ground downslope of the wetland. This groundwater seepage primarily results from the upslope land application of treated wastewater. These non-jurisdictional wetlands have developed away from, and do not have a connection to, a water of the U.S. There are 6 non-jurisdictional wetlands within the study area that comprise approximately 1.21 ac.

C.5 Summary and Recommendations

The approximately 800-ac study area contains 9 streams and 23 wetlands totaling 45.30 ac that were considered to be waters of the U.S. based on this study. The study area also contains non-jurisdictional aquatic features.

C.5.1 Regulatory and Permitting Discussion

This delineation and proposed jurisdictional determination of the study area is based on the best professional judgment of HDR's team of wetland delineators, with extensive experience with similar resources in the north-west Texas region. However, it does not constitute a final Jurisdictional Determination or significant nexus determination which can only be officially rendered by the USACE Regulatory Branch through the formal review process. Non-jurisdictional aquatic features in the study area were identified based on HDR's experience and interpretation of USACE guidance on Supreme Court rulings; however, the proposed jurisdictional determination for these features should be confirmed with the USACE to ensure consistency with the application of the USACE guidance in the Fort Worth District. Additionally, the evaluation methodology for determining surface hydrologic connection and significant nexus used for this site was confirmed in a meeting on February 6, 2008 between James Thomas, PWS, and Ricky Wilson of HDR, and Ms. Jennifer Walker, USACE Fort Worth District (SWF) - Permits Section Chief, for an unrelated project. Based on that discussion, subsequent discussions with SWF staff, and the findings of this evaluation, HDR recommends that this delineation and jurisdictional evaluation report be submitted to the USACE for verification.

Projects can be conducted in uplands and in non-jurisdictional waters (e.g., non-jurisdictional aquatic features) with no Section 404 permitting requirements. However, the proposed project will likely cause fill to the features identified as waters of the U.S. in this report. Therefore, if the findings of this report are verified by the USACE, impacts to these features would require authorization under Section 404. Due to the size and nature of this project, it would likely be authorized under an Individual Permit and would require the submittal of an application and mitigation plan to the USACE.

C.5.2 Other Permitting Requirements

Section 401 of the CWA requires that projects permitted under Section 404 permits meet conditions to ensure water quality protection during and following placement of fill into waters of the U.S. (e.g., construction activities). Within Texas, the TCEQ administers the Section 401 water quality protection program. Projects that affect more than three ac of waters of the U.S. and/or 1,500 LF of stream require Tier II 401 certification from the TCEQ. If required, a Section 401 certification should be submitted with the Section 404 permit application.

C.6 References

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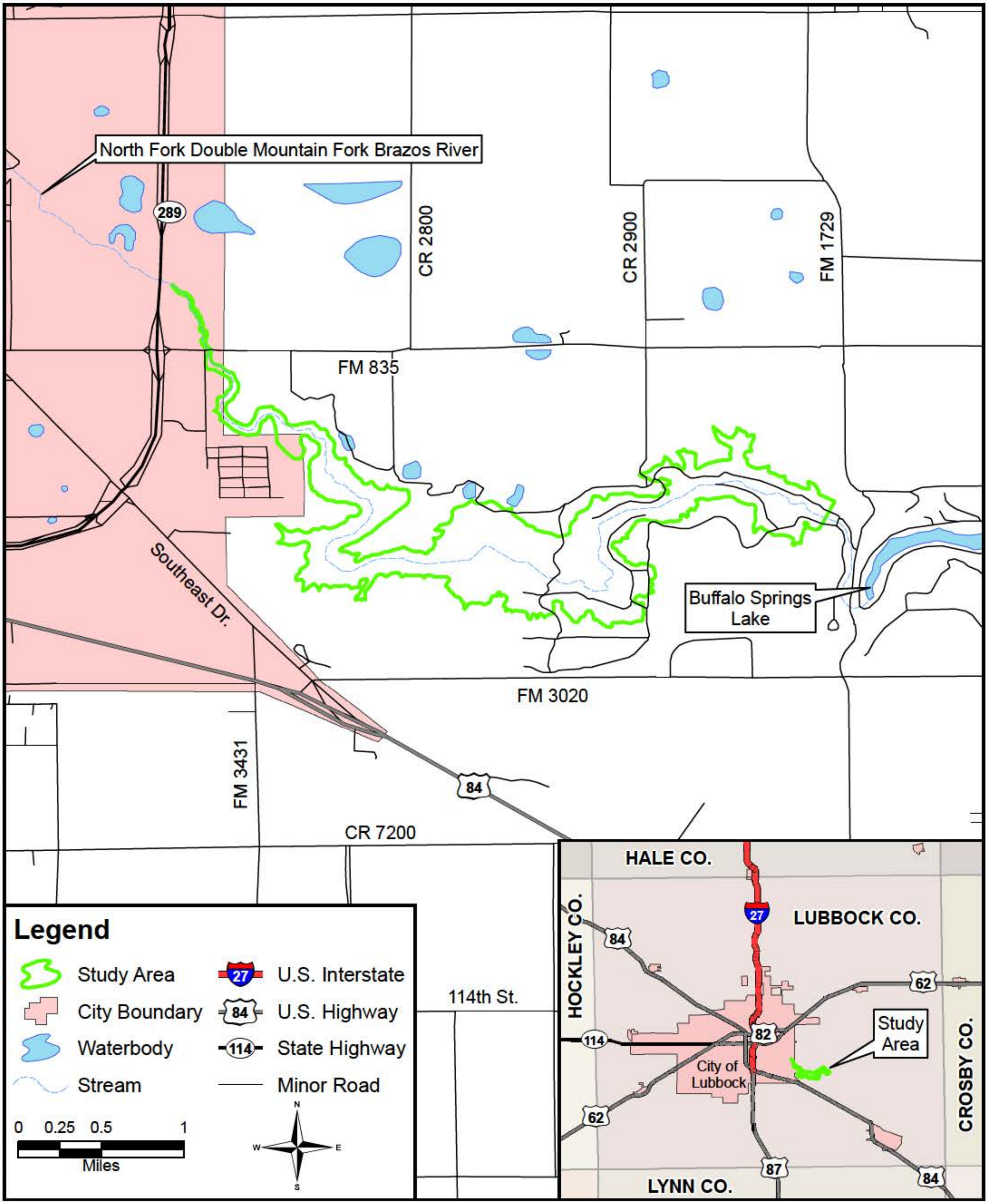
Attachment C1

General Location Map and Waters of the U.S. Delineation Maps



GENERAL LOCATION MAP

Proposed Lubbock Lake No. 7

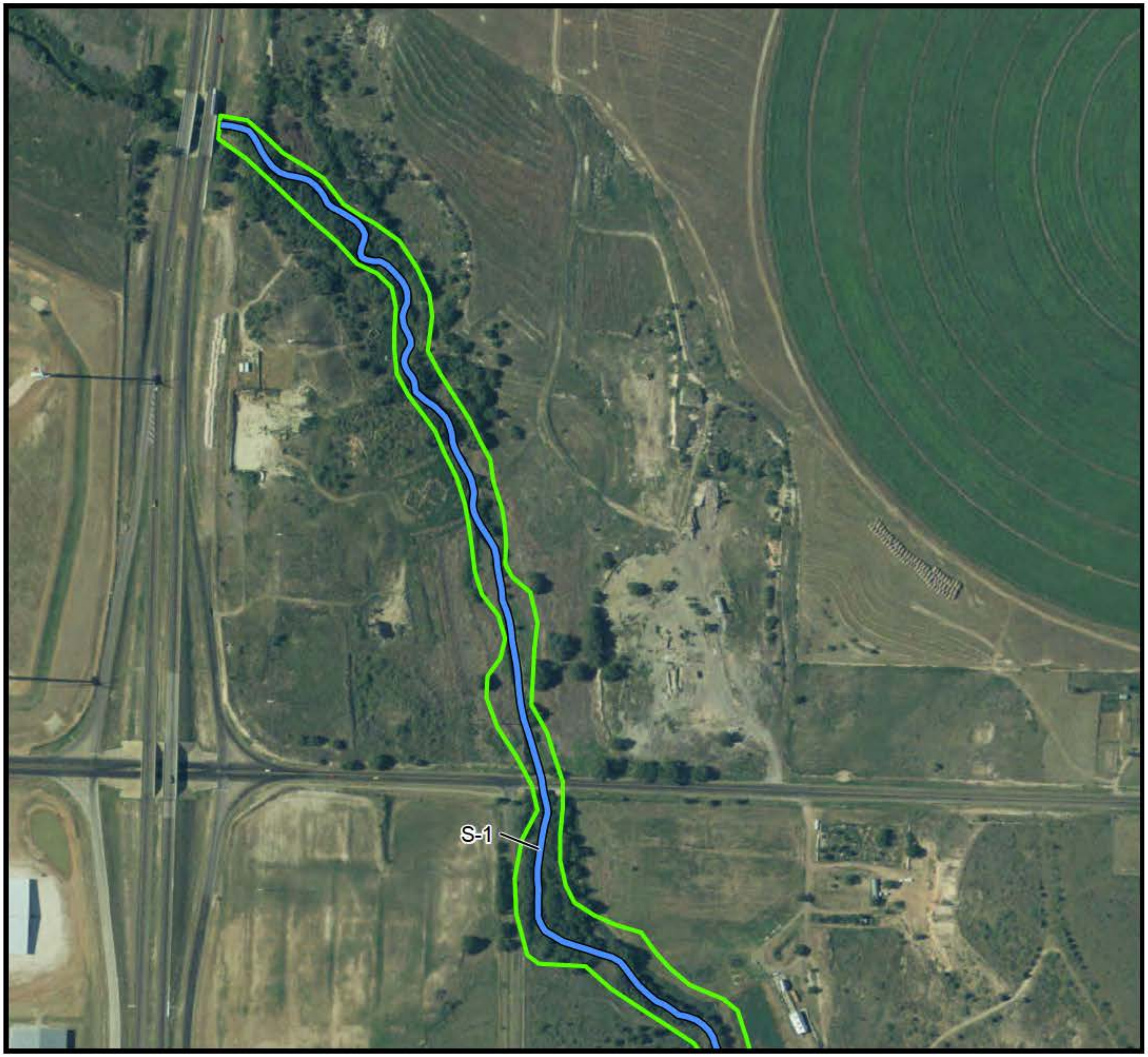
HDR Engineering, Inc.
17111 Preston Rd. Suite 200
Dallas, Texas 75248-1232
972-960-4400

FIGURE 1

MAY 2010

FILE: O:\Dept037_DallasEngineering\EnvSciences\116724_Lubbock_Lake_7\MapDocs\arcmap\Delineation Report Gen Loc Map_DLM.mxd

Lubbock Lake No. 7
Delineation of Waters of the U.S., including Wetlands



Legend

Waters of the U.S.

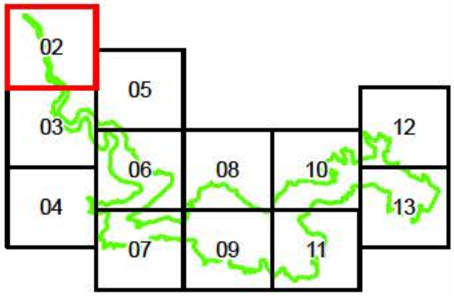
- 🟦 Perennial Stream
- 🟦 Intermittent Stream
- 🟦 Ephemeral Stream
- 🟦 On-Channel Impoundment
- 🟩 Wetland

Features that are not Waters of the U.S.

- ✦ Data Point
- ∧ Study Area Boundary
- 🟧 Non-Jurisdictional Wetland
- 🟨 Upland Pond

0 125 250 500 Feet

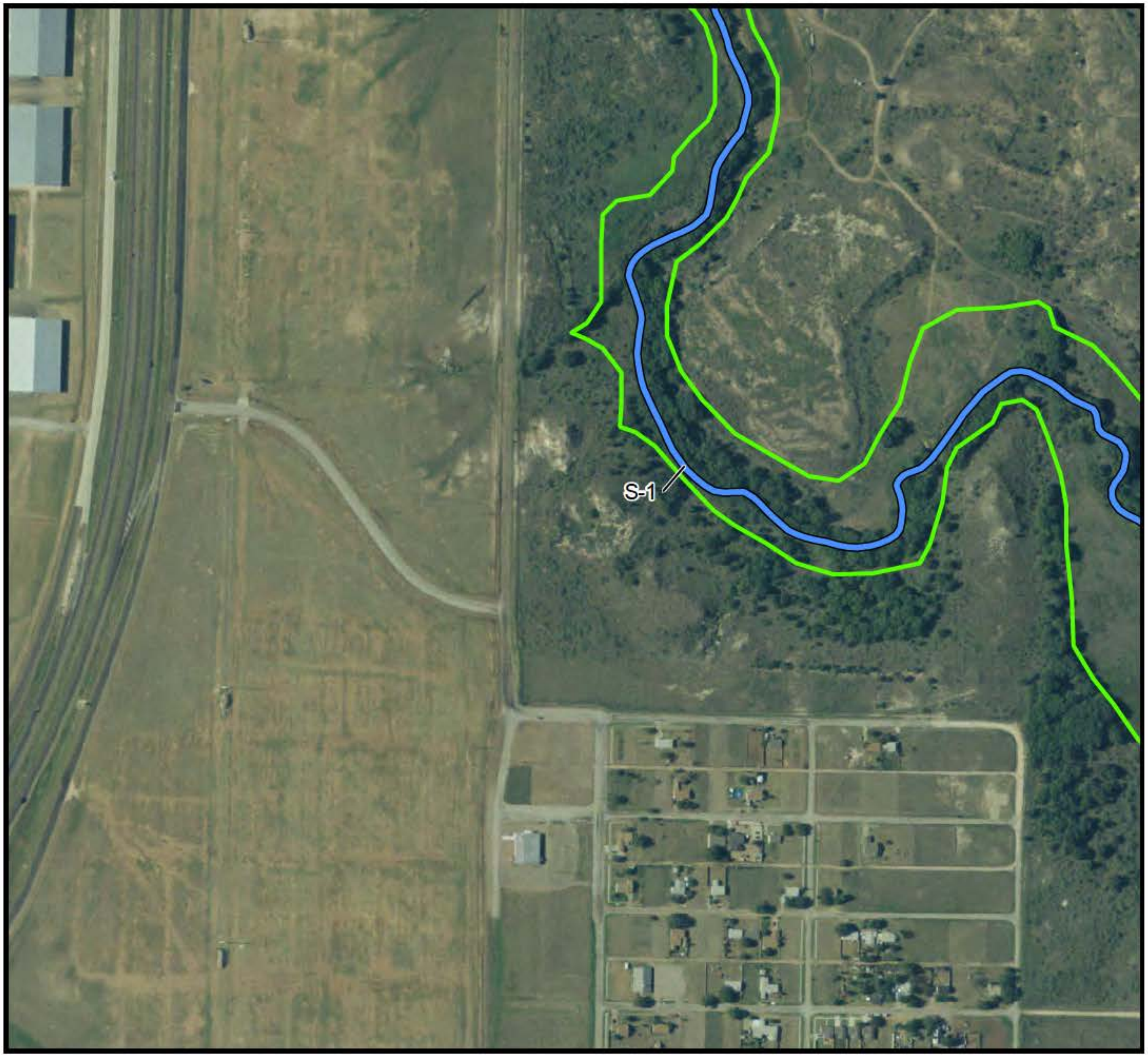
N



MAY 2010

FIGURE 02 OF 13

Lubbock Lake No. 7
Delineation of Waters of the U.S., including Wetlands



Legend

Waters of the U.S.

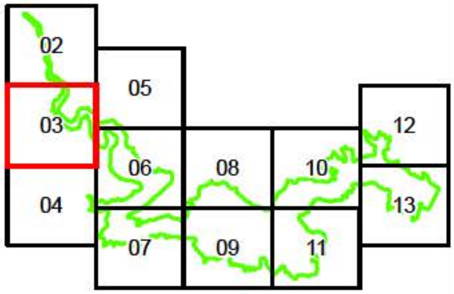
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- Data Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N



city of lubbock TEXAS

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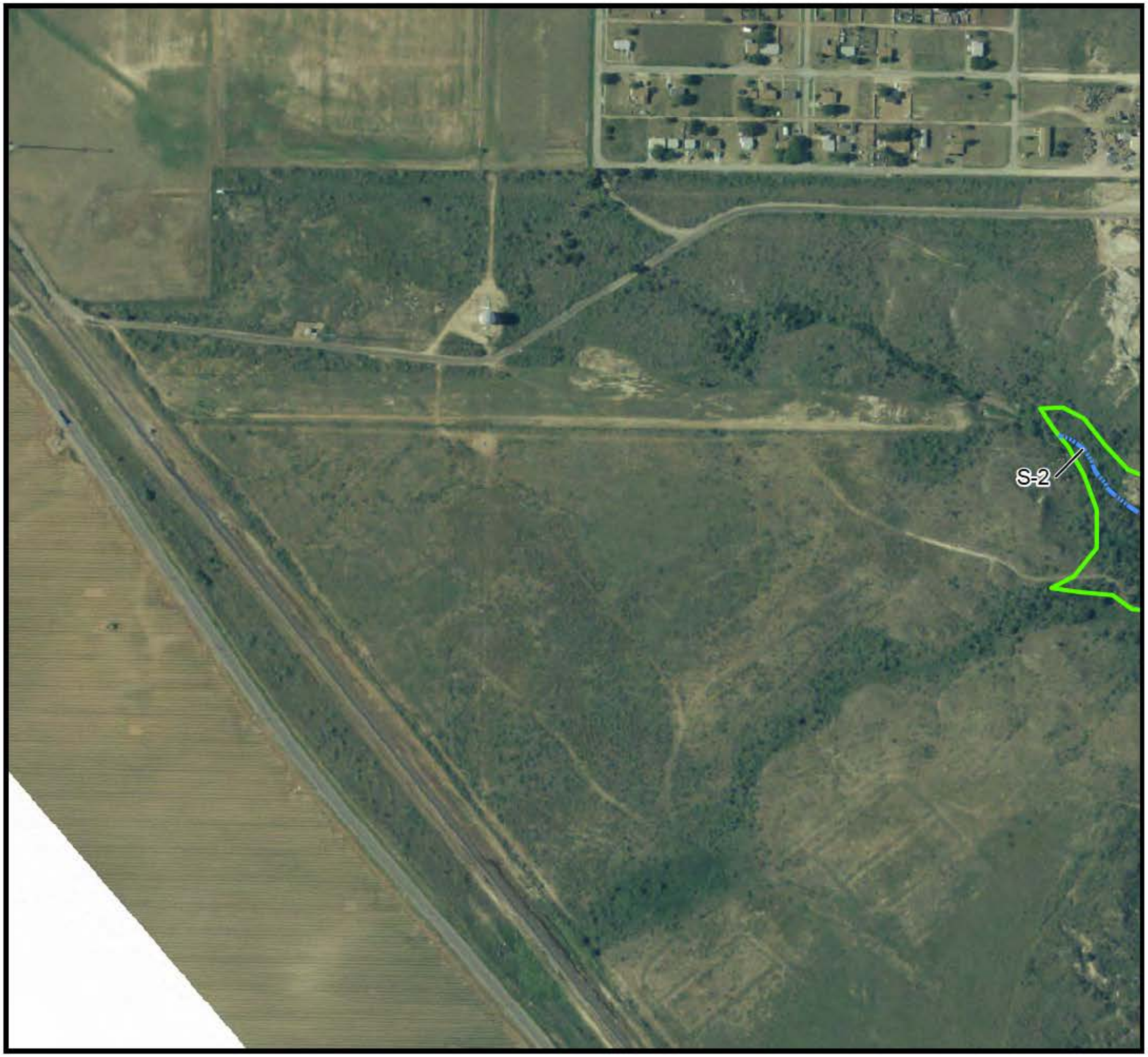
FIGURE 03 OF 13

Lubbock Lake No. 7
Delineation of Waters of the U.S., including Wetlands



Legend

Waters of the U.S.

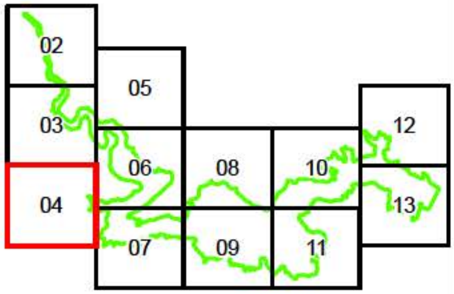
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- Data Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N



city of lubbock TEXAS

HDR

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Lubbock Lake No. 7
Delineation of Waters of the U.S., including Wetlands

Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- Data Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N

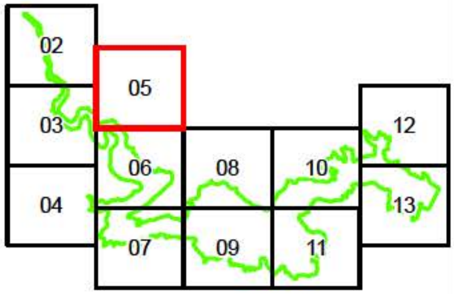

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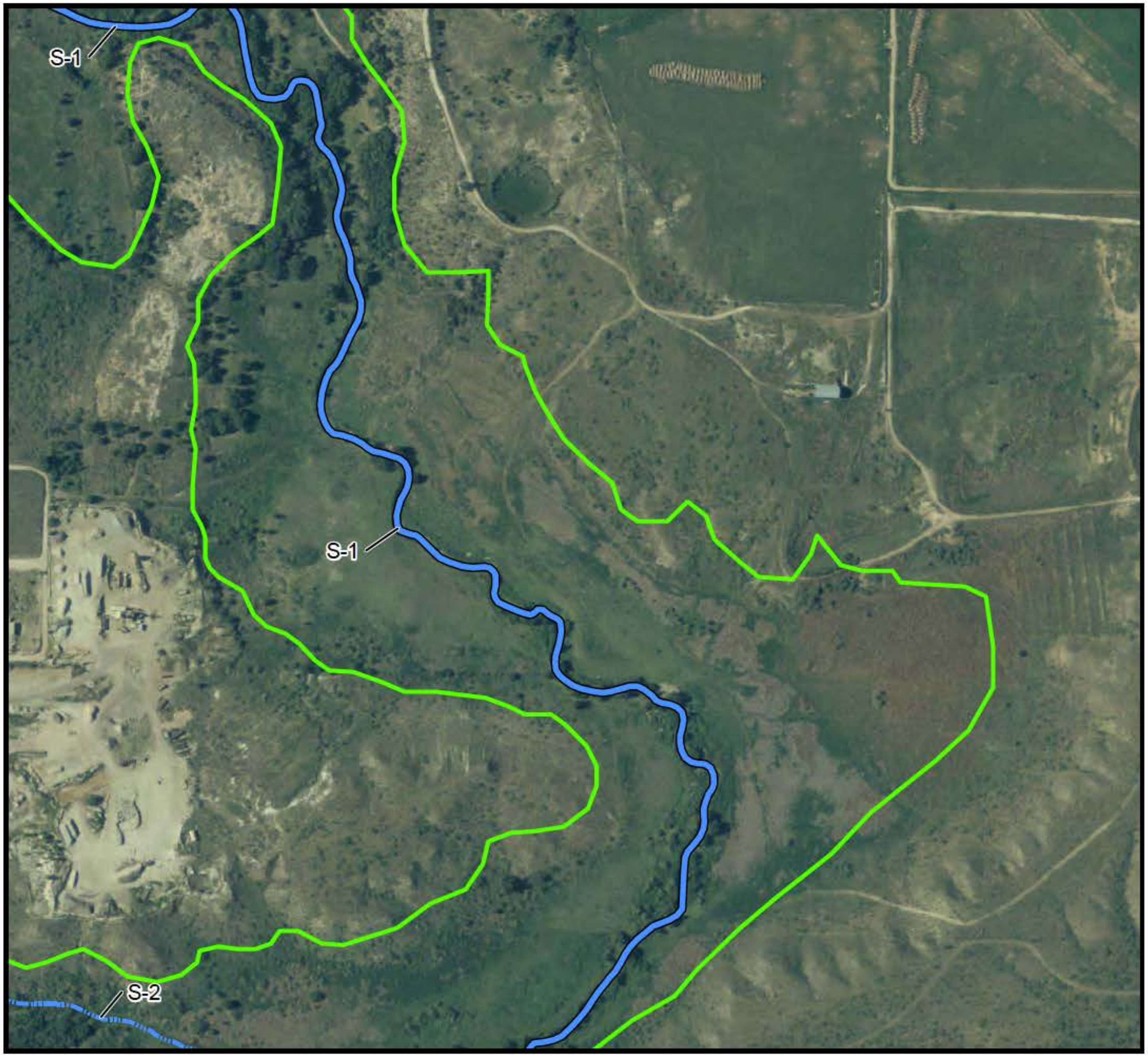
FIGURE 05 OF 13

Lubbock Lake No. 7
Delineation of Waters of the U.S., including Wetlands



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- Data Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N

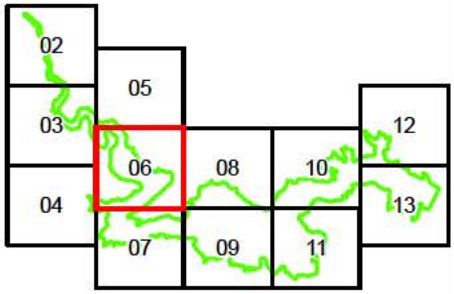


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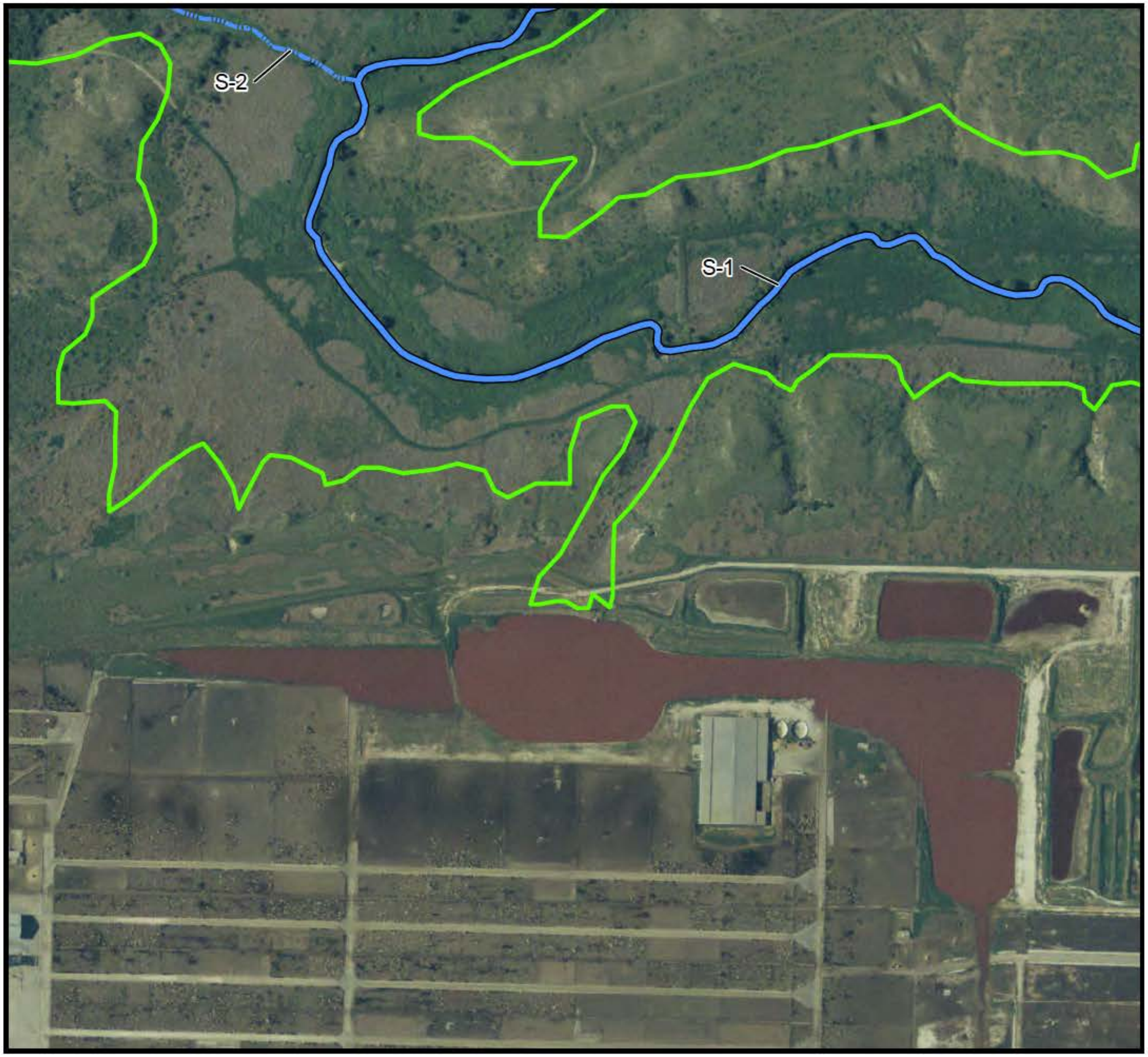
FIGURE 06 OF 13

Lubbock Lake No. 7
Delineation of Waters of the U.S., including Wetlands



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- Data Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N

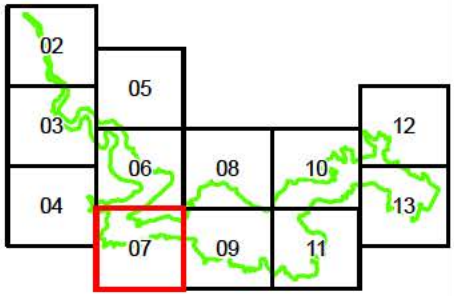


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FIGURE 07 OF 13

Lubbock Lake No. 7
Delineation of Waters of the U.S., including Wetlands

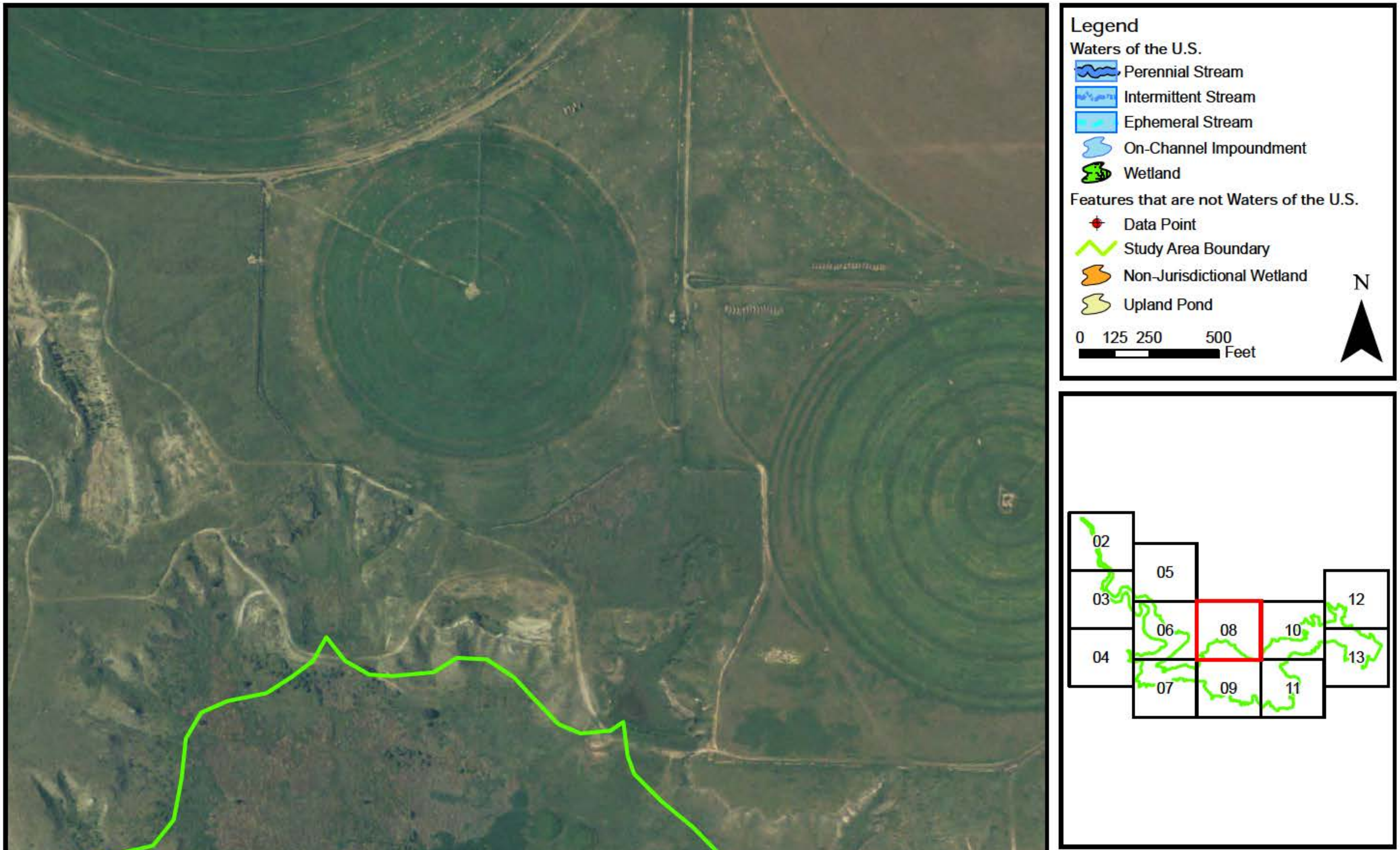

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FIGURE 08 OF 13

Lubbock Lake No. 7
Delineation of Waters of the U.S., including Wetlands

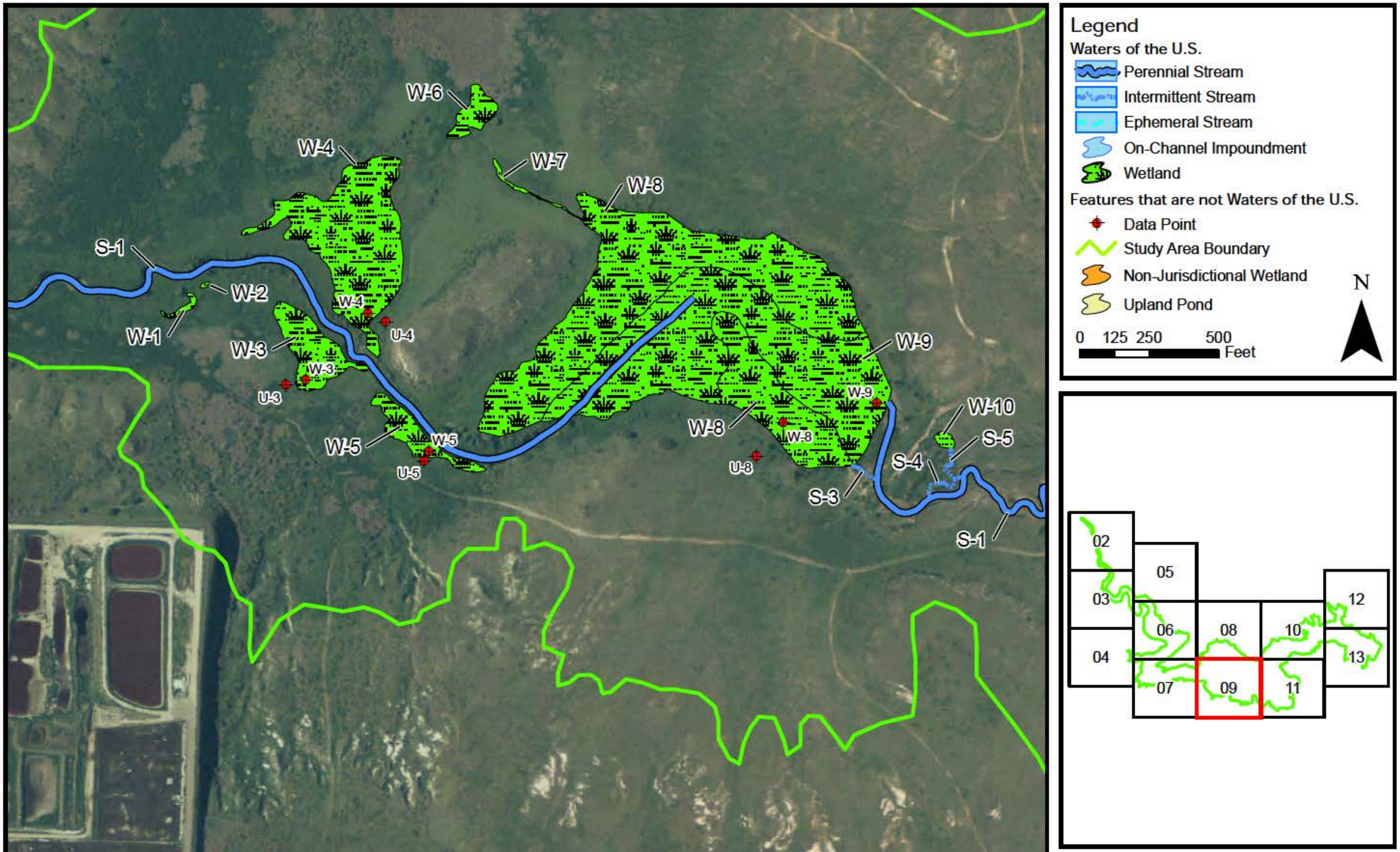

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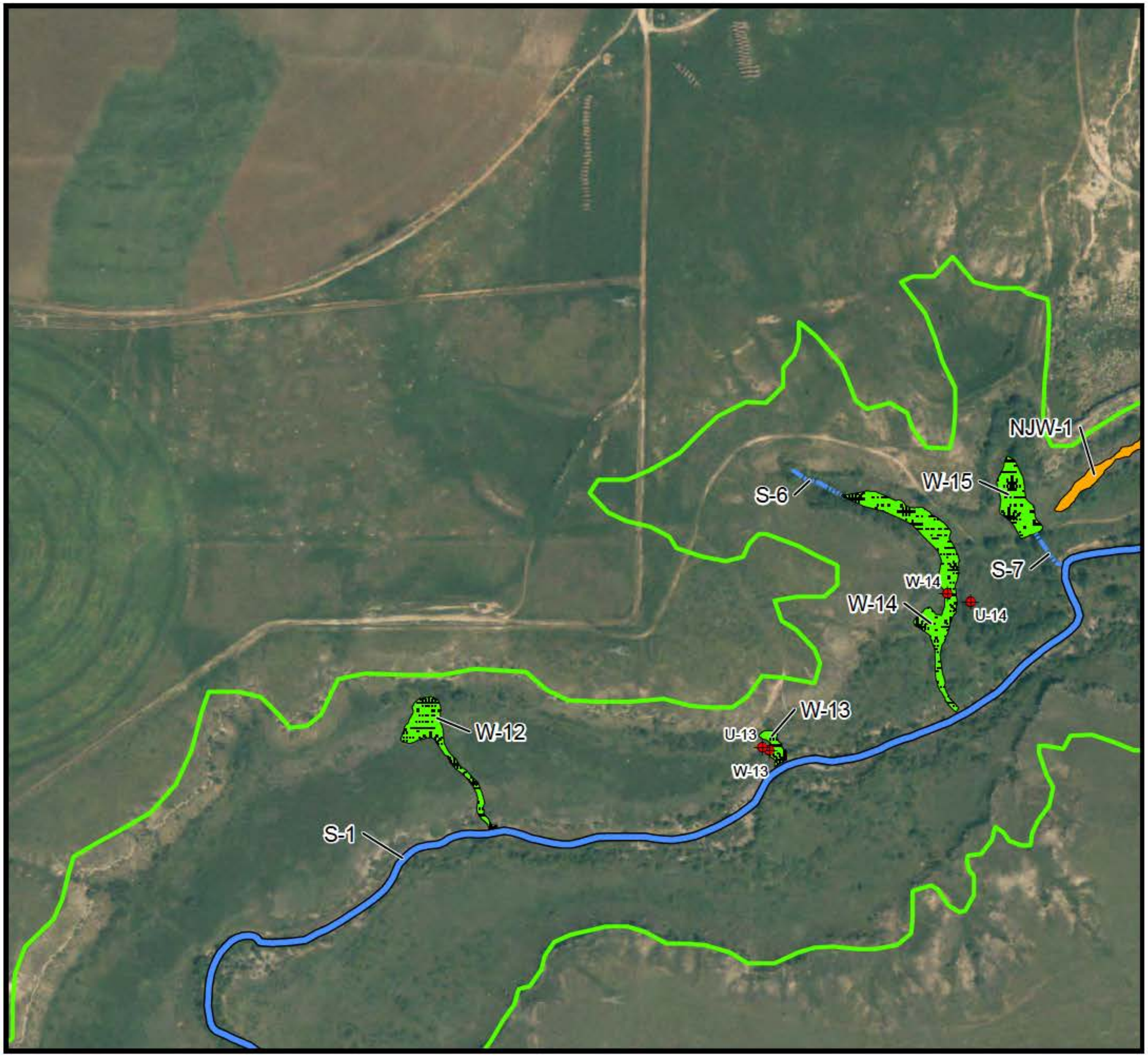
FIGURE 09 OF 13

Lubbock Lake No. 7
Delineation of Waters of the U.S., including Wetlands



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- Data Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N

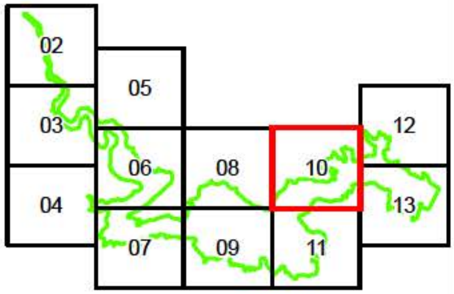


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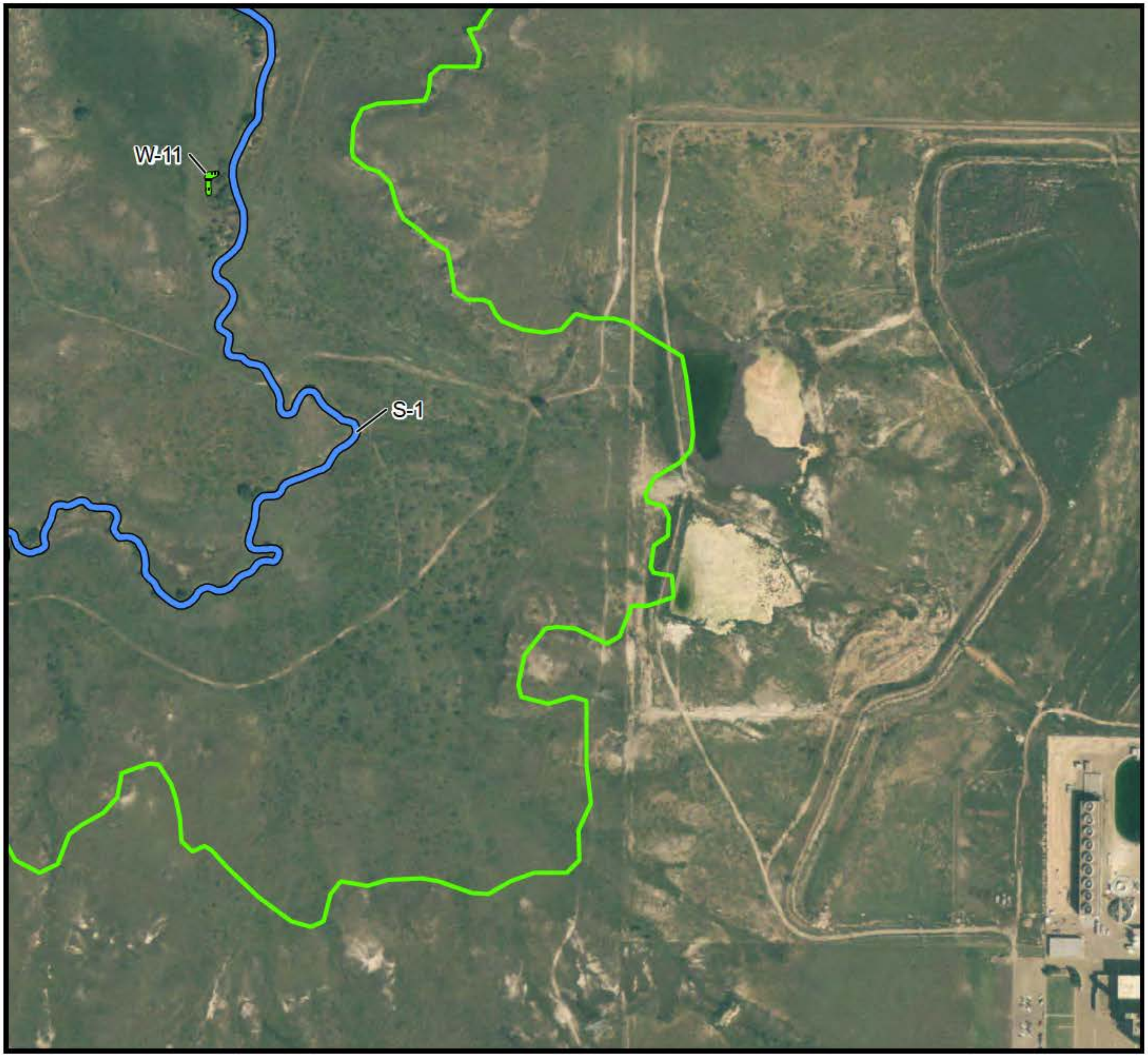
FIGURE 10 OF 13

Lubbock Lake No. 7
Delineation of Waters of the U.S., including Wetlands



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- Data Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

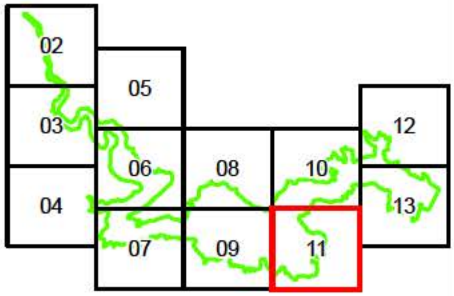


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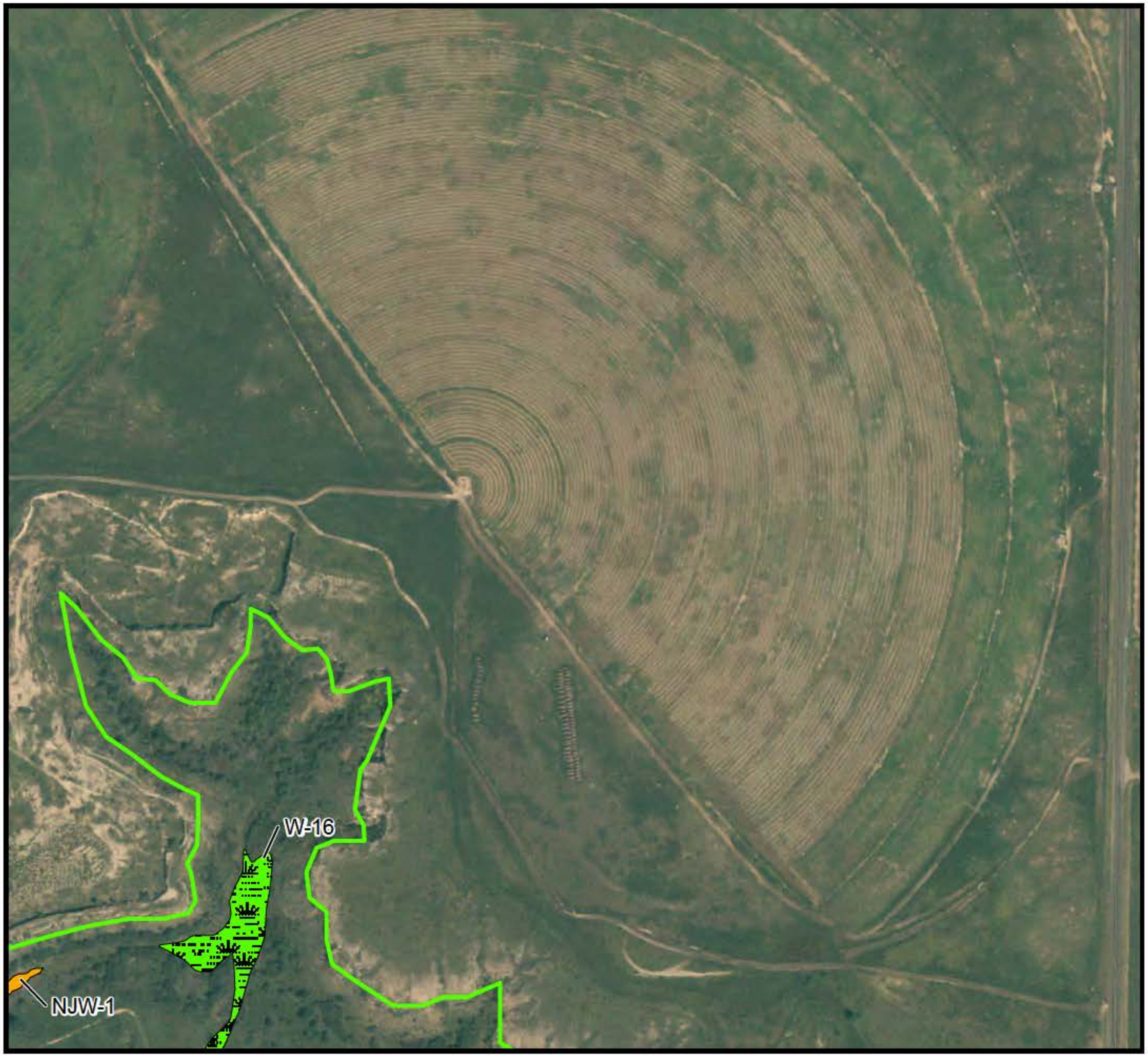
FIGURE 11 OF 13

Lubbock Lake No. 7
Delineation of Waters of the U.S., including Wetlands



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- Data Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N

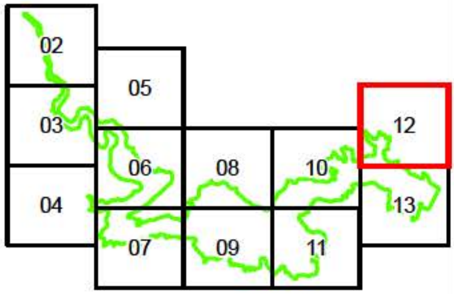


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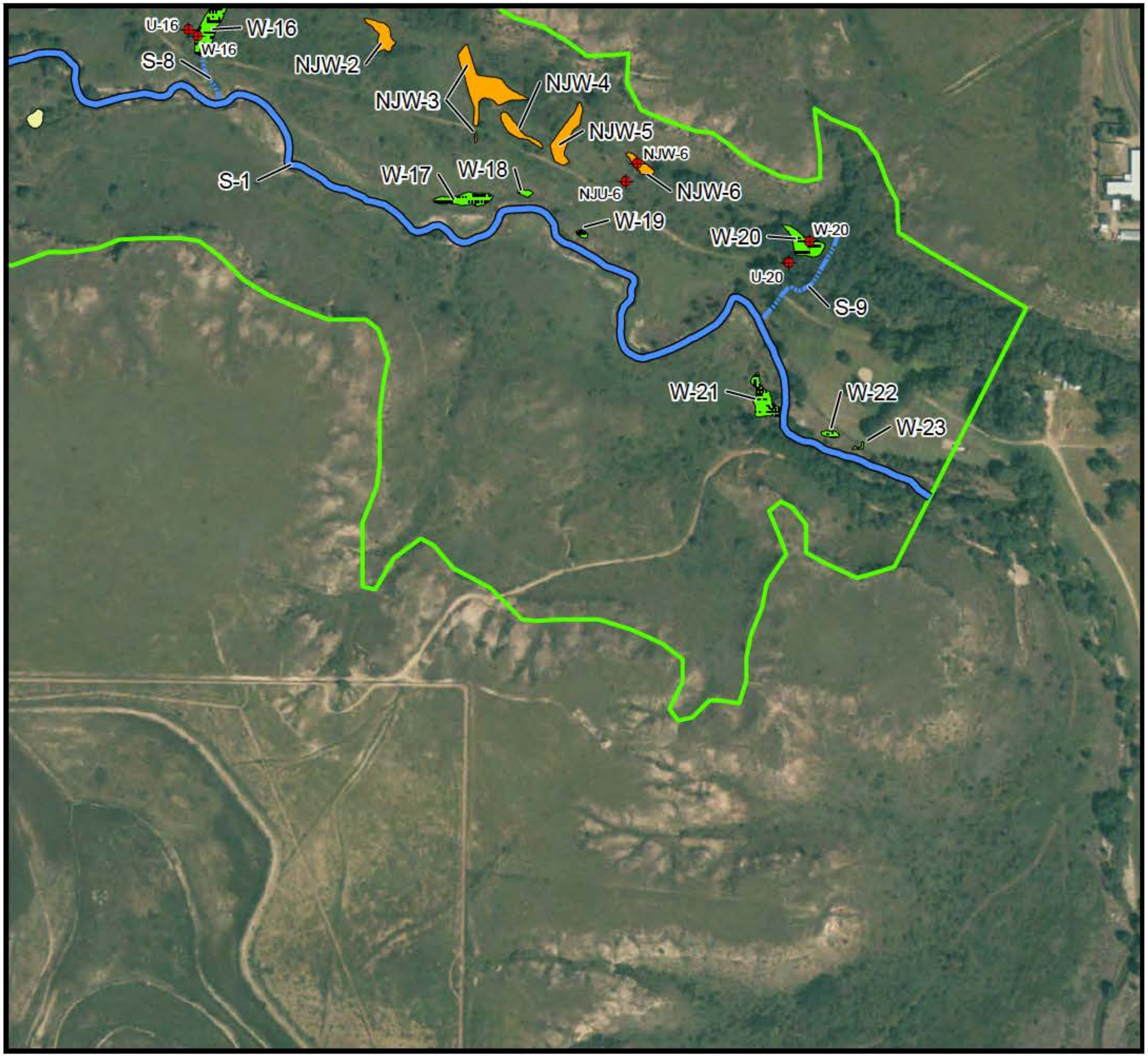
FIGURE 12 OF 13

Lubbock Lake No. 7
Delineation of Waters of the U.S., including Wetlands



Legend

Waters of the U.S.
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.
- Data Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500
Feet

N

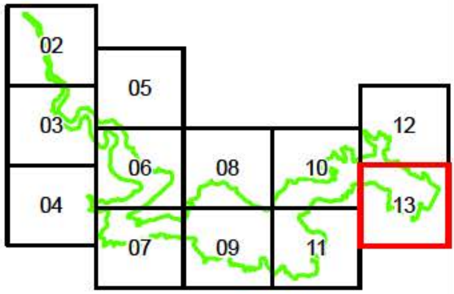


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FIGURE 13 OF 13

Attachment C2
Site Photographs and Photograph Location Maps

Representative Site Photographs
Delineation and Proposed Jurisdictional Determination
Lubbock Lake 7

Pictures Taken November 11–12, 2009 and April 29, 2010
Photograph Locations are Shown on Accompanying Maps

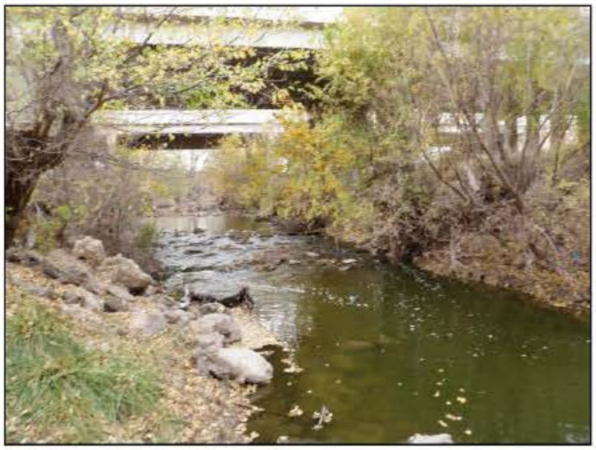


Photo 1. Stream S-1 (North Fork Double Mountain Fork Brazos River) facing upstream (northwest) at the TX-289 loop bridge. The OHWM width averages 20 ft in the study area. Note the bridge in the background and the rocky riffle below it.

Photo 2. Stream S-1 facing downstream (southeast) at the TX-289 loop bridge. Note the pool within the river and the open understory along the wooded riparian corridor.

Photo 3. Stream S-1 facing downstream (south). The OHWM width averages 20 ft in the study area. Note the dense herbaceous vegetation along the channel.

Photo 4. Stream S-1 facing east, across the stream channel, upstream of the Farm-to-Market Road (FM) 835 bridge. Note the clearing adjacent to river. The photograph was taken at the mouth of an apparently newly constructed ditch cut down to the river assumed to facilitate drainage of the surrounding uplands.

Photo 5. Stream S-1 facing upstream (north) at the FM 835 bridge. The OHWM width averages 20 ft in the study area. Note the pipe crossing the river in background is the same pipe in the previous image (Photo 4). Note the river forms a pool along this stretch and the vegetation along the shoreline is primarily herbaceous.

Photo 6. Stream S-1 facing downstream (south) at the FM 835 bridge. Note the riffle formed below the bridge and the dense woody vegetation along the riparian corridor.

Photo 7. Stream S-1 facing upstream (northwest). The OHWM width averages 20 ft in the study area. Note the dense herbaceous vegetation along the shoreline in the foreground and the eroding shoreline and exposed tree roots on the opposite bank.

Photo 8. Stream S-1 facing upstream (north). Note the wooded riparian corridor and open understory and the undercutting of the left stream bank. Also note that the river is pooled along this stretch.

Photo 9. Stream S-1 facing west, across the stream channel. The OHWM width averages 20 ft in the study area. Note the river forms a shallow riffle along this stretch. Also note the wooded riparian corridor and open understory.

Photo 10. Stream S-2 facing upstream (west). The OHWM width averages 10 ft in the study area. Note the dense herbaceous vegetation at the right and the dense woody vegetation at the left.

Photo 11. Stream S-2 facing upstream (northwest). Note the vegetated stream channel along this stretch of stream and the herbaceous vegetation surrounding the stream corridor.

Photo 12. Stream S-2 facing upstream (northwest). The OHWM width averages 10 ft in the study area. Note the herbaceous vegetation on both sides of the stream corridor.

Photo 13. Stream S-1 facing upstream (west). The OHWM width averages 20 ft in the study area. Note that the river is pooled along this stretch. Also note the gently sloping vegetated banks in this reach.

Photo 14. Stream S-1 facing downstream (east). Note the vegetated stream banks and the herbaceous vegetation along the riparian corridor.

Photo 15. Wetland W-3 facing north. W-3 is a non-forested wetland that abuts to stream S-1. Note the dense emergent vegetation surrounding the small area of open water and mud seen in the background.

Photo 16. Wetland W-4 facing southwest. W-4 is a non-forested wetland adjacent to S-1. Note the emergent and shrub vegetation scattered in shallow water. W-4 receives floodwaters from S-1, and appears to have formed in the location of a previous impoundment.

Photo 17. Wetland W-5 facing east. W-5 is a non-forested wetland that abuts to stream S-1. Note the wetland connecting to stream S-1.

Photo 18. Wetland W-7 facing northwest. W-7 appears to have formed in a swale connecting two previous impoundments of S-1. W-7 appears to receive floodwaters from S-1 that overflow into W-4 and W-6. W-7 overflows into W-8.

Photo 19. Wetland W-8 facing southeast. W-8 is a non-forested wetland that abuts to stream S-1. Note the shallow open water interspersed within dense emergent vegetation.

Photo 20. Wetland W-8 facing west. W-8 is a non-forested wetland that abuts to stream S-1. Note the dense emergent vegetation at the left and the herbaceous upland vegetation at the right.

Photo 21. Wetland W-9 facing north. W-9 is a forested wetland that abuts to stream S-1. Note the dense woody vegetation in the background.

Photo 22. Wetland W-8 facing southeast. W-8 is a non-forested wetland that abuts to stream S-1. Note the dense emergent vegetation at the left and the flowing water at the center of the photograph.

Photo 23. Wetland W-8 facing northwest. W-8 is a non-forested wetland that abuts to stream S-1. Note the dense emergent vegetation. Also note in the foreground the small channels of flowing water merging to form stream S-3 which flows directly into stream S-1.

Photo 24. Stream S-3 facing downstream (southeast). The OHWM width averages 5 ft. This photograph is near the convergence of S-3 with S-1. Note the washed out dam structure of a previously existing impoundment along stream S-1.

Photo 25. Stream S-1 facing downstream (south). The OHWM width averages 20 ft in the study area. Note woody and herbaceous vegetation within riparian corridor. At this location S-1 has just emerged from wetland W-9. Stream S-3 joins with S-1 just downstream of this photograph.

Photo 26. Stream S-4 facing downstream (east). The OHWM averages 5ft. S-4 is a well-defined side channel of S-1 below an old breached dam. Note the debris in the trees which indicate recent heavy flooding.

Photo 27. Wetland W-10 facing southeast. W-10 is a non-forested wetland which occurs in the scour pool formed at the outlet from a previously existing impoundment. W-10 abuts and overflows into stream S-5 which connects to S-1. Note the open water in the middle of the wetland.

Photo 28. Stream S-1 facing upstream (northwest). Note the gently sloping vegetated stream bank on right and the steep, eroding bank on the left. Also note that the predominant vegetation surrounding the stream corridor is herbaceous.

Photo 29. Stream S-1 facing downstream (north). The OHWM width averages 20 ft in the study area. Note that the river is pooled along this stretch. Also note the steep stream bank along the right with overhanging woody vegetation.

Photo 30. Stream S-1 facing upstream (south). Note the woods along the channel in this reach, as well as the sediment deposition in the floodplain in the background.


Photo 31. Stream S-1 facing downstream (northeast). Note the debris in the foreground and background indicating recent heavy flooding.


Photo 32. Stream S-1 facing downstream (east). The OHWM width averages 20 ft in the study area. Note the sparsely vegetated stream banks along this stretch. Also note in the foreground the sparse herbaceous vegetation along the riparian corridor and the more dense woody vegetation in the background.


Photo 33. Wetland W-13 facing southeast. W-13 is a non-forested wetland that has formed where groundwater seeps from the canyon wall upslope of S-1. W-13 directly abuts S-1 (in the background). Note the dense emergent vegetation in W-13.

Photo 34. Stream S-1 facing upstream (west). Note the shallow riffles formed along this stretch and the moderately steep unvegetated stream banks. Also note the herbaceous vegetation along the riparian corridor.

Photo 35. Wetland W-14 facing northwest. W-14 is a non-forested wetland that abuts to stream S-1. Note the dense emergent vegetation at the left and the upland herbaceous vegetation at the right. This wetland is a result of water seeping from upslope canyon walls. Stream S-6 flows into W-14.

Photo 36. Wetland W-15 facing northwest. W-15 is a non-forested wetland that abuts to stream S-7, which flows directly into stream S-1. Note the dense emergent vegetation at the right and the standing water at the left. This wetland is a result of water seeping from upslope canyon walls.

Photo 37. Stream S-1 facing upstream (southeast). The OHWM width averages 20 ft in the study area. Note the low-lying and densely vegetated stream banks. Also note the steep and eroded second bank at the left, behind the vegetated low-lying first bank.

Photo 38. Stream S-1 facing downstream (east). Note that the river forms a shallow rock riffle along this stretch. Also note the steep, unvegetated, and eroding bank at the left and the gently sloping, vegetated bank at the right.

Photo 39. Non-jurisdictional wetland NJW-1 facing south. This wetland is a result of groundwater seeping from upslope canyon walls, but the water infiltrates the ground downslope of the wetland and thus it has no surface hydrologic connection to a water of the U.S.

Photo 40. Wetland W-16 facing south. W-16 is a non-forested wetland that abuts to stream S-8 (which flows directly into stream S-1). Note the dense emergent vegetation and standing water. This wetland is a result of water seeping from upslope canyon walls.

Photo 41. Upland pond facing southwest. Note the low water and large culvert connecting to uplands on the other side of the berm. This upland pond has no surface hydrologic connection to waters of the U.S. and is likely a result of the breeching and draining of a previously existing dam and impoundment along stream S-1. At present this pond likely only receives local run-off during rain events.

Photo 42. Stream S-1 facing downstream (east). The OHWM width averages 20 ft in the study area. Note the moderately steep stream banks with some herbaceous and woody vegetation. Also note that the river is pooled along this stretch.

Photo 43. Stream S-1 facing upstream (west). Note the steep, unvegetated, and eroding bank at the left, and the gently sloping vegetated bank at the right. Also note that the river begins to form a shallow riffle in the foreground.

Photo 44. Stream S-1 facing downstream (east). The OHWM width averages 20 ft in the study area. Note the steep, unvegetated, and eroding stream banks. Also note that the river forms a shallow riffle along this stretch.

Photo 45. Stream S-1 facing upstream (west). Note the steep unvegetated stream bank at the left. Also note the herbaceous vegetation and scattered woody vegetation along the riparian corridor.

Photo 46. Non-jurisdictional wetland NJW-3 facing north. NJW-3 is a result of groundwater seeping from upslope canyon walls, but the water infiltrates the ground downslope of the wetland and thus it has no surface hydrologic connection to a water of the U.S.

Photo 47. Non-jurisdictional wetland NJW-6 facing southeast. NJW-6 is a result of groundwater seeping from upslope canyon walls, but the water infiltrates the ground downslope of the wetland and thus it has no surface hydrologic connection to a water of the U.S. Note the dense emergent vegetation dominated by common spikerush.

Photo 48. Stream S-1 facing upstream (northwest). The OHWM width averages 20 ft in the study area. Note the gently sloping stream banks with herbaceous vegetation and scattered trees. Also note that the river is pooled along this stretch.

Photo 49. Stream S-1 facing downstream (southeast). Note the dense herbaceous and woody vegetation along the moderately steep stream banks. Also note that the river is pooled along this stretch.

Photo 50. Stream S-9 facing downstream (southwest). The OHWM width averages 4 ft. Note the woody overstory and open herbaceous understory. Also note the flowing water in stream channel.

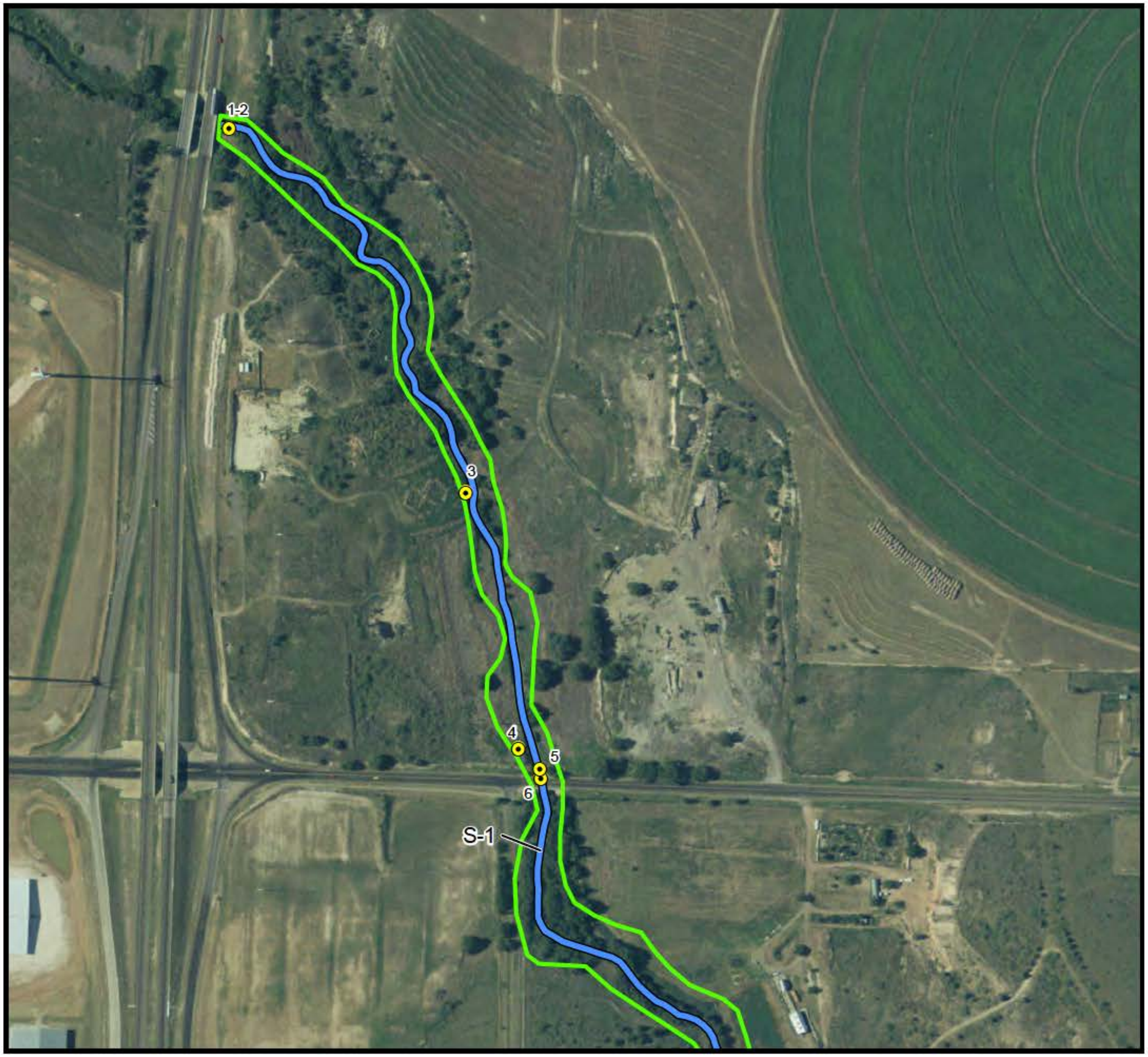
Photo 51. Stream S-9 facing upstream (northeast). The OHWM width averages 4 ft. Note the dense canopy cover and open understory. Also note the eroding stream bank on the left and the flowing water in the stream channel.

Photo 52. Wetland W-21 facing east. W-21 is a non-forested wetland that abuts S-1. Note the emergent vegetation dominated by common threesquare and surface water in the wetland. W-21 receives floodwaters which overflow from S-1.

Photo 53. Stream S-1 facing north at a small dam/concrete crossing downstream of the study area. Note the river is pooled by the small dam/concrete crossing and has a wooded riparian corridor.

Photo 54. Stream S-1 facing downstream (southeast) at a small dam/concrete crossing downstream of the study area. Note the wooded riparian corridor. Also note that the river is flowing out of a culvert beneath the small dam/concrete crossing and forms a shallow riffle in the background.

Lubbock Lake No. 7
Photograph Locations



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- ⊙ Photo Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N

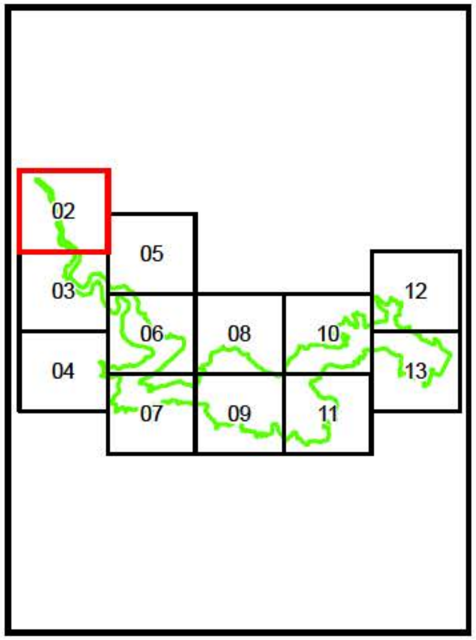


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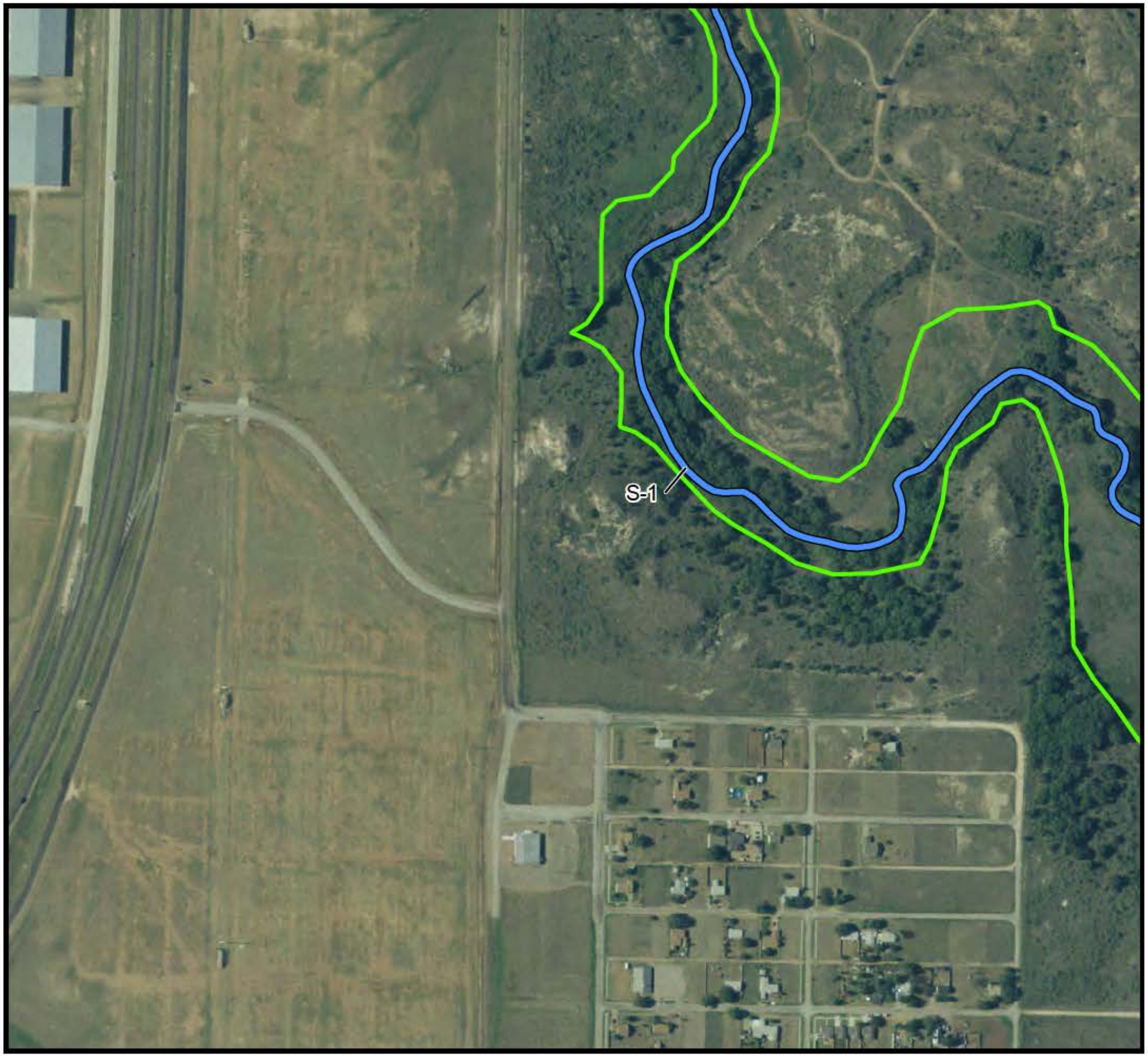
FIGURE 02 OF 13

Lubbock Lake No. 7
Photograph Locations



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- ⊙ Photo Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500
Feet

N

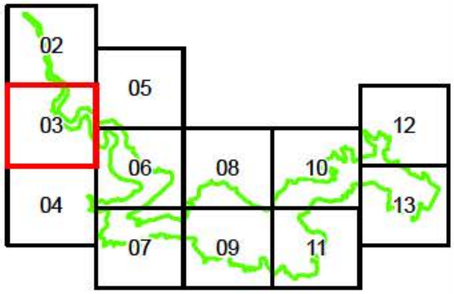


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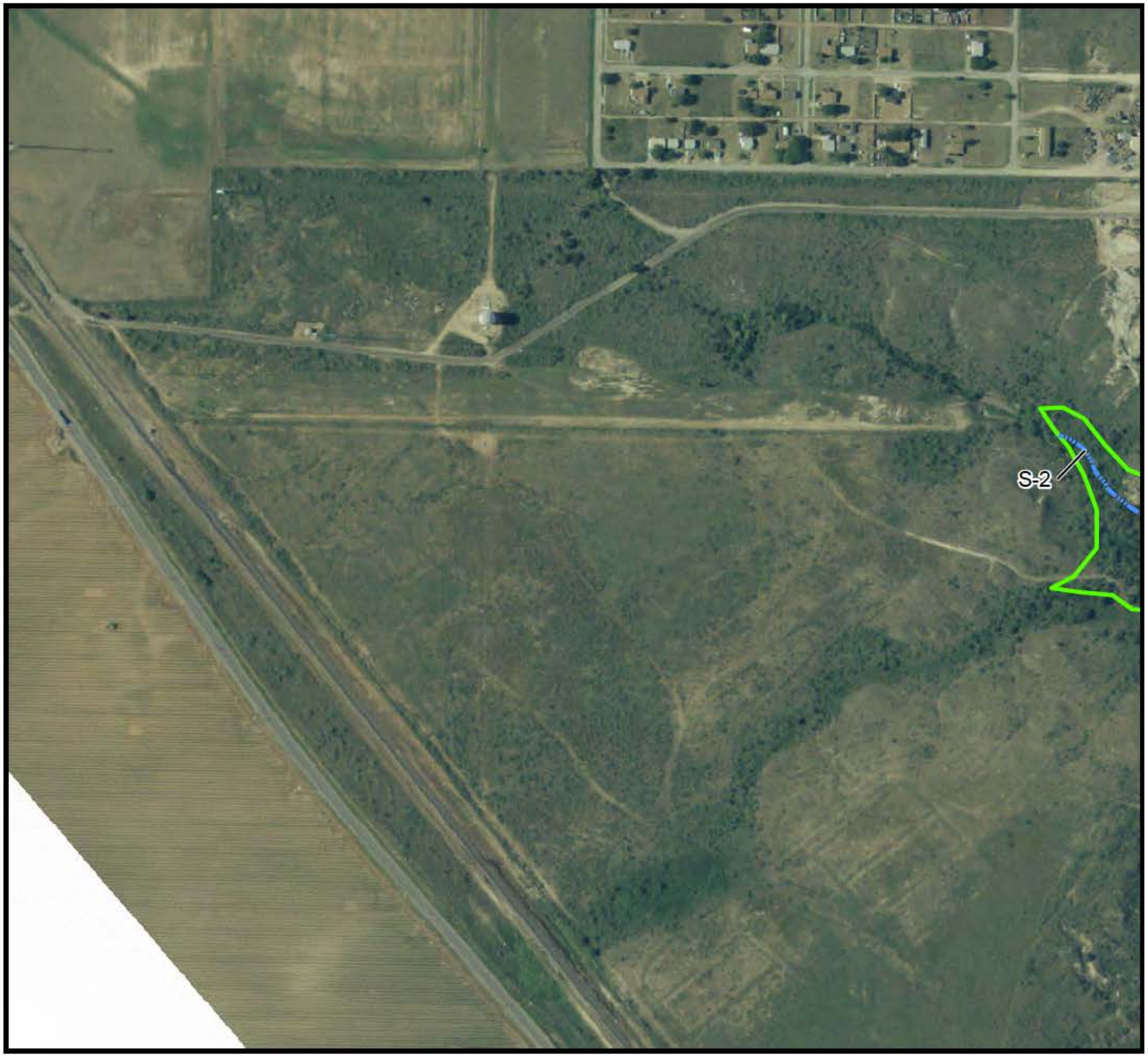
FIGURE 03 OF 13

Lubbock Lake No. 7
Photograph Locations



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- ⦿ Photo Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N

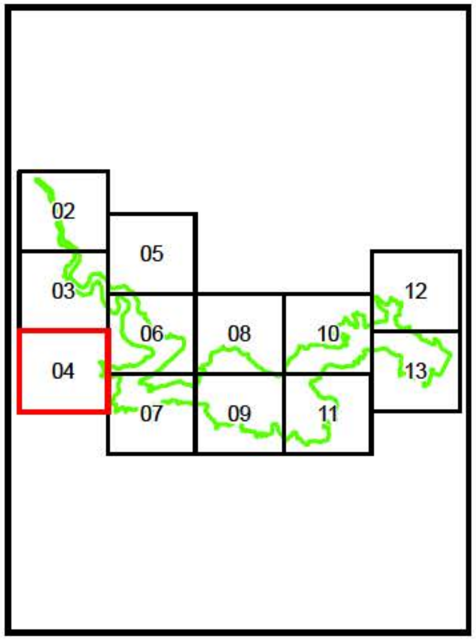


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FIGURE 04 OF 13

Lubbock Lake No. 7
Photograph Locations

Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- ⊙ Photo Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N

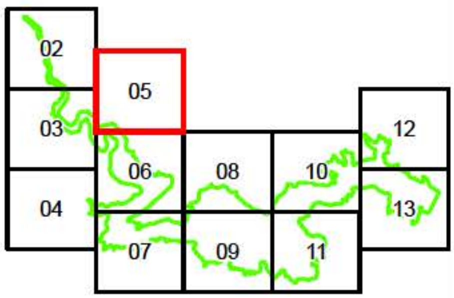

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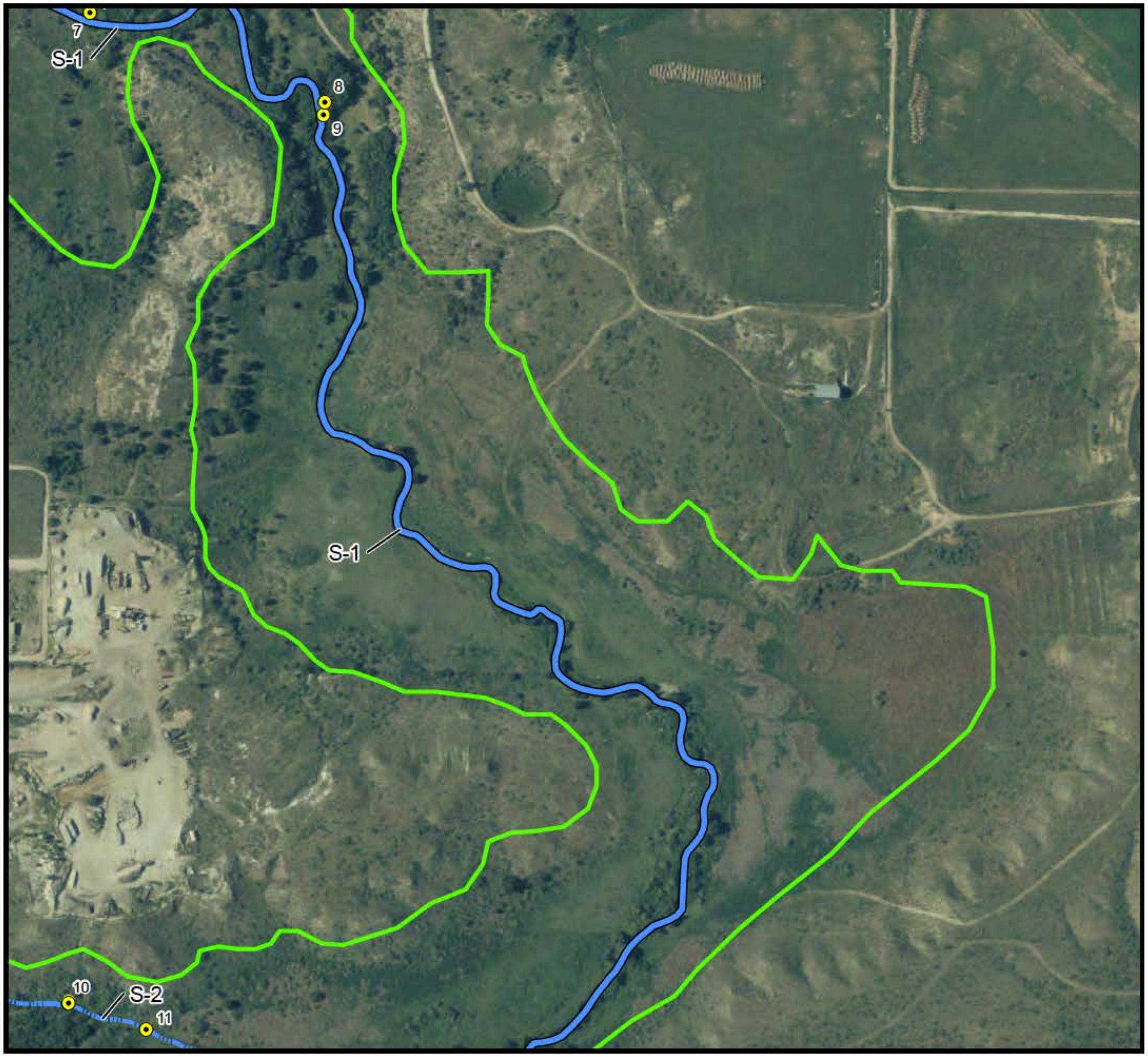
FIGURE 05 OF 13

Lubbock Lake No. 7
Photograph Locations



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- ● Photo Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

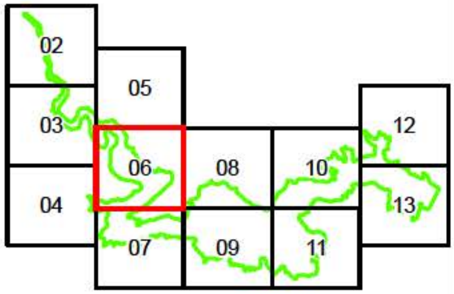


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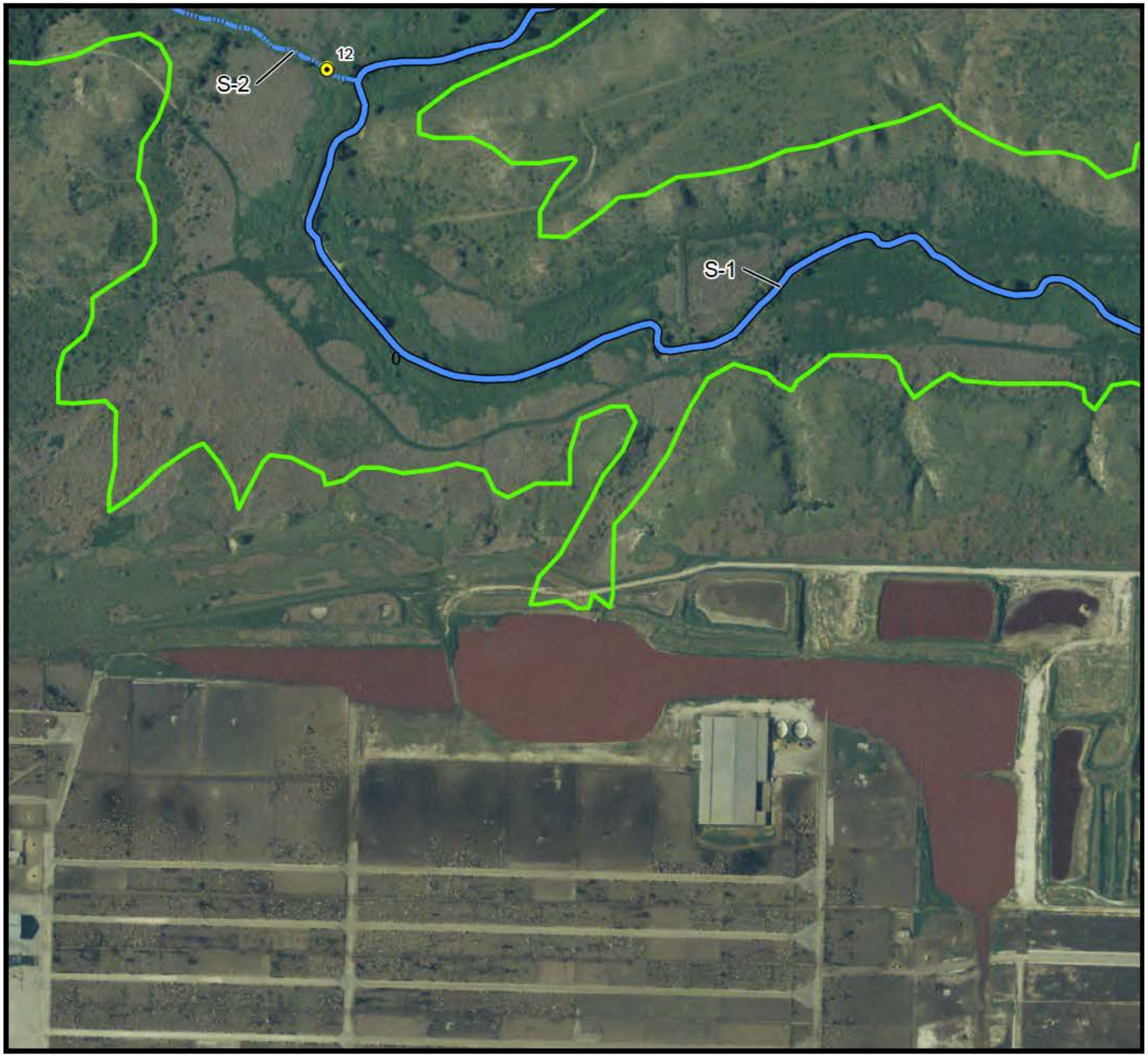
FIGURE 06 OF 13

Lubbock Lake No. 7
Photograph Locations



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- ⊙ Photo Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N

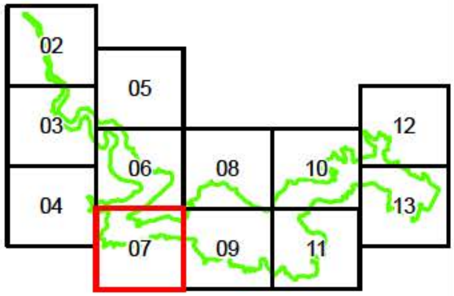


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FIGURE 07 OF 13

Lubbock Lake No. 7
Photograph Locations

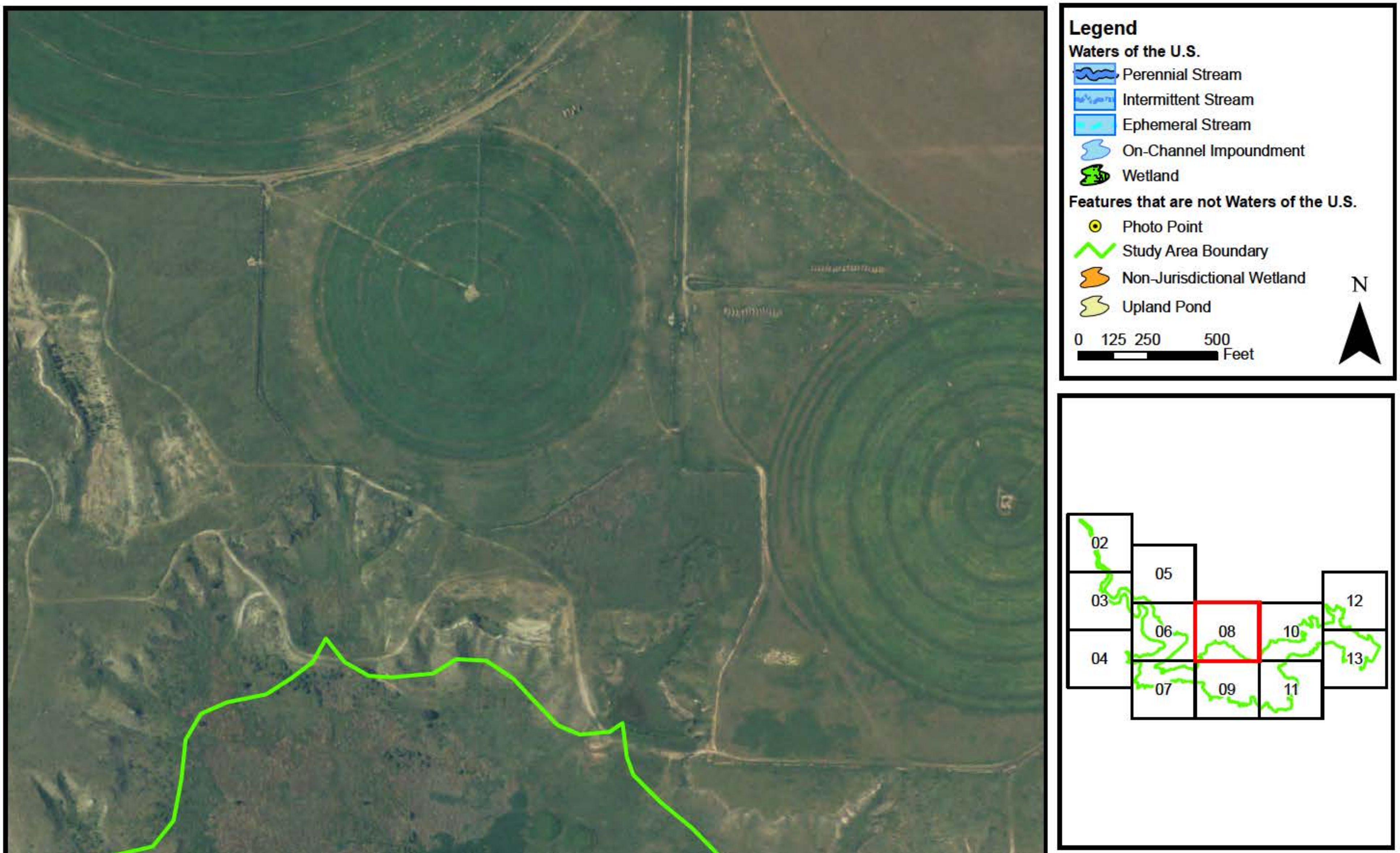

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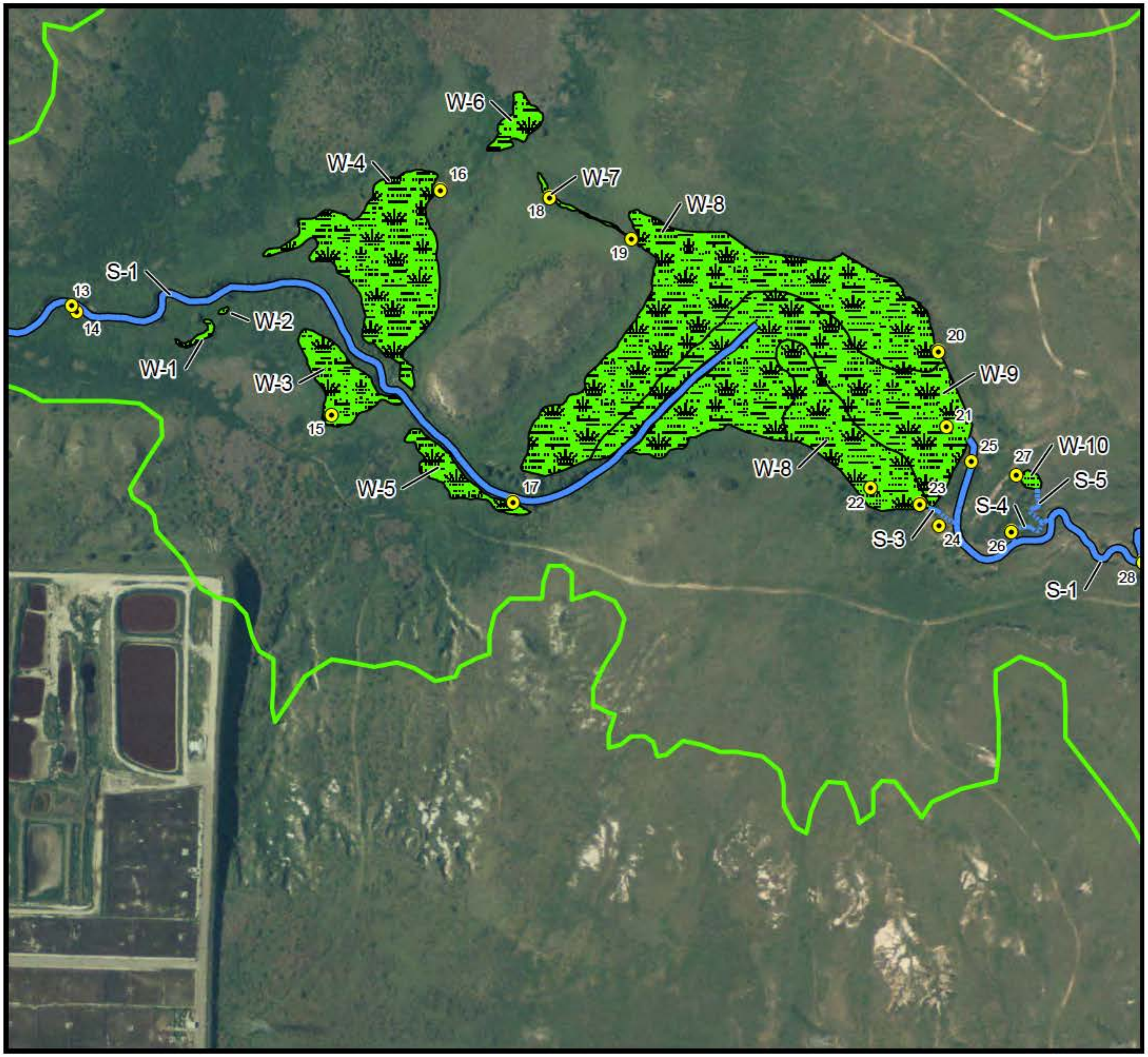
FIGURE 08 OF 13

Lubbock Lake No. 7
Photograph Locations



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- ⦿ Photo Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500
Feet

N

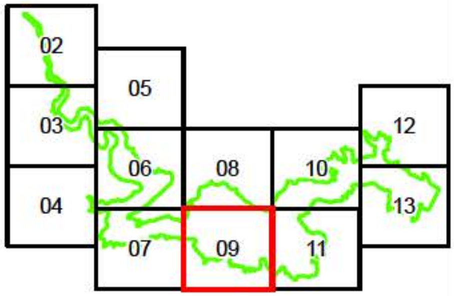


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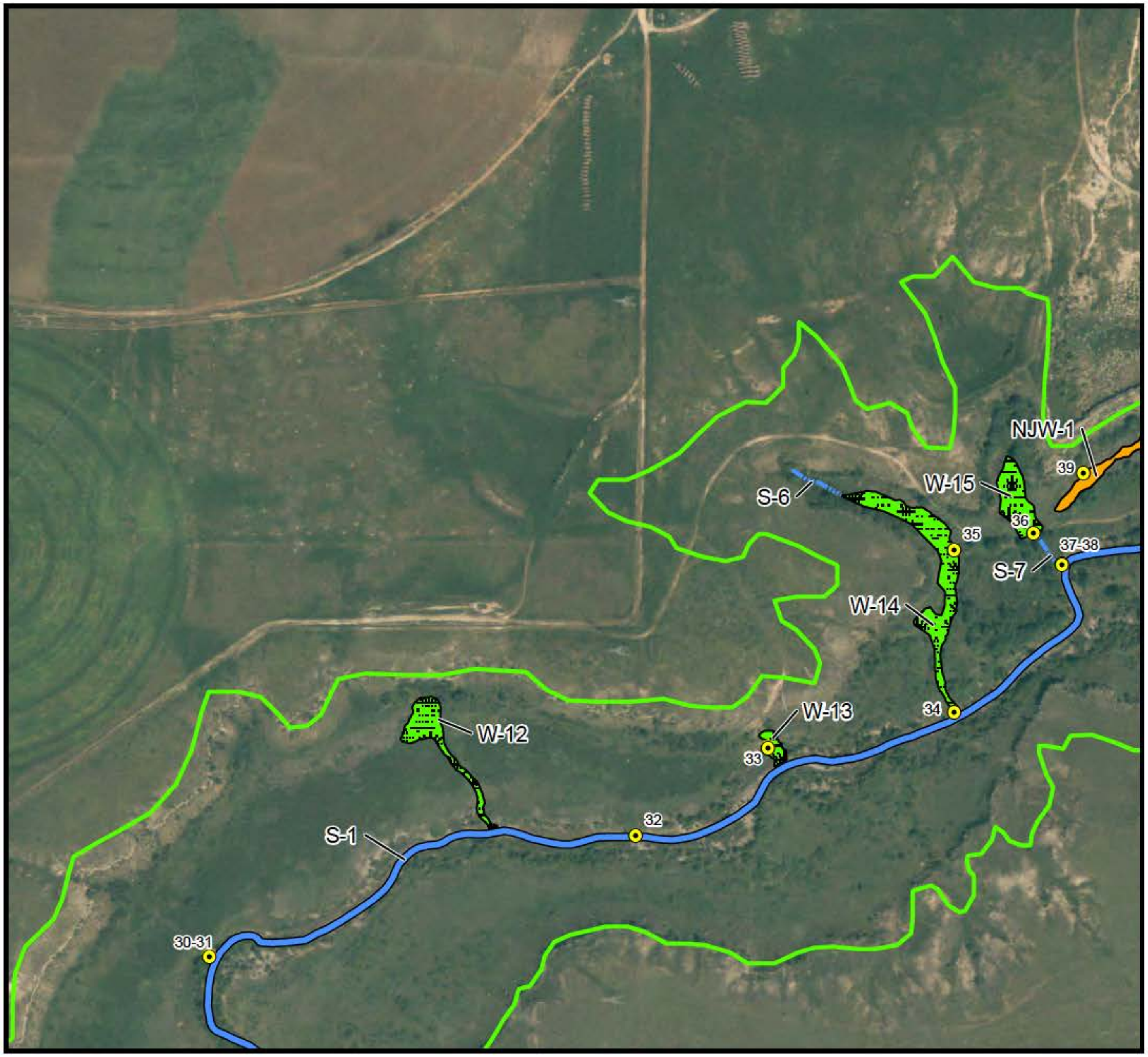
FIGURE 09 OF 13

Lubbock Lake No. 7
Photograph Locations



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- ⊙ Photo Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N

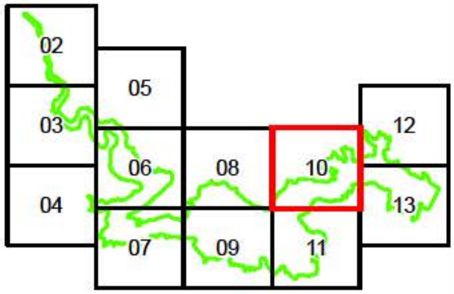


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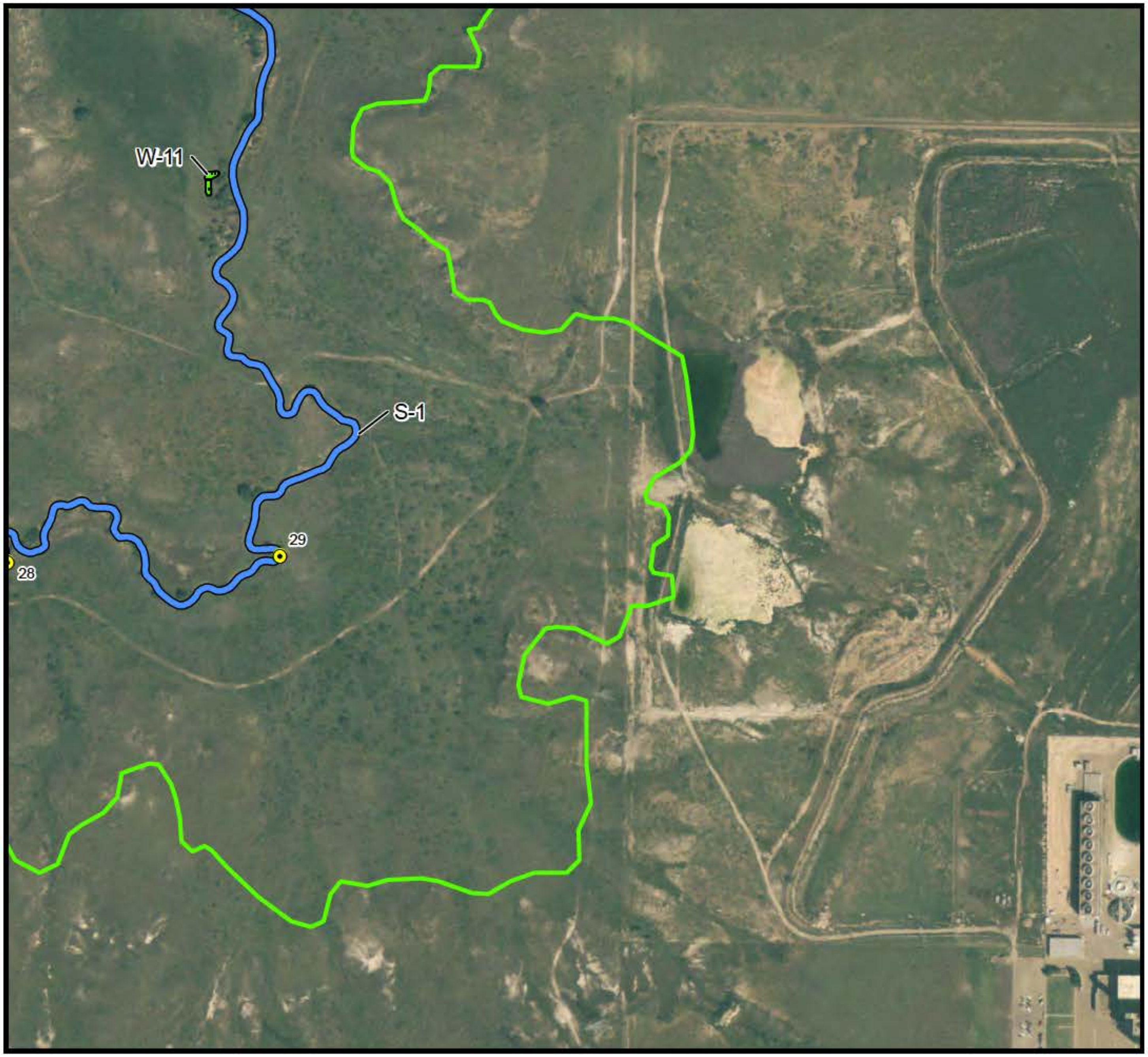
FIGURE 10 OF 13

Lubbock Lake No. 7
Photograph Locations



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- ⊙ Photo Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500 Feet

N

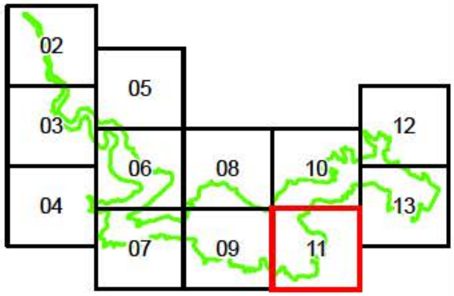


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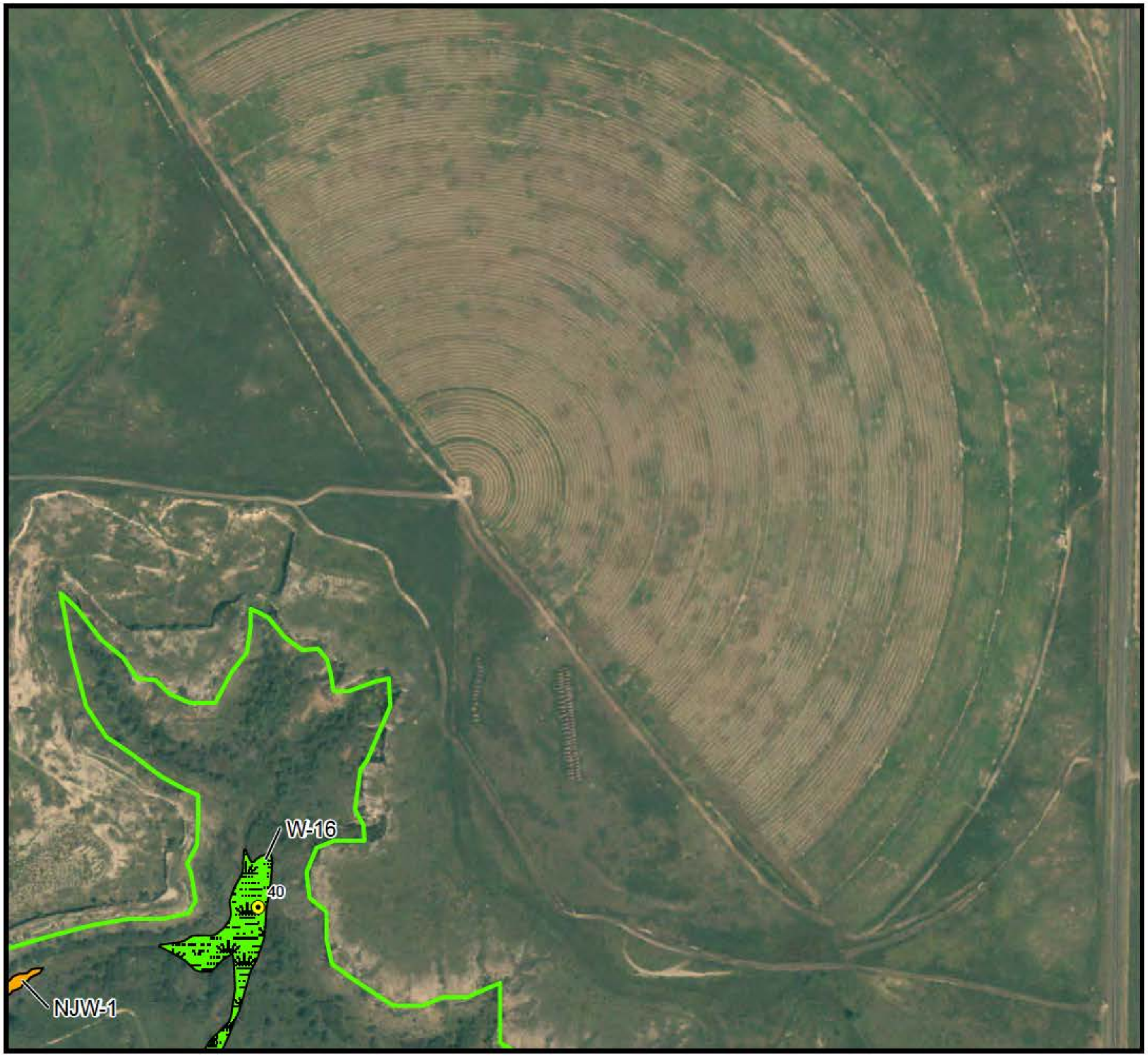
FIGURE 11 OF 13

Lubbock Lake No. 7
Photograph Locations



Legend

Waters of the U.S.

- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- On-Channel Impoundment
- Wetland

Features that are not Waters of the U.S.

- ⊙ Photo Point
- Study Area Boundary
- Non-Jurisdictional Wetland
- Upland Pond

0 125 250 500
Feet

N

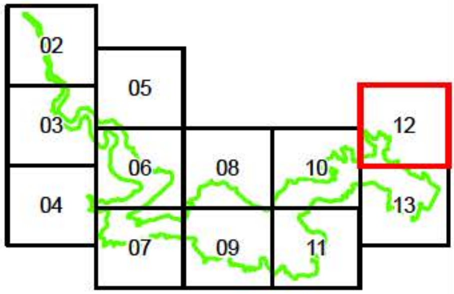


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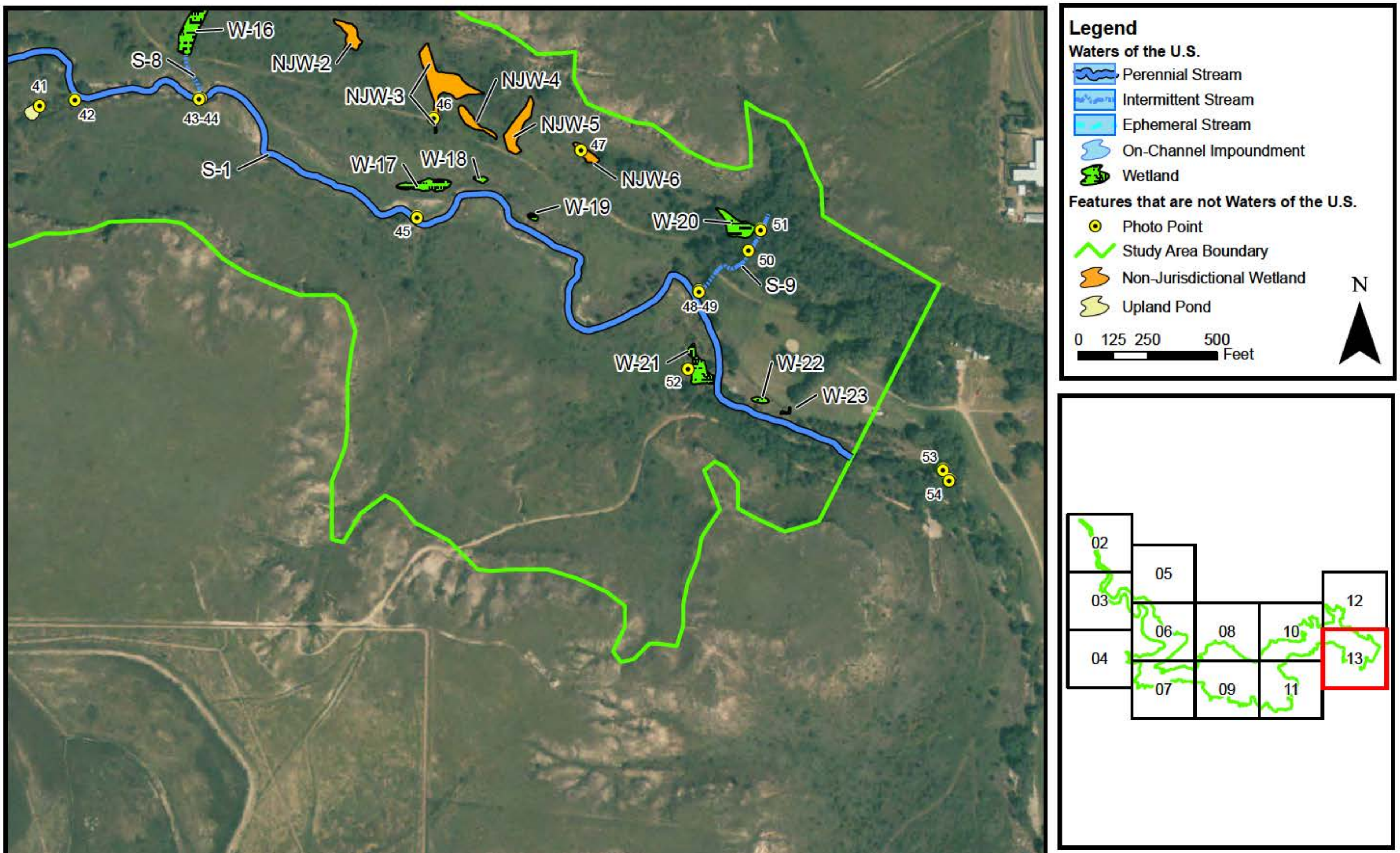
FIGURE 12 OF 13

Lubbock Lake No. 7
Photograph Locations



MAY 2010

FIGURE 13 OF 13

Attachment C3
Stream Data Sheets and Wetland Determination Data Forms

Stream Data Sheet

Stream No: S-1

Date: 11/11/2009

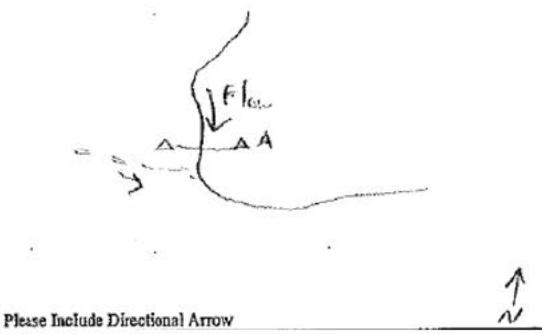
Project Name: Lake 7	Project No: 116724
County/State: Lubbock/TX	Surveyor(s): RW, DM
Stream Name: NFDMFBR	GPS Unit #: 2

Steam Characteristics

Stream Width:	(Feet)	Stream Height/Depth:	(Feet)
Bank to Bank:	25'	Avg. Banks:	10'
Water's Edge:	15'	Avg. Water:	1.5'
OHWM:	20'	OHWM:	3'

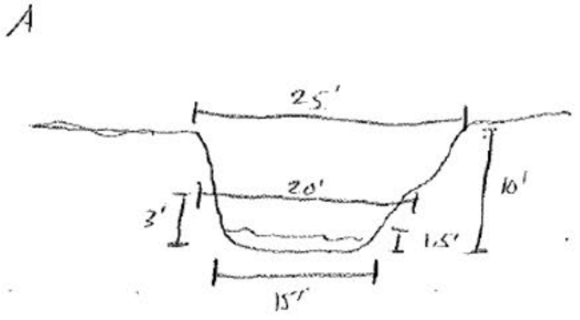
Stream Flow:	☑ Perennial	☐ Intermittent	☐ Ephemeral
Erosion:	☐ Heavy	☑ Moderate	☐ Slight
Flow Regime:	☑ Upstream Development	☐ Dense Regrowth	☐ Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ Silt/Clay ☐ Organic ☐ Concrete
☐ Other

Aquatic Habitat (In-Stream) Description

☑ Undercut Banks ☑ Logs/Brush ☐ Aquatic Veg. ☐ Sand Bar ☐ Mud Bar ☐ Overhanging Veg.
☐ Gravel Riffle ☐ Deep Pools ☐ Oxbows ☐ Shallows

Species (Description):

Riparian Zone Description

☐ Forest ☑ Scrub/Shrub ☐ Old-field/ROW ☑ Pasture ☐ Row Crop ☐ Wetland
☐ Paved ☐ Residential ☐ Park ☐ Other

Species (Description):

black willow, saltcedar, sunflower, giant ragweed, bermudagrass, goldenrod, kochia

Notes:

livestock grazing in flood plain; drift debris in flood plain; water somewhat cloudy; aquatic insects seen; no fish seen

OHWM: scour and litter

Stream Data Sheet

Stream No: S-2

Date: 11/11/2009

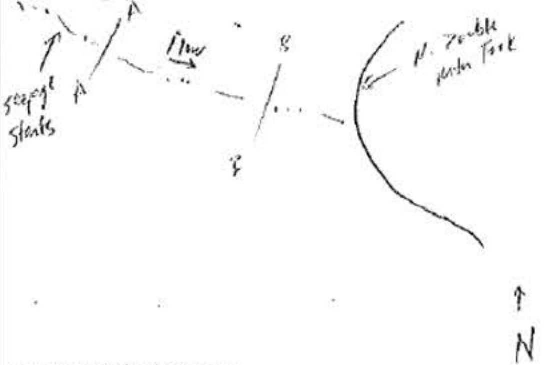
Project Name: Lake 7	Project No: 116724
County/State: Lubbock/TX	Surveyor(s): RW, DM
Stream Name: N/A	GPS Unit #: 2

Steam Characteristics

Stream Width:	(Feet)	Stream Height/Depth:	(Feet)
Bank to Bank:	25'	Avg. Banks:	5'
Water's Edge:	5'	Avg. Water:	0.5'
OHWM:	10'	OHWM:	1'

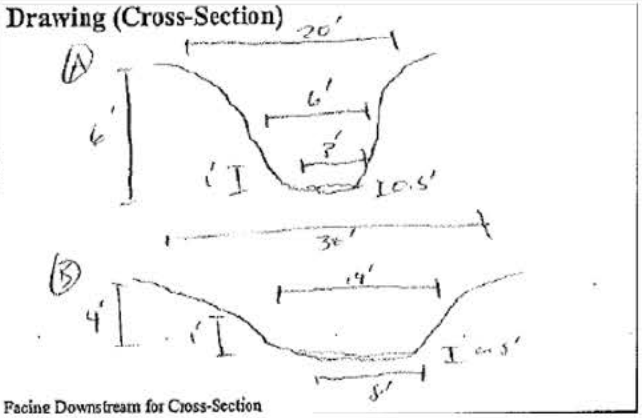
Stream Flow:	☐ Perennial	☑ Intermittent	☐ Ephemeral
Erosion:	☐ Heavy	☑ Moderate	☐ Slight
Flow Regime:	☑ Upstream Development	☐ Dense Regrowth	☐ Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☑ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ Silt/Clay ☐ Organic ☐ Concrete
☐ Other

Aquatic Habitat (In-Stream) Description

☐ Undercut Banks ☐ Logs/Brush ☑ Aquatic Veg. ☐ Sand Bar ☐ Mud Bar ☐ Overhanging Veg.
☐ Gravel Riffle ☐ Deep Pools ☐ Oxbows ☐ Shallows

Species (Description):

Three-square, cattail (in lower reach)

Riparian Zone Description

☐ Forest ☑ Scrub/Shrub ☐ Old-field/ROW ☐ Pasture ☐ Row Crop ☐ Wetland
☐ Paved ☐ Residential ☐ Park ☐ Other

Species (Description):

hackberry, mesquite, saltcedar, cocklebur, kochia, thistle, sunflower

Notes:

OHWM: scour, destruction of terrestrial vegetation.
Channel with pools, some flow for majority of length
Seepage starts at headcut/drop. Cattail in channel at lower end.

Stream Data Sheet

Stream No: S-3 Date: 11/12/2009

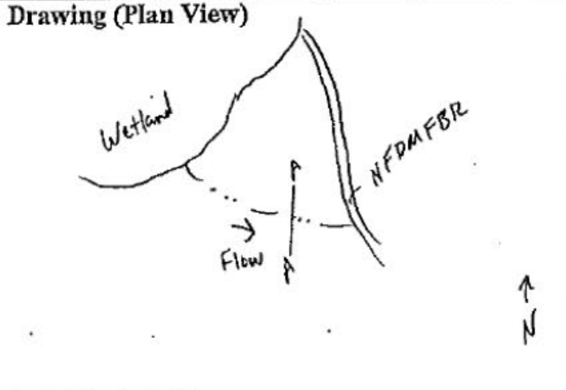
Project Name: Lake 7	Project No: 116724
County/State: Lubbock/TX	Surveyor(s): RW, DM
Stream Name: N/A	GPS Unit #:

Steam Characteristics

Stream Width:	(Feet)	Stream Height/Depth:	(Feet)
Bank to Bank:	10 ft	Avg. Banks:	3 ft
Water's Edge:	4 ft	Avg. Water:	1 ft
OHWM:	5 ft	OHWM:	2 ft

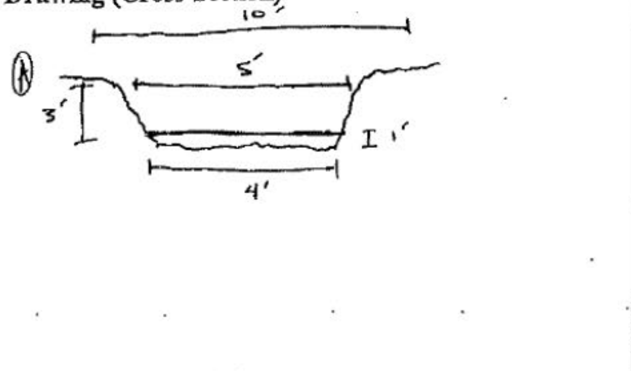
Stream Flow:	☐ Perennial	☑ Intermittent	☐ Ephemeral
Erosion:	☑ Heavy	☐ Moderate	☐ Slight
Flow Regime:	☑ Upstream Development	☐ Dense Regrowth	☐ Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ Silt/Clay ☐ Organic ☐ Concrete
☐ Other

Aquatic Habitat (In-Stream) Description

☐ Undercut Banks ☐ Logs/Brush ☐ Aquatic Veg. ☐ Sand Bar ☐ Mud Bar ☐ Overhanging Veg.
☐ Gravel Riffle ☐ Deep Pools ☐ Oxbows ☐ Shallows

Species (Description):

Riparian Zone Description

☐ Forest ☑ Scrub/Shrub ☐ Old-field/ROW ☑ Pasture ☐ Row Crop ☐ Wetland
☐ Paved ☐ Residential ☐ Park ☐ Other

Species (Description):

bermudagrass, tall dropseed, giant ragweed, common sunflower, mesquite

Notes:
No aquatic habitat.
Cattle access to channel for water evident by erosion on banks.
Flow from wetland formed in location of previous impoundment.
Connects to NFDMFBR near breach in old dam.

Stream Data Sheet

Stream No: S-4 Date: 4/29/2010

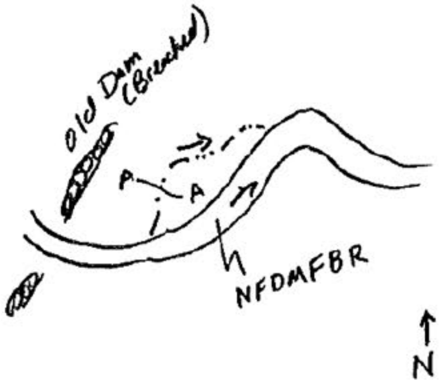
Project Name: Lake 7	Project No: 116724
County/State: Lubbock/TX	Surveyor(s): RW, PJ
Stream Name: N/A	GPS Unit #:

Steam Characteristics

Stream Width:	(Feet)	Stream Height/Depth:	(Feet)
Bank to Bank:	10	Avg. Banks:	4
Water's Edge:	3	Avg. Water:	0.5
OHWM:	5	OHWM:	2

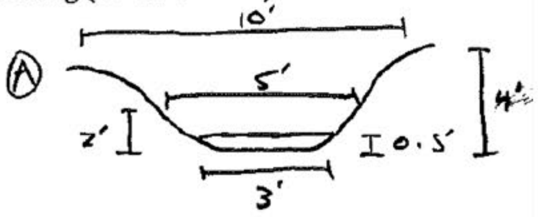
Stream Flow:	☐ Perennial	☑ Intermittent	☐ Ephemeral
Erosion:	☐ Heavy	☑ Moderate	☐ Slight
Flow Regime:	☑ Upstream Development	☐ Dense Regrowth	☐ Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☐ Bedrock ☐ Boulder ☐ Cobble ☑ Gravel ☐ Sand ☑ Silt/Clay ☐ Organic ☐ Concrete
☐ Other

Aquatic Habitat (In-Stream) Description

☐ Undercut Banks ☑ Logs/Brush ☐ Aquatic Veg. ☐ Sand Bar ☐ Mud Bar ☑ Overhanging Veg.
☐ Gravel Riffle ☐ Deep Pools ☐ Oxbows ☐ Shallows

Species (Description):

Riparian Zone Description

☑ Forest ☐ Scrub/Shrub ☐ Old-field/ROW ☐ Pasture ☐ Row Crop ☐ Wetland
☐ Paved ☐ Residential ☐ Park ☐ Other

Species (Description):

black willow, honeylocust, tree of heaven, saltcedar, hackberry, giant ragweed, curly dock, Canada wildrye

Notes:

Side channel to NFDMFBR that receives overflow from main channel. Small flow at time of survey. Lots of leaf litter and debris from flooding present.

Stream Data Sheet

Stream No: S-5

Date: 4/29/2010

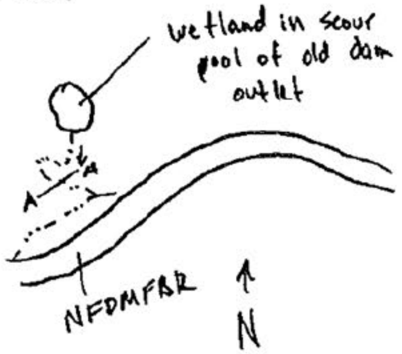
Project Name: Lake 7	Project No: 116724
County/State: Lubbock/TX	Surveyor(s): RW, PJ
Stream Name: N/A	GPS Unit #:

Steam Characteristics

Stream Width:	(Feet)	Stream Height/Depth:	(Feet)
Bank to Bank:	12	Avg. Banks:	3
Water's Edge:	6	Avg. Water:	0.5
OHWM:	8	OHWM:	1

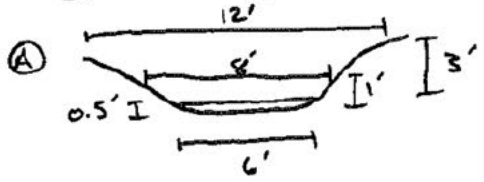
Stream Flow:	☐ Perennial	☑ Intermittent	☐ Ephemeral
Erosion:	☐ Heavy	☑ Moderate	☐ Slight
Flow Regime:	☑ Upstream Development	☐ Dense Regrowth	☐ Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☐ Bedrock ☐ Boulder ☐ Cobble ☑ Gravel ☐ Sand ☑ Silt/Clay ☐ Organic ☐ Concrete
☐ Other

Aquatic Habitat (In-Stream) Description

☐ Undercut Banks ☑ Logs/Brush ☑ Aquatic Veg. ☐ Sand Bar ☐ Mud Bar ☑ Overhanging Veg.
☐ Gravel Riffle ☐ Deep Pools ☐ Oxbows ☐ Shallows

Species (Description):

cattail, common threesquare

Riparian Zone Description

☑ Forest ☐ Scrub/Shrub ☐ Old-field/ROW ☐ Pasture ☐ Row Crop ☐ Wetland
☐ Paved ☐ Residential ☐ Park ☐ Other

Species (Description):

black willow, honeylocust, tree of heaven, saltcedar, hackberry, giant ragweed, curly dock, Canada wildrye

Notes:

Channel flows from wetland that has formed in scour pool from old dam outlet pipe. Filled with water at time of survey, likely due to heavy rain and flooding two weeks before.

Stream Data Sheet

Stream No: S-6 Date: 11/11/2009

Project Name: Lake 7	Project No: 116724
County/State: Lubbock/TX	Surveyor(s): RW, DM
Stream Name: N/A	GPS Unit #: 2

Steam Characteristics

Stream Width:	(Feet)	Stream Height/Depth:	(Feet)
Bank to Bank:	15'	Avg. Banks:	10'
Water's Edge:	1'	Avg. Water:	0.1'
OHWM:	3'	OHWM:	1'

Stream Flow:	☐ Perennial	☑ Intermittent	☐ Ephemeral
Erosion:	☐ Heavy	☐ Moderate	☑ Slight
Flow Regime:	☐ Upstream Development	☑ Dense Regrowth	☐ Heavy Downcutting

Drawing (Plan View)

Please Include Directional Arrow

Drawing (Cross-Section)

Facing Downstream for Cross-Section

Substrate Description

☑ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ Silt/Clay ☐ Organic ☐ Concrete
☐ Other

Aquatic Habitat (In-Stream) Description

☐ Undercut Banks ☑ Logs/Brush ☐ Aquatic Veg. ☐ Sand Bar ☐ Mud Bar ☐ Overhanging Veg.
☐ Gravel Riffle ☐ Deep Pools ☐ Oxbows ☐ Shallows

Species (Description):

Riparian Zone Description

☑ Forest ☐ Scrub/Shrub ☐ Old-field/ROW ☐ Pasture ☐ Row Crop ☐ Wetland
☐ Paved ☐ Residential ☐ Park ☐ Other

Species (Description):

hackberry, soapberry, saltcedar, skunkbush sumac, switchgrass, broomweed

Notes:
seepage up to base of large drop from plains above.
Rock outcrop.
Feeds wetland downslope.

Stream Data Sheet Stream No: S-7 Date: 11/12/2009

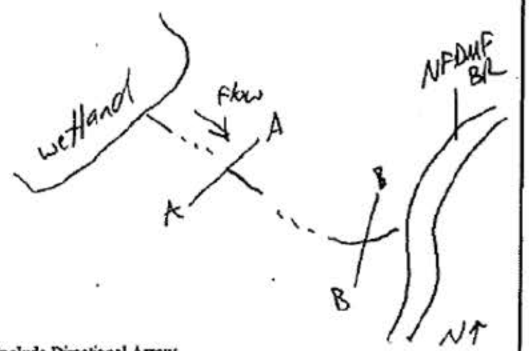
Project Name: Lake 7	Project No: 116724
County/State: Lubbock/TX	Surveyor(s): RW, DM
Stream Name: N/A	GPS Unit #:

Steam Characteristics

Stream Width:	(Feet)	Stream Height/Depth:	(Feet)
Bank to Bank:	6'	Avg. Banks:	3'
Water's Edge:	6"	Avg. Water:	2"
OHWM:	1'	OHWM:	6"

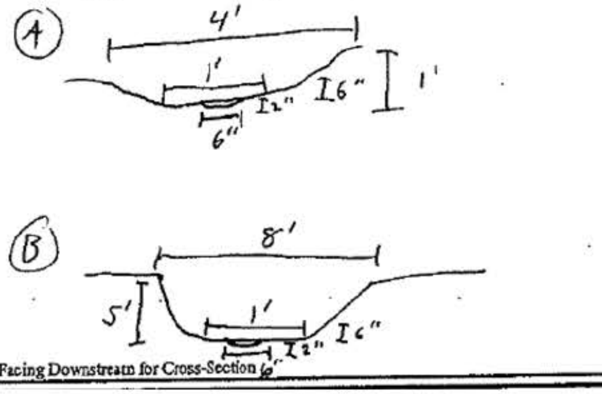
Stream Flow:	☐ Perennial	☑ Intermittent	☐ Ephemeral
Erosion:	☐ Heavy	☑ Moderate	☐ Slight
Flow Regime:	☐ Upstream Development	☐ Dense Regrowth	☑ Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ Silt/Clay ☐ Organic ☐ Concrete
☐ Other

Aquatic Habitat (In-Stream) Description

☐ Undercut Banks ☐ Logs/Brush ☐ Aquatic Veg. ☐ Sand Bar ☐ Mud Bar ☐ Overhanging Veg.
☐ Gravel Riffle ☐ Deep Pools ☐ Oxbows ☐ Shallows

Species (Description):

Riparian Zone Description

☐ Forest ☐ Scrub/Shrub ☐ Old-field/ROW ☐ Pasture ☐ Row Crop ☐ Wetland
☐ Paved ☐ Residential ☑ Park ☐ Other

Species (Description):

hackberry, Siberian elm, mesquite, saltcedar, bermudagrass, tall dropseed, kochia

Notes:
No aquatic habitat.
Short stream that downcuts to river quickly from approx 1 ft down to 6 ft
Flowing out of culvert under a ranch rd; connects to a wetland.

Stream Data Sheet Stream No: S-8 Date: 11/12/2009

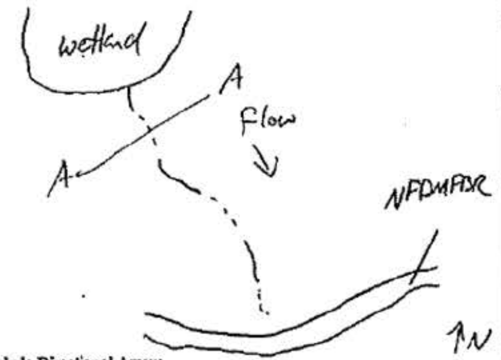
Project Name: Lake 7	Project No: 116724
County/State: Lubbock/TX	Surveyor(s):
Stream Name: N/A	GPS Unit #: 0

Steam Characteristics

Stream Width:	(Feet)	Stream Height/Depth:	(Feet)
Bank to Bank:	5'	Avg. Banks:	2'
Water's Edge:	6"	Avg. Water:	2"
OHWM:	2'	OHWM:	6"

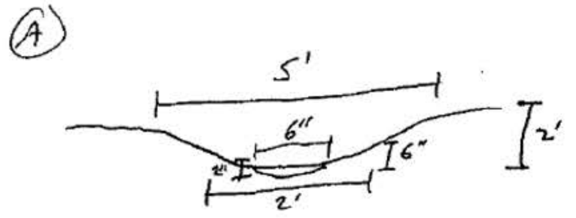
Stream Flow:	☐ Perennial	☑ Intermittent	☐ Ephemeral
Erosion:	☐ Heavy	☐ Moderate	☑ Slight
Flow Regime:	☑ Upstream Development	☐ Dense Regrowth	☐ Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ Silt/Clay ☐ Organic ☐ Concrete
☐ Other

Aquatic Habitat (In-Stream) Description

☐ Undercut Banks ☐ Logs/Brush ☐ Aquatic Veg. ☐ Sand Bar ☐ Mud Bar ☐ Overhanging Veg.
☐ Gravel Riffle ☐ Deep Pools ☐ Oxbows ☐ Shallows

Species (Description):

Riparian Zone Description

☐ Forest ☑ Scrub/Shrub ☐ Old-field/ROW ☐ Pasture ☐ Row Crop ☐ Wetland
☐ Paved ☐ Residential ☐ Park ☐ Other

Species (Description):

mesquite, bermudagrass, giant ragweed, kochia

Notes:

No aquatic habitat.
Flowing out from culvert that passes under ranch rd; connects to a wetland.

Stream Data Sheet Stream No: S-9 Date: 11/12/2009

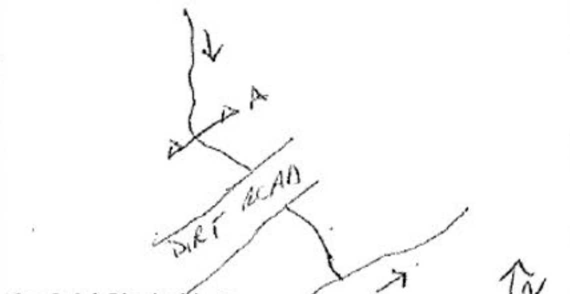
Project Name: Lake 7	Project No: 116724
County/State: Lubbock/TX	Surveyor(s): RW, DM
Stream Name: N/A	GPS Unit #: 2

Steam Characteristics

Stream Width:	(Feet)	Stream Height/Depth:	(Feet)
Bank to Bank:	5'	Avg. Banks:	3"
Water's Edge:	3'	Avg. Water:	1"
OHWM:	4'	OHWM:	2"

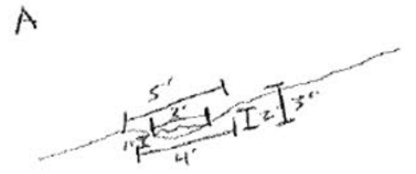
Stream Flow:	☐ Perennial	☑ Intermittent	☐ Ephemeral
Erosion:	☐ Heavy	☑ Moderate	☐ Slight
Flow Regime:	☐ Upstream Development	☐ Dense Regrowth	☐ Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ Silt/Clay ☑ Organic ☐ Concrete
☐ Other

Aquatic Habitat (In-Stream) Description

☐ Undercut Banks ☐ Logs/Brush ☐ Aquatic Veg. ☐ Sand Bar ☐ Mud Bar ☐ Overhanging Veg.
☐ Gravel Riffle ☐ Deep Pools ☐ Oxbows ☐ Shallows
Species (Description):

Riparian Zone Description

☑ Forest ☑ Scrub/Shrub ☐ Old-field/ROW ☐ Pasture ☐ Row Crop ☐ Wetland
☐ Paved ☐ Residential ☐ Park ☐ Other
Species (Description):

Siberian elm, hackberry, Canada wildrye, switchgrass, bermudagrass

Notes:
Flow Regime: seep from canyon
cattle use for water
OHWM: scour

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/11/2009

Applicant/Owner: City of Lubbock State: TX Sampling Point: W-3

Investigator(s): RW, DM Section, Township, Range: NA

Landform (hillslope, terrace, etc.): depression Local Relief (concave, convex, none): concave Slope (%): 1

Subregion (LRR): Central Great Plains Lat: 33° 31' 44.549" N Long: 101° 45' 39.921" W Datum NAD83

Soil Map Unit Name: Bippus clay loam, frequently flooded NWI classification: PEM1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☑ No ☐	**Is the Sampled Area within a Wetland?** Yes ☑ No ☐
Hydric Soils Present?	Yes ☑ No ☐	
Wetland Hydrology Present?	Yes ☑ No ☐	

Remarks:

VEGETATION - Use scientific names of plants

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum Plot size: 30'			
1.	0		
2.	0		
3.	0		
4.	0		
	0 = Total Cover		
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
	0 = Total Cover		
Herb Stratum Plot size: 5'			
1. Schoenoplectus pungens	100	yes	OBL
2.	0		
3.	0		
4.	0		
5.	0		
6.	0		
	100 = Total Cover		
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0 = Total Cover		

Percent Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☑ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0*
- ☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ● Yes ○ No

Remarks:

SOIL

Sampling Point: W-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-5	10YR 4/2	95	5YR 4/4	5	C	M	silty clay loam	
5-14	10Y 6/1	100					silty loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)

☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Loamy Mucky Mineral (F1)
☐ Loamy Gleyed Matrix (F2)
☑ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☑ No ☐

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☑ High Water Table (A2)
☑ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)

☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):

Water Table Present? Yes ☑ No ☐ Depth (inches): 7

Saturation Present? (includes capillary fringe) Yes ☑ No ☐ Depth (inches): 0

Wetland Hydrology Present? Yes ☑ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/11/2009

Applicant/Owner: City of Lubbock State: TX Sampling Point: U-3

Investigator(s): RW, DM Section, Township, Range: NA

Landform (hillslope, terrace, etc.): hillslope Local Relief (concave, convex, none): none/convex Slope (%): 3

Subregion (LRR): Central Great Plains Lat: 33° 31' 44.347" N Long: 101° 45' 40.754 W Datum NAD83

Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☐ No ☑	**Is the Sampled Area within a Wetland?**	Yes ☐ No ☑
Hydric Soils Present?	Yes ☐ No ☑		
Wetland Hydrology Present?	Yes ☐ No ☑		

Remarks:

VEGETATION - Use scientific names of plants

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum Plot size: 30'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Herb Stratum Plot size: 5'			
1. Sporobolus cryptandrus	95	yes	FACU-
2. Kochia scoparia	5	no	FACU
3. Helianthus annuus	5	no	FAC
4. Solanum elaeagnifolium	2	no	NL
5.	0		
6.	0		
	107	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0	= Total Cover	

Percent Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0*
- ☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ○ Yes ● No

Remarks:

SOIL

Sampling Point: U-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-12	5YR 4/4	100					fine sandy loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (LRR F)
- ☐ 1 cm Muck (A9) (LRR F, G, H)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

- ☐ 1 cm Muck (A9) (LRR I, J)
- ☐ Coast Prairie Redox (A16) (LRR F, G, H)
- ☐ Dark Surface (S7) (LRR G)
- ☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Dry Season Water Table (C2)
- ☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
- ☐ Presence of Reduced Iron (C4)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ FAC-Neutral Test (D5)
- ☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):

Water Table Present? Yes ☐ No ☑ Depth (inches):

Saturation Present? Yes ☐ No ☑ Depth (inches):
(includes capillary fringe)

Wetland Hydrology Present? Yes ☐ No ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/11/2009

Applicant/Owner: City of Lubbock State: TX Sampling Point: W-4

Investigator(s): RW, DM Section, Township, Range: NA

Landform (hillslope, terrace, etc.): depression Local Relief (concave, convex, none): concave Slope (%): 1

Subregion (LRR): Central Great Plains Lat: 33° 31' 46.980" N Long: 101° 45' 37.358" W Datum NAD83

Soil Map Unit Name: Bippus clay loam, frequently flooded NWI classification: PEM1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☐ No ☑

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☑ No ☐	**Is the Sampled Area within a Wetland?** Yes ☑ No ☐
Hydric Soils Present?	Yes ☑ No ☐	
Wetland Hydrology Present?	Yes ☑ No ☐	

Remarks: Location of old pond. Adjacent to stream. Much of area dried/unvegetated mud, but with wetland fringe. Likely holds water after rain.

VEGETATION - Use scientific names of plants

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum Plot size: 30'			
1.	0		
2.	0		
3.	0		
4.	0		
	0 = Total Cover		
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
	0 = Total Cover		
Herb Stratum Plot size: 5'			
1. Schoenoplectus pungens	100	yes	OBL
2.	0		
3.	0		
4.	0		
5.	0		
6.	0		
	100 = Total Cover		
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0 = Total Cover		

Percent Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☑ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0*
- ☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ● Yes ○ No

Remarks: Bare ground 30' from data point.

SOIL

Sampling Point: W-4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-14	7.5YR 4/1	98	7.5YR 3/4	2	C	M	sandy clay loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (LRR F)
- ☐ 1 cm Muck (A9) (LRR F, G, H)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

- ☐ 1 cm Muck (A9) (LRR I, J)
- ☐ Coast Prairie Redox (A16) (LRR F, G, H)
- ☐ Dark Surface (S7) (LRR G)
- ☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☑ No ☐

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Dry Season Water Table (C2)
- ☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
- ☐ Presence of Reduced Iron (C4)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ FAC-Neutral Test (D5)
- ☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):

Water Table Present? Yes ☑ No ☐ Depth (inches): 12

Saturation Present? (includes capillary fringe) Yes ☑ No ☐ Depth (inches): 0

Wetland Hydrology Present? Yes ☑ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/11/2009

Applicant/Owner: City of Lubbock State: TX Sampling Point: U-4

Investigator(s): RW, DM Section, Township, Range: NA

Landform (hillslope, terrace, etc.): hillslope Local Relief (concave, convex, none): none Slope (%): 4

Subregion (LRR): Central Great Plains Lat: 33° 31' 46.683" N Long: 101° 45' 36.589"W Datum NAD83

Soil Map Unit Name: Berda-Potter association, hilly NWI classification: upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☐ No ☑	**Is the Sampled Area within a Wetland?** Yes ☐ No ☑
Hydric Soils Present?	Yes ☐ No ☑	
Wetland Hydrology Present?	Yes ☐ No ☑	

Remarks:

VEGETATION - Use scientific names of plants

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum Plot size: 30'			
1.	0		
2.	0		
3.	0		
4.	0		
= Total Cover	0		
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
= Total Cover	0		
Herb Stratum Plot size: 5'			
1. Sporobolus compositus	80	yes	UPL
2. Elymus canadensis	20	no	FAC+
3. Kochia scoparia	5	no	FACU
4. Helianthus annuus	5	no	FAC
5.	0		
6.	0		
= Total Cover	110		
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
= Total Cover	0		

Percent Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0*
- ☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ○ Yes ● No

Remarks:

SOIL

Sampling Point: U-4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-12	10YR 3/1	100					sandy clay loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Loamy Mucky Mineral (F1)
☐ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☐ High Water Table (A2)
☐ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)
☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):
Water Table Present? Yes ☐ No ☑ Depth (inches):
Saturation Present? Yes ☐ No ☑ Depth (inches):
(includes capillary fringe)

Wetland Hydrology Present? Yes ☐ No ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/11/2009

Applicant/Owner: City of Lubbock State: TX Sampling Point: W-5

Investigator(s): RW, DM Section, Township, Range: NA

Landform (hillslope, terrace, etc.): depression Local Relief (concave, convex, none): concave Slope (%): 1

Subregion (LRR): Central Great Plains Lat: 33° 31' 42.111" N Long: 101° 45' 34.612" W Datum NAD83

Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: PEM1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present? Yes ☑ No ☐

Hydric Soils Present? Yes ☑ No ☐

Wetland Hydrology Present? Yes ☑ No ☐

Is the Sampled Area within a Wetland? Yes ☐ No ☑

Remarks:

VEGETATION - Use scientific names of plants

Tree Stratum Plot size: 30'	Absolute % Cover	Dominant Species?	Indicator Status
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Herb Stratum Plot size: 5'			
1. Eleocharis palustris	80	yes	OBL
2. Schoenoplectus pungens	30	yes	OBL
3.	0		
4.	0		
5.	0		
6.	0		
	110	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0	= Total Cover	

Percent Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:		
OBL species	0	x 1 =	0	
FACW species	0	x 2 =	0	
FAC species	0	x 3 =	0	
FACU species	0	x 4 =	0	
UPL species	0	x 5 =	0	
Column Totals	0	(A)	0	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☑ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0*
- ☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ● Yes ○ No

Remarks:

SOIL

Sampling Point: W-5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-6	10YR 5/2	98	7.5YR 6/6	2	C	PL	clay loam	
6-12	7.5YR 7/2	60	7.5YR 7/6	2	C	M	silty clay	black staining from OM
	7.5YR 6/1	38						

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains.   **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Loamy Mucky Mineral (F1)
☐ Loamy Gleyed Matrix (F2)
☑ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☑ No ☐

Remarks:

OM = organic matter

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☐ High Water Table (A2)
☑ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)
☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):
Water Table Present? Yes ☐ No ☑ Depth (inches):
Saturation Present? Yes ☑ No ☐ Depth (inches): 0
(includes capillary fringe)

Wetland Hydrology Present? Yes ☑ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/11/2009
Applicant/Owner: City of Lubbock State: TX Sampling Point: U-5
Investigator(s): RW, DM Section, Township, Range: NA
Landform (hillslope, terrace, etc.): hillslope Local Relief (concave, convex, none): none Slope (%): 5
Subregion (LRR): Central Great Plains Lat: 33° 31' 41.767 N Long: 101° 45' 34.805" W Datum NAD83
Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: upland
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)
Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐
Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☐ No ☑	**Is the Sampled Area within a Wetland?** Yes ☐ No ☑
Hydric Soils Present?	Yes ☐ No ☑	
Wetland Hydrology Present?	Yes ☐ No ☑	

Remarks:

VEGETATION - Use scientific names of plants

Tree Stratum Plot size: 30'	Absolute % Cover	Dominant Species?	Indicator Status
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Herb Stratum Plot size: 5'			
1. Sporobolus compositus	70	yes	UPL
2. Kochia scoparia	30	yes	FACU
3. Bouteloua curtipendula	10	no	FACU
4. Elymus canadensis	5	no	FAC+
5. Solanum elaeagnifolium	5	no	NL
6.	0		
	120	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0	= Total Cover	

Percent Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)
Total Number of Dominant Species Across All Strata: 2 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

☐ Dominance Test is >50%
☐ Prevalence Index is ≤3.0*
☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)
☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ○ Yes ● No

Remarks:

SOIL

Sampling Point: U-5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-12	5YR 4/3	100					fine sandy loam	small gravel

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains.

**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Loamy Mucky Mineral (F1)
☐ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☐ High Water Table (A2)
☐ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)
☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):
Water Table Present? Yes ☐ No ☑ Depth (inches):
Saturation Present? Yes ☐ No ☑ Depth (inches):
(includes capillary fringe)

Wetland Hydrology Present? Yes ☐ No ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/11/2009

Applicant/Owner: City of Lubbock State: TX Sampling Point: W-8

Investigator(s): RW, DM Section, Township, Range: NA

Landform (hillslope, terrace, etc.): floodplain Local Relief (concave, convex, none): concave Slope (%): 1

Subregion (LRR): Central Great Plains Lat: 33° 31' 43.477" N Long: 101° 45' 19.603" W Datum NAD83

Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: PEM1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☐ No ☑

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present? Yes ☑ No ☐

Hydric Soils Present? Yes ☑ No ☐

Wetland Hydrology Present? Yes ☑ No ☐

Is the Sampled Area within a Wetland? Yes ☑ No ☐

Remarks: Location of old "lake" and breeched dam.

VEGETATION - Use scientific names of plants

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum Plot size: 30'			
1.	0		
2.	0		
3.	0		
4.	0		
	0 = Total Cover		
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
	0 = Total Cover		
Herb Stratum Plot size: 5'			
1. Schoenoplectus pungens	50	yes	OBL
2. Typha latifolia	30	yes	OBL
3. Polygonum lapathifolium	5	no	FACW-
4. Ambrosia trifida	5	no	FAC
5.	0		
6.	0		
	90 = Total Cover		
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0 = Total Cover		

Percent Bare Ground in Herb Stratum: 5

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

☑ Dominance Test is >50%

☐ Prevalence Index is ≤3.0*

☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ● Yes ○ No

Remarks: litter on ground

SOIL

Sampling Point: W-8

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-4	10YR 4/2	100					clay loam	
4-14	10Y 6/1	100					silty clay	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Loamy Mucky Mineral (F1)
☑ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☑ No ☐

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☐ High Water Table (A2)
☑ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)
☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):
Water Table Present? Yes ☐ No ☑ Depth (inches):
Saturation Present? Yes ☑ No ☐ Depth (inches): 9
(includes capillary fringe)

Wetland Hydrology Present? Yes ☑ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7
City/County: Lubbock/Lubbock
Sampling Date: 11/11/2009
Applicant/Owner: City of Lubbock
State: TX
Sampling Point: U-8
Investigator(s): RW, DM
Section, Township, Range: NA
Landform (hillslope, terrace, etc.): hillslope
Local Relief (concave, convex, none): none
Slope (%): 3
Subregion (LRR): Central Great Plains
Lat: 33° 31' 42.242" N
Long: 101° 45' 20.705" W
Datum NAD83
Soil Map Unit Name: Berda loam, 3-5% slopes
NWI classification: upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present? Yes ☐ No ☑
Hydric Soils Present? Yes ☐ No ☑
Wetland Hydrology Present? Yes ☐ No ☑

Is the Sampled Area within a Wetland? Yes ☐ No ☑

Remarks:

VEGETATION - Use scientific names of plants

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum Plot size: 30'			
1.	0		
2.	0		
3.	0		
4.	0		
= Total Cover	0		
Sapling/Shrub Stratum Plot size: 15'			
1. Robinia pseudoacacia	5	yes	FACU-
2.	0		
3.	0		
4.	0		
= Total Cover	5		
Herb Stratum Plot size: 5'			
1. Sporobolus cryptandrus	40	yes	FACU-
2. Kochia scoparia	40	yes	FACU
3. Solanum elaeagnifolium	5	no	NL
4. Elymus canadensis	5	no	FAC+
5.	0		
6.	0		
= Total Cover	90		
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
= Total Cover	0		

Percent Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	5	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0*
- ☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ○ Yes ● No

Remarks: litter on ground

SOIL

Sampling Point: U-8

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-12	7.5YR 5/3	100					fine sandy loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (LRR F)
- ☐ 1 cm Muck (A9) (LRR F, G, H)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

- ☐ 1 cm Muck (A9) (LRR I, J)
- ☐ Coast Prairie Redox (A16) (LRR F, G, H)
- ☐ Dark Surface (S7) (LRR G)
- ☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Dry Season Water Table (C2)
- ☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
- ☐ Presence of Reduced Iron (C4)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ FAC-Neutral Test (D5)
- ☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):

Water Table Present? Yes ☐ No ☑ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ☐ No ☑ Depth (inches):

Wetland Hydrology Present? Yes ☐ No ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/11/2009

Applicant/Owner: City of Lubbock State: TX Sampling Point: W-9

Investigator(s): RW, DM Section, Township, Range: NA

Landform (hillslope, terrace, etc.): floodplain Local Relief (concave, convex, none): concave Slope (%): 2

Subregion (LRR): Central Great Plains Lat: 33° 31' 44.254" N Long: 101° 45' 15.660" W Datum NAD83

Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: PFO/EM1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☐ No ☑

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present? Yes ☑ No ☐

Hydric Soils Present? Yes ☑ No ☐

Wetland Hydrology Present? Yes ☑ No ☐

Is the Sampled Area within a Wetland? Yes ☐ No ☑

Remarks: Location of pond where dam has been breeched. Likely floods with runoff events.

VEGETATION - Use scientific names of plants

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum Plot size: 30'			
1. Salix nigra	10	yes	FACW+
2.	0		
3.	0		
4.	0		
	10	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Herb Stratum Plot size: 5'			
1. Typha latifolia	50	yes	OBL
2. Polygonum lapathifolium	30	yes	FACW-
3. Ambrosia trifida	10	no	FAC
4. Elymus canadensis	10	no	FAC+
5.	0		
6.	0		
	100	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0	= Total Cover	

Percent Bare Ground in Herb Stratum: 5

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

☑ Dominance Test is >50%

☐ Prevalence Index is ≤3.0*

☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ● Yes ○ No

Remarks: litter

SOIL

Sampling Point: W-9

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-14	10Y 5/1	98	10YR 6/8	2	C	PL	sandy clay loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (LRR F)
- ☐ 1 cm Muck (A9) (LRR F, G, H)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☑ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

- ☐ 1 cm Muck (A9) (LRR I, J)
- ☐ Coast Prairie Redox (A16) (LRR F, G, H)
- ☐ Dark Surface (S7) (LRR G)
- ☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☑ No ☐

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Dry Season Water Table (C2)
- ☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
- ☐ Presence of Reduced Iron (C4)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ FAC-Neutral Test (D5)
- ☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches):
Water Table Present?	Yes ☐	No ☑	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ☑	No ☐	Depth (inches): 10

Wetland Hydrology Present? Yes ☑ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 4/29/2010

Applicant/Owner: City of Lubbock State: TX Sampling Point: W-13

Investigator(s): RW, PJ Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): hillslope Local Relief (concave, convex, none): none Slope (%): 5

Subregion (LRR): Central Great Plains Lat: 33° 32' 8.6" N Long: 101° 44' 39.5" W Datum NAD 83

Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: PEM1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☑ No ☐	**Is the Sampled Area within a Wetland?** Yes ☑ No ☐
Hydric Soils Present?	Yes ☑ No ☐	
Wetland Hydrology Present?	Yes ☑ No ☐	

Remarks: Wetland on slope of canyon wall due to groundwater seepage. Wetland abuts NFDMFBR.

VEGETATION - Use scientific names of plants

Tree Stratum Plot size: 30'	Absolute % Cover	Dominant Species?	Indicator Status
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1. Tamarix sp.	1	no	FACW
2.	0		
3.	0		
4.	0		
	1	= Total Cover	
Herb Stratum Plot size: 5'			
1. Schoenoplectus pungens	70	yes	OBL
2. Eleocharis palustris	10	no	OBL
3. Nasturtium officinale	5	no	OBL
4.	0		
5.	0		
6.	0		
	85	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0	= Total Cover	

Percent Bare Ground in Herb Stratum: 15

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

☑ Dominance Test is >50%

☐ Prevalence Index is ≤3.0*

☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ● Yes ○ No

Remarks: Shrub/Sapling stratum lacks sufficient cover to count as present.

SOIL

Sampling Point: W-13

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-6	10 YR 5/2	100					mucky loam	high OM
6-12	10 YR 6/1	60					clay loam	
	N 4/	40						

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☑ Loamy Mucky Mineral (F1)
☐ Loamy Gleyed Matrix (F2)
☑ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☑ No ☐

Remarks:

OM = organic matter

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☑ Surface Water (A1)
☑ High Water Table (A2)
☑ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)
☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☑ No ☐ Depth (inches): 1
Water Table Present? Yes ☑ No ☐ Depth (inches): 10
Saturation Present? (includes capillary fringe) Yes ☑ No ☐ Depth (inches): 0

Wetland Hydrology Present? Yes ☑ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 4/29/2010

Applicant/Owner: City of Lubbock State: TX Sampling Point: U-13

Investigator(s): RW, PJ Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): hillslope Local Relief (concave, convex, none): none Slope (%): 5

Subregion (LRR): Central Great Plains Lat: 33° 32' 8.7" N Long: 101° 44' 39.7" W Datum NAD 83

Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☑ No ☐	**Is the Sampled Area within a Wetland?** Yes ☐ No ☑
Hydric Soils Present?	Yes ☐ No ☑	
Wetland Hydrology Present?	Yes ☐ No ☑	

Remarks: Upland adjacent to slope wetland.

VEGETATION - Use scientific names of plants

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum Plot size: 30'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1. Celtis laevigata	1	no	FAC
2.	0		
3.	0		
4.	0		
	1	= Total Cover	
Herb Stratum Plot size: 5'			
1. Paspalum dilatatum	50	yes	FAC
2. Cynodon dactylon	10	no	FACU+
3. Solanum elaeagnifolium	1	no	UPL(NI)
4. unknown forb	1	no	
5.	0		
6.	0		
	62	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1. Vitis rotundifolia	1	no	FAC-
2.	0		
	1	= Total Cover	

Percent Bare Ground in Herb Stratum: 10

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☑ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0*
- ☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ● Yes ○ No

Remarks: Plant litter on ground.Shrub/Sapling and Woody Vine strata lack sufficient cover to count as present.

SOIL

Sampling Point: U-13

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-12	7.5 YR 6/4	80					loam	
	7.5 YR 4/2	20						

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)

☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Loamy Mucky Mineral (F1)
☐ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☐ High Water Table (A2)
☐ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)

☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):
Water Table Present? Yes ☐ No ☑ Depth (inches):
Saturation Present? Yes ☐ No ☑ Depth (inches):
(includes capillary fringe)

Wetland Hydrology Present? Yes ☐ No ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/11/2009

Applicant/Owner: City of Lubbock State: TX Sampling Point: W-14

Investigator(s): RW, DM Section, Township, Range: NA

Landform (hillslope, terrace, etc.): hillslope Local Relief (concave, convex, none): Slope (%):

Subregion (LRR): Central Great Plains Lat: 33° 32' 13.888" N Long: 101° 44' 32.680" W Datum NAD83

Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: PEM1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☑ No ☐	**Is the Sampled Area within a Wetland?** Yes ☑ No ☐
Hydric Soils Present?	Yes ☑ No ☐	
Wetland Hydrology Present?	Yes ☑ No ☐	

Remarks: Seepage slope, begins below canyon edge where small channel flows into wetland, and continues in a low area until it abuts the NFDMFBR.

VEGETATION - Use scientific names of plants

Tree Stratum Plot size: 30'	Absolute % Cover	Dominant Species?	Indicator Status
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Herb Stratum Plot size: 5'			
1. Schoenoplectus pungens	40	yes	OBL
2. Eleocharis palustris	30	yes	OBL
3. Panicum virgatum	20	yes	FACW
4.	0		
5.	0		
6.	0		
	90	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0	= Total Cover	

Percent Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

☑ Dominance Test is >50%

☐ Prevalence Index is ≤3.0*

☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ● Yes ○ No

Remarks: litter on ground

SOIL

Sampling Point: W-14

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-6	10YR 3/2	100					silt loam	
6-14	5G 6/1	60					sandy loam	
	N 2.5/	40						Staining from OM

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Loamy Mucky Mineral (F1)
☑ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☑ No ☐

Remarks:

OM = organic matter

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☑ High Water Table (A2)
☑ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)
☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):
Water Table Present? Yes ☑ No ☐ Depth (inches): 14
Saturation Present? Yes ☑ No ☐ Depth (inches): 0
(includes capillary fringe)

Wetland Hydrology Present? Yes ☑ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/11/2009

Applicant/Owner: City of Lubbock State: TX Sampling Point: U-14

Investigator(s): RW, DM Section, Township, Range: NA

Landform (hillslope, terrace, etc.): hillslope Local Relief (concave, convex, none): none Slope (%): 5

Subregion (LRR): Central Great Plains Lat: 33° 32' 13.628" N Long: 101° 44' 31.758" W Datum NAD83

Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☐ No ☑	**Is the Sampled Area within a Wetland?** Yes ☐ No ☑
Hydric Soils Present?	Yes ☐ No ☑	
Wetland Hydrology Present?	Yes ☐ No ☑	

Remarks: Upslope of seepage wetland.

VEGETATION - Use scientific names of plants

Tree Stratum Plot size: 30'	Absolute % Cover	Dominant Species?	Indicator Status
1. Ulmus pumila	20	yes	UPL(NI)
2.	0		
3.	0		
4.	0		
	20	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1. Prosopis glandulosa	10	yes	NL
2. Celtis ehrenbergiana	10	yes	NL
3.	0		
4.	0		
	20	= Total Cover	
Herb Stratum Plot size: 5'			
1. Sporobolus compositus	50	yes	UPL
2. Kochia scoparia	10	no	FACU
3. Setaria leucopila	5	no	NL
4.	0		
5.	0		
6.	0		
	65	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0	= Total Cover	

Percent Bare Ground in Herb Stratum: 5

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0 (A)		0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

☐ Dominance Test is >50%

☐ Prevalence Index is ≤3.0*

☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ○ Yes ● No

Remarks: litter on ground

SOIL

Sampling Point: U-14

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features					
	Color (moist)	%	Color (moist)	%	Type*	Loc**	Texture	Remarks
0-12	7.5YR 3/2	100					sandy loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (LRR F)
- ☐ 1 cm Muck (A9) (LRR F, G, H)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

- ☐ 1 cm Muck (A9) (LRR I, J)
- ☐ Coast Prairie Redox (A16) (LRR F, G, H)
- ☐ Dark Surface (S7) (LRR G)
- ☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Dry Season Water Table (C2)
- ☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
- ☐ Presence of Reduced Iron (C4)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ FAC-Neutral Test (D5)
- ☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):

Water Table Present? Yes ☐ No ☑ Depth (inches):

Saturation Present? Yes ☐ No ☑ Depth (inches):

(includes capillary fringe)

Wetland Hydrology Present? Yes ☐ No ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/12/2009

Applicant/Owner: City of Lubbock State: TX Sampling Point: W-16

Investigator(s): RW, DM Section, Township, Range: NA

Landform (hillslope, terrace, etc.): depression/drainage Local Relief (concave, convex, none): concave Slope (%): 2

Subregion (LRR): Central Great Plains Lat: 33° 32' 16.599" N Long: 101° 44' 17.727" W Datum NAD83

Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: PEM1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☑ No ☐	**Is the Sampled Area within a Wetland?** Yes ☑ No ☐
Hydric Soils Present?	Yes ☑ No ☐	
Wetland Hydrology Present?	Yes ☑ No ☐	

Remarks: Dirt road downslope with culvert that carries flow from wetland to river. Seepage from upslope.

VEGETATION - Use scientific names of plants

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum Plot size: 30'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Herb Stratum Plot size: 5'			
1. Schoenoplectus pungens	100	yes	OBL
2.	0		
3.	0		
4.	0		
5.	0		
6.	0		
	100	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0	= Total Cover	

Percent Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☑ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0*
- ☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ● Yes ○ No

Remarks: Scattered willow on edge of wetland outside the plot.

SOIL

Sampling Point: W-16

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-4	10YR 3/1	100					mucky loam	high OM
4-8	10Y 5/1	100					sandy loam	
8-12	10YR 4/1	100					clay loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☑ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (LRR F)
- ☐ 1 cm Muck (A9) (LRR F, G, H)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
- ☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☑ Loamy Mucky Mineral (F1)
- ☑ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

- ☐ 1 cm Muck (A9) (LRR I, J)
- ☐ Coast Prairie Redox (A16) (LRR F, G, H)
- ☐ Dark Surface (S7) (LRR G)
- ☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☑ No ☐

Remarks:

OM = organic matter

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Dry Season Water Table (C2)
- ☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
- ☐ Presence of Reduced Iron (C4)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ FAC-Neutral Test (D5)
- ☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):

Water Table Present? Yes ☐ No ☑ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ☑ No ☐ Depth (inches): 0

Wetland Hydrology Present? Yes ☑ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/12/2009

Applicant/Owner: City of Lubbock State: TX Sampling Point: U-16

Investigator(s): RW, DM Section, Township, Range: NA

Landform (hillslope, terrace, etc.): hillslope Local Relief (concave, convex, none): none Slope (%): 5

Subregion (LRR): Central Great Plains Lat: 33° 32' 16.768" N Long: 101° 44' 18.087" W Datum NAD83

Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☐ No ☑	**Is the Sampled Area within a Wetland?** Yes ☐ No ☑
Hydric Soils Present?	Yes ☐ No ☑	
Wetland Hydrology Present?	Yes ☐ No ☑	

Remarks: Upslope of wetland.

VEGETATION - Use scientific names of plants

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum Plot size: 30'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1. Prosopis glandulosa	5	yes	NL
2. Celtis ehrenbergiana	5	yes	NL
3.	0		
4.	0		
	10	= Total Cover	
Herb Stratum Plot size: 5'			
1. Sporobolus compositus	30	yes	UPL
2. Setaria leucopila	20	yes	NL
3.	0		
4.	0		
5.	0		
6.	0		
	50	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0	= Total Cover	

Percent Bare Ground in Herb Stratum: 30

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

☐ Dominance Test is >50%

☐ Prevalence Index is ≤3.0*

☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ○ Yes ● No

Remarks: leaf litter

SOIL

Sampling Point: U-16

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-12	7.5YR 3/3	100					sandy loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Loamy Mucky Mineral (F1)
☐ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☐ High Water Table (A2)
☐ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)
☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):
Water Table Present? Yes ☐ No ☑ Depth (inches):
Saturation Present? (includes capillary fringe) Yes ☐ No ☑ Depth (inches):

Wetland Hydrology Present? Yes ☐ No ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/12/2009
Applicant/Owner: City of Lubbock State: TX Sampling Point: W-20
Investigator(s): RW, DM Section, Township, Range: NA
Landform (hillslope, terrace, etc.): hillslope Local Relief (concave, convex, none): none Slope (%): 15
Subregion (LRR): Central Great Plains Lat: 33° 32' 10.406" N Long: 101° 43' 53.707" W Datum NAD83
Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: PEM/FO1C
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)
Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐
Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☑ No ☐	**Is the Sampled Area within a Wetland?** Yes ☑ No ☐
Hydric Soils Present?	Yes ☑ No ☐	
Wetland Hydrology Present?	Yes ☑ No ☐	

Remarks: Seepage at base of canyon wall. Adjacent to stream, but no surface connection.

VEGETATION - Use scientific names of plants

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum Plot size: 30'			
1. Salix nigra	5	yes	FACW+
2.	0		
3.	0		
4.	0		
	5	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Herb Stratum Plot size: 5'			
1. Panicum virgatum	50	yes	FACW
2. Eleocharis palustris	50	yes	OBL
3. Cynodon dactylon	10	no	FACU+
4.	0		
5.	0		
6.	0		
	110	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0	= Total Cover	

Percent Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 3 (A)
Total Number of Dominant Species Across All Strata: 3 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☑ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0*
- ☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ● Yes ○ No

Remarks:

SOIL

Sampling Point: W-20

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-14	5YR 2.5/1	100					sandy clay loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☑ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Loamy Mucky Mineral (F1)
☐ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☑ No ☐

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☐ High Water Table (A2)
☑ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)
☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):
Water Table Present? Yes ☐ No ☑ Depth (inches):
Saturation Present? Yes ☑ No ☐ Depth (inches): 0
(includes capillary fringe)

Wetland Hydrology Present? Yes ☑ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 11/12/2009

Applicant/Owner: City of Lubbock State: TX Sampling Point: U-20

Investigator(s): RW, DM Section, Township, Range: NA

Landform (hillslope, terrace, etc.): hillslope Local Relief (concave, convex, none): none Slope (%): 3

Subregion (LRR): Central Great Plains Lat: 33° 32' 9.709" N Long: 101°43' 54.489" W Datum NAD83

Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☐ No ☑	**Is the Sampled Area within a Wetland?** Yes ☐ No ☑
Hydric Soils Present?	Yes ☐ No ☑	
Wetland Hydrology Present?	Yes ☐ No ☑	

Remarks:

VEGETATION - Use scientific names of plants

Tree Stratum Plot size: 30'	Absolute % Cover	Dominant Species?	Indicator Status
1. Ulmus pumila	30	yes	UPL(NI)
2.	0		
3.	0		
4.	0		
	30	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1. Ulmus pumila	10	yes	UPL(NI)
2. Celtis laevigata	10	yes	FAC
3.	0		
4.	0		
	20	= Total Cover	
Herb Stratum Plot size: 5'			
1. Sporobolus compositus	80	yes	UPL
2. Elymus canadensis	15	no	FAC+
3. Solanum elaeagnifolium	5	no	NL
4.	0		
5.	0		
6.	0		
	100	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0	= Total Cover	

Percent Bare Ground in Herb Stratum: 5

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 1 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 25 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0*
- ☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ○ Yes ● No

Remarks: leaf litter on ground

SOIL

Sampling Point: U-20

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-12	2.5Y 2.5/1	100					sandy clay loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Loamy Mucky Mineral (F1)
☐ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:
Depth (inches):

Hydric Soil Present? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☐ High Water Table (A2)
☐ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)
☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):
Water Table Present? Yes ☐ No ☑ Depth (inches):
Saturation Present? (includes capillary fringe) Yes ☐ No ☑ Depth (inches):

Wetland Hydrology Present? Yes ☐ No ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 4/29/2010

Applicant/Owner: City of Lubbock State: TX Sampling Point: NJW-6

Investigator(s): RW, PJ Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): hillslope Local Relief (concave, convex, none): none Slope (%): 5

Subregion (LRR): Central Great Plains Lat: 33° 32' 12.8" N Long: 101° 44' 0.5" W Datum NAD 83

Soil Map Unit Name: Mobeetie fine sandy loam, 5-8% slopes NWI classification: PEM1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☑ No ☐	**Is the Sampled Area within a Wetland?**	Yes ☑ No ☐
Hydric Soils Present?	Yes ☑ No ☐		
Wetland Hydrology Present?	Yes ☑ No ☐		

Remarks: Wetland on slope of canyon wall due to groundwater seepage. Wetland lacks surface connection to a water of the U.S.

VEGETATION - Use scientific names of plants

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum Plot size: 30'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
	0	= Total Cover	
Herb Stratum Plot size: 5'			
1. Eleocharis palustris	60	yes	OBL
2. Typha latifolia	10	no	OBL
3. Helianthus annuus	1	no	FAC
4. Ambrosia trifida	1	no	FAC
5.	0		
6.	0		
	72	= Total Cover	
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
	0	= Total Cover	

Percent Bare Ground in Herb Stratum: 10

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0 (A)		0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

☑ Dominance Test is >50%

☐ Prevalence Index is ≤3.0*

☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ● Yes ○ No

Remarks: Plant litter on ground.

SOIL

Sampling Point: NJW-6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-5	7.5 YR 4/1	100					mucky loam	high OM
5-12	10 Y 5/1	100					clay loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☑ Loamy Mucky Mineral (F1)
☑ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☑ No ☐

Remarks:

OM = organic matter

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☑ High Water Table (A2)
☑ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)
☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches):
Water Table Present?	Yes ☑	No ☐	Depth (inches): 9
Saturation Present? (includes capillary fringe)	Yes ☑	No ☐	Depth (inches): 0

Wetland Hydrology Present? Yes ☑ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Great Plains Region

Project/Site: Lubbock Lake 7 City/County: Lubbock/Lubbock Sampling Date: 4/29/2010
Applicant/Owner: City of Lubbock State: TX Sampling Point: NJU-6
Investigator(s): RW, PJ Section, Township, Range: N/A
Landform (hillslope, terrace, etc.): hillslope Local Relief (concave, convex, none): none Slope (%): 2
Subregion (LRR): Central Great Plains Lat: 33° 32' 12.2" N Long: 101° 44' 0.9" W Datum NAD 83
Soil Map Unit Name: Berda loam, 3-5% slopes NWI classification: upland
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐
Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc

Hydrophytic Vegetation Present?	Yes ☐ No ☑	**Is the Sampled Area within a Wetland?**	Yes ☐ No ☑
Hydric Soils Present?	Yes ☐ No ☑		
Wetland Hydrology Present?	Yes ☐ No ☑		

Remarks: Downslope of wetland on slope of canyon wall without connection to a water of the U.S.

VEGETATION - Use scientific names of plants

Tree Stratum Plot size: 30'	Absolute % Cover	Dominant Species?	Indicator Status
1.	0		
2.	0		
3.	0		
4.	0		
= Total Cover	0		
Sapling/Shrub Stratum Plot size: 15'			
1.	0		
2.	0		
3.	0		
4.	0		
= Total Cover	0		
Herb Stratum Plot size: 5'			
1. Sporobolus cryptandrus	95	yes	FACU-
2.	0		
3.	0		
4.	0		
5.	0		
6.	0		
= Total Cover	95		
Woody Vine Stratum Plot size: 30'			
1.	0		
2.	0		
= Total Cover	0		

Percent Bare Ground in Herb Stratum: 5

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)
Total Number of Dominant Species Across All Strata: 1 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals	0	(A)	0 (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0*
- ☐ Morphological Adaptations* (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation* (Explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? ○ Yes ● No

Remarks:

SOIL

Sampling Point: NJU-6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type*	Loc**		
0-12	7.5 YR 3/1						clay loam	small gravel

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. **Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (LRR F)
☐ 1 cm Muck (A9) (LRR F, G, H)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (LRR G, H)
☐ 5 cm Mucky Peat or Peat (S3) (LRR F)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Loamy Mucky Mineral (F1)
☐ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16) (MLRA 72 and 73 of LRR H)

Indicators for Problematic Hydric Soils***

☐ 1 cm Muck (A9) (LRR I, J)
☐ Coast Prairie Redox (A16) (LRR F, G, H)
☐ Dark Surface (S7) (LRR G)
☐ High Plains Depressions (F16) (LRR H outside of MLRA 72 and 73)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Other (Explain in Remarks)

***Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☐ High Water Table (A2)
☐ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water Stained Leaves (B9)
☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3) (where not tilled)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3) (where tilled)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (LRR F)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):
Water Table Present? Yes ☐ No ☑ Depth (inches):
Saturation Present? Yes ☐ No ☑ Depth (inches):
(includes capillary fringe)

Wetland Hydrology Present? Yes ☐ No ☑

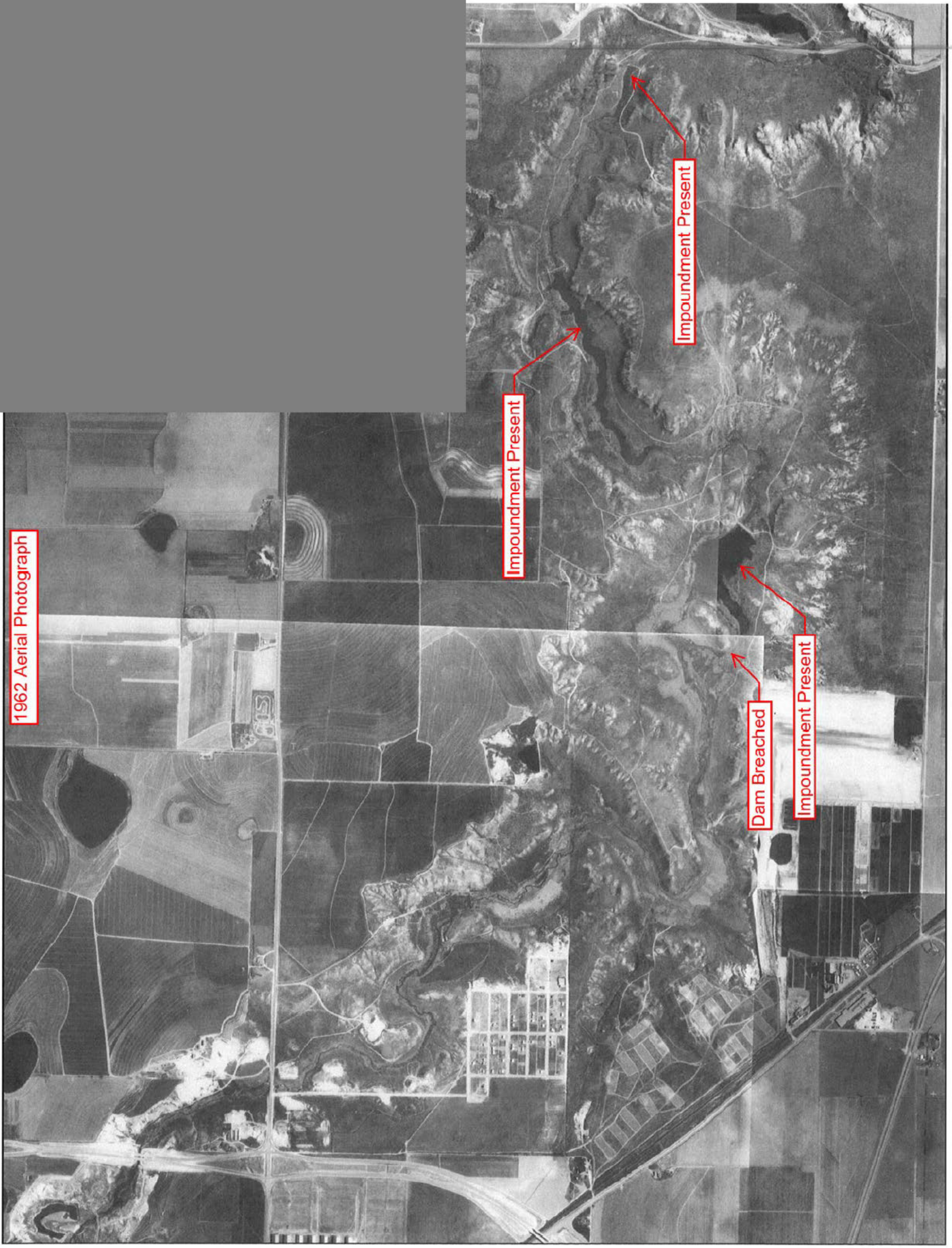
Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Attachment C4
Historic Aerial Photographs

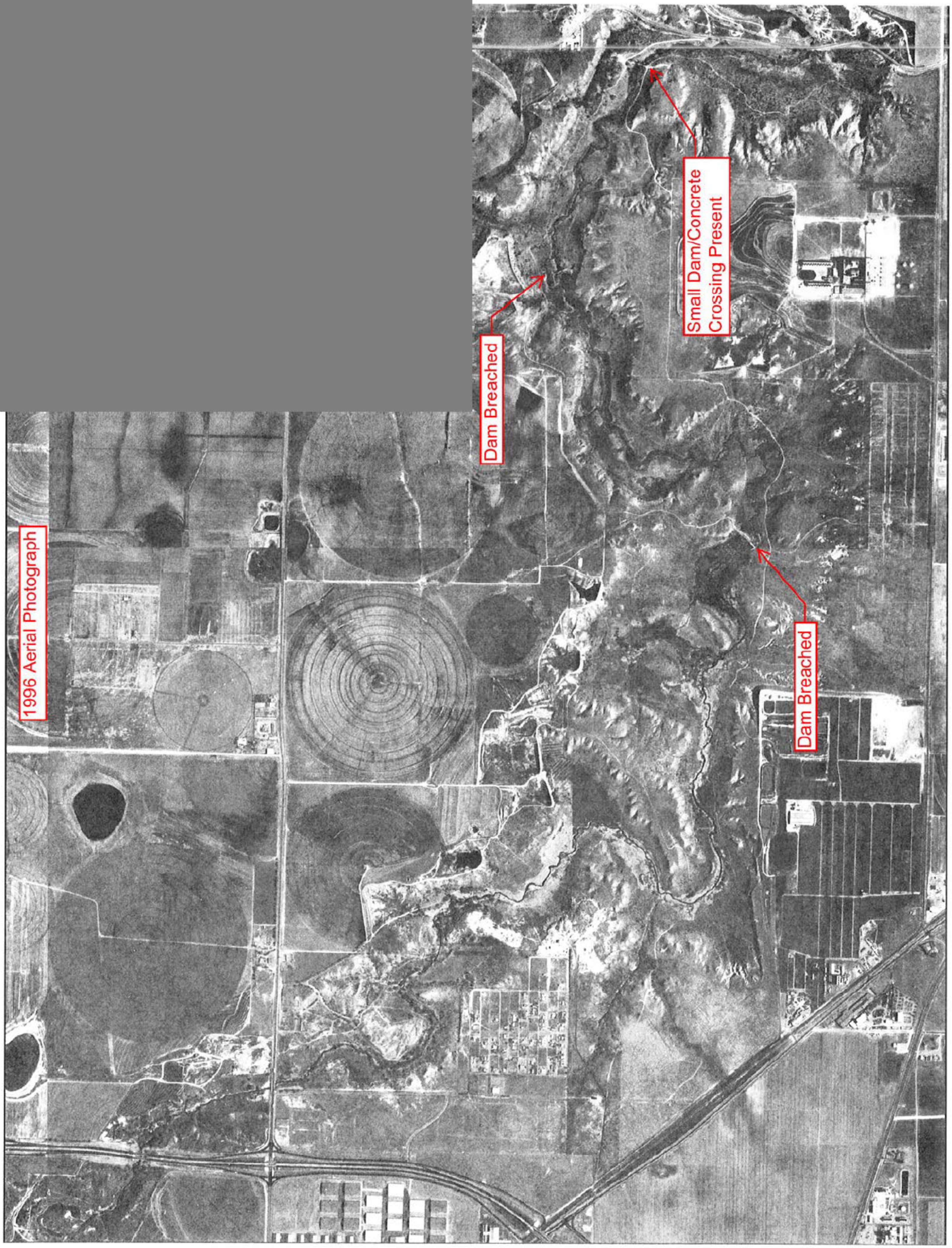

1954 Aerial Photograph
Impoundment Present
Impoundment Present
Impoundment Present

[redacted]


1962 Aerial Photograph
Impoundment Present
Impoundment Present
Impoundment Present
Dam Breached


1978 Aerial Photograph
Impoundment Present
Dam Breached
Impoundment Present

Missing Frames



1996 Aerial Photograph

2008 Aerial Photograph

Appendix D
Aquatic Life Monitoring

Appendix D
Aquatic Life Monitoring
North Fork Double Mountain Fork Brazos River

Lake 7 Reservoir Project
Lubbock County, Texas

Prepared for:

city of lubbock TEXAS

Prepared by:

HDR | ONE COMPANY *Many Solutions*℠

January 2010

Table of Contents

Table of Contents (Concluded)

Attachments

List of Tables

Table **Page**

D.1 Introduction

A total of four sampling areas on the North Fork Double Mountain Fork Brazos River within Lubbock County were selected for Aquatic Life Monitoring (ALM) based on an inventory of wadeable portions of the river (i.e., small and shallow enough to adequately sample without a boat) taken during the field reconnaissance survey conducted by HDR biologists on 22 June 2009 (Figure 1). Factors that restricted the choice of accessible locations were based on land access, physical barriers and safety concerns for the aquatic field crew.

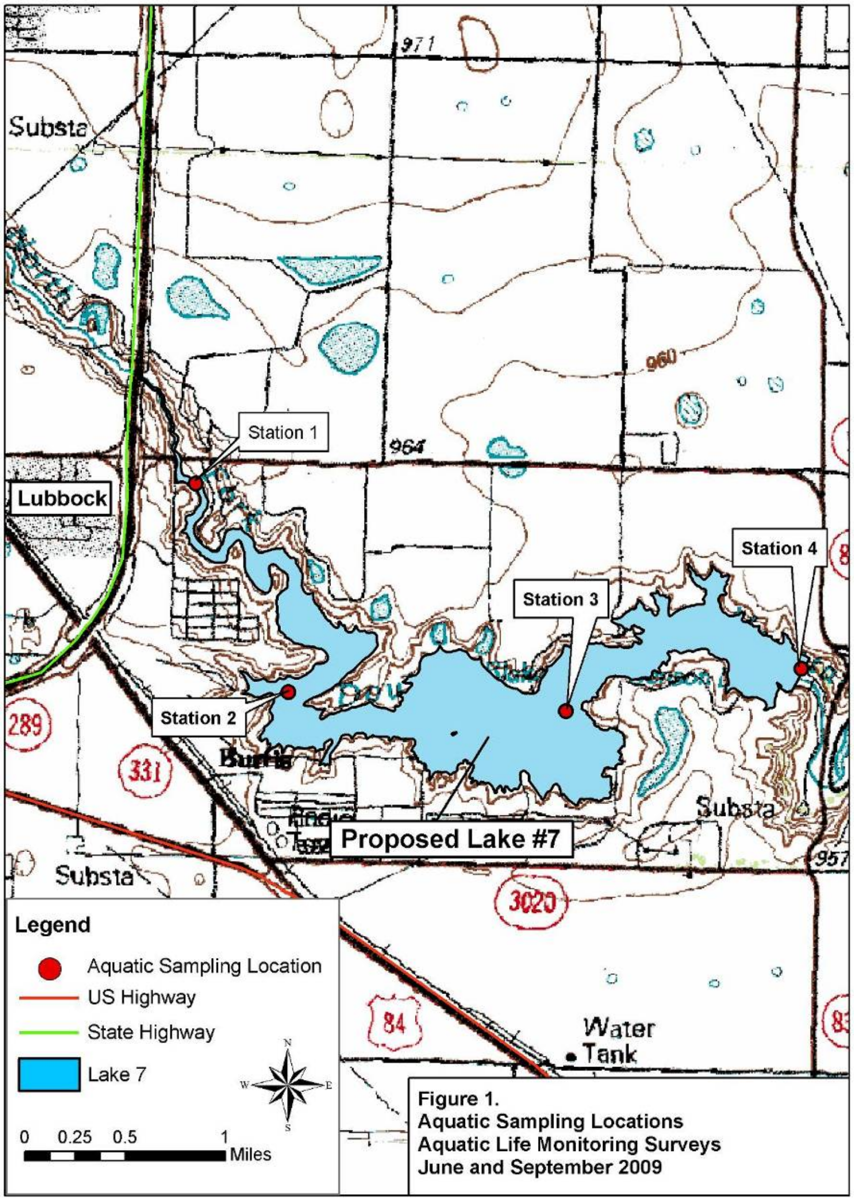


Figure 1.
Aquatic Sampling Locations
Aquatic Life Monitoring Surveys
June and September 2009

Evaluation of stream physio-chemical conditions, stream habitat, characterization of stream flow, and the assessment of the fish and macroinvertebrate community was conducted during the non-critical (index) period on 23–24 June 2009 and the critical period on 22-23 September 2009. The primary purpose of the collection program for the project was to provide an accurate and detailed description of the existing aquatic environment by identifying and documenting the aquatic communities residing within the section of North Fork Double Mountain Fork Brazos River proposed for impoundment.

D.2 Methods and Materials

The methods and materials for the ALM work performed followed the guidelines of the Texas Commission on Environmental Quality's (TCEQ) *Surface Water Quality Monitoring Procedures Manual, Volume 1* (TCEQ, 2008a). Macroinvertebrate and fish community integrity, together with occurrences of aquatic vegetation, were also documented during the June and September 2009 surveys. The methods and procedures used are consistent with those outlined in the TCEQ *Biological Monitoring Fact Sheet* (TCEQ, 2006) and the TCEQ *Surface Water Quality Monitoring Procedures, Volume 2* (TCEQ, 2007).

In accordance to the standardized stream characteristics forms and with the Surface Water Quality Monitoring (SWQM) field sampling manual, stream habitat evaluations, flow characteristics, and fish and benthic macroinvertebrate populations were assessed twice during the calendar year 2009. Standard field parameters and stream flow were recorded concurrent to each ALM sampling event.

D.2.1 Station Locations

A field reconnaissance trip covering approximately 6 miles of the North Fork Double Mountain Fork Brazos River was conducted on 22 June 2009, during which several properties with river frontage extending downstream from Farm to Market Road (FM) 835 east of Loop 289 to FM 835 north of FM 3020 near at the upper end of Buffalo Springs Lake were inspected. The primary objectives of this river survey were 1) selection of potential sampling locations for subsequent ALM; 2) to determine the feasibility of the use of a backpack electroshocker based on conductivity; 3) identification of potential habitat for two imperiled cyprinid species (minnows), smalleye shiner (*Notropis buccula*) and sharpnose shiner (*Notropis oxyrhynchus*) habitat; and 4) identification of potential Texas horned lizard (*Phrynosoma cornutum*) habitat. A total of five potential aquatic sampling locations were identified during the initial field reconnaissance of the study area of which four were then chosen based on river access and landowner permission for biological collection and physical habitat evaluation during the 2009 index and critical periods (Figure 1).

Sampling occurred during 23-24 June 2009 and 22-23 September 2009 on privately owned lands at the following four monitoring stations: 1) directly downstream of FM 835 east of Loop 289 on the Chapman Property; 2) the upper river crossing on the V8 Ranch Property; 3) the middle river crossing on V8 Ranch property; and 4) the lower river crossing on the V8 Ranch Property (Figure 1). Sampling locations were selected to represent a lower, middle and upper spatial position on the river. Three locations (Stations 1, 2, and 3) were sampled in the approximate length of creek selected for proposed impoundment upstream of the proposed dam structure. Station 1 was established approximately 0.15 mile (800 ft) downstream of the FM 835 crossing. Station 2 was positioned approximately 1.9 river miles downstream of Station 1. Station 3 was established on the river slightly over 2.0 river miles downstream of Station 2. Station 4 was located on the river approximately 1.5 miles downstream of Station 3, directly south of the V8 Ranch homestead, situated at and immediately downstream of the area proposed for the current dam structure.

D.2.2 Physical Habitat Observations

A Habitat Quality Index (HQI) was prepared from riparian vegetation and physical habitat characteristics observed at five transect lines. Habitat quality is a representation of the physical conditions in a stream channel, the surrounding riparian zone, and the watershed land use. The riparian vegetation and physical characteristics were documented during each of the ALM sampling efforts with a series of cross sections and associated habitat evaluations. Transect placement at each selected site involved sections of river both upstream or downstream of a river crossing and measured at four evenly spaced distances of 75 m for a total of five cross sections (T1 through T5), which were considered to be representative of habitats within each stream reach. The riparian vegetation and physical habitat characteristics at each of the five transect locations were characterized by a series of attributes and associated aquatic habitat measurements as outlined in TCEQ (2007) and recorded on TCEQ's Part I-Stream Physical Characteristics Worksheet.

Instream channel measurements include habitat type, number of riffles, dominant substrate type, percent of substrate composed of gravel, presence or absence of algae and aquatic macrophytes, instream cover types and percentage of each. Stream morphological parameters include channel sinuosity, channel obstructions/modifications, channel flow status, stream width and depth. Features that describe the riparian environment include width of natural vegetative buffer, aesthetics, percentage of riparian vegetation types, bank slope, bank stability, canopy cover and dominant types of riparian vegetation. The percentage of tree canopy cover was determined with a concave spherical densiometer. The percentage of the dominant riparian vegetation types along the left and right banks at each transect station was made by visual estimation. A Suunto clinometer was used to determine creek bank slope in degrees. At each stream site, a digital camera was used to document the upstream, downstream, left bank, and right bank habitat conditions at each transect. Additionally, each location was marked with a global-positioning system (GPS) hand-held unit so these areas could be easily and accurately relocated as needed.

D.2.3 Standard Field Parameters

In situ determinations of water temperature (°C), dissolved oxygen (DO) (mg/L), conductivity (µS/cm), and surface pH readings were obtained with a Yellow Springs Instrument (YSI) Model 650-04 display with high memory and barometer connected to a Model 600 XLM-M data sonde with temperature, conductivity, DO, and pH sensors concurrent with the biological sampling efforts. The data sonde was calibrated according to the TCEQ and manufacturer's recommendations prior to field use, and post-calibrated upon return to the office. Light penetration was measured in meters with a 20-cm diameter black-and-white Secchi disk

D.2.4 Instantaneous Flow Measurements

Cross-sectional flow measurements were taken at all stations to determine stream discharge in cubic feet per second (cfs). The average velocity (ft/s) was determined with a Marsh-McBirney Model 2000 Flo-Mate portable velocity meter and top-setting wading rod. Stream flow discharge in cubic feet per second (cfs) was calculated by multiplying the section width by the section depth (ft^2) by the velocity (f/s).

D.2.5 Biological Collections

D.2.5.1 Aquatic Macrophytes

The presence or absence of rooted aquatic plants was recorded during each site visit.

D.2.5.2 Benthic Macroinvertebrates

Field methods were consistent with the protocols of the Surface Water Quality Manual developed by the TCEQ (TCEQ, 2007). This manual provides standard guidelines which are periodically updated for the rapid biological assessment field protocol, laboratory analysis, and qualitative evaluation commonly used in this region. Qualitative sampling was conducted using a 10.5” x 18.5” rectangular frame dip net (500 x 500 micron mesh) at four stream locations during flowing conditions on 23-24 June and 22-23 September of 2009. A minimum of five minutes of kick time per station was expended through all available microhabitats over stable substrates located in areas exposed to current (e.g., large cobble, gravel bars, logs, woody snags, etc.). Sampling along each stream reach was conducted in a “zig-zag” pattern from downstream to upstream in order to best represent the longitudinal and cross sectional areas. Dip net samples were collected by placing the framed net on the streambed facing upstream and using the foot or hand to disturb the bottom substrate allowing dislodged material to flow into the net. Processing of the dip net samples was accomplished in the field by thoroughly washing the sample in the dip net then placing appropriate sample aliquots in a shallow white pan. The sample was stirred in the pan to disperse the contents as evenly as possible and individual specimens were removed by forceps. This process was repeated until a minimum of 200 individuals were picked. Organisms were placed into 70% ethanol and returned to the HDR Austin laboratory for taxonomic identification, enumeration, and metric calculations. Each sample bottle was labeled using waterproof ink in the field with the field collector initials, station number, date, and time of collection. A chain of custody (COC) inventory form was kept to ensure precise laboratory sample tracking and integrity.

Laboratory identification of benthic invertebrates was conducted with a dissecting microscope (45X) to provide the lowest practical taxon (LPT) for each specimen. Consistent with TCEQ protocol (TCEQ, 2007), the LPT is primarily considered the level of genus, with some difficult groups such as midges, crustaceans and worms identified to less specific taxonomic levels such as family or class. Standard taxonomic reference manuals for invertebrate identification included Merritt (2008), Wiggins (2000), Needham (2000), Pennak (1989), Thorp (2001) and Westfall (1996).

D.2.5.3 Fish

For ALM purposes, the collection of fish usually involves the combination of two collection methods, seine and electrofishing, to obtain a representative fish collection. However, the water quality of the North Fork Double Mountain Brazos River is characterized as having high dissolved solids and conductivity levels. High water conductivity (e.g., 1,000-3,000 µS/cm) causes backpack electrofishing to become less effective for accurately depicting fish populations. High water conductivities in excess of 900 µS/cm were recorded throughout the river during both survey events. Therefore, the fish populations were collected in a downstream to upstream direction at each sampling location from accessible habitat areas using a 6.1-m x 1.5-m x 0.32-cm common-sense minnow seine. A minimum of 10 seine hauls were taken at each station covering a minimum of 186 square meters (m^2) of the stream reach during each survey effort to capture a representative collection of fish from North Fork Double Mountain Fork in the study area.

The majority of the netted fish were sorted and placed into plastic bottles containing 10% formalin when seine hauls at their respective stations/reaches were completed and returned to HDR Austin laboratory for positive identification. Larger, easily identified fish were examined in the field and released. Additionally, all fish collected from each seine sample were visually examined for obvious diseases, parasites, and other abnormalities. Fish identification quality assurance was achieved by meeting with Gordon Linam, Stream Assessment Team Leader of Texas Parks and Wildlife Department in San Marcos, Texas, to confirm fish species identified by HDR Engineering, Inc. A minimum of one specimen of each fish species collected at each station during every survey was preserved in 70% ethanol and kept as a voucher collection. Taxonomic references include Hubbs (1970), Douglas (1974), and Hubbs et al. (1991).

D.2.6 Data Analyses

D.2.6.1 Habitat

Physical habitat assessments were conducted at all four stations to evaluate the habitat effects on biota. As discussed in Section 2.2, TCEQ Habitat Assessment Forms used to record required data in the field were compiled from field information taken at all locations. General observations for the entire evaluated reach, coupled with observations and measurements taken at the five specific transect locations at each location including the presence or absence of rooted aquatic plants, were recorded on the Stream Physical Characteristics Worksheet—Part I. Several parameters including instream habitat, epifaunal substrate, water depth and width, bank erosion/stability, pool/glide/run/riffle quality and shading were scored based on visual observation.

Using this information, a summary of the general physical characteristics and averages of the stream at each location were determined from information noted on the field worksheet and recorded on the Physical Characteristics of Water Body—Part II summary worksheet. A total of nine habitat parameters contained on the HQI—Part III form were then evaluated and rated on a numeric scale of 0 to 4 (highest) and total habitat score calculated based on the worksheet values summarized in Part II and other relevant observations taken during each visit. The ratings are then totaled to provide a final habitat ranking. The highest value possible using this habitat assessment technique is 31.

A HQI was calculated for the four stations following summation of these values to determine the aquatic habitat quality during the summer season (index period) and late summer season (critical period). The habitat quality worksheets for each of the four stations are found in tables D1-1 through D1-8 in Attachment D1. At each ALM stream site, a digital camera was used to document the upstream and downstream habitat conditions from each of the five transect lines. Photographs were taken upstream, downstream, right bank and left bank for documentation of current stream habitat conditions during each site visit and for descriptive purposes to supplement the physical habitat evaluation at the time of each field effort (Attachment D2).

D.2.6.2 Benthic Macroinvertebrates

Evaluation of the benthic macroinvertebrate data primarily followed the metric and scoring criteria guidelines provided in the TCEQ Surface Water Quality Manual qualitative assessment of kick samples. This protocol was selected because it is specific to samples collected in Texas. This method evaluates the sample based on 12 metric parameters which assess the diversity, tolerance to pollution, community structure and trophic balance of the sample. The rubric for each of 12 metric parameters and overall scoring criteria developed by the

TCEQ is presented in Table 1. Each of the 12 metrics are calculated with a score of 1, 2, 3, or 4, so a total score can range from 12 (i.e., 12 x 1) to 48 (i.e., 12 x 4).

Table 1.
TCEQ Rapid Bioassessment Protocol Metric Evaluation Protocol for Benthic Macroinvertebrate Kicknet Samples

Metric	***Scoring Criteria***			
	4	***3***	***2***	***1***
Taxa richness	> 21	15-21	8-14	< 8
EPT taxa abundance	> 9	7-9	4-6	< 4
Biotic index (HBI)	< 3.77	3.77-4.52	4.53-5.27	>5.27
% Chironomidae	0.79-4.10	4.11-9.48	9.49-16.19	< 0.79 or >16.19
% Dominant taxon	< 22.15	22.15-31.01	31.02-39.88	> 39.88
% Dominant FFG	< 36.50	36.50-45.30	45.31-54.12	> 54.12
% Predators	4.73-15.20	15.21-25.67	25.68-36.14	< 4.73 or >36.14
Ratio of intolerant:tolerant taxa	> 4.79	3.21-4.79	1.63-3.20	< 1.63
% of total Trichoptera as Hydropsychidae	< 25.50	25.51-50.50	50.51-75.50	> 75.50 or no Trichoptera
# of non-insect taxa	> 5	4-5	2-3	< 2
% Collector-gatherers	8.00-19.23	19.24-30.46	30.47-41.68	< 8.00 or >41.68
% of total number as Elmidae	0.88-10.04	10.05-20.08	20.09-30.12	< 0.88 or >30.12
Aquatic life use point score ranges:	Exceptional: > 36; High: 29-36; Intermediate: 22-28; Limited: < 22			

Diversity is assessed by three parameters: total number of taxa (taxa richness) identified to the LPT, total number of mayfly/stonefly/caddisfly taxa (EPT taxa), and total number of taxa that are not in class Insecta (Non-insect taxa). Ecosystems with high integrity are typically complex and display high diversity of taxa. In each of these parameters, increasing taxa number translates to a corresponding increase in aquatic integrity. Streams with high aquatic integrity will likely have more than seven EPT taxa, more than four non-insect taxa and more than fifteen total taxa overall.

Relative sensitivity to chemical and physicochemical conditions is reflected by a TCEQ Pollution Tolerance Index (PTI) which ranges from 10 (pollution tolerant) to 0 (pollution intolerant). The PTI was established to compare an organism's ability to cope with adverse ambient conditions including, but not limited to, nutrient enrichment and low dissolved oxygen concentrations. The relative sensitivity to these aquatic stressors is assessed by three parameters: a weighted average value of the PTI values (Hilsenhof Biotic Index), a ratio of the total number of individuals with PTI <6 to the total number of individuals with PTI ≥6 (ratio of intolerant to tolerant taxa), and the relative dominance of the pollution tolerant family Hydropsychidae to the other relatively pollution intolerant caddisflies (% of total Trichoptera as Hydropsychidae). An increasing ratio of intolerant to tolerant taxa indicates increasing aquatic integrity due to the higher percentage of pollution tolerant composition. Conversely, decreasing Hilsenhof Biotic Index values and decreasing percentages of Hydropsychidae indicate increasing aquatic integrity.

Community structure is evaluated by three parameters: the number of individuals of the most numerous taxon divided by the total number of individuals in the sample (% Dominant taxon), the number of midges divided by the total number of individuals in the sample (% Chironomidae), and the total number riffle beetles divided by the total number of individuals in the sample (% Elmidae). Increasing dominance of any these categories indicates decreasing aquatic integrity; however, depauperate percentages of midges and riffle beetles could also indicate poor integrity. Generally speaking, a value of 33% or more in any of these groups indicates an impaired community.

Trophic structure is determined by the relative abundance of the different Functional Feeding Groups (FFG) in a community, including predators, collector-gatherers, scrapers, filtering-collectors, and shredders. Trophic balance is evaluated by three parameters: the total number of individuals of the numerically dominant functional feeding group (% Dominant FFG), the number of individual predators divided by the sample total (% Predators), and the number of individual collector-gatherers divided by the sample total (% Collector-gatherers). Less than 45% of the dominant functional feeding group, and less than 30% predators or collector-gatherers is generally indicative of well balanced trophic composition. Although the values for each individual metric parameter is used for sample-to-sample comparison, the overall aquatic integrity of each stream reach is evaluated based on a composite score of the 12 metrics.

D.2.6.3 Fish

For the biological evaluation, all fish collected by seine were combined in the data set and treated identically. Because watershed characteristics and fish communities from the North Fork Double Mountain Fork Brazos River differ from those for midwestern headwater streams originally used by Karr et al. (1986), the community trophic structure status and intolerance/tolerance data as described by Linam and Kleinsasser (1998) along with a regionalized adaptation of the Index of Biotic Integrity (IBI) developed by Linam et al. (2002) for representative Texas streams in Ecoregions 25 and 26 (Western High Plains and Southwestern Tablelands) was calculated to provide a fish aquatic life use rating for each station. The cumulative score of this index consisting of eight separate metrics falling within three broad categories (species composition, trophic composition, and fish abundance and condition) provides a baseline evaluation of the overall condition of the fish community residing in the four stream reaches of the North Fork Double Mountain Fork Brazos River (Table 2). For each location, the eight metrics are tabulated using the raw data. After the metrics are calculated, they are each converted to a score of 1, 3, or 5 in order to facilitate comparisons between sampling sites, watersheds, or regions. The resulting scores can range from Limited to Exceptional.

Table 2.
Scoring Criteria for Assessment of Stream Fish Assemblages
Western High Plains and Southwestern Tablelands (Ecoregions 25 and 26)

Metric Category	***Metric Names***	***Score***		
		5	***3***	***1***
Species Richness and Compositions	1. Total number of fish species	*	*	*
	2. Number of native Cyprind species	>2	2	<2
	3. Number of sunfish species	>1	1	0
Trophic Composition	4. Percentage of individuals as omnivores	>9%	9-6%	>16%
	5. Percentage of individuals as invertivorges	>65%	33-65%	<33%
Fish Abundance and Condition	6. Number of individuals/seine haul	>41.7	20.9-41.7	>20.9
	7. Percentage of individuals as non-native species	<1.4%	1.4-2.7%	>2.7%
	8. Percentage of individuals with disease or other anomaly	<0.6%	0.6-1.0%	>1.0%
Fish Species	Fish species richness based on drainage basin size (km^2); see Linam et al. (2002)			
Aquatic Life Use: Exceptional: ≥36; High: 34-35; Intermediate: 24-33; Limited: <24				

D.3 Results

D.3.1 Physical Description of Aquatic Sample Stations

D.3.1.1 General Stream Habitat Characteristics

The North Fork Double Mountain Fork Brazos River within the study area is a low gradient, third-order stream that flows through rural, predominately unmanaged floodplain characterized by turbid water, stream bank erosion, and low overhanging black willow (*Salix nigra*), salt cedar (*Tamarix ramosissima*), and American elm (*Ulmus americana*) trees. Riparian vegetation is sparse along the central portion of the channel but is densely forested in the upper and lower sections of the reach investigated. The floodplain area within and adjacent to the study area is generally utilized for farming and ranching while substantial development occurs downstream around Buffalo Springs Lake and Lake Ransom Canyon. Except during periods of heavy rainfall, the river moves slowly as stream discharge is highly variable and strongly influenced by precipitation, water diversions, and agricultural practices.

Aquatic habitats found in this region include playa lakes, perennial river habitats and intermittent tributary streams. Typical of plains streams, the North Fork Double Mountain Fork Brazos River experiences large variations in discharge, exhibiting an annual pattern of prolonged periods of low flow punctuated by high flow events. Although the river upstream of Lake Buffalo Springs may be subject to large variations in discharge, it is predominantly intermittent in nature containing species characteristic of, and in some cases restricted to, small riverine systems. At each of the four locations, three individual habitat types representing available habitat were identified: riffles, pools, and runs. Each habitat has characteristic species assemblages which depend on or are regulated by temperature, pH, current velocity, light, nutrients, and turbidity.

Riffles were classified as stream reaches with turbulent flow with greater than 50% of the river bottom composed of gravel or larger substrates. In several areas, the river channel is constricted, forming shallow, relatively fast-flowing riffle habitats. The riffle areas tend to be very shallow, ranging from 5 to 30 cm and are generally floored by large gravel and cobble substrates. The presence of riffle areas, common at all locations, is very dependent upon the volume of water flowing down the creek. The faster flowing habitats and more suitable substrate have the potential to provide a more diversified and abundant macroinvertebrate food base than occurs in pools, as well as shallow water habitat for many small species of fish.

The most common habitat available to aquatic organisms in the study area are the long, slow flowing pools. The pools, which are often in excess of 1.0 m in depth, are typically floored primarily of clay sand and silt substrates at all locations. The pool areas were noted by their biological character to be permanent or usually persistent.

The homogenous transitional zones flowing over scoured clay bottoms between pools and riffles were classified as runs. The extent of wood cover in woody habitats in the upstream and downstream channel reaches was low and ranged from 5 to 10% of the total sample zone surface area. These woody habitats generally had depth and velocity characteristics of pools but contained abundant wood structure.

Riparian communities are generally composed of four primary vegetation types based upon substrate and elevation above the river’s surface. Variations of these primary types occur throughout the stream reach based on changes in the composition of woody and herbaceous species and the physiognomy of localized conditions and specific range sites. The first type, aquatic beds, usually found as emergent or submergent growths within the river channel or shoreline margins, were not observed at any of the sampling locations. The second, sand and gravel bars usually abundant along river bend areas, were absent at all locations investigated. The third type, sloughs, are areas that tend to support emergent vegetation if water is present for any length of time. This community type was not observed at any of the sampling locations. The river banks form the fourth type of community. Streamside riparian areas composed of woody and herbaceous species have different vegetation production capacities based on a range of factors such as soils, hydraulic controls, or slope gradients. Establishment of vegetated riparian buffers of grasses, trees, and shrubs adjacent to the river banks varied along the study reach. A thick growth of vegetation, composed of grasses, shrubs, and trees, covers the streambanks in the upper and lower reaches of the study area and provides shade over the river. Patchy or scrubby riparian growth with occasional bare ground was common in the central portion of the floodplain. Livestock intrusions to the riparian areas have had the most significant negative impact on this community, causing bank erosion and subsequent sedimentation and siltation. This is likely due to the presence of numerous stream crossings which disrupt riparian continuity and provide access of silt to streams.

D.3.1.2 Station Locations and Descriptions

Station 1 is the uppermost river access selected for monitoring found approximately 0.15 mile downstream of the FM 835 crossing near Loop 289 on the Chapman Property at coordinates latitude 33° 32’ 43.115” N, longitude 101° 46’ 54.521” W (Figure 1). The total drainage area upstream of this location is approximately 3,807 mi^2. This location receives stormwater runoff and groundwater discharged from the LLAS that appears to provide a steady flow to this portion of the river. The conditions observed during the September 2009 survey were consistent with the previous investigation in June. A shallow riffle area occurs in the central portion of the sample zone at Transect 3 floored with large gravel and cobble. At high flow, this riffle area will completely disappear, however this area was more prominent during the September survey as sampling was conducted under a lower flow regime than observed in June. Water depth ranged from 0.16 ft at Transect 3 to over 5.9 ft in the pooled section of river immediately upstream downstream of the riffle. The river channel is bounded by nearly vertical banks, 5.0 to 8.0 ft in height, of a sand and clay formation with numerous exposed tree roots and undercut banks. Both banks were heavily wooded, providing a closed canopy with light undergrowth. The floodplain was wooded by stands of American elm, Siberian elm (*Ulmus pumilla*), salt cedar, black willow, and eastern red cedar (*Juniperus virginiana*) and these species are present as saplings in the shrub layer as well. The ground cover consisted of silver nightshade (*Solanum elaeagnifolium*), Canada wildrye (*Elymus canadensis*), marsh-elder (*Iva annua*), false indigo (*Amorpha fruticosa*) and sawtooth daisy (*Crindelia squarrosa*). There was no emergent or submergent aquatic vegetation.

Station 2 was established about 1.9 river miles downstream of Station 1 at the upper river crossing located on the V8 Ranch Property at coordinates latitude 33° 31’ 48.009” N, longitude 101° 46’ 24.174” W (Figure 1). Total drainage area upstream of this location is approximately 3,824.7 mi^2 . A commercial livestock feedlot was located south of the river channel. It did not appear that the surface waters at this location receives effluent from this facility. Sampling was conducted upstream of the river crossing that is heavily utilized as a watering place for crossing livestock. The water was muddy and flows over a soft, predominately sandy clay substrate throughout the entire sample reach. Stream banks are fairly steep along both banks ranging from 6 to 8 ft in height. Access to the upper sample zone in September was limited by tall stands (> 10 ft high) of common sunflower (*Helianthus annuus*) occupying both sides of the river. Pool habitat dominated the entire sample area comprising at least 85% coverage of the total surface area. A riffle was present at Transect 5 with sediments consisting of assorted-sized gravels with scattered patches of cobble covered with a thin layer of fine sand and silt. Characteristic species bordering the river at this location include American elm, black willow, mesquite (*Prosopis glandulosa*), burmudagrass (*Cynodon dactylon*), buffalobur (*Solanum rostratum*), marsh-elder and sagewort (*Artemisia ludoviciana*).

Station 3 is located approximately 2.0 river miles downstream of Station 2 at the middle river crossing on the V8 Ranch Property at coordinates latitude 33° 31’ 46.726” N, longitude 101° 44’ 58.458” W (Figure 1). Total drainage area upstream of this location is approximately 3,839.6 mi^2. The length of the North Fork Double Mountain Fork upstream and downstream of the river crossing represents a high sinuous aquatic environment that is characterized with very little riparian cover or tree canopy. Deep pools limited accessibility for habitat inventory and biological assessment upstream of Transect 1 and downstream of Transect 5. This habitat type was more common downstream of the river crossing, especially at the river bends where most of the meanders were located. Cattle utilize the crossing area at Transect 3 as a water source. This location did not have a developed riparian border, although some shading was provided over the river at various times of the day. Exposed tree roots occurred infrequently along the channel reach, and the banks were covered with a light understory growth composed of common sunflower, Texas croton (*Corton texensis*), tall goldenrod (*Solidago altissima*), mesquite, sideoats gram (*Bouteloua curtipendula*), and switchgrass (*Panicum virgatum*). No aquatic vegetation was observed at this station.

Station 4 was located on the river approximately 1.5 miles downstream of Station 3, directly south of the V8 Ranch homestead, situated at and immediately downstream of the area proposed for the current dam structure at coordinates latitude 33° 32’ 01. 105” N, longitude 101° 43’ 44.021” W (Figure 1). The total drainage area upstream of this location is approximately 3,843.2 mi^2. This station is heavily shaded with extensive pool habitat. A deep and wide man-made impoundment was located in the upper portion of the habitat characterization zone at Transects 1 and 2 above a bridge recently constructed across the channel. Two corrugated metal pipe culverts, 6.0 ft high and 20.0 ft long, are positioned side-to-side and encased in concrete. These pipes enable overflow from the pooled section of river upstream of the crossing to pass under the road. The channel width is 33 to 50 ft wide with banks ranging from 1.0 to 3.0 ft above the water level. The depth of the upstream channel was 1 to 6 ft and the dominant substrate type was soft clayey mud. Downstream of the bridge, the channel narrowed considerably and became less deep characterized by several connected shallow riffle/run areas floored with gravel and coarse sand. Logjams created by fallen trees were evident in the portion of river immediately upstream of Transect 5. Species dominating the areas along the stream bank include American elm, black willow, cottonwood (*Populus deltoides*), switchgrass, Canadian wildrye, tall goldenrod, barnyardgrass (Echinochloa crusgalli), and giant ragweed (Ambrosia trifida). There was no aquatic vegetation present at this station.

D.3.2 Water Quality

Overall water quality in the Brazos River Basin is relatively good. Elevated bacteria levels are the most common problem, which is generally caused by several factors such as wastewater treatment plants, agricultural and urban runoff, and animal feeding operations (TCEQ, 2009; BRA, 2007, 2009). Elevated levels of nitrogen, phosphorus, nutrients, total dissolved solids, chloride, and sulfate are found in many locations within the basin. High nutrient levels combined with high TDS have been identified as a potential causative factor of golden algal blooms which result in low DO levels and release of toxins detrimental to several fish species. Golden algal blooms have been linked to large fish kills within this area in the past (BRA, 2007; TPWD, 2005).

The majority of base flow to the North Fork Double Mountain Fork Brazos River includes runoff from natural rainfall, which is generally infrequent and irregular in this area, releases of cooling water from the municipal power plant, springs associated with the irrigation of adjoining farm lands, groundwater pumped from underneath the LLAS and runoff from the City’s storm sewer system. Currently, the stormwater and groundwater is discharged into a series of six impoundments located upstream of the four stations investigated. The quantity and quality of water received by the portion of river to be inundated would be dependant on direct discharges from these upper lakes and overland surface runoff from upstream areas. The principal function of the proposed Lake 7 Reservoir will be to store and reuse reclaimed water and stormwater, and to provide additional recreation opportunities. Although the North Fork is considered perennial, flow periodically ceases, and its perennial surface waters are confined to isolated pools.

The Texas Water Quality Inventory [305(b)] and 303(d) List promulgated by TCEQ (2008b) identifies water bodies that do not meet, or are not expected to meet, applicable water quality standards. The TCEQ identifies surface water quality standards and appropriate water uses for each classified river segment in Texas. Within the Brazos River Basin a number of streams and stream segments are listed on the 303(d) List due to various reasons including low DO levels, high levels of bacteria, low and high pH, nutrients, total dissolved solids, chlorides, and sulfates (BRA, 2009). The following information, based on the most recent seven years of data, provides an assessment of water quality results in the TCEQ-defined Segment 1241 of the Brazos River Basin (Double Mountain Fork Brazos River). Segment 1241 extends from the confluence with the Salt Fork Brazos River in Stonewall County to the confluence of the North Fork Double Mountain Fork Brazos. Data analyses continue to show elevated levels of chlorides, as the geologic formations that underlie this watershed contain a very high salt content. Based on long-term data collections, the TCEQ is currently proposing to the EPA an increase of the chloride default criteria value from the current 2,500 mg/L to 3,270 mg/L. It is anticipated that this segment will be removed from the 2010 303(d) list for chloride impairment upon EPA approval of this increase (BRA, 2007).

Relevant to the study area, the area of land drained by the length of the North Fork Double Mountain Fork Brazos River is considered by the TCEQ to be an unclassified stream assigned to Sub-Segment 1241A. As specified in Appendix D of 30 TAC §307.10(4), the assigned aquatic life use designation for Segment 1241 is Limited with a corresponding 24-hour dissolved oxygen mean of 3.0 mg/L. This watershed is predominantly undeveloped, flowing southeasterly through an area containing primarily agricultural farming and rangeland for cattle. This sub-segment is listed for not supporting its water quality standard for *E. coli* and has concern for ammonia, nitrate, chlorophyll a, and excessive algal growth. Potential sources of bacteria and nutrients within this watershed include stormwater runoff from urban and suburban areas, wildlife wastes and municipal discharges (BRA, 2007).

Concurrent with the habitat/biological assessment efforts and water quality sampling, instantaneous measurements of temperature (°C), conductivity (µS/cm), dissolved oxygen (mg/L), pH, and Secchi depth (m) were recorded during the June and September 2009 surveys (Table 3).

Water temperature determines the amount of oxygen water can contain when at equilibrium with the atmosphere. Temperatures recorded at the four biological monitoring stations over the 2-day survey in June varied from 23.85 °C at Station 2 to 27.14 °C at Station 4 and ranged from 13.35 °C recorded at Stations 3 to 18.56 °C at Station 2 in September. Except for a measurement of 4.47 mg/L at Station 1 on 24 June, dissolved oxygen (DO) levels were above 5.0 mg/L at every location measured during 2009 study period.

Oxygen percent saturation reflects oxygen availability to invertebrates. DO levels recorded at Stations 3 and 4 on 23 June 2009 were above saturation with values at the upper two stations below 65% solubility. Recorded supersaturation levels of greater than 100% suggest high levels of photosynthetic activity of algae suspended in the water column. Two locations (Stations 2 and 4) exhibited supersaturation during the August survey with a DO reading of 10.75 and 10.42 mg/L, respectively. The section of river within the area surveyed has few riffles and consequently little mixing of air and water resulting in low oxygen saturations. Underwater algal respiration releases oxygen into waterways, but algae in this area did not appear to be very abundant except at the road crossings where cattle activity increases the enrichment of the water. Rainfall can cause periodic increases in oxygen saturation, but the more typical low values could limit aquatic invertebrate diversity.

The pH of the North Fork Double Mountain Fork Brazos River is slightly alkaline, which is typical for this region as the river bed and upland areas are characterized by Potter-Berda-Bippus mildly to moderately alkaline loamy soils. No values outside of the TCEQ stream standards for Segment 1241 were measured during this survey (Table 3). Overall, the parameters sampled indicate no unusual water quality conditions. All recorded values appear well within the range to support aquatic life.

Table 3.
Water Quality Parameters by Sampling Station
Lake 7 Reservoir Project
23-24 June and 22-23 September 2009

Station	Date	Time	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Percent Saturation (%)	Conductivity (µS/cm)	pH (S.U.)	Secchi Depth (m)
1	24 June	11:14	25.05	4.47	54.4	1083	7.93	0.41
	22 September	08: 55	17.37	6.44	67.3	1205	7.97	0.30
2	23 June	08:15	23.85	5.24	62.2	949	8.04	0.46
	22 September	15:14	18.56	10.75	114.4	1281	8.27	0.49
3	23 June	12:46	26.25	8.24	102.4	1223	8.21	0.30
	23 September	08:45	13.35	9.10	87.7	1622	8.07	0.33
4	23 June	17:01	27.14	8.75	110.2	1012	8.56	0.49
	24 June	08:05	24.37	6.27	75.2	1106	8.08	0.15
	23 September	13:24	16.24	10.42	106.2	1765	8.25	0.22

Turbidity measures the cloudiness of the materials, such as algae and microbes, suspended in the water. Secchi disc depth (transparency) averaged about 0.36 m (1.2 ft) during the June sampling period, and 0.34 m (1.1ft) in September. During each survey, turbidity varied amongst the four locations. Excessively turbid water, suggesting sediment-laden runoff, was observed in the river at Station 4 during both sample events after the area received heavy rainfall overnight prior to sampling on 24 June and 23 September 2009. The overall low Secchi depths recorded are probably due to a combination of the algal concentrations and the prevalence of clayey soils common at all locations.

Surface water quality monitoring is currently being conducted by the TCEQ Regions 2 and 3 staff at six locations in Segment 1241. Water monitoring, data collection and analysis on Segment 1241 of the Brazos River are being conducted near the study area on the North Fork at FM 835 immediately downstream of the proposed dam (TCEQ Station 11534) and Buffalo

Springs Lake (TCEQ Station 11529). Two locations on the North Fork downstream of Buffalo Springs Lake near Slaton at State Highway (SH) 400 (TCEQ Station 11527) and SH 207 north of Post (TCEQ Station 11525), and two additional stations, Double Mountain Fork at US 83 south of Aspermont (TCEQ Station 12029) and Lake Alan Henry (TCEQ Station 18414) are being monitored during Fiscal Year 2010 (TCEQ, 2009).

Streamflows in the North Fork Double Mountain Fork Brazos River currently are ungaged; the nearest active station providing streamflow monitoring is U.S. Geological Survey (USGS) Gage No. 08080500 located downstream of the confluence with the Double Mountain fork Brazos River near Aspermont in Stonewall County, over 100 river miles downstream of the proposed reservoir project (USGS, 2009). Flow is highly dependent on upper watershed inflow and the rate of evaporation/transpiration during dry periods. The total discharge values (cfs) calculated for each of the four locations during the June and September field efforts are presented in Table 4. In June, sampling was conducted under somewhat high flow rates after weather-induced runoff resulting from a storm system that passed through the area prior to the summer survey. Stream flow characteristics did not change significantly after localized heavy storm events prior to and during the September survey.

Table 4.
Instantaneous Streamflow Measurements by Sampling Station
Lake 7 Reservoir Project
23-24 June and 22-23 September 2009

Date	**Weather Conditions**	***Station 1 Chapman***		***Station 2 Upper V8 Ranch***		***Station 3 Middle V8 Ranch***		***Station 4 Lower V8 Ranch***	
		Stream Width (m)	***Discharge (cfs)***	***Stream Width (m)***	***Discharge (cfs)***	***Stream Width (m)***	***Discharge (cfs)***	***Stream Width (m)***	***Discharge (cfs)***
Index Period									
24 June	Clear; hot; calm, sunny	6.71	11.17			--	--	--	--
23 June	Clear; hot; calm, sunny	--	--	6.25	24.15	9.20	14.56	3.57	15.73
Critical Period									
22 Sept.	Overcast to ptly cldy; cool	6.83	11.60	5.27	6.40	--	--	--	--
23 Sept.	Overcast to ptly cldy; cool	--	--	--	--	8.84	3.01	3.11	4.22

D.3.3 Aquatic Life Monitoring Survey

Habitat assessments and biological collections were conducted along a standardized length of 300 meters (984 ft) during 2009 at each of the four study locations on 23-24 June and 22-23 September (Figure 1). Analysis of a minimum of 180 benthic macroinvertebrates sampled from all available microhabitats and fisheries data collected exclusively with a 20-ft straight seine was integrated through the use of comparative statistical parameters and available benthic and fish community trophic structure data to provide an aquatic life use rating for each stream investigated.

D.3.3.1 Habitat Quality

Many of the primary habitat quality characteristics of the North Fork Double Mountain Fork Brazos River were quite similar between the four sampling locations (Table 5). One visible difference was the extent of riparian zones bordering the river channel. The tree-lined banks at Stations 1 and 4 contribute leafy detritus, whereas the rangeland areas not densely shaded at Stations 2 and 3 supported grasses typical to the area. Low to moderate amounts of terrestrial plant debris, ranging from small tree branches to leaf litter, provides the predominant source of instream cover. No stands of submergent or emergent aquatic vegetation are found along the stream segments investigated. The cross sections measured at each transect show that the creek channels are relatively shallow and narrow. The overall natural aesthetics of the river corridor based on physical habitat alterations received a “Common Setting’ rating defined by the TCEQ as an area that has been developed by man but not in a cluttered, offensive way. An urban park setting would be a good example of this classification.

Evidence of wildlife utilization was noted by footprints of deer and raccoon along the muddy shoreline margins. There was considerable evidence of recent flooding (i.e., woody deposits lodged in tree branches high above the current water level) at all sites. The physical habitat availability in the North Fork Double Mountain Fork Brazos River is susceptible to fluctuating depths and higher magnitude of stream velocities. The Stream Physical Characteristics Worksheets (Attachment D1, Tables D1-1 through D1-8) were compiled for both surveys.

Table 5.
Habitat Quality Index
Lake 7 Reservoir Project
North Fork Double Mountain Fork Brazos River
23-24 June and 22-23 September 2009

Metric	**Station 1 Chapman Property 24 June 2009**	**Station 2 Upper V8 Ranch Crossing 23 June 2009**	**Station 3 Middle V8 Ranch Crossing 23 June 2009**	**Station 4 Lower V8 Ranch Crossing 23 June 2009**
	Score	**Score**	**Score**	**Score**
1. Available Instream Cover	2 Rare	2 Rare	2 Rare	2 Rare
2. Bottom Substrate Stability	3 Moderately Stable	2 Moderately Unstable	3 Moderately Stable	3 Moderately Stable
3. Number of Riffles	1 Rare	1 Rare	3 Common	3 Common
4. Dimensions of Largest Pool	4 Large	4 Large	4 Large	4 Large
5. Channel Flow Status	3 High	3 High	3 High	3 High
6. Bank Stability	0.5 Mod. Unstable/Unstable	1 Moderately Unstable	1 Moderately Unstable	1.5 Mod. Stable/Mod Unstable
7. Channel Sinuosity	2 Moderate	3 High	3 High	3 High
8. Riparian Buffer Vegetation	2 Wide	1 Moderate	1 Moderate	2 Wide
9. Aesthetics of Reach	1 Common Setting	1 Common Setting	1 Common Setting	1 Common Setting
Total Score	**19.5**	**19.0**	**21.0**	**22.5**
Aquatic Life Use*	**Intermediate/High**	**Intermediate**	**High**	**High**

Metric	**Station 1 Chapman Property 22 September 2009**	**Station 2 Upper V8 Ranch Crossing 22 September 2009**	**Station 3 Middle V8 Ranch Crossing 23 September 2009**	**Station 4 Lower V8 Ranch Crossing 23 September 2009**
	Score	**Score**	**Score**	**Score**
1. Available Instream Cover	2 Rare	2 Rare	2 Rare	2 Rare
2. Bottom Substrate Stability	3 Moderately Stable	2 Moderately Unstable	3 Moderately Stable	3 Moderately Stable
3. Number of Riffles	1 Rare	1 Rare	3 Common	3 Common
4. Dimensions of Largest Pool	4 Large	4 Large	4 Large	4 Large
5. Channel Flow Status	3 High	3 High	3 High	3 High
6. Bank Stability	0.5 Mod. Unstable/Unstable	1 Moderately Unstable	1.5 Mod. Stable/Mod Unstable	1.5 Mod. Stable/Mod Unstable
7. Channel Sinuosity	2 Moderate	3 High	3 High	3 High
8. Riparian Buffer Vegetation	2 Wide	1 Moderate	1 Moderate	2 Wide
9. Aesthetics of Reach	1 Common Setting	1 Common Setting	1 Common Setting	1 Common Setting
Total Score	**19.5**	**19.0**	**21.5**	**22.5**
Aquatic Life Use*	**Intermediate/High**	**Intermediate**	**High**	**High**

*Aquatic Life Use Point Score Ranges: Exceptional: 26-31; High: 20-25; Intermediate: 14-19; Limited: ≤13

The North Fork Double Mountain Fork Brazos River at Station 1 had an average wetted stream width of 21.69 ft and an average water depth of 1.15 ft in June and an average wetted width of 21.88 ft and an average depth of 1.08 ft in September. When compared to the other three locations, this length of river is fairly straight having one well defined, two moderately defined, and one poorly defined stream bends. In addition, this station exhibited a moderate percentage (22.5%) of stream bank erosion potential, a mean stream bank slope of 61 degrees, an average of 13% instream cover, and the highest tree canopy percentage of all stations investigated (90%). A total of one riffle area was present within the sample zone at Transect 3 and the dominant substrate is cobble with a high percentage of gravel composition. The habitat data indicated an Intermediate/High aquatic habitat rating after summation of identical HQI values of 19.5 for June and September (Table 5). The total flow measured during June was 11.17 cfs compared to 11.60 cfs during September.

The North Fork Double Mountain Fork Brazos River at Station 2 had an average wetted stream width of 17.13 ft and an average water depth of 1.08 ft in June and an average wetted width of 17.55 ft and an average depth of 1.44 ft in September. This section of the river has two moderately defined and four poorly-defined stream bends, a low amount of instream cover (23%), low percentage (59%) of canopy cover, a somewhat high percentage of stream bank erosion (33%), and an average bank slope of 56 degrees. A total of one riffle area was present within the sample zone at Transect 5 and the dominant substrate is gravel with scattered cobble. The lowest habitat value in this study was at Station 2. The HQI results for June and September were identical, with values of 19.0 corresponding to an Intermediate habitat category (Table 5). The total flow measured during June was 24.15 cfs compared to 6.40 cfs during September[1].

The North Fork Double Mountain Fork Brazos River at Station 3 had an average wetted stream width of 18.47 ft and an average water depth of 1.18 ft in June and an average wetted width of 18.27 ft and an average depth of 1.15 ft in September. The stream reach was serpentine with nine notable stream bends: six well defined, two moderately defined and one poorly defined. There are two cobble/gravel riffle areas within the upper and central portion of the sample zone, deeper pool habitat was common in the river downstream of the lowermost riffle at

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[1] These discharge measurements appear to be inconsistent because discharges do not always increase in the downstream direction. However, the field notes have been checked and verified. The apparent inconsistencies between adjacent measurements are likely due to a combination of 1) subsurface flow between adjacent measurement sections, and 2) measurement inaccuracy inherent in measuring discharge in a natural channel.

Transect 3, and the dominant substrate type was clay. Bank stability is moderately unstable with a moderate potential for erosion (21%), bank angles that averaged 53.5 degrees, and the lowest percentage (20%) of tree canopy cover observed during the study. The HQI results compiled from the worksheets (Table 5) for June and September correspond to a High habitat ranking with a total score of 21.0 and 21.5, respectively. This was the only scoring difference observed between sampling events of all stations and the higher bank stability status score calculated for this location during September was attributed to the slight increase in the total habitat quality score. The two riffle zones occupying the middle and upstream reaches were more prominent in September since sampling was conducted under a lower flow regime (3.01 cfs) than during the June survey (14.56 cfs).

The North Fork Double Mountain Fork Brazos River at Station 4 had an average wetted stream width of 28.05 ft and an average water depth of 2.16 ft in June and an average wetted width of 22.9 ft and an average depth of 1.77 in September. The sample length has high sinuosity with two well defined, one moderately defined and three poorly defined stream bends; a relatively high percentage of gravel-sized or larger substrate (40%); and sporadic available instream cover. The main channel exhibited deeper pooled areas with a wide (40 ft) and deep channel (6.5 ft) throughout the upper segment of the sample zone, less steep creek banks, more potential for bank erosion potential and the second highest tree canopy percentage (69%). The potential for erosion is very low upstream of the concrete bridge but at several points along the narrower downstream channel between Transects 3 to 5 the stream banks are severely eroded. The two gravelly riffle areas present at Transects 3 and 4 were very evident in September as sampling was conducted at 4.22 cfs opposed to 15.73 cfs during the June field effort. The HQI results for this stream reach exhibited an identical score of 22.5 for June and September, which corresponds with the High aquatic habitat subcategory (Table 5).

D.3.3.2 Benthic Macroinvertebrate Community Evaluation

Benthic macroinvertebrates are bottom-dwelling organisms that use water bodies as habitat for one or more parts of their life cycle. Benthic macroinvertebrates inhabit a variety of substrates in streams and rivers, from the bottom sediments (silt, sand, gravel, cobble) to vegetation or debris piles along margins or in pools. The density and diversity of the benthic fauna of this region is influenced by the quality of the water they inhabit, including substrate character, organic content of the substrate, persistence of water, and predator-prey relationships.

Examination of benthic macroinvertebrate community structure and composition can provide insight to the integrity of water quality and aquatic habitat of the water body. Assumptions about the water quality and habitat can be inferred from the benthic macroinvertebrate community since most of the organisms are generally restricted in their mobility (unable to move great distances) and many of the organisms live for several years, which requires them to integrate the effects of both chemical and physical perturbations over time. Changes in water chemistry, such as nutrient enrichment and toxic contamination, in addition to changes in stream characteristics (such as morphology, erosion, and sedimentation) will be reflected by changes in the macroinvertebrate community structure and composition. Therefore benthic macroinvertebrate assemblages reflect the substrates, flow regimes, and food supplies available at the time of collection. Benthic macroinvertebrate communities generally show low diversity where scoured sandy clays dominate streambeds. An increase in substrate surface area and stratification (e.g., layers of cobble, leaf packs, and submerged vegetation) generally promotes the establishment of a diverse and stable benthic macroinvertebrate community.

The density and diversity of the benthic fauna of this region are influenced by the quality of the water they inhabit, including substrate character, organic content of the substrate, persistence of water, and predator-prey relationships. The abundance of benthic macroinvertebrates belonging to the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) was evaluated for each sample collected. Together, these three benthic groups are considered relatively pollution sensitive, and constitute the EPT index, which is used as an indicator of water quality. A higher number of taxa from the EPT group indicate healthy water chemistry and aquatic habitat.

The substrate along the evaluated reaches of the North Fork Double Mountain Fork Brazos River is characterized by the predominance of soft, clayey mud bottoms in the deeper pool areas, firm scoured clay in run habitats and loose, small to large gravel, with scattered cobble in the short and shallow fast-flowing riffle habitats. Instream riparian cover is usually composed of variable amounts of dead woody debris such as leaves, logs, branches, and roots along the stream edge and was rather limited. Therefore, substrate diversity was fairly homogenous, which decreases the stability of available aquatic habitat for macroinvertebrate colonization.

Table 6 presents a checklist of the benthic macroinvertebrate assemblages collected by station during the June and September surveys. A total of 1,773 individuals representing 27 taxa were collected and identified to the LPTL. Overall, the samples displayed relatively low overall diversity as a result of the preponderance of groups that are generally indicative of an aquatic system with low integrity. Mayflies (Ephemeroptera) and caddisflies (Trichoptera), two major groups widely considered to be representative of exceptional aquatic integrity, were poorly represented as only two taxa from each group were present. All river collections had relatively high densities of midge larvae (Chironomidae), averaging a minimum of 47 individuals per sample. Midges have the tendency to proliferate in waters exhibiting less than optimal conditions, and usually indicate poor water quality which most other invertebrates tend to avoid. Riffle beetle dominance and diversity is often assessed in the context of benthic communities. Typically, a diversity of taxa with pollution-sensitive individuals in low densities (less than 10%) is considered ideal. The low scores computed for the June and September samples reflected the paucity of EPT (pollution sensitive) taxa with only one relatively ubiquitous and pollution-tolerant taxon (*Stenelmis*) present. Other pollution intolerant taxa present at one or more sample locations included the dragonfly (*Erpetogomphus*) at Station 3 in September and the caddisfly (*Hydroptila*) found at Stations 2 and 3 in June. Numerically dominant taxa included chironomids, the caddisfly (*Cheumatopsyche*) and the mayfly (*Fallceon quilleri*).

D.3.3.2.1 June 2009

The bioassessments at four sample stations during 23-24 June 2009 resulted in a total of 864 individual benthic macroinvertebrates distributed over 23 taxa. An inventory of taxa collected at the four stations during the June 2009 sample events is presented in Table 7. Samples had an average sample size of 216 individuals and an average number of 16 taxa per sample. Taxa present at all four stations during the June sample event included aquatic worms (Oligochaetae), a riffle beetle (*Stenelmis*), a mayfly (*Fallceon quilleri*), two damselflies (*Enallagma* and *Haeterina*), one caddisfly (*Cheumatopsyche*), an amphipod (*Hyallela*), and grass shrimp (*Palaemonetes*). Station 3 displayed more diversity than the other stations during the June 2009 sampling event. Despite having the highest number of individuals collected in any one sample, Station 1 was the least productive location sampled with only 14 taxa.

Table 6.
Checklist of Benthic Macroinvertebrate Taxa Collected by Kicknet
Lake 7 Reservoir Project
23-24 June and 22-23 September 2009

Phylum	***Class***	***Order***	***LPTL***	***Sta. 1***	***Sta. 2***	***Sta. 3***	***Sta. 4***
Platyhelminthes	Turbellaria	Tricladida	*Dugesia*	✓	✓	✓	
Mollusca	Gastropoda	Basommatophora	*Physella*	✓	✓	✓	✓
Annelida	Oligochaeta*			✓	✓	✓	✓
	Ostracoda*				✓		
Arthropoda	Malacostraca	Decapoda	*Palaemonetes*	✓	✓	✓	✓
			Cambaridae		✓		✓
		Amphipoda	*Hyalella*	✓	✓	✓	✓
	Insecta	Diptera	Chironomidae*	✓	✓	✓	✓
			Bezzia		✓		
			Simulium	✓	✓	✓	✓
			Hemerodromia	✓			✓
		Coleoptera	*Stenelmis*	✓	✓	✓	✓
			Agabus		✓		
			Liodessus			✓	
			Berosus			✓	
			Scirtes				✓
		Ephemeroptera	*Callibaetis*		✓	✓	✓
			Fallceon quilleri	✓	✓	✓	✓
		Hemiptera	*Trichocorixa*			✓	✓
			Ranatra			✓	
		Odonata	*Erpetogomphus*			✓	
			Ischnura			✓	✓
			Argia	✓	✓	✓	✓
			Enallagma	✓	✓	✓	✓
			Haeterina	✓	✓	✓	✓
		Trichoptera	*Cheumatopsyche*	✓	✓	✓	✓
			Hydroptila		✓	✓	

Table 7.
Benthic Macroinvertebrate Taxa Collected by Kicknet at Four Locations
Lake 7 Reservoir Project
23-24 June 2009

Lowest Identified Taxon	***Invertebrate Group Common Name***	***TCEQ Storet ID***	***Pollution Tolerance Index (PTI)****	***Functional Feeding Group (FFG)*****	***Number of Individuals By Station***			
					1	***2***	***3***	***4***
Dugesia	Flatworm	90075	7.5	CG/P	23	28	6	
Physella	Snail	92874	6	SCR	18	4	3	2
Oligochaeta*	Worm	90382	8	CG	38	3	4	1
Chironomidae*	Midge	92491	6	P/CG/FC	50	51	23	34
Simulium	Fly	92596	4	FC	1	9	1	
Hemerodromia	Midge	92628	6	P/CG	3			1
Stenelmis	Riffle Beetle	92253	7	SCR/CG	3	2	24	16
Liodessus	Beetle	92112	5	P			1	
Berosus	Beetle	92154	9	CG			5	
Scirtes	Beetle	92206	***	SHR				3
Callibaetis	Mayfly	91650	4	CG		2	8	2
Fallceon quilleri	Mayfly	91651	4	SCR/CG	1	3	5	1
Trichocorixa	True bug	92044	5	P/CG			1	33
Ranatra	True bug	92002	7	P			1	
Argia	Damselfly	91683	6	P	1	1	2	
Enallagma	Damselfly	91687	6	P	3	12	14	22
Ischnura	Damselfly	91695	9	P			1	16
Haeterina	Damselfly	91669	6	P	2	3	1	14
Cheumatopsyche	Caddisfly	92292	6	FC	102	54	96	22
Hydroptila	Caddisfly	92324	2	SCR		3	4	
Hyalella	Amphipod	91241	8	CG/SHR	13	20	24	9
Palaemonetes	Shrimp	91397	4	CG	1	1	3	4
Cambaridae	Crayfish	91409	5	CG				2
TOTAL INDIVIDUALS					**259**	**196**	**227**	**182**
TOTAL TAXA					**14**	**15**	**20**	**16**

* PTI designations numerically ascend from (0) pollution intolerant to (10) pollution tolerant (2005, TCEQ SWQM Manual)
** P=predator, CG=collector/gatherer, SCR=scraper, SHR=shredder, FC=filtering collector (2005, TCEQ SWQM Manual)
*** No pollution tolerance index value is provided for taxon

A noteworthy organism of this sampling event which is very intolerant of poor conditions such as low dissolved oxygen included the caddisfly (*Hydroptila*). Numerically dominant taxa included the chronomids (midges) and the caddisfly (*Cheumatopsyche*). An evaluation of the diversity, pollution tolerance, community structure and trophic balance of benthic macroinvertebrate samples can provide insight to the overall aquatic integrity of the system. Diversity of more than 15 taxa per sample and greater than seven genera of mayflies, stoneflies and caddisflies (EPT taxa) indicate good aquatic integrity. A low Hilsenhof Biotic Index (<4.52), a high ratio of intolerant to tolerant taxa (> 3.21), and more than 4 non-insect taxa are also indicators of good aquatic integrity. A balanced trophic community is indicative of a stable and well structured ecosystem as well. Metric parameters which indicate this balanced system are typically less than 25% of any one functional feeding group such as predators or collector-gathers in addition to low dominance of any one group or taxa. Additional indicators of a healthy community include: less than 10% midges, less than 20% riffle beetles and less than half of all caddisflies of the family Hydropsychidae. Table 8 presents the results of these metric parameters from the samples collected on the North Fork Double Mountain Fork Brazos River from the four sample stations during 23-24 June 2009.

The sample collection taken from Station 1 contained considerably more individuals than the other June samples, yet the least number of taxa. Dominant taxa included the caddisfly (*Cheumatopsyche*), midges (Chironomidae) and aquatic worms (Oligochaetes). Despite the higher number of individuals collected, Station 1 had the lowest diversity of EPT taxa represented by the presence of only 1 species each of mayfly and caddisfly. No individual taxa was unique to this station as 9 of the 23 total taxa collected were absent at this location. Notably, 100% of the caddisflies represented were of the genus *Cheumatapsyche,* of the Family Hydropsychidae. Hydropsychid caddisflies are more pollution-tolerant than other caddisflies and are relatively ubiquitous. Although *Cheumatopsyche* can certainly be found in the most optimal environments, a lack of complimentary caddisflies is generally considered an indicator of poor conditions. Indicators of an imbalanced trophic structure included the highest dominance of any functional feeding group at 69.2%. This dominant functional feeding group was collector-gatherer which indicates that the dominant feeding method is similar to scavenging. The overall low diversity, imbalanced trophic structure and dominance of pollution-tolerant taxa indicate relatively poor biological integrity.

Table 8.
Aquatic Integrity Indicators
Lake 7 Reservoir Project
23-24 June 2009

Metric Parameter		***Station***			
		1	***2***	***3***	***4***
		Value	***Value***	***Value***	***Value***
Total Number	Total number of individuals in the sample	259	196	227	182
Taxa Richness	Total number of different taxa identified to lowest practical taxon	14	15	20	16
EPT Taxa	Total number mayfly, stonefly and caddisfly taxa in the sample	2	4	4	3
Hilsenhof Biotic Index	Community score of tolerance to poor conditions	6.52	6.24	6.25	6.09
% Chironomidae	Ratio of the total number of midges in the sample to the total individuals of all specimens	19.31	26.02	10.13	18.68
% Dominant Taxon	Taxon with the most numerous individuals divided by total number of individuals in sample	39.38	27.55	42.29	18.68
% Dominant Functional Feeding Group	Ratio of numerically dominant Functional Feeding Group to total individuals	69.18	40.82	46.11	44.14
% Predators	Total number of predatory individuals divided by the total number of all individuals in sample	13.77	23.98	13.73	44.14
Ratio of Intolerant : Tolerant Taxa	Ratio of tolerant individuals (PTI ≥6) to intolerant (PTI<6)	0.01	0.10	0.11	0.30
% of Trichoptera as Hydropsychidae	The percent of Hydropsychid caddisflies of the total of all types of caddisflies	100.0	94.74	96.00	100.0
Number of non-insect taxa	Number of taxa that are not in the class Insecta	5	5	5	5
% Collector-Gatherers	Total number of collector-gatherer individuals divided by the total number of all individuals	69.18	25.26	25.40	27.66
% of total number as Elmidae	Ratio of number of riffle beetles to total individuals in sample	1.16	3.57	10.57	8.79

Similar to Station 1, the majority of taxa found at Station 2 are pollution tolerant organisms dominated by a caddisfly species (*Cheumatopsyche*), larval chironomids and oligochaete worms. Although the stream community diversity at this location was low, containing no unique taxa, there were two times as many mayfly and caddisfly taxa than were found at Station 1. The caddisfly (*Hydroptila*) is a pollution intolerant species typically found in high quality waters. The chironomids accounted for 26% of the total kicknet collection comprising a much larger proportion of the river assemblage at this point than seen at the other 3 stations. The community trophic structure was fairly well balanced with 24% predators and 25% collector-gatherers. Similar to the other three stations, a high Hilsenhof Biotic Index of 6.52 coupled with a low ratio of intolerant to tolerant taxa implies an aquatic community of less than high integrity. Despite a low value calculated for each of these two parameters, the total score was the highest count of any collection taken during this study.

The macroinvertebrate assesemblage at Station 3 was the most diverse of any collection taken during the 2009 river study. A total of 20 taxa including three taxa unique to this location, two beetles (*Liodessus* and *Berosus*) and the water scorpion (*Ranatra*), were captured. These organisms breathe atmospheric oxygen rather than aqueous dissolved oxygen and are highly mobile allowing them able to survive in the poorest of conditions. Although the invertebrate taxon was dominated by the caddisfly (*Cheumatopsyche*), other abundant taxa included larval chironomids, riffle beetle (*Stenelmis*), and a common amphipod (*Hyalella*). Comparable to Station 2, this sample contained several mayfly and caddisly taxa that included the pollution-sensitive caddisfly (*Hydroptila*). This sample exhibited the greatest diversity of damselfly species encountered along the river which can be attributed to the increased instream habitat structure such as woody snags and submerged terrestrial vegetation. The trophic structure was reasonably well balanced with low and comparable percentages of predators and collector-gatherers.

The benthic collection at Station 4 represented a biodiversity comparable to the June assemblage results, despite producing the fewest total number of individuals collected. The emergence of two taxa collected from this location only included a crayfish (Cambaridae) and a scirtid beetle (*Scirtes*). In contrast with the other summer collection results, no single taxa numerically dominated the sample. The community composition was distributed somewhat equally between midges, damselflies, caddisflies, riffle beetles and true bugs. Another interesting aspect of the final benthic invertebrate results revealed the absence of local populations such as flatworms, blackflies and the damselfly (*Argia*) common to the three upstream locations. During the June survey, the highest percentage of predators relative to the other feeding groups (44%) was found at this location and suggested disproportion in trophic structure. Overall, the benthic community similarity with the other stations is typically characteristic of diversity and community composition associated with a less than high aquatic integrity.

Results of the benthic macroinvertebrate community assessement are found in Table 9. All four monitored locations sampled in June were rated as having an Intermediate biotic integrity. Each station contained fairly taxa rich communities and a high representation of non-insect taxa, however the EPT taxa abundance was low. The low percentage of riffle beetles is generally considered a high aquatic life use characteristic, while a large quantity of midge larvae is representative of a low-aquatic habitat quality characteristic. Metric indicators such as a low proportion of pollution intolerant taxa and the disproportionate abundance of hydropsychid caddisflies (*Cheumatopsyche*) indicate that the river does not provide optimal conditions. Despite this, the community trophic structure was generally good with low dominance overall and well distributed functional feeding groups. As a result, all four of the June stations indicated intermediate aquatic integrity in the stream as determined by the TCEQ qualitative method.

Table 9.
TCEQ Method Evaluation of Aquatic Integrity
Benthic Macroinvertebrate Samples
Lake 7 Reservoir Project
June 23-24, 2009

Metric	***Station***			
	1	***2***	***3***	***4***
	Score	***Score***	***Score***	***Score***
Taxa Richness	2	3	3	3
EPT Taxa Abundance	1	2	2	1
Hilsenhof Biotic Index	1	1	1	1
Percent Chironomidae	1	1	2	1
Percent Dominant Taxon	2	3	1	4
Percent Dominant FFG	1	3	2	3
Percent Predators	4	3	4	1
Ratio of Intolerant : Tolerant Taxa	1	1	1	1
% Trichoptera as Hydropsychidae	1	1	1	1
Number of non-insect taxa	3	3	3	3
Percent Collector-Gatherers	1	3	3	3
Percent of total number as Elmidae	4	4	3	4
Total	**22**	**28**	**26**	**26**
TCEQ Aquatic Life Use Score*	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**
*Limited: ≤22, Intermediate: 22-28, High: 29-36 and Exceptional: ≥36				

D.3.3.2.2 September 2009

The bioassessments at five sample stations during 22-23 September 2009 resulted in a total of 909 benthic macroinvertebrates representing 18 taxa. The average number of individuals per sample in September (227) was larger than the average number in June (216). There was a significant decrease in the average number of taxa per sample (10.5 compared to 16.3). The overwhelming majority of taxa collected were pollution tolerant. Taxa present at all four September stations included the freshwater worms (Oligochaetes), midges (Chironomidae), the riffle beetle (Stenelmis), the mayfly (Fallceon), the damselfly (Argia), and the caddisfly

(Cheumatopsyche). Similar to results of the June sampling event, numerically dominant taxa included Chironomids, Fallceon, and Cheumatopsyche. All of the caddisflies collected during the September survey were members of the family Hydropsychidae, which is generally considered pollution-tolerant. The lack of other representatives of Trichoptera families suggests that habitat conditions may be considerably less than optimal. Taxa collected at the four stations during the September 2009 sample event are presented in Table 10.

Table 10.
Benthic Macroinvertebrate Taxa Collected by Kicknet
Lake 7 Reservoir Project
September 22-23, 2009

Lowest Identified Taxon	**Invertebrate Group Common Name**	**TCEQ Storet ID**	**Pollution Tolerance Index (PTI)***	**Functional Feeding Group (FFG)****	**Number of Individuals By Station**			
					1	**2**	**3**	**4**
Dugesia	Flatworm	90075	7.5	CG/P	9	23	12	
Physella	Snail	92874	6	SCR		4		
Oligochaeta*	Worm	90382	8	CG	1	20	5	5
Chironomidae*	Midge	92491	6	P/CG/FC	44	96	25	55
Bezzia	Midge	92478	7	P		1		
Simulium	Midge	92596	4	FC	2			10
Stenelmis	Riffle Beetle	92253	7	SCR/CG	8	1	31	27
Agabus	Riffle Beetle	92108	5	P		1		
Fallceon quilleri	Mayfly	91651	4	SCR/CG	96	2	93	66
Trichocorixa	True Bug	92044	5	P/CG				2
Erpetogomphus	Dragonfly	91713	1	P			1	
Argia	Damselfly	91683	6	P	15	24	6	9
Haeterina	Damselfly	91669	6	P	2	2	2	
Cheumatopsyche	Caddisfly	92292	6	FC	26	23	79	27
Ostracoda	Seed Shrimp	91056	***	CG		2		
Hyalella	Shrimp	91241	8	CG/SHR	8	42		
Palaemonetes	Shrimp	91397	4	CG				1
Cambaridae	Crayfish	91409	5	CG		1		
TOTAL INDIVIDUALS					**211**	**242**	**254**	**202**
TOTAL TAXA					**10**	**14**	**9**	**9**

* PTI designations numerically ascend from (0) pollution intolerant to (10) pollution tolerant (2005, TCEQ SWQM Manual)
** P=predator, CG=collector/gatherer, SCR=scraper, SHR=shredder, FC=filtering collector (2005, TCEQ SWQM Manual)
*** No pollution tolerance index value is provided for taxon

Table 11 presents the results of these metric parameters from the samples collected on the North Fork Double Mountain Fork Brazos River on 22-23 September 2009. As described previously, an evaluation of the diversity and composition of benthic macroinvertebrate samples can provide insight to the overall aquatic integrity of the system. Diversities composed of greater than 15 taxa and greater than seven genera of mayflies, stoneflies and caddisflies (EPT taxa) are both indicators of good aquatic integrity. A low Hilsenhof Biotic Index (< 4.52), a high intolerant / tolerant ratio (greater than 3.21), and the presence of more than 4 non-insect taxa are also indicators of good aquatic integrity. A balanced trophic community is indicative of a stable and well structured ecosystem as well. Metric parameters which indicate this balanced system are typically less than 25% of any one functional feeding group such as predators or collector-gathers in addition to low dominance of any one group or taxa. Additional indicators of a healthy community composition include: less than 10% midges, less than 20% riffle beetles and less than half of all caddisflies of the family Hydropsychidae.

Approximately two-thirds of the taxa collected from Station 1 were represented by chironomid midges and *Fallceon quilleri*, a relatively pollution intolerant mayfly that is short-lived and very common to most aquatic habitats. The imbalance of species composition as a result of the dominance of these two taxa is not indicative of a high quality benthic community. Species richness was low with 10 taxa represented. As was noticed at all locations in September, only one representative each from the mayfly and caddisfly groups was collected. More pollution intolerant individuals were observed here than at the other three monitored stations. The overall range of tolerance was high as evidenced by the high Hilsenhoff biotic index value based solely on the abundance of the relatively tolerant *Cheumatopsyche* spp. Trophic group balance was relatively good and was influenced by a low percentage of predators among the several functional feeding groups present. The proportion of riffle beetles in the total September collection was low, a relationship similar to the June results. Despite these positive indicators, the poor sample diversity and community balance resulted in a relatively low overall score indicative of low aquatic integrity.

Among the sites sampled, Station 2 exhibited the most significant change between the two surveys. This location scored at the upper range of the Intermediate scale in June. However, a rating of Limited was assessed for the September collection as a 9-point decline in the final

Table 11.
Aquatic Integrity Indicators
Lake 7 Reservoir Project
September 22-23, 2009

Metric Parameter		**Station 1 Value**	**Station 2 Value**	**Station 3 Value**	**Station 4 Value**
Total Number	Total number of individuals in the sample	211	242	254	202
Taxa Richness	Total number of different taxa identified to lowest practical taxon	10	14	9	9
EPT Taxa	Total number mayfly, stonefly and caddisfly taxa in the sample	2	2	2	2
Hilsenhof Biotic Index	Community score of tolerance to poor conditions	5.26	6.59	5.48	5.41
% Chironomidae	Ratio of the total number of midges in the sample to the total individuals of all specimens	20.85	39.67	9.84	27.23
% Dominant Taxon	Taxon with the most numerous individuals divided by total number of individuals in sample	45.50	39.67	36.61	32.67
% Dominant Functional Feeding Group	Ratio of numerically dominant Functional Feeding Group to total individuals	35.62	46.69	34.38	35.56
% Predators	Total number of predatory individuals divided by the total number of all individuals in sample	17.14	29.13	9.19	14.03
Ratio of Intolerant : Tolerant Taxa	Ratio of tolerant individuals (PTI ≥6) to intolerant (PTI<6)	0.87	0.02	0.59	0.64
% of Trichoptera as Hydropsychidae	The percent of Hydropsychid caddisflies of the total of all types of caddisflies	100.00	100.00	100.00	100.00
Number of non-insect taxa	Number of taxa that are not in the class Insecta	3	6	2	2
% Collector-Gatherers	Total number of collector-gatherer individuals divided by the total number of all individuals	35.62	46.69	32.02	35.56
% of total number as Elmidae	Ratio of number of riffle beetles to total individuals in sample	3.79	0.41	12.20	13.37

score tabulation was determined with lower individual scores being recorded for 8 of the 12 metric parameters. A total of 14 taxa were collected including a crayfish (Cambaridae), a pulmonate snail (*Physella*), a biting midge (*Bezzia*) and a diving beetle (*Agabus*) not found at the other three monitoring locations during the September survey. All aspects of the biodiversity, trophic balance and community structure indicated low aquatic integrity. None of the taxa collected are indicative of high water quality conditions as the sample was predominated by chironomid (midge) larvae and the amphipod (*Hyalella* spp.), both indicators of poor water quality. Cattle have direct access to the stream location, creating some erosion problems as well as introducing organic pollution (e.g., manure).

The sample at Station 3 had the highest total number of individuals of the all September samples collected with 254 organisms, yet had the lowest species diversity, with only nine taxa. The total number of organisms collected is a measure of relative abundance and not how many invertebrates inhabit the river. Besides having a low EPT taxa abundance, only two non-insect taxa (*Dugesia* and Oligochaeta) were netted; marking the fewest number found during the two sample efforts in June and September. Dominant taxa again included the caddisfly (*Cheumatopsyche*) and the mayfly (*Fallceon quilleri*). A good ratio of predator and collector-gatherer diversity combined with a low percentage of the numerically dominant functional feeding group indicates a balanced trophic structure. One individual of the dragonfly (*Erpetogomphus*), considered pollution-intolerant, made its only appearance of the study at this location during the fall. This carnivous larvae or nymph was captured during its early immature (instar) growth stage. As they grow, the nymphs will molt numerous times before crawling out of the water and attaching themselves to a rock or plant stem. Poor community composition was attributed to the abundance of pollution-tolerant taxa and the predominance of the top two taxa which accounted for 68% of the total collection. Despite several poor metric indicator qualities, this sample scored better overall than the other September samples, due in part to the good trophic balance.

Analysis of the macroinvertebrate community at Station 4 corresponded in similarity with Stations 1 and 3. Overall diversity was very low with a sample population represented by low numbers of non-insect, mayfly and caddisfly taxa. The grass shrimp *(Palaemonetes*), collected from all four stations in June, occurred only at this location. The consistent low scores for the EPT taxa abundance and the intolerant/tolerant species ratio reflects a lack of generally intolerant organisms, and a relatively high proportion of generally tolerant organisms including the two dominant taxa collected here and from the other monitored stations in September (e.g., chironomids and *Fallceon quilleri*). A relatively large percentage of riffle beetles (13%) of the total number of individuals caught was the highest among the September collections. Although metric indicators receiving high scores in the predator percentage composition and dominant functional feeding group percentage categories suggest a moderately well balanced trophic structure, low diversity and poor community composition scores contributed to an overall indication of low aquatic integrity.

The benthic macroinvertebrate samples from all four stations taken during the fall indicated an Intermediate or Limited aquatic integrity in the river (Table 12). Similar to the June 2009 samples, almost all metric indicators of aquatic integrity were sub-optimal or lower. Diversity was low and organisms were generally pollution-tolerant. Despite these low-quality indicators, several samples showed a well-balanced trophic community. The percent dominant functional feeding group and percent predators were typically exceptional or high. However, the community structure was poor and most individuals were considered low-quality and ubiquitous. The overall results of the TCEQ-based method for aquatic life use assessment determined that the existing benthic macroinvertebrate community is of relatively low quality and indicates intermediate to low aquatic integrity.

Table 12.
TCEQ Method Evaluation of Aquatic Integrity
Benthic Macroinvertebrate Samples
Lake 7 Reservoir Project
22-23 September 2009

Metric	***Station***			
	1	***2***	***3***	***4***
	Score	***Score***	***Score***	***Score***
Taxa Richness	2	2	2	2
EPT Taxa Abundance	1	1	1	1
Hilsenhof Biotic Index	2	1	1	1
Percent Chironomidae	1	1	2	1
Percent Dominant Taxon	1	2	2	2
Percent Dominant FFG	4	2	4	4
Percent Predators	3	2	4	4
Ratio of Intolerant : Tolerant Taxa	1	1	1	1
% Trichoptera as Hydropsychidae	1	1	1	1
Number of non-insect taxa	2	4	2	2
Percent Collector-Gatherers	2	1	2	2
Percent of total number as Elmidae	4	1	3	3
Total	**24**	**19**	**25**	**24**
TCEQ Aquatic Life Use Score*	**Intermediate**	**Limited**	**Intermediate**	**Intermediate**

*Limited: ≤22, Intermediate: 22-28, High: 29-36 and Exceptional: ≥36

D.3.3.2.3 Discussion

Habitat parameters collected concurrent with benthic assessments provide additional information in evaluating the benthic community results. Instream habitat such as undercut banks, overhanging brush, macrophytes and snags provide niches to a variety of invertebrate groups and in significant quantities can increase the diversity and community structure significantly. All four stations exhibited these four structural components of instream habitat to varying degrees. Stream substrate is also important to the diversity and complexity of the benthic macroinvertebrate community. Vertically stratified and diverse stream substrates provide a wide variety of micro-niches and interstitial spaces, which tend to increase the complexity of the ecosystem. The four stations are primarily dominated by clay with varying compositions of gravel, sand and soft bottom substrates, which provide ample interstitial spaces. Stations 3 and 4 included a dominance of soft and gravel substrate with a small amount of sand substrate. None of the stream beds consisted of exposed bedrock.

A total of 1,773 individuals were collected during the two field efforts. The summer and early fall collections were similar with 864 individuals collected in June and 909 individuals collected in September. The average sample size at each site was 222 individuals. All locations displayed relatively low overall diversity and a relatively low diversity of sensitive groups such as mayflies and caddisflies, of which only two mayfly taxa and two caddisfly taxa were present. All 8 samples had relatively high density of midges (family Chironomidae), averaging more than 47 individuals per sample. Midges have the tendency to proliferate in conditions that most taxa will not thrive in and a preponderance is typically indicative of sub-optimal or low aquatic integrity. Riffle beetle dominance and diversity is often assessed in the context of benthic communities. Typically, a diversity of taxa with pollution-sensitive individuals in low densities (less than 10%) is considered ideal. The June and September samples were not ideal with only one relatively ubiquitous and pollution-tolerant taxon (*Stenelmis*) present. Other pollution intolerant taxa present in one or more samples included the dragonfly *Erpetogomphus* (Station 3, September) and the caddisfly *Hydroptila* (Stations 2 and 3, June). Numerically dominant taxa included Chironomids, *Cheumatopsyche* (caddisfly) and *Fallceon* (mayfly).

The benthic macroinvertebrate communities of the four stations were generally similar to each other with almost half of all identified taxa (12 of 27) consistently represented at all four stations. Two thirds (18 of 27) of the taxa were collected from two or more sites and only a few taxa (8) were found at only one site. A preliminary review of the taxa present at the four stations indicates that there is poor representation of mayflies (Ephemeroptera) and caddisflies (Trichoptera). This is generally considered indicative of poor aquatic integrity since sites with superior aquatic integrity generally have more than four taxa of each. Although some taxa which can tolerate poor water quality such as flatworms (*Dugesia*) and amphipods (*Hyallela*) were present in most samples, these organisms are not unexpected at even the most pristine of habitats. Overall, the samples showed a relatively low diversity composed primarily of taxa from groups which are generally indicative of an aquatic system with average to low integrity.

Based on the 12 parameter evaluation developed by TCEQ, seven of the eight samples from 2009 reflected an Intermediate overall aquatic life use rating while one sample was rated Limited. This multi-metric evaluation assesses aspects of diversity, taxa pollution sensitivity, trophic community structure and relative abundance of indicator taxa such as midges and riffle beetles. Typical samples in this assessment had relatively low diversity, balanced trophic structure and imbalanced benthic community indicative of a relatively simple and low quality ecosystem. Consistent with these conclusions, all samples had a relatively high density of midges (family Chironomidae), which have the tendency to proliferate in poor conditions. In addition, all samples showed a dominance of pollution tolerant taxa. Based on the eight benthic macroinvertebrate samples collected in June and September, the overall community structure, diversity and trophic composition consistently indicate that the aquatic integrity and biological health of this stream is generally below average and of Intermediate or Limited quality.

Although many physical and chemical parameters indicate a healthy stream, the waterway's potential is limited by the effects of bank erosion, scour, limited suitable substrates, and other stressors. Low biodiversities at all sites demonstrate the aquatic invertebrate communities in the North Fork Double Mountain Fork Brazos River are somewhat unstable. Cattle at Stations 2 and 3 had free access to the river. During each survey, cows were either grazing along the banks or actively crossing to another area. The level of disturbance at these two access points was visibly more extensive than at Stations 1 and 4 as evidenced by actively eroding banks and livestock feces in the stream.

Grazing by livestock not only reduces the amount of vegetation biomass at the stream edge available for aquatic insects to perch and emerge as winged adults, but may also have harmful impacts on water quality, including increases in nutrient concentrations through the introduction of livestock waste material into the river, and increases in temperature, sediment, and turbidity due to trampling and bank alteration.

D.3.3.3 Fish Community Evaluation

Since water conductivities were greater than those feasible for backpack electrofishing, fish populations were collected at each sampling location in a downstream to upstream direction using a 20-ft common-sense minnow seine. Sampling was conducted on a qualitative basis to obtain relative abundance and species composition of the fish community. A checklist of fish species collected, the total number of individuals collected by seine during the 2009 June and September field efforts, TPWD designated functional feeding groups, and DO tolerance classification levels, is presented in Tables 13 and 14, respectively, and are discussed below. Since fish collection effort was held constant for all stations sampled, the data presented can be compared across stations for each location and should be a constant proportion of the actual fish population. These data do not represent the total fish population, either in number or by species present, since fish are highly mobile organisms and avoid collection gear.

D.3.3.3.1 June 2009

During the June survey, a total of 2,180 individuals of fish representing 7 families, 15 species and 1 hybrid species were collected from the four sites on the North Fork Double Mountain Fork Brazos River (Table 13). A total of three major trophic (feeding) groups were present that included invertivores, or insect feeders; omnivores, which are general feeders; and piscivores that feed on other fish. Of the 15 species collected, nine were identified as tolerant and no species having intolerance to pollution were represented in the collections. Four species were found throughout the stream survey area that included the red shiner (*Cyprinella lutrensis*), fathead minnow (*Pimphales promelas*), western mosquitofish (*Gambusia affinis*), and green sunfish (*Lepomis cyanellus*). This survey marked the first and last appearance of the golden shiner (*Notemigonus crysoleucas*), longear sunfish (*Lepomis megalotis*) and the bluegill/green sunfish hybrid (*Lepomis macrochirus x Lepomis cyanellus*). Only four specimens of the golden shiner and 3 individuals of the sunfish hybrid were collected at Station 4 and the longear sunfish occurred in low numbers at Stations 3 and 4.

The red shiner comprised 52% of the total June catch and dominated the seine collections taken at Stations 3 and 4. The fathead minnow was the second most common fish collected and accounted for approximately 34% of all fish taken. This species was present at all four stations

Table 13.
Total Number of Fish Species Collected by Seine in June 2009
Lake 7 Reservoir Project

Species					***Station 1 Chapman 24 June 2009***	***Station 2 Upper V8 Ranch 23 June 2009***	***Station 3 Middle V8 Ranch 23 June 2009***	***Station 4 Lower V8 Ranch 24 June 2009***
Scientific Name	***Common Name***	***Type***	***Trophic Group****	***Tolerance Class*****	***Seine***	***Seine***	***Seine***	***Seine***
Dorosoma cepedianum	Gizzard shad		O	T	2		1	2
Cyprinella lutrensis	Red shiner		IF	T	77	169	459	427
Cyprinus carpio	Common carp		O	T			2	2
Notemigonus chrysoleucas	Golden shiner		IF	T				4
Pimephales promelas	Fathead minnow		O	T	125	216	107	302
Amieurus melas	Black bullhead		O	T			3	19
Gambusia affinis	Western mosquitofish		IF	T	1	4	13	4
Menidia beryllina	Inland silverside		IF		7	1		
Morone saxatilis	Striped bass		P					2
Lepomis cyanellus	Green sunfish	sunfish	P	T	5	30	3	3
Lepomis macrochirus	Bluegill	sunfish	IF	T	2		10	126
Lepomis megalotis	Longear sunfish	sunfish	IF				3	3
Micropterus salmoides	Largemouth bass	sunfish	P		2	1		
Pomoxis annularis	White crappie	sunfish	P			2	4	31
Pomoxis nigromaculatus	Black crappie	sunfish	P			3		
L. macrochirus x L. cyanellus	Hybrid sunfish	sunfish						3
				TOTAL TAXA	8	8	10	13
				TOTAL INDIVIDUALS	221	426	605	928

Trophic group designations are as follows: IF - invertivore; P - piscivore; O - omnivore; and H – herbivore

**Tolerance designations are: T - tolerant; I - intolerant. Those species without a tolerance designation are considered intermediate.

Table 14.
Total Number of Fish Species Collected by Seine in September 2009
Lake 7 Reservoir Project

Species		***Type***	***Trophic Group****	***Tolerance Class*****	***Station 1 Chapman 22 Sep 2009***	***Station 2 Upper V8 Ranch 22 Sep 2009***	***Station 3 Middle V8 Ranch 23 Sep 2009***	***Station 4 Lower V8 Ranch 23 Sep 2009***
Scientific Name	***Common Name***				***Seine***	***Seine***	***Seine***	***Seine***
Dorosoma cepedianum	Gizzard shad		O	T	1			14
Cyprinella lutrensis	Red shiner		IF	T	127	71	395	887
Cyprinus carpio	Common carp		O	T	1	2	2	27
Pimephales promelas	Fathead minnow		O	T	33	24	58	35
Amieurus melas	Black bullhead		O	T			2	3
Gambusia affinis	Western mosquitofish		IF	T	6	31	58	359
Menidia beryllina	Inland silverside		IF		4	3	4	8
Morone saxatilis	Striped bass		P					1
Lepomis cyanellus	Green sunfish	sunfish	P	T	3	4	3	2
Lepomis macrochirus	Bluegill	sunfish	IF	T	7	17	11	24
Micropterus salmoides	Largemouth bass	sunfish	P		1	1	1	
Pomoxis annularis	White crappie	sunfish	P				2	1
Pomoxis nigromaculatus	Black crappie	sunfish	P			3		1
TOTAL TAXA					9	9	10	12
TOTAL INDIVIDUALS					183	156	536	1362

Trophic group designations are as follows: IF - invertivore; P - piscivore; O - omnivore; and H – herbivore

**Tolerance designations are: T - tolerant; I - intolerant. Those species without a tolerance designation are considered intermediate.

with Station 4 producing the most individuals with 302. The third most abundant species was the bluegill with 138 individuals or slightly over 6% of the total catch in June. The majority of this species (91%) were collected in the small pool area below the concrete river crossing at Station 4. The remaining 7% of the total catch in numerical order were the green sunfish, white crappie (*Pomoxis annularis*), black bullhead (*Ameiurus melas*), western mosquitorfish, inland silverside (*Menidia beryllina*), longear sunfish, gizzard shad (*Dorosoma cepedianum*), common carp (*Cyprinus carpio*), golden shiner, largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), sunfish hybrid, and striped bass (*Morone saxatilis*). The proportion of pollution tolerant individuals was high at all stations sampled. No diseased fish were collected during this survey.

Station 4 ranked first in total numbers collected with 928 individuals representing 13 species. Station 3 ranked second with a total of 605 individuals and 10 species. Station 2 yielded 426 individuals and 8 genera and Station 1 was represented by 221 individuals and 8 species.

An IBI score was calculated for the four stations using the raw fish data along with the eight metric parameters developed by Linam et al. (2002) for the stream fishes found in the Western High Plains of Texas (Ecoregion 25). Application of the scoring and evaluation criteria is presented in Table 15. Using the species richness and composition, trophic composition, and fish abundance and condition, an IBI score was tabulated for each sample site.

No intolerant or darter species were collected at Station 1, among the eight fish species identified at this site (Table 13). The IBI integrity value of 28 indicates a rating of an Intermediate rating score (Table 15). The number of native cyprinid species, the percentage of individuals as omnivores, and low numbers of individuals collected resulted in a less than High IBI rating. Approximately 57% of the upper river community was comprised by the omnivorous fathead minnow while 35% of the catch at this location was represented by the invertebrate feeding red shiner.

No intolerant or darter species were collected at Station 2 among the seven species identified at this site (Table 13). The IBI value of 30 indicated a rating of Intermediate (Table 15). The combination of low number of native cyprinid species, high percentage of omnivore species, and low numbers of total fish collected from this location resulted in a less than High IBI rating for this study.

Table 15.
Metrics and Scoring Criteria for Fish Samples Based on Ecoregions 25 and 26 Criteria
Lake 7 Reservoir Project
Index and Critical Period[1]

Metric	*North Fork Double Mountain Fork Brazos River*															
	Station 1				*Station 2*				*Station 3*				*Station 4*			
	Index		*Critical*		*Index*		*Critical*		*Index*		*Critical*		*Index*		*Critical*	
	Value	*Score*	*Value*	*Score*	*Value*	*Score*	*Value*	*Score*	*Value*	*Score*	*Value*	*Score*	*Value*	*Score*	*Value*	*Score*
1. Total number of fish species	8	5	9	5	8	5	9	5	10	5	10	5	13	5	12	5
2. Number of native cyprinid species	2	3	2	3	2	3	2	3	2	3	2	3	3	5	2	3
3. Number of sunfish species	2	5	2	5	3	5	3	5	4	5	3	5	5	5	4	5
4. Percentage of individuals as omnivores	57.5	1	19.1	1	50.7	1	16.7	1	18.7	1	11.6	3	35.0	1	5.8	5
5. Percentage of individuals as invertivores	39.4	3	78.7	5	40.8	3	78.2	5	80.2	5	87.3	5	60.8	3	93.8	5
6. Number of individuals/seine haul	18.4	1	15.3	1	35.5	3	13.0	1	50.4	5	44.7	5	77.3	5	113.5	5
7. Percentage of individuals as Non-native species	0.0	5	0.0	5	0.0	5	1.3	5	0.3	5	0.4	5	0.4	5	2.1	3
8. Percentage of individuals with disease or anomalies	0.0	5	0.0	5	0.0	5	0.0	5	0.0	5	0.0	5	0.0	5	0.0	5
Total Score	**28**		**30**		**30**		**30**		**34**		**36**		**34**		**36**	
Aquatic Life Use*	**Intermediate**		**Intermediate**		**Intermediate**		**Intermediate**		**High**		**Exceptional**		**High**		**Exceptional**	

[1] Index Period (23-24 June 2009); Critical Period (22-23 August 2009)

*Exceptional (≥36); High (34-35): Intermediate (24-33); Limited (< 24)

Of the 10 fish species collected at Station 3 (Table 13), no intolerant or darter species were collected at this site. The IBI value of 34 calculated for this section of river was higher than the previous two upstream sites discussed (Table 15). Based on the Ecoregion 25 criteria, this stream reach exhibits a High aquatic life use. The values for six of the eight metric parameters received the highest achievable value of 5 while lower scores was recorded for the number of native cyprinid species represented and the high sample composition percentage of the omnivorous fathead minnow.

The highest species richness occurred at Station 4 where 13 of the 15 total fish species during the index period survey were collected (Table 13). No intolerant or darter species were collected from this site. Summing the eight IBI metric scores (34) for the June survey shows the most downstream river segment attained an integrity classification of High (Table 15). Identical to the tabulated score recorded for Station 3, this was the highest index period value calculated at all locations. The fish community sampled during this site visit was represented by a high percentage of omnivore species and a low percentage of invertivore species.

D.3.3.3.2 September 2009

Fish species collected from the North Fork Double Mountain Fork Brazos River at the four sites in September 2009 are listed in Table 16. There were a total of 2,237 fish captured by 20-ft seine representing 7 families and 13 species. The four species collected at every river location in June were also present at all stations in September. Two additional species also present in June, the inland silverside and bluegill, were also found in every collection taken in September. The golden shiner, longear sunfish and the bluegill/green sunfish hybrid, collected in June, were absent in the September samples. The three major trophic categories (invertivore, omnivore, and piscivore) were again represented with nine species classified as tolerant. No new entries were added to the collection list.

The red shiner was again the most abundant species accounting for approximately 66% of the total critical period catch. Stations 3 and 4 produced the greatest number of this species with 395 and 887, respectively. The second most dominant species was the western mosquitofish comprising approximately 20% of the total catch with 454 individuals. This aggressive fish frequents shallow, marginal areas of standing warmer water. This was the most dominant habitat type observed in the upper sample zone at Station 4 where 79% of this species were collected.

Table 16.
Fish Species Reported from the Upper Brazos River Drainage[1]

Scientific Name	Common Name	TPWD[2]	Lake 7 Area[3]
Lepisosteus oculatus	Spotted gar		
Lepisosteus osseus	Longnose gar		
Dorosoma cepedianum	Gizzard shad		✓
Campostoma anomalum	Central stoneroller		
Cyprinella lutrensis	Red shiner	✓	✓
Cyprinella venusta	Blacktail shiner		
Cyprinus carpio	Common carp		✓
Hybognathus placitus	Plains minnow	✓	
Macrhybopsis aestivalis	Speckled chub	✓	
Notemigonus crysoleucas	Golden shiner		✓
Notropis buccula	Smalleye shiner	✓	
Notropis oxyrhynchus	Sharpnose shiner	✓	
Phenocobius mirabilis	Suckermouth minnow		
Pimephales promelas	Fathead minnow		✓
Pimephales vigilax	Bullhead minnow		
Carpiodes carpio	River carpsucker		
Ameiurus melas	Black bullhead		✓
Ictalurus punctatus	Channel catfish		
Ictalurus furcatus	Blue catfish		
Pylodictis olivaris	Flathead catfish		
Fundulus zebrinus	Plains killifish	✓	
Cyprinodon rubrofluviatilis	Red River pupfish		
Gambusia affinis	Western mosquitofish	✓	✓
Menidia beryllina	Inland silverside		✓
Morone chrysops	White bass		
Morone saxatilis	Striped bass		✓
Lepomis auritus	Redbreast sunfish		
Lepomis gulosus	Warmouth		
Lepomis cyanellus	Green sunfish		✓
Lepomis humilis	Orangespotted sunfish		
Lepomis macrochirus	Bluegill		✓
Lepomis megalotis	Longear sunfish		✓
Lepomis microlophus	Redear sunfish		
Micropterus punctulatus	Spotted bass		
Micropterus salmoides	Largemouth bass		✓
Pomoxis annularis	White crappie		✓
Pomoxis nigromaculatus	Black crappie		✓
Percina sciera	Dusky darter		
Aplodinotus grunniens	Freshwater drum		

Source: Moss and Mayes (1993); TPWD (2004; 2005); HDR (2009)

[1] Salt and Double Mountain Forks including the North Fork Double Mountain Fork, Lake Buffalo Springs and Lake Ransom Canyon

[2] North Fork Double Mountain Fork downstream of Lake Buffalo Springs and Lake Ransom Canyon

[3] North Fork Double Mountain Fork upstream of Lake Buffalo Springs and Lake Ransom Canyo

The third most common fish was the fathead minnow which comprised approximately 7% of the total August seine collection. The fourth most abundant species was the bluegill which produced a total of 59 fish (2.6%) at all four stations.

The remaining 4.4% of the fish collected represented by less than 35 individuals each and listed in descending order of abundance included the common carp, inland silverside, gizzard shad, green sunfish, black bullhead, black crappie, largemouth bass, white crappie, and striped bass. Station 4 again ranked first in total numbers collected with 1,362 individuals representing 12 species. Station 3 again ranked second with a total of 536 individuals and 10 species. Station 1 produced 183 individuals and 9 species and Station 2 yielded 156 individuals and 9 genera. For comparability, IBI scores were calculated for the September samples for any differences noted between the two sampling events (Table 15). Overall, the proportion of omnivous individuals collected was lower with an inverse increase in invertivore species at all 4 stations sampled in September. Total catch numbers decreased at Stations 1, 2, and 3 while increasing at Station 4. No diseased fish were collected during the critical period survey.

No darter or intolerant species were among the 9 species collected at Station 1 (Table 14). The IBI value of 30 calculated for this location in September was two points higher than June; however both scores are within the range assigned as Intermediate (Table 15). The only scoring difference between the two surveys was the increase in percent composition in invertebrate feeding species which added two points to the final IBI count. There were other slight variations that did not affect individual metric scoring such as the increase in the number of species caught (8 to 9), a lower percentage of omnivorous species (57.5 vs. 19.1) and a reduction in the total numbers of individuals from 221 to 183.

No intolerant or darter species were collected at Station 2 among the nine species identified at this site (Table 14). The fish IBI scoring results for September were identical with the June total, with values of 30, corresponding to an Intermediate aquatic life use category.   Six of the eight metrics examined received identical counts while the metric scores for proportion of invertivore species increased by two points and a lower total catch decreased by two points.

A total of 10 fish species were collected at Station 3 (Table 14). The IBI value of 36 was the highest of all stations investigated during 2009, resulting in a rating of Exceptional (Table 15). The two point increase was attributed to a lower percentage of omnivorous species collected (11.6 vs. 18.7).   Other variations noted that did not affect the individual metric scoring between the two survey periods include a lower number of sunfish species collected, a higher percentage of invertebrate feeding species, a lower percentage of omnivore species, and a slight increase in the percentage of non-native species collected.

A total of 12 fish species were collected at Station 4, one species less than was caught in the June collections (Table 14). Similar to Station 3, the IBI value of 36 calculated for this location increased by two points over the computed score for June and was assigned an Exceptional ranking (Table 15). The seine collection at this station had the highest proportion of invertebrate feeding individuals (93.8) and the lowest percentage of omnivore species (5.8) collected during the 2009 study. The higher score was directly attributed to the metric scoring for the percentages of omnivore species collected which increased from 1 in June to 5 in September. Other differences noted among the individual metrics involving scoring changes included a decrease in the number of native cyprinid species represented, a higher percentage of invertebrate feeding species, and a lower amount of non-native species in the total sample.

D.3.3.3.3 Discussion

The geographic ranges of roughly 89 species of freshwater fish found in the Brazos River Basin (Linam and Kleinsasser, 1998) include the immediate and surrounding area, although, based on size and habitat suitability, not all of these species would occur in each area. While there is considerable information already available for the Salt Fork Brazos River and Double Mountain Fork Brazos River watersheds, very little information regarding fish assemblages is available for the North Fork Double Mountain Fork Brazos River drainage downstream of Buffalo Springs Lake and no recognized pre- and post-impoundment fisheries information is available for the length of river upstream of this reservoir (Wilde, 2009; Munger, 2009).

Aside from the study area collections, the fish assemblages in the North Fork Double Mountain Fork Brazos River have been most recently sampled at three locations near Post, Texas in Garza County by the TPWD during a 1988-1992 study (Moss and Mayes, 1993). Wilde and Ostrand (1999) collected fish from the Double Mountain Fork above Alan Henry Reservoir, impounded in 1993 approximately six miles upstream of its confluence with the North Fork Double Mountain Fork Brazos River. A total of 39 fish species has been reported in the upper Brazos River Drainage (i.e., the Salt and Double Mountain Forks), consisting of species that tend to be typical of the relatively harsh environments of prairie streams (Table 16). Prairie streams tend to exhibit wide ranges in temperature, dissolved oxygen and dissolved solids (salinity), and their typical fish assemblages tend to be dominated by species with tolerance for wide ranges of physical and chemical conditions that fluctuate widely (Mathews, 1987). This is particularly the case in headwater areas like the North Fork Double Mountain Fork Brazos River, where flow may cease seasonally and aquatic habitats are restricted to isolated pools. These same species tend to be poor competitors in less stressed environments, especially with regard to dissolved solids concentrations, and are thought to be limited in their downstream distributions by the presence of species populations less tolerant of high salinities.

A total of 24 community fishing lakes are found in Lubbock County (TPWD, 2009). Community fishing lakes are defined by the TPWD as public impoundments 75 acres or less found completely within a city limits, public or state park. Six of these 24 small impoundments are found in the upper reaches of the North Fork Double Mountain Fork Brazos River canyon upstream of the proposed Lake 7 reservoir, and two much larger lake systems, Buffalo Springs Lake and Lake Ransom Canyon exist downstream of the proposed Lake 7 reservoir. The six community lakes comprise the core of an extensive urban park system, known as the Jim Bertram Lake System, where boating and fishing are permitted. The TPWD manages the fisheries through the stocking of largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*) and rainbow trout (*Oncorhynchus mykiss*). Buffalo Springs Lake and Lake Ransom Canyon are regional recreational centers which appear to be maintaining stable fisheries; however, a significant fish kill caused by blooms of golden algae (*Prymnesium parvum*) during 2003 and a smaller kill event in 2005 have had an impact on the reservoir fishery (TPWD, 2005). Important sport fish include largemouth bass, channel catfish, sunfish (*Lepomis* spp.), white crappie (*Pomoxis annularis*), white bass (*Morone chrysops*), and striped bass. The TPWD also conducts fisheries studies on the area lakes including Buffalo Springs Lake (TPWD, 2004) and Lake Alan Henry (2005) to determine the need for changes in fish harvest regulations, stocking, population control, vegetation control, habitat improvement and pollution control.

The fish species recorded from the aforementioned scientific collections along with a comparison of fish species captured during the two HDR investigations at the four sampling locations in 2009 are presented in Table 16. Representative species known from this region include fish typical of riffle areas (certain minnow species and one darter species), pool habitats (sunfish species, several minnow species, gizzard shad, and inland silverside), and larger streams with relatively consistent flows. The latter includes river carpsucker (*Carpiodes carpio*), smallmouth buffalo (*Ictiobus bubalus*), white bass, and freshwater drum. The top predators in this watershed include the largemouth bass, channel catfish, flathead catfish, white bass, striped bass, white crappie, black crappie and several species of sunfish.

A total of 4,417 fish representing 15 species from seven families and one hybrid sunfish species were collected during the present study. The representative freshwater fauna found in the seine collections consists of smaller forage fish populations that include the red shiner, inland silverside, fathead minnow, western mosquitofish, and gizzard shad. The sunfish family (Centrarchidae) was represented by only six species. Pools were the most commonly encountered mesohabitat type. The fish community appears to be restricted to less sensitive species (i.e., tolerant) which are able to withstand wide fluctuations in stream conditions.

The most numerous species collected in order of decreasing relative abundance were the red shiner, fathead minnow, western mosquitofish, and bluegill. These four species comprised almost 95% of the total catch. The red shiner was the most common fish species taken in the study area comprising approximately 59% of the total catch with 2,613 individuals. This species was taken in large numbers mostly from the shallow pool habitat areas prevalent at each of the four stations. Its extremely high tolerance to a wide range and sometime harsh ecological conditions including high turbidity and siltation, allow them to be highly competitive with other fishes. The fathead minnow is another highly tolerant species that was more dominant in terms of numbers in the June samples. This species can be very abundant locally in the small pools and backwater areas of the river, thriving in warm turbid waters of high temperatures and low oxygen levels. Western mosquitofish, introduced world wide for mosquito larvae control, are very tolerant of warm temperatures and low DO conditions. Sunfish, including the bluegill, were mostly collected in very low numbers from backwater areas in generally low velocity habitats frequently having large woody debris.

Average Aquatic Life Use (ALU) scores calculated for the fish communities of the North Fork Double Mountain Fork Brazos River reflect the characteristics typical of Intermediate to Exceptional quality stream habitat. The June and September collections at Stations 1 and 2 exhibited a qualitative biological score of either a 28 or 30. The June collection at Stations 3 and 4 scored a High rating of 34 and an Exceptional rating of 36 in September. Minor variations of species observed between the two surveys probably indicate differences in seasonality, individual collection performance and chance rather than changes in species occurrence. Very few species were indicators of a particular mesohabitat type, as the study length of North Fork Double Mountain Fork Brazos River contains mostly generalist forage species that use a variety of habitats. Many of the species present are among the more common species for the state and are typical of perennial stream habitats. Nothing unusual was noted concerning the condition of the collected fish. No alarming parasite or disease incidence was detected.

Some fish species migrate to survive, having the natural ability to move across various aquatic ecosystems without bottlenecks or barriers. This trait is vital to the maintenance of a healthy and stable population of these species. Lake Alan Henry was constructed on the Double Mountain Fork as a water supply source for the City of Lubbock. Ostrand and Wilde (2001) reported that the fish assemblage in the river reach upstream of this impoundment had changed substantially, presumably in response to construction of the dam and reservoir. A subsequent physiology study of the dominant species in that assemblage indicated that those changes are most likely the result of an inability of cyprinid species to repopulate the river above Lake Alan Henry following episodes of intermittency when aquatic habitats are reduced to isolated pools. The plains minnow (*Hybognathus placitus*), smalleye shiner and the sharpnose shiner, whose populations were greatly reduced in the late 1990s in the Double Mountain Fork Brazos River, were found to be eliminated from pool habitats by increasing salinities as evaporation proceeded, but that the dominant cyprinodontids, Red River pupfish (*Cyprinodon rubrofluviatilis*) and plains killifish (*Fundulus zebrinus*), were sufficiently tolerant of high salinities to survive in isolated pools until streamflow resumed. Conversely, the cyprinids were not able to repopulate the river when flowing conditions resumed because of the migratory barrier imposed by Lake Alan Henry (Wilde and Ostrand, 1999).

The North Fork Double Mountain Fork Brazos River is in the geographic range of historical distribution and potential fish habitat for the smalleye shiner and sharpnose shiner, species which have been proposed for federal protection; however, neither fish has been reported to occur within Lubbock County. Both of these species require fairly shallow water in broad, open sandy channels with moderate current. Since no pre-impoundment fisheries information exists for the North Fork it is unknown if the two species inhabited the upper limits of this river prior to construction of Buffalo Springs Lake and Lake Ransom Canyon. The effects of on-channel river impoundment have created a migration barrier for these two cyprinid species and function as major obstacles to their migration routes. Therefore, the North Fork Double Mountain Fork Brazos River upstream of the two physical barriers could essentially be considered functionally fragmented from the existing downstream smalleye and sharpnose shiner populations.

D.4 Aquatic Life Use Summary

The following summarizes the ALM surveys conducted during 2009:

- The proposed Lake 7 Reservoir is located southeast (downstream) of Lubbock, a major urban area. Land-use in the The North Fork Double Mountain Fork Brazos River Basin surrounding Lake 7 supports intense agricultural activities, including irrigated row crops, rangeland, and confined animal feeding operations (CAFOs). To clarify the stream nature to be inundated, site–specific baseline information on water quality, habitat quality, and biological integrity was collected to determine existing aquatic conditions at four locations along Segment 1241A of the Brazos River between FM 835 near Loop 289 to a point immediately at and downstream of the currently proposed new dam near Station 4. Field observations, habitat evaluations, and biological sampling efforts occurred during the index period (23-24 June 2009) and the critical period (22-23 September 2009). The study was undertaken through the guidelines of the TCEQ (2006, 2007, 2008a). Transect data collected from four locations along the main channel were deemed adequate for habitat assessment. The river within the four designated sample zones of a standardized length of 300 m was effectively sampled only by seine at accessible locations. High water conductivities ranging from 949 to 1765 µS/cm disallowed the use of the backpack electrofisher to supplement the seine collections during this study. Macroinvertebrate collections were taken at all available microhabitats offered at each location.
- The standard field parameters measured at the four monitoring locations showed water quality in this section of the North Fork Double Mountain Fork Brazos River is suitable to sustain aquatic life. Water quality data collected on 23-24 June 2009 and 22-23 September 2009 do not identify any numeric water quality standards exceedences.
- Although no water chemistry samples were collected along the river, nutrient enrichment is a probable concern as the water quality is heavily influenced by many agricultural and municipal practices utilized in the North Fork Double Mountain Fork Brazos River watershed. Algae is common at all locations and excessive growths (blooms) may be particularly problematic to aquatic organisms subjected to large swings in D.O. and pH over a 24-hour period. This is especially true during warm and hot months when the oxygen carrying capacity of the water is reduced during low stream flow. Typical nonpoint sources of nutrient enrichment to the surface waters of this river may include stormwater, discharge of groundwater pumped from beneath the LLAS, livestock manure, and fertilizers contained in runoff from nearby cultivated lands. Each of the four locations had direct access to the river by livestock. The crossings at Stations 2 and 3 were heavily utilized by cattle. Large numbers of livestock can trample river banks, decreasing the ability of streamside vegetation to filter out pollutants and accelerating erosion.
- The river habitat quality observed at all four locations was quite similar as all of the sites had a riffle-run-pool morphology generally characterized as shallow, fast flowing riffle and run areas and slower, deeper pool areas. High water marks, sediment-stained vegetation on the banks and infrequent accumulation of instream woody debris near channel bends indicate the river carries a high volume of runoff

during storm events. With such tremendous variation in streamflow, the aquatic communities are subject to the extremes of intensive scour as well as stagnation.

- Using TCEQ's HQI, the physical characteristics of the North Fork Double Mountain Fork Brazos River were summarized for June and September 2009. Habitat quality ranged from Intermediate to High; the scores calculated at the two upstream sites varied between 2 to 3.5 points lower than the two downstream locations. Other than minor metric scoring differences associated with the number of riffle areas, bottom substrate stability, riparian buffer vegetation, and bank stability, no discernable changes in habitat were noted between sampling events at each location.
- A total of 1,773 benthic invertebrate individuals representing 27 taxa were collected during 2009. The TCEQ-based IBI indicates the macroinvertebrate community of the study area river reach is not well diversified and is comprised of those taxa which favor more compromised conditions. Nine of the 10 samples collected reflected an Intermediate overall aquatic life use rating; Station 3 rated Limited in September. Fewer pollution intolerant macroinvertebrates, such as mayflies, stoneflies, and caddisflies, and more pollution tolerant species, particularly chironomid midges, were found. A filter-feeding caddisfly (*Cheumatopsyche*) dominated the June collections at Stations 1, 2, and 3 and was prevalent at all sites in September. Caddisflies of this genus, as a group, tolerate disturbance. The mayfly (*Fallceon quilleri*) is an extremely common and wide-ranging species that was collected in low numbers in June and high numbers at 3 of the 4 locations in September. The overall metric index score calculated for Stations 1, 3, and 4 indicates an Intermediate biological condition. Station 2 exhibited the most significant change between the two surveys. This location scored a 28, which was the upper range of the Intermediate scale in June. However, a score of 19 was determined for the September collection as lower individual scores were recorded for eight of the 12 metric parameters
- Historical information on the fishes of this region is generally limited. The intent of this study was to determine the current species composition of the fish community in the section of the North Fork Double Mountain Fork Brazos River proposed for impoundment. Fish habitat in the study area includes a streambed of clay, silt, sand, gravel, and scattered cobble. Passage for mobile aquatic organisms was generally accessible during the survey.
- A total of 4,417 individuals of fish represented by 7 families, 15 species, and one hybrid sunfish species were collected during the two sampling events. Approximately 38% of the 39 documented species were captured. The Family Cyprinidae was represented by four species numbering 80% of all fishes collected. Three native minnow species (golden shiner, red shiner and fathead minnow) were the most numerous cyprinids and constituted almost 79% of the total catch. The sample results show the river supports 6 species of centrachids. Although this family comprised a small percentage of the fish collections, the bluegill, green sunfish and the white crappie were the three most common species.
- The biological quality of the North Fork Double Mountain Fork Brazos River as measured by a regionalized fish based IBI was lowest at Station 1 and gradually improved downstream. The June and September 2009 aquatic life use category calculated for the river at Stations 1 and 2 show fish data values indicative of an aquatic

life use in the Intermediate range. Computation of the qualitative biological scores for Stations 3 and 4 shows these stream segments exhibit a High aquatic life use in June and a September aquatic life use in the Exceptional range.

- No federal or state protected species were found at the four locations. Neither the smalleye shiner nor the sharpnose shiner (both candidates for federal listing) were collected. The probability of these species inhabiting the North Fork Double Mountain Fork Brazos River is very low. The construction of the two on-channel impoundments, Buffalo Springs Lake and Ransom Canyon Lake, has created a barrier to fish movement in the North Fork Double Mountain Fork Brazos River watershed. Therefore, the section of river upstream of these lakes could essentially be considered functionally fragmented from the existing downstream smalleye and sharpnose shiner populations.
- Seasonal changes in stream flow, water temperature and biological activity are ordinarily reflected in cyclical changes in population sizes and relative abundance of fish and benthic macroinvertebrate species. Therefore, temporal and spatial variation in macroinvertebrate and fish communities suggest differences in seasonality, individual collection performance and chance rather than changes in species occurrence.

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Attachment D1
Stream Physical Characteristics Worksheets, Physical Characteristics of Water Body Worksheets

TABLE D1-1
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Habitat Assessment Worksheet B Part I of III

Worksheet # NFDMFBR-01a | **Part I - Stream Physical Characteristics Worksheet** | **Page 1 of 6**

Observers: DJT; DM | Date: 24 June 2009 | Time: 11:37 – 12:58

Weather conditions: Sunny, hot; 95° + F

Stream: North Fork Double Mountain Fork Brazos River | Stream segment no. 1241A

Location of site: Station 1 at Chapman Property | Length of reach: 300 meters

Observed stream uses: Wildlife; surface runoff

Stream type (circle one): [✓ perennial] or **intermittent w/ perennial pools**

Stream bends: 4 | No. well defined 1 | No. moderately defined 2 | No. poorly defined 1

Aesthetics (circle one): **(1) wilderness** **(2) natural** **(3) [✓ common]** **(4) offensive**

Channel obstructions or modifications: Hose attached to a pump along LB | No. of riffles: 1

Channel flow status (circle one): [✓ high] **moderate** **low** **no flow**

Riparian vegetation (%):	**Left Bank**	**Right Bank**
Trees	41.0	26.0
Shrubs	21.0	25.0
Grasses or forbs	11.0	16.0
Cultivated fields	0.0	0.0
Other	27.0	33.0

Observations:

Scattered localized rain fell in the area prior to sampling and the evening of 23 June 2009, but not enough rain fell in the study area to affect flow conditions. The survey area is located downstream (south) of FM 835 on private property. This location was well shaded by a thin belt of riparian vegetation composed mostly of black willow, American elm and eastern red-cedar.

Transect Photo Sequence: US, DS, RB, LB.

Sampling order consisted of water chemistry, flow measurement, habitat evaluation, and biological collections at 11.17 cfs on 24 June 2009. A 20' seine was used entirely at this station between the shallow run habitats and deeper pool sections found alternating between T1 and T5 and the riffle habitat in the middle portion of the sample zone.

There were a total of 1 cobble/gravel riffles in the sample zone found at T3 that disappears during higher flows.

Pool depths exceeded 1.80 m ~40' US of T3. This length of creek receives stormwater runoff during rain events and was evident by the high amount of accumulated domestic trash along the banks and within the stream.

Notes

Channel Flow Status:
High-Water reaches the base of both lower banks; <5% of channel exposed
Moderate-Water fills >75% of channel or <25% channel substrate exposure
Low-Water fills 25-75% of available channel a/o riffle mostly exposed
No Flow-Very little water in channel and mostly present in standing pools; DRY

Stream Cover Types
Large/small woody debris/snags, filamentous algae, aquatic macrophytes, cobble, in-channel live trees or roots, undercut banks, overhanging vegetation, artificial structures (concrete, asphalt, tires)

Substrate Measurement
Bedrock-Smooth or rough
Boulders-Large (LB) yard stick to car size; (SB) basketball to yard stick size
Cobbles (CB)-Tennis ball to basketball size
Gravel (coarse)-Marble to tennis ball size (GC)
(fine)-Ladybug to marble size (GF)
Sand (SA)-Smaller than ladybug but visible
Fines (FN)-Silt Clay Muck
Wood – regardless of size
Concrete – regardless of size

Substrate Stability:
Stable - >50% gravel or larger substrate; gravel, cobble, boulders
Mod. Stable – 30-50% gravel or larger substrate; dominant is mix of gravel w/ finer sediments
Mod. Unstable – 10-29.9% gravel or larger; dominant size finer than gravel but w/ an mix of sizes
Unstable - <10% gravel or larger; substrate uniform sand, silt clay or bedrock

Dimensions of Largest Pool
Large-More than 50% coverage of channel width; depth > 1 meter
Moderate-50% or slightly less coverage; max. depth is 0.5-1 meter
Small-Approximately 25% coverage of channel; max. depth < 0.5 meters
Absent-No existing pools; only shallow auxiliary pockets

Human Influence
Walls, dikes, revetments, riprap and dams.
Buildings;
Pavement/cleared lot (paved, graveled, dirt parking lot, foundation
Roads or railroads
Inlet or outlet pipes
Landfills or trash
Parks or maintained lawns
Row Crops
Pastures, rangeland, hay fields, or evidence of livestock
Logging
Mining (including gravel mining)

Hydromorphological Units
Pool – Deep water impounded by a channel blockage or partial channel obstruction. Slow velocities with a concave streambed shape.
Riffle – Shallow stream reach with moderate current velocity, some surface turbulence, high gradient, and convex streambed morphology.
Run – Deeper stream reach with moderate current velocity, but no surface turbulence (laminar flow). Streambed is longitudinally flat and laterally concave.
Glide – Moderately shallow stream channel with laminar flow. Lacks pronounced turbulence, and exhibits flat streambed morphology.

TCEQ 20156-A (Rev. 4-14-2005)

Worksheet #
NFDMFBR-01a

Table D1-1 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.50 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 1 North Fork Double Mountain Fork Brazos River Transect 1	5.60	63	15	0.08	0.21	0.35	0.44	0.47	0.50	0.50	0.42	0.35	0.28	0.19	48	5	Total	75

Habitat type (circle one) **Riffle** [✓ **Run**] **Glide** **Pool**	Dominant substrate type CLAY w/ patches of sand & gravel	Dominant types riparian vegetation: **Left bank: 35% Trees; 5% Shrubs; 35% Grasses; 25% barren** American elm, sumpweed, wildrye, Johnson grass, mesquite, goldenrod **Right bank: 0% Trees; 20% Shrubs; 55% Grasses; 25% barren** Same species as left bank	% Gravel or larger 15	CL	100
				CR	100

Macrophytes (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Algae (circle one) **Abundant** **Common** **Rare** [✓ **Absent**]	Width of natural buffer vegetation (m)		Instream cover types: Overhanging vegetation; emergent and submergent woody debris	% Instream cover 10	LB	100
		LB: 15	RB: 5			RB	0

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.78 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 1 North Fork Double Mountain Fork Brazos River Transect 2	6.95	72	15	0.34	0.43	0.51	0.60	0.69	0.78	0.75	0.75	0.74	0.59	0.39	59	40	Total	100

Habitat type (Circle One) **Riffle** **Run** **Glide** [✓ **Pool**]	Dominant substrate type CLAY	Dominant types riparian vegetation: **Left bank: 50% Trees; 30% Shrubs; 5% Grasses; 15% Barren** American elm trees and saplings **Right bank: 30% Trees; 30% Shrubs; 5% Grasses; 35% Barren** American elm trees and saplings	% Gravel or larger 0	CL	100
				CR	100

Macrophytes (circle one) **Abundant** **Common** **Rare** [✓ **Absent**]	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Width of natural buffer vegetation (m)		Instream cover types: Overhanging vegetation; cut banks; exposed tree roots	% Instream cover 25	LB	100
		LB: 10	RB: 10			RB	100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.25 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 1 North Fork Double Mountain Fork Brazos River Transect 3	9.80	52	15	0.09	0.17	0.25	0.17	0.13	0.10	0.09	0.11	0.05	0.10	0.07	73	40	Total	75

Habitat type (circle one) [✓ **Riffle**] **Run** **Glide** **Pool**	Dominant substrate type GRAVEL	Dominant types riparian vegetation: **Left bank: 45% Trees; 25% Shrubs; 10% Grasses; 20% Barren** American elm, goldenrod, sumpweed, wildrye **Right bank: 40% Trees; 15% Shrubs; 10% Grasses; 35% Barren** American elm, goldenrod, sumpweed	% Gravel or larger 100	CL	100
				CR	100

Macrophytes (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Algae (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Width of natural buffer vegetation (m)		Instream cover types: Overhanging vegetation; cut banks; exposed tree roots; root wads	% Instream cover 15	LB	100
		LB: 20	RB: 15			RB	0

Worksheet #

NFDMFBR-01a

Table D1-1 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.51 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 1 North Fork Double Mountain Fork Brazos River Transect 4	6.15	72	25	0.19	0.45	0.51	0.42	0.33	0.28	0.24	0.22	0.15	0.18	0.10	57	40	Total	100

Habitat type (circle one) **Riffle** [✓ **Run**] **Glide** **Pool**	Dominant substrate type GRAVEL	Dominant types riparian vegetation: **Left bank: 55% Trees; 25% Shrubs; 5% Grasses; 15% Barren** American elm trees and saplings **Right bank: 30% Trees; 25% Shrubs; 10% Grasses; 35% Barren** American elm trees and saplings	% Gravel or larger 75	CL CR	100 100

Macrophytes (circle one) **Abundant** **Common** **Rare** [✓ **Absent**]	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Width of natural buffer vegetation (m) LB: 15	RB: 10	Instream cover types: Overhanging vegetation; exposed tree roots; root wads	% Instream cover 15	LB RB	100 100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.59 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 1 North Fork Double Mountain Fork Brazos River Transect 5	4.55	66	10	0.10	0.20	0.26	0.43	0.49	0.49	0.56	0.59	0.53	0.42	0.18	46	30	Total	100

Habitat type (Circle One) **Riffle** **Run** **Glide** [✓ **Pool**]	Dominant substrate type CLAY	Dominant types riparian vegetation: **Left bank: 20% Trees; 20% Grasses; 60% Barren** American elm, bermudagrass, cockelbur **Right bank: 30% Trees; 35% Shrubs; 35% Barren** American elm trees and saplings	% Gravel or larger 20	CL CR	100 100

Macrophytes (circle one) **Abundant** **Common** **Rare** [✓ **Absent**]	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Width of natural buffer vegetation (m) LB: 20	RB: 20	Instream cover types: Overhanging vegetation; cut banks; emergent and submergent woody debris.	% Instream cover 5	LB RB	100 100

Table D1-1 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Worksheet # NFDMFBR-01a
Habitat Assessment Worksheet B Part II of III

Part II - Summary of Physical Characteristics of Water Body

Using information from all of the transects and measurements in Part I and other sources, report the following general characteristics or averages for the entire reach:

Stream Name	Station 1 – NFDMFBR at the Chapman Property	**Date**	24 June 2009

Physical Characteristics	**Value**
Stream bed slope over evaluated reach (from USGS map; elevation change in meters/reach length in meters)	0.0102
Approximate drainage area above the transect furthest downstream (from USGS or county highway map in km^2)	9860.2
Stream order	3rd
Length of stream evaluated (in meters or kilometers)	300 meters
Number of lateral transects made	5
Average stream width (in meters)	6.61
Average stream depth (in meters)	0.35
Instantaneous stream flow (in ft^3/sec)	11.17
Indicate flow measurement method	Marsh McBirney
Channel flow status (high, moderate, low, or no flow)	High
Maximum pool width (in meters)	1.80
Maximum pool depth (in meters)	6.95
Total number of stream bends	4
Number of well defined bends	1
Number of moderately defined bends	2
Number of poorly defined bends	1
Total number of riffles	1
Dominant substrate type	Clay
Average percent of substrate gravel sized or larger	42.0
Average percent instream cover	13.0
Number of stream cover types	5
Average percent stream bank erosion potential	22.5
Average stream bank slope (in degrees)	61.0
Average width of natural buffer vegetation (in meters)	14.0
Average riparian vegetation percent composition by: (total to equal 100%)	
Trees	33.5
Shrubs	23.0
Grasses and Forbes	13.5
Cultivated fields	0.0
Other	30.0
Average percent tree canopy coverage	90.0
Overall aesthetic appraisal of the stream	Common

Table D1-1 (cont'd)
TCEQ Surface Water Quality Monitoring
Habitat Assessment Worksheet B Part III of III (NFDMFBR-01a)
Station 1 – North Fork Double Mountain Fork Brazos River at Chapman Property
Part III - Habitat Quality Index, 24 June 2009

Habitat Parameter	**Scoring Category**			
Available Instream Cover	**Abundant** >50% of substrate favorable for colonization and fish cover; good mix of several stable (not new fall or transient) cover types such as snags, cobble, undercut banks, macrophytes	**Common** 30-50% of substrate supports stable habitat; adequate habitat for maintenance of populations; may be limited in the number of different habitat types	[✓ **Rare** 10-29.9% of substrate supports stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed]	**Absent** <10% of substrate supports stable habitat; lack of habitat is obvious; substrate unstable or lacking
Score 2	4	3	2	1
Bottom Substrate Stability	**Stable** >50% gravel or larger substrate; gravel, cobble, boulders; dominant substrate type is gravel or larger	[✓ **Moderately Stable** 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments]	**Moderately Unstable** 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a mix of sizes	**Unstable** <10% gravel or larger substrate; substrate is uniform sand, silt, clay or bedrock
Score 3	4	3	2	1
Number of Riffles. To be counted, riffles must extend >50% the width of the channel and be at least as long as the channel width	**Abundant** ≥ 5 riffles	**Common** 2-4 riffles	[✓ **Rare** 1 riffle]	**Absent** No riffles
Score 2	4	3	2	1
Dimensions of Largest Pool	[✓ **Large** Pool covers more than 50% of the channel width; maximum depth is >1 meter]	**Moderate** Pool covers approximately 50% or slightly less of the channel width; maximum depth is 0.5-1 meter	**Small** Pool covers approximately 25% of the channel width; maximum depth is <0.5 meter	**Absent** No existing pools; only shallow auxiliary pockets
Score 4	4	3	2	1
Channel Flow Status	[✓ **High** Water reaches the base of both lower banks; < 5% of channel substrate is exposed]	**Moderate** Water fills >75% of the channel; or <25% of channel substrate is exposed	**Low** Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	**No Flow** Very little water in the channel and mostly present in standing pools; or stream is dry
Score 3	3	2	1	0

Table D1-1 (concluded)
Worksheet # NFDMFBR-01a
Station 1 – North Fork Double Mountain Fork Brazos River at Chapman Property
Part III - Habitat Quality Index, 24 June 2009 (concluded)

Habitat Parameter	**Scoring Category**			
Bank Stability	**Stable** Little evidence (<10%) of erosion or bank failure; bank angles average <30°	**Moderately Stable** Some evidence (10-29.9%) of erosion or bank failure; small areas of erosion mostly healed over; bank angles average 30-39.9°	**Moderately Unstable** Evidence of erosion or bank failure is common (30-50%); high potential of erosion during flooding; bank angles average 40-60°	**Unstable** Large and frequent evidence (>50%) of erosion or bank failure; raw areas frequent along steep banks; bank angles average >60°
Score 1	3	2	1	0
Channel Sinuosity	**High** ≥ 2 well-defined bends with deep outside areas (cut banks) and shallow inside areas (point bars) present	**Moderate** 1 well-defined bend or ≥ 3 moderately-defined bends present	**Low** <3 moderately-defined bends or only poorly-defined bends present	**None** Straight channel; may be channelized
Score 2	3	2	1	0
Riparian Buffer Vegetation	**Extensive** Width of natural buffer is >20 meters	**Wide** Width of natural buffer is 10.1-20 meters	**Moderate** Width of natural buffer is 5-10 meters	**Narrow** Width of natural buffer is <5 meters
Score 2	3	2	1	0
Aesthetics of Reach	**Wilderness** Outstanding natural beauty; usually wooded or unpastured area; water clarity is usually exceptional	**Natural Area** Trees and/or native vegetation are common; some development evident (from fields, pastures, dwellings); water clarity may be slightly turbid	**Common Setting** Not offensive; area is developed, but uncluttered such as in an urban park; water clarity may be turbid or discolored	**Offensive** Stream does not enhance the aesthetics of the area; cluttered; highly developed; may be a dumping area; water clarity is usually turbid or discolored
Score 1	3	2	1	0

Total Score 20.0

HABITAT QUALITY INDEX

26 - 31 **Exceptional**
[✓ 20 - 25 **High**]
14 - 19 **Intermediate**
≤ 13 **Limited**

TABLE D1-2
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Habitat Assessment Worksheet B Part I of III

Worksheet # NFDMFBR-02a	**Part I - Stream Physical Characteristics Worksheet**	**Page 1 of 6**

Observers: DJT; DM

Date: 23 June 2009

Time: 09:00 – 10:15

Weather conditions: Clear, hot

Stream: North Fork Double Mountain Fork Brazos River

Stream segment no. 1241A

Location of site: Station 2 at the Upper Crossing on the V8 Ranch

Length of reach: 300 meters

Observed stream uses: Wildlife; surface runoff

Stream type (circle one): [✓ **perennial**] or **intermittent w/ perennial pools**

Stream bends: 6	No. well defined 2	No. moderately defined 0	No. poorly defined 4

Aesthetics (circle one): **(1) wilderness** **(2) natural** **(3)** [✓ **common**] **(4) offensive**

Channel obstructions or modifications: gravel crossing at Transect 5

No. of riffles: 1

Channel flow status (circle one): [✓ **high**] **moderate** **low** **no flow**

Riparian vegetation (%):	**Left Bank**	**Right Bank**
Trees	8.0	37.0
Shrubs	5.0	12.0
Grasses or forbs	73.0	44.0
Cultivated fields	0.0	0.0
Other	14.0	7.0

Observations:

Scattered localized rain fell in the area prior to sampling and the evening of 23 June 2009, but not enough rain fell in the study area to affect flow conditions. The survey area is located at the upper crossing located on private property near a large feedlot to the south. The river at this location had a thin riparian border, although shading was not provided by streamside vegetation composed mostly of mesquite and American elm. Common sunflower was the dominant ground cover along both banks.

Transect Photo Sequence: US, DS, RB, LB.

Sampling order consisted of water chemistry, flow measurement, habitat evaluation, and biological collections at 24.15 cfs on 23 June 2009. A 20' seine was used entirely at this station between the alternating run and pool habitats that dominated throughout the sample zone. A large pool area was in the vicinity of the river crossing ~25 US of T5 which was used extensively by livestock.

There were a total of 1 cobble/gravel riffles in the sample zone found at T5 that disappears during higher flows.

Pool depths exceeded 1.50 m between T3 and T4.

Two of white crappie were collected, inspected and released:
<u>20' Seine</u>
White crappie length: 7", 8"

Notes

<u>**Channel Flow Status**</u>:
High-Water reaches the base of both lower banks; <5% of channel exposed
Moderate-Water fills >75% of channel or <25% channel substrate exposure
Low-Water fills 25-75% of available channel a/o riffle mostly exposed
No Flow-Very little water in channel and mostly present in standing pools; DRY

<u>**Stream Cover Types**</u>
Large/small woody debris/snags, filamentous algae, aquatic macrophytes, cobble, in-channel live trees or roots, undercut banks, overhanging vegetation, artificial structures (concrete, asphalt, tires)

<u>**Substrate Measurement**</u>
Bedrock-Smooth or rough
Boulders-Large (LB) yard stick to car size; (SB) basketball to yard stick size
Cobbles (CB)-Tennis ball to basketball size
Gravel (coarse)-Marble to tennis ball size (GC)
(fine)-Ladybug to marble size (GF)
Sand (SA)-Smaller than ladybug but visible
Fines (FN)-Silt Clay Muck
Wood – regardless of size
Concrete – regardless of size

<u>**Substrate Stability**</u>:
Stable - >50% gravel or larger substrate; gravel, cobble, boulders
Mod. Stable – 30-50% gravel or larger substrate; dominant is mix of gravel w/ finer sediments
Mod. Unstable – 10-29.9% gravel or larger; dominant size finer than gravel but w/ an mix of sizes
Unstable - <10% gravel or larger; substrate uniform sand, silt clay or bedrock

<u>**Dimensions of Largest Pool**</u>
Large-More than 50% coverage of channel width; depth > 1 meter
Moderate-50% or slightly less coverage; max. depth is 0.5-1 meter
Small-Approximately 25% coverage of channel; max. depth < 0.5 meters
Absent-No existing pools; only shallow auxiliary pockets

<u>**Human Influence**</u>
Walls, dikes, revetments, riprap and dams.
Buildings;
Pavement/cleared lot (paved, graveled, dirt parking lot, foundation
Roads or railroads
Inlet or outlet pipes
Landfills or trash
Parks or maintained lawns
Row Crops
Pastures, rangeland, hay fields, or evidence of livestock
Logging
Mining (including gravel mining)

<u>**Hydromorphological Units**</u>
Pool – Deep water impounded by a channel blockage or partial channel obstruction. Slow velocities with a concave streambed shape.
Riffle – Shallow stream reach with moderate current velocity, some surface turbulence, high gradient, and convex streambed morphology.
Run – Deeper stream reach with moderate current velocity, but no surface turbulence (laminar flow). Streambed is longitudinally flat and laterally concave.
Glide – Moderately shallow stream channel with laminar flow. Lacks pronounced turbulence, and exhibits flat streambed morphology.

TCEQ 20156-A (Rev. 4-14-2005)

Table D1-2 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.64 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 2 North Fork Double Mountain Fork Brazos River Transect 1	5.10	63	30	0.20	0.25	0.49	0.53	0.55	0.64	0.63	0.50	0.34	0.24	0.15	56	25	Total	98

Habitat type (circle one) **Riffle** **Run** **[✓ Glide]** **Pool**	Dominant substrate type CLAY w/ thin layer of silt	Dominant types riparian vegetation: **Left bank: 100% Grasses** Sunflower; golden rod **Right bank: 50% Trees; 0% Shrubs; 50% Grasses** Black willow, sunflower, golden rod	% Gravel or larger 0	CL	100
				CR	94

Macrophytes (circle one) **Abundant** **Common** **[✓ Rare]** **Absent**	Algae (circle one) **Abundant** **[✓ Common]** **Rare** **Absent**	Width of natural buffer vegetation (m) LB: <5	RB: <5	Instream cover types: Overhanging vegetation; emergent and submergent woody debris	% Instream cover 20	LB 100 RB 100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.35 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 2 North Fork Double Mountain Fork Brazos River Transect 2	5.30	66	25	0.28	0.27	0.26	0.34	0.34	0.35	0.34	0.23	0.15	0.10	0.05	62	45	Total	75

Habitat type (Circle One) **Riffle** **[✓ Run]** **Glide** **Pool**	Dominant substrate type CLAY w/ thin layer of silt	Dominant types riparian vegetation: **Left bank: 100% Grasses** Fox tail, bermudagrass, sunflower, golden rod **Right bank: 90% Trees; 10% Grasses** Salt cedar, sunflower, bermudagrass, goldenrod	% Gravel or larger 10	CL	100
				CR	100

Macrophytes (circle one) **Abundant** **Common** **[✓ Rare]** **Absent**	Algae (circle one) **[✓ Abundant]** **Common** **Rare** **Absent**	Width of natural buffer vegetation (m) LB: <5	RB: 5	Instream cover types: Overhanging vegetation; cut banks; emergent and submergent woody debris; root wads	% Instream cover 35	LB 0 RB 100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.89 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 2 North Fork Double Mountain Fork Brazos River Transect 3	4.90	73	50	0.43	0.62	0.71	0.80	0.89	0.76	0.44	0.44	0.35	0.25	0.14	40	40	Total	98

Habitat type (Circle One) **Riffle** **[✓ Run]** **Glide** **Pool**	Dominant substrate type CLAY w/ thin layer of silt and sand	Dominant types riparian vegetation: **Left bank: 25% Trees; 25% Shrubs; 30% Grasses; 20% Exposed Roots** American elm, sunflower, bermudagrass **Right bank: 45% Trees; 0% Shrubs; 40% Grasses; 15% Barren** Black willow, goldenrod, sunflower, bermudagrass	% Gravel or larger 10	CL	100
				CR	100

Macrophytes (circle one) **Abundant** **Common** **Rare** **[✓ Absent]**	Algae (circle one) **Abundant** **[✓ Common]** **Rare** **Absent**	Width of natural buffer vegetation (m) LB: <5	RB: 10	Instream cover types: Overhanging vegetation; cut banks; exposed tree roots; emergent and submergent woody debris	% Instream cover 25	LB 100 RB 94

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Table D1-2 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.53 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 2 North Fork Double Mountain Fork Brazos River Transect 4	4.60	70	20	0.20	0.34	0.50	0.53	0.45	0.44	0.44	0.31	0.25	0.25	0.24	56	15	Total	42

	Habitat type (Circle One) **Riffle** [✓ **Run**] **Glide** **Pool**	Dominant substrate type CLAY w/ thin layer of silt	Dominant types riparian vegetation: **Left bank: 100% Grasses** Sunflower, golden rod **Right bank: 0% Trees; 30% Shrubs; 70% Grasses** Black willow, sunflower, golden rod	% Gravel or larger 5	CL	64
					CR	0
Macrophytes (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Algae (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Width of natural buffer vegetation (m) LB: 5 RB: 10	Instream cover types: Overhanging vegetation; cut banks; root wads	% Instream cover 10	LB	5
					RB	100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.18 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 2 North Fork Double Mountain Fork Brazos River Transect 5	6.20	33	45	0.09	0.11	0.11	0.12	0.10	0.15	0.15	0.12	0.15	0.18	0.12	37	35	Total	4

	Habitat type (Circle One) [✓ **Riffle**] **Run** **Glide** **Pool**	Dominant substrate type GRAVEL	Dominant types riparian vegetation: **Left bank: 15% Trees; 0% Shrubs; 35% Grasses: 50% Barren** Black willow, sunflower, bermudagrass **Right bank: 0% Trees; 30% Shrubs; 50% Grasses; 20% Barren** Same as left bank vegetation	% Gravel or larger 100	CL	0
					CR	0
Macrophytes (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Algae (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Width of natural buffer vegetation (m) LB: 5 RB: 5	Instream cover types: Overhanging vegetation; cut banks; exposed tree roots.	% Instream cover 15	LB	0
					RB	17

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Table D1-2 (cont'd)
TCEQ Surface Water Quality Monitoring Program
Worksheet # NFDMFBR-02a
Habitat Assessment Worksheet B Part II of III

Part II - Summary of Physical Characteristics of Water Body

Using information from all of the transects and measurements in Part I and other sources, report the following general characteristics or averages for the entire reach:

Stream Name	Station 2 – NFDMFBR at the Upper Crossing on V8 Ranch	**Date**	23 June 2009

Physical Characteristics	**Value**
Stream bed slope over evaluated reach (from USGS map; elevation change in meters/reach length in meters)	0.0457
Approximate drainage area above the transect furthest downstream (from USGS or county highway map in km^2)	9905.9
Stream order	3rd
Length of stream evaluated (in meters or kilometers)	300 meters
Number of lateral transects made	5
Average stream width (in meters)	5.22
Average stream depth (in meters)	0.33
Instantaneous stream flow (in ft^3/sec)	24.15
Indicate flow measurement method	Marsh-McBirney
Channel flow status (high, moderate, low, or no flow)	High
Maximum pool width (in meters)	7.15
Maximum pool depth (in meters)	1.50
Total number of stream bends	6
Number of well defined bends	2
Number of moderately defined bends	0
Number of poorly defined bends	4
Total number of riffles	1
Dominant substrate type	Clay
Average percent of substrate gravel sized or larger	25.0
Average percent instream cover	21.0
Number of stream cover types	5
Average percent stream bank erosion potential	33.0
Average stream bank slope (in degrees)	56.0
Average width of natural buffer vegetation (in meters)	5.0
Average riparian vegetation percent composition by: (total to equal 100%)	
Trees	22.5
Shrubs	8.5
Grasses and Forbes	58.5
Cultivated fields	0.0
Other	10.5
Average percent tree canopy coverage	63.0
Overall aesthetic appraisal of the stream	Common

Table D1-2 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring
Habitat Assessment Worksheet B Part III of III (NFDMFBR-02a)
Station 2 – North Fork Double Mountain Fork Brazos River at the Upper Crossing on the V8 Ranch
Part III - Habitat Quality Index, 23 June 2009

Habitat Parameter	Scoring Category			
Available Instream Cover	**Abundant** >50% of substrate favorable for colonization and fish cover; good mix of several stable (not new fall or transient) cover types such as snags, cobble, undercut banks, macrophytes	**Common** 30-50% of substrate supports stable habitat; adequate habitat for maintenance of populations; may be limited in the number of different habitat types	**Rare** 10-29.9% of substrate supports stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	**Absent** <10% of substrate supports stable habitat; lack of habitat is obvious; substrate unstable or lacking
Score 2	4	3	2	1
Bottom Substrate Stability	**Stable** >50% gravel or larger substrate; gravel, cobble, boulders; dominant substrate type is gravel or larger	**Moderately Stable** 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments	**Moderately Unstable** 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a mix of sizes	**Unstable** <10% gravel or larger substrate; substrate is uniform sand, silt, clay or bedrock
Score 2	4	3	2	1
Number of Riffles To be counted, riffles must extend >50% the width of the channel and be at least as long as the channel width	**Abundant** ≥ 5 riffles	**Common** 2-4 riffles	**Rare** 1 riffle	**Absent** No riffles
Score 2	4	3	2	1
Dimensions of Largest Pool	**Large** Pool covers more than 50% of the channel width; maximum depth is >1 meter	**Moderate** Pool covers approximately 50% or slightly less of the channel width; maximum depth is 0.5-1 meter	**Small** Pool covers approximately 25% of the channel width; maximum depth is <0.5 meter	**Absent** No existing pools; only shallow auxiliary pockets
Score 4	4	3	2	1
Channel Flow Status	**High** Water reaches the base of both lower banks; < 5% of channel substrate is exposed	**Moderate** Water fills >75% of the channel; or <25% of channel substrate is exposed	**Low** Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	**No Flow** Very little water in the channel and mostly present in standing pools; or stream is dry
Score 3	3	2	1	0

Table D1-2 (concluded)
Worksheet # NFDMFBR-02a
Station 2 – North Fork Double Mountain Fork Brazos River at the Upper Crossing on the V8 Ranch
Part III - Habitat Quality Index, 23 June 2009 (concluded)

Habitat Parameter	**Scoring Category**			
Bank Stability	**Stable** Little evidence (<10%) of erosion or bank failure; bank angles average <30°	**Moderately Stable** Some evidence (10-29.9%) of erosion or bank failure; small areas of erosion mostly healed over; bank angles average 30-39.9°	**Moderately Unstable** Evidence of erosion or bank failure is common (30-50%); high potential of erosion during flooding; bank angles average 40-60°	**Unstable** Large and frequent evidence (>50%) of erosion or bank failure; raw areas frequent along steep banks; bank angles average >60°
Score 1	3	2	1	0
Channel Sinuosity	**High** ≥ 2 well-defined bends with deep outside areas (cut banks) and shallow inside areas (point bars) present	**Moderate** 1 well-defined bend or ≥ 3 moderately-defined bends present	**Low** <3 moderately-defined bends or only poorly-defined bends present	**None** Straight channel; may be channelized
Score 3	3	2	1	0
Riparian Buffer Vegetation	**Extensive** Width of natural buffer is >20 meters	**Wide** Width of natural buffer is 10.1-20 meters	**Moderate** Width of natural buffer is 5-10 meters	**Narrow** Width of natural buffer is <5 meters
Score 1	3	2	1	0
Aesthetics of Reach	**Wilderness** Outstanding natural beauty; usually wooded or unpastured area; water clarity is usually exceptional	**Natural Area** Trees and/or native vegetation are common; some development evident (from fields, pastures, dwellings); water clarity may be slightly turbid	**Common Setting** Not offensive; area is developed, but uncluttered such as in an urban park; water clarity may be turbid or discolored	**Offensive** Stream does not enhance the aesthetics of the area; cluttered; highly developed; may be a dumping area; water clarity is usually turbid or discolored
Score 1	3	2	1	0

Total Score 19.0

HABITAT QUALITY INDEX

26 - 31 **Exceptional**
20 - 25 **High**
14 - 19 **Intermediate**
≤ 13 **Limited**

TABLE D1-3
TCEQ Surface Water Quality Monitoring Program
Habitat Assessment Worksheet B Part I of III

Worksheet # NFDMFBR-03a	**Part I - Stream Physical Characteristics Worksheet**	**Page 1 of 6**

Observers: DJT; DM

Date: 23 June 2009

Time: 13:25 – 14:37

Weather conditions: Partly cloudy; 45% cloud cover; hot

Stream: North Fork Double Mountain Fork Brazos River

Stream segment no. 1241A

Location of site: Station 3 at the Middle Crossing on the V8 Ranch

Length of reach: 300 meters

Observed stream uses: Wildlife; surface runoff

Stream type (circle one): [✓ **perennial**] or **intermittent w/ perennial pools**

Stream bends: 9	No. well defined 6	No. moderately defined 2	No. poorly defined 1

Aesthetics (circle one): **(1) wilderness** **(2) natural** **(3)** [✓ **common**] **(4) offensive**

Channel obstructions or modifications: Gravel road crossing; telephone pole

No. of riffles: 2

Channel flow status (circle one): [✓ **high**] **moderate** **low** **no flow**

Riparian vegetation (%):	**Left Bank**	**Right Bank**
Trees	8.0	0.0
Shrubs	3.0	6.0
Grasses or forbs	87.0	88.0
Cultivated fields	0.0	0.0
Other	0.0	7.0

Observations:

Scattered localized rain fell in the area prior to sampling and the evening of 23 June 2009, but not enough rain fell in the study area to affect flow conditions. The survey area is located at the middle river crossing located on private property. The river at this location did not have a developed riparian border, although some shading was provided over the river at various times of the day. Vegetation composed mostly of mesquite, sunflower and bermudagrass.

Transect Photo Sequence: US, DS, RB, LB.

Sampling order consisted of water chemistry, flow measurement, habitat evaluation, and biological collections at 14.56 cfs on 23 June 2009. A 20' seine was used entirely at this station between the alternating run and pool habitats that dominated the sample zone. Deep pool habitat was more common DS of the river crossing especially at creek bends where most of the meanders were located.

There were a total of 2 cobble/gravel riffles in the sample zone found at between T1/T2 and at T3 that disappears during higher flows.

Pool depths exceeded 1.75 m between T3 and T4.

Two large individuals of fish were collected, inspected and released:

<u>20' Seine</u>

Black bullhead	1	14"	Found in pool between T1 & T2
White crappie	1	12"	Found in pool US of T3

Notes

Channel Flow Status:
High-Water reaches the base of both lower banks; <5% of channel exposed
Moderate-Water fills >75% of channel or <25% channel substrate exposure
Low-Water fills 25-75% of available channel a/o riffle mostly exposed
No Flow-Very little water in channel and mostly present in standing pools; DRY

Stream Cover Types
Large/small woody debris/snags, filamentous algae, aquatic macrophytes, cobble, in-channel live trees or roots, undercut banks, overhanging vegetation, artificial structures (concrete, asphalt, tires)

Substrate Measurement
Bedrock-Smooth or rough
Boulders-Large (LB) yard stick to car size; (SB) basketball to yard stick size
Cobbles (CB)-Tennis ball to basketball size
Gravel (coarse)-Marble to tennis ball size (GC)
(fine)-Ladybug to marble size (GF)
Sand (SA)-Smaller than ladybug but visible
Fines (FN)-Silt Clay Muck
Wood – regardless of size
Concrete – regardless of size

Substrate Stability:
Stable - >50% gravel or larger substrate; gravel, cobble, boulders
Mod. Stable – 30-50% gravel or larger substrate; dominant is mix of gravel w/ finer sediments
Mod. Unstable – 10-29.9% gravel or larger; dominant size finer than gravel but w/ an mix of sizes
Unstable - <10% gravel or larger; substrate uniform sand, silt clay or bedrock

Dimensions of Largest Pool
Large-More than 50% coverage of channel width; depth > 1 meter
Moderate-50% or slightly less coverage; max. depth is 0.5-1 meter
Small-Approximately 25% coverage of channel; max. depth < 0.5 meters
Absent-No existing pools; only shallow auxiliary pockets

Human Influence
Walls, dikes, revetments, riprap and dams.
Buildings;
Pavement/cleared lot (paved, graveled, dirt parking lot, foundation
Roads or railroads
Inlet or outlet pipes
Landfills or trash
Parks or maintained lawns
Row Crops
Pastures, rangeland, hay fields, or evidence of livestock
Logging
Mining (including gravel mining)

Hydromorphological Units
Pool – Deep water impounded by a channel blockage or partial channel obstruction. Slow velocities with a concave streambed shape.
Riffle – Shallow stream reach with moderate current velocity, some surface turbulence, high gradient, and convex streambed morphology.
Run – Deeper stream reach with moderate current velocity, but no surface turbulence (laminar flow). Streambed is longitudinally flat and laterally concave.
Glide – Moderately shallow stream channel with laminar flow. Lacks pronounced turbulence, and exhibits flat streambed morphology.

Worksheet #
NFDMFBR-03a

Table D1-3 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.57 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 3 North Fork Double Mountain Fork Brazos River Transect 1	5.40	10	25	0.20	0.32	0.48	0.49	0.56	0.57	0.54	0.53	0.50	0.40	0.19	53	20	Total	57
	Habitat type (circle one) **Riffle** **Run** **Glide** [✓ **Pool**]		Dominant substrate type CLAY				Dominant types riparian vegetation: **Left bank: 100% Grasses** Sunflower, goldenrod, sumpweed, bermudagras, switchgrass **Right bank: 25 % Sapling; 75% Grasses** American elm, black willow, sunflower, goldenrod,									% Gravel or larger 5	CL	100
																	CR	0
Macrophytes (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**		Width of natural buffer vegetation (m)				Instream cover types: Overhanging vegetation; cut banks; exposed roots									% Instream cover 20	LB	29
			LB: 20	RB: 20													RB	100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.83 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 3 North Fork Double Mountain Fork Brazos River Transect 2	8.80	65	45	0.17	0.42	0.52	0.55	0.63	0.69	0.75	0.83	0.73	0.54	0.37	58	35	Total	44
	Habitat type (Circle One) **Riffle** **Run** **Glide** [✓ **Pool**]		Dominant substrate type CLAY				Dominant types riparian vegetation: **Left bank: 30% Trees; 10% Shrubs; 60% Grasses** American elm; sunflower, golden rod **Right bank: 100% Grasses** Sunflower, goldenrod, switchgrass, nightshade,									% Gravel or larger 40	CL	29
																	CR	47
Macrophytes (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**		Width of natural buffer vegetation (m)				Instream cover types: Overhanging vegetation; cut banks; exposed roots									% Instream cover 20	LB	100
			LB: >5	RB: >5													RB	0

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.23 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 3 North Fork Double Mountain Fork Brazos River Transect 3	4.60	53	5	0.10	0.13	0.14	0.14	0.19	0.20	0.22	0.18	0.18	0.20	0.23	67	40	Total	0
	Habitat type (circle one) [✓ **Riffle**] **Run** **Glide** **Pool**		Dominant substrate type GRAVEL				Dominant types riparian vegetation: **Left bank: 5% Saplings; 95% Grasses** Saltcedar, sunflower, switchgrass, goldenrod, purple aster, **Right bank: 5% Saplings; 60% Grasses; 35% Barren** Same as left bank vegetation									% Gravel or larger 100	CL	0
																	CR	0
Macrophytes (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Algae (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**		Width of natural buffer vegetation (m)				Instream cover types: Overhanging vegetation; cut banks; root wads: rock									% Instream cover 25	LB	0
			LB: 5	RB: 5													RB	0

Worksheet #

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Table D1-3 Stream Physical Characteristics Worksheet Part I – (cont'd)

Page 3 of 6

Location of transect Station 3 North Fork Double Mountain Fork Brazos River Transect 4	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.46 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
	5.20	72	10	0.29	0.42	0.43	0.46	0. 46	0.46	0.45	0.42	0.40	0.40	0.15	59	10	Total	0
	Habitat type (circle one) **Riffle** **Run** **Glide** [✓ **Pool**]		Dominant substrate type CLAY				Dominant types riparian vegetation: **Left bank: 100% Grasses** Sunflower, switchgrass, goldenrod, purple aster, buffalobur, sumpweed, sedges **Right bank: 100% Grasses** Sunflower, switchgrass, goldenrod, purple aster, buffalobur, sumpweed, sedges									% Gravel or larger 5	CL	0
																	CR	0
Macrophytes (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Algae (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**		Width of natural buffer vegetation LB: 5	RB: 5		Instream cover types: Overhanging vegetation; emergent vegetation (sedges)										% Instream cover 5	LB	0
																	RB	0
Location of transect Station 3 North Fork Double Mountain Fork Brazos River Transect 5	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.49 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
	4.14	35	0	0.35	0.49	0.38	0.21	0.24	0.23	0.18	0.15	0.20	0.19	0.11	63	20	Total	0
	Habitat type (Circle One) **Riffle** [✓ **Run**] **Glide** **Pool**		Dominant substrate type CLAY				Dominant types riparian vegetation: **Left bank: 10% Trees; 90% Grasses** Salt cedar, sunflower, golden rod, buffalobur, bermudagrass **Right bank: 100% Grasses** Sunflower, golden rod, sumpweed, buffalobur, bermudagrass									% Gravel or larger 35	CL	0
																	CR	0
Macrophytes (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Algae (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**		Width of natural buffer vegetation LB: 5	RB: 5		Instream cover types: Overhanging vegetation; cut banks; large rock.										% Instream cover 10	LB	0
																	RB	0

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Table D1-3 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Worksheet # NFDMFBR-03a
Habitat Assessment Worksheet B Part II of III

Part II - Summary of Physical Characteristics of Water Body

Using information from all of the transects and measurements in Part I and other sources, report the following general characteristics or averages for the entire reach:

Stream Name	Station 3 – NFDMFBR at the Middle Crossing on V8 Ranch	**Date**	23 June 2009

Physical Characteristics	**Value**
Stream bed slope over evaluated reach (from USGS map; elevation change in meters/reach length in meters)	0.0000
Approximate drainage area above the transect furthest downstream (from USGS or county highway map in km^2)	9944.5
Stream order	3rd
Length of stream evaluated (in meters or kilometers)	300 meters
Number of lateral transects made	5
Average stream width (in meters)	5.63
Average stream depth (in meters)	0.36
Instantaneous stream flow (in ft^3/sec)	14.56
Indicate flow measurement method	Marsh-McBirney
Channel flow status (high, moderate, low, or no flow)	High
Maximum pool width (in meters)	9.20
Maximum pool depth (in meters)	1.75
Total number of stream bends	9
Number of well defined bends	6
Number of moderately defined bends	2
Number of poorly defined bends	1
Total number of riffles	2
Dominant substrate type	Clay
Average percent of substrate gravel sized or larger	37.0
Average percent instream cover	16.0
Number of stream cover types	6
Average percent stream bank erosion potential	21.0
Average stream bank slope (in degrees)	53.5
Average width of natural buffer vegetation (in meters)	7.6
Average riparian vegetation percent composition by: (total to equal 100%)	
Trees	4.0
Shrubs	4.5
Grasses and Forbes	88.0
Cultivated fields	0.00.0
Other	3.5
Average percent tree canopy coverage	20.0
Overall aesthetic appraisal of the stream	Common

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Table D1-3 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring
Habitat Assessment Worksheet B Part III of III (NFDMFBR-03a)
Station 3 – North Fork Double Mountain Fork Brazos River at the Middle Crossing on the V8 Ranch
Part III - Habitat Quality Index, 23 June 2009

Habitat Parameter	Scoring Category			
Available Instream Cover	**Abundant** >50% of substrate favorable for colonization and fish cover; good mix of several stable (not new fall or transient) cover types such as snags, cobble, undercut banks, macrophytes	**Common** 30-50% of substrate supports stable habitat; adequate habitat for maintenance of populations; may be limited in the number of different habitat types	**Rare** 10-29.9% of substrate supports stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	**Absent** <10% of substrate supports stable habitat; lack of habitat is obvious; substrate unstable or lacking
Score 2	4	3	2	1
Bottom Substrate Stability	**Stable** >50% gravel or larger substrate; gravel, cobble, boulders; dominant substrate type is gravel or larger	**Moderately Stable** 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments	**Moderately Unstable** 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a mix of sizes	**Unstable** <10% gravel or larger substrate; substrate is uniform sand, silt, clay or bedrock
Score 3	4	3	2	1
Number of Riffles To be counted, riffles must extend >50% the width of the channel and be at least as long as the channel width	**Abundant** ≥ 5 riffles	**Common** 2-4 riffles	**Rare** 1 riffle	**Absent** No riffles
Score 3	4	3	2	1
Dimensions of Largest Pool	**Large** Pool covers more than 50% of the channel width; maximum depth is >1 meter	**Moderate** Pool covers approximately 50% or slightly less of the channel width; maximum depth is 0.5-1 meter	**Small** Pool covers approximately 25% of the channel width; maximum depth is <0.5 meter	**Absent** No existing pools; only shallow auxiliary pockets
Score 4	4	3	2	1
Channel Flow Status	**High** Water reaches the base of both lower banks; < 5% of channel substrate is exposed	**Moderate** Water fills >75% of the channel; or <25% of channel substrate is exposed	**Low** Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	**No Flow** Very little water in the channel and mostly present in standing pools; or stream is dry
Score 3	3	2	1	0

Table D1-3 (concluded)
Worksheet # NFDMFBR-03a
Station 3 – North Fork Double Mountain Fork Brazos River at the Middle Crossing on the V8 Ranch
Part III - Habitat Quality Index, 23 June 2009 (concluded)

Habitat Parameter	**Scoring Category**			
Bank Stability	**Stable** Little evidence (<10%) of erosion or bank failure; bank angles average <30°	**Moderately Stable** Some evidence (10-29.9%) of erosion or bank failure; small areas of erosion mostly healed over; bank angles average 30-39.9°	**Moderately Unstable** Evidence of erosion or bank failure is common (30-50%); high potential of erosion during flooding; bank angles average 40-60°	**Unstable** Large and frequent evidence (>50%) of erosion or bank failure; raw areas frequent along steep banks; bank angles average >60°
Score 1.5	3	2	1	0
Channel Sinuosity	**High** ≥ 2 well-defined bends with deep outside areas (cut banks) and shallow inside areas (point bars) present	**Moderate** 1 well-defined bend or ≥ 3 moderately-defined bends present	**Low** <3 moderately-defined bends or only poorly-defined bends present	**None** Straight channel; may be channelized
Score 3	3	2	1	0
Riparian Buffer Vegetation	**Extensive** Width of natural buffer is >20 meters	**Wide** Width of natural buffer is 10.1-20 meters	**Moderate** Width of natural buffer is 5-10 meters	**Narrow** Width of natural buffer is <5 meters
Score 1	3	2	1	0
Aesthetics of Reach	**Wilderness** Outstanding natural beauty; usually wooded or unpastured area; water clarity is usually exceptional	**Natural Area** Trees and/or native vegetation are common; some development evident (from fields, pastures, dwellings); water clarity may be slightly turbid	**Common Setting** Not offensive; area is developed, but uncluttered such as in an urban park; water clarity may be turbid or discolored	**Offensive** Stream does not enhance the aesthetics of the area; cluttered; highly developed; may be a dumping area; water clarity is usually turbid or discolored
Score 1	3	2	1	0

Total Score 21.5

HABITAT QUALITY INDEX

26 - 31 **Exceptional**
[✓ 20 - 25 **High**]
14 - 19 **Intermediate**
≤ 13 **Limited**

TABLE D1-4
TCEQ Surface Water Quality Monitoring Program
Habitat Assessment Worksheet B Part I of III

Worksheet # NFDMFBR-04a	**Part I - Stream Physical Characteristics Worksheet**	**Page 1 of 6**

Observers: DJT; DM

Date: 23 June 2009

Time: 17:20 – 18:31

Weather conditions: Partly cloudy; 40% cover; hot

Stream: North Fork Double Mountain Fork Brazos River

Stream segment no. 1241A

Location of site: Station 4 at the Lower Crossing on the V8 Ranch

Length of reach: 350 meters

Observed stream uses: Wildlife; surface runoff

Stream type (circle one): [✓ **perennial**] or **intermittent w/ perennial pools**

Stream bends: 6	No. well defined 2	No. moderately defined 1	No. poorly defined 3

Aesthetics (circle one): **(1) wilderness** **(2) natural** **(3)** [✓ **common**] **(4) offensive**

Channel obstructions or modifications: 2 concrete encased 5-ft diameter culverts

No. of riffles: 2

Channel flow status (circle one): [✓ **high**] **moderate** **low** **no flow**

Riparian vegetation (%):	**Left Bank**	**Right Bank**
Trees	12.0	53.0
Shrubs	15.0	8.0
Grasses or forbs	55.0	8.0
Cultivated fields	0.0	0.0
Other	18.0	19.0

Observations:

Scattered localized rain fell in he area prior to sampling and the evening of 23 June 2009, but not enough rain fell in the study area to affect flow conditions. The survey area is located at the lower river crossing located near a large home on private property and the proposed centerline of the dam structure. The river at this location exhibited a developed riparian border, but only provides shading at various times of the day. Vegetation composed mostly of American elm, ragweed, switchgrass and wildrye.

Transect Photo Sequence: US, DS, RB, LB.

Sampling order consisted of water chemistry, flow measurement, and habitat evaluation on 6-23-09 at 15.73 cfs. Macroinvertebrate collection, and seining were conducted the following day under a slightly higher flow rate (not measured) due to early morning rainfall. A 20' seine was used entirely at this station. Several hauls were made in the deeper standing pool areas at T1 and T2. A concrete bridge was recently constructed over the river to access property to the south. Water from the deep pool habitat passed through 2 side by side 6' diameter culverts. A small quiet pool was adjacent swift current emerging from each culvert to the downstream reach. Downstream habitat consisted of narrow run areas until the river widened and deepened ~35' US of T5.

There were a total of 2 cobble/gravel riffles in the sample zone found at T3 and near T4 that disappear during higher flows. Pool depths exceeded 2.00 m along the left bank between T1 and immediately DS of T2 and again between T4 and T5.

Several large and small individuals of fish were collected, inspected and released:

<u>20' Seine</u>

Common carp	1	11"
Striped bass	1	8"
White crappie	28	All 5-6"
Bluegill	121	All 3-5"
Black bullhead	16	All 3-4"

Notes

<u>Channel Flow Status</u>:
High-Water reaches the base of both lower banks; <5% of channel exposed
Moderate-Water fills >75% of channel or <25% channel substrate exposure
Low-Water fills 25-75% of available channel a/o riffle mostly exposed
No Flow-Very little water in channel and mostly present in standing pools; DRY

<u>Stream Cover Types</u>
Large/small woody debris/snags, filamentous algae, aquatic macrophytes, cobble, in-channel live trees or roots, undercut banks, overhanging vegetation, artificial structures (concrete, asphalt, tires)

<u>Substrate Measurement</u>
Bedrock-Smooth or rough
Boulders-Large (LB) yard stick to car size; (SB) basketball to yard stick size
Cobbles (CB)-Tennis ball to basketball size
Gravel (coarse)-Marble to tennis ball size (GC)
(fine)-Ladybug to marble size (GF)
Sand (SA)-Smaller than ladybug but visible
Fines (FN)-Silt Clay Muck
Wood – regardless of size
Concrete – regardless of size

<u>Substrate Stability</u>:
Stable - >50% gravel or larger substrate; gravel, cobble, boulders
Mod. Stable – 30-50% gravel or larger substrate; dominant is mix of gravel w/ finer sediments
Mod. Unstable – 10-29.9% gravel or larger; dominant size finer than gravel but w/ an mix of sizes
Unstable - <10% gravel or larger; substrate uniform sand, silt clay or bedrock

<u>Dimensions of Largest Pool</u>
Large-More than 50% coverage of channel width; depth > 1 meter
Moderate-50% or slightly less coverage; max. depth is 0.5-1 meter
Small-Approximately 25% coverage of channel; max. depth < 0.5 meters
Absent-No existing pools; only shallow auxiliary pockets

<u>Human Influence</u>
Walls, dikes, revetments, riprap and dams.
Buildings;
Pavement/cleared lot (paved, graveled, dirt parking lot, foundation
Roads or railroads
Inlet or outlet pipes
Landfills or trash
Parks or maintained lawns
Row Crops
Pastures, rangeland, hay fields, or evidence of livestock
Logging
Mining (including gravel mining)

<u>Hydromorphological Units</u>
Pool – Deep water impounded by a channel blockage or partial channel obstruction. Slow velocities with a concave streambed shape.
Riffle – Shallow stream reach with moderate current velocity, some surface turbulence, high gradient, and convex streambed morphology.
Run – Deeper stream reach with moderate current velocity, but no surface turbulence (laminar flow). Streambed is longitudinally flat and laterally concave.
Glide – Moderately shallow stream channel with laminar flow. Lacks pronounced turbulence, and exhibits flat streambed morphology.

Table D1-4 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 1.35 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 4 North Fork Double Mountain Fork Brazos River Transect 1	12.19	51	10	0.70	1.20	1.30	1.35	1.32	1.28	1.19	1.10	0.93	0.76	0.52	32	10	Total	48

Habitat type (circle one) **Riffle** **Run** **Glide** [✓ **Pool**]	Dominant substrate type CLAY w/ layer of silt	Dominant types riparian vegetation: **Left bank: 5% Trees; 0% Shrubs; 90% Grasses; 5% barren** Black willow, American elm, sunflower **Right bank: 75% Trees; 0% Shrubs; 20% Grasses; 5% barren** Black willow, American elm, switchgrass, Johnsongrass, goldenrod	% Gravel or larger 0	CL	82
				CR	11

Macrophytes (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Width of natural buffer vegetation (m)		Instream cover types: Overhanging vegetation; cut banks; emergent and submergent woody debris; root wads	% Instream cover 25	LB	0
		LB: >20	RB: >20			RB	100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 1.40 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 4 North Fork Double Mountain Fork Brazos River Transect 2	10.67	64	5	0.44	0.65	0.81	0.98	0.97	1.40	0.83	0.58	0.58	0.37	0.29	27	10	Total	59

Habitat type (Circle One) **Riffle** **Run** **Glide** [✓ **Pool**]	Dominant substrate type CLAY	Dominant types riparian vegetation: **Left bank: 5% Trees; 30% Shrubs; 60% Grasses; 5% Barren** Black willow, sunflower, goldenrod **Right bank: 70% Trees; 0% Shrubs; 30% Grasses** American elm, goldenrod	% Gravel or larger 0	CL	100
				CR	11

Macrophytes (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Width of natural buffer vegetation (m)		Instream cover types: Overhanging vegetation; cut banks	% Instream cover 15	LB	35
		LB: >20	RB: >20			RB	88

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.40 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 4 North Fork Double Mountain Fork Brazos River Transect 3	3.95	67	35	0.20	0.25	0.39	0.40	0.39	0.38	0. 30	0.22	0.21	0.13	0.05	13	20	Total	40

Habitat type (circle one) [✓ **Riffle**] **Run** **Glide** **Pool**	Dominant substrate type GRAVEL	Dominant types riparian vegetation: **Left bank: 5% Trees; 0% Shrubs; 80% Grasses; 15% Barren** American elm, cottonwood, goldenrod **Right bank: 25% Trees; 40% Shrubs; 35% Gravel** Cottonwood, black willow	% Gravel or larger 100	CL	47
				CR	24

Macrophytes (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Algae (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Width of natural buffer vegetation (m)		Instream cover types: Overhanging vegetation; cut banks; exposed tree roots; root wads	% Instream cover 20	LB	35
		LB: 5	RB: >20			RB	53

Worksheet #

NFDMFBR-04a

Table D1-4 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.36 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 4 North Fork Double Mountain Fork Brazos River Transect 4	5.30	30	15	0.10	0.17	0.16	0.20	0.22	0.23	0.31	0.33	0.36	0.36	0.18	34	20	Total	100

Habitat type (circle one) **[✓ Riffle]** **Run** **Glide** **Pool**	Dominant substrate type GRAVEL	Dominant types riparian vegetation: **Left bank: 5% Trees; 30% Grasses; 65% Barren** American elm, switchgrass, ragweed **Right bank: 70% Trees; 5% Grasses; 25% Barren** American elm, ragweed, wildrye		% Gravel or larger 100	CL	100
					CR	100
Macrophytes (circle one) **Abundant** **Common** **Rare** **[✓ Absent]**	Algae (circle one) **Abundant** **Common** **[✓ Rare]** **Absent**	Width of natural buffer vegetation LB: 10	RB: >20	Instream cover types: Overhanging vegetation; cut banks; exposed tree roots	LB	100
				% Instream cover 5	RB	100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 1.60 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 4 North Fork Double Mountain Fork Brazos River Transect 5	10.66	31	40	0.23	0.44	1.00	1.15	1.30	1.50	1.60	1.30	1.10	0.80	0.65	70	55	Total	100

Habitat type (Circle One) **Riffle** **Run** **Glide** **[✓ Pool]**	Dominant substrate type CLAY	Dominant types riparian vegetation: **Left bank: 40% Trees; 45% Shrubs; 15% Grasses** Black willow, ragweed, switchgrass **Right bank: 25% Trees; 45% Grasses; 30% Barren** American elm, black willow, ragweed		% Gravel or larger 0	CL	100
					CR	100
Macrophytes (circle one) **Abundant** **Common** **Rare** **[✓ Absent]**	Algae (circle one) **Abundant** **Common** **Rare** **[✓ Absent]**	Width of natural buffer vegetation LB: 10	RB: 5	Instream cover types: Overhanging vegetation; cut banks; emergent and submergent woody debris;	LB	100
				% Instream cover 25	RB	100

TCEQ 20156-A (Rev. 4-14-2005)

Table D1-4 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Worksheet # NFDMFBR-04a
Habitat Assessment Worksheet B Part II of III

Part II - Summary of Physical Characteristics of Water Body

Using information from all of the transects and measurements in Part I and other sources, report the following general characteristics or averages for the entire reach:

Stream Name	Station 4 – NFDMFBR at the Lower Crossing on V8 Ranch	**Date**	23 June 2009

Physical Characteristics	**Value**
Stream bed slope over evaluated reach (from USGS map; elevation change in meters/reach length in meters)	0.0253
Approximate drainage area above the transect furthest downstream (from USGS or county highway map in km^2)	9953.8
Stream order	3^{rd}
Length of stream evaluated (in meters or kilometers)	350 meters
Number of lateral transects made	5
Average stream width (in meters)	8.55
Average stream depth (in meters)	0.66
Instantaneous stream flow (in ft^3/sec)	15.73
Indicate flow measurement method	Marsh-McBirney
Channel flow status (high, moderate, low, or no flow)	High
Maximum pool width (in meters)	12.19
Maximum pool depth (in meters)	2.00
Total number of stream bends	6
Number of well defined bends	2
Number of moderately defined bends	1
Number of poorly defined bends	3
Total number of riffles	2
Dominant substrate type	Clay
Average percent of substrate gravel sized or larger	40.0
Average percent instream cover	18.0
Number of stream cover types	5
Average percent stream bank erosion potential	22.0
Average stream bank slope (in degrees)	42.0
Average width of natural buffer vegetation (in meters)	15.0
Average riparian vegetation percent composition by: (total to equal 100%)	
Trees	32.5
Shrubs	11.5
Grasses and Forbes	37.5
Cultivated fields	0.0
Other	18.5
Average percent tree canopy coverage	69.0
Overall aesthetic appraisal of the stream	Common

Table D1-4 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring
Habitat Assessment Worksheet B Part III of III (NFDMFBR-04a)
Station 4 – North Fork Double Mountain Fork Brazos River at the Lower Crossing on the V8 Ranch
Part III - Habitat Quality Index, 23 June 2009

Habitat Parameter	**Scoring Category**			
Available Instream Cover	**Abundant** >50% of substrate favorable for colonization and fish cover; good mix of several stable (not new fall or transient) cover types such as snags, cobble, undercut banks, macrophytes	**Common** 30-50% of substrate supports stable habitat; adequate habitat for maintenance of populations; may be limited in the number of different habitat types	**Rare** 10-29.9% of substrate supports stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	**Absent** <10% of substrate supports stable habitat; lack of habitat is obvious; substrate unstable or lacking
Score 2	4	3	2	1
Bottom Substrate Stability	**Stable** >50% gravel or larger substrate; gravel, cobble, boulders; dominant substrate type is gravel or larger	**Moderately Stable** 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments	**Moderately Unstable** 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a mix of sizes	**Unstable** <10% gravel or larger substrate; substrate is uniform sand, silt, clay or bedrock
Score 3	4	3	2	1
Number of Riffles To be counted, riffles must extend >50% the width of the channel and be at least as long as the channel width	**Abundant** ≥ 5 riffles	**Common** 2-4 riffles	**Rare** 1 riffle	**Absent** No riffles
Score 3	4	3	2	1
Dimensions of Largest Pool	**Large** Pool covers more than 50% of the channel width; maximum depth is >1 meter	**Moderate** Pool covers approximately 50% or slightly less of the channel width; maximum depth is 0.5-1 meter	**Small** Pool covers approximately 25% of the channel width; maximum depth is <0.5 meter	**Absent** No existing pools; only shallow auxiliary pockets
Score 4	4	3	2	1
Channel Flow Status	**High** Water reaches the base of both lower banks; < 5% of channel substrate is exposed	**Moderate** Water fills >75% of the channel; or <25% of channel substrate is exposed	**Low** Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	**No Flow** Very little water in the channel and mostly present in standing pools; or stream is dry
Score 3	3	2	1	0

Table D1-4 (concluded)
Worksheet # NFDMFBR-04a
Station 4 – North Fork Double Mountain Fork Brazos River at the Lower Crossing on the V8 Ranch
Part III - Habitat Quality Index, 23 June 2009 (concluded)

Habitat Parameter	**Scoring Category**			
Bank Stability	**Stable** Little evidence (<10%) of erosion or bank failure; bank angles average <30°	**Moderately Stable** Some evidence (10-29.9%) of erosion or bank failure; small areas of erosion mostly healed over; bank angles average 30-39.9°	**Moderately Unstable** Evidence of erosion or bank failure is common (30-50%); high potential of erosion during flooding; bank angles average 40-60°	**Unstable** Large and frequent evidence (>50%) of erosion or bank failure; raw areas frequent along steep banks; bank angles average >60°
Score 1.5	3	2	1	0
Channel Sinuosity	**High** ≥ 2 well-defined bends with deep outside areas (cut banks) and shallow inside areas (point bars) present	**Moderate** 1 well-defined bend or ≥ 3 moderately-defined bends present	**Low** <3 moderately-defined bends or only poorly-defined bends present	**None** Straight channel; may be channelized
Score 3	3	2	1	0
Riparian Buffer Vegetation	**Extensive** Width of natural buffer is >20 meters	**Wide** Width of natural buffer is 10.1-20 meters	**Moderate** Width of natural buffer is 5-10 meters	**Narrow** Width of natural buffer is <5 meters
Score 2	3	2	1	0
Aesthetics of Reach	**Wilderness** Outstanding natural beauty; usually wooded or unpastured area; water clarity is usually exceptional	**Natural Area** Trees and/or native vegetation are common; some development evident (from fields, pastures, dwellings); water clarity may be slightly turbid	**Common Setting** Not offensive; area is developed, but uncluttered such as in an urban park; water clarity may be turbid or discolored	**Offensive** Stream does not enhance the aesthetics of the area; cluttered; highly developed; may be a dumping area; water clarity is usually turbid or discolored
Score 1	3	2	1	0

Total Score 22.5

HABITAT QUALITY INDEX

26 - 31 **Exceptional**
20 - 25 **High**
14 - 19 **Intermediate**
≤ 13 **Limited**

TABLE D1-5
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Habitat Assessment Worksheet B Part I of III

Worksheet # NFDMFBR-01b | **Part I - Stream Physical Characteristics Worksheet** | **Page 1 of 6**

Observers: DJT; PJ | Date: 22 September 2009 | Time: 09:46 – 10:49

Weather conditions: Cool, 20% cloud cover, rainy during early morning hours, 45°F and warming to mid-50s

Stream: North Fork Double Mountain Fork Brazos River | Stream segment no. 1241A

Location of site: Station 1 at Chapman Property | Length of reach: 300 meters

Observed stream uses: Wildlife; surface runoff

Stream type (circle one): [✓ **perennial**] or **intermittent w/ perennial pools**

Stream bends: 4 | No. well defined 1 | No. moderately defined 2 | No. poorly defined 1

Aesthetics (circle one): **(1) wilderness** **(2) natural** **(3)** [✓ **common**] **(4) offensive**

Channel obstructions or modifications: Hose attached to a pump along LB | No. of riffles: 1

Channel flow status (circle one): [✓ **high**] **moderate** **low** **no flow**

Riparian vegetation (%):	**Left Bank**	**Right Bank**
Trees	41.0	27.0
Shrubs	15.0	23.0
Grasses or forbs	10.0	13.0
Cultivated fields	0.0	0.0
Other	34.0	37.0

Observations:

Scattered localized rain fell in the area in the early morning hours of 22 September 2009 prior to sampling, but not enough rain fell in the study area to affect flow conditions of the project area. The survey area is located downstream (south) of FM 835 on private property. This location was well shaded by a thin belt of riparian vegetation composed mostly of black willow, American elm and eastern red-cedar.

Transect Photo Sequence: US, DS, RB, LB.

Sampling order consisted of water chemistry, flow measurement, habitat evaluation, and biological collections at 11.60 cfs similar to that observed on 24 June 2009. A 20' seine was used entirely at this station between the shallow run habitats and deeper pool sections found alternating between T1 and T5 and the riffle habitat in the middle portion of the sample zone.

There was a total of 1 cobble/gravel riffles in the sample zone found at T3 that with similar flow and depth characteristics to the June sampling event.

Pool depths exceeded 1.80 m ~40' US of T3. This length of creek receives stormwater runoff during rain events and was evident by the high amount of accumulated domestic trash noted along the banks and draped upon instream woody limbs and debris.

Notes

Channel Flow Status:
High-Water reaches the base of both lower banks; <5% of channel exposed
Moderate-Water fills >75% of channel or <25% channel substrate exposure
Low-Water fills 25-75% of available channel a/o riffle mostly exposed
No Flow-Very little water in channel and mostly present in standing pools; DRY

Stream Cover Types
Large/small woody debris/snags, filamentous algae, aquatic macrophytes, cobble, in-channel live trees or roots, undercut banks, overhanging vegetation, artificial structures (concrete, asphalt, tires)

Substrate Measurement
Bedrock-Smooth or rough
Boulders-Large (LB) yard stick to car size; (SB) basketball to yard stick size
Cobbles (CB)-Tennis ball to basketball size
Gravel (coarse)-Marble to tennis ball size (GC)
(fine)-Ladybug to marble size (GF)
Sand (SA)-Smaller than ladybug but visible
Fines (FN)-Silt Clay Muck
Wood – regardless of size
Concrete – regardless of size

Substrate Stability:
Stable - >50% gravel or larger substrate; gravel, cobble, boulders
Mod. Stable – 30-50% gravel or larger substrate; dominant is mix of gravel w/ finer sediments
Mod. Unstable – 10-29.9% gravel or larger; dominant size finer than gravel but w/ an mix of sizes
Unstable - <10% gravel or larger; substrate uniform sand, silt clay or bedrock

Dimensions of Largest Pool
Large-More than 50% coverage of channel width; depth > 1 meter
Moderate-50% or slightly less coverage; max. depth is 0.5-1 meter
Small-Approximately 25% coverage of channel; max. depth < 0.5 meters
Absent-No existing pools; only shallow auxiliary pockets

Human Influence
Walls, dikes, revetments, riprap and dams.
Buildings;
Pavement/cleared lot (paved, graveled, dirt parking lot, foundation
Roads or railroads
Inlet or outlet pipes
Landfills or trash
Parks or maintained lawns
Row Crops
Pastures, rangeland, hay fields, or evidence of livestock
Logging
Mining (including gravel mining)

Hydromorphological Units
Pool – Deep water impounded by a channel blockage or partial channel obstruction. Slow velocities with a concave streambed shape.
Riffle – Shallow stream reach with moderate current velocity, some surface turbulence, high gradient, and convex streambed morphology.
Run – Deeper stream reach with moderate current velocity, but no surface turbulence (laminar flow). Streambed is longitudinally flat and laterally concave.
Glide – Moderately shallow stream channel with laminar flow. Lacks pronounced turbulence, and exhibits flat streambed morphology.

Worksheet #
NFDMFBR-01b

Table D1-5 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.58 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 1 North Fork Double Mountain Fork Brazos River Transect 1	5.65	63	15	0.08	0.21	0.54	0.58	0.48	0.48	0.38	0.36	0.33	0.18	0.10	48	5	Total	75

Habitat type (circle one) **Riffle** [✓ **Run**] **Glide** **Pool**	Dominant substrate type CLAY w/ patches of sand & gravel	Dominant types riparian vegetation: **Left bank: 35% Trees; 15% Shrubs; 15% Grasses; 35% barren** American elm, sunflower, goldenrod, Johnson grass, mesquite **Right bank: 0% Trees; 20% Shrubs; 55% Grasses; 25% barren** Same species as left bank	% Gravel or larger 15	CL	100
				CR	100
Macrophytes (circle one) **Abundant** **Common** **Rare** [✓ **Absent**]	Algae (circle one) **Abundant** **Common** **Rare** [✓ **Absent**]	Width of natural buffer vegetation (m) LB: 15 RB: 5	Instream cover types: Overhanging vegetation; emergent and submergent woody debris	% Instream cover 10	LB	100
					RB	0

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.69 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 1 North Fork Double Mountain Fork Brazos River Transect 2	7.00	72	15	0.22	0.42	0.53	0.56	0.58	0.60	0.69	0.60	0.51	0.42	0.30	59	40	Total	100

Habitat type (Circle One) **Riffle** **Run** **Glide** [✓ **Pool**]	Dominant substrate type CLAY	Dominant types riparian vegetation: **Left bank: 50% Trees; 10% Shrubs; 0% Grasses; 40% Barren** American elm trees and saplings **Right bank: 30% Trees; 20% Shrubs; 0% Grasses; 50% Barren** American elm trees and saplings	% Gravel or larger 0	CL	100
				CR	100
Macrophytes (circle one) **Abundant** **Common** **Rare** [✓ **Absent**]	Algae (circle one) **Abundant** **Common** **Rare** [✓ **Absent**]	Width of natural buffer vegetation (m) LB: 10 RB: 10	Instream cover types: Overhanging vegetation; cut banks; exposed tree roots	% Instream cover 25	LB	100
					RB	100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.29 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 1 North Fork Double Mountain Fork Brazos River Transect 3	9.85	52	15	0.10	0.19	0.29	0.15	0.12	0.11	0.10	0.11	0.05	0.10	0.07	73	40	Total	75

Habitat type (circle one) [✓ **Riffle**] **Run** **Glide** **Pool**	Dominant substrate type GRAVEL	Dominant types riparian vegetation: **Left bank: 45% Trees; 25% Shrubs; 10% Grasses; 20% Barren** American elm, goldenrod, sumpweed, wildrye **Right bank: 40% Trees; 15% Shrubs; 10% Grasses; 35% Barren** American elm, goldenrod, sumpweed	% Gravel or larger 100	CL	100
				CR	100
Macrophytes (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Algae (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Width of natural buffer vegetation (m) LB: 20 RB: 15	Instream cover types: Overhanging vegetation; cut banks; exposed tree roots; root wads	% Instream cover 15	LB	100
					RB	0

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Worksheet #

NFDMFBR-01b

Table D1-5 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.58 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 1 North Fork Double Mountain Fork Brazos River Transect 4	6.20	72	25	0.30	0.43	0.51	0.58	0.33	0.28	0.28	0.22	0.15	0.12	0.11	57	40	Total	100

Habitat type (circle one) **Riffle** [✓ **Run**] **Glide** **Pool**	Dominant substrate type GRAVEL		Dominant types riparian vegetation: **Left bank: 55% Trees; 25% Shrubs; 5% Grasses; 15% Barren** American elm trees and saplings **Right bank: 35% Trees; 25% Shrubs; 0% Grasses; 40% Barren** American elm trees and saplings	% Gravel or larger 75	CL	100
					CR	100
Macrophytes (circle one) **Abundant** **Common** **Rare** [✓ **Absent**]	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Width of natural buffer vegetation (m) LB: 15 RB: 10	Instream cover types: Overhanging vegetation; exposed tree roots; root wads	% Instream cover 15	LB	100
					RB	100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.59 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 1 North Fork Double Mountain Fork Brazos River Transect 5	4.63	66	10	0.10	0.25	0.26	0.43	0.50	0.50	0.56	0.59	0.53	0.42	0.18	46	30	Total	100

Habitat type (Circle One) **Riffle** **Run** **Glide** [✓ **Pool**]	Dominant substrate type CLAY		Dominant types riparian vegetation: **Left bank: 20% Trees; 20% Grasses; 60% Barren** American elm, bermudagrass, cockelbur **Right bank: 30% Trees; 35% Shrubs; 35% Barren** American elm trees and saplings	% Gravel or larger 20	CL	100
					CR	100
Macrophytes (circle one) **Abundant** **Common** **Rare** [✓ **Absent**]	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Width of natural buffer vegetation (m) LB: 20 RB: 20	Instream cover types: Overhanging vegetation; cut banks; emergent and submergent woody debris.	% Instream cover 5	LB	100
					RB	100

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Table D1-5 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Worksheet # NFDMFBR-01b
Habitat Assessment Worksheet B Part II of III

Part II - Summary of Physical Characteristics of Water Body

Using information from all of the transects and measurements in Part I and other sources, report the following general characteristics or averages for the entire reach:

Stream Name	Station 1 – NFDMFBR at the Chapman Property	**Date**	

Physical Characteristics	**Value**
Stream bed slope over evaluated reach (from USGS map; elevation change in meters/reach length in meters)	0.0102
Approximate drainage area above the transect furthest downstream (from USGS or county highway map in km^2)	9860.2
Stream order	3^{rd}
Length of stream evaluated (in meters or kilometers)	300 meters
Number of lateral transects made	5
Average stream width (in meters)	6.67
Average stream depth (in meters)	0.33
Instantaneous stream flow (in ft^3/sec)	11.60
Indicate flow measurement method	Marsh-McBirney
Channel flow status (high, moderate, low, or no flow)	High
Maximum pool width (in meters)	8.75
Maximum pool depth (in meters)	1.80
Total number of stream bends	4
Number of well defined bends	1
Number of moderately defined bends	2
Number of poorly defined bends	1
Total number of riffles	1
Dominant substrate type	Clay
Average percent of substrate gravel sized or larger	42.0
Average percent instream cover	14.0
Number of stream cover types	5
Average percent stream bank erosion potential	23.5
Average stream bank slope (in degrees)	61.0
Average width of natural buffer vegetation (in meters)	14.0
Average riparian vegetation percent composition by: (total to equal 100%)	
Trees	34.0
Shrubs	19.0
Grasses and Forbes	11.5
Cultivated fields	0.0
Other	35.5
Average percent tree canopy coverage	90.0
Overall aesthetic appraisal of the stream	Common

Table D1-5 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring
Habitat Assessment Worksheet B Part III of III (NFDMFBR-01b)
Station 1 – North Fork Double Mountain Fork Brazos River at Chapman Property
Part III - Habitat Quality Index, 22 September 2009

Habitat Parameter	**Scoring Category**			
Available Instream Cover	**Abundant** >50% of substrate favorable for colonization and fish cover; good mix of several stable (not new fall or transient) cover types such as snags, cobble, undercut banks, macrophytes	**Common** 30-50% of substrate supports stable habitat; adequate habitat for maintenance of populations; may be limited in the number of different habitat types	**Rare** 10-29.9% of substrate supports stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	**Absent** <10% of substrate supports stable habitat; lack of habitat is obvious; substrate unstable or lacking
Score 2	4	3	2	1
Bottom Substrate Stability	**Stable** >50% gravel or larger substrate; gravel, cobble, boulders; dominant substrate type is gravel or larger	**Moderately Stable** 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments	**Moderately Unstable** 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a mix of sizes	**Unstable** <10% gravel or larger substrate; substrate is uniform sand, silt, clay or bedrock
Score 3	4	3	2	1
Number of Riffles To be counted, riffles must extend >50% the width of the channel and be at least as long as the channel width	**Abundant** ≥ 5 riffles	**Common** 2-4 riffles	**Rare** 1 riffle	**Absent** No riffles
Score 2	4	3	2	1
Dimensions of Largest Pool	**Large** Pool covers more than 50% of the channel width; maximum depth is >1 meter	**Moderate** Pool covers approximately 50% or slightly less of the channel width; maximum depth is 0.5-1 meter	**Small** Pool covers approximately 25% of the channel width; maximum depth is <0.5 meter	**Absent** No existing pools; only shallow auxiliary pockets
Score 4	4	3	2	1
Channel Flow Status	**High** Water reaches the base of both lower banks; < 5% of channel substrate is exposed	**Moderate** Water fills >75% of the channel; or <25% of channel substrate is exposed	**Low** Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	**No Flow** Very little water in the channel and mostly present in standing pools; or stream is dry
Score 3	3	2	1	0

Table D1-5 (concluded)
Worksheet # NFDMFBR-01b
Station 1 – North Fork Double Mountain Fork Brazos River at Chapman Property
Part III - Habitat Quality Index, 22 September 2009 (concluded)

Habitat Parameter	**Scoring Category**			
Bank Stability	**Stable** Little evidence (<10%) of erosion or bank failure; bank angles average <30°	**Moderately Stable** Some evidence (10-29.9%) of erosion or bank failure; small areas of erosion mostly healed over; bank angles average 30-39.9°	**Moderately Unstable** Evidence of erosion or bank failure is common (30-50%); high potential of erosion during flooding; bank angles average 40-60°	**Unstable** Large and frequent evidence (>50%) of erosion or bank failure; raw areas frequent along steep banks; bank angles average >60°
Score 1	3	2	1	0
Channel Sinuosity	**High** ≥ 2 well-defined bends with deep outside areas (cut banks) and shallow inside areas (point bars) present	**Moderate** 1 well-defined bend or ≥ 3 moderately-defined bends present	**Low** <3 moderately-defined bends or only poorly-defined bends present	**None** Straight channel; may be channelized
Score 2	3	2	1	0
Riparian Buffer Vegetation	**Extensive** Width of natural buffer is >20 meters	**Wide** Width of natural buffer is 10.1-20 meters	**Moderate** Width of natural buffer is 5-10 meters	**Narrow** Width of natural buffer is <5 meters
Score 2	3	2	1	0
Aesthetics of Reach	**Wilderness** Outstanding natural beauty; usually wooded or unpastured area; water clarity is usually exceptional	**Natural Area** Trees and/or native vegetation are common; some development evident (from fields, pastures, dwellings); water clarity may be slightly turbid	**Common Setting** Not offensive; area is developed, but uncluttered such as in an urban park; water clarity may be turbid or discolored	**Offensive** Stream does not enhance the aesthetics of the area; cluttered; highly developed; may be a dumping area; water clarity is usually turbid or discolored
Score 1	3	2	1	0

Total Score 20.0

HABITAT QUALITY INDEX

26 - 31 **Exceptional**
20 - 25 **High**
14 - 19 **Intermediate**
≤ 13 **Limited**

TABLE D1-6
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Habitat Assessment Worksheet B Part I of III

Worksheet # NFDMFBR-02b	**Part I - Stream Physical Characteristics Worksheet**		**Page 1 of 6**
Observers: DJT		Date: 22 September 2009	Time: 16:01 – 17:23
Weather conditions: Mostly sunny, 25% cloud cover, breezy with a NW wind 5-10 mph, 73°F			
Stream: North Fork Double Mountain Fork Brazos River		Stream segment no. 1241A	
Location of site: Station 2 at the Upper Crossing on the V8 Ranch		Length of reach: 300 meters	
Observed stream uses: Wildlife; surface runoff			
Stream type (circle one):	[✓ perennial]	or	**intermittent w/ perennial pools**
Stream bends: 6	No. well defined 2	No. moderately defined 0	No. poorly defined 4
Aesthetics (circle one):	**(1) wilderness** **(2) natural**	**(3)** [✓ common]	**(4) offensive**
Channel obstructions or modifications: gravel crossing at Transect 5		No. of riffles: 1	
Channel flow status (circle one):	[✓ high] **moderate**	**low**	**no flow**

Riparian vegetation (%):	**Left Bank**	**Right Bank**
Trees	8.0	43.0
Shrubs	5.0	12.0
Grasses or forbs	73.0	36.0
Cultivated fields	0.0	0.0
Other	14.0	9.0

Observations:

Scattered localized rain fell in the area in the early morning hours of 22 September 2009 prior to sampling, but not enough rain fell in the study area to affect flow conditions of the project area. The survey area is located at the upper crossing located on private property near a large feedlot to the south. The river at this location had a thin riparian border, although shading was not provided by streamside vegetation composed mostly of mesquite and American elm. Dense stands of common sunflower with heights upwards to 10' tall were the dominant ground cover along both banks. A machete was used to access the upstream portion of the sample zone.

Transect Photo Sequence: US, DS, RB, LB.

Sampling order consisted of water chemistry, flow measurement, habitat evaluation, and biological collections at 6.40 cfs that was much lower than 24.15 cfs recorded on 23 June 2009. A 20' seine was used entirely at this station between the alternating run and pool habitats that dominated throughout the sample zone. A large pool area was in the vicinity of the river crossing ~25 US of T5 which was used extensively by livestock.

There was 1 cobble/gravel riffles in the sample zone found at T5 that was more prominent under the lower flow regime than observed in June 2009.

Pool depths exceeded 1.50 m between T3 and T4.

Two common carp were collected, inspected and released:

<u>20' Seine</u>

Common carp 2 8", 10"

Notes

<u>Channel Flow Status</u>:
High-Water reaches the base of both lower banks; <5% of channel exposed
Moderate-Water fills >75% of channel or <25% channel substrate exposure
Low-Water fills 25-75% of available channel a/o riffle mostly exposed
No Flow-Very little water in channel and mostly present in standing pools; DRY

<u>Stream Cover Types</u>
Large/small woody debris/snags, filamentous algae, aquatic macrophytes, cobble, in-channel live trees or roots, undercut banks, overhanging vegetation, artificial structures (concrete, asphalt, tires)

<u>Substrate Measurement</u>
Bedrock-Smooth or rough
Boulders-Large (LB) yard stick to car size; (SB) basketball to yard stick size
Cobbles (CB)-Tennis ball to basketball size
Gravel (coarse)-Marble to tennis ball size (GC)
(fine)-Ladybug to marble size (GF)
Sand (SA)-Smaller than ladybug but visible
Fines (FN)-Silt Clay Muck
Wood – regardless of size
Concrete – regardless of size

<u>Substrate Stability</u>:
Stable - >50% gravel or larger substrate; gravel, cobble, boulders
Mod. Stable – 30-50% gravel or larger substrate; dominant is mix of gravel w/ finer sediments
Mod. Unstable – 10-29.9% gravel or larger; dominant size finer than gravel but w/ an mix of sizes
Unstable - <10% gravel or larger; substrate uniform sand, silt clay or bedrock

<u>Dimensions of Largest Pool</u>
Large-More than 50% coverage of channel width; depth > 1 meter
Moderate-50% or slightly less coverage; max. depth is 0.5-1 meter
Small-Approximately 25% coverage of channel; max. depth < 0.5 meters
Absent-No existing pools; only shallow auxiliary pockets

<u>Human Influence</u>
Walls, dikes, revetments, riprap and dams.
Buildings;
Pavement/cleared lot (paved, graveled, dirt parking lot, foundation
Roads or railroads
Inlet or outlet pipes
Landfills or trash
Parks or maintained lawns
Row Crops
Pastures, rangeland, hay fields, or evidence of livestock
Logging
Mining (including gravel mining)

<u>Hydromorphological Units</u>
Pool – Deep water impounded by a channel blockage or partial channel obstruction. Slow velocities with a concave streambed shape.
Riffle – Shallow stream reach with moderate current velocity, some surface turbulence, high gradient, and convex streambed morphology.
Run – Deeper stream reach with moderate current velocity, but no surface turbulence (laminar flow). Streambed is longitudinally flat and laterally concave.
Glide – Moderately shallow stream channel with laminar flow. Lacks pronounced turbulence, and exhibits flat streambed morphology.

Worksheet #
NFDMFBR-02b

Table D1-6 Stream Physical Characteristics Worksheet Part I – (cont'd)

Page 2 of 6

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.60 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 2 North Fork Double Mountain Fork Brazos River Transect 1	5.20	63	30	0.21	0.24	0.51	0.50	0.56	0.59	0.60	0.49	0.31	0.22	0.10	56	25	Total	98

Habitat type (circle one) **Riffle** [✓ **Run**] **Glide** **Pool**	Dominant substrate type CLAY w/ thin layer of silt		Dominant types riparian vegetation: **Left bank: 100% Grasses** Sunflower; golden rod **Right bank: 50% Trees; 0% Shrubs; 50% Grasses** Black willow, sunflower, golden rod	% Gravel or larger 0	CL 100 CR 94
Macrophytes (circle one) **Abundant** **Common** **Rare** [✓ **Absent**]	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Width of natural buffer vegetation (m) LB: <5 RB: <5	Instream cover types: Overhanging vegetation; emergent and submergent woody debris	% Instream cover 20	LB 100 RB 100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.34 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 2 North Fork Double Mountain Fork Brazos River Transect 2	5.35	66	25	0.27	0.28	0.25	0.33	0.33	0.34	0.34	0.25	0.18	0.09	0.06	62	45	Total	75

Habitat type (circle one) **Riffle** [✓ **Run**] **Glide** **Pool**	Dominant substrate type CLAY w/ thin layer of silt		Dominant types riparian vegetation: **Left bank: 100% Grasses** Fox tail, bermudagrass, sunflower, golden rod **Right bank: 90% Trees; 0% Grasses; 10% Barren Scour Area** Salt cedar, sunflower, bermudagrass, goldenrod	% Gravel or larger 10	CL 100 CR 100
Macrophytes (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Algae (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Width of natural buffer vegetation (m) LB: <5 RB: 5	Instream cover types: FLOOD WATERS HERE; WOODY DEBRIS Overhanging vegetation; cut banks; emergent and submergent woody debris; root wads	% Instream cover 45	LB 0 RB 100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.91 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 2 North Fork Double Mountain Fork Brazos River Transect 3	5.30	73	50	0.43	0.61	0.75	0.79	0.91	0.70	0.45	0.43	0.38	0.25	0.15	40	40	Total	75

Habitat type (circle one) **Riffle** [✓ **Run**] **Glide** **Pool**	Dominant substrate type CLAY w/ thin layer of silt and sand		Dominant types riparian vegetation: **Left bank: 25% Trees; 25% Shrubs; 30% Grasses; 20% Exposed Roots** American elm, sunflower, bermudagrass **Right bank: 45% Trees; 0% Shrubs; 40% Grasses; 15% Barren** Black willow, goldenrod, sunflower, bermudagrass	% Gravel or larger 10	CL 100 CR 100
Macrophytes (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Width of natural buffer vegetation (m) LB: <5 RB: 10	Instream cover types: Overhanging vegetation; cut banks; exposed tree roots; emergent and submergent woody debris	% Instream cover 25	LB 100 RB 0

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Worksheet # NFDMFBR-02b

Table D1-6 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect Station 2 North Fork Double Mountain Fork Brazos River Transect 4	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.53 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
	4.87	70	20	0.20	0.34	0.50	0.53	0.45	0.44	0.44	0.31	0.25	0.25	0.24	56	15	Total	42
	Habitat type (circle one) **Riffle** [✓ **Run**] **Glide** **Pool**		Dominant substrate type CLAY w/ thin layer of silt			Dominant types riparian vegetation: **Left bank: 100% Grasses** Sunflower, golden rod, sumpweed **Right bank: 30% Trees; 30% Shrubs; 40% Grasses** Black willow, sunflower, golden rod, sumpweed										% Gravel or larger 5	CL	64
																	CR	0
Macrophytes (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Algae (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**		Width of natural buffer vegetation		Instream cover types: Overhanging vegetation; cut banks; root wads											% Instream cover 10	LB	5
			LB: 5	RB: 10													RB	100
Location of transect Station 2 North Fork Double Mountain Fork Brazos River Transect 5	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.18 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
	6.05	33	45	0.08	0.10	0.10	0.11	0.12	0.14	0.14	0.13	0.14	0.15	0.11	37	35	Total	4
	Habitat type (Circle One) [✓ **Riffle**] **Run** **Glide** **Pool**		Dominant substrate type GRAVEL			Dominant types riparian vegetation: **Left bank: 15% Trees; 0% Shrubs; 35% Grasses: 50% Barren** Black willow, sunflower, bermudagrass cocklebur **Right bank: 0% Trees; 30% Shrubs; 50% Grasses; 20% Barren** Same as left bank vegetation										% Gravel or larger 100	CL	0
																	CR	0
Macrophytes (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Algae (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**		Width of natural buffer vegetation		Instream cover types: Overhanging vegetation; cut banks; exposed tree roots.											% Instream cover 15	LB	0
			LB: 5	RB: 5													RB	17

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Table D1-6 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Worksheet # NFDMFBR-02b
Habitat Assessment Worksheet B Part II of III

Part II - Summary of Physical Characteristics of Water Body

Using information from all of the transects and measurements in Part I and other sources, report the following general characteristics or averages for the entire reach:

Stream Name	Station 2 – NFDMFBR at the Lower Crossing on V8 Ranch	**Date**	22 September 2009

Physical Characteristics	**Value**
Stream bed slope over evaluated reach (from USGS map; elevation change in meters/reach length in meters)	0.0457
Approximate drainage area above the transect furthest downstream (from USGS or county highway map in km^2)	9905.9
Stream order	3rd
Length of stream evaluated (in meters or kilometers)	300 meters
Number of lateral transects made	5
Average stream width (in meters)	5.35
Average stream depth (in meters)	0.44
Instantaneous stream flow (in ft^3/sec)	6.40
Indicate flow measurement method	Marsh-McBirney
Channel flow status (high, moderate, low, or no flow)	High
Maximum pool width (in meters)	7.00
Maximum pool depth (in meters)	1.50
Total number of stream bends	6
Number of well defined bends	2
Number of moderately defined bends	0
Number of poorly defined bends	4
Total number of riffles	1
Dominant substrate type	Clay
Average percent of substrate gravel sized or larger	25.0
Average percent instream cover	23.0
Number of stream cover types	5
Average percent stream bank erosion potential	33.0
Average stream bank slope (in degrees)	56.0
Average width of natural buffer vegetation (in meters)	5.0
Average riparian vegetation percent composition by: (total to equal 100%)	
Trees	25.5
Shrubs	8.5
Grasses and Forbes	54.5
Cultivated fields	0.0
Other	11.5
Average percent tree canopy coverage	59.0
Overall aesthetic appraisal of the stream	Common

Table D1-6 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring
Habitat Assessment Worksheet B Part III of III (NFDMFBR-02b)
Station 2 – North Fork Double Mountain Fork Brazos River at the Upper Crossing on the V8 Ranch
Part III - Habitat Quality Index, 22 September 2009

Habitat Parameter	**Scoring Category**			
Available Instream Cover	**Abundant** >50% of substrate favorable for colonization and fish cover; good mix of several stable (not new fall or transient) cover types such as snags, cobble, undercut banks, macrophytes	**Common** 30-50% of substrate supports stable habitat; adequate habitat for maintenance of populations; may be limited in the number of different habitat types	**Rare** 10-29.9% of substrate supports stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	**Absent** <10% of substrate supports stable habitat; lack of habitat is obvious; substrate unstable or lacking
Score 2	4	3	2	1
Bottom Substrate Stability	**Stable** >50% gravel or larger substrate; gravel, cobble, boulders; dominant substrate type is gravel or larger	**Moderately Stable** 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments	**Moderately Unstable** 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a mix of sizes	**Unstable** <10% gravel or larger substrate; substrate is uniform sand, silt, clay or bedrock
Score 2	4	3	2	1
Number of Riffles To be counted, riffles must extend >50% the width of the channel and be at least as long as the channel width	**Abundant** ≥ 5 riffles	**Common** 2-4 riffles	**Rare** 1 riffle	**Absent** No riffles
Score 2	4	3	2	1
Dimensions of Largest Pool	**Large** Pool covers more than 50% of the channel width; maximum depth is >1 meter	**Moderate** Pool covers approximately 50% or slightly less of the channel width; maximum depth is 0.5-1 meter	**Small** Pool covers approximately 25% of the channel width; maximum depth is <0.5 meter	**Absent** No existing pools; only shallow auxiliary pockets
Score 4	4	3	2	1
Channel Flow Status	**High** Water reaches the base of both lower banks; < 5% of channel substrate is exposed	**Moderate** Water fills >75% of the channel; or <25% of channel substrate is exposed	**Low** Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	**No Flow** Very little water in the channel and mostly present in standing pools; or stream is dry
Score 3	3	2	1	0

Table D1-6 (concluded)
Worksheet # NFDMFBR-02b
Station 2 – North Fork Double Mountain Fork Brazos River at the Upper Crossing on the V8 Ranch
Part III - Habitat Quality Index, 22 September 2009 (concluded)

Habitat Parameter	**Scoring Category**			
Bank Stability	**Stable** Little evidence (<10%) of erosion or bank failure; bank angles average <30°	**Moderately Stable** Some evidence (10-29.9%) of erosion or bank failure; small areas of erosion mostly healed over; bank angles average 30-39.9°	**Moderately Unstable** Evidence of erosion or bank failure is common (30-50%); high potential of erosion during flooding; bank angles average 40-60°	**Unstable** Large and frequent evidence (>50%) of erosion or bank failure; raw areas frequent along steep banks; bank angles average >60°
Score 1	3	2	1	0
Channel Sinuosity	**High** ≥ 2 well-defined bends with deep outside areas (cut banks) and shallow inside areas (point bars) present	**Moderate** 1 well-defined bend or ≥ 3 moderately-defined bends present	**Low** <3 moderately-defined bends or only poorly-defined bends present	**None** Straight channel; may be channelized
Score 3	3	2	1	0
Riparian Buffer Vegetation	**Extensive** Width of natural buffer is >20 meters	**Wide** Width of natural buffer is 10.1-20 meters	**Moderate** Width of natural buffer is 5-10 meters	**Narrow** Width of natural buffer is <5 meters
Score 1	3	2	1	0
Aesthetics of Reach	**Wilderness** Outstanding natural beauty; usually wooded or unpastured area; water clarity is usually exceptional	**Natural Area** Trees and/or native vegetation are common; some development evident (from fields, pastures, dwellings); water clarity may be slightly turbid	**Common Setting** Not offensive; area is developed, but uncluttered such as in an urban park; water clarity may be turbid or discolored	**Offensive** Stream does not enhance the aesthetics of the area; cluttered; highly developed; may be a dumping area; water clarity is usually turbid or discolored
Score 1	3	2	1	0

Total Score 19.0

HABITAT QUALITY INDEX

26 - 31 **Exceptional**
20 - 25 **High**
14 - 19 **Intermediate**
≤ 13 **Limited**

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TABLE D1-7
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Habitat Assessment Worksheet B Part I of III

Worksheet # NFDMFBR-03b	**Part I - Stream Physical Characteristics Worksheet**	**Page 1 of 6**

Observers: DJT | Date: 23 September 2009 | Time: 09:41 – 10:34

Weather conditions: Ptly cldy; 20% cloud cover; cool, calm, 48° F

Stream: North Fork Double Mountain Fork Brazos River | Stream segment no. 1241A

Location of site: Station 3 at the Middle Crossing on the V8 Ranch | Length of reach: 300 meters

Observed stream uses: Wildlife; surface runoff

Stream type (circle one): [✓ **perennial**] or **intermittent w/ perennial pools**

Stream bends: 9	No. well defined 6	No. moderately defined 2	No. poorly defined 1

Aesthetics (circle one): **(1) wilderness** **(2) natural** **(3)** [✓ **common**] **(4)** [✓ **offensive**]

Channel obstructions or modifications: Gravel road crossing; telephone pole | No. of riffles: 2

Channel flow status (circle one): [✓ **high**] **moderate** **low** **no flow**

Riparian vegetation (%):	**Left Bank**	**Right Bank**
Trees	8.0	1.0
Shrubs	3.0	5.0
Grasses or forbs	89.0	88.0
Cultivated fields	0.0	0.0
Other	0.0	6.0

Observations:

Scattered localized rain fell in the area in the early morning hours of 22 September 2009 prior to sampling, but not enough rain fell in the study area to affect flow conditions of the project area. The survey area is located at the middle river crossing located on private property. The river at this location did not have a developed riparian border, although some shading was provided over the river at various times of the day. Bank vegetation was composed mostly of mesquite, common sunflower and bermudagrass.

Transect Photo Sequence: US, DS, RB, LB.

Sampling order consisted of water chemistry, flow measurement, habitat evaluation, and biological collections at 3.01 cfs much lower than 14.56 cfs recorded on 23 June 2009. A 20' seine was used entirely at this station between the alternating run and pool habitats that dominated the sample zone. Deep pool habitat was more common DS of the river crossing especially at creek bends where most of the meanders were located.

There were a total of 2 cobble/gravel riffles in the sample zone; found between T1/T2 and at T3 that were more prominent under the lower flow regime than observed in June 2009.

Pool depths exceeded 1.75 m between T3 and T4.

Five assorted-sized individuals of fish were collected, inspected and released:

<u>20' Seine</u>

Common carp	2	24", 8"
Black bullhead	1	12"
White crappie	2	both 8"

Notes

<u>Channel Flow Status</u>:
High-Water reaches the base of both lower banks; <5% of channel exposed
Moderate-Water fills >75% of channel or <25% channel substrate exposure
Low-Water fills 25-75% of available channel a/o riffle mostly exposed
No Flow-Very little water in channel and mostly present in standing pools; DRY

<u>Stream Cover Types</u>
Large/small woody debris/snags, filamentous algae, aquatic macrophytes, cobble, in-channel live trees or roots, undercut banks, overhanging vegetation, artificial structures (concrete, asphalt, tires)

<u>Substrate Measurement</u>
Bedrock-Smooth or rough
Boulders-Large (LB) yard stick to car size; (SB) basketball to yard stick size
Cobbles (CB)-Tennis ball to basketball size
Gravel (coarse)-Marble to tennis ball size (GC)
(fine)-Ladybug to marble size (GF)
Sand (SA)-Smaller than ladybug but visible
Fines (FN)-Silt Clay Muck
Wood – regardless of size
Concrete – regardless of size

<u>Substrate Stability</u>:
Stable - >50% gravel or larger substrate; gravel, cobble, boulders
Mod. Stable – 30-50% gravel or larger substrate; dominant is mix of gravel w/ finer sediments
Mod. Unstable – 10-29.9% gravel or larger; dominant size finer than gravel but w/ an mix of sizes
Unstable - <10% gravel or larger; substrate uniform sand, silt clay or bedrock

<u>Dimensions of Largest Pool</u>
Large-More than 50% coverage of channel width; depth > 1 meter
Moderate-50% or slightly less coverage; max. depth is 0.5-1 meter
Small-Approximately 25% coverage of channel; max. depth < 0.5 meters
Absent-No existing pools; only shallow auxiliary pockets

<u>Human Influence</u>
Walls, dikes, revetments, riprap and dams.
Buildings;
Pavement/cleared lot (paved, graveled, dirt parking lot, foundation
Roads or railroads
Inlet or outlet pipes
Landfills or trash
Parks or maintained lawns
Row Crops
Pastures, rangeland, hay fields, or evidence of livestock
Logging
Mining (including gravel mining)

<u>Hydromorphological Units</u>
Pool – Deep water impounded by a channel blockage or partial channel obstruction. Slow velocities with a concave streambed shape.
Riffle – Shallow stream reach with moderate current velocity, some surface turbulence, high gradient, and convex streambed morphology.
Run – Deeper stream reach with moderate current velocity, but no surface turbulence (laminar flow). Streambed is longitudinally flat and laterally concave.
Glide – Moderately shallow stream channel with laminar flow. Lacks pronounced turbulence, and exhibits flat streambed morphology.

Table D1-7 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.55 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 3 North Fork Double Mountain Fork Brazos River Transect 1	5.35	10	25	0.19	0.30	0.46	0.47	0.55	0.54	0.53	0.51	0.49	0.37	0.20	53	20	Total	57

	Habitat type (circle one) **Riffle** **Run** **Glide** [✓ **Pool**]	Dominant substrate type CLAY	Dominant types riparian vegetation: **Left bank: 100% Grasses** Sunflower, goldenrod, sumpweed, bermudagras, switchgrass **Right bank: 25 % Sapling; 75% Grasses** American elm, black willow, sunflower, goldenrod,	% Gravel or larger 5	CL	100
					CR	0
Macrophytes (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Algae (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Width of natural buffer vegetation (m) LB: 20 RB: 20	Instream cover types: Overhanging vegetation; cut banks; exposed roots	% Instream cover 20	LB	29
					RB	100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.77 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 3 North Fork Double Mountain Fork Brazos River Transect 2	8.91	65	45	0.18	0.41	0.53	0.54	0.59	0.65	0.69	0.77	0.68	0.49	0.34	58	35	Total	44

	Habitat type (Circle One) **Riffle** **Run** **Glide** [✓ **Pool**]	Dominant substrate type CLAY	Dominant types riparian vegetation: **Left bank: 30% Trees; 10% Shrubs; 60% Grasses** American elm; sunflower, golden rod **Right bank: 100% Grasses** Sunflower, goldenrod, switchgrass, nightshade,	% Gravel or larger 40	CL	29
					CR	47
Macrophytes (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Algae (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Width of natural buffer vegetation (m) LB: <5 RB: <5	Instream cover types: Overhanging vegetation; cut banks; exposed roots	% Instream cover 20	LB	100
					RB	0

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.23 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 3 North Fork Double Mountain Fork Brazos River Transect 3	4.35	53	5	0.09	0.11	0.13	0.13	0.15	0.19	0.20	0.17	0.17	0.19	0.20	67	40	Total	0

	Habitat type (circle one) [✓ **Riffle**] **Run** **Glide** **Pool**	Dominant substrate type GRAVEL	Dominant types riparian vegetation: **Left bank: 5% Saplings; 95% Grasses** Saltcedar, sunflower, switchgrass, goldenrod, purple aster, **Right bank: 5% Saplings; 65% Grasses; 30% Barren** Same as left bank vegetation	% Gravel or larger 100	CL	0
					CR	0
Macrophytes (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Algae (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Width of natural buffer vegetation (m) LB: 5 RB: 5	Instream cover types: Overhanging vegetation; cut banks; root wads: rock	% Instream cover 25	LB	0
					RB	0

Table D1-7 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.46 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 3 North Fork Double Mountain Fork Brazos River Transect 4	5.15	72	10	0.27	0.41	0.40	0.46	0. 45	0.44	0.43	0.41	0.39	0.40	0.13	59	10	Total	0

Habitat type (circle one) **Riffle** **Run** **Glide** [✓ **Pool**]	Dominant substrate type CLAY		Dominant types riparian vegetation: **Left bank: 100% Grasses** Sunflower, switchgrass, goldenrod, purple aster, buffalobur, sumpweed **Right bank: 100% Grasses** Sunflower, switchgrass, goldenrod, purple aster, buffalobur, sumpweed	% Gravel or larger 5	CL CR	0 0
Macrophytes (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Algae (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Width of natural buffer vegetation ( ) LB: 5 RB: 5	Instream cover types: Overhanging vegetation; emergent vegetation (sedges)	% Instream cover 5	LB RB	0 0

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.48 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 3 North Fork Double Mountain Fork Brazos River Transect 5	4.10	35	0	0.36	0.48	0.37	0.25	0.23	0.24	0.19	0.13	0.15	0.15	0.09	63	20	Total	0

Habitat type (Circle One) **Riffle** [✓ **Run**] **Glide** **Pool**	Dominant substrate type CLAY		Dominant types riparian vegetation: **Left bank: 10% Trees; 90% Grasses** Salt cedar, sunflower, golden rod, buffalobur, bermudagrass **Right bank: 100% Grasses** Sunflower, golden rod, sumpweed, buffalobur, bermudagrass	% Gravel or larger 35	CL CR	0 0
Macrophytes (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Algae (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Width of natural buffer vegetation ( ) LB: 5 RB: 5	Instream cover types: Overhanging vegetation; cut banks; large rock.	% Instream cover 10	LB RB	0 0

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Table D1-7 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Worksheet # NFDMFBR-03b
Habitat Assessment Worksheet B Part II of III

Part II - Summary of Physical Characteristics of Water Body

Using information from all of the transects and measurements in Part I and other sources, report the following general characteristics or averages for the entire reach:

Stream Name	Station 3 – NFDMFBR at the Middle Crossing on V8 Ranch	**Date**	23 September 2009

Physical Characteristics	**Value**
Stream bed slope over evaluated reach (from USGS map; elevation change in meters/reach length in meters)	0.0000
Approximate drainage area above the transect furthest downstream (from USGS or county highway map in km^2)	9944.5
Stream order	3rd
Length of stream evaluated (in meters or kilometers)	300 meters
Number of lateral transects made	5
Average stream width (in meters)	5.57
Average stream depth (in meters)	0.35
Instantaneous stream flow (in ft^3/sec)	3.01
Indicate flow measurement method	Marsh-McBirney
Channel flow status (high, moderate, low, or no flow)	High
Maximum pool width (in meters)	9.30
Maximum pool depth (in meters)	1.82
Total number of stream bends	9
Number of well defined bends	6
Number of moderately defined bends	2
Number of poorly defined bends	1
Total number of riffles	2
Dominant substrate type	Clay
Average percent of substrate gravel sized or larger	37.0
Average percent instream cover	16.0
Number of stream cover types	6
Average percent stream bank erosion potential	21.0
Average stream bank slope (in degrees)	54.0
Average width of natural buffer vegetation (in meters)	8.0
Average riparian vegetation percent composition by: (total to equal 100%)	
Trees	4.5
Shrubs	4.0
Grasses and Forbes	88.5
Cultivated fields	0.0
Other	3.0
Average percent tree canopy coverage	20.0
Overall aesthetic appraisal of the stream	Common

Table D1-7 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring
Habitat Assessment Worksheet B Part III of III (NFDMFBR-03b)
Station 3 – North Fork Double Mountain Fork Brazos River at the Middle Crossing on the V8 Ranch
Part III - Habitat Quality Index, 23 September 2009

Habitat Parameter	**Scoring Category**			
Available Instream Cover	**Abundant** >50% of substrate favorable for colonization and fish cover; good mix of several stable (not new fall or transient) cover types such as snags, cobble, undercut banks, macrophytes	**Common** 30-50% of substrate supports stable habitat; adequate habitat for maintenance of populations; may be limited in the number of different habitat types	[✓ **Rare** 10-29.9% of substrate supports stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed]	**Absent** <10% of substrate supports stable habitat; lack of habitat is obvious; substrate unstable or lacking
Score ___2___	4	3	2	1
Bottom Substrate Stability	**Stable** >50% gravel or larger substrate; gravel, cobble, boulders; dominant substrate type is gravel or larger	[✓ **Moderately Stable** 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments]	**Moderately Unstable** 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a mix of sizes	**Unstable** <10% gravel or larger substrate; substrate is uniform sand, silt, clay or bedrock
Score ___3___	4	3	2	1
Number of Riffles To be counted, riffles must extend >50% the width of the channel and be at least as long as the channel width	**Abundant** ≥ 5 riffles	[✓ **Common** 2-4 riffles]	**Rare** 1 riffle	**Absent** No riffles
Score ___3___	4	3	2	1
Dimensions of Largest Pool	[✓ **Large** Pool covers more than 50% of the channel width; maximum depth is >1 meter]	**Moderate** Pool covers approximately 50% or slightly less of the channel width; maximum depth is 0.5-1 meter	**Small** Pool covers approximately 25% of the channel width; maximum depth is <0.5 meter	**Absent** No existing pools; only shallow auxiliary pockets
Score ___4___	4	3	2	1
Channel Flow Status	[✓ **High** Water reaches the base of both lower banks; < 5% of channel substrate is exposed]	**Moderate** Water fills >75% of the channel; or <25% of channel substrate is exposed	**Low** Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	**No Flow** Very little water in the channel and mostly present in standing pools; or stream is dry
Score ___3___	3	2	1	0

Table D1-7 (concluded)
Worksheet # NFDMFBR-03b
Station 3 – North Fork Double Mountain Fork Brazos River at the Middle Crossing on the V8 Ranch
Part III - Habitat Quality Index, 23 September 2009 (concluded)

Habitat Parameter	**Scoring Category**			
Bank Stability	**Stable** Little evidence (<10%) of erosion or bank failure; bank angles average <30°	**Moderately Stable** Some evidence (10-29.9%) of erosion or bank failure; small areas of erosion mostly healed over; bank angles average 30-39.9°	**Moderately Unstable** Evidence of erosion or bank failure is common (30-50%); high potential of erosion during flooding; bank angles average 40-60°	**Unstable** Large and frequent evidence (>50%) of erosion or bank failure; raw areas frequent along steep banks; bank angles average >60°
Score 1.5	3	2	1	0
Channel Sinuosity	**High** ≥ 2 well-defined bends with deep outside areas (cut banks) and shallow inside areas (point bars) present	**Moderate** 1 well-defined bend or ≥ 3 moderately-defined bends present	**Low** <3 moderately-defined bends or only poorly-defined bends present	**None** Straight channel; may be channelized
Score 3	3	2	1	0
Riparian Buffer Vegetation	**Extensive** Width of natural buffer is >20 meters	**Wide** Width of natural buffer is 10.1-20 meters	**Moderate** Width of natural buffer is 5-10 meters	**Narrow** Width of natural buffer is <5 meters
Score 1	3	2	1	0
Aesthetics of Reach	**Wilderness** Outstanding natural beauty; usually wooded or unpastured area; water clarity is usually exceptional	**Natural Area** Trees and/or native vegetation are common; some development evident (from fields, pastures, dwellings); water clarity may be slightly turbid	**Common Setting** Not offensive; area is developed, but uncluttered such as in an urban park; water clarity may be turbid or discolored	**Offensive** Stream does not enhance the aesthetics of the area; cluttered; highly developed; may be a dumping area; water clarity is usually turbid or discolored
Score 1	3	2	1	0

Total Score 21.5

HABITAT QUALITY INDEX

26 - 31 **Exceptional**
20 - 25 **High**
14 - 19 **Intermediate**
≤ 13 **Limited**

TABLE D1-8
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Habitat Assessment Worksheet B Part I of III

Worksheet # NFDMFBR-04b	**Part I - Stream Physical Characteristics Worksheet**	**Page 1 of 6**

Observers: DJT

Date: 23 September 2009

Time: 14: 01 – 15:03

Weather conditions: Clear, sunny, calm, cool becoming warmer 70° F

Stream: North Fork Double Mountain Fork Brazos River

Stream segment no. 1241A

Location of site: Station 4 at the Lower Crossing on the V8 Ranch

Length of reach: 300 meters

Observed stream uses: Wildlife; surface runoff

Stream type (circle one): [✓ **perennial**] or **intermittent w/ perennial pools**

Stream bends: 6	No. well defined 2	No. moderately defined 1	No. poorly defined 3

Aesthetics (circle one): **(1) wilderness** **(2) natural** **(3)** [✓ **common**] **(4) offensive**

Channel obstructions or modifications: 2 concrete encased 5-ft diameter culverts

No. of riffles: 2

Channel flow status (circle one): [✓ **high**] **moderate** **low** **no flow**

Riparian vegetation (%):	**Left Bank**	**Right Bank**
Trees	13.0	47.0
Shrubs	12.0	12.0
Grasses or forbs	64.0	27.0
Cultivated fields	0.0	0.0
Other	11.0	14.0

Observations:

Scattered localized rain fell in the area in the early morning hours of 22 September 2009 prior to sampling, but not enough rain fell in the study area to affect flow conditions of the project area. The survey area is located at the lower river crossing located near a large home on private property and the proposed centerline of the dam structure. The river at this location exhibited a developed riparian border, but only provides shading at various times of the day. Vegetation composed mostly of American elm, ragweed, switchgrass and wildrye.

Transect Photo Sequence: US, DS, RB, LB.

Sampling order consisted of water chemistry, flow measurement, habitat evaluation, and biological collections at 4.22 cfs lower than 15.73 cfs recorded on 6-23-09 at. A 20' seine was used entirely at this station. Several hauls were made in the deeper standing pool areas at T1 and T2. A concrete bridge was recently constructed over the river to access property to the south. Water from the deep pool habitat passed through 2 side by side 6' diameter culverts. A small quiet pool was adjacent swift current emerging from each culvert to the downstream reach. Downstream habitat consisted of narrow run areas until the river widened and deepened ~35' US of T5.

There were a total of 2 cobble/gravel riffles in the sample zone found at T3 and near T4 that that were more prominent under the lower flow regime than observed in June 2009.

Pool depths exceeded 2.00 m along the left bank between T1 and immediately DS of T2 and again between T4 and T5.

Several individuals of fish were collected, inspected and released:

20' Seine

Gizzard shad	1	14"
Common carp	25	All 6-7"
Black bullhead	3	All 6"
Bluegill	10	All 3-4"

Notes

Channel Flow Status:
High-Water reaches the base of both lower banks; <5% of channel exposed
Moderate-Water fills >75% of channel or <25% channel substrate exposure
Low-Water fills 25-75% of available channel a/o riffle mostly exposed
No Flow-Very little water in channel and mostly present in standing pools; DRY

Stream Cover Types
Large/small woody debris/snags, filamentous algae, aquatic macrophytes, cobble, in-channel live trees or roots, undercut banks, overhanging vegetation, artificial structures (concrete, asphalt, tires)

Substrate Measurement
Bedrock-Smooth or rough
Boulders-Large (LB) yard stick to car size; (SB) basketball to yard stick size
Cobbles (CB)-Tennis ball to basketball size
Gravel (coarse)-Marble to tennis ball size (GC)
(fine)-Ladybug to marble size (GF)
Sand (SA)-Smaller than ladybug but visible
Fines (FN)-Silt Clay Muck
Wood – regardless of size
Concrete – regardless of size

Substrate Stability:
Stable - >50% gravel or larger substrate; gravel, cobble, boulders
Mod. Stable – 30-50% gravel or larger substrate; dominant is mix of gravel w/ finer sediments
Mod. Unstable – 10-29.9% gravel or larger; dominant size finer than gravel but w/ an mix of sizes
Unstable - <10% gravel or larger; substrate uniform sand, silt clay or bedrock

Dimensions of Largest Pool
Large-More than 50% coverage of channel width; depth > 1 meter
Moderate-50% or slightly less coverage; max. depth is 0.5-1 meter
Small-Approximately 25% coverage of channel; max. depth < 0.5 meters
Absent-No existing pools; only shallow auxiliary pockets

Human Influence
Walls, dikes, revetments, riprap and dams.
Buildings;
Pavement/cleared lot (paved, graveled, dirt parking lot, foundation
Roads or railroads
Inlet or outlet pipes
Landfills or trash
Parks or maintained lawns
Row Crops
Pastures, rangeland, hay fields, or evidence of livestock
Logging
Mining (including gravel mining)

Hydromorphological Units
Pool – Deep water impounded by a channel blockage or partial channel obstruction. Slow velocities with a concave streambed shape.
Riffle – Shallow stream reach with moderate current velocity, some surface turbulence, high gradient, and convex streambed morphology.
Run – Deeper stream reach with moderate current velocity, but no surface turbulence (laminar flow). Streambed is longitudinally flat and laterally concave.
Glide – Moderately shallow stream channel with laminar flow. Lacks pronounced turbulence, and exhibits flat streambed morphology.

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Worksheet #
NFDMFBR-04b

Table D1-8 Stream Physical Characteristics Worksheet Part I – (cont'd)

Page 2 of 6

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 1.30 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 4 North Fork Double Mountain Fork Brazos River Transect 1	11.75	51	10	0.58	1.05	1.21	1.30	1.30	1.20	1.15	1.05	0.90	0.67	0.48	32	10	Total	48

Habitat type (circle one) **Riffle** **Run** **Glide** [✓ **Pool**]	Dominant substrate type CLAY w/ layer of silt ***Centerline of proposed dam ~15' DS**	Dominant types riparian vegetation: **Left bank: 5% Trees; 0% Shrubs; 90% Grasses; 5% barren** Black willow, American elm, sunflower, ragweed, poverty weed **Right bank: 75% Trees; 0% Shrubs; 20% Grasses; 5% barren** Black willow, American elm, switchgrass, Johnsongrass, goldenrod	% Gravel or larger 0	CL CR	82 11
Macrophytes (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Algae (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Width of natural buffer vegetation (m) LB: >20 RB: >20	Instream cover types: Overhanging vegetation; cut banks; emergent and submergent woody debris; root wads	% Instream cover 25	LB 0 RB 100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 1.21 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 4 North Fork Double Mountain Fork Brazos River Transect 2	9.39	64	5	0.34	0.55	0.60	0.79	0.78	1.21	0.64	0.39	0.35	0.29	0.14	27	10	Total	59

Habitat type (Circle One) **Riffle** **Run** **Glide** [✓ **Pool**]	Dominant substrate type CLAY	Dominant types riparian vegetation: **Left bank: 0% Trees; 45% Shrubs; 55% Grasses; 0% Barren** Black willow, sunflower, goldenrod, ragweed, cocklebur, poverty weed **Right bank: 60% Trees; 10% Shrubs; 30% Grasses** American elm, goldenrod, sumpweed, cocklebur, goldenrod	% Gravel or larger 0	CL CR	100 11
Macrophytes (circle one) [✓ **Abundant**] **Common** **Rare** **Absent**	Algae (circle one) **Abundant** [✓ **Common**] **Rare** **Absent**	Width of natural buffer vegetation (m) LB: >20 RB: >20	Instream cover types: Overhanging vegetation; cut banks	% Instream cover 15	LB 35 RB 88

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.35 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 4 North Fork Double Mountain Fork Brazos River Transect 3	2.31	67	35	0.25	0.27	0.35	0.29	0.25	0.20	0. 19	0.13	0.09	0.05	0.01	13	20	Total	37

Habitat type (circle one) [✓ **Riffle**] **Run** **Glide** **Pool**	Dominant substrate type GRAVEL	Dominant types riparian vegetation: **Left bank: 5% Trees; 0% Shrubs; 80% Grasses; 15% Barren** American elm, cottonwood, goldenrod, ragweed **Right bank: 35% Trees; 40% Shrubs; 25% Gravel** Cottonwood, black willow	% Gravel or larger 100	CL CR	47 24
Macrophytes (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Width of natural buffer vegetation (m) LB: 5 RB: >20	Instream cover types: Overhanging vegetation; cut banks; exposed tree roots; root wads	% Instream cover 20	LB 35 RB 53

Worksheet #

NFDMFBR-04b

Table D1-8 Stream Physical Characteristics Worksheet Part I – (cont'd)

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.60 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 4 North Fork Double Mountain Fork Brazos River Transect 4	2.63	30	10	0.21	0.32	0.33	0.50	0.55	0.60	0.37	0.21	0.10	0.09	0.12	55	15	Total	100

Habitat type (circle one) **Riffle** [✓ **Run**] **Glide** **Pool**	Dominant substrate type GRAVEL **SCOUR AREA**	Dominant types riparian vegetation: **Left bank: 10% Trees; 5% Shrubs; 60% Grasses; 25% Barren** American elm, switchgrass, ragweed **Right bank: 40% Trees; 0% Shrubs; 30% Grasses; 30% Barren** American elm, ragweed, wildrye, bermudagrass	% Gravel or larger 95	CL	100
				CR	100

Macrophytes (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Width of natural buffer vegetation (m) LB: 10	RB: >20	Instream cover types: Overhanging vegetation; cut banks; exposed tree roots	% Instream cover 25	LB 100 RB 100

Location of transect	Stream width (m)	Left bank slope ( )	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.90 m											Right bank slope ( )	Right bank erosion potential (%)	Tree canopy (%)	
Station 4 North Fork Double Mountain Fork Brazos River Transect 5	8.80	35	0	0.35	0.45	0.53	0.67	0.73	0.75	0.80	0.90	0.85	0.63	0.41	39	10	Total	100

Habitat type (Circle One) **Riffle** **Run** **Glide** [✓ **Pool**]	Dominant substrate type Fine SAND SCOUR AREA – SEDIMENT STAINED	Dominant types riparian vegetation: **Left bank: 45% Trees; 10% Shrubs; 35% Grasses; 10% Barren** Black willow, ragweed, switchgrass **Right bank: 25% Trees; 10% Shrubs; 55% Grasses; 10% Barren** American elm, black willow, ragweed	% Gravel or larger 30	CL	100
				CR	100

Macrophytes (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Algae (circle one) **Abundant** **Common** [✓ **Rare**] **Absent**	Width of natural buffer vegetation ( ) LB: 10	RB: 5	Instream cover types: Overhanging vegetation; cut banks; emergent and submergent woody debris;	% Instream cover 35	LB 100 RB 100

TCEQ 20156-A (Rev. 4-14-2005)

Table D1-8 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Worksheet # NFDMFBR-04b
Habitat Assessment Worksheet B Part II of III

Part II - Summary of Physical Characteristics of Water Body

Using information from all of the transects and measurements in Part I and other sources, report the following general characteristics or averages for the entire reach:

Stream Name	Station 4 – NFDMFBR at the Lower Crossing on V8 Ranch	**Date**	23 September 2009

Physical Characteristics	**Value**
Stream bed slope over evaluated reach (from USGS map; elevation change in meters/reach length in meters)	0.0253
Approximate drainage area above the transect furthest downstream (from USGS or county highway map in km^2)	9953.8
Stream order	3rd
Length of stream evaluated (in meters or kilometers)	300 meters
Number of lateral transects made	5
Average stream width (in meters)	6.98
Average stream depth (in meters)	0.54
Instantaneous stream flow (in ft^3/sec)	4.22
Indicate flow measurement method	Marsh-McBirney
Channel flow status (high, moderate, low, or no flow)	High
Maximum pool width (in meters)	11.75
Maximum pool depth (in meters)	2.00
Total number of stream bends	6
Number of well defined bends	2
Number of moderately defined bends	1
Number of poorly defined bends	3
Total number of riffles	2
Dominant substrate type	Clay
Average percent of substrate gravel sized or larger	45.0
Average percent instream cover	24.0
Number of stream cover types	5
Average percent stream bank erosion potential	12.5
Average stream bank slope (in degrees)	41.0
Average width of natural buffer vegetation (in meters)	15.0
Average riparian vegetation percent composition by: (total to equal 100%)	
Trees	30.0
Shrubs	12.0
Grasses and Forbes	45.5
Cultivated fields	0.0
Other	12.5
Average percent tree canopy coverage	69.0
Overall aesthetic appraisal of the stream	Common

TCEQ-20156-B (Rev. 04-15-2004) Page 4 of 6

Table D1-8 (cont'd)
Texas Commission on Environmental Quality
Surface Water Quality Monitoring
Habitat Assessment Worksheet B Part III of III (NFDMFBR-04b)
Station 4 – North Fork Double Mountain Fork Brazos River at the Lower Crossing on the V8 Ranch
Part III - Habitat Quality Index, 23 September 2009

Habitat Parameter	**Scoring Category**			
Available Instream Cover	**Abundant** >50% of substrate favorable for colonization and fish cover; good mix of several stable (not new fall or transient) cover types such as snags, cobble, undercut banks, macrophytes	**Common** 30-50% of substrate supports stable habitat; adequate habitat for maintenance of populations; may be limited in the number of different habitat types	**Rare** 10-29.9% of substrate supports stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	**Absent** <10% of substrate supports stable habitat; lack of habitat is obvious; substrate unstable or lacking
Score 2	4	3	2	1
Bottom Substrate Stability	**Stable** >50% gravel or larger substrate; gravel, cobble, boulders; dominant substrate type is gravel or larger	**Moderately Stable** 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments	**Moderately Unstable** 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a mix of sizes	**Unstable** <10% gravel or larger substrate; substrate is uniform sand, silt, clay or bedrock
Score 3	4	3	2	1
Number of Riffles To be counted, riffles must extend >50% the width of the channel and be at least as long as the channel width	**Abundant** ≥ 5 riffles	**Common** 2-4 riffles	**Rare** 1 riffle	**Absent** No riffles
Score 3	4	3	2	1
Dimensions of Largest Pool	**Large** Pool covers more than 50% of the channel width; maximum depth is >1 meter	**Moderate** Pool covers approximately 50% or slightly less of the channel width; maximum depth is 0.5-1 meter	**Small** Pool covers approximately 25% of the channel width; maximum depth is <0.5 meter	**Absent** No existing pools; only shallow auxiliary pockets
Score 4	4	3	2	1
Channel Flow Status	**High** Water reaches the base of both lower banks; < 5% of channel substrate is exposed	**Moderate** Water fills >75% of the channel; or <25% of channel substrate is exposed	**Low** Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	**No Flow** Very little water in the channel and mostly present in standing pools; or stream is dry
Score 3	3	2	1	0

Table D1-8 (concluded)
Worksheet # NFDMFBR-04b
Station 4 – North Fork Double Mountain Fork Brazos River at the Lower Crossing on the V8 Ranch
Part III - Habitat Quality Index, 23 September 2009 (concluded)

Habitat Parameter	**Scoring Category**			
Bank Stability	**Stable** Little evidence (<10%) of erosion or bank failure; bank angles average <30°	**Moderately Stable** Some evidence (10-29.9%) of erosion or bank failure; small areas of erosion mostly healed over; bank angles average 30-39.9°	**Moderately Unstable** Evidence of erosion or bank failure is common (30-50%); high potential of erosion during flooding; bank angles average 40-60°	**Unstable** Large and frequent evidence (>50%) of erosion or bank failure; raw areas frequent along steep banks; bank angles average >60°
Score 1.5	3	2	1	0
Channel Sinuosity	**High** ≥ 2 well-defined bends with deep outside areas (cut banks) and shallow inside areas (point bars) present	**Moderate** 1 well-defined bend or ≥ 3 moderately-defined bends present	**Low** <3 moderately-defined bends or only poorly-defined bends present	**None** Straight channel; may be channelized
Score 3	3	2	1	0
Riparian Buffer Vegetation	**Extensive** Width of natural buffer is >20 meters	**Wide** Width of natural buffer is 10.1-20 meters	**Moderate** Width of natural buffer is 5-10 meters	**Narrow** Width of natural buffer is <5 meters
Score 2	3	2	1	0
Aesthetics of Reach	**Wilderness** Outstanding natural beauty; usually wooded or unpastured area; water clarity is usually exceptional	**Natural Area** Trees and/or native vegetation are common; some development evident (from fields, pastures, dwellings); water clarity may be slightly turbid	**Common Setting** Not offensive; area is developed, but uncluttered such as in an urban park; water clarity may be turbid or discolored	**Offensive** Stream does not enhance the aesthetics of the area; cluttered; highly developed; may be a dumping area; water clarity is usually turbid or discolored
Score 1	3	2	1	0

Total Score 22.5

HABITAT QUALITY INDEX

26 - 31 **Exceptional**
[✓ 20 - 25 **High**]
14 - 19 **Intermediate**
≤ 13 **Limited**

Attachment D2

Photographs of Aquatic Life Monitoring Locations

Station 1. Downstream View from Transect 1 on 24 June 2009

Station 1. Right Bank View from Transect 1 on 24 June 2009

Station 1. Left Bank View from Transect 1 on 24 June 2009

Station 1. Upstream View from Transect 2 on 24 June 2009

Station 1. Downstream View from Transect 2 on 24 June 2009

Station 1. Right Bank View from Transect 2 on 24 June 2009

Station 1. Left Bank View from Transect 2 on 24 June 2009

Station 1. Upstream View from Transect 3 on 24 June 2009

Station 1. Downstream View from Transect 3 on 24 June 2009

Station 1. Right Bank View from Transect 3 on 24 June 2009

Station 1. Left Bank View from Transect 3 on 24 June 2009

Station 1. Upstream View from Transect 4 on 24 June 2009

Station 1. Downstream View from Transect 4 on 24 June 2009

Station 1. Right Bank View from Transect 4 on 24 June 2009

Station 1. Left Bank View from Transect 4 on 24 June 2009

Station 1. Upstream View from Transect 5 on 24 June 2009

Station 1. Downstream View from Transect 5 on 24 June 2009

Station 1. Right Bank View from Transect 5 on 24 June 2009

Station 1. Left Bank View from Transect 5 on 24 June 2009

Station 2. Upstream View from Transect 1 on 23 June 2009

Station 2. Downstream View from Transect 1 on 23 June 2009

Station 2. Right Bank View from Transect 1 on 23 June 2009

Station 2. Left Bank View from Transect 1 on 23 June 2009

Station 2. Upstream View from Transect 2 on 23 June 2009

Station 2. Downstream View from Transect 2 on 23 June 2009

Station 2. Right Bank View from Transect 2 on 23 June 2009

Station 2. Left Bank View from Transect 2 on 23 June 2009

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Station 2. Downstream View from Transect 3 on 23 June 2009

Station 2. Right Bank View from Transect 3 on 23 June 2009

Station 2. Left Bank View from Transect 3 on 23 June 2009

Station 2. Upstream View from Transect 4 on 23 June 2009

Station 2. Downstream View from Transect 4 on 23 June 2009

Station 2. Right Bank View from Transect 4 on 23 June 2009

Station 2. Left Bank View from Transect 4 on 23 June 2009

Station 2. Upstream View from Transect 5 on 23 June 2009

Station 2. Downstream View from Transect 5 on 23 June 2009

Station 2. Right Bank View from Transect 5 on 23 June 2009

Station 2. Left Bank View from Transect 5 on 23 June 2009

Station 3. Upstream View from Transect 1 on 23 June 2009

Station 3. Downstream View from Transect 1 on 23 June 2009

Station 3. Right Bank View from Transect 1 on 23 June 2009

Station 3. Left Bank View from Transect 1 on 23 June 2009

Station 3. Upstream View from Transect 2 on 23 June 2009

Station 3. Downstream View from Transect 2 on 23 June 2009

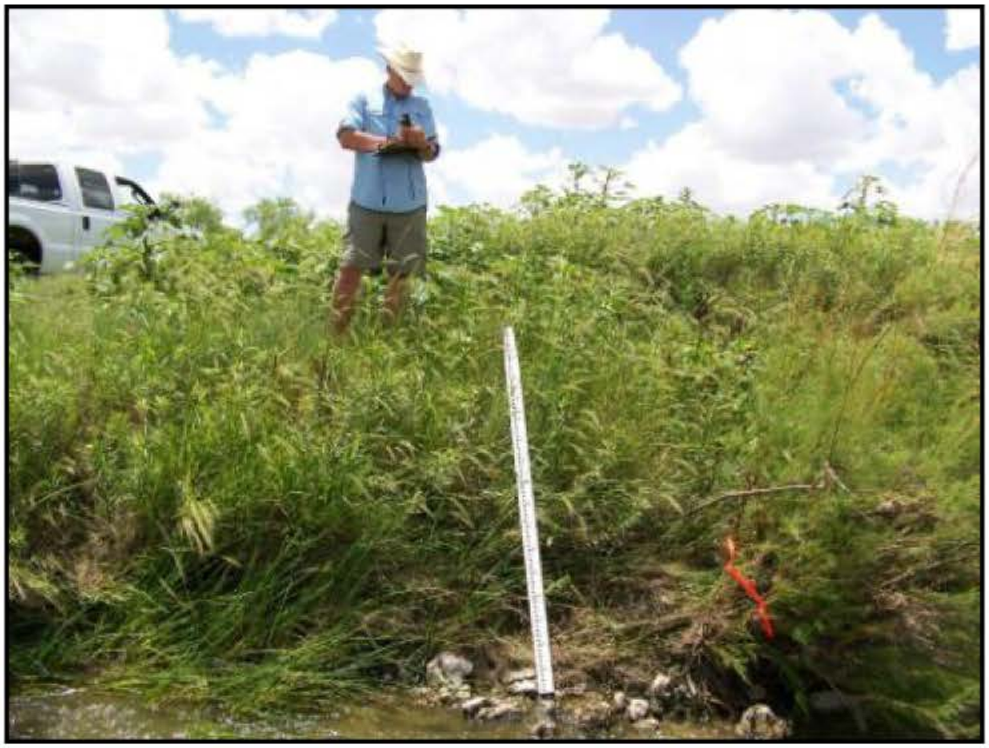
Station 3. Right Bank View from Transect 2 on 23 June 2009

Station 3. Left Bank View from Transect 2 on 23 June 2009

Station 3. Upstream View from Transect 3 on 23 June 2009

Station 3. Downstream View from Transect 3 on 23 June 2009

Station 3. Right Bank View from Transect 3 on 23 June 2009



Station 3. Left Bank View from Transect 3 on 23 June 2009

Station 3. Upstream View from Transect 4 on 23 June 2009

Station 3. Downstream View from Transect 4 on 23 June 2009

Station 3. Right Bank View from Transect 4 on 23 June 2009

Station 3. Left Bank View from Transect 4 on 23 June 2009

Station 3. Upstream View from Transect 5 on 23 June 2009

Station 3. Downstream View from Transect 5 on 23 June 2009

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Station 3. Left Bank View from Transect 5 on 23 June 2009

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Station 4. Downstream View from Transect 1 on 23 June 2009

Station 4. Right Bank View from Transect 1 on 23 June 2009

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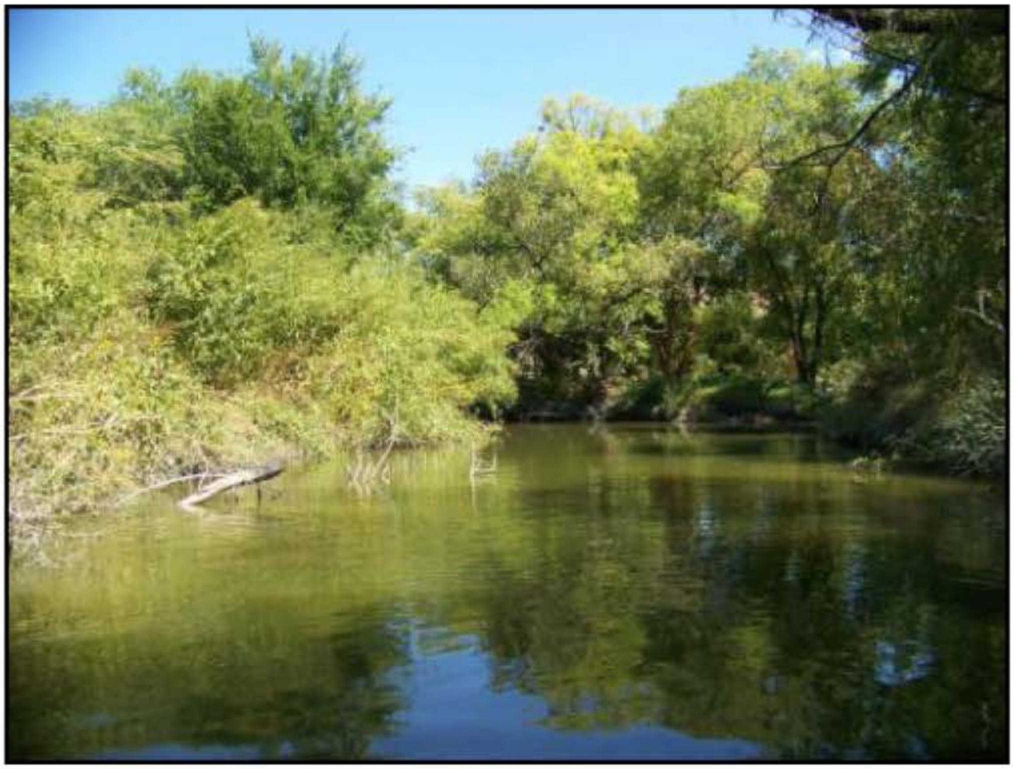
Station 4. Right Bank View from Transect 1 on 23 September 2009

Station 4. Left Bank View from Transect 1 on 23 September 2009

Station 4. Upstream View from Transect 2 on 23 September 2009



Station 4. Downstream View from Transect 2 on 23 September 2009

Station 4. Right Bank View from Transect 2 on 23 September 2009

Station 4. Left Bank View from Transect 2 on 23 September 2009

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Station 4. Left Bank View from Transect 5 on 23 September 2009

Appendix E
Texas Horned Lizard Survey Memorandum

Appendix E
Texas Horned Lizard Survey Memorandum

HDR | ONE COMPANY *Many Solutions*℠

Memo

To:	Aubrey Spear, P.E., City of Lubbock		
From:	Dustin McBride	Project:	Lubbock Lake No. 7
CC:	James Thomas, David Dunn, P.E.		
Date:	09 September 2009	Job No:	

RE: Lake 7 Texas Horned Lizard Survey

List of Participants

Dustin McBride, Herpetologist
Erin Hatchett, Terrestrial Wildlife Biologist

List of Attachments

Figure 1 – General Location Map of Proposed Lake No. 7.
Figure 2 – Texas Horned Lizard Survey & Potential Habitat Map.

Introduction

HDR biologists conducted a baseline survey for the Texas horned lizard (*Phrynosoma cornutum*) from 23–24 July 2009, within the preliminary conservation pool boundary of the proposed Lake No. 7 (Lake 7) in Lubbock County, Texas. This survey was conducted to assess the potential habitat and occurrence of the state threatened Texas horned lizard within the proposed reservoir's area of impact. A summary of results obtained during this survey is presented below.

Study Area and Methods

The proposed Lake 7 site is located along the North Fork of the Double Mountain Fork of the Brazos River in central Lubbock County, Texas (Fig. 1). The preliminary conservation pool boundary encompasses approximately 800 acres (323 hectares) consisting primarily of agricultural rangeland. Prior to conducting surveys for Texas horned lizards, the habitat within the proposed Lake 7 boundary was evaluated for Texas horned lizard suitability using aerial photography from 2004. While Texas horned lizards may be found in a variety of habitats, they typically inhabit relatively flat, open areas lacking dense vegetative cover,[1, 2] and these characteristics were used to remotely delineate potentially suitable habitat. In addition to the examination and delineation of aerial photography, an on-the-ground evaluation of potentially suitable Texas horned lizard habitat within the proposed reservoir boundary was conducted concurrently with aquatic surveys completed in June 2009.

Surveys for Texas horned lizards were conducted from 23–24 July 2009, and consisted of walking along and adjacent to dirt roads identified to bisect potentially suitable Texas horned lizard habitat and visually searching the ground and vegetative cover for Texas horned lizards, their scat (i.e., fecal pellets), harvester ant mounds, and fire ant beds.[1, 2] The following data were recorded during surveys of each transect: total elapsed time; weather conditions (temperature, cloud cover, and wind speed); habitat conditions (habitat type, land use, and soil type); and the number of Texas

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[1] Henke, S. E., and W. S. Fair. 1998. Management of Texas horned lizards. Caesar Kleberg Wildlife Research Institute, Texas A&M University – Kingsville. Management Bulletin No. 2.

[2] Texas Parks and Wildlife Department. 2008. Texas Horned Lizard Watch monitoring packet. Texas Parks and Wildlife Department, Austin.<http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_w7000_0038.pdf>. Accessed 25 August 2009.

horned lizards, Texas horned lizard scat, harvester ant beds, and fire ant mounds observed. Data collected for captured Texas horned lizards included time of capture, location, snout-vent length, tail length, mass, sex, and age. Prior to releasing captured lizards, a small mark was painted on the lizard's back, anterior to the tail, to prevent recounting. This was not done on hatchlings due to their small size.

Results

Preliminary analysis of aerial photography indicated that approximately 240 acres (97 hectares) within the proposed Lake 7 conservation pool boundary contained potentially suitable habitat for Texas horned lizards (Fig. 2). During the field evaluation of the proposed project site, the western (i.e., upstream) half was found to be dominated by kochia weed (*Kochia scoparia*) and sunflowers (*Helianthus* spp.) along the riparian corridor and was not suitable for Texas horned lizards. All areas identified to contain potentially suitable Texas horned lizard habitat were located in the eastern (i.e., downstream) half of the proposed reservoir on the V-8 ranch, where the habitat generally consisted of a mixed grass/shrub community.

Surveys for Texas horned lizards were conducted during a 2-day period (23–24 July 2009) in which 11.9 man-hours were spent intensively surveying 3.55 miles (5.71 kilometers) of linear transects (Fig. 2). Seven Texas horned lizards were observed during these searches. Of these, 5 were hatchlings and 2 were sub-adults/adults. A total of 6 Texas horned lizard scats were observed along 3 transects and lizards were captured along 2 of these transects. Catch-per-unit-effort during this survey resulted in 1 Texas horned lizard/1.7 man-hours of searching. In addition to the lizards observed during this survey, a single sub-adult Texas horned lizard was captured within the proposed Lake 7 conservation pool boundary in June 2009. Therefore, a total of 8 Texas horned lizards have been found within the preliminary conservation pool boundary of Lake 7.

Discussion and Future Recommendations

While this survey represents a rapid assessment of Texas horned lizard habitat and occurrence within the preliminary Lake 7 conservation pool boundary, it clearly demonstrates that this species inhabits portions of the area to be inundated by the proposed reservoir project. Furthermore, the presence of hatchlings indicates that the population is reproducing. A cursory evaluation of aerial photography from 2004 indicates that potentially suitable Texas horned lizard habitat adjacent to and above the proposed Lake 7 conservation pool may include approximately 619 acres (250 hectares) (Fig. 2); however, to confirm these areas as potentially suitable habitat, a field verification of the habitat should be conducted. Furthermore, it is unknown whether these areas support an existing lizard population and if it could effectively support the addition of lizards emigrating from inundated habitat. It is apparent from this survey that Texas horned lizards inhabit at least a portion of the proposed Lake 7 site; however, the degree to which this area and adjacent areas above the conservation pool are inhabited by the Texas horned lizard remains unclear. Additional surveys will be necessary to gain a better understanding of the Texas horned lizard population in the vicinity of the Lake 7 site.

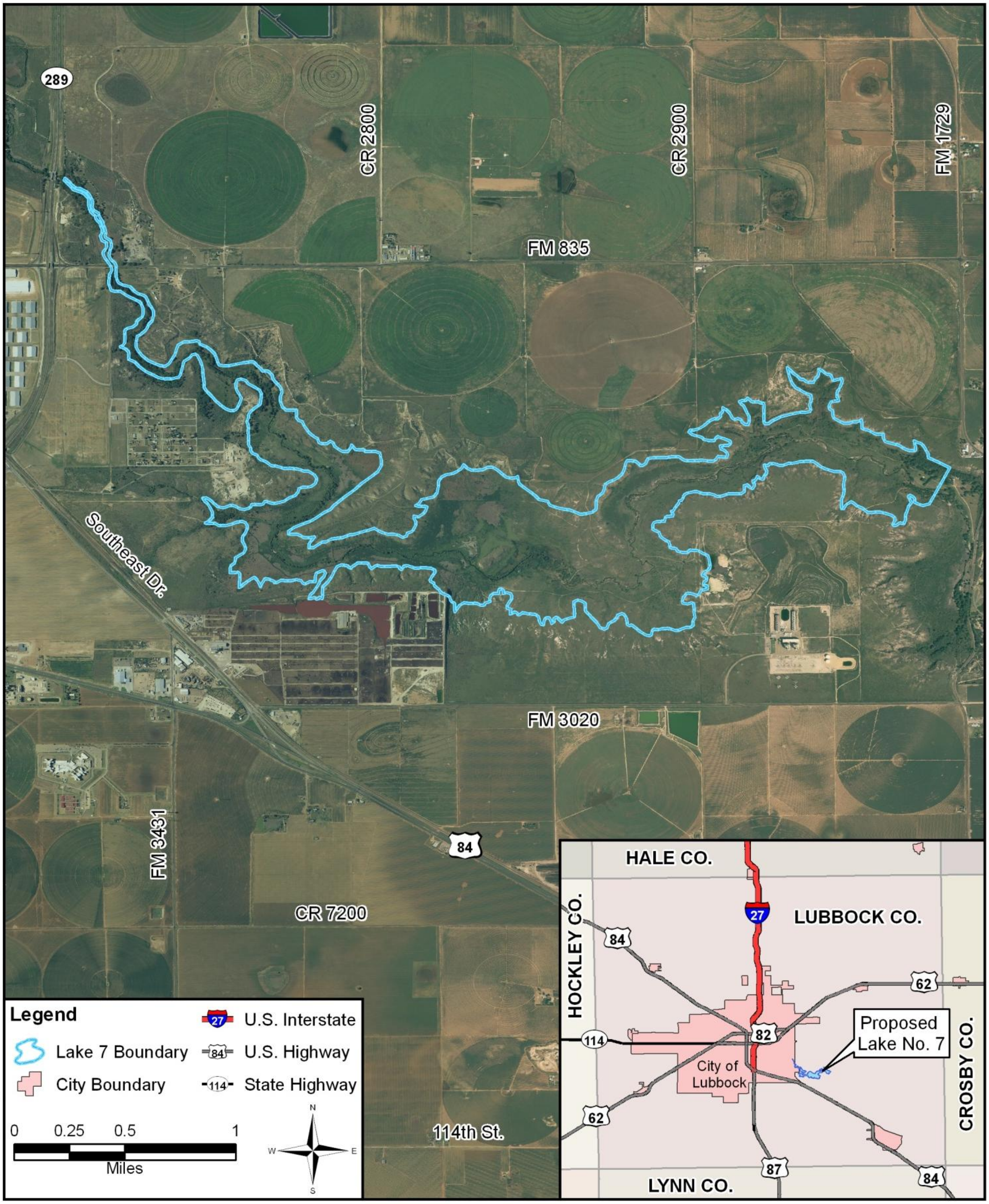
At present, HDR's scope of work related to the Texas horned lizard is limited to the presence/absence survey reported here. Given the results of this survey, HDR recommends the following actions:

1. Conduct additional surveys within the conservation pool boundary and within areas adjacent to and above the conservation pool of the proposed reservoir to estimate current Texas horned lizard densities and determine habitat suitability.

2. Evaluate off-site areas in the vicinity of the proposed reservoir for their potential as eventual relocation sites for Texas horned lizards.

3. Develop a Preliminary Management Plan detailing alternatives to mitigate impacts to Texas horned lizards due to habitat inundation from reservoir construction. Measures could include: (a) relocation of lizards to adjacent habitat above the proposed reservoir's conservation pool, or (b) relocation of lizards to other suitable habitat sites in the vicinity of the project area.

4. Coordination with TCEQ/TPWD staff to determine feasibility of mitigation alternatives.



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GENERAL LOCATION MAP

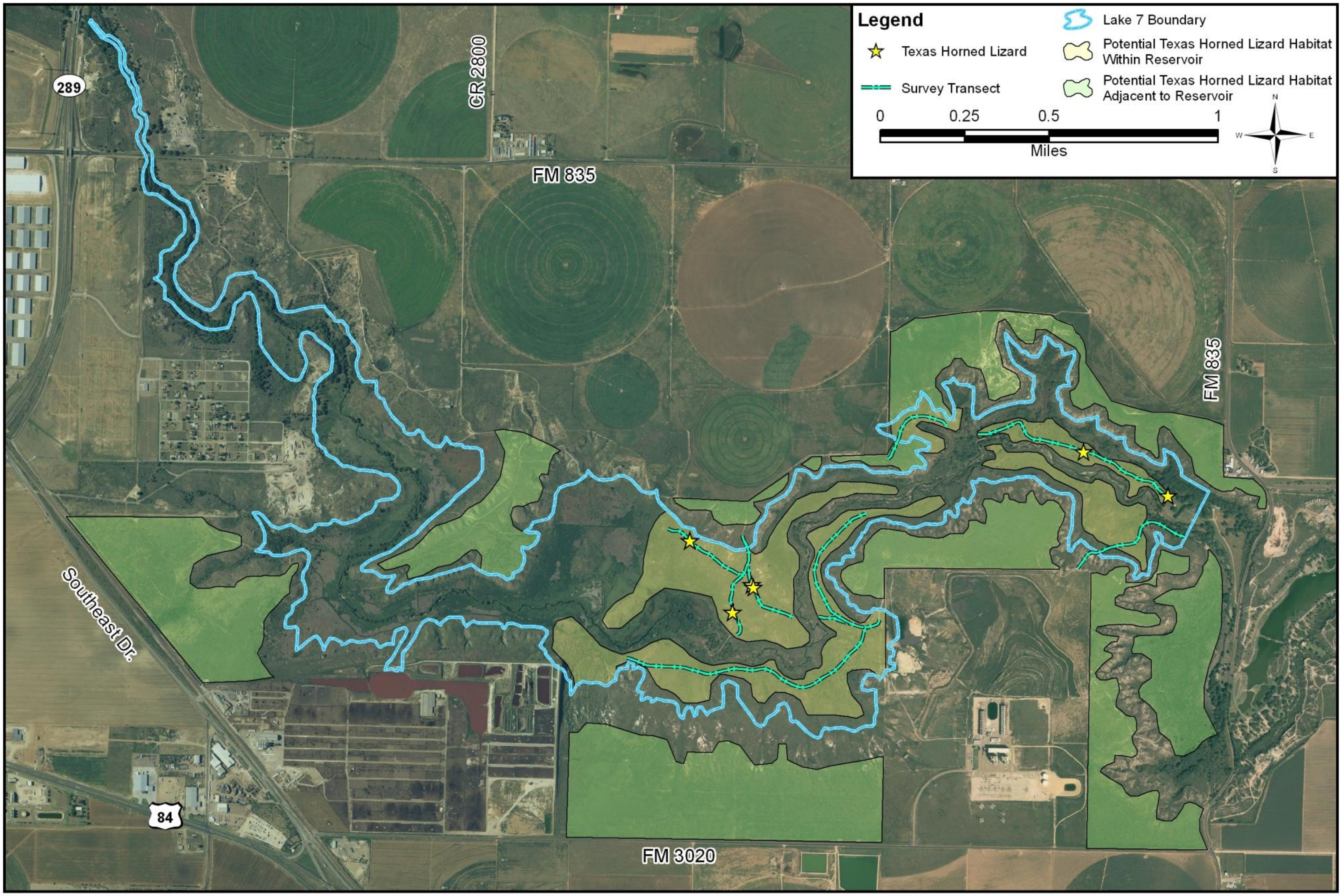
Proposed Lake 7

HDR Engineering, Inc.
17111 Preston Rd. Suite 200
Dallas, Texas 75248-1232
972-960-4400

Figure 1

September 2009

city of lubbock TEXAS



TEXAS HORNED LIZARD SURVEY & POTENTIAL HABITAT MAP

Proposed Lake 7

HDR Engineering, Inc.
17111 Preston Rd. Suite 200
Dallas, Texas 75248-1232
972-960-4400

Figure 2

September 2009

city of lubbock TEXAS

FILE: N:\Dept037_DallasEngineering\Workspace\Dustin\Lubbock_Lake 7\GIS\THL Report Potential Hab Map.mxd

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 16, 2010

CERTIFIED MAIL

Mr. Martin Rochelle
Lloyd Gosselink Blevins Rochelle & Townsend, P.C.
816 Congress Avenue, Suite 1900
Austin, TX 78701

RE: City of Lubbock
WRPERM 5921
CN600130736
Application No. 5921 for a Water Use Permit
Texas Water Code §11.121, Requiring Published and Mailed Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

Dear Mr. Rochelle:

Additional information is required to complete the technical review of the referenced application.

In response to staff's letter dated July 28, 2008, the applicant indicates that environmental analyses would "commence in May 2009" and would "require approximately six (6) months to complete". To date, staff have not received the requested environmental analyses. Please provide a status update on the progress of the analyses.

Please provide the requested information by July 19, 2010, or the application may be returned pursuant to 30 TAC §281.19. You have the option of having the question of sufficiency of the necessary requested data referred to the Commission for a decision instead of having the application returned; such referral shall be provided by July 19, 2010.

Please be aware that additional information may be required during further technical review of the application.

If you have any questions concerning this application, please contact me at (512) 239-1282 or by email at roellis@tceq.state.tx.us.

Sincerely,

Ron Ellis, Project Manager
Mail Code 160
Water Rights Permitting & Availability Section
Water Supply Division

P.O. Box 13087 Austin, Texas 78711-3087 512-239-1000 Internet address: www.tceq.state.tx.us

Report

City of Lubbock

Municipal Precipitation Runoff Contributions to North Fork of Double Mountain Fork of Brazos River Discharge Points 30 and 31 Lubbock, Texas

October 2008

PSC Project #: 01259705

Parkhill, Smith & Cooper, Inc.
Engineers ▪ Architects ▪ Planners

Report

City of Lubbock

Municipal Precipitation Runoff Contributions to North Fork of Double Mountain Fork of Brazos River Discharge Points 30 and 31 Lubbock, Texas

October 2008

PSC Project #: 01259705

RP McMillen

R.P. McMILLEN
52683

10-9-08

Parkhill, Smith & Cooper, Inc.
Engineers ▪ Architects ▪ Planners

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Municipal Precipitation Runoff
Contributions to the North Fork of the Double Mountain Fork of the Brazos River
City of Lubbock Discharge Points 30 and 31

1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

In December 2005, the City of Lubbock retained Parkhill, Smith & Cooper, Inc. (PSC) to perform hydrologic and hydraulic analyses associated with precipitation runoff conveyed by City infrastructure improvements. This report addresses precipitation runoff conveyed to City-designated discharge points 30 and 31. Point 30 is locally known as the South Central Lubbock Drainage Improvements project where construction was substantially completed in 2003. Point 31 is locally known as the South Lubbock Drainage Improvements Project. The South Lubbock Drainage Improvements Project is currently nearing the end of construction with the main trunk storm sewer and seven collection laterals and inlets completed.

Also, as part of the first construction contract for the South Lubbock Drainage Improvements, there were five additional inlets with pipe stubs constructed for later connections. A certificate of substantial completion is expected to be issued for the current project in August 2008. The second construction contract for the South Lubbock Drainage Improvements Project has been signed and a July 2008 notice to proceed has been issued. This second contract will install the five laterals to connect the trunk sewer outfall to the five inlets with pipe stubs listed above. Completion is scheduled for January 2010.

The storm sewer system for Point 30 (South Central Lubbock Drainage Improvements) connects 12 playa lakes to the gravity outfall, and receives overflow discharges from another 14 playa lakes. The storm sewer system for Point 31 (South Lubbock Drainage Improvements) connects 12 playa lakes to its gravity outfall, and receives overflow discharges from an additional three playa lakes.

1.2 STUDY AREA

The study area for Discharge Point 30 comprises 13,894 acres (21.7 square miles) in what is defined as playa lake System E. The study area for Discharge Point 31 comprises 7,919 acres (12.4 square miles) in what is defined as playa lake System G. The study areas for these two discharge points are shown in Figure 1-1, with a larger view of the same study areas shown in Figure 1-2. The larger view is necessary in order to discern the lake numbers.

1.3 METHODOLOGY

The method for determination of precipitation runoff was the Natural Resources Conservation Service (NRCS) curve number theory method. The precipitation depths analyzed were 0.5 inches, 1.0 inches, 1.5 inches, 2.0 inches, 2.5 inches, 2.8 inches (2-year 24-hour), 3.8 inches (5-year 24-hour), 4.6 inches (10-year 24-hour), 5.3 inches (25-year 24-hour), 6.0 inches (50-year 24-hour) and 6.8 inches (100-year 24-hour). The defined depth duration 24-hour events were from the U.S. Department of Commerce National Weather Service Technical Paper 40. The precipitation depths that are less than 2.8 inches were assigned 24-hour durations. No areal precipitation reduction factors were applied.

1.4 WATERSHED ANALYSES

A. Discharge Point 30

Discharge Point 30, also defined earlier as the South Central Lubbock Drainage Improvements Project comprising 13,894 acres, contains a mixture of playa lakes connected to the storm sewer system, playa lakes that are not connected directly to the storm sewer system but that do contribute when those lakes overflow, plus an additional contributing watershed connected to the storm sewer system. The playa lakes that are tied directly to the storm sewer system are constant level lakes where the lake water surface is constantly at the low port opening of each lake inlet. Therefore, 100 percent of the runoff from the connected lakes' watersheds is conveyed through the storm sewer system to the North Fork of the Double Mountain Fork of the Brazos River. The storm sewer pipe outfall from the most downstream lake to the river also has an additional watershed connected to the 72-inch diameter storm sewer where 100 percent of the runoff from that watershed is conveyed by the storm sewer to the river. For those lakes not connected to the storm sewer system, only the overflows are accounted from those lakes after available lake storage volumes are satisfied.

B. Discharge Point 31

Discharge Point 31 was defined earlier as being assigned to the South Lubbock Drainage Improvements Project, and controls water surface levels in 12 playa lakes. These are constant level lakes that are connected to the storm sewer system, thus 100 percent of the runoff to these 12 connected lakes is conveyed to the river. There is an additional watershed associated with the 54-inch diameter outfall of the storm sewer system, and 100 percent of this watershed's runoff is assigned to Discharge Point 31. There are also a few related watersheds to playa lakes that are not connected to the storm sewer system, and these disconnected lakes do not contribute until the lakes' storage volumes are fulfilled and then overflow to a connected lake.

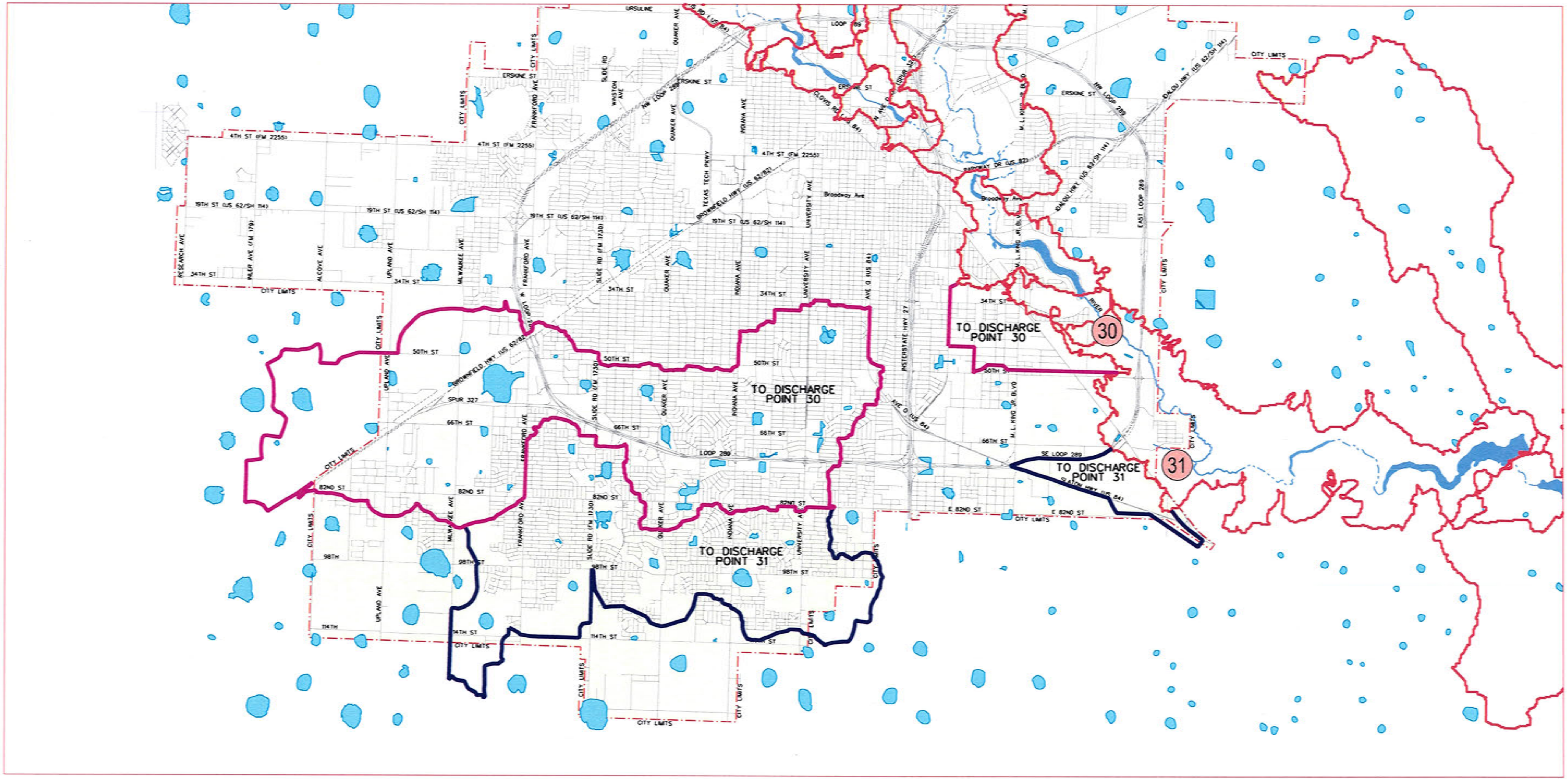
1.5 SUMMARY OF RESULTS

The NRCS curve number theory method was applied to the watersheds for Discharge Points 30 and 31. The storm sewers are designed for surcharge gravity storm sewer hydraulics, are designed to rapidly achieve surcharge hydraulic heads, and thus rapidly achieve upper limits on the storm sewer's discharge capacities. Table 1-1 summarizes the runoff calculated volume discharged to the North Fork of the Double Mountain Fork of the Brazos River for the defined precipitation depths, plus the instantaneous storm sewer peak discharge from the storm sewer outfalls at the river associated with each runoff event. It can be seen from the peak discharge values that the storm sewers are operating under full-conduit hydraulic friction flow where several feet of additional head on the inlets from increased runoff volumes results in only minor increases in discharge rates.

TABLE 1-1
RUNOFF VOLUMES AND FLOW RATES
DISCHARGE POINTS 30 AND 31

	Point 30		Point 31	
Precipitation Depth (Inches)	Peak Discharge (cfs)	Runoff Volume (ac. ft.)	Peak Discharge (cfs)	Runoff Volume (ac. ft.)
0.5	36	13	3	2
1.0	81	152	44	74
1.5	164	382	73	220
2.0	196	671	75	412
2.5	198	1,037	75	631
2.8	199	1,278	75.7	773
3.8	202	2,182	77	1,279
4.6	203	2,941	78	1,713
5.3	204	3,623	78	2,114
6.0	207	4,318	78	2,523
6.8	210	5,146	79	2,999

Note: Final outfall to Point 30 is a 72-inch diameter storm sewer.
Final outfall to Point 31 is a 54-inch diameter storm sewer.
All storm durations based on 24 hours.
Discharges and volumes are at the outlet points at the North Fork of the Double Mountain Fork of the Brazos River.



LEGEND

▭ INCORPORATED LIMITS[1]

(181) PLAYA LAKE SHAPE AND CITY-DESIGNATED NUMBER[2]

RIVER NORTH FORK DOUBLE MOUNTAIN BRAZOS RIVER[2]

CITY LIMITS[1]

TCEQ BOUNDARIES

WATERSHED BOUNDARY

(30) STORM SEWER OUTFALL LOCATION AND DESIGNATED NUMBER

N

4000 0 4000 8000 12000 16000

SCALE IN FEET

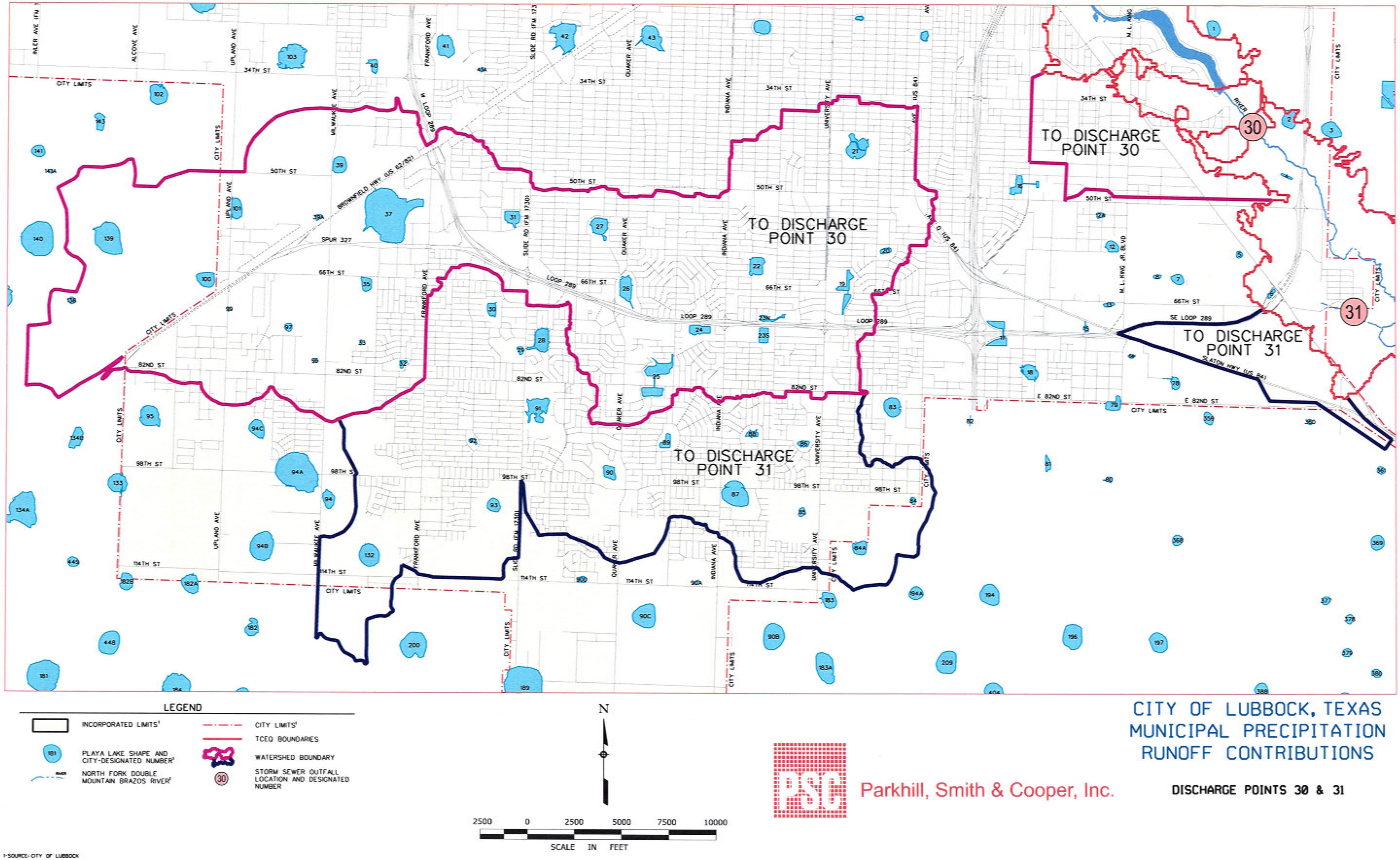
PSC Parkhill, Smith & Cooper, Inc.

CITY OF LUBBOCK, TEXAS
MUNICIPAL PRECIPITATION RUNOFF CONTRIBUTIONS

DISCHARGE POINTS 30 & 31

1-SOURCE: CITY OF LUBBOCK

FIGURE 1-1



1-SOURCE: CITY OF LUBBOCK

Parkhill, Smith & Cooper, Inc.

CITY OF LUBBOCK, TEXAS MUNICIPAL PRECIPITATION RUNOFF CONTRIBUTIONS

DISCHARGE POINTS 30 & 31

FIGURE 1-2

TAB

INTRODUCTION

2.0 INTRODUCTION

2.1 GENERAL

In December 2005, the City of Lubbock retained Parkhill, Smith & Cooper, Inc. (PSC) to perform hydrologic and hydraulic analyses associated with precipitation runoff conveyed by City infrastructure improvements to the North Fork of the Double Mountain Fork of the Brazos River. This report addresses precipitation runoff conveyed to two local points of discharge at the North Fork of the Double Mountain Fork of the Brazos River (hereinafter referred to as the Brazos River). These two local points of discharge are locally designated as Point 30 and Point 31 by the City's Stormwater Management Department. Both of these discharge points were constructed after year 2000, and convey precipitation runoff to the river that would otherwise remain isolated from the river course. PSC is the prime consultant for the team that designed both storm sewer systems, and thus is intimately familiar with the hydrology, hydraulics and construction for both systems.

2.2 SCOPE OF PROFESSIONAL SERVICES

The scope of professional services involved hydrological and hydraulic analysis for two playa lake systems where two new storm sewer systems created new outlets to the river. The South Central Lubbock Drainage Improvements Project serves Playa Lake System E (Discharge Point 30) while the South Lubbock Drainage Improvements Project serves Playa Lake System G (Discharge Point 31). The volumes of precipitation runoff for various precipitation depths were analyzed for runoff volume contributions to the Brazos River. The conveyance capacities for the storm sewer systems were analyzed for peak discharges at the Brazos River for each precipitation depth. Within the hydrological analyses, the upstream boundaries for the playa systems were established at playa lakes that are not expected to contribute runoff to Playa Lake Systems E and G up to and including the 100-year 24-hour (one-percent probability) single event precipitation depth.

2.3 STUDY AREA

A. Playa Lake System E

The total watershed for the Playa Lake System E study area is shown on Figure 2-1. The total watershed area of interest comprises 13,894 acres. The discharge for the storm sewer system serving Playa Lake System E is noted as Discharge Point 30, and the final five-mile outfall is a 72-inch diameter gravity flow pipeline constructed in various segments of cast-in-place nonreinforced concrete pipe, precast reinforced concrete pipe and reinforced fiberglass mortar pipe. The pipe materials conform to American Concrete Institute (ACI), American Society for Testing and Materials (ASTM), or American Water Works Association (AWWA) standards for specific types of pipe materials. The upstream limit of the watershed study area was determined to be where upstream lakes that are not connected to the storm sewer system ceased to contribute runoff via lake overflow through the 100-year 24-hour precipitation event, or that the watershed contributes to playa lakes belonging to a different playa lake system.

B. Playa Lake System G

The total watershed for the Playa Lake System G study area is shown on Figure 2-2. The total watershed area of interest comprises 7,919 acres. The discharge for the storm sewer system serving Playa Lake System G is noted as Discharge Point 31, and the final 6.1-mile outfall is a 54-inch diameter gravity flow pipeline constructed of reinforced fiberglass mortar pipe manufactured in accordance with ASTM D3262. The upstream limit of the watershed study area was determined to be where upstream lakes that are not connected to the storm sewer system ceased to contribute runoff via lake overflow through the 100-year 24-hour precipitation event, or that the watershed contributes to playa lakes belonging to a different playa lake system. It can be seen from Figures 2-1 and 2-2 that Playa Lake System E and Playa Lake System G have a common watershed boundary.

2.4 PLAYA LAKE SYSTEMS

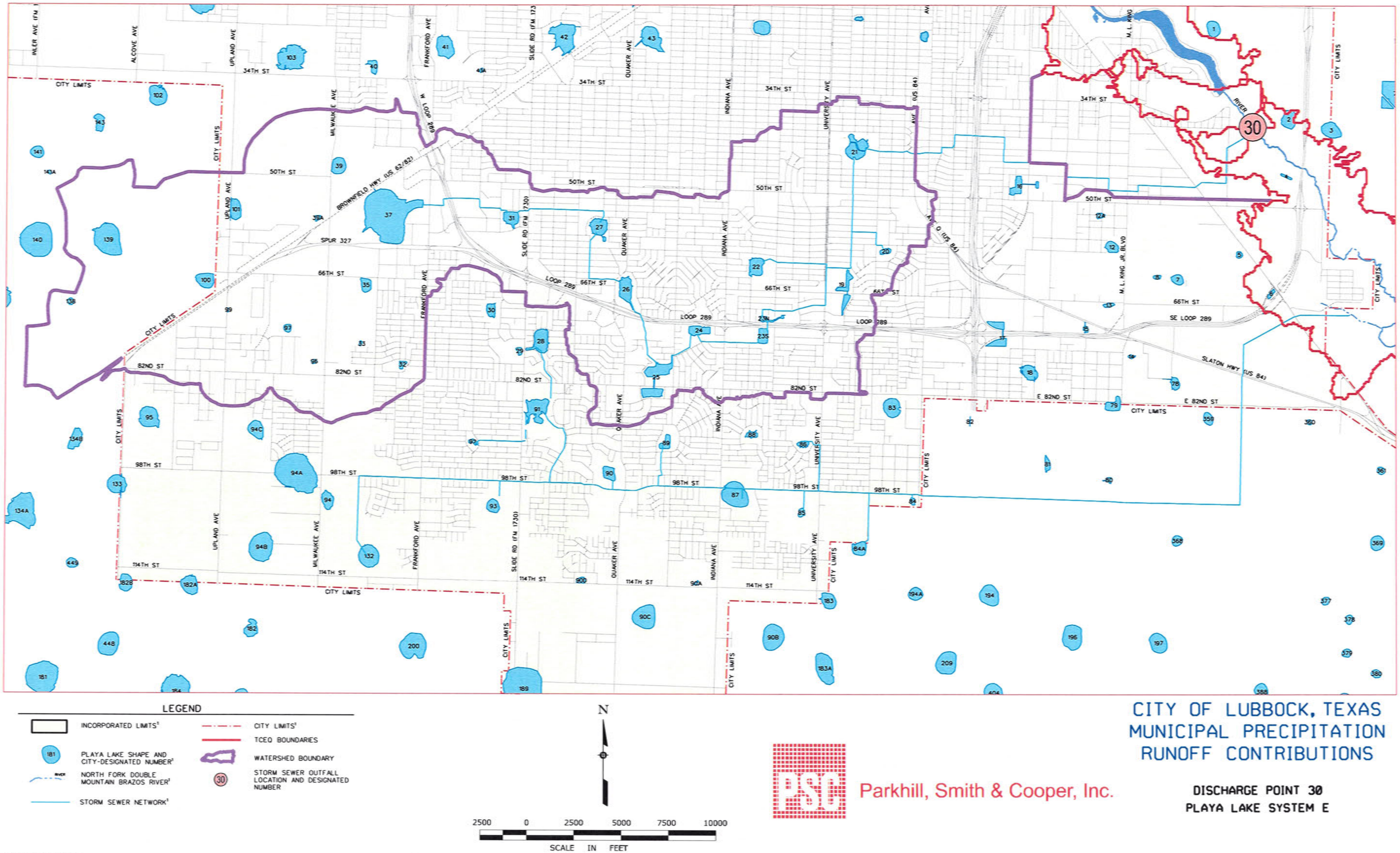
The City of Lubbock is unique in that the vast majority of its drainage area naturally drains to shallow surface depressions known as playa lakes. Away from the immediate topography of the North Fork of the Double Mountain Fork of the Brazos River, playa lakes are the only natural topographic features to receive surface runoff. The formation of these depressions in the local topography is usually attributed to wind erosion acting over geologic time. The density of playa lakes within and near the City of Lubbock averages about one lake per square mile of land surface.

When viewing the topographic contours for the playa lake watersheds it can be seen that a pattern emerges that, if followed, would resemble a stream tributary. Each lake has a topographic ground surface overflow elevation. If that lake were to fill with surface runoff to the extent that its storage volume is exceeded and it would overflow, then that overflow path is traced topographically to each successive playa lake. Once this topographic pattern is established, then it can be seen that tracing this pattern places groups of playa lakes into systems.

Not all playa lakes are predicted to overflow. Some do not overflow even through the 500-year 24-hour (0.2-percent probability) precipitation event. However, the placement of lakes within a system is solely dependent on topographic overflow direction. Then, once the watershed boundaries are depicted, the pattern emerges that the playa lake systems resemble stream tributaries in layout, with topographic ridges dividing the systems much like there are ridges dividing the watersheds between stream tributaries. Thus, the City of Lubbock ends up with several playa lake systems that serve as its drainage receptacles for surface runoff. This can also be readily discerned with a review of the City's flood insurance maps.

2.5 SUMMARY

The City of Lubbock retained PSC to perform hydrological and hydraulic analyses for two new storm sewer systems. These two storm sewer systems convey surface precipitation runoff to Discharge Points 30 and 31 at the Brazos River. The surface runoff discharged is received from two playa lake systems, System E to Point 30 and System G to Point 31.



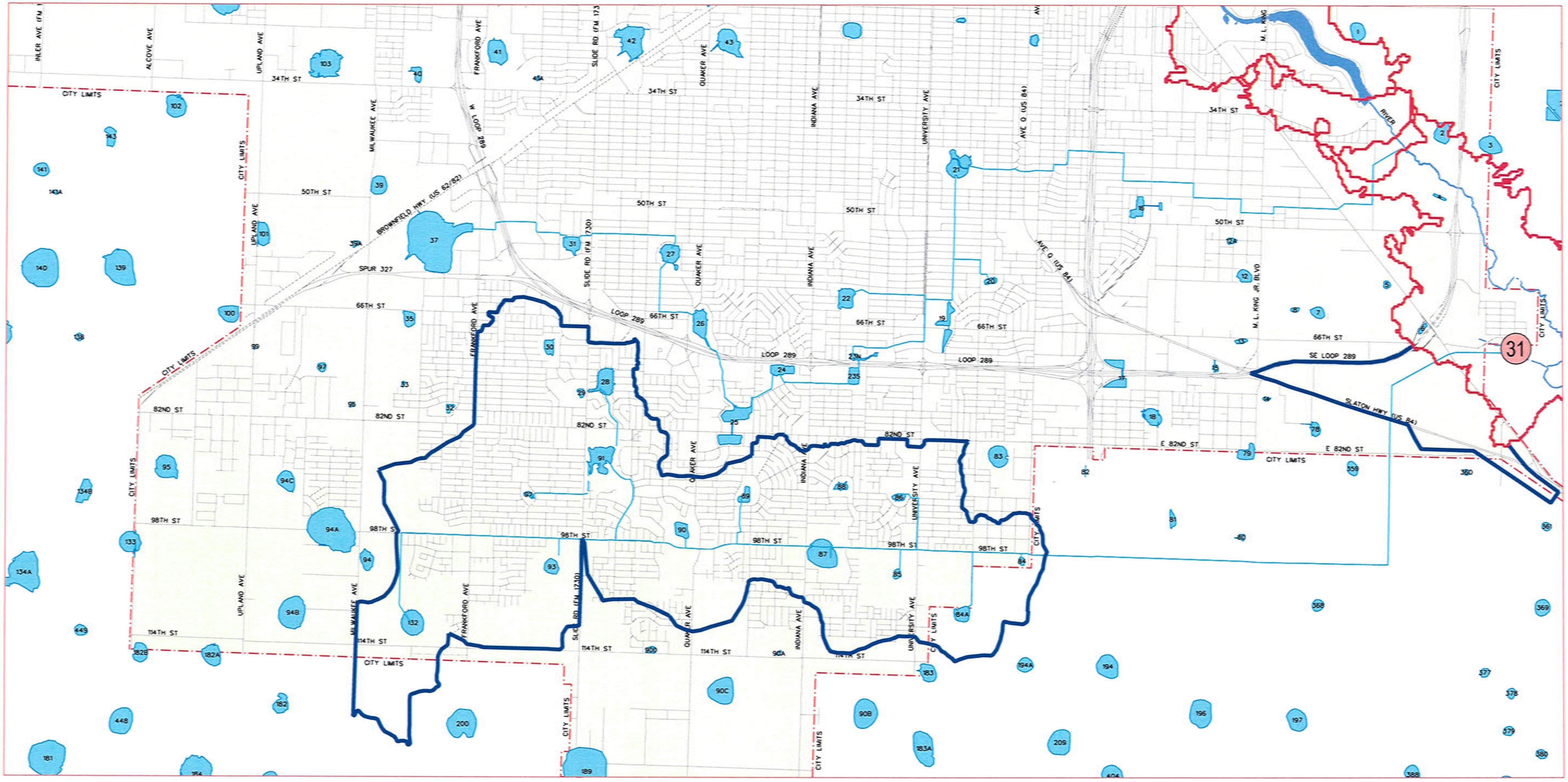
1-SOURCE: CITY OF LUBBOCK

Parkhill, Smith & Cooper, Inc.

CITY OF LUBBOCK, TEXAS MUNICIPAL PRECIPITATION RUNOFF CONTRIBUTIONS

DISCHARGE POINT 30
PLAYA LAKE SYSTEM E

FIGURE 2-1



CITY OF LUBBOCK, TEXAS
MUNICIPAL PRECIPITATION RUNOFF CONTRIBUTIONS

PSC Parkhill, Smith & Cooper, Inc.

DISCHARGE POINT 31
PLAYA LAKE SYSTEM G

FIGURE 2-2

TAB

METHODOLOGY

3.0 METHODOLOGY

3.1 INTRODUCTION

This section covers the methods that were used to arrive at the discharge volumes and the peak discharge flow rates for Discharge Points 30 and 31 to the Brazos River. Covered in this section are the hydrological approach to precipitation runoff, how peak discharges from the storm sewers at the river were determined, the precipitation events that were analyzed, and data sources that were available and applicable to the work.

3.2 PRECIPITATION RUNOFF VOLUME ANALYSES

The method used to determine the precipitation runoff volume was the U. S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) curve number theory applied to each subwatershed. The USDA-NRCS curve number theory uses a combination of hydrological soil groups plus land use and soil cover to arrive at a curve number. There may be more than one curve number in a watershed to cover various land use or soil cover subareas. In the case of multiple curve numbers within a subwatershed, then a single weighted curve number value was calculated. The weighted curve number is simply the sum of the curve numbers times subareas within the watershed divided by the total watershed area. Mathematically, the equation is:

$$CN = \frac{(CN_1 A_1) + (CN_2 A_2) + (CN_3 A_3) + \ldots.(CN_N A_N)}{A_T}$$

Where:

CN = Single weighted curve number, dimensionless

CN_1 = Curve number for subarea 1, dimensionless

A_1 = Subarea associated with CN_1, acres

CN_2 = Curve number for subarea 2, dimensionless

A_2 = Subarea associated with CN_2, acres

A_T = Total area of the watershed or subwatershed, acres

Thus, for example, even though Playa Lake System E has a total watershed of 13,894 acres considered in this report, it is further subdivided into 26 subwatersheds, each with a calculated USDA-NRCS weighted curve number. All of the curve numbers used were for fully-urbanized conditions.

Once a curve number is assigned, then the runoff is calculated for each subwatershed through the equation:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

Where:

Q = Runoff, inches

P = Precipitation depth, inches

S = Potential maximum retention, inches

and

$$S = \frac{1000}{CN} - 10$$

Then, once the inches of runoff are calculated, the runoff volume as defined herein is simply the inches of runoff multiplied by the number of acres in the applicable subwatershed and divided by 12 to arrive at the acre-feet of precipitation runoff volume.

3.3 PRECIPITATION PEAK DISCHARGE ANALYSES

The analyses for peak discharges were confined to the hydraulic capacities of the storm sewer outfalls associated with Discharge Points 30 and 31. Both systems were simulated in computer models defined in Interconnected Pond and Channel Routing (ICPR), a hydrological and hydraulic software package developed by Streamline Technologies, Winter Springs, Florida. ICPR was selected since it is capable of accommodating constantly fluctuating conditions, and enabled modeling of the hydrology and storm sewer hydraulics into one model. This software was used for the engineering design of both the South Central Lubbock Drainage Improvements (Point 30) and the South Lubbock Drainage Improvements (Point 31) projects. ICPR is also approved by the Federal Emergency Management Agency (FEMA) for flood insurance studies associated with the National Flood Insurance Program.

The 72-inch diameter storm sewer pipeline outfall to Discharge Point 30 was constructed on an invert, or flow line, gradient of 0.18 feet per hundred feet of length (0.18 percent) for its initial mile of length, the center three-mile length was constructed at a gradient of 0.15 feet per hundred feet of length (0.15 percent), and the last (most downstream) mile of length was constructed at gradients of 0.50 feet per hundred feet of length (0.50 percent) or greater. Thus, the discharge at the outlet is limited by 1) the head available to the pipeline at the outfall's source lake, or 2) the pipeline gradient for its initial four-mile length, being somewhat flat at the 0.15 percent to 0.18 percent invert gradient. Once the pipeline becomes surcharged and flows under a pressure gradient from the source lake, then the source lake level can increase by several feet but have only minor effect on the outfall's discharge flow rate. Manning's *n* for conduit flow has recommended values of 0.009 for fiberglass reinforced mortar pipe to 0.013 for concrete materials. However, these Manning's *n* values are usually determined under clean water conditions. Since the storm water usually carries with it a certain amount of detritus and colloidal materials, a Manning's *n* value of 0.015 was used for storm sewer hydraulic calculations. Appropriate head losses were also incorporated at the lake inlets and for storm sewer appurtenances such as manholes.

The 54-inch diameter outfall to Discharge Point 31 was constructed on an invert gradient of 0.16 feet of fall per one hundred feet of length (0.16 percent) for most of its length. Thus, as with Discharge Point 30 above, the flow rate through this 54-inch pipeline is limited by 1) the head available to the pipeline from the contributing source lakes, or 2) the constructed pipeline gradient. Once the pipeline becomes surcharged and flows under a pressure gradient from the source lakes, then the source lake levels can increase by several feet but have only minor effect on the outfall's discharge flow rate. As for the system discussed above, a Manning's *n* value of 0.015 was used for storm sewer hydraulic calculations along with appropriate head loss factors for the lake inlets and appurtenances.

3.4 PLAYA LAKE STORAGE ANALYSES

Playa lake storage was calculated using the average end area method based on City of Lubbock one-foot interval contour maps. In this manner elevation-area-storage tables were developed for each playa lake.

For playa lakes connected to the storm sewer systems, these are constant level lakes where the permanent water level resides at the invert elevation of the lowest intake port at each lake inlet. Thus, at the inlet low-port elevation lake storage is zero. Maximum lake storage is achieved at the topographic overflow elevation for that lake. Since these connected lakes have permanent water levels at the low-ports, 100 percent of surface runoff plus inflow from upstream lakes is discharged to the Brazos River through these storm sewer systems.

For playa lakes that are not connected to the storm sewer systems, these lakes contribute to the connected lakes, and hence to the storm sewer systems, only after the disconnected lakes' storage volumes are satisfied and then overflow occurs. Maximum lake storage is achieved at the topographic overflow elevation for each lake considered. Some of these disconnected lakes are normally shallow and dry in their natural state, thus the lake bottom was taken as the zero storage elevation. Other disconnected lakes do have some permanent water as evidenced by historical observation and wave action/vegetation lines at those lakes. For these lakes, the zero storage elevations were established at the permanent water level evidence. Again, only the runoff that exceeded available storage for these disconnected lakes was considered contributory to the connected lakes and hence to Discharge Points 30 and 31.

For all lakes, connected and disconnected, hydrological routing through the lakes was performed. This routing takes into account the rate of inflow to each lake, volume of inflow to each lake, rate of discharge from each lake, and volume of discharge from each lake. With these inflow and discharge parameters, the effect on lake storage could be examined.

3.5 PRECIPITATION EVENTS

The initial precipitation events analyzed were for the 24-hour durations as defined by the U. S. Department of Commerce National Weather Service Technical Paper 40 for the 2-year (50 percent probability) through the 100-year (1 percent probability) recurrence interval single precipitation events. In response to a request to include lesser precipitation depths, the 0.5 - inch to 2.5 – inch depths of precipitation were added to the analyses. In summary, the precipitation recurrence intervals, durations and depths included for analysis are listed in Table 3-1. As noted in the table, all precipitation events are for 24-hour durations.

TABLE 3-1
PRECIPITATION DEPTHS ANALYZED

Recurrence Interval	Duration	Precipitation (Inches)
N/A	24-hour	0.5
N/A	24-hour	1.0
N/A	24-hour	1.5
N/A	24-hour	2.0
N/A	24-hour	2.5
2-year	24-hour	2.8
5-year	24-hour	3.8
10-year	24-hour	4.6
25-year	24-hour	5.3
50-year	24-hour	6.0
100-year	24-hour	6.8

3.6 SUMMARY

This study uses the USDA-NRCS curve number method for precipitation runoff volume determination. Peak discharge rates to the Brazos River are limited to the conveyance capacities of the storm sewer systems that serve Playa Lake Systems E and G. Rainfall precipitation depths ranging from 0.5 inches in 24 hours to 6.8 inches in 24 hours comprise the analytical range for runoff volumes.

3.7 REFERENCES

A number of references were used in developing the analyses and results for this study. Some are in the public domain while others are more proprietary.

U. S. Dept. of Commerce, "Technical Paper No. 40, Rainfall Frequency Atlas Of The United States For Durations From 30 Minutes To 24 Hours And Return Periods From 1 To 100 Years," May 1961.

Texas Commission on Environmental Quality, Water Allocation Model (WAM) Watershed Boundaries as furnished by HDR, Inc., Austin, Texas.

City of Lubbock, Texas, "Drainage Criteria Manual," adopted October 1997.

City of Lubbock, Texas, "Master Drainage Plan," adopted December, 1997.

Parkhill, Smith & Cooper, Inc., Hugo Reed & Associates, Inc., "South Central Lubbock Drainage Improvements," construction documents issued January 2001 and project design files.

Parkhill, Smith & Cooper, Inc., Hugo Reed & Associates, Inc., "South Lubbock Drainage Improvements, Package #1," construction documents issued May 2004 and project design files.

Parkhill, Smith & Cooper, Inc., Hugo Reed & Associates, Inc., "South Lubbock Drainage Improvements, Package #1A, construction documents issued February 2008 and project design files.

TAB

DISCHARGE 14 30

4.0 DISCHARGE POINT 30

4.1 INTRODUCTION

As noted earlier in this report, Discharge Point 30 is the point of discharge for a storm sewer network that provides conveyance of stormwater from playa lakes that lie within Playa System E of the City of Lubbock. This system begins at Lake 37 on the west side of Lubbock and continues to Lake 21 in central Lubbock, then reaches the river from Lake 21 via a final five-mile 72- inch diameter outfall. The feasibility study for this project was completed in 1997, with a supplemental study completed in September 1999 after the June 22, 1999 flooding event. Plans and specifications were completed in January 2001 and substantial construction completion was achieved in September 2003. The overall project area served is shown in Figure 4-1.

4.2 FUNCTIONAL CHARACTERISTICS

The primary purpose of the South Central Lubbock Drainage Improvements conveyance to Discharge Point 30 is to restore lake storage capacity in a much shorter elapsed time period after a runoff event. Prior to the installation of these drainage improvements the only storage restoration mechanisms available were evaporation and lake bottom infiltration/percolation. On numerous occasions the evaporation and infiltration/percolation losses were insufficient to recover available lake storage prior to some significant storm events. Thus, when playa lake storages were exceeded, then the lakes would overflow via overland flow to the next downstream lake. Unfortunately, property damages would occur not only around the lake pools themselves, but also in some of the overflow reaches.

The design team completed a feasibility study in September 1997 and was tasked by the City to perform a supplemental study after the June 22, 1999 flood. That supplemental feasibility study was completed in September 1999. From that supplemental study came a re-direction in the size of storm sewer conduits to achieve more rapid recovery of lake storage.

The South Central Lubbock Drainage Improvements essentially provide positive control of playa lake water surface elevations, and to recover storage within a relatively short time. The storm sewer improvements are not intended to provide full flood mitigation. However, with reliable lake storage recovery and a definitive permanent water surface elevation established, some flood damage mitigation is realized. Also, by installing the storm sewer system, Lake 21 at the downstream end of Playa System E ceased to be a non-outlet lake that received not only its own subwatershed runoff, but also the overflows from upstream lakes in System E. The five-mile gravity storm sewer outfall from Lake 21 to the North Fork of the Double Mountain Fork of the Brazos River provides a previously non-existent discharge mechanism where otherwise Lake 21 and the upstream connected lakes would still be subject to the slow natural processes for lake storage recovery.

4.3 HYDROLOGICAL PARAMETERS

The hydrological parameters for Playa System E served by the South Central Lubbock Drainage Improvements are based on the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) curve number method for determination of precipitation runoff volume and watershed runoff peak discharges. Hydrological routings through lake storages were performed using elevation-area-storage tables for each involved lake in Playa System E. Inlets, pipelines and overflow reaches were modeled in Interconnected Pond and Channel Routing (ICPR) software to provide the discharge conditions for each lake hydrograph's routing. Figure 4-1 shows the overall watersheds' boundaries involved along with each study lake's sub-watershed. These boundaries were established by using City of Lubbock one-foot interval contour maps. The South Central Lubbock Drainage Improvements storm sewer network is also shown on Figure 4-1 along with the storm sewer pipe diameters. The lake numbers come from the City of Lubbock's playa lake designation system. The lakes that are served by the storm sewer system are referred to as "connected" lakes while those that contribute only by surface overflow are referred to as "disconnected" lakes. The disconnected lakes are shown with overflow directional arrows to indicate the general direction in which overflow occurs once runoff volume exceeds lake storage volume. It can be seen that on the western end of the study area that Lake 100 overflows to Lake 39A and then Lake 39A overflows to Lake 37. Lake 99 and Lake 35 overflow directly to Lake 37. The water level in Lake 37 is now positively controlled since it is connected to the storm sewer system. The lakes upstream of Lake 37 only contribute once their storage volumes are exceeded. Lakes downstream of, and including, Lake 37 are served by the storm sewer system.

When development occurred in the Lake 32 sub-watershed, Lake 32 was excavated to increase its storage capacity. Despite the urbanization of that sub-watershed, the increased Lake 32 storage capacity apparently retains runoff volume through the 100-year (one percent) 24-hour storm event analysis. For all practical purposes, Lake 32 is considered non-contributing and dropped from inclusion in the contributing precipitation runoff analyses.

The western limit of the study area was determined according to the existing lakes' storages available. Essentially, west of the boundary shown in Figure 4-1, the upstream existing lakes' storages contain the calculated runoff up to and including the calculated 100-year 24-hour (one-percent) probabilistic event. Thus, lakes in Playa System E that are upstream of the boundary shown are not only disconnected lakes, but are also considered non-contributing for the purposes of this study.

At the eastern limit of this study area shown in Figure 4-1 is a sub-watershed labeled as the "Vanda Area". Within this area surface inlets were placed in the Vanda Avenue – 46th Street– 47th Street – 48th Street vicinities and connected to the storm sewer outfall to provide positive drainage. This area historically has experienced ponding of runoff waters including a few intersections that would remain impassable for days. It is suspected, although no proof has been found, that a playa lake once existed in this sub-watershed and was poorly filled-in a long time ago. It is also suspected that some of that supposed fill settled and consolidated resulting in the broad shallow-water ponding reaches.

The hydrological parameters established for the sub-watersheds included sub-watershed areas, curve numbers, and times of concentration along with lakes elevation-area-storage tables plus discharge measures. Since discharge to Point 30 is controlled by the conveyance capacity of the 72-inch diameter outfall from Lake 21, local peak inflow rates to each lake become less significant, and thus the local times of concentration become less significant for discharge rates at Point 30. Fully-urbanized NRCS curve number values were assigned to each sub-watershed. The sub-watershed's curve numbers and areas are listed in Table 4-2 through Table 4-12. The sub-watersheds are identified by lake number or name in those tables.

4.4 ANALYTICAL SUMMARY

The analyses for calculating the runoff volumes to Point 30 primarily involve calculating the runoff for the various precipitation events, then taking each sub-watershed's total volume and deducting the runoff retained by the disconnected playa lakes. For the connected lakes, these lakes are designed for constant water level at the invert to the lowest port elevation. Thus, 100 percent of the runoff or overflow received by the connected playa lakes is conveyed to Point 30. For the disconnected lakes, the available storage to overflow elevation must be satisfied prior to any overflow contribution to the storm sewer system, thus a certain volume of precipitation runoff does not reach the river. In the sub-watershed labeled as the "Vanda Area", the surface inlets capture the ponded runoff and send it to the storm sewer system.

For the peak discharge from the storm sewer outlet at Point 30, the various precipitation depths were analyzed in the ICPR computer simulation for the Playa System E study area. For each precipitation depth and corresponding runoff volume, a discharge from Playa System E was calculated through the Lake 21 inlet and the 72-inch storm sewer outfall. The hydraulics for the lake inlet and the outfall pipeline are designed to surcharge the outfall pipeline to achieve full conduit flow with an internal pipeline pressure. The 72-inch outfall achieves limiting hydraulic energy gradients at approximately 200 cubic feet per second flow rate. Thus, the Lake 21 lake water surface can increase significantly, but the pipeline discharge increases very little because of the pipe friction, pipeline grade, available head, and the resultant energy grade line.

In summary the original design analyses included the following:

a. NRCS curve number, time of concentration and area for each sub-watershed.

b. Elevation-area-storage data for each playa lake.

c. Discharge capability modeled for each lake, whether connected or disconnected, overflow or storm sewer.

d. Disconnected lakes do not contribute except via overflow, and only after the disconnected lakes storage capacities are satisfied.

e. For connected lakes and surface inlets, the entire runoff from their sub-watershed is conveyed to the river.

The analysis can be reduced to a spreadsheet to calculate volume discharged to the river, and ICPR modeling to find the node-time series for the maximum discharge from the 72-inch outfall. Tables 4-2 through 4-12 show the spreadsheet analysis and results for volume of runoff from the South Central Lubbock Drainage Improvements. Tables 4-13 through 4-23 show the maximum discharges calculated for the 72-inch storm sewer. Table 4-1 below summarizes the results. Some rounding of the numerical results has been incorporated.

Table 4-1

Point 30 Discharge Volume and Peak Flow Rate

Probability Event	Duration	Precipitation Depth (inches)	Peak Discharge Flow Rate (cfs)	Runoff Volume Discharged (acre-feet)
N/A	24-hour	0.5	36	13
N/A	24-hour	1.0	81	152
N/A	24-hour	1.5	164	382
N/A	24-hour	2.0	196	671
N/A	24-hour	2.5	198	1,037
2-Year (50%)	24-hour	2.8	199	1,278
5-Year (20%)	24-hour	3.8	202	2,182
10-Year (10%)	24-hour	4.6	203	2,941
25-Year (4%)	24-hour	5.3	204	3,623
50-Year (2%)	24-hour	6.0	207	4,318
100-Year (1%)	24-hour	6.8	210	5,146

TABLE 4-2
Discharge Point 30
Playa System E Developed Urban Runoff to Brazos River
Computation of 0.5-Inch, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 0.50 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	0.5-Inch, 24-hr Storm Runoff Volume (inches) ⑦	(acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-E											
Connected	L019	610.00	203.51	87	1.49	0.02	1.21	202.30	0.00		L020
Connected	L020	225.00	27.03	80	2.50	0.00	0.00	27.03	0.00		L021
Connected	L021	1463.00	1465.35	84	1.90	0.01	0.85	1464.50	0.00	All to storm sewer	
Connected	L022	464.00	228.24	82	2.20	0.00	0.06	228.18	0.00		L023N
Connected	L023S	421.00	62.36	86	1.63	0.02	0.59	61.77	0.00		L023N
Connected	L023N	160.00	39.10	86	1.63	0.02	0.23	38.87	0.00		L019
Connected	L024	389.00	205.75	82	2.20	0.00	0.05	205.70	0.00		L023S
Connected	L025	481.00	87.43	87	1.49	0.02	0.96	86.47	0.00		L024S
Connected	L026	882.00	85.62	88	1.36	0.03	2.39	83.23	0.00		L025
Connected	L027	563.00	61.49	83	2.05	0.00	0.18	61.31	0.00		L026
Connected	L031	506.00	97.26	91	0.99	0.07	2.98	94.28	0.00		L027
	L033	36.00	8.49	83	2.05	0.00	0.01	8.48	0.00		L035
	L035	496.00	1.20	86	1.63	0.02	0.70	0.50	0.00		L037
Connected	L037	1493.00	301.32	87	1.49	0.02	2.97	298.35	0.00		L031
	L039	543.00	70.98	88	1.36	0.03	1.47	69.51	0.00		L037
	L039A	344.00	43.90	83	2.05	0.00	0.11	43.79	0.00		L037
	L096	488.00	52.79	84	1.90	0.01	0.28	52.51	0.00		L035
	L097	334.00	17.17	82	2.20	0.00	0.05	17.12	0.00		L035
	L099	469.00	19.74	83	2.05	0.00	0.15	19.59	0.00		L037
	L100	821.00	27.90	83	2.05	0.00	0.26	27.64	0.00		L039A
	L101	418.00	144.63	84	1.90	0.01	0.24	144.39	0.00		L039A
	L138	253.00	15.20	81	2.35	0.00	0.01	15.19	0.00		L139
	L139	541.00	540.89	85	1.76	0.01	0.51	540.38	0.00		L100
Vanda	E1	135.60	None	84	1.90	0.01	0.08		N/A	N/A	N/A
Vanda	E2	241.60	None	84	1.90	0.01	0.14		N/A	N/A	N/A
Vanda	E3	1117.20	None	84	1.90	0.01	0.65		N/A	N/A	N/A
Totals		13,894.40					17.14				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Volume to river is sum of runoff to Lake 37 and Lakes 19 through 27, plus runoff to Lake 31, plus overflow from Lakes 35, 39, 39A, 99 to Lake 37 = 13.35
plus the Vanda area runoff volume Round to 13

TABLE 4-3
Discharge Point 30
Playa System E Developed Urban Runoff to Brazos River
Computation of 1-Inch, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 1.00 inches
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	1-Inch, 24-hr Storm Runoff Volume (inches) ⑦	1-Inch, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-E											
Connected	L019	610.00	203.51	87	1.49	0.22	11.38	192.13	0.00		L020
Connected	L020	225.00	27.03	80	2.50	0.08	1.56	25.47	0.00		L021
Connected	L021	1463.00	1465.35	84	1.90	0.15	18.51	1446.84	0.00	All to storm sewer	
Connected	L022	464.00	228.24	82	2.20	0.11	4.41	223.83	0.00		L023N
Connected	L023S	421.00	62.36	86	1.63	0.20	6.93	55.43	0.00		L023N
Connected	L023N	160.00	39.10	86	1.63	0.20	2.63	36.47	0.00		L019
Connected	L024	389.00	205.75	82	2.20	0.11	3.70	202.05	0.00		L023S
Connected	L025	481.00	87.43	87	1.49	0.22	8.98	78.45	0.00		L024S
Connected	L026	882.00	85.62	88	1.36	0.25	18.59	67.03	0.00		L025
Connected	L027	563.00	61.49	83	2.05	0.13	6.20	55.29	0.00		L026
Connected	L031	506.00	97.26	91	0.99	0.36	15.15	82.11	0.00		L027
	L033	36.00	8.49	83	2.05	0.13	0.40	8.09	0.00		L035
	L035	496.00	1.20	86	1.63	0.20	8.17	-6.97	6.97		L037
Connected	L037	1493.00	301.32	87	1.49	0.22	27.86	266.49	0.00		L031
	L039	543.00	70.98	88	1.36	0.25	11.45	59.53	0.00		L037
	L039A	344.00	43.90	83	2.05	0.13	3.79	40.11	0.00		L037
	L096	488.00	52.79	84	1.90	0.15	6.17	46.62	0.00		L035
	L097	334.00	17.17	82	2.20	0.11	3.18	13.99	0.00		L035
	L099	469.00	19.74	83	2.05	0.13	5.16	14.58	0.00		L037
	L100	821.00	27.90	83	2.05	0.13	9.04	18.86	0.00		L039A
	L101	418.00	144.63	84	1.90	0.15	5.29	139.34	0.00		L039A
	L138	253.00	15.20	81	2.35	0.10	2.07	13.13	0.00		L139
	L139	541.00	540.89	85	1.76	0.17	7.83	533.06	0.00		L100
Vanda	E1	135.60	None	84	1.90	0.15	1.72		N/A	N/A	N/A
Vanda	E2	241.60	None	84	1.90	0.15	3.06		N/A	N/A	N/A
Vanda	E3	1117.20	None	84	1.90	0.15	14.14		N/A	N/A	N/A
Total		13,894.40					207.35				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Volume to river is sum of runoff to Lake 37 and Lakes 19 through 27, plus runoff to Lake 31, plus overflow from Lakes 35, 39, 39A, 99 to Lake 37 = 151.79
plus the Vanda area runoff volume Round to 152

TABLE 4-4
Discharge Point 30
Playa System E Developed Urban Runoff to Brazos River
Computation of 1.5-Inch, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P):	1.50	inches
Initial Abstraction (Ia):	0.20	S

FILENAME: COL WATER RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	1.5-Inch, 24-hr Storm Runoff Volume		Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
						(inches) ⑦	(acre-feet) ⑧				
SYSTEM-E											
Connected	L019	610.00	203.51	87	1.49	0.54	27.21	176.30	0.00		L020
Connected	L020	225.00	27.03	80	2.50	0.29	5.36	21.67	0.00		L021
Connected	L021	1463.00	1465.35	84	1.90	0.41	50.49	1414.86	0.00	All to storm sewer	
Connected	L022	464.00	228.24	82	2.20	0.35	13.37	214.87	0.00		L023N
Connected	L023S	421.00	62.36	86	1.63	0.49	17.27	45.09	0.00		L023N
Connected	L023N	160.00	39.10	86	1.63	0.49	6.56	32.54	0.00		L019
Connected	L024	389.00	205.75	82	2.20	0.35	11.21	194.54	0.00		L023S
Connected	L025	481.00	87.43	87	1.49	0.54	21.46	65.97	0.00		L024S
Connected	L026	882.00	85.62	88	1.36	0.58	42.73	42.89	0.00		L025
Connected	L027	563.00	61.49	83	2.05	0.38	17.77	43.72	0.00		L026
Connected	L031	506.00	97.26	91	0.99	0.74	31.21	66.05	0.00		L027
	L033	36.00	8.49	83	2.05	0.38	1.14	7.35	0.00		L035
	L035	496.00	1.20	86	1.63	0.49	20.34	-19.14	19.14		L037
Connected	L037	1493.00	301.32	87	1.49	0.54	66.60	215.58	0.00		L031
	L039	543.00	70.98	88	1.36	0.58	26.31	44.67	0.00		L037
	L039A	344.00	43.90	83	2.05	0.38	10.86	33.04	0.00		L037
	L096	488.00	52.79	84	1.90	0.41	16.84	35.95	0.00		L035
	L097	334.00	17.17	82	2.20	0.35	9.62	7.55	0.00		L035
	L099	469.00	19.74	83	2.05	0.38	14.80	4.94	0.00		L037
	L100	821.00	27.90	83	2.05	0.38	25.92	1.98	0.00		L039A
	L101	418.00	144.63	84	1.90	0.41	14.43	130.20	0.00		L039A
	L138	253.00	15.20	81	2.35	0.31	6.64	8.56	0.00		L139
	L139	541.00	540.89	85	1.76	0.45	20.37	520.52	0.00		L100
Vanda	E1	135.60	None	84	1.90	0.41	4.68		N/A	N/A	N/A
Vanda	E2	241.60	None	84	1.90	0.41	8.34		N/A	N/A	N/A
Vanda	E3	1117.20	None	84	1.90	0.41	38.56		N/A	N/A	N/A
Totals		13,894.40					530.06				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Volume to river is sum of runoff to Lake 37 and Lakes 19 through 27, plus runoff to Lake 31, plus overflow from Lakes 35, 39, 39A, 99 to Lake 37 = 381.94
plus the Vanda area runoff volume Round to 382

TABLE 4-5
Discharge Point 30
Playa System E Developed Urban Runoff to Brazos River
Computation of 2-Inch, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 2.00 inches
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	2-Inch, 24-hr Storm Runoff Volume (inches) ⑦	2-Inch, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-E											
Connected	L019	610.00	203.51	87	1.49	0.91	46.04	157.47	0.00		L020
Connected	L020	225.00	27.03	80	2.50	0.56	10.55	16.48	0.00		L021
Connected	L021	1463.00	1465.35	84	1.90	0.74	90.69	1374.66	0.00	All to storm sewer	
Connected	L022	464.00	228.24	82	2.20	0.65	25.08	203.16	0.00		L023N
Connected	L023S	421.00	62.36	86	1.63	0.85	29.79	32.57	0.00		L023N
Connected	L023N	160.00	39.10	86	1.63	0.85	11.32	27.78	0.00		L019
Connected	L024	389.00	205.75	82	2.20	0.65	21.03	184.72	0.00		L023S
Connected	L025	481.00	87.43	87	1.49	0.91	36.30	51.13	0.00		L024S
Connected	L026	882.00	85.62	88	1.36	0.97	70.95	14.67	0.00		L025
Connected	L027	563.00	61.49	83	2.05	0.70	32.61	28.88	0.00		L026
Connected	L031	506.00	97.26	91	0.99	1.16	49.07	48.19	0.00		L027
	L033	36.00	8.49	83	2.05	0.70	2.09	6.40	0.00		L035
	L035	496.00	1.20	86	1.63	0.85	35.09	-34.78	34.78		L037
Connected	L037	1493.00	301.32	87	1.49	0.91	112.68	146.44	0.00		L031
	L039	543.00	70.98	88	1.36	0.97	43.68	27.30	0.00		L037
	L039A	344.00	43.90	83	2.05	0.70	19.93	4.31	0.00		L037
	L096	488.00	52.79	84	1.90	0.74	30.25	22.54	0.00		L035
	L097	334.00	17.17	82	2.20	0.65	18.06	-0.89	0.89		L035
	L099	469.00	19.74	83	2.05	0.70	27.17	-7.43	7.43		L037
	L100	821.00	27.90	83	2.05	0.70	47.56	-19.66	19.66		L039A
	L101	418.00	144.63	84	1.90	0.74	25.91	118.72	0.00		L039A
	L138	253.00	15.20	81	2.35	0.60	12.75	2.45	0.00		L139
	L139	541.00	540.89	85	1.76	0.80	35.85	505.04	0.00		L100
Vanda	E1	135.60	None	84	1.90	0.74	8.41		N/A	N/A	N/A
Vanda	E2	241.60	None	84	1.90	0.74	14.98		N/A	N/A	N/A
Vanda	E3	1117.20	None	84	1.90	0.74	69.26		N/A	N/A	N/A
Totals		13,894.40					927.06				

COL. 1 FROM MICROSTATION

COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS

COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0

COL. 4 = COL. 2 - COL. 3

COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.

COL. 6 = (1000/COL. 5)-10

COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)

COL. 8 = (COL. 1 * COL. 7)/12

COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)

COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA

COL. 11 = SUB-BASIN ID

COL. 12 = PLAYA LAKE ID

Checked

Volume to river is sum of runoff to Lake 37 and Lakes 19 through 27, plus runoff to Lake 31, plus overflow from Lakes 35, 39, 39A, 99 to Lake 37 = 670.94
plus the Vanda area runoff volume Round to 671

TABLE 4-6
Discharge Point 30
Playa System E Developed Urban Runoff to Brazos River
Computation of 2.5-Inch, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 2.50 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	2.5-Inch, 24-hr Storm Runoff Volume (inches) ⑦	2.5-Inch, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-E											
Connected	L019	610.00	203.51	87	1.49	1.31	66.65	136.86	0.00		L020
Connected	L020	225.00	27.03	80	2.50	0.89	16.67	10.36	0.00		L021
Connected	L021	1463.00	1465.35	84	1.90	1.12	136.05	1329.30	0.00	All to storm sewer	
Connected	L022	464.00	228.24	82	2.20	1.00	38.59	189.65	0.00		L023N
Connected	L023S	421.00	62.36	86	1.63	1.24	43.63	18.73	0.00		L023N
Connected	L023N	160.00	39.10	86	1.63	1.24	16.58	22.52	0.00		L019
Connected	L024	389.00	205.75	82	2.20	1.00	32.35	173.40	0.00		L023S
Connected	L025	481.00	87.43	87	1.49	1.31	52.55	18.96	0.00		L024S
Connected	L026	882.00	85.62	88	1.36	1.38	101.54	-15.92	15.92		L025
Connected	L027	563.00	61.49	83	2.05	1.06	49.54	11.95	0.00		L026
Connected	L031	506.00	97.26	91	0.99	1.61	67.90	29.36	0.00		L027
	L033	36.00	8.49	83	2.05	1.06	3.17	5.32	0.00		L035
	L035	496.00	1.20	86	1.63	1.24	51.40	-60.80	60.80		L037
Connected	L037	1493.00	301.32	87	1.49	1.31	163.12	25.16	0.00		L031
	L039	543.00	70.98	88	1.36	1.38	62.51	8.47	0.00		L037
	L039A	344.00	43.90	83	2.05	1.06	30.27	-30.70	30.70		L037
	L096	488.00	52.79	84	1.90	1.12	45.38	7.41	0.00		L035
	L097	334.00	17.17	82	2.20	1.00	27.78	-10.61	10.61		L035
	L099	469.00	19.74	83	2.05	1.06	41.27	-21.53	21.53		L037
	L100	821.00	27.90	83	2.05	1.06	72.24	-44.34	44.34		L039A
	L101	418.00	144.63	84	1.90	1.12	38.87	105.76	0.00		L039A
	L138	253.00	15.20	81	2.35	0.94	19.87	-4.67	4.67		L139
	L139	541.00	540.89	85	1.76	1.18	53.13	483.09	0.00		L100
Vanda	E1	135.60	None	84	1.90	1.12	12.61		N/A	N/A	N/A
Vanda	E2	241.60	None	84	1.90	1.12	22.47		N/A	N/A	N/A
Vanda	E3	1117.20	None	84	1.90	1.12	103.89		N/A	N/A	N/A
Totals		13,894.40					1,370.02				

COL. 1 FROM MICROSTATION

COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS

COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0

COL. 4 = COL. 2 - COL. 3

COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.

COL. 6 = (1000/COL. 5)-10

COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)

COL. 8 = (COL. 1 * COL. 7)/12

COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)

COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA

COL. 11 = SUB-BASIN ID

COL. 12 = PLAYA LAKE ID

Checked

Volume to river is sum of runoff to Lake 37 and Lakes 19 through 27, plus runoff to Lake 31, plus overflow from Lakes 35, 39, 39A, 99 to Lake 37 = 1,037.18
plus the Vanda area runoff volume

Round to 1037

TABLE 4-7
Discharge Point 30
Playa System E Developed Urban Runoff to Brazos River
Computation of 2-Year, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P):	2.80 inches	(Source: TP40)
Initial Abstraction (Ia):	0.20 S	

FILENAME: COL WATER RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	2-Yr., 24-hr Storm Runoff Volume (inches) ⑦	2-Yr., 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-E											
Connected	L019	610.00	203.51	87	1.49	1.57	79.59	123.92	0.00		L020
Connected	L020	225.00	27.03	80	2.50	1.10	20.66	6.37	0.00		L021
Connected	L021	1463.00	1465.35	84	1.90	1.35	165.00	1300.35	0.00	All to storm sewer	
Connected	L022	464.00	228.24	82	2.20	1.22	47.31	180.93	0.00		L023N
Connected	L023S	421.00	62.36	86	1.63	1.49	52.36	10.00	0.00		L023N
Connected	L023N	160.00	39.10	86	1.63	1.49	19.90	19.20	0.00		L019
Connected	L024	389.00	205.75	82	2.20	1.22	39.66	114.42	0.00		L023S
Connected	L025	481.00	87.43	87	1.49	1.57	62.76	-51.67	51.67		L024S
Connected	L026	882.00	85.62	88	1.36	1.64	120.65	-76.34	76.34		L025
Connected	L027	563.00	61.49	83	2.05	1.29	60.40	-41.31	41.31		L026
Connected	L031	506.00	97.26	91	0.99	1.89	79.51	-42.40	42.40		L027
	L033	36.00	8.49	83	2.05	1.29	3.86	4.63	0.00		L035
	L035	496.00	1.20	86	1.63	1.49	61.69	-79.62	79.62		L037
Connected	L037	1493.00	301.32	87	1.49	1.57	194.80	-60.15	60.15		L031
	L039	543.00	70.98	88	1.36	1.64	74.28	-3.30	3.30		L037
	L039A	344.00	43.90	83	2.05	1.29	36.90	-53.18	53.18		L037
	L096	488.00	52.79	84	1.90	1.35	55.04	-2.25	2.25		L035
	L097	334.00	17.17	82	2.20	1.22	34.05	-16.88	16.88		L035
	L099	469.00	19.74	83	2.05	1.29	50.31	-30.57	30.57		L037
	L100	821.00	27.90	83	2.05	1.29	88.07	-60.17	60.17		L039A
	L101	418.00	144.63	84	1.90	1.35	47.14	97.49	0.00		L039A
	L138	253.00	15.20	81	2.35	1.16	24.49	-9.29	9.29		L139
	L139	541.00	540.89	85	1.76	1.42	64.10	467.50	0.00		L100
Vanda	E1	135.60	None	84	1.90	1.35	15.29		N/A	N/A	N/A
Vanda	E2	241.60	None	84	1.90	1.35	27.25		N/A	N/A	N/A
Vanda	E3	1117.20	None	84	1.90	1.35	126.00		N/A	N/A	N/A
Totals		13,894.40					1,651.10				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Volume to river is sum of runoff to Lake 37 and Lakes 19 through 27, plus runoff to Lake 31, plus overflow from Lakes 35, 39, 39A, 99 to Lake 37 = plus the Vanda area runoff volume 1,277.82

Round to 1278

TABLE 4-8
Discharge Point 30
Playa System E Developed Urban Runoff to Brazos River
Computation of 5-Year, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 3.80 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	5-yr, 24-hr Storm Runoff Volume (inches) ⑦	5-yr, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-E											
Connected	L019	610.00	203.51	87	1.49	2.45	124.74	-383.21	383.21		L020
Connected	L020	225.00	27.03	80	2.50	1.88	35.20	-391.39	391.39		L021
Connected	L021	1463.00	1465.35	84	1.90	2.20	267.70	806.26	0.00	All to storm sewer	
Connected	L022	464.00	228.24	82	2.20	2.03	78.61	149.63	0.00		L023N
Connected	L023S	421.00	62.36	86	1.63	2.37	83.00	-469.54	469.54		L023N
Connected	L023N	160.00	39.10	86	1.63	2.37	31.55	-461.99	461.99		L019
Connected	L024	389.00	205.75	82	2.20	2.03	65.91	-448.90	448.90		L023S
Connected	L025	481.00	87.43	87	1.49	2.45	98.36	-588.74	588.74		L024S
Connected	L026	882.00	85.62	88	1.36	2.54	186.97	-577.81	577.81		L025
Connected	L027	563.00	61.49	83	2.05	2.11	99.16	-476.46	476.46		L026
Connected	L031	506.00	97.26	91	0.99	2.83	119.17	-438.79	438.79		L027
	L033	36.00	8.49	83	2.05	2.11	6.34	2.15	0.00		L035
	L035	496.00	1.20	86	1.63	2.37	97.79	-172.51	172.51		L037
Connected	L037	1493.00	301.32	87	1.49	2.45	305.30	-416.88	416.88		L031
	L039	543.00	70.98	88	1.36	2.54	115.11	-44.13	44.13		L037
	L039A	344.00	43.90	83	2.05	2.11	60.59	-133.39	133.39		L037
	L096	488.00	52.79	84	1.90	2.20	89.29	-36.50	36.50		L035
	L097	334.00	17.17	82	2.20	2.03	56.59	-39.42	39.42		L035
	L099	469.00	19.74	83	2.05	2.11	82.60	-62.86	62.86		L037
	L100	821.00	27.90	83	2.05	2.11	144.60	-116.70	116.70		L039A
	L101	418.00	144.63	84	1.90	2.20	76.49	68.14	0.00		L039A
	L138	253.00	15.20	81	2.35	1.95	41.21	-26.01	26.01		L139
	L139	541.00	540.89	85	1.76	2.28	102.78	412.10	0.00		L100
Vanda	E1	135.60	None	84	1.90	2.20	24.81				
Vanda	E2	241.60	None	84	1.90	2.20	44.21				
Vanda	E3	1117.20	None	84	1.90	2.20	204.43				
Totals		13,894.40					2,642.52				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Volume to river is sum of runoff to Lake 37 and Lakes 19 through 27, plus runoff to Lake 31, plus overflow from Lakes 35, 39, 39A, 99 to Lake 37 = 2,182.02
plus the Vanda area runoff volume

Round to 2182

TABLE 4-9
Discharge Point 30
Playa System E Developed Urban Runoff to Brazos River
Computation of 10-Year, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 4.60 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	10-yr, 24-hr Storm Runoff Volume (inches) ⑦	10-yr, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-E											
Connected	L019	610.00	203.51	87	1.49	3.19	162.27	-927.62	927.62		L020
Connected	L020	225.00	27.03	80	2.50	2.55	47.76	-948.35	948.35		L021
Connected	L021	1463.00	1465.35	84	1.90	2.91	354.38	162.62	0.00	All to storm sewer	
Connected	L022	464.00	228.24	82	2.20	2.72	105.33	122.91	0.00		L023N
Connected	L023S	421.00	62.36	86	1.63	3.10	108.60	-966.69	966.69		L023N
Connected	L023N	160.00	39.10	86	1.63	3.10	41.27	-968.86	968.86		L019
Connected	L024	389.00	205.75	82	2.20	2.72	88.30	-920.45	920.45		L023S
Connected	L025	481.00	87.43	87	1.49	3.19	127.95	-1037.90	1037.90		L024S
Connected	L026	882.00	85.62	88	1.36	3.29	241.84	-997.38	997.38		L025
Connected	L027	563.00	61.49	83	2.05	2.81	132.05	-841.15	841.15		L026
Connected	L031	506.00	97.26	91	0.99	3.59	151.57	-770.59	770.59		L027
	L033	36.00	8.49	83	2.05	2.81	8.44	0.05	0.00		L035
	L035	496.00	1.20	86	1.63	3.10	127.95	-250.81	250.81		L037
Connected	L037	1493.00	301.32	87	1.49	3.19	397.16	-716.28	716.28		L031
	L039	543.00	70.98	88	1.36	3.29	148.89	-77.91	77.91		L037
	L039A	344.00	43.90	83	2.05	2.81	80.69	-201.45	201.45		L037
	L096	488.00	52.79	84	1.90	2.91	118.21	-65.42	65.42		L035
	L097	334.00	17.17	82	2.20	2.72	75.82	-58.65	58.65		L035
	L099	469.00	19.74	83	2.05	2.81	110.00	-90.26	90.26		L037
	L100	821.00	27.90	83	2.05	2.81	192.57	-164.67	164.67		L039A
	L101	418.00	144.63	84	1.90	2.91	101.25	43.38	0.00		L039A
	L138	253.00	15.20	81	2.35	2.63	55.55	-40.35	40.35		L139
	L139	541.00	540.89	85	1.76	3.00	135.27	365.27	0.00		L100
Vanda	E1	135.60	None	84	1.90	2.91	32.85				
Vanda	E2	241.60	None	84	1.90	2.91	58.52				
Vanda	E3	1117.20	None	84	1.90	2.91	270.62				
Totals		13,894.40					3,475.10				

COL. 1 FROM MICROSTATION

COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS

COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0

COL. 4 = COL. 2 - COL. 3

COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.

COL. 6 = (1000/COL. 5)-10

COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)

COL. 8 = (COL. 1 * COL. 7)/12

COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)

COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA

COL. 11 = SUB-BASIN ID

COL. 12 = PLAYA LAKE ID

Checked

Volume to river is sum of runoff to Lake 37 and Lakes 19 through 27, plus runoff to Lake 31, plus overflow from Lakes 35, 39, 39A, 99 to Lake 37 = plus the Vanda area runoff volume 2,940.91

Round to 2941

TABLE 4-10
Discharge Point 30
Playa System E Developed Urban Runoff to Brazos River
Computation of 25-Year, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 5.30 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	25-yr, 24-hr Storm Runoff Volume (inches) ⑦	25-yr, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-E											
Connected	L019	610.00	203.51	87	1.49	3.85	195.74	-1416.71	1416.71		L020
Connected	L020	225.00	27.03	80	2.50	3.16	59.18	-1448.86	1448.86		L021
Connected	L021	1463.00	1465.35	84	1.90	3.55	432.31	-415.82	415.82	All to storm sewer	
Connected	L022	464.00	228.24	82	2.20	3.35	129.48	98.76	0.00		L023N
Connected	L023S	421.00	62.36	86	1.63	3.75	131.49	-1413.60	1413.60		L023N
Connected	L023N	160.00	39.10	86	1.63	3.75	49.97	-1424.48	1424.48		L019
Connected	L024	389.00	205.75	82	2.20	3.35	108.56	-1344.48	1344.48		L023S
Connected	L025	481.00	87.43	87	1.49	3.85	154.35	-1441.67	1441.67		L024S
Connected	L026	882.00	85.62	88	1.36	3.95	290.66	-1374.75	1374.75		L025
Connected	L027	563.00	61.49	83	2.05	3.45	161.71	-1169.71	1169.71		L026
Connected	L031	506.00	97.26	91	0.99	4.27	180.21	-1069.49	1069.49		L027
	L033	36.00	8.49	83	2.05	3.45	10.34	-1.85	1.85		L035
	L035	496.00	1.20	86	1.63	3.75	154.91	-323.01	323.01		L037
Connected	L037	1493.00	301.32	87	1.49	3.85	479.08	-986.54	986.54		L031
	L039	543.00	70.98	88	1.36	3.95	178.95	-107.97	107.97		L037
	L039A	344.00	43.90	83	2.05	3.45	98.81	-262.82	262.82		L037
	L096	488.00	52.79	84	1.90	3.55	144.20	-91.41	91.41		L035
	L097	334.00	17.17	82	2.20	3.35	93.21	-76.04	76.04		L035
	L099	469.00	19.74	83	2.05	3.45	134.71	-114.97	114.97		L037
	L100	821.00	27.90	83	2.05	3.45	235.82	-207.92	207.92		L039A
	L101	418.00	144.63	84	1.90	3.55	123.52	21.11	0.00		L039A
	L138	253.00	15.20	81	2.35	3.25	68.56	-53.36	53.36		L139
	L139	541.00	540.89	85	1.76	3.65	164.39	323.14	0.00		L100
Vanda	E1	135.60	None	84	1.90	3.55	40.07				
Vanda	E2	241.60	None	84	1.90	3.55	71.39				
Vanda	E3	1117.20	None	84	1.90	3.55	330.13				
Totals		13,894.40					4,221.75				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Volume to river is sum of runoff to Lake 37 and Lakes 19 through 27, plus runoff to Lake 31, plus overflow from Lakes 35, 39, 39A, 99 to Lake 37 = 3,623.11
plus the Vanda area runoff volume

Round to 3623

TABLE 4-11
Discharge Point 30
Playa System E Developed Urban Runoff to Brazos River
Computation of 50-Year, 24-hour Storm Runoff Volume
and Discharge from Upstream Playas

Precipitation (P): 6.00 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	50-yr, 24-hr Storm Runoff Volume (inches) ⑦	50-yr, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-E											
Connected	L019	610.00	203.51	87	1.49	4.52	229.62	-1914.56	1914.56		L020
Connected	L020	225.00	27.03	80	2.50	3.78	70.90	-1958.43	1958.43		L021
Connected	L021	1463.00	1465.35	84	1.90	4.20	511.62	-1004.70	1004.70	All to storm sewer	
Connected	L022	464.00	228.24	82	2.20	3.99	154.17	74.07	0.00		L023N
Connected	L023S	421.00	62.36	86	1.63	4.41	154.70	-1868.75	1868.75		L023N
Connected	L023N	160.00	39.10	86	1.63	4.41	58.79	-1888.44	1888.44		L019
Connected	L024	389.00	205.75	82	2.20	3.99	129.25	-1776.41	1776.41		L023S
Connected	L025	481.00	87.43	87	1.49	4.52	181.06	-1852.91	1852.91		L024S
Connected	L026	882.00	85.62	88	1.36	4.63	340.00	-1759.28	1759.28		L025
Connected	L027	563.00	61.49	83	2.05	4.09	191.95	-1504.90	1504.90		L026
Connected	L031	506.00	97.26	91	0.99	4.96	209.03	-1374.43	1374.43		L027
	L033	36.00	8.49	83	2.05	4.09	12.27	-3.78	3.78		L035
	L035	496.00	1.20	86	1.63	4.41	182.26	-396.51	396.51		L037
Connected	L037	1493.00	301.32	87	1.49	4.52	562.02	-1262.67	1262.67		L031
	L039	543.00	70.98	88	1.36	4.63	209.32	-138.34	138.34		L037
	L039A	344.00	43.90	83	2.05	4.09	117.29	-326.95	326.95		L037
	L096	488.00	52.79	84	1.90	4.20	170.66	-117.87	117.87		L035
	L097	334.00	17.17	82	2.20	3.99	110.97	-93.80	93.80		L035
	L099	469.00	19.74	83	2.05	4.09	159.90	-140.16	140.16		L037
	L100	821.00	27.90	83	2.05	4.09	279.92	-252.02	252.02		L039A
	L101	418.00	144.63	84	1.90	4.20	146.18	-1.55	1.55		L039A
	L138	253.00	15.20	81	2.35	3.88	81.88	-66.68	66.68		L139
	L139	541.00	540.89	85	1.76	4.30	193.97	280.24	0.00		L100
Vanda	E1	135.60	None	84	1.90	4.20	47.42				
Vanda	E2	241.60	None	84	1.90	4.20	84.49				
Vanda	E3	1117.20	None	84	1.90	4.20	390.69				
Totals		13,894.40					4,980.35				

Checked

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Volume to river is sum of runoff to Lake 37 and Lakes 19 through 27, plus runoff to Lake 31, plus overflow from Lakes 35, 39, 39A, 99 to Lake 37 = 4,317.69
plus the Vanda area runoff volume Round to 4318

TABLE 4-12
Discharge Point 30
Playa System E Developed Urban Runoff to Brazos River
Computation of 100-Year, 24-hour Storm Runoff Volume
and Discharge from Upstream Playas

Precipitation (P):	6.80	inches (Source: TP40)
Initial Abstraction (Ia):	0.20	S

FILENAME: COL WATER RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID		Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	100-yr, 24-hr Storm Runoff Volume (inches) ⑦	100-yr, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-E												
	Connected	L019	610.00	203.51	87	1.49	5.29	268.71	-2514.44	2514.44		L020
	Connected	L020	225.00	27.03	80	2.50	4.51	84.57	-2571.97	2571.97		L021
	Connected	L021	1463.00	1465.35	84	1.90	4.95	603.51	-1710.13	1710.13	All to storm sewer	
	Connected	L022	464.00	228.24	82	2.20	4.73	182.86	45.38	0.00		L023N
	Connected	L023S	421.00	62.36	86	1.63	5.17	181.51	-2419.35	2419.35		L023N
	Connected	L023N	160.00	39.10	86	1.63	5.17	68.98	-2449.23	2449.23		L019
	Connected	L024	389.00	205.75	82	2.20	4.73	153.30	-2300.21	2300.21		L023S
	Connected	L025	481.00	87.43	87	1.49	5.29	211.89	-2352.66	2352.66		L024S
	Connected	L026	882.00	85.62	88	1.36	5.40	396.85	-2228.20	2228.20		L025
	Connected	L027	563.00	61.49	83	2.05	4.84	227.04	-1916.97	1916.97		L026
	Connected	L031	506.00	97.26	91	0.99	5.74	242.12	-1751.42	1751.42		L027
		L033	36.00	8.49	83	2.05	4.84	14.52	-6.03	6.03		L035
		L035	496.00	1.20	86	1.63	5.17	213.84	-481.64	481.64		L037
	Connected	L037	1493.00	301.32	87	1.49	5.29	657.69	-1606.56	1606.56		L031
		L039	543.00	70.98	88	1.36	5.40	244.32	-173.34	173.34		L037
		L039A	344.00	43.90	83	2.05	4.84	138.73	-425.82	425.82		L037
		L096	488.00	52.79	84	1.90	4.95	201.31	-148.52	148.52		L035
		L097	334.00	17.17	82	2.20	4.73	131.62	-114.45	114.45		L035
		L099	469.00	19.74	83	2.05	4.84	189.14	-169.40	169.40		L037
		L100	821.00	27.90	83	2.05	4.84	331.09	-303.19	303.19		L039A
		L101	418.00	144.63	84	1.90	4.95	172.43	-27.80	27.80		L039A
		L138	253.00	15.20	81	2.35	4.62	97.39	-82.19	82.19		L139
		L139	541.00	540.89	85	1.76	5.06	228.19	230.51	0.00		L100
	Vanda	E1	135.60	None	84	1.90	4.95	55.94				
	Vanda	E2	241.60	None	84	1.90	4.95	99.66				
	Vanda	E3	1117.20	None	84	1.90	4.95	460.86				
	Totals		13,894.40					5,858.05				

COL. 1 FROM MICROSTATION CADD WATERSHED DELINEATIONS

COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS

COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0

COL. 4 = COL. 2 - COL. 3

COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.

COL. 6 = (1000/COL. 5)-10

COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)

COL. 8 = (COL. 1 * COL. 7)/12

COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)

COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA

COL. 11 = SUB-BASIN ID

COL. 12 = PLAYA LAKE ID

Checked

Volume to river is sum of runoff to Lake 37 and Lakes 19 through 27, plus runoff to Lake 31, plus overflow from Lakes 35, 39, 39A, 99 to Lake 37 = 5,145.67
plus the Vanda area runoff volume Round to 5146

SCLDIP

Table 4-13
Discharge Point 30, 72-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 0.5-Inch Precipitation

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af	Total Vol Out af
0.5-Inch	MH_A1-01	LINE-A1	0.00	3113.500	3132.980	642	0.000	0.000	0.000	0.000	0.000	0.000	-587.187	0.0	0.0
0.5-Inch	MH_A1-01	LINE-A1	1.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.115	35.115	34.795	1.5	-22.8
0.5-Inch	MH_A1-01	LINE-A1	2.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.886	34.886	35.178	4.3	-19.9
0.5-Inch	MH_A1-01	LINE-A1	3.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	7.2	-17.0
0.5-Inch	MH_A1-01	LINE-A1	4.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.008	35.008	34.993	10.1	-14.1
0.5-Inch	MH_A1-01	LINE-A1	5.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.028	35.028	34.958	13.0	-11.3
0.5-Inch	MH_A1-01	LINE-A1	6.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	15.9	-8.4
0.5-Inch	MH_A1-01	LINE-A1	7.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.771	34.771	35.340	18.8	-5.5
0.5-Inch	MH_A1-01	LINE-A1	8.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	21.7	-2.6
0.5-Inch	MH_A1-01	LINE-A1	9.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.009	35.009	34.997	24.6	0.3
0.5-Inch	MH_A1-01	LINE-A1	10.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.079	35.079	34.886	27.5	3.2
0.5-Inch	MH_A1-01	LINE-A1	11.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.980	34.980	35.037	30.4	6.1
0.5-Inch	MH_A1-01	LINE-A1	12.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	33.3	9.0
0.5-Inch	MH_A1-01	LINE-A1	13.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	36.1	11.9
0.5-Inch	MH_A1-01	LINE-A1	14.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.014	35.014	35.014	39.0	14.8
0.5-Inch	MH_A1-01	LINE-A1	15.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	35.146	35.146	35.146	41.9	17.7
0.5-Inch	MH_A1-01	LINE-A1	16.00	3124.061	3132.980	514	0.000	0.000	0.000	0.000	35.433	35.433	35.432	44.9	20.6
0.5-Inch	MH_A1-01	LINE-A1	17.00	3124.062	3132.980	514	0.000	0.000	0.000	0.000	35.709	35.709	35.709	47.8	23.6
0.5-Inch	MH_A1-01	LINE-A1	18.00	3124.062	3132.980	514	0.000	0.000	0.000	0.000	35.886	35.886	35.886	50.8	26.5
0.5-Inch	MH_A1-01	LINE-A1	19.00	3124.063	3132.980	514	0.000	0.000	0.000	0.000	35.985	35.985	35.985	53.7	29.5
0.5-Inch	MH_A1-01	LINE-A1	20.00	3124.063	3132.980	514	0.000	0.000	0.000	0.000	36.030	36.030	36.030	56.7	32.5
0.5-Inch	MH_A1-01	LINE-A1	21.00	3124.063	3132.980	514	0.000	0.000	0.000	0.000	36.021	36.021	36.021	59.7	35.4
0.5-Inch	MH_A1-01	LINE-A1	22.00	3124.063	3132.980	514	0.000	0.000	0.000	0.000	35.986	35.986	35.986	62.7	38.4
0.5-Inch	MH_A1-01	LINE-A1	23.00	3124.063	3132.980	514	0.000	0.000	0.000	0.000	35.959	35.959	35.959	65.6	41.4
0.5-Inch	MH_A1-01	LINE-A1	24.00	3124.063	3132.980	514	0.000	0.000	0.000	0.000	35.946	35.946	35.946	68.6	44.4
0.5-Inch	MH_A1-01	LINE-A1	25.00	3124.062	3132.980	514	0.000	0.000	0.000	0.000	35.919	35.919	35.919	71.6	47.3
0.5-Inch	MH_A1-01	LINE-A1	26.00	3124.062	3132.980	514	0.000	0.000	0.000	0.000	35.716	35.716	35.717	74.5	50.3
0.5-Inch	MH_A1-01	LINE-A1	27.00	3124.061	3132.980	514	0.000	0.000	0.000	0.000	35.416	35.416	35.416	77.5	53.2
0.5-Inch	MH_A1-01	LINE-A1	28.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	35.203	35.203	35.203	80.4	56.1
0.5-Inch	MH_A1-01	LINE-A1	29.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	35.091	35.091	35.091	83.3	59.0
0.5-Inch	MH_A1-01	LINE-A1	30.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.037	35.037	35.037	86.2	61.9
0.5-Inch	MH_A1-01	LINE-A1	31.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.007	35.007	35.007	89.1	64.8
0.5-Inch	MH_A1-01	LINE-A1	32.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	92.0	67.7
0.5-Inch	MH_A1-01	LINE-A1	33.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	94.9	70.6
0.5-Inch	MH_A1-01	LINE-A1	34.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	97.8	73.5
0.5-Inch	MH_A1-01	LINE-A1	35.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	100.7	76.4
0.5-Inch	MH_A1-01	LINE-A1	36.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	103.5	79.3
0.5-Inch	MH_A1-01	LINE-A1	37.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	106.4	82.2
0.5-Inch	MH_A1-01	LINE-A1	38.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	109.3	85.1
0.5-Inch	MH_A1-01	LINE-A1	39.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	112.2	88.0
0.5-Inch	MH_A1-01	LINE-A1	40.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	115.1	90.9
0.5-Inch	MH_A1-01	LINE-A1	41.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	118.0	93.8
0.5-Inch	MH_A1-01	LINE-A1	42.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.998	34.998	34.998	120.9	96.7
0.5-Inch	MH_A1-01	LINE-A1	43.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	123.8	99.5
0.5-Inch	MH_A1-01	LINE-A1	44.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	126.7	102.4
0.5-Inch	MH_A1-01	LINE-A1	45.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	129.6	105.3
0.5-Inch	MH_A1-01	LINE-A1	46.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	132.5	108.2
0.5-Inch	MH_A1-01	LINE-A1	47.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	135.4	111.1
0.5-Inch	MH_A1-01	LINE-A1	48.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	138.3	114.0
0.5-Inch	MH_A1-01	LINE-A1	49.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	141.1	116.9
0.5-Inch	MH_A1-01	LINE-A1	50.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	144.0	119.8
0.5-Inch	MH_A1-01	LINE-A1	51.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	146.9	122.7
0.5-Inch	MH_A1-01	LINE-A1	52.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	149.8	125.6
0.5-Inch	MH_A1-01	LINE-A1	53.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	152.7	128.5
0.5-Inch	MH_A1-01	LINE-A1	54.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.998	34.998	34.998	155.6	131.4
0.5-Inch	MH_A1-01	LINE-A1	55.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	158.5	134.3
0.5-Inch	MH_A1-01	LINE-A1	56.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	161.4	137.2
0.5-Inch	MH_A1-01	LINE-A1	57.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	164.3	140.0
0.5-Inch	MH_A1-01	LINE-A1	58.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	167.2	142.9
0.5-Inch	MH_A1-01	LINE-A1	59.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	170.1	145.8
0.5-Inch	MH_A1-01	LINE-A1	60.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	173.0	148.7
0.5-Inch	MH_A1-01	LINE-A1	61.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	175.9	151.6
0.5-Inch	MH_A1-01	LINE-A1	62.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	178.8	154.5
0.5-Inch	MH_A1-01	LINE-A1	63.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	181.6	157.4
0.5-Inch	MH_A1-01	LINE-A1	64.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	184.5	160.3
0.5-Inch	MH_A1-01	LINE-A1	65.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	187.4	163.2
0.5-Inch	MH_A1-01	LINE-A1	66.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	190.3	166.1
0.5-Inch	MH_A1-01	LINE-A1	67.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	193.2	169.0
0.5-Inch	MH_A1-01	LINE-A1	68.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	196.1	171.9
0.5-Inch	MH_A1-01	LINE-A1	69.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.998	34.998	34.998	199.0	174.8

Table 4-14
Discharge Point 30, 72-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 1.0-Inch Precipitation

SCLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af	Total Vol Out af
1.0-Inch	MH_A1-01	LINE-A1	0.00	3113.500	3132.980	642	0.000	0.000	0.000	0.000	0.000	0.000	-587.187	0.0	0.0
1.0-Inch	MH_A1-01	LINE-A1	1.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.115	35.115	34.795	1.5	-22.8
1.0-Inch	MH_A1-01	LINE-A1	2.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.886	34.886	35.178	4.3	-19.9
1.0-Inch	MH_A1-01	LINE-A1	3.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	7.2	-17.0
1.0-Inch	MH_A1-01	LINE-A1	4.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.008	35.008	34.993	10.1	-14.1
1.0-Inch	MH_A1-01	LINE-A1	5.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.028	35.028	34.958	13.0	-11.3
1.0-Inch	MH_A1-01	LINE-A1	6.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	15.9	-8.4
1.0-Inch	MH_A1-01	LINE-A1	7.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.771	34.771	35.340	18.8	-5.5
1.0-Inch	MH_A1-01	LINE-A1	8.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	21.7	-2.6
1.0-Inch	MH_A1-01	LINE-A1	9.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.009	35.009	34.997	24.6	0.3
1.0-Inch	MH_A1-01	LINE-A1	10.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.079	35.079	34.886	27.5	3.2
1.0-Inch	MH_A1-01	LINE-A1	11.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.980	34.980	35.037	30.4	6.1
1.0-Inch	MH_A1-01	LINE-A1	12.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.005	35.005	35.005	33.3	9.0
1.0-Inch	MH_A1-01	LINE-A1	13.00	3124.087	3132.980	514	0.000	0.000	0.000	0.000	42.444	42.444	42.434	36.5	12.2
1.0-Inch	MH_A1-01	LINE-A1	14.00	3124.193	3132.980	514	0.000	0.000	0.000	0.000	61.874	61.874	61.860	40.8	16.5
1.0-Inch	MH_A1-01	LINE-A1	15.00	3124.213	3132.980	514	0.000	0.000	0.000	0.000	65.001	65.001	65.001	46.0	21.8
1.0-Inch	MH_A1-01	LINE-A1	16.00	3124.267	3132.980	514	0.000	0.000	0.000	0.000	72.774	72.774	72.717	51.7	27.5
1.0-Inch	MH_A1-01	LINE-A1	17.00	3124.332	3132.980	514	0.000	0.000	0.000	0.000	81.150	81.150	81.150	58.1	33.8
1.0-Inch	MH_A1-01	LINE-A1	18.00	3124.318	3132.980	514	0.000	0.000	0.000	0.000	79.382	79.382	79.385	64.7	40.4
1.0-Inch	MH_A1-01	LINE-A1	19.00	3124.294	3132.980	514	0.000	0.000	0.000	0.000	76.325	76.325	76.328	71.1	46.9
1.0-Inch	MH_A1-01	LINE-A1	20.00	3124.273	3132.980	514	0.000	0.000	0.000	0.000	73.596	73.596	73.598	77.3	53.1
1.0-Inch	MH_A1-01	LINE-A1	21.00	3124.257	3132.980	514	0.000	0.000	0.000	0.000	71.336	71.336	71.338	83.3	59.1
1.0-Inch	MH_A1-01	LINE-A1	22.00	3124.243	3132.980	514	0.000	0.000	0.000	0.000	69.373	69.373	69.375	89.1	64.9
1.0-Inch	MH_A1-01	LINE-A1	23.00	3124.232	3132.980	514	0.000	0.000	0.000	0.000	67.781	67.781	67.783	94.8	70.5
1.0-Inch	MH_A1-01	LINE-A1	24.00	3124.224	3132.980	514	0.000	0.000	0.000	0.000	66.678	66.678	66.679	100.4	76.1
1.0-Inch	MH_A1-01	LINE-A1	25.00	3124.219	3132.980	514	0.000	0.000	0.000	0.000	65.794	65.794	65.795	105.8	81.6
1.0-Inch	MH_A1-01	LINE-A1	26.00	3124.205	3132.980	514	0.000	0.000	0.000	0.000	63.750	63.750	63.753	111.2	86.9
1.0-Inch	MH_A1-01	LINE-A1	27.00	3124.182	3132.980	514	0.000	0.000	0.000	0.000	60.015	60.015	60.019	116.3	92.0
1.0-Inch	MH_A1-01	LINE-A1	28.00	3124.152	3132.980	514	0.000	0.000	0.000	0.000	56.021	56.021	56.024	121.1	96.8
1.0-Inch	MH_A1-01	LINE-A1	29.00	3124.138	3132.980	514	0.000	0.000	0.000	0.000	53.359	53.359	53.359	125.6	101.4
1.0-Inch	MH_A1-01	LINE-A1	30.00	3124.131	3132.980	514	0.000	0.000	0.000	0.000	51.964	51.964	51.965	130.0	105.7
1.0-Inch	MH_A1-01	LINE-A1	31.00	3124.126	3132.980	514	0.000	0.000	0.000	0.000	50.938	50.938	50.938	134.2	110.0
1.0-Inch	MH_A1-01	LINE-A1	32.00	3124.122	3132.980	514	0.000	0.000	0.000	0.000	50.254	50.254	50.112	138.4	114.1
1.0-Inch	MH_A1-01	LINE-A1	33.00	3124.119	3132.980	514	0.000	0.000	0.000	0.000	49.648	49.648	49.649	142.5	118.3
1.0-Inch	MH_A1-01	LINE-A1	34.00	3124.117	3132.980	514	0.000	0.000	0.000	0.000	49.242	49.242	49.242	146.6	122.4
1.0-Inch	MH_A1-01	LINE-A1	35.00	3124.116	3132.980	514	0.000	0.000	0.000	0.000	48.912	48.912	48.966	150.7	126.4
1.0-Inch	MH_A1-01	LINE-A1	36.00	3124.115	3132.980	514	0.000	0.000	0.000	0.000	48.693	48.693	48.693	154.7	130.4
1.0-Inch	MH_A1-01	LINE-A1	37.00	3124.114	3132.980	514	0.000	0.000	0.000	0.000	48.505	48.505	48.506	158.7	134.5
1.0-Inch	MH_A1-01	LINE-A1	38.00	3124.113	3132.980	514	0.000	0.000	0.000	0.000	48.362	48.362	48.362	162.7	138.5
1.0-Inch	MH_A1-01	LINE-A1	39.00	3124.113	3132.980	514	0.000	0.000	0.000	0.000	48.241	48.241	48.241	166.7	142.5
1.0-Inch	MH_A1-01	LINE-A1	40.00	3124.112	3132.980	514	0.000	0.000	0.000	0.000	48.144	48.144	48.144	170.7	146.4
1.0-Inch	MH_A1-01	LINE-A1	41.00	3124.112	3132.980	514	0.000	0.000	0.000	0.000	48.061	48.061	48.061	174.7	150.4
1.0-Inch	MH_A1-01	LINE-A1	42.00	3124.111	3132.980	514	0.000	0.000	0.000	0.000	47.987	47.987	47.987	178.6	154.4
1.0-Inch	MH_A1-01	LINE-A1	43.00	3124.111	3132.980	514	0.000	0.000	0.000	0.000	47.917	47.917	47.917	182.6	158.3
1.0-Inch	MH_A1-01	LINE-A1	44.00	3124.111	3132.980	514	0.000	0.000	0.000	0.000	47.848	47.848	47.848	186.6	162.3
1.0-Inch	MH_A1-01	LINE-A1	45.00	3124.110	3132.980	514	0.000	0.000	0.000	0.000	47.778	47.778	47.778	190.5	166.3
1.0-Inch	MH_A1-01	LINE-A1	46.00	3124.110	3132.980	514	0.000	0.000	0.000	0.000	47.704	47.704	47.704	194.5	170.2
1.0-Inch	MH_A1-01	LINE-A1	47.00	3124.110	3132.980	514	0.000	0.000	0.000	0.000	47.628	47.628	47.628	198.4	174.1
1.0-Inch	MH_A1-01	LINE-A1	48.00	3124.109	3132.980	514	0.000	0.000	0.000	0.000	47.547	47.547	47.547	202.3	178.1
1.0-Inch	MH_A1-01	LINE-A1	49.00	3124.109	3132.980	514	0.000	0.000	0.000	0.000	47.462	47.462	47.462	206.3	182.0
1.0-Inch	MH_A1-01	LINE-A1	50.00	3124.109	3132.980	514	0.000	0.000	0.000	0.000	47.373	47.373	47.373	210.2	185.9
1.0-Inch	MH_A1-01	LINE-A1	51.00	3124.108	3132.980	514	0.000	0.000	0.000	0.000	47.281	47.281	47.281	214.1	189.8
1.0-Inch	MH_A1-01	LINE-A1	52.00	3124.108	3132.980	514	0.000	0.000	0.000	0.000	47.186	47.186	47.186	218.0	193.7
1.0-Inch	MH_A1-01	LINE-A1	53.00	3124.107	3132.980	514	0.000	0.000	0.000	0.000	47.089	47.089	47.089	221.9	197.6
1.0-Inch	MH_A1-01	LINE-A1	54.00	3124.107	3132.980	514	0.000	0.000	0.000	0.000	46.988	46.988	46.988	225.8	201.5
1.0-Inch	MH_A1-01	LINE-A1	55.00	3124.106	3132.980	514	0.000	0.000	0.000	0.000	46.885	46.885	46.885	229.6	205.4
1.0-Inch	MH_A1-01	LINE-A1	56.00	3124.106	3132.980	514	0.000	0.000	0.000	0.000	46.780	46.780	46.780	233.5	209.3
1.0-Inch	MH_A1-01	LINE-A1	57.00	3124.105	3132.980	514	0.000	0.000	0.000	0.000	46.678	46.678	46.678	237.4	213.1
1.0-Inch	MH_A1-01	LINE-A1	58.00	3124.105	3132.980	514	0.000	0.000	0.000	0.000	46.565	46.565	46.565	241.2	217.0
1.0-Inch	MH_A1-01	LINE-A1	59.00	3124.104	3132.980	514	0.000	0.000	0.000	0.000	46.454	46.454	46.454	245.1	220.8
1.0-Inch	MH_A1-01	LINE-A1	60.00	3124.104	3132.980	514	0.000	0.000	0.000	0.000	46.343	46.343	46.343	248.9	224.7
1.0-Inch	MH_A1-01	LINE-A1	61.00	3124.103	3132.980	514	0.000	0.000	0.000	0.000	46.232	46.232	46.232	252.7	228.5
1.0-Inch	MH_A1-01	LINE-A1	62.00	3124.103	3132.980	514	0.000	0.000	0.000	0.000	46.117	46.117	46.117	256.6	232.3
1.0-Inch	MH_A1-01	LINE-A1	63.00	3124.102	3132.980	514	0.000	0.000	0.000	0.000	46.004	46.004	46.004	260.4	236.1
1.0-Inch	MH_A1-01	LINE-A1	64.00	3124.102	3132.980	514	0.000	0.000	0.000	0.000	45.893	45.893	45.893	264.2	239.9
1.0-Inch	MH_A1-01	LINE-A1	65.00	3124.101	3132.980	514	0.000	0.000	0.000	0.000	45.777	45.777	45.777	267.9	243.7
1.0-Inch	MH_A1-01	LINE-A1	66.00	3124.101	3132.980	514	0.000	0.000	0.000	0.000	45.667	45.667	45.667	271.7	247.5
1.0-Inch	MH_A1-01	LINE-A1	67.00	3124.100	3132.980	514	0.000	0.000	0.000	0.000	45.561	45.561	45.561	275.5	251.2
1.0-Inch	MH_A1-01	LINE-A1	68.00	3124.100	3132.980	514	0.000	0.000	0.000	0.000	45.452	45.452	45.452	279.3	255.0
1.0-Inch	MH_A1-01	LINE-A1	69.00	3124.100	3132.980	514	0.000	0.000	0.000	0.000	45.345	45.345	45.349	283.0	258.8

SCLDIP

Table 4-15
Discharge Point 30, 72-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 1.5-Inch Precipitation

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af	Total Vol Out af
1.5-Inch	MH_A1-01	LINE-A1	0.00	3113.500	3132.980	642	0.000	0.000	0.000	0.000	0.000	0.000	-587.187	0.0	0.0
1.5-Inch	MH_A1-01	LINE-A1	1.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.115	35.115	34.795	1.5	-22.8
1.5-Inch	MH_A1-01	LINE-A1	2.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.886	34.886	35.178	4.3	-19.9
1.5-Inch	MH_A1-01	LINE-A1	3.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	7.2	-17.0
1.5-Inch	MH_A1-01	LINE-A1	4.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.008	35.008	34.993	10.1	-14.1
1.5-Inch	MH_A1-01	LINE-A1	5.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.028	35.028	34.958	13.0	-11.3
1.5-Inch	MH_A1-01	LINE-A1	6.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	15.9	-8.4
1.5-Inch	MH_A1-01	LINE-A1	7.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.771	34.771	35.340	18.8	-5.5
1.5-Inch	MH_A1-01	LINE-A1	8.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	21.7	-2.6
1.5-Inch	MH_A1-01	LINE-A1	9.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.009	35.009	34.997	24.6	0.3
1.5-Inch	MH_A1-01	LINE-A1	10.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	27.5	3.2
1.5-Inch	MH_A1-01	LINE-A1	11.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	30.4	6.1
1.5-Inch	MH_A1-01	LINE-A1	12.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	35.159	35.159	35.158	33.3	9.0
1.5-Inch	MH_A1-01	LINE-A1	13.00	3124.165	3132.980	514	0.000	0.000	0.000	0.000	58.405	58.405	58.362	37.1	12.9
1.5-Inch	MH_A1-01	LINE-A1	14.00	3124.213	3132.980	514	0.000	0.000	0.000	0.000	64.999	64.999	64.999	42.2	18.0
1.5-Inch	MH_A1-01	LINE-A1	15.00	3125.044	3132.980	514	0.000	0.000	0.000	0.000	142.263	142.263	142.196	50.8	26.5
1.5-Inch	MH_A1-01	LINE-A1	16.00	3125.312	3132.980	514	0.000	0.000	0.000	0.000	160.407	160.407	160.325	63.3	39.0
1.5-Inch	MH_A1-01	LINE-A1	17.00	3125.375	3132.980	514	0.000	0.000	0.000	0.000	164.115	164.115	164.120	76.7	52.5
1.5-Inch	MH_A1-01	LINE-A1	18.00	3125.354	3132.980	514	0.000	0.000	0.000	0.000	162.900	162.900	162.890	90.2	66.0
1.5-Inch	MH_A1-01	LINE-A1	19.00	3125.226	3132.980	514	0.000	0.000	0.000	0.000	154.958	154.958	154.955	103.4	79.1
1.5-Inch	MH_A1-01	LINE-A1	20.00	3125.185	3132.980	514	0.000	0.000	0.000	0.000	152.254	152.254	152.448	116.0	91.8
1.5-Inch	MH_A1-01	LINE-A1	21.00	3125.159	3132.980	514	0.000	0.000	0.000	0.000	149.837	149.837	149.826	128.5	104.3
1.5-Inch	MH_A1-01	LINE-A1	22.00	3125.067	3132.980	514	0.000	0.000	0.000	0.000	143.735	143.735	143.744	140.7	116.4
1.5-Inch	MH_A1-01	LINE-A1	23.00	3124.969	3132.980	514	0.000	0.000	0.000	0.000	136.865	136.865	137.074	152.3	128.0
1.5-Inch	MH_A1-01	LINE-A1	24.00	3124.909	3132.980	514	0.000	0.000	0.000	0.000	132.668	132.668	132.735	163.4	139.2
1.5-Inch	MH_A1-01	LINE-A1	25.00	3124.908	3132.980	514	0.000	0.000	0.000	0.000	132.565	132.565	132.623	174.4	150.1
1.5-Inch	MH_A1-01	LINE-A1	26.00	3124.888	3132.980	514	0.000	0.000	0.000	0.000	131.062	131.062	131.188	185.2	161.0
1.5-Inch	MH_A1-01	LINE-A1	27.00	3124.663	3132.980	514	0.000	0.000	0.000	0.000	114.642	114.642	114.551	195.4	171.2
1.5-Inch	MH_A1-01	LINE-A1	28.00	3124.459	3132.980	514	0.000	0.000	0.000	0.000	95.391	95.391	95.411	204.1	179.9
1.5-Inch	MH_A1-01	LINE-A1	29.00	3124.363	3132.980	514	0.000	0.000	0.000	0.000	84.763	84.763	84.774	211.5	187.3
1.5-Inch	MH_A1-01	LINE-A1	30.00	3124.309	3132.980	514	0.000	0.000	0.000	0.000	78.274	78.274	78.279	218.3	194.1
1.5-Inch	MH_A1-01	LINE-A1	31.00	3124.277	3132.980	514	0.000	0.000	0.000	0.000	74.077	74.077	74.082	224.6	200.4
1.5-Inch	MH_A1-01	LINE-A1	32.00	3124.254	3132.980	514	0.000	0.000	0.000	0.000	71.687	71.687	70.582	230.6	206.3
1.5-Inch	MH_A1-01	LINE-A1	33.00	3124.242	3132.980	514	0.000	0.000	0.000	0.000	69.207	69.207	69.207	236.4	212.1
1.5-Inch	MH_A1-01	LINE-A1	34.00	3124.232	3132.980	514	0.000	0.000	0.000	0.000	67.838	67.838	67.854	242.1	217.8
1.5-Inch	MH_A1-01	LINE-A1	35.00	3124.223	3132.980	514	0.000	0.000	0.000	0.000	66.642	66.642	66.484	247.6	223.3
1.5-Inch	MH_A1-01	LINE-A1	36.00	3124.216	3132.980	514	0.000	0.000	0.000	0.000	65.411	65.411	65.412	253.1	228.8
1.5-Inch	MH_A1-01	LINE-A1	37.00	3124.208	3132.980	514	0.000	0.000	0.000	0.000	64.411	64.411	64.112	258.4	234.1
1.5-Inch	MH_A1-01	LINE-A1	38.00	3124.202	3132.980	514	0.000	0.000	0.000	0.000	63.222	63.222	63.215	263.7	239.4
1.5-Inch	MH_A1-01	LINE-A1	39.00	3124.190	3132.980	514	0.000	0.000	0.000	0.000	61.475	61.475	61.402	268.9	244.5
1.5-Inch	MH_A1-01	LINE-A1	40.00	3124.183	3132.980	514	0.000	0.000	0.000	0.000	59.590	59.590	60.482	273.9	249.6
1.5-Inch	MH_A1-01	LINE-A1	41.00	3124.175	3132.980	514	0.000	0.000	0.000	0.000	58.807	58.807	58.806	278.8	254.5
1.5-Inch	MH_A1-01	LINE-A1	42.00	3124.164	3132.980	514	0.000	0.000	0.000	0.000	58.178	58.178	58.177	283.6	259.3
1.5-Inch	MH_A1-01	LINE-A1	43.00	3124.161	3132.980	514	0.000	0.000	0.000	0.000	57.642	57.642	57.658	288.4	264.1
1.5-Inch	MH_A1-01	LINE-A1	44.00	3124.161	3132.980	514	0.000	0.000	0.000	0.000	56.427	56.427	58.215	293.1	268.9
1.5-Inch	MH_A1-01	LINE-A1	45.00	3124.156	3132.980	514	0.000	0.000	0.000	0.000	56.807	56.807	56.705	297.8	273.7
1.5-Inch	MH_A1-01	LINE-A1	46.00	3124.154	3132.980	514	0.000	0.000	0.000	0.000	56.458	56.458	56.458	302.5	278.3
1.5-Inch	MH_A1-01	LINE-A1	47.00	3124.153	3132.980	514	0.000	0.000	0.000	0.000	56.205	56.205	56.217	307.1	283.0
1.5-Inch	MH_A1-01	LINE-A1	48.00	3124.153	3132.980	514	0.000	0.000	0.000	0.000	55.872	55.872	56.255	311.7	287.6
1.5-Inch	MH_A1-01	LINE-A1	49.00	3124.151	3132.980	514	0.000	0.000	0.000	0.000	55.884	55.884	55.884	316.4	292.3
1.5-Inch	MH_A1-01	LINE-A1	50.00	3124.151	3132.980	514	0.000	0.000	0.000	0.000	55.781	55.781	55.781	321.0	296.9
1.5-Inch	MH_A1-01	LINE-A1	51.00	3124.150	3132.980	514	0.000	0.000	0.000	0.000	55.707	55.707	55.707	325.6	301.5
1.5-Inch	MH_A1-01	LINE-A1	52.00	3124.150	3132.980	514	0.000	0.000	0.000	0.000	55.660	55.660	55.660	330.2	306.1
1.5-Inch	MH_A1-01	LINE-A1	53.00	3124.150	3132.980	514	0.000	0.000	0.000	0.000	55.633	55.633	55.633	334.8	310.7
1.5-Inch	MH_A1-01	LINE-A1	54.00	3124.150	3132.980	514	0.000	0.000	0.000	0.000	55.622	55.622	55.622	339.4	315.3
1.5-Inch	MH_A1-01	LINE-A1	55.00	3124.150	3132.980	514	0.000	0.000	0.000	0.000	55.639	55.639	55.639	344.0	319.9
1.5-Inch	MH_A1-01	LINE-A1	56.00	3124.150	3132.980	514	0.000	0.000	0.000	0.000	55.691	55.691	55.691	348.6	324.5
1.5-Inch	MH_A1-01	LINE-A1	57.00	3124.150	3132.980	514	0.000	0.000	0.000	0.000	55.765	55.765	55.765	353.2	329.1
1.5-Inch	MH_A1-01	LINE-A1	58.00	3124.151	3132.980	514	0.000	0.000	0.000	0.000	55.847	55.847	55.847	357.8	333.7
1.5-Inch	MH_A1-01	LINE-A1	59.00	3124.151	3132.980	514	0.000	0.000	0.000	0.000	55.934	55.934	55.934	362.4	338.3
1.5-Inch	MH_A1-01	LINE-A1	60.00	3124.152	3132.980	514	0.000	0.000	0.000	0.000	56.020	56.020	56.020	367.0	343.0
1.5-Inch	MH_A1-01	LINE-A1	61.00	3124.152	3132.980	514	0.000	0.000	0.000	0.000	56.106	56.106	56.106	371.7	347.6
1.5-Inch	MH_A1-01	LINE-A1	62.00	3124.153	3132.980	514	0.000	0.000	0.000	0.000	56.189	56.189	56.189	376.3	352.2
1.5-Inch	MH_A1-01	LINE-A1	63.00	3124.153	3132.980	514	0.000	0.000	0.000	0.000	56.269	56.269	56.269	381.0	356.9
1.5-Inch	MH_A1-01	LINE-A1	64.00	3124.154	3132.980	514	0.000	0.000	0.000	0.000	56.346	56.346	56.346	385.6	361.5
1.5-Inch	MH_A1-01	LINE-A1	65.00	3124.154	3132.980	514	0.000	0.000	0.000	0.000	56.420	56.420	56.420	390.3	366.2
1.5-Inch	MH_A1-01	LINE-A1	66.00	3124.154	3132.980	514	0.000	0.000	0.000	0.000	56.490	56.490	56.490	394.9	370.9
1.5-Inch	MH_A1-01	LINE-A1	67.00	3124.155	3132.980	514	0.000	0.000	0.000	0.000	56.558	56.558	56.557	399.6	375.5
1.5-Inch	MH_A1-01	LINE-A1	68.00	3124.155	3132.980	514	0.000	0.000	0.000	0.000	56.618	56.618	56.618	404.3	380.2
1.5-Inch	MH_A1-01	LINE-A1	69.00	3124.155	3132.980	514	0.000	0.000	0.000	0.000	56.669	56.669	56.669	409.0	384.9

Table 4-16
Discharge Point 30, 72-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 2.0-Inch Precipitation

SCLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af	Total Vol Out af
2.0-Inch	MH_A1-01	LINE-A1	0.00	3113.500	3132.980	642	0.000	0.000	0.000	0.000	0.000	0.000	-587.187	0.0	0.0
2.0-Inch	MH_A1-01	LINE-A1	1.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.115	35.115	34.795	1.5	-22.8
2.0-Inch	MH_A1-01	LINE-A1	2.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.886	34.886	35.178	4.3	-19.9
2.0-Inch	MH_A1-01	LINE-A1	3.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	7.2	-17.0
2.0-Inch	MH_A1-01	LINE-A1	4.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.008	35.008	34.993	10.1	-14.1
2.0-Inch	MH_A1-01	LINE-A1	5.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.028	35.028	34.958	13.0	-11.3
2.0-Inch	MH_A1-01	LINE-A1	6.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	15.9	-8.4
2.0-Inch	MH_A1-01	LINE-A1	7.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.771	34.771	35.340	18.8	-5.5
2.0-Inch	MH_A1-01	LINE-A1	8.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	21.7	-2.6
2.0-Inch	MH_A1-01	LINE-A1	9.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	24.6	0.3
2.0-Inch	MH_A1-01	LINE-A1	10.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	27.5	3.2
2.0-Inch	MH_A1-01	LINE-A1	11.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.022	35.022	35.022	30.4	6.1
2.0-Inch	MH_A1-01	LINE-A1	12.00	3124.066	3132.980	514	0.000	0.000	0.000	0.000	36.960	36.960	36.956	33.3	9.1
2.0-Inch	MH_A1-01	LINE-A1	13.00	3124.212	3132.980	514	0.000	0.000	0.000	0.000	64.742	64.742	64.738	37.5	13.3
2.0-Inch	MH_A1-01	LINE-A1	14.00	3124.214	3132.980	514	0.000	0.000	0.000	0.000	65.148	65.148	65.141	42.9	18.7
2.0-Inch	MH_A1-01	LINE-A1	15.00	3125.819	3132.980	514	0.000	0.000	0.000	0.000	188.773	188.773	188.751	53.4	29.2
2.0-Inch	MH_A1-01	LINE-A1	16.00	3125.942	3132.980	514	0.000	0.000	0.000	0.000	195.062	195.062	195.055	69.3	45.0
2.0-Inch	MH_A1-01	LINE-A1	17.00	3125.966	3132.980	514	0.000	0.000	0.000	0.000	196.237	196.237	196.236	85.4	61.2
2.0-Inch	MH_A1-01	LINE-A1	18.00	3125.969	3132.980	514	0.000	0.000	0.000	0.000	196.424	196.424	196.424	101.7	77.4
2.0-Inch	MH_A1-01	LINE-A1	19.00	3125.969	3132.980	514	0.000	0.000	0.000	0.000	196.402	196.402	196.403	117.9	93.6
2.0-Inch	MH_A1-01	LINE-A1	20.00	3125.967	3132.980	514	0.000	0.000	0.000	0.000	196.315	196.315	196.316	134.1	109.9
2.0-Inch	MH_A1-01	LINE-A1	21.00	3125.965	3132.980	514	0.000	0.000	0.000	0.000	196.187	196.187	196.188	150.3	126.1
2.0-Inch	MH_A1-01	LINE-A1	22.00	3125.960	3132.980	514	0.000	0.000	0.000	0.000	195.963	195.963	195.964	166.5	142.3
2.0-Inch	MH_A1-01	LINE-A1	23.00	3125.955	3132.980	514	0.000	0.000	0.000	0.000	195.706	195.706	195.707	182.7	158.5
2.0-Inch	MH_A1-01	LINE-A1	24.00	3125.948	3132.980	514	0.000	0.000	0.000	0.000	195.370	195.370	195.371	198.9	174.6
2.0-Inch	MH_A1-01	LINE-A1	25.00	3125.935	3132.980	514	0.000	0.000	0.000	0.000	194.706	194.706	194.711	215.0	190.8
2.0-Inch	MH_A1-01	LINE-A1	26.00	3125.845	3132.980	514	0.000	0.000	0.000	0.000	190.136	190.136	190.146	230.9	206.7
2.0-Inch	MH_A1-01	LINE-A1	27.00	3125.813	3132.980	514	0.000	0.000	0.000	0.000	188.455	188.455	188.464	246.5	222.3
2.0-Inch	MH_A1-01	LINE-A1	28.00	3125.456	3132.980	514	0.000	0.000	0.000	0.000	168.829	168.829	168.920	261.3	237.1
2.0-Inch	MH_A1-01	LINE-A1	29.00	3125.140	3132.980	514	0.000	0.000	0.000	0.000	148.551	148.551	148.609	274.4	250.2
2.0-Inch	MH_A1-01	LINE-A1	30.00	3124.909	3132.980	514	0.000	0.000	0.000	0.000	132.678	132.678	132.737	286.0	261.8
2.0-Inch	MH_A1-01	LINE-A1	31.00	3124.862	3132.980	514	0.000	0.000	0.000	0.000	129.409	129.409	129.198	296.9	272.6
2.0-Inch	MH_A1-01	LINE-A1	32.00	3124.799	3132.980	514	0.000	0.000	0.000	0.000	124.578	124.578	124.310	307.4	283.1
2.0-Inch	MH_A1-01	LINE-A1	33.00	3124.774	3132.980	514	0.000	0.000	0.000	0.000	122.587	122.587	122.391	317.6	293.3
2.0-Inch	MH_A1-01	LINE-A1	34.00	3124.750	3132.980	514	0.000	0.000	0.000	0.000	120.149	120.149	120.730	327.6	303.4
2.0-Inch	MH_A1-01	LINE-A1	35.00	3124.691	3132.980	514	0.000	0.000	0.000	0.000	117.043	117.043	117.006	337.4	313.2
2.0-Inch	MH_A1-01	LINE-A1	36.00	3124.507	3132.980	514	0.000	0.000	0.000	0.000	100.217	100.217	100.235	346.4	322.2
2.0-Inch	MH_A1-01	LINE-A1	37.00	3124.410	3132.980	514	0.000	0.000	0.000	0.000	90.127	90.127	90.138	354.3	330.0
2.0-Inch	MH_A1-01	LINE-A1	38.00	3124.355	3132.980	514	0.000	0.000	0.000	0.000	83.890	83.890	83.895	361.5	337.2
2.0-Inch	MH_A1-01	LINE-A1	39.00	3124.331	3132.980	514	0.000	0.000	0.000	0.000	80.946	80.946	80.962	368.3	344.0
2.0-Inch	MH_A1-01	LINE-A1	40.00	3124.313	3132.980	514	0.000	0.000	0.000	0.000	78.783	78.783	78.770	374.9	350.6
2.0-Inch	MH_A1-01	LINE-A1	41.00	3124.296	3132.980	514	0.000	0.000	0.000	0.000	76.554	76.554	76.556	381.3	357.1
2.0-Inch	MH_A1-01	LINE-A1	42.00	3124.279	3132.980	514	0.000	0.000	0.000	0.000	74.373	74.373	74.375	387.5	363.3
2.0-Inch	MH_A1-01	LINE-A1	43.00	3124.266	3132.980	514	0.000	0.000	0.000	0.000	72.548	72.548	72.549	393.6	369.4
2.0-Inch	MH_A1-01	LINE-A1	44.00	3124.255	3132.980	514	0.000	0.000	0.000	0.000	71.083	71.083	71.084	399.5	375.3
2.0-Inch	MH_A1-01	LINE-A1	45.00	3124.245	3132.980	514	0.000	0.000	0.000	0.000	70.354	70.354	69.339	405.4	381.1
2.0-Inch	MH_A1-01	LINE-A1	46.00	3124.240	3132.980	514	0.000	0.000	0.000	0.000	69.007	69.007	69.008	411.1	386.8
2.0-Inch	MH_A1-01	LINE-A1	47.00	3124.235	3132.980	514	0.000	0.000	0.000	0.000	68.259	68.259	68.259	416.8	392.5
2.0-Inch	MH_A1-01	LINE-A1	48.00	3124.230	3132.980	514	0.000	0.000	0.000	0.000	67.903	67.903	67.276	422.4	398.1
2.0-Inch	MH_A1-01	LINE-A1	49.00	3124.227	3132.980	514	0.000	0.000	0.000	0.000	66.999	66.999	66.995	428.0	403.6
2.0-Inch	MH_A1-01	LINE-A1	50.00	3124.222	3132.980	514	0.000	0.000	0.000	0.000	66.382	66.382	66.383	433.5	409.2
2.0-Inch	MH_A1-01	LINE-A1	51.00	3124.218	3132.980	514	0.000	0.000	0.000	0.000	65.787	65.787	65.787	439.0	414.6
2.0-Inch	MH_A1-01	LINE-A1	52.00	3124.215	3132.980	514	0.000	0.000	0.000	0.000	65.213	65.213	65.213	444.4	420.0
2.0-Inch	MH_A1-01	LINE-A1	53.00	3124.211	3132.980	514	0.000	0.000	0.000	0.000	64.668	64.668	64.668	449.8	425.4
2.0-Inch	MH_A1-01	LINE-A1	54.00	3124.206	3132.980	514	0.000	0.000	0.000	0.000	64.468	64.468	63.701	455.1	430.7
2.0-Inch	MH_A1-01	LINE-A1	55.00	3124.205	3132.980	514	0.000	0.000	0.000	0.000	63.680	63.680	63.677	460.4	436.0
2.0-Inch	MH_A1-01	LINE-A1	56.00	3124.202	3132.980	514	0.000	0.000	0.000	0.000	63.236	63.236	63.236	465.6	441.2
2.0-Inch	MH_A1-01	LINE-A1	57.00	3124.199	3132.980	514	0.000	0.000	0.000	0.000	62.677	62.677	62.835	470.8	446.4
2.0-Inch	MH_A1-01	LINE-A1	58.00	3124.194	3132.980	514	0.000	0.000	0.000	0.000	62.029	62.029	62.030	476.0	451.6
2.0-Inch	MH_A1-01	LINE-A1	59.00	3124.191	3132.980	514	0.000	0.000	0.000	0.000	61.564	61.564	61.564	481.1	456.7
2.0-Inch	MH_A1-01	LINE-A1	60.00	3124.189	3132.980	514	0.000	0.000	0.000	0.000	61.254	61.254	61.227	486.2	461.8
2.0-Inch	MH_A1-01	LINE-A1	61.00	3124.188	3132.980	514	0.000	0.000	0.000	0.000	61.009	61.009	61.009	491.2	466.8
2.0-Inch	MH_A1-01	LINE-A1	62.00	3124.187	3132.980	514	0.000	0.000	0.000	0.000	60.831	60.831	60.831	496.3	471.8
2.0-Inch	MH_A1-01	LINE-A1	63.00	3124.186	3132.980	514	0.000	0.000	0.000	0.000	60.691	60.691	60.691	501.3	476.9
2.0-Inch	MH_A1-01	LINE-A1	64.00	3124.185	3132.980	514	0.000	0.000	0.000	0.000	60.578	60.578	60.578	506.3	481.9
2.0-Inch	MH_A1-01	LINE-A1	65.00	3124.185	3132.980	514	0.000	0.000	0.000	0.000	60.484	60.484	60.485	511.3	486.9
2.0-Inch	MH_A1-01	LINE-A1	66.00	3124.184	3132.980	514	0.000	0.000	0.000	0.000	60.404	60.404	60.410	516.3	491.9
2.0-Inch	MH_A1-01	LINE-A1	67.00	3124.184	3132.980	514	0.000	0.000	0.000	0.000	60.296	60.296	60.419	521.3	496.9
2.0-Inch	MH_A1-01	LINE-A1	68.00	3124.183	3132.980	514	0.000	0.000	0.000	0.000	60.290	60.290	60.290	526.3	501.9
2.0-Inch	MH_A1-01	LINE-A1	69.00	3124.183	3132.980	514	0.000	0.000	0.000	0.000	60.246	60.246	60.247	531.2	506.8

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Table 4-17
Discharge Point 30, 72-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 2.5-Inch Precipitation

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af	Total Vol Out af
2.5-Inch	MH_A1-01	LINE-A1	0.00	3113.500	3132.980	642	0.000	0.000	0.000	0.000	0.000	0.000	-587.187	0.0	0.0
2.5-Inch	MH_A1-01	LINE-A1	1.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.115	35.115	34.795	1.5	-22.8
2.5-Inch	MH_A1-01	LINE-A1	2.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.886	34.886	35.178	4.3	-19.9
2.5-Inch	MH_A1-01	LINE-A1	3.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	7.2	-17.0
2.5-Inch	MH_A1-01	LINE-A1	4.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.008	35.008	34.993	10.1	-14.1
2.5-Inch	MH_A1-01	LINE-A1	5.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.028	35.028	34.958	13.0	-11.3
2.5-Inch	MH_A1-01	LINE-A1	6.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	15.9	-8.4
2.5-Inch	MH_A1-01	LINE-A1	7.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.771	34.771	35.340	18.8	-5.5
2.5-Inch	MH_A1-01	LINE-A1	8.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	21.7	-2.6
2.5-Inch	MH_A1-01	LINE-A1	9.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	24.6	0.3
2.5-Inch	MH_A1-01	LINE-A1	10.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.020	35.020	35.020	27.5	3.2
2.5-Inch	MH_A1-01	LINE-A1	11.00	3124.063	3132.980	514	0.000	0.000	0.000	0.000	35.983	35.983	35.982	30.4	6.2
2.5-Inch	MH_A1-01	LINE-A1	12.00	3124.090	3132.980	514	0.000	0.000	0.000	0.000	43.175	43.175	43.164	33.7	9.4
2.5-Inch	MH_A1-01	LINE-A1	13.00	3124.213	3132.980	514	0.000	0.000	0.000	0.000	64.991	64.991	64.991	38.1	13.9
2.5-Inch	MH_A1-01	LINE-A1	14.00	3125.392	3132.980	514	0.000	0.000	0.000	0.000	165.326	165.326	165.056	47.7	23.4
2.5-Inch	MH_A1-01	LINE-A1	15.00	3125.917	3132.980	514	0.000	0.000	0.000	0.000	193.800	193.800	193.779	62.5	38.2
2.5-Inch	MH_A1-01	LINE-A1	16.00	3125.987	3132.980	514	0.000	0.000	0.000	0.000	197.316	197.316	197.312	78.7	54.4
2.5-Inch	MH_A1-01	LINE-A1	17.00	3126.001	3132.980	514	0.000	0.000	0.000	0.000	198.024	198.024	198.023	95.0	70.8
2.5-Inch	MH_A1-01	LINE-A1	18.00	3126.005	3132.980	514	0.000	0.000	0.000	0.000	198.216	198.216	198.215	111.4	87.1
2.5-Inch	MH_A1-01	LINE-A1	19.00	3126.007	3132.980	514	0.000	0.000	0.000	0.000	198.280	198.280	198.280	127.8	103.5
2.5-Inch	MH_A1-01	LINE-A1	20.00	3126.007	3132.980	514	0.000	0.000	0.000	0.000	198.300	198.300	198.300	144.2	119.9
2.5-Inch	MH_A1-01	LINE-A1	21.00	3126.007	3132.980	514	0.000	0.000	0.000	0.000	198.296	198.296	198.296	160.5	136.3
2.5-Inch	MH_A1-01	LINE-A1	22.00	3126.006	3132.980	514	0.000	0.000	0.000	0.000	198.269	198.269	198.270	176.9	152.7
2.5-Inch	MH_A1-01	LINE-A1	23.00	3126.005	3132.980	514	0.000	0.000	0.000	0.000	198.220	198.220	198.220	193.3	169.1
2.5-Inch	MH_A1-01	LINE-A1	24.00	3126.004	3132.980	514	0.000	0.000	0.000	0.000	198.156	198.156	198.156	209.7	185.4
2.5-Inch	MH_A1-01	LINE-A1	25.00	3126.003	3132.980	514	0.000	0.000	0.000	0.000	198.081	198.081	198.081	226.1	201.8
2.5-Inch	MH_A1-01	LINE-A1	26.00	3126.001	3132.980	514	0.000	0.000	0.000	0.000	197.977	197.977	197.977	242.4	218.2
2.5-Inch	MH_A1-01	LINE-A1	27.00	3125.997	3132.980	514	0.000	0.000	0.000	0.000	197.815	197.815	197.815	258.8	234.5
2.5-Inch	MH_A1-01	LINE-A1	28.00	3125.993	3132.980	514	0.000	0.000	0.000	0.000	197.611	197.611	197.612	275.1	250.9
2.5-Inch	MH_A1-01	LINE-A1	29.00	3125.989	3132.980	514	0.000	0.000	0.000	0.000	197.385	197.385	197.385	291.4	267.2
2.5-Inch	MH_A1-01	LINE-A1	30.00	3125.984	3132.980	514	0.000	0.000	0.000	0.000	197.149	197.149	197.150	307.7	283.5
2.5-Inch	MH_A1-01	LINE-A1	31.00	3125.979	3132.980	514	0.000	0.000	0.000	0.000	196.902	196.902	196.903	324.0	299.8
2.5-Inch	MH_A1-01	LINE-A1	32.00	3125.973	3132.980	514	0.000	0.000	0.000	0.000	196.596	196.596	196.596	340.3	316.0
2.5-Inch	MH_A1-01	LINE-A1	33.00	3125.966	3132.980	514	0.000	0.000	0.000	0.000	196.281	196.281	196.282	356.5	332.3
2.5-Inch	MH_A1-01	LINE-A1	34.00	3125.958	3132.980	514	0.000	0.000	0.000	0.000	195.869	195.869	195.871	372.8	348.5
2.5-Inch	MH_A1-01	LINE-A1	35.00	3125.948	3132.980	514	0.000	0.000	0.000	0.000	195.354	195.354	195.356	388.9	364.6
2.5-Inch	MH_A1-01	LINE-A1	36.00	3125.886	3132.980	514	0.000	0.000	0.000	0.000	192.195	192.195	192.214	404.9	380.6
2.5-Inch	MH_A1-01	LINE-A1	37.00	3125.821	3132.980	514	0.000	0.000	0.000	0.000	188.902	188.902	188.906	420.6	396.4
2.5-Inch	MH_A1-01	LINE-A1	38.00	3125.611	3132.980	514	0.000	0.000	0.000	0.000	177.584	177.584	177.706	435.8	411.5
2.5-Inch	MH_A1-01	LINE-A1	39.00	3125.180	3132.980	514	0.000	0.000	0.000	0.000	151.221	151.221	151.217	449.4	425.1
2.5-Inch	MH_A1-01	LINE-A1	40.00	3125.089	3132.980	514	0.000	0.000	0.000	0.000	145.201	145.201	145.215	461.6	437.4
2.5-Inch	MH_A1-01	LINE-A1	41.00	3124.909	3132.980	514	0.000	0.000	0.000	0.000	132.657	132.657	132.722	473.1	448.9
2.5-Inch	MH_A1-01	LINE-A1	42.00	3124.895	3132.980	514	0.000	0.000	0.000	0.000	131.565	131.565	131.714	484.0	459.8
2.5-Inch	MH_A1-01	LINE-A1	43.00	3124.863	3132.980	514	0.000	0.000	0.000	0.000	129.126	129.126	129.353	494.8	470.6
2.5-Inch	MH_A1-01	LINE-A1	44.00	3124.812	3132.980	514	0.000	0.000	0.000	0.000	125.567	125.567	125.377	505.3	481.1
2.5-Inch	MH_A1-01	LINE-A1	45.00	3124.800	3132.980	514	0.000	0.000	0.000	0.000	124.234	124.234	124.605	515.6	491.4
2.5-Inch	MH_A1-01	LINE-A1	46.00	3124.788	3132.980	514	0.000	0.000	0.000	0.000	123.651	123.651	123.472	525.9	501.7
2.5-Inch	MH_A1-01	LINE-A1	47.00	3124.775	3132.980	514	0.000	0.000	0.000	0.000	122.606	122.606	122.497	536.1	511.9
2.5-Inch	MH_A1-01	LINE-A1	48.00	3124.762	3132.980	514	0.000	0.000	0.000	0.000	121.085	121.085	121.627	546.1	521.9
2.5-Inch	MH_A1-01	LINE-A1	49.00	3124.748	3132.980	514	0.000	0.000	0.000	0.000	120.514	120.514	120.294	556.1	531.9
2.5-Inch	MH_A1-01	LINE-A1	50.00	3124.734	3132.980	514	0.000	0.000	0.000	0.000	119.341	119.341	119.201	566.0	541.8
2.5-Inch	MH_A1-01	LINE-A1	51.00	3124.721	3132.980	514	0.000	0.000	0.000	0.000	118.274	118.274	118.146	575.8	551.6
2.5-Inch	MH_A1-01	LINE-A1	52.00	3124.651	3132.980	514	0.000	0.000	0.000	0.000	113.570	113.570	113.601	585.4	561.2
2.5-Inch	MH_A1-01	LINE-A1	53.00	3124.482	3132.980	514	0.000	0.000	0.000	0.000	97.739	97.739	97.756	594.2	570.0
2.5-Inch	MH_A1-01	LINE-A1	54.00	3124.388	3132.980	514	0.000	0.000	0.000	0.000	87.637	87.637	87.650	601.8	577.6
2.5-Inch	MH_A1-01	LINE-A1	55.00	3124.331	3132.980	514	0.000	0.000	0.000	0.000	80.994	80.994	81.002	608.8	584.6
2.5-Inch	MH_A1-01	LINE-A1	56.00	3124.309	3132.980	514	0.000	0.000	0.000	0.000	78.253	78.253	78.186	615.4	591.2
2.5-Inch	MH_A1-01	LINE-A1	57.00	3124.292	3132.980	514	0.000	0.000	0.000	0.000	76.036	76.036	76.056	621.8	597.5
2.5-Inch	MH_A1-01	LINE-A1	58.00	3124.277	3132.980	514	0.000	0.000	0.000	0.000	74.108	74.108	74.110	628.0	603.7
2.5-Inch	MH_A1-01	LINE-A1	59.00	3124.266	3132.980	514	0.000	0.000	0.000	0.000	72.534	72.534	72.536	634.0	609.8
2.5-Inch	MH_A1-01	LINE-A1	60.00	3124.256	3132.980	514	0.000	0.000	0.000	0.000	71.265	71.265	71.273	640.0	615.7
2.5-Inch	MH_A1-01	LINE-A1	61.00	3124.249	3132.980	514	0.000	0.000	0.000	0.000	70.290	70.290	70.291	645.8	621.6
2.5-Inch	MH_A1-01	LINE-A1	62.00	3124.244	3132.980	514	0.000	0.000	0.000	0.000	69.483	69.483	69.484	651.6	627.4
2.5-Inch	MH_A1-01	LINE-A1	63.00	3124.236	3132.980	514	0.000	0.000	0.000	0.000	69.331	69.331	68.038	657.3	633.1
2.5-Inch	MH_A1-01	LINE-A1	64.00	3124.235	3132.980	514	0.000	0.000	0.000	0.000	68.252	68.252	68.252	663.0	638.7
2.5-Inch	MH_A1-01	LINE-A1	65.00	3124.232	3132.980	514	0.000	0.000	0.000	0.000	67.785	67.785	67.816	668.6	644.3
2.5-Inch	MH_A1-01	LINE-A1	66.00	3124.228	3132.980	514	0.000	0.000	0.000	0.000	67.279	67.279	67.279	674.2	649.9
2.5-Inch	MH_A1-01	LINE-A1	67.00	3124.225	3132.980	514	0.000	0.000	0.000	0.000	66.804	66.804	66.805	679.7	655.4
2.5-Inch	MH_A1-01	LINE-A1	68.00	3124.222	3132.980	514	0.000	0.000	0.000	0.000	66.344	66.344	66.344	685.2	660.9
2.5-Inch	MH_A1-01	LINE-A1	69.00	3124.219	3132.980	514	0.000	0.000	0.000	0.000	65.892	65.892	65.910	690.7	666.4

Table 4-18
Discharge Point 30, 72-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 2-Year 24-Hour Precipitation (2.8 Inches)

SCLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af
002-YR	MH_A1-01	LINE-A1	0.00	3113.500	3132.980	642	0.000	0.000	0.000	0.000	0.000	0.000	-587.187	0.0
002-YR	MH_A1-01	LINE-A1	1.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.115	35.115	34.795	1.5
002-YR	MH_A1-01	LINE-A1	2.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.886	34.886	35.178	4.3
002-YR	MH_A1-01	LINE-A1	3.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	7.2
002-YR	MH_A1-01	LINE-A1	4.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.008	35.008	34.993	10.1
002-YR	MH_A1-01	LINE-A1	5.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.028	35.028	34.958	13.0
002-YR	MH_A1-01	LINE-A1	6.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	15.9
002-YR	MH_A1-01	LINE-A1	7.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.998	34.998	34.998	18.8
002-YR	MH_A1-01	LINE-A1	8.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	21.7
002-YR	MH_A1-01	LINE-A1	9.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	24.6
002-YR	MH_A1-01	LINE-A1	10.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	35.247	35.247	35.247	27.5
002-YR	MH_A1-01	LINE-A1	11.00	3124.070	3132.980	514	0.000	0.000	0.000	0.000	37.902	37.902	37.899	30.5
002-YR	MH_A1-01	LINE-A1	12.00	3124.114	3132.980	514	0.000	0.000	0.000	0.000	48.545	48.545	48.532	34.1
002-YR	MH_A1-01	LINE-A1	13.00	3124.213	3132.980	514	0.000	0.000	0.000	0.000	65.000	65.000	65.000	38.8
002-YR	MH_A1-01	LINE-A1	14.00	3125.592	3132.980	514	0.000	0.000	0.000	0.000	176.773	176.773	176.531	48.8
002-YR	MH_A1-01	LINE-A1	15.00	3125.948	3132.980	514	0.000	0.000	0.000	0.000	195.372	195.372	195.355	64.1
002-YR	MH_A1-01	LINE-A1	16.00	3126.006	3132.980	514	0.000	0.000	0.000	0.000	198.232	198.232	198.229	80.4
002-YR	MH_A1-01	LINE-A1	17.00	3126.019	3132.980	514	0.000	0.000	0.000	0.000	198.867	198.867	198.866	96.8
002-YR	MH_A1-01	LINE-A1	18.00	3126.023	3132.980	514	0.000	0.000	0.000	0.000	199.065	199.065	199.065	113.3
002-YR	MH_A1-01	LINE-A1	19.00	3126.024	3132.980	514	0.000	0.000	0.000	0.000	199.149	199.149	199.149	129.7
002-YR	MH_A1-01	LINE-A1	20.00	3126.025	3132.980	514	0.000	0.000	0.000	0.000	199.192	199.192	199.192	146.2
002-YR	MH_A1-01	LINE-A1	21.00	3126.026	3132.980	514	0.000	0.000	0.000	0.000	199.211	199.211	199.211	162.7
002-YR	MH_A1-01	LINE-A1	22.00	3126.026	3132.980	514	0.000	0.000	0.000	0.000	199.211	199.211	199.211	179.1
002-YR	MH_A1-01	LINE-A1	23.00	3126.025	3132.980	514	0.000	0.000	0.000	0.000	199.197	199.197	199.197	195.6
002-YR	MH_A1-01	LINE-A1	24.00	3126.025	3132.980	514	0.000	0.000	0.000	0.000	199.176	199.176	199.176	212.0
002-YR	MH_A1-01	LINE-A1	25.00	3126.024	3132.980	514	0.000	0.000	0.000	0.000	199.149	199.149	199.150	228.5
002-YR	MH_A1-01	LINE-A1	26.00	3126.023	3132.980	514	0.000	0.000	0.000	0.000	199.099	199.099	199.099	244.9
002-YR	MH_A1-01	LINE-A1	27.00	3126.021	3132.980	514	0.000	0.000	0.000	0.000	198.995	198.995	198.996	261.4
002-YR	MH_A1-01	LINE-A1	28.00	3126.018	3132.980	514	0.000	0.000	0.000	0.000	198.853	198.853	198.853	277.9
002-YR	MH_A1-01	LINE-A1	29.00	3126.015	3132.980	514	0.000	0.000	0.000	0.000	198.691	198.691	198.692	294.3
002-YR	MH_A1-01	LINE-A1	30.00	3126.011	3132.980	514	0.000	0.000	0.000	0.000	198.516	198.516	198.517	310.7
002-YR	MH_A1-01	LINE-A1	31.00	3126.008	3132.980	514	0.000	0.000	0.000	0.000	198.332	198.332	198.333	327.1
002-YR	MH_A1-01	LINE-A1	32.00	3126.004	3132.980	514	0.000	0.000	0.000	0.000	198.139	198.139	198.139	343.5
002-YR	MH_A1-01	LINE-A1	33.00	3126.000	3132.980	514	0.000	0.000	0.000	0.000	197.936	197.936	197.936	359.9
002-YR	MH_A1-01	LINE-A1	34.00	3125.995	3132.980	514	0.000	0.000	0.000	0.000	197.724	197.724	197.724	376.2
002-YR	MH_A1-01	LINE-A1	35.00	3125.991	3132.980	514	0.000	0.000	0.000	0.000	197.500	197.500	197.501	392.5
002-YR	MH_A1-01	LINE-A1	36.00	3125.986	3132.980	514	0.000	0.000	0.000	0.000	197.268	197.268	197.269	408.8
002-YR	MH_A1-01	LINE-A1	37.00	3125.982	3132.980	514	0.000	0.000	0.000	0.000	197.032	197.032	197.033	425.2
002-YR	MH_A1-01	LINE-A1	38.00	3125.976	3132.980	514	0.000	0.000	0.000	0.000	196.765	196.765	196.766	441.4
002-YR	MH_A1-01	LINE-A1	39.00	3125.970	3132.980	514	0.000	0.000	0.000	0.000	196.463	196.463	196.464	457.6
002-YR	MH_A1-01	LINE-A1	40.00	3125.964	3132.980	514	0.000	0.000	0.000	0.000	196.145	196.145	196.146	473.9
002-YR	MH_A1-01	LINE-A1	41.00	3125.955	3132.980	514	0.000	0.000	0.000	0.000	195.726	195.726	195.728	490.1
002-YR	MH_A1-01	LINE-A1	42.00	3125.945	3132.980	514	0.000	0.000	0.000	0.000	195.182	195.182	195.185	506.2
002-YR	MH_A1-01	LINE-A1	43.00	3125.863	3132.980	514	0.000	0.000	0.000	0.000	191.023	191.023	191.039	522.2
002-YR	MH_A1-01	LINE-A1	44.00	3125.816	3132.980	514	0.000	0.000	0.000	0.000	188.636	188.636	188.637	537.9
002-YR	MH_A1-01	LINE-A1	45.00	3125.517	3132.980	514	0.000	0.000	0.000	0.000	172.296	172.296	172.413	552.8
002-YR	MH_A1-01	LINE-A1	46.00	3125.184	3132.980	514	0.000	0.000	0.000	0.000	151.831	151.831	152.453	566.2
002-YR	MH_A1-01	LINE-A1	47.00	3125.130	3132.980	514	0.000	0.000	0.000	0.000	148.036	148.036	147.906	578.6
002-YR	MH_A1-01	LINE-A1	48.00	3124.926	3132.980	514	0.000	0.000	0.000	0.000	134.020	134.020	133.923	590.2
002-YR	MH_A1-01	LINE-A1	49.00	3124.910	3132.980	514	0.000	0.000	0.000	0.000	132.737	132.737	132.793	601.2
002-YR	MH_A1-01	LINE-A1	50.00	3124.907	3132.980	514	0.000	0.000	0.000	0.000	132.697	132.697	132.496	612.2
002-YR	MH_A1-01	LINE-A1	51.00	3124.900	3132.980	514	0.000	0.000	0.000	0.000	131.966	131.966	132.071	623.1
002-YR	MH_A1-01	LINE-A1	52.00	3124.883	3132.980	514	0.000	0.000	0.000	0.000	130.712	130.712	130.819	634.0
002-YR	MH_A1-01	LINE-A1	53.00	3124.846	3132.980	514	0.000	0.000	0.000	0.000	128.230	128.230	127.980	644.7
002-YR	MH_A1-01	LINE-A1	54.00	3124.813	3132.980	514	0.000	0.000	0.000	0.000	125.247	125.247	125.615	655.2
002-YR	MH_A1-01	LINE-A1	55.00	3124.804	3132.980	514	0.000	0.000	0.000	0.000	125.007	125.007	124.727	665.5
002-YR	MH_A1-01	LINE-A1	56.00	3124.794	3132.980	514	0.000	0.000	0.000	0.000	124.204	124.204	124.002	675.8
002-YR	MH_A1-01	LINE-A1	57.00	3124.784	3132.980	514	0.000	0.000	0.000	0.000	123.377	123.377	123.203	686.0
002-YR	MH_A1-01	LINE-A1	58.00	3124.773	3132.980	514	0.000	0.000	0.000	0.000	122.030	122.030	122.527	696.2

SCLDIP

Table 4-19
Discharge Point 30, 72-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 5-Year 24-Hour Precipitation (3.8 Inches)

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af
005-YR	MH_A1-01	LINE-A1	0.00	3113.500	3132.980	642	0.000	0.000	0.000	0.000	0.000	0.000	-587.187	0.0
005-YR	MH_A1-01	LINE-A1	1.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.115	35.115	34.795	1.5
005-YR	MH_A1-01	LINE-A1	2.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.886	34.886	35.178	4.3
005-YR	MH_A1-01	LINE-A1	3.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	7.2
005-YR	MH_A1-01	LINE-A1	4.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.008	35.008	34.993	10.1
005-YR	MH_A1-01	LINE-A1	5.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.028	35.028	34.958	13.0
005-YR	MH_A1-01	LINE-A1	6.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	15.9
005-YR	MH_A1-01	LINE-A1	7.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.998	34.998	34.998	18.8
005-YR	MH_A1-01	LINE-A1	8.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.033	35.033	35.033	21.7
005-YR	MH_A1-01	LINE-A1	9.00	3124.063	3132.980	514	0.000	0.000	0.000	0.000	36.023	36.023	36.022	24.6
005-YR	MH_A1-01	LINE-A1	10.00	3124.080	3132.980	514	0.000	0.000	0.000	0.000	40.666	40.666	40.662	27.8
005-YR	MH_A1-01	LINE-A1	11.00	3124.128	3132.980	514	0.000	0.000	0.000	0.000	51.416	51.416	51.406	31.6
005-YR	MH_A1-01	LINE-A1	12.00	3124.212	3132.980	514	0.000	0.000	0.000	0.000	64.747	64.747	64.744	36.4
005-YR	MH_A1-01	LINE-A1	13.00	3124.213	3132.980	514	0.000	0.000	0.000	0.000	64.976	64.976	64.977	41.8
005-YR	MH_A1-01	LINE-A1	14.00	3125.839	3132.980	514	0.000	0.000	0.000	0.000	189.834	189.834	189.790	52.3
005-YR	MH_A1-01	LINE-A1	15.00	3126.012	3132.980	514	0.000	0.000	0.000	0.000	198.554	198.554	198.544	68.3
005-YR	MH_A1-01	LINE-A1	16.00	3126.051	3132.980	514	0.000	0.000	0.000	0.000	200.469	200.469	200.466	84.8
005-YR	MH_A1-01	LINE-A1	17.00	3126.063	3132.980	514	0.000	0.000	0.000	0.000	201.027	201.027	201.026	101.4
005-YR	MH_A1-01	LINE-A1	18.00	3126.068	3132.980	514	0.000	0.000	0.000	0.000	201.265	201.265	201.264	118.1
005-YR	MH_A1-01	LINE-A1	19.00	3126.070	3132.980	514	0.000	0.000	0.000	0.000	201.400	201.400	201.399	134.7
005-YR	MH_A1-01	LINE-A1	20.00	3126.072	3132.980	514	0.000	0.000	0.000	0.000	201.493	201.493	201.492	151.3
005-YR	MH_A1-01	LINE-A1	21.00	3126.074	3132.980	514	0.000	0.000	0.000	0.000	201.559	201.559	201.559	168.0
005-YR	MH_A1-01	LINE-A1	22.00	3126.075	3132.980	514	0.000	0.000	0.000	0.000	201.605	201.605	201.604	184.7
005-YR	MH_A1-01	LINE-A1	23.00	3126.075	3132.980	514	0.000	0.000	0.000	0.000	201.636	201.636	201.636	201.3
005-YR	MH_A1-01	LINE-A1	24.00	3126.076	3132.980	514	0.000	0.000	0.000	0.000	201.659	201.659	201.659	218.0
005-YR	MH_A1-01	LINE-A1	25.00	3126.076	3132.980	514	0.000	0.000	0.000	0.000	201.676	201.676	201.676	234.7
005-YR	MH_A1-01	LINE-A1	26.00	3126.076	3132.980	514	0.000	0.000	0.000	0.000	201.670	201.670	201.670	251.3
005-YR	MH_A1-01	LINE-A1	27.00	3126.075	3132.980	514	0.000	0.000	0.000	0.000	201.623	201.623	201.623	268.0
005-YR	MH_A1-01	LINE-A1	28.00	3126.073	3132.980	514	0.000	0.000	0.000	0.000	201.549	201.549	201.549	284.6
005-YR	MH_A1-01	LINE-A1	29.00	3126.072	3132.980	514	0.000	0.000	0.000	0.000	201.465	201.465	201.466	301.3
005-YR	MH_A1-01	LINE-A1	30.00	3126.070	3132.980	514	0.000	0.000	0.000	0.000	201.378	201.378	201.378	318.0
005-YR	MH_A1-01	LINE-A1	31.00	3126.068	3132.980	514	0.000	0.000	0.000	0.000	201.289	201.289	201.290	334.6
005-YR	MH_A1-01	LINE-A1	32.00	3126.066	3132.980	514	0.000	0.000	0.000	0.000	201.199	201.199	201.199	351.3
005-YR	MH_A1-01	LINE-A1	33.00	3126.064	3132.980	514	0.000	0.000	0.000	0.000	201.109	201.109	201.109	367.8
005-YR	MH_A1-01	LINE-A1	34.00	3126.062	3132.980	514	0.000	0.000	0.000	0.000	201.016	201.016	201.017	384.5
005-YR	MH_A1-01	LINE-A1	35.00	3126.061	3132.980	514	0.000	0.000	0.000	0.000	200.923	200.923	200.924	401.1
005-YR	MH_A1-01	LINE-A1	36.00	3126.059	3132.980	514	0.000	0.000	0.000	0.000	200.837	200.837	200.837	417.7
005-YR	MH_A1-01	LINE-A1	37.00	3126.057	3132.980	514	0.000	0.000	0.000	0.000	200.742	200.742	200.742	434.3
005-YR	MH_A1-01	LINE-A1	38.00	3126.055	3132.980	514	0.000	0.000	0.000	0.000	200.645	200.645	200.645	450.8
005-YR	MH_A1-01	LINE-A1	39.00	3126.053	3132.980	514	0.000	0.000	0.000	0.000	200.544	200.544	200.544	467.4
005-YR	MH_A1-01	LINE-A1	40.00	3126.051	3132.980	514	0.000	0.000	0.000	0.000	200.435	200.435	200.435	484.0
005-YR	MH_A1-01	LINE-A1	41.00	3126.048	3132.980	514	0.000	0.000	0.000	0.000	200.322	200.322	200.323	500.6
005-YR	MH_A1-01	LINE-A1	42.00	3126.046	3132.980	514	0.000	0.000	0.000	0.000	200.206	200.206	200.207	517.1
005-YR	MH_A1-01	LINE-A1	43.00	3126.043	3132.980	514	0.000	0.000	0.000	0.000	200.089	200.089	200.089	533.6
005-YR	MH_A1-01	LINE-A1	44.00	3126.041	3132.980	514	0.000	0.000	0.000	0.000	199.968	199.968	199.969	550.2
005-YR	MH_A1-01	LINE-A1	45.00	3126.039	3132.980	514	0.000	0.000	0.000	0.000	199.846	199.846	199.846	566.7
005-YR	MH_A1-01	LINE-A1	46.00	3126.036	3132.980	514	0.000	0.000	0.000	0.000	199.721	199.721	199.722	583.2
005-YR	MH_A1-01	LINE-A1	47.00	3126.033	3132.980	514	0.000	0.000	0.000	0.000	199.594	199.594	199.595	599.7
005-YR	MH_A1-01	LINE-A1	48.00	3126.031	3132.980	514	0.000	0.000	0.000	0.000	199.464	199.464	199.464	616.2
005-YR	MH_A1-01	LINE-A1	49.00	3126.028	3132.980	514	0.000	0.000	0.000	0.000	199.328	199.328	199.329	632.7
005-YR	MH_A1-01	LINE-A1	50.00	3126.025	3132.980	514	0.000	0.000	0.000	0.000	199.188	199.188	199.188	649.2
005-YR	MH_A1-01	LINE-A1	51.00	3126.022	3132.980	514	0.000	0.000	0.000	0.000	199.042	199.042	199.043	665.6
005-YR	MH_A1-01	LINE-A1	52.00	3126.019	3132.980	514	0.000	0.000	0.000	0.000	198.891	198.891	198.892	682.0
005-YR	MH_A1-01	LINE-A1	53.00	3126.016	3132.980	514	0.000	0.000	0.000	0.000	198.733	198.733	198.734	698.5
005-YR	MH_A1-01	LINE-A1	54.00	3126.013	3132.980	514	0.000	0.000	0.000	0.000	198.568	198.568	198.569	714.9
005-YR	MH_A1-01	LINE-A1	55.00	3126.009	3132.980	514	0.000	0.000	0.000	0.000	198.397	198.397	198.398	731.3
005-YR	MH_A1-01	LINE-A1	56.00	3126.005	3132.980	514	0.000	0.000	0.000	0.000	198.221	198.221	198.221	747.7
005-YR	MH_A1-01	LINE-A1	57.00	3126.002	3132.980	514	0.000	0.000	0.000	0.000	198.040	198.040	198.040	764.1
005-YR	MH_A1-01	LINE-A1	58.00	3125.998	3132.980	514	0.000	0.000	0.000	0.000	197.853	197.853	197.853	780.4

Table 4-20
Discharge Point 30, 72-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 10-Year 24-Hour Precipitation (4.6 Inches)

SCLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af
010-YR	MH_A1-01	LINE-A1	0.00	3113.500	3132.980	642	0.000	0.000	0.000	0.000	0.000	0.000	-587.187	0.0
010-YR	MH_A1-01	LINE-A1	1.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.115	35.115	34.795	1.5
010-YR	MH_A1-01	LINE-A1	2.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.886	34.886	35.178	4.3
010-YR	MH_A1-01	LINE-A1	3.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	7.2
010-YR	MH_A1-01	LINE-A1	4.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.008	35.008	34.993	10.1
010-YR	MH_A1-01	LINE-A1	5.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	13.0
010-YR	MH_A1-01	LINE-A1	6.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	15.9
010-YR	MH_A1-01	LINE-A1	7.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.025	35.025	35.025	18.8
010-YR	MH_A1-01	LINE-A1	8.00	3124.063	3132.980	514	0.000	0.000	0.000	0.000	35.986	35.986	35.985	21.7
010-YR	MH_A1-01	LINE-A1	9.00	3124.079	3132.980	514	0.000	0.000	0.000	0.000	40.354	40.354	40.350	24.9
010-YR	MH_A1-01	LINE-A1	10.00	3124.121	3132.980	514	0.000	0.000	0.000	0.000	50.080	50.080	50.071	28.6
010-YR	MH_A1-01	LINE-A1	11.00	3124.201	3132.980	514	0.000	0.000	0.000	0.000	63.038	63.038	63.025	33.3
010-YR	MH_A1-01	LINE-A1	12.00	3124.213	3132.980	514	0.000	0.000	0.000	0.000	65.000	65.000	65.000	38.6
010-YR	MH_A1-01	LINE-A1	13.00	3125.018	3132.980	514	0.000	0.000	0.000	0.000	140.873	140.873	140.217	47.1
010-YR	MH_A1-01	LINE-A1	14.00	3125.917	3132.980	514	0.000	0.000	0.000	0.000	193.827	193.827	193.792	60.9
010-YR	MH_A1-01	LINE-A1	15.00	3126.047	3132.980	514	0.000	0.000	0.000	0.000	200.282	200.282	200.274	77.2
010-YR	MH_A1-01	LINE-A1	16.00	3126.081	3132.980	514	0.000	0.000	0.000	0.000	201.906	201.906	201.903	93.8
010-YR	MH_A1-01	LINE-A1	17.00	3126.092	3132.980	514	0.000	0.000	0.000	0.000	202.459	202.459	202.458	110.6
010-YR	MH_A1-01	LINE-A1	18.00	3126.098	3132.980	514	0.000	0.000	0.000	0.000	202.722	202.722	202.722	127.3
010-YR	MH_A1-01	LINE-A1	19.00	3126.101	3132.980	514	0.000	0.000	0.000	0.000	202.880	202.880	202.880	144.0
010-YR	MH_A1-01	LINE-A1	20.00	3126.103	3132.980	514	0.000	0.000	0.000	0.000	202.994	202.994	202.994	160.8
010-YR	MH_A1-01	LINE-A1	21.00	3126.105	3132.980	514	0.000	0.000	0.000	0.000	203.080	203.080	203.079	177.6
010-YR	MH_A1-01	LINE-A1	22.00	3126.106	3132.980	514	0.000	0.000	0.000	0.000	203.143	203.143	203.143	194.4
010-YR	MH_A1-01	LINE-A1	23.00	3126.107	3132.980	514	0.000	0.000	0.000	0.000	203.192	203.192	203.192	211.2
010-YR	MH_A1-01	LINE-A1	24.00	3126.108	3132.980	514	0.000	0.000	0.000	0.000	203.221	203.221	203.221	228.0
010-YR	MH_A1-01	LINE-A1	25.00	3126.109	3132.980	514	0.000	0.000	0.000	0.000	203.256	203.256	203.256	244.8
010-YR	MH_A1-01	LINE-A1	26.00	3126.109	3132.980	514	0.000	0.000	0.000	0.000	203.268	203.268	203.268	261.6
010-YR	MH_A1-01	LINE-A1	27.00	3126.108	3132.980	514	0.000	0.000	0.000	0.000	203.237	203.237	203.237	278.4
010-YR	MH_A1-01	LINE-A1	28.00	3126.107	3132.980	514	0.000	0.000	0.000	0.000	203.180	203.180	203.180	295.2
010-YR	MH_A1-01	LINE-A1	29.00	3126.106	3132.980	514	0.000	0.000	0.000	0.000	203.113	203.113	203.113	312.0
010-YR	MH_A1-01	LINE-A1	30.00	3126.104	3132.980	514	0.000	0.000	0.000	0.000	203.042	203.042	203.043	328.7
010-YR	MH_A1-01	LINE-A1	31.00	3126.103	3132.980	514	0.000	0.000	0.000	0.000	202.981	202.981	202.981	345.5
010-YR	MH_A1-01	LINE-A1	32.00	3126.101	3132.980	514	0.000	0.000	0.000	0.000	202.907	202.907	202.908	362.3
010-YR	MH_A1-01	LINE-A1	33.00	3126.100	3132.980	514	0.000	0.000	0.000	0.000	202.834	202.834	202.834	379.1
010-YR	MH_A1-01	LINE-A1	34.00	3126.098	3132.980	514	0.000	0.000	0.000	0.000	202.760	202.760	202.761	395.8
010-YR	MH_A1-01	LINE-A1	35.00	3126.097	3132.980	514	0.000	0.000	0.000	0.000	202.686	202.686	202.686	412.6
010-YR	MH_A1-01	LINE-A1	36.00	3126.095	3132.980	514	0.000	0.000	0.000	0.000	202.611	202.611	202.611	429.3
010-YR	MH_A1-01	LINE-A1	37.00	3126.094	3132.980	514	0.000	0.000	0.000	0.000	202.535	202.535	202.535	446.1
010-YR	MH_A1-01	LINE-A1	38.00	3126.092	3132.980	514	0.000	0.000	0.000	0.000	202.459	202.459	202.459	462.8
010-YR	MH_A1-01	LINE-A1	39.00	3126.091	3132.980	514	0.000	0.000	0.000	0.000	202.382	202.382	202.382	479.5
010-YR	MH_A1-01	LINE-A1	40.00	3126.089	3132.980	514	0.000	0.000	0.000	0.000	202.303	202.303	202.304	496.3
010-YR	MH_A1-01	LINE-A1	41.00	3126.087	3132.980	514	0.000	0.000	0.000	0.000	202.229	202.229	202.229	513.0
010-YR	MH_A1-01	LINE-A1	42.00	3126.086	3132.980	514	0.000	0.000	0.000	0.000	202.153	202.153	202.154	529.7
010-YR	MH_A1-01	LINE-A1	43.00	3126.084	3132.980	514	0.000	0.000	0.000	0.000	202.073	202.073	202.073	546.4
010-YR	MH_A1-01	LINE-A1	44.00	3126.083	3132.980	514	0.000	0.000	0.000	0.000	201.992	201.992	201.992	563.1
010-YR	MH_A1-01	LINE-A1	45.00	3126.081	3132.980	514	0.000	0.000	0.000	0.000	201.909	201.909	201.909	579.8
010-YR	MH_A1-01	LINE-A1	46.00	3126.079	3132.980	514	0.000	0.000	0.000	0.000	201.825	201.825	201.826	596.5
010-YR	MH_A1-01	LINE-A1	47.00	3126.077	3132.980	514	0.000	0.000	0.000	0.000	201.741	201.741	201.741	613.1
010-YR	MH_A1-01	LINE-A1	48.00	3126.076	3132.980	514	0.000	0.000	0.000	0.000	201.655	201.655	201.656	629.8
010-YR	MH_A1-01	LINE-A1	49.00	3126.074	3132.980	514	0.000	0.000	0.000	0.000	201.569	201.569	201.569	646.5
010-YR	MH_A1-01	LINE-A1	50.00	3126.072	3132.980	514	0.000	0.000	0.000	0.000	201.481	201.481	201.482	663.1
010-YR	MH_A1-01	LINE-A1	51.00	3126.070	3132.980	514	0.000	0.000	0.000	0.000	201.390	201.390	201.391	679.8
010-YR	MH_A1-01	LINE-A1	52.00	3126.068	3132.980	514	0.000	0.000	0.000	0.000	201.294	201.294	201.295	696.4
010-YR	MH_A1-01	LINE-A1	53.00	3126.066	3132.980	514	0.000	0.000	0.000	0.000	201.195	201.195	201.196	713.0
010-YR	MH_A1-01	LINE-A1	54.00	3126.064	3132.980	514	0.000	0.000	0.000	0.000	201.094	201.094	201.094	729.6
010-YR	MH_A1-01	LINE-A1	55.00	3126.062	3132.980	514	0.000	0.000	0.000	0.000	200.991	200.991	200.991	746.3
010-YR	MH_A1-01	LINE-A1	56.00	3126.060	3132.980	514	0.000	0.000	0.000	0.000	200.888	200.888	200.889	762.9
010-YR	MH_A1-01	LINE-A1	57.00	3126.058	3132.980	514	0.000	0.000	0.000	0.000	200.789	200.789	200.790	779.5
010-YR	MH_A1-01	LINE-A1	58.00	3126.056	3132.980	514	0.000	0.000	0.000	0.000	200.683	200.683	200.683	796.1

Table 4-21
Discharge Point 30, 72-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 25-Year 24-Hour Precipitation (5.3 Inches)

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af
025-YR	MH_A1-01	LINE-A1	0.00	3113.500	3132.980	642	0.000	0.000	0.000	0.000	0.000	0.000	-587.187	0.0
025-YR	MH_A1-01	LINE-A1	1.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.115	35.115	34.795	1.5
025-YR	MH_A1-01	LINE-A1	2.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.886	34.886	35.178	4.3
025-YR	MH_A1-01	LINE-A1	3.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	7.2
025-YR	MH_A1-01	LINE-A1	4.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.008	35.008	34.993	10.1
025-YR	MH_A1-01	LINE-A1	5.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	13.0
025-YR	MH_A1-01	LINE-A1	6.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	15.9
025-YR	MH_A1-01	LINE-A1	7.00	3124.061	3132.980	514	0.000	0.000	0.000	0.000	35.408	35.408	35.408	18.8
025-YR	MH_A1-01	LINE-A1	8.00	3124.072	3132.980	514	0.000	0.000	0.000	0.000	38.661	38.661	38.658	21.9
025-YR	MH_A1-01	LINE-A1	9.00	3124.106	3132.980	514	0.000	0.000	0.000	0.000	46.714	46.714	46.707	25.4
025-YR	MH_A1-01	LINE-A1	10.00	3124.168	3132.980	514	0.000	0.000	0.000	0.000	58.894	58.894	58.884	29.8
025-YR	MH_A1-01	LINE-A1	11.00	3124.213	3132.980	514	0.000	0.000	0.000	0.000	64.999	64.999	64.999	34.9
025-YR	MH_A1-01	LINE-A1	12.00	3124.411	3132.980	514	0.000	0.000	0.000	0.000	90.243	90.243	90.180	41.3
025-YR	MH_A1-01	LINE-A1	13.00	3125.462	3132.980	514	0.000	0.000	0.000	0.000	169.322	169.322	169.182	52.0
025-YR	MH_A1-01	LINE-A1	14.00	3125.968	3132.980	514	0.000	0.000	0.000	0.000	196.380	196.380	196.353	67.1
025-YR	MH_A1-01	LINE-A1	15.00	3126.073	3132.980	514	0.000	0.000	0.000	0.000	201.527	201.527	201.520	83.6
025-YR	MH_A1-01	LINE-A1	16.00	3126.103	3132.980	514	0.000	0.000	0.000	0.000	202.988	202.988	202.985	100.3
025-YR	MH_A1-01	LINE-A1	17.00	3126.114	3132.980	514	0.000	0.000	0.000	0.000	203.538	203.538	203.537	117.1
025-YR	MH_A1-01	LINE-A1	18.00	3126.120	3132.980	514	0.000	0.000	0.000	0.000	203.814	203.814	203.814	134.0
025-YR	MH_A1-01	LINE-A1	19.00	3126.124	3132.980	514	0.000	0.000	0.000	0.000	203.986	203.986	203.986	150.8
025-YR	MH_A1-01	LINE-A1	20.00	3126.126	3132.980	514	0.000	0.000	0.000	0.000	204.113	204.113	204.113	167.7
025-YR	MH_A1-01	LINE-A1	21.00	3126.129	3132.980	514	0.000	0.000	0.000	0.000	204.211	204.211	204.211	184.5
025-YR	MH_A1-01	LINE-A1	22.00	3126.130	3132.980	514	0.000	0.000	0.000	0.000	204.287	204.287	204.287	201.4
025-YR	MH_A1-01	LINE-A1	23.00	3126.131	3132.980	514	0.000	0.000	0.000	0.000	204.348	204.348	204.348	218.3
025-YR	MH_A1-01	LINE-A1	24.00	3126.132	3132.980	514	0.000	0.000	0.000	0.000	204.400	204.400	204.400	235.2
025-YR	MH_A1-01	LINE-A1	25.00	3126.133	3132.980	514	0.000	0.000	0.000	0.000	204.446	204.446	204.446	252.1
025-YR	MH_A1-01	LINE-A1	26.00	3126.134	3132.980	514	0.000	0.000	0.000	0.000	204.469	204.469	204.469	269.0
025-YR	MH_A1-01	LINE-A1	27.00	3126.134	3132.980	514	0.000	0.000	0.000	0.000	204.451	204.451	204.451	285.9
025-YR	MH_A1-01	LINE-A1	28.00	3126.133	3132.980	514	0.000	0.000	0.000	0.000	204.408	204.408	204.408	302.8
025-YR	MH_A1-01	LINE-A1	29.00	3126.132	3132.980	514	0.000	0.000	0.000	0.000	204.355	204.355	204.355	319.7
025-YR	MH_A1-01	LINE-A1	30.00	3126.130	3132.980	514	0.000	0.000	0.000	0.000	204.300	204.300	204.300	336.6
025-YR	MH_A1-01	LINE-A1	31.00	3126.129	3132.980	514	0.000	0.000	0.000	0.000	204.244	204.244	204.244	353.4
025-YR	MH_A1-01	LINE-A1	32.00	3126.128	3132.980	514	0.000	0.000	0.000	0.000	204.187	204.187	204.187	370.3
025-YR	MH_A1-01	LINE-A1	33.00	3126.127	3132.980	514	0.000	0.000	0.000	0.000	204.131	204.131	204.131	387.2
025-YR	MH_A1-01	LINE-A1	34.00	3126.126	3132.980	514	0.000	0.000	0.000	0.000	204.075	204.075	204.075	404.1
025-YR	MH_A1-01	LINE-A1	35.00	3126.125	3132.980	514	0.000	0.000	0.000	0.000	204.020	204.020	204.020	420.9
025-YR	MH_A1-01	LINE-A1	36.00	3126.123	3132.980	514	0.000	0.000	0.000	0.000	203.968	203.968	203.968	437.8
025-YR	MH_A1-01	LINE-A1	37.00	3126.123	3132.980	514	0.000	0.000	0.000	0.000	203.923	203.923	203.923	454.6
025-YR	MH_A1-01	LINE-A1	38.00	3126.122	3132.980	514	0.000	0.000	0.000	0.000	203.881	203.881	203.881	471.5
025-YR	MH_A1-01	LINE-A1	39.00	3126.121	3132.980	514	0.000	0.000	0.000	0.000	203.841	203.841	203.841	488.3
025-YR	MH_A1-01	LINE-A1	40.00	3126.120	3132.980	514	0.000	0.000	0.000	0.000	203.799	203.799	203.799	505.2
025-YR	MH_A1-01	LINE-A1	41.00	3126.119	3132.980	514	0.000	0.000	0.000	0.000	203.756	203.756	203.756	522.0
025-YR	MH_A1-01	LINE-A1	42.00	3126.118	3132.980	514	0.000	0.000	0.000	0.000	203.710	203.710	203.710	538.8
025-YR	MH_A1-01	LINE-A1	43.00	3126.117	3132.980	514	0.000	0.000	0.000	0.000	203.662	203.662	203.662	555.7
025-YR	MH_A1-01	LINE-A1	44.00	3126.116	3132.980	514	0.000	0.000	0.000	0.000	203.610	203.610	203.610	572.5
025-YR	MH_A1-01	LINE-A1	45.00	3126.115	3132.980	514	0.000	0.000	0.000	0.000	203.555	203.555	203.556	589.3
025-YR	MH_A1-01	LINE-A1	46.00	3126.114	3132.980	514	0.000	0.000	0.000	0.000	203.499	203.499	203.499	606.2
025-YR	MH_A1-01	LINE-A1	47.00	3126.113	3132.980	514	0.000	0.000	0.000	0.000	203.441	203.441	203.441	623.0
025-YR	MH_A1-01	LINE-A1	48.00	3126.111	3132.980	514	0.000	0.000	0.000	0.000	203.382	203.382	203.382	639.8
025-YR	MH_A1-01	LINE-A1	49.00	3126.110	3132.980	514	0.000	0.000	0.000	0.000	203.321	203.321	203.322	656.6
025-YR	MH_A1-01	LINE-A1	50.00	3126.109	3132.980	514	0.000	0.000	0.000	0.000	203.261	203.261	203.261	673.4
025-YR	MH_A1-01	LINE-A1	51.00	3126.107	3132.980	514	0.000	0.000	0.000	0.000	203.199	203.199	203.199	690.2
025-YR	MH_A1-01	LINE-A1	52.00	3126.106	3132.980	514	0.000	0.000	0.000	0.000	203.137	203.137	203.138	707.0
025-YR	MH_A1-01	LINE-A1	53.00	3126.105	3132.980	514	0.000	0.000	0.000	0.000	203.075	203.075	203.075	723.8
025-YR	MH_A1-01	LINE-A1	54.00	3126.104	3132.980	514	0.000	0.000	0.000	0.000	203.012	203.012	203.012	740.6
025-YR	MH_A1-01	LINE-A1	55.00	3126.103	3132.980	514	0.000	0.000	0.000	0.000	202.959	202.959	202.959	757.3
025-YR	MH_A1-01	LINE-A1	56.00	3126.101	3132.980	514	0.000	0.000	0.000	0.000	202.894	202.894	202.894	774.1
025-YR	MH_A1-01	LINE-A1	57.00	3126.100	3132.980	514	0.000	0.000	0.000	0.000	202.830	202.830	202.830	790.9
025-YR	MH_A1-01	LINE-A1	58.00	3126.098	3132.980	514	0.000	0.000	0.000	0.000	202.765	202.765	202.765	807.6

SCLDIP

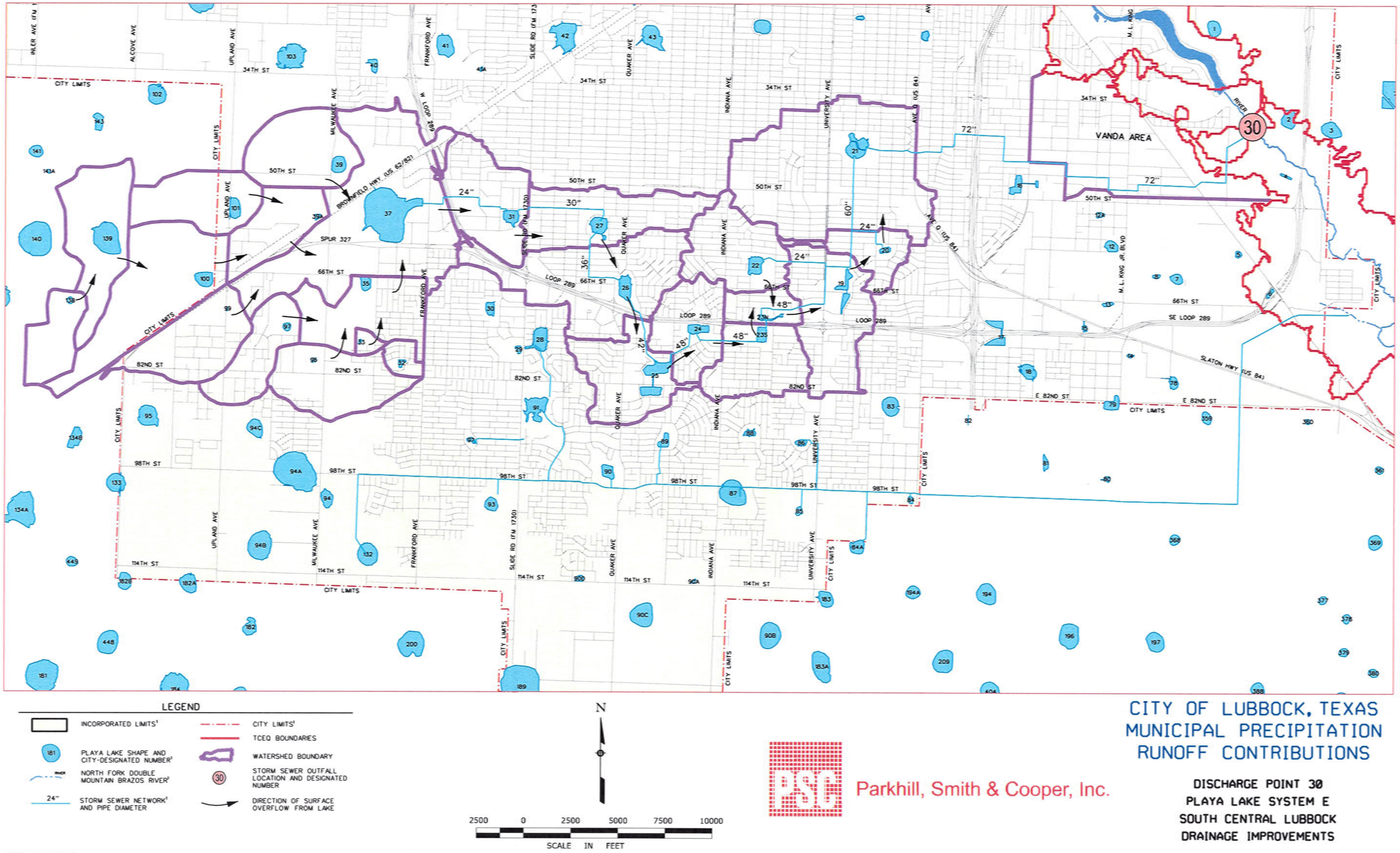
Table 4-22
Discharge Point 30, 72-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 50-Year 24-Hour Precipitation (6.0 Inches)

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af
050-YR	MH_A1-01	LINE-A1	0.00	3113.500	3132.980	642	0.000	0.000	0.000	0.000	0.000	0.000	-587.187	0.0
050-YR	MH_A1-01	LINE-A1	1.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.115	35.115	34.795	1.5
050-YR	MH_A1-01	LINE-A1	2.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.886	34.886	35.178	4.3
050-YR	MH_A1-01	LINE-A1	3.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	7.2
050-YR	MH_A1-01	LINE-A1	4.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.001	35.001	35.001	10.1
050-YR	MH_A1-01	LINE-A1	5.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	34.999	34.999	34.999	13.0
050-YR	MH_A1-01	LINE-A1	6.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.061	35.061	35.061	15.9
050-YR	MH_A1-01	LINE-A1	7.00	3124.065	3132.980	514	0.000	0.000	0.000	0.000	36.719	36.719	36.717	18.9
050-YR	MH_A1-01	LINE-A1	8.00	3124.090	3132.980	514	0.000	0.000	0.000	0.000	43.094	43.094	43.088	22.2
050-YR	MH_A1-01	LINE-A1	9.00	3124.145	3132.980	514	0.000	0.000	0.000	0.000	54.745	54.745	54.735	26.2
050-YR	MH_A1-01	LINE-A1	10.00	3124.213	3132.980	514	0.000	0.000	0.000	0.000	64.890	64.890	64.888	31.2
050-YR	MH_A1-01	LINE-A1	11.00	3124.214	3132.980	514	0.000	0.000	0.000	0.000	65.144	65.144	65.143	36.5
050-YR	MH_A1-01	LINE-A1	12.00	3124.713	3132.980	514	0.000	0.000	0.000	0.000	118.610	118.610	118.956	44.1
050-YR	MH_A1-01	LINE-A1	13.00	3125.761	3132.980	514	0.000	0.000	0.000	0.000	185.810	185.810	185.742	56.7
050-YR	MH_A1-01	LINE-A1	14.00	3126.010	3132.980	514	0.000	0.000	0.000	0.000	198.466	198.466	198.446	72.6
050-YR	MH_A1-01	LINE-A1	15.00	3126.095	3132.980	514	0.000	0.000	0.000	0.000	202.600	202.600	202.594	89.2
050-YR	MH_A1-01	LINE-A1	16.00	3126.123	3132.980	514	0.000	0.000	0.000	0.000	203.942	203.942	203.939	106.0
050-YR	MH_A1-01	LINE-A1	17.00	3126.134	3132.980	514	0.000	0.000	0.000	0.000	204.496	204.496	204.494	122.9
050-YR	MH_A1-01	LINE-A1	18.00	3126.141	3132.980	514	0.000	0.000	0.000	0.000	204.791	204.791	204.790	139.8
050-YR	MH_A1-01	LINE-A1	19.00	3126.145	3132.980	514	0.000	0.000	0.000	0.000	204.986	204.986	204.985	156.7
050-YR	MH_A1-01	LINE-A1	20.00	3126.148	3132.980	514	0.000	0.000	0.000	0.000	205.134	205.134	205.134	173.7
050-YR	MH_A1-01	LINE-A1	21.00	3126.150	3132.980	514	0.000	0.000	0.000	0.000	205.254	205.254	205.254	190.6
050-YR	MH_A1-01	LINE-A1	22.00	3126.153	3132.980	514	0.000	0.000	0.000	0.000	205.361	205.361	205.361	207.6
050-YR	MH_A1-01	LINE-A1	23.00	3126.155	3132.980	514	0.000	0.000	0.000	0.000	205.479	205.479	205.479	224.5
050-YR	MH_A1-01	LINE-A1	24.00	3126.159	3132.980	514	0.000	0.000	0.000	0.000	205.646	205.646	205.645	241.5
050-YR	MH_A1-01	LINE-A1	25.00	3126.163	3132.980	514	0.000	0.000	0.000	0.000	205.860	205.860	205.859	258.5
050-YR	MH_A1-01	LINE-A1	26.00	3126.168	3132.980	514	0.000	0.000	0.000	0.000	206.099	206.099	206.098	275.6
050-YR	MH_A1-01	LINE-A1	27.00	3126.173	3132.980	514	0.000	0.000	0.000	0.000	206.317	206.317	206.317	292.6
050-YR	MH_A1-01	LINE-A1	28.00	3126.177	3132.980	514	0.000	0.000	0.000	0.000	206.508	206.508	206.507	309.7
050-YR	MH_A1-01	LINE-A1	29.00	3126.180	3132.980	514	0.000	0.000	0.000	0.000	206.672	206.672	206.672	326.7
050-YR	MH_A1-01	LINE-A1	30.00	3126.183	3132.980	514	0.000	0.000	0.000	0.000	206.812	206.812	206.811	343.8
050-YR	MH_A1-01	LINE-A1	31.00	3126.185	3132.980	514	0.000	0.000	0.000	0.000	206.925	206.925	206.924	360.9
050-YR	MH_A1-01	LINE-A1	32.00	3126.187	3132.980	514	0.000	0.000	0.000	0.000	207.015	207.015	207.015	378.0
050-YR	MH_A1-01	LINE-A1	33.00	3126.189	3132.980	514	0.000	0.000	0.000	0.000	207.087	207.087	207.086	395.1
050-YR	MH_A1-01	LINE-A1	34.00	3126.190	3132.980	514	0.000	0.000	0.000	0.000	207.142	207.142	207.141	412.3
050-YR	MH_A1-01	LINE-A1	35.00	3126.191	3132.980	514	0.000	0.000	0.000	0.000	207.183	207.183	207.182	429.4
050-YR	MH_A1-01	LINE-A1	36.00	3126.192	3132.980	514	0.000	0.000	0.000	0.000	207.210	207.210	207.210	446.5
050-YR	MH_A1-01	LINE-A1	37.00	3126.192	3132.980	514	0.000	0.000	0.000	0.000	207.226	207.226	207.226	463.6
050-YR	MH_A1-01	LINE-A1	38.00	3126.192	3132.980	514	0.000	0.000	0.000	0.000	207.234	207.234	207.234	480.7
050-YR	MH_A1-01	LINE-A1	39.00	3126.192	3132.980	514	0.000	0.000	0.000	0.000	207.234	207.234	207.234	497.9
050-YR	MH_A1-01	LINE-A1	40.00	3126.192	3132.980	514	0.000	0.000	0.000	0.000	207.228	207.228	207.228	515.0
050-YR	MH_A1-01	LINE-A1	41.00	3126.192	3132.980	514	0.000	0.000	0.000	0.000	207.216	207.216	207.216	532.1
050-YR	MH_A1-01	LINE-A1	42.00	3126.191	3132.980	514	0.000	0.000	0.000	0.000	207.199	207.199	207.199	549.3
050-YR	MH_A1-01	LINE-A1	43.00	3126.191	3132.980	514	0.000	0.000	0.000	0.000	207.179	207.179	207.179	566.4
050-YR	MH_A1-01	LINE-A1	44.00	3126.190	3132.980	514	0.000	0.000	0.000	0.000	207.155	207.155	207.156	583.5
050-YR	MH_A1-01	LINE-A1	45.00	3126.190	3132.980	514	0.000	0.000	0.000	0.000	207.130	207.130	207.130	600.6
050-YR	MH_A1-01	LINE-A1	46.00	3126.189	3132.980	514	0.000	0.000	0.000	0.000	207.103	207.103	207.103	617.7
050-YR	MH_A1-01	LINE-A1	47.00	3126.189	3132.980	514	0.000	0.000	0.000	0.000	207.074	207.074	207.074	634.8
050-YR	MH_A1-01	LINE-A1	48.00	3126.188	3132.980	514	0.000	0.000	0.000	0.000	207.043	207.043	207.043	652.0
050-YR	MH_A1-01	LINE-A1	49.00	3126.187	3132.980	514	0.000	0.000	0.000	0.000	207.009	207.009	207.009	669.1
050-YR	MH_A1-01	LINE-A1	50.00	3126.187	3132.980	514	0.000	0.000	0.000	0.000	206.973	206.973	206.973	686.2
050-YR	MH_A1-01	LINE-A1	51.00	3126.186	3132.980	514	0.000	0.000	0.000	0.000	206.936	206.936	206.936	703.3
050-YR	MH_A1-01	LINE-A1	52.00	3126.185	3132.980	514	0.000	0.000	0.000	0.000	206.897	206.897	206.897	720.4
050-YR	MH_A1-01	LINE-A1	53.00	3126.184	3132.980	514	0.000	0.000	0.000	0.000	206.857	206.857	206.857	737.5
050-YR	MH_A1-01	LINE-A1	54.00	3126.183	3132.980	514	0.000	0.000	0.000	0.000	206.815	206.815	206.816	754.6
050-YR	MH_A1-01	LINE-A1	55.00	3126.182	3132.980	514	0.000	0.000	0.000	0.000	206.773	206.773	206.773	771.7
050-YR	MH_A1-01	LINE-A1	56.00	3126.181	3132.980	514	0.000	0.000	0.000	0.000	206.729	206.729	206.729	788.7
050-YR	MH_A1-01	LINE-A1	57.00	3126.180	3132.980	514	0.000	0.000	0.000	0.000	206.685	206.685	206.685	805.8
050-YR	MH_A1-01	LINE-A1	58.00	3126.179	3132.980	514	0.000	0.000	0.000	0.000	206.640	206.640	206.640	822.9

Table 4-23
Discharge Point 30, 72-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 100-Year 24-Hour Precipitation (6.8 Inches)

SCLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af
100-YR	MH_A1-01	LINE-A1	0.00	3113.500	3132.980	642	0.000	0.000	0.000	0.000	0.000	0.000	-587.187	0.0
100-YR	MH_A1-01	LINE-A1	1.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.115	35.115	34.795	1.5
100-YR	MH_A1-01	LINE-A1	2.00	3124.060	3132.980	514	0.000	0.000	0.000	0.000	34.886	34.886	35.178	4.3
100-YR	MH_A1-01	LINE-A1	3.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.002	35.002	35.002	7.2
100-YR	MH_A1-01	LINE-A1	4.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.000	35.000	35.000	10.1
100-YR	MH_A1-01	LINE-A1	5.00	3124.059	3132.980	514	0.000	0.000	0.000	0.000	35.003	35.003	35.003	13.0
100-YR	MH_A1-01	LINE-A1	6.00	3124.061	3132.980	514	0.000	0.000	0.000	0.000	35.505	35.505	35.504	15.9
100-YR	MH_A1-01	LINE-A1	7.00	3124.076	3132.980	514	0.000	0.000	0.000	0.000	39.641	39.641	39.637	19.0
100-YR	MH_A1-01	LINE-A1	8.00	3124.120	3132.980	514	0.000	0.000	0.000	0.000	49.882	49.882	49.873	22.7
100-YR	MH_A1-01	LINE-A1	9.00	3124.197	3132.980	514	0.000	0.000	0.000	0.000	62.418	62.418	62.408	27.4
100-YR	MH_A1-01	LINE-A1	10.00	3124.213	3132.980	514	0.000	0.000	0.000	0.000	65.001	65.001	65.001	32.6
100-YR	MH_A1-01	LINE-A1	11.00	3124.478	3132.980	514	0.000	0.000	0.000	0.000	97.308	97.308	97.269	39.3
100-YR	MH_A1-01	LINE-A1	12.00	3125.168	3132.980	514	0.000	0.000	0.000	0.000	150.549	150.549	150.342	49.6
100-YR	MH_A1-01	LINE-A1	13.00	3125.866	3132.980	514	0.000	0.000	0.000	0.000	191.212	191.212	191.174	63.7
100-YR	MH_A1-01	LINE-A1	14.00	3126.048	3132.980	514	0.000	0.000	0.000	0.000	200.321	200.321	200.306	79.9
100-YR	MH_A1-01	LINE-A1	15.00	3126.117	3132.980	514	0.000	0.000	0.000	0.000	203.659	203.659	203.654	96.6
100-YR	MH_A1-01	LINE-A1	16.00	3126.143	3132.980	514	0.000	0.000	0.000	0.000	204.925	204.925	204.922	113.5
100-YR	MH_A1-01	LINE-A1	17.00	3126.155	3132.980	514	0.000	0.000	0.000	0.000	205.497	205.497	205.496	130.4
100-YR	MH_A1-01	LINE-A1	18.00	3126.163	3132.980	514	0.000	0.000	0.000	0.000	205.852	205.852	205.851	147.4
100-YR	MH_A1-01	LINE-A1	19.00	3126.169	3132.980	514	0.000	0.000	0.000	0.000	206.152	206.152	206.151	164.5
100-YR	MH_A1-01	LINE-A1	20.00	3126.175	3132.980	514	0.000	0.000	0.000	0.000	206.440	206.440	206.439	181.5
100-YR	MH_A1-01	LINE-A1	21.00	3126.181	3132.980	514	0.000	0.000	0.000	0.000	206.733	206.733	206.733	198.6
100-YR	MH_A1-01	LINE-A1	22.00	3126.188	3132.980	514	0.000	0.000	0.000	0.000	207.042	207.042	207.042	215.7
100-YR	MH_A1-01	LINE-A1	23.00	3126.195	3132.980	514	0.000	0.000	0.000	0.000	207.368	207.368	207.367	232.8
100-YR	MH_A1-01	LINE-A1	24.00	3126.202	3132.980	514	0.000	0.000	0.000	0.000	207.709	207.709	207.708	250.0
100-YR	MH_A1-01	LINE-A1	25.00	3126.209	3132.980	514	0.000	0.000	0.000	0.000	208.054	208.054	208.053	267.1
100-YR	MH_A1-01	LINE-A1	26.00	3126.216	3132.980	514	0.000	0.000	0.000	0.000	208.380	208.380	208.379	284.3
100-YR	MH_A1-01	LINE-A1	27.00	3126.222	3132.980	514	0.000	0.000	0.000	0.000	208.660	208.660	208.659	301.6
100-YR	MH_A1-01	LINE-A1	28.00	3126.227	3132.980	514	0.000	0.000	0.000	0.000	208.897	208.897	208.897	318.8
100-YR	MH_A1-01	LINE-A1	29.00	3126.232	3132.980	514	0.000	0.000	0.000	0.000	209.100	209.100	209.099	336.1
100-YR	MH_A1-01	LINE-A1	30.00	3126.235	3132.980	514	0.000	0.000	0.000	0.000	209.273	209.273	209.272	353.4
100-YR	MH_A1-01	LINE-A1	31.00	3126.238	3132.980	514	0.000	0.000	0.000	0.000	209.417	209.417	209.417	370.7
100-YR	MH_A1-01	LINE-A1	32.00	3126.241	3132.980	514	0.000	0.000	0.000	0.000	209.531	209.531	209.530	388.0
100-YR	MH_A1-01	LINE-A1	33.00	3126.243	3132.980	514	0.000	0.000	0.000	0.000	209.618	209.618	209.618	405.3
100-YR	MH_A1-01	LINE-A1	34.00	3126.244	3132.980	514	0.000	0.000	0.000	0.000	209.689	209.689	209.689	422.6
100-YR	MH_A1-01	LINE-A1	35.00	3126.245	3132.980	514	0.000	0.000	0.000	0.000	209.745	209.745	209.745	440.0
100-YR	MH_A1-01	LINE-A1	36.00	3126.246	3132.980	514	0.000	0.000	0.000	0.000	209.787	209.787	209.787	457.3
100-YR	MH_A1-01	LINE-A1	37.00	3126.247	3132.980	514	0.000	0.000	0.000	0.000	209.818	209.818	209.818	474.7
100-YR	MH_A1-01	LINE-A1	38.00	3126.248	3132.980	514	0.000	0.000	0.000	0.000	209.841	209.841	209.841	492.0
100-YR	MH_A1-01	LINE-A1	39.00	3126.248	3132.980	514	0.000	0.000	0.000	0.000	209.857	209.857	209.857	509.3
100-YR	MH_A1-01	LINE-A1	40.00	3126.248	3132.980	514	0.000	0.000	0.000	0.000	209.868	209.868	209.868	526.7
100-YR	MH_A1-01	LINE-A1	41.00	3126.248	3132.980	514	0.000	0.000	0.000	0.000	209.873	209.873	209.873	544.0
100-YR	MH_A1-01	LINE-A1	42.00	3126.248	3132.980	514	0.000	0.000	0.000	0.000	209.876	209.876	209.876	561.4
100-YR	MH_A1-01	LINE-A1	43.00	3126.248	3132.980	514	0.000	0.000	0.000	0.000	209.875	209.875	209.875	578.7
100-YR	MH_A1-01	LINE-A1	44.00	3126.248	3132.980	514	0.000	0.000	0.000	0.000	209.872	209.872	209.872	596.1
100-YR	MH_A1-01	LINE-A1	45.00	3126.248	3132.980	514	0.000	0.000	0.000	0.000	209.868	209.868	209.868	613.4
100-YR	MH_A1-01	LINE-A1	46.00	3126.248	3132.980	514	0.000	0.000	0.000	0.000	209.863	209.863	209.863	630.8
100-YR	MH_A1-01	LINE-A1	47.00	3126.248	3132.980	514	0.000	0.000	0.000	0.000	209.856	209.856	209.856	648.1
100-YR	MH_A1-01	LINE-A1	48.00	3126.248	3132.980	514	0.000	0.000	0.000	0.000	209.849	209.849	209.849	665.4
100-YR	MH_A1-01	LINE-A1	49.00	3126.247	3132.980	514	0.000	0.000	0.000	0.000	209.840	209.840	209.840	682.8
100-YR	MH_A1-01	LINE-A1	50.00	3126.247	3132.980	514	0.000	0.000	0.000	0.000	209.831	209.831	209.831	700.1
100-YR	MH_A1-01	LINE-A1	51.00	3126.247	3132.980	514	0.000	0.000	0.000	0.000	209.822	209.822	209.822	717.5
100-YR	MH_A1-01	LINE-A1	52.00	3126.247	3132.980	514	0.000	0.000	0.000	0.000	209.811	209.811	209.811	734.8
100-YR	MH_A1-01	LINE-A1	53.00	3126.247	3132.980	514	0.000	0.000	0.000	0.000	209.801	209.801	209.801	752.2
100-YR	MH_A1-01	LINE-A1	54.00	3126.246	3132.980	514	0.000	0.000	0.000	0.000	209.789	209.789	209.789	769.5
100-YR	MH_A1-01	LINE-A1	55.00	3126.246	3132.980	514	0.000	0.000	0.000	0.000	209.778	209.778	209.778	786.8
100-YR	MH_A1-01	LINE-A1	56.00	3126.246	3132.980	514	0.000	0.000	0.000	0.000	209.765	209.765	209.765	804.2
100-YR	MH_A1-01	LINE-A1	57.00	3126.246	3132.980	514	0.000	0.000	0.000	0.000	209.753	209.753	209.753	821.5
100-YR	MH_A1-01	LINE-A1	58.00	3126.245	3132.980	514	0.000	0.000	0.000	0.000	209.739	209.739	209.739	838.8



CITY OF LUBBOCK, TEXAS
MUNICIPAL PRECIPITATION RUNOFF CONTRIBUTIONS

Parkhill, Smith & Cooper, Inc.

DISCHARGE POINT 30
PLAYA LAKE SYSTEM E
SOUTH CENTRAL LUBBOCK
DRAINAGE IMPROVEMENTS

FIGURE 4-1

Discharge Pt. 31

TAB

5.0 DISCHARGE POINT 31

5.1 INTRODUCTION

As noted in Chapter 2, Discharge Point 31 is the outlet at the North Fork of the Double Mountain Fork of the Brazos River for the South Lubbock Drainage Improvements storm sewer system. The South Lubbock Drainage Improvements convey storm water runoff from several lakes in the City of Lubbock's Playa Lake System G. This system begins at Lake 132 on the west side of Lubbock and primarily follows 98th Street eastward to future Olive Avenue, and then north to a tributary that drains into the river. The final outfall segment is a 54-inch diameter pipeline. The 98th Street portion is referred to as the trunk sewer, and smaller diameter lateral sewers connect this trunk sewer to playa lakes in System G. The feasibility study for this project was completed in June 2000. The flood that the City of Lubbock experienced on June 22, 1999 prompted that feasibility study. The first construction package was awarded in 2004 and substantial completion is expected in August 2008. The second construction package has been awarded and has a July 2008 notice to proceed. Completion of the second construction package is planned for January 2010. The overall project area served is shown in Figure 5-1.

Currently, with the substantial completion of the first construction package and previous completion of a separate thoroughfare package, the following features are in place:

a. Outfall and trunk storm sewer in 98th Street to the river.

b. Inlet structures and laterals for Playa Lakes 84, 84A, 85, 87, 90, 91 and 93.

c. Inlet structures for Playa Lakes 28, 86, 89, 92 and 132. Pipelines to connect these inlets to the trunk storm sewer are in the second construction package.

With the scheduled 2010 completion of the second construction package, the drainage system will be complete and that construction package will accomplish the following:

a. Lateral connection from the now-existing inlet at Lake 28 which will discharge into Lake 91, with Lake 91 discharging to the trunk storm sewer system.

b. Lateral connection from the now-existing inlet at Lake 86 which will discharge into the trunk storm sewer in 98th Street.

c. Lateral connection from the now existing inlet at Lake 89 which will discharge into the trunk storm sewer in 98th Street.

d. Lateral connection from the now-existing inlet at Lake 92 which will discharge into Lake 91, again, with Lake 91 discharging to the trunk storm sewer system.

e. Lateral connection from the now-existing inlet at Lake 132 which will discharge into the trunk storm sewer in 98th Street.

Thus, the South Lubbock Drainage Improvements will provide positive water level control to 12 playa lakes in Playa Lake System G. Currently, positive control is achieved at seven playa lakes within Playa System G. In 2010, the second construction package is expected to be complete and a further five playa lakes will also have positive water level control.

5.2 FUNCTIONAL CHARACTERISTICS

The primary purpose of the South Lubbock Drainage Improvements is the conveyance of stormwater to Discharge Point 31 and restore lake storage capacity in a much shorter elapsed time period after a runoff-producing rainfall event. Prior to the installation of these drainage improvements, the only water loss mechanisms to restore lake storage were evaporation and lake bottom infiltration/percolation. On numerous occasions the evaporation and infiltration/percolation losses were insufficient to recover available lake storage prior to some significant storm events. Thus, when lake storage hadn't recovered sufficiently and significant runoff occurred to the lakes, then the increased lake water elevations would threaten surrounding properties. For example, after the June 1999 flood, one business in Playa System G remained inundated for close to six months. A few of the lakes in Playa Lake System G do overflow at the 100-year probability event, and some structures in those overflow reaches become threatened when overflows do occur.

The design team completed a feasibility study in June 2000 and was tasked to proceed with design later that same year. As noted above, a major part of the storm sewer system will be substantially complete in August 2008, with the remainder of the system scheduled for completion in January 2010.

The South Lubbock Drainage Improvements essentially provide positive control of playa lake water surface elevations, and recover lake storage within a reasonable time period. The storm sewer improvements are not intended to provide full flood mitigation. However, with reliable lake storage recovery and a definitive permanent water surface elevation established, some reduction in frequency of flooding could be realized. The South Lubbock Drainage System provides discharge capacity to the river for Playa Lake System G where no discharge capability existed previously.

5.3 HYDROLOGICAL PARAMETERS

The hydrological parameters for Playa System G served by the South Lubbock Drainage Improvements are based on the U. S. Department of Agriculture Natural Resources Conservation Service (NRCS) curve number method for determination of precipitation runoff volume and watershed runoff peak discharges. Hydrological routings through lake storages were performed using elevation-area-storage tables for each involved lake in

Playa System G. Inlets, pipelines and overflow reaches were modeled in Interconnected Pond and Channel Routing (ICPR) software to provide the discharge conditions for each lake's hydrograph routing. Figure 5-1 shows the overall watershed's boundaries involved along with each lake's sub-watershed. The boundaries were established by using City of Lubbock one-foot interval contour maps. The South Lubbock Drainage improvements storm sewer network is also shown on Figure 5.1 along with the storm sewer pipe diameters. The lake numbers come from the City of Lubbock's playa lake designation system. The lakes that are served by the storm sewer system are referred to as "connected" lakes while those that contribute only by surface overflow are referred to as "disconnected" lakes. The disconnected lakes are shown with overflow directional arrows to indicate the general direction in which overflow occurs once runoff volume exceeds lake storage volume. It can be seen from the overflow arrows in Figure 5-1 that Lakes 30 and 88 are "disconnected" lakes that contribute runoff only after the lakes' storages are satisfied. Lakes 28, 29, 86, 87 and 92 are not only "connected" lakes, but also can overflow to a downstream "connected" lake in the one-percent precipitation event (Lakes 28 and 29 are hydraulically connected to each other by a culvert under Slide Road). The remaining playa lakes (84, 84A, 85, 89, 90, 91, 93 and 132) are "connected" and were not predicted to overflow through the one-percent precipitation event, both prior to and after storm sewer construction.

The western limit of the study was determined by a combination of the existing lakes' storage volumes available. West of the boundary shown in Figure 5-1 the lakes have available storage in excess of the one percent 24-hour probabilistic runoff volume. The only way these upstream lakes could contribute is by surface overflow, but are calculated to be non-overflow through the one-percent (100-year) storm event.

At the eastern limit of this study area shown in Figure 5-1 is a sub-watershed labeled as the "Southeast Quadrant". This area is very flat. The topography has been changed somewhat over the years through NRCS conservation programs and has undergone agricultural land-leveling and agricultural land-planing and drains very little, or at least very slowly. It is expected that future storm drain inlets will have to be constructed in this area and connected to the 54-inch diameter outfall to achieve acceptable surface drainage as this area develops. Additional building pads are being constructed along the US Highway 84 frontage as this report goes to press, so development pressure is occurring in this sub-watershed. However, the Southeast Quadrant is currently a disconnected sub-watershed.

For the peak discharge from the storm sewer outlet at Point 31, the various precipitation depths were analyzed in the ICPR computer simulation for the Playa System G study area. From these simulations, peak discharges for each precipitation event were determined. The 54-inch diameter outfall approaches hydraulic conveyance limitations in the 75-80 cubic feet per second (cfs) flow rate range. This is where the pipeline operates under surcharge full-flow conditions, and several feet of additional head at the connected lakes results in very little increase in discharge flow rate.

In summary, the design analyses included the following:

a. NRCS curve number, time of concentration and area for each sub-watershed.

b. Elevation-area-storage data for each playa lake.

c. Discharge capability modeled for each lake, whether connected or disconnected, whether overflow or storm sewer discharge.

d. Disconnected lakes do not contribute except via overflow, and only after the disconnected lakes' storage capacities are satisfied.

The analysis for contributions to the North Fork of the Double Mountain Fork of the Brazos River can essentially be reduced to a spreadsheet to account for volume discharged to the river, and ICPR modeling to find the node-time series for the maximum discharge from the 54-inch diameter outfall. Tables 5-2 through 5-12 show the spreadsheet analysis and results for volume of runoff from the South Lubbock Drainage Improvements. Tables 5-13 through 5-23 show the maximum discharges calculated for the 54-inch storm sewer. Table 4-1 below summarizes the results. Some rounding of the numerical results has been incorporated.

Table 5-1

Point 31 Peak Flow Rate and Discharge Volume

Probability Event	Duration	Precipitation Depth (inches)	Peak Discharge Flow Rate (cfs)	Runoff Volume Discharged (acre-feet)
N/A	24-hour	0.5	3	2
N/A	24-hour	1.0	44	74
N/A	24-hour	1.5	73	220
N/A	24-hour	2.0	75	412
N/A	24-hour	2.5	75	631
2-Year (50%)	24-hour	2.8	75.7	773
5-Year (20%)	24-hour	3.8	77	1,279
10-Year (10%)	24-hour	4.6	78	1,713
25-Year (4%)	24-hour	5.3	78	2,114
50-Year (2%)	24-hour	6.0	78	2,523
100-Year (1%)	24-hour	6.8	79	2,999

Table 5-2
Discharge Point 31
Playa System G Developed Urban Runoff to Brazos River (Discharge Point #31)
Computation of 0.5-Inch, 24-hour Storm Runoff Volume
and Discharge from Upstream Playas

Precipitation (P): 0.50 inches
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER PERMIT RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	0.5-Inch, 24-hr Storm Runoff Volume (inches) ⑦	0.5-Inch, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-G											
Connected	L132	535.16	389.96	85	1.76	0.01	0.50	389.46	0.00		N/A
Connected	L093	1261.94	1213.25	84	1.90	0.01	0.74	1212.51	0.00		N/A
	L030	253.19	148.56	82	2.20	0.00	0.03	148.52	0.00		L029
Connected	L029	354.03	5.19	82	2.20	0.00	0.05	5.14	0.00		L028
Connected	L028	129.17	55.48	84	1.90	0.01	0.08	55.40	0.00		L091
Connected	L092	261.78	0.83	80	2.50	0.00	0.00	0.83	0.00		L091
Connected	L091	828.35	943.57	83	2.05	0.00	0.26	943.31	0.00		L090
Connected	L090	761.18	479.34	82	2.20	0.00	0.10	479.24	0.00		L087
Connected	L087	464.30	40.65	82	2.20	0.00	0.06	40.59	0.00		L085
	L088	237.59	50.31	82	2.20	0.00	0.03	50.28	0.00		L086
Connected	L086	439.27	244.83	84	1.90	0.01	0.26	244.57	0.00		L085
Connected	L085	655.27	1338.70	80	2.50	0.00	0.00	1338.70	0.00		L084A
Connected	L084A	415.40	1978.95	83	2.05	0.00	0.13	1978.82	0.00		L084
Connected	L084	259.04	281.57	82	2.20	0.00	0.04	281.53	0.00		N/A
Connected	L089	342.00	809.13	81	2.35	0.00	0.01	809.12	0.00		N/A
SE Quadrant		721.10	None	81	2.35	0.00	0.02	-0.02	0.02		N/A
Totals		7918.77					2.32				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Round to

Runoff volume to Point 31 is the total runoff minus Lake 30 runoff minus Lake 29 runoff minus Lake 88 runoff = 2.21 | 2

Table 5-3
Discharge Point 31
Playa System G Developed Urban Runoff to Brazos River
Computation of 1.0-Inch, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 1.00 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER PERMIT RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	1-Inch, 24-hr Storm Runoff Volume		Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
						(inches) ⑦	(acre-feet) ⑧				
SYSTEM-G											
Connected	L132	535.16	389.96	85	1.76	0.17	7.74	382.22	0.00		N/A
Connected	L093	1261.94	1213.25	84	1.90	0.15	15.97	1197.28	0.00		N/A
	L030	253.19	148.56	82	2.20	0.11	2.41	146.15	0.00		L029
Connected	L029	354.03	5.19	82	2.20	0.11	3.37	1.82	0.00		L028
Connected	L028	129.17	55.48	84	1.90	0.15	1.63	53.85	0.00		L091
Connected	L092	261.78	0.83	80	2.50	0.08	1.82	-0.99	0.99		L091
Connected	L091	828.35	943.57	83	2.05	0.13	9.12	933.46	0.00		L090
Connected	L090	761.18	479.34	82	2.20	0.11	7.24	472.10	0.00		L087
Connected	L087	464.30	40.65	82	2.20	0.11	4.42	36.23	0.00		L085
	L088	237.59	50.31	82	2.20	0.11	2.26	48.05	0.00		L086
Connected	L086	439.27	244.83	84	1.90	0.15	5.56	239.27	0.00		L085
Connected	L085	655.27	1338.70	80	2.50	0.08	4.55	1334.15	0.00		L084A
Connected	L084A	415.40	1978.95	83	2.05	0.13	4.57	1974.38	0.00		L084
Connected	L084	259.04	281.57	82	2.20	0.11	2.46	279.11	0.00		N/A
Connected	L089	342.00	809.13	81	2.35	0.10	2.79	806.34	0.00		N/A
SE Quadrant		721.10	None	81	2.35	0.10	5.89	-5.89	5.89		N/A
TOTAL		7918.77					81.80				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Round to

Runoff volume to Point 31 is the total runoff minus Lake 30 runoff minus Lake 29 runoff minus Lake 88 runoff = 73.77 74

Table 5-4
Discharge Point 31
Playa System G Developed Urban Runoff to Brazos River
Computation of 1.5-Inch, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 1.50 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER PERMIT RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	1.5-Inch, 24-hr Storm Runoff Volume		Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
						(inches) ⑦	(acre-feet) ⑧				
SYSTEM-G											
Connected	L132	535.16	389.96	85	1.76	0.45	20.15	369.81	0.00		N/A
Connected	L093	1261.94	1213.25	84	1.90	0.41	43.55	1169.70	0.00		N/A
	L030	253.19	148.56	82	2.20	0.35	7.29	141.26	0.00		L029
Connected	L029	354.03	5.19	82	2.20	0.35	10.20	-5.01	5.01		L028
Connected	L028	129.17	55.48	84	1.90	0.41	4.46	46.01	0.00		L091
Connected	L092	261.78	0.83	80	2.50	0.29	6.23	-5.40	5.40		L091
Connected	L091	828.35	943.57	83	2.05	0.38	26.15	912.02	0.00		L090
Connected	L090	761.18	479.34	82	2.20	0.35	21.93	457.41	0.00		L087
Connected	L087	464.30	40.65	82	2.20	0.35	13.38	27.27	0.00		L085
	L088	237.59	50.31	82	2.20	0.35	6.84	43.46	0.00		L086
Connected	L086	439.27	244.83	84	1.90	0.41	15.16	229.67	0.00		L085
Connected	L085	655.27	1338.70	80	2.50	0.29	15.60	1323.10	0.00		L084A
Connected	L084A	415.40	1978.95	83	2.05	0.38	13.11	1965.84	0.00		L084
Connected	L084	259.04	281.57	82	2.20	0.35	7.46	274.11	0.00		N/A
Connected	L089	342.00	809.13	81	2.35	0.31	8.97	800.16	0.00		N/A
SE Quadrant		721.10	None	81	2.35	0.31	18.91	-18.91	18.91		N/A
Totals		7918.77					239.40				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Runoff volume to Point 31 is the total runoff minus runoff from Lake 30 minus Lake 29 storage minus Lake 88 runoff = 220.08

Round to
220

Table 5-5
Discharge Point 31
Playa System G Developed Urban Runoff to Brazos River Computation of 2.0-Inch, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 2.00 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER PERMIT RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	2-Inch, 24-hr Storm Runoff Volume (inches) ⑦	2-Inch, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-G											
Connected	L132	535.16	389.96	85	1.76	0.80	35.46	354.50	0.00		N/A
Connected	L093	1261.94	1213.25	84	1.90	0.74	78.23	1135.02	0.00		N/A
	L030	253.19	148.56	82	2.20	0.65	13.69	134.87	0.00		L029
Connected	L029	354.03	5.19	82	2.20	0.65	19.14	-13.95	13.95		L028
Connected	L028	129.17	55.48	84	1.90	0.74	8.01	33.52	0.00		L091
Connected	L092	261.78	0.83	80	2.50	0.56	12.27	-11.44	11.44		L091
Connected	L091	828.35	943.57	83	2.05	0.70	47.98	884.15	0.00		L090
Connected	L090	761.18	479.34	82	2.20	0.65	41.15	438.19	0.00		L087
Connected	L087	464.30	40.65	82	2.20	0.65	25.10	15.55	0.00		L085
	L088	237.59	50.31	82	2.20	0.65	12.84	37.46	0.00		L086
Connected	L086	439.27	244.83	84	1.90	0.74	27.23	217.60	0.00		L085
Connected	L085	655.27	1338.70	80	2.50	0.56	30.72	1307.99	0.00		L084A
Connected	L084A	415.40	1978.95	83	2.05	0.70	24.06	1954.89	0.00		L084
Connected	L084	259.04	281.57	82	2.20	0.65	14.00	267.57	0.00		N/A
Connected	L089	342.00	809.13	81	2.35	0.60	17.23	791.90	0.00		N/A
SE Quadrant		721.10	None	81	2.35	0.60	36.33	-36.33	36.33		N/A
Totals		7918.77					443.44				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Round to

Runoff volume to Point 31 is the total runoff minus runoff from Lake 30 minus Lake 29 storage minus Lake 88 runoff = 411.72 412

Table 5-6
Discharge Point 31
Playa System G Developed Urban Runoff to Brazos River
Computation of 2.5-Inch, 24-hour Storm Runoff Volume
and Discharge from Upstream Playas

Precipitation (P): 2.50 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER PERMIT RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	2.5-inch, 24-hr Storm Runoff Volume		Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
						(inches) ⑦	(acre-feet) ⑧				
SYSTEM-G											
Connected	L132	535.16	389.96	85	1.76	1.18	52.56	337.40	0.00		N/A
Connected	L093	1261.94	1213.25	84	1.90	1.12	117.35	1095.90	0.00		N/A
	L030	253.19	148.56	82	2.20	1.00	21.06	127.50	0.00		L029
Connected	L029	354.03	5.19	82	2.20	1.00	29.44	-24.25	24.25		L028
Connected	L028	129.17	55.48	84	1.90	1.12	12.01	19.21	0.00		L091
Connected	L092	261.78	0.83	80	2.50	0.89	19.39	-18.56	18.56		L091
Connected	L091	828.35	943.57	83	2.05	1.06	72.88	852.13	0.00		L090
Connected	L090	761.18	479.34	82	2.20	1.00	63.31	416.03	0.00		L087
Connected	L087	464.30	40.65	82	2.20	1.00	38.61	2.04	0.00		L085
	L088	237.59	50.31	82	2.20	1.00	19.76	30.55	0.00		L086
Connected	L086	439.27	244.83	84	1.90	1.12	40.85	203.98	0.00		L085
Connected	L085	655.27	1338.70	80	2.50	0.89	48.54	1290.16	0.00		L084A
Connected	L084A	415.40	1978.95	83	2.05	1.06	36.55	1942.40	0.00		L084
Connected	L084	259.04	281.57	82	2.20	1.00	21.54	260.03	0.00		N/A
Connected	L089	342.00	809.13	81	2.35	0.94	26.86	782.27	0.00		N/A
SE Quadrant		721.10	None	81	2.35	0.94	56.63	-56.63	56.63		N/A
Totals		7918.77					677.35				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Runoff volume to Point 31 is the total runoff minus runoff from Lake 30 minus Lake 29 storage minus Lake 88 runoff = 631.34

Round to
631

Table 5-7
Discharge Point 31
Playa System G Developed Urban Runoff to Brazos River
Computation of 2-year, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 2.80 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER PERMIT RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	2-yr, 24-hr Storm Runoff Volume (inches) ⑦	2-yr, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-G											
Connected	L132	535.16	389.96	85	1.76	1.42	63.41	326.55	0.00		N/A
Connected	L093	1261.94	1213.25	84	1.90	1.35	142.32	1070.93	0.00		N/A
	L030	253.19	148.56	82	2.20	1.22	25.81	122.74	0.00		L029
Connected	L029	354.03	5.19	82	2.20	1.22	36.10	-30.91	30.91		L028
Connected	L028	129.17	55.48	84	1.90	1.35	14.57	10.01	0.00		L091
Connected	L092	261.78	0.83	80	2.50	1.10	24.04	-23.21	23.21		L091
Connected	L091	828.35	943.57	83	2.05	1.29	88.86	831.50	0.00		L090
Connected	L090	761.18	479.34	82	2.20	1.22	77.61	401.73	0.00		L087
Connected	L087	464.30	40.65	82	2.20	1.22	47.34	-6.69	6.69		L085
	L088	237.59	50.31	82	2.20	1.22	24.22	26.08	0.00		L086
Connected	L086	439.27	244.83	84	1.90	1.35	49.54	195.29	0.00		L085
Connected	L085	655.27	1338.70	80	2.50	1.10	60.18	1271.83	0.00		L084A
Connected	L084A	415.40	1978.95	83	2.05	1.29	44.56	1934.39	0.00		L084
Connected	L084	259.04	281.57	82	2.20	1.22	26.41	255.16	0.00		N/A
Connected	L089	342.00	809.13	81	2.35	1.16	33.11	776.02	0.00		N/A
SE Quadrant		721.10	None	81	2.35	1.16	69.81	-69.81	69.81		N/A
TOTAL							827.89				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Runoff volume to Point 31 is the total runoff minus runoff from Lake 30 minus Lake 29 storage minus Lake 88 runoff = 772.67 Round to 773

Table 5-8
Discharge Point 31
Playa System G Developed Urban Runoff to Brazos River
Computation of 5-year, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 3.80 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER PERMIT RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	5-yr, 24-hr Storm Runoff Volume (inches) ⑦	5-yr, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-G											
Connected	L132	535.16	389.96	85	1.76	2.28	101.68	288.28	0.00		N/A
Connected	L093	1261.94	1213.25	84	1.90	2.20	230.91	982.34	0.00		N/A
	L030	253.19	148.56	82	2.20	2.03	42.90	105.66	0.00		L029
Connected	L029	354.03	5.19	82	2.20	2.03	59.98	-54.79	54.79		L028
Connected	L028	129.17	55.48	84	1.90	2.20	23.64	-22.95	22.95		L091
Connected	L092	261.78	0.83	80	2.50	1.88	40.96	-40.13	40.13		L091
Connected	L091	828.35	943.57	83	2.05	2.11	145.90	734.60	0.00		L090
Connected	L090	761.18	479.34	82	2.20	2.03	128.96	350.38	0.00		L087
Connected	L087	464.30	40.65	82	2.20	2.03	78.66	-38.01	38.01		L085
	L088	237.59	50.31	82	2.20	2.03	40.25	10.05	0.00		L086
Connected	L086	439.27	244.83	84	1.90	2.20	80.38	164.45	0.00		L085
Connected	L085	655.27	1338.70	80	2.50	1.88	102.53	1198.16	0.00		L084A
Connected	L084A	415.40	1978.95	83	2.05	2.11	73.16	1905.79	0.00		L084
Connected	L084	259.04	281.57	82	2.20	2.03	43.89	237.68	0.00		N/A
Connected	L089	342.00	809.13	81	2.35	1.95	55.70	753.43	0.00		N/A
SE Quadrant		721.10	None	81	2.35	1.95	117.45	-117.45	117.45		N/A
TOTAL		7918.77					1366.94				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Runoff volume to Point 31 is the total runoff minus runoff from Lake 30 minus Lake 29 storage minus Lake 88 runoff = 1278.60

Round to
1279

Table 5-9
Discharge Point 31
Playa System G Developed Urban Runoff to Brazos River (Discharge Point #31)
Computation of 10-year, 24-hour Storm Runoff Volume
and Discharge from Upstream Playas

Precipitation (P): 4.60 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER PERMIT RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	10-yr, 24-hr Storm Runoff Volume (inches) ⑦	10-yr, 24-hr Storm Runoff Volume (acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-G											
Connected	L132	535.16	389.96	85	1.76	3.00	133.81	256.15	0.00		N/A
Connected	L093	1261.94	1213.25	84	1.90	2.91	305.68	907.57	0.00		N/A
	L030	253.19	148.56	82	2.20	2.72	57.47	91.08	0.00		L029
Connected	L029	354.03	5.19	82	2.20	2.72	80.36	-75.17	75.17		L028
Connected	L028	129.17	55.48	84	1.90	2.91	31.29	-50.98	50.98		L091
Connected	L092	261.78	0.83	80	2.50	2.55	55.56	-54.73	54.73		L091
Connected	L091	828.35	943.57	83	2.05	2.81	194.29	643.57	0.00		L090
Connected	L090	761.18	479.34	82	2.20	2.72	172.78	306.56	0.00		L087
Connected	L087	464.30	40.65	82	2.20	2.72	105.39	-64.74	64.74		L085
	L088	237.59	50.31	82	2.20	2.72	53.93	-3.62	3.62		L086
Connected	L086	439.27	244.83	84	1.90	2.91	106.40	134.80	0.00		L085
Connected	L085	655.27	1338.70	80	2.50	2.55	139.08	1134.88	0.00		L084A
Connected	L084A	415.40	1978.95	83	2.05	2.81	97.43	1881.52	0.00		L084
Connected	L084	259.04	281.57	82	2.20	2.72	58.80	222.77	0.00		N/A
Connected	L089	342.00	809.13	81	2.35	2.63	75.09	734.04	0.00		N/A
SE Quadrant		721.10	None	81	2.35	2.63	158.33	-158.33	158.33		N/A
TOTAL		7918.77					1825.71				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Round to

Runoff volume to Point 31 is the total runoff minus runoff from Lake 30 minus Lake 29 storage minus Lake 88 storage = 1712.74 | 1713

Table 5-10
Discharge Point 31
Playa System G Developed Urban Runoff to Brazos River
Computation of 25-year, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 5.30 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER PERMIT RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	25-yr, 24-hr Storm Runoff Volume (inches) ⑦	(acre-feet) ⑧	Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
SYSTEM-G											
Connected	L132	535.16	389.96	85	1.76	3.65	162.61	227.35	0.00		N/A
Connected	L093	1261.94	1213.25	84	1.90	3.55	372.90	840.35	0.00		N/A
	L030	253.19	148.56	82	2.20	3.35	70.66	77.90	0.00		L029
Connected	L029	354.03	5.19	82	2.20	3.35	98.80	-93.61	93.61		L028
Connected	L028	129.17	55.48	84	1.90	3.55	38.17	-76.30	76.30		L091
Connected	L092	261.78	0.83	80	2.50	3.16	68.85	-68.02	68.02		L091
Connected	L091	828.35	943.57	83	2.05	3.45	237.93	561.32	0.00		L090
Connected	L090	761.18	479.34	82	2.20	3.35	212.42	266.92	0.00		L087
Connected	L087	464.30	40.65	82	2.20	3.35	129.57	-88.92	88.92		L085
	L088	237.59	50.31	82	2.20	3.35	66.30	-15.99	15.99		L086
Connected	L086	439.27	244.83	84	1.90	3.55	129.80	99.03	0.00		L085
Connected	L085	655.27	1338.70	80	2.50	3.16	172.34	1077.44	0.00		L084A
Connected	L084A	415.40	1978.95	83	2.05	3.45	119.32	1859.63	0.00		L084
Connected	L084	259.04	281.57	82	2.20	3.35	72.29	209.28	0.00		N/A
Connected	L089	342.00	809.13	81	2.35	3.25	92.68	716.45	0.00		N/A
SE Quadrant		721.10	None	81	2.35	3.25	195.41	-195.41	195.41		N/A
TOTAL		7918.77					2240.05				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Runoff volume to Point 31 is the total runoff minus runoff from Lake 30 minus Lake 29 storage minus Lake 88 storage = 2113.89

Round to
2114

Table 5-11
Discharge Point 31
Playa System G Developed Urban Runoff to Brazos River
Computation of 50-year, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 6.00 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER PERMIT RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	50-yr, 24-hr Storm Runoff Volume		Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
						(inches) ⑦	(acre-feet) ⑧				
SYSTEM-G											
Connected	L132	535.16	389.96	85	1.76	4.30	191.88	198.08	0.00		N/A
Connected	L093	1261.94	1213.25	84	1.90	4.20	441.31	771.94	0.00		N/A
	L030	253.19	148.56	82	2.20	3.99	84.12	64.43	0.00		L029
Connected	L029	354.03	5.19	82	2.20	3.99	117.63	-112.44	112.44		L028
Connected	L028	129.17	55.48	84	1.90	4.20	45.17	-102.13	102.13		L091
Connected	L092	261.78	0.83	80	2.50	3.78	82.49	-81.66	81.66		L091
Connected	L091	828.35	943.57	83	2.05	4.09	282.42	477.36	0.00		L090
Connected	L090	761.18	479.34	82	2.20	3.99	252.91	226.43	0.00		L087
Connected	L087	464.30	40.65	82	2.20	3.99	154.27	-113.62	113.62		L085
	L088	237.59	50.31	82	2.20	3.99	78.94	-28.63	28.63		L086
Connected	L086	439.27	244.83	84	1.90	4.20	153.62	62.58	0.00		L085
Connected	L085	655.27	1338.70	80	2.50	3.78	206.48	1018.61	0.00		L084A
Connected	L084A	415.40	1978.95	83	2.05	4.09	141.63	1837.32	0.00		L084
Connected	L084	259.04	281.57	82	2.20	3.99	86.07	195.50	0.00		N/A
Connected	L089	342.00	809.13	81	2.35	3.88	110.69	698.44	0.00		N/A
SE Quadrant		721.10	None	81	2.35	3.88	233.38	-233.38	233.38		N/A
TOTAL		7918.77					2663.01				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Runoff volume to Point 31 is the total runoff minus runoff from Lake 30 minus Lake 29 storage minus Lake 88 storage = 2523.38

Round to
2523

Table 5-12
Discharge Point 31
Playa System G Developed Urban Runoff to Brazos River
Computation of 100-year, 24-hour Storm Runoff Volume and Discharge from Upstream Playas

Precipitation (P): 6.80 inches (Source: TP40)
Initial Abstraction (Ia): 0.20 S

FILENAME: COL WATER PERMIT RUNOFF VOLUME SYSTEM E & G.XLS

Sub-Basin ID	Lake ID	Sub-Basin Area (ac) ①	Total Lake Storage To Overflow Elevation (acre-feet) ②	AMC II Curve Number (CN) ⑤	S ⑥	100-yr, 24-hr Storm Runoff Volume		Available Storage Remaining (acre-feet) ⑨	Discharge To Downstream Playa (acre-feet) ⑩	Discharge Overflows to ⑪	Receiving Lake ⑫
						(inches) ⑦	(acre-feet) ⑧				
SYSTEM-G											
Connected	L132	535.16	389.96	85	1.76	5.06	225.73	164.23	0.00		N/A
Connected	L093	1261.94	1213.25	84	1.90	4.95	520.57	692.68	0.00		N/A
	L030	253.19	148.56	82	2.20	4.73	99.78	48.78	0.00		L029
Connected	L029	354.03	5.19	82	2.20	4.73	139.52	-134.33	134.33		L028
Connected	L028	129.17	55.48	84	1.90	4.95	53.28	-132.13	132.13		L091
Connected	L092	261.78	0.83	80	2.50	4.51	98.39	-97.56	97.56		L091
Connected	L091	828.35	943.57	83	2.05	4.84	334.05	379.82	0.00		L090
Connected	L090	761.18	479.34	82	2.20	4.73	299.97	179.37	0.00		L087
Connected	L087	464.30	40.65	82	2.20	4.73	182.97	-142.32	142.32		L085
	L088	237.59	50.31	82	2.20	4.73	93.63	-43.32	43.32		L086
Connected	L086	439.27	244.83	84	1.90	4.95	181.20	20.30	0.00		L085
Connected	L085	655.27	1338.70	80	2.50	4.51	246.28	950.09	0.00		L084A
Connected	L084A	415.40	1978.95	83	2.05	4.84	167.52	1811.43	0.00		L084
Connected	L084	259.04	281.57	82	2.20	4.73	102.08	179.49	0.00		N/A
Connected	L089	342.00	809.13	81	2.35	4.62	131.65	677.48	0.00		N/A
SE Quadrant		721.10	None	81	2.35	4.62	277.58	-277.58	277.58		N/A
TOTAL		7918.77					3154.22				

COL. 1 FROM MICROSTATION
COL. 2 FROM CONTOUR MAPS AND LAKE STORAGE CALCULATIONS
COL. 3 = (COL. 1 * 2 inches) * 0.7 / 12 = acre-feet. If the 70% of 2" rain exceeded storage at overflow elevation then COL. 3 = 0
COL. 4 = COL. 2 - COL. 3
COL. 5 WEIGHTED CURVE NUMBER FOR WESTERN DRAINAGE AREAS. CURVE NUMBER FROM VALENCE FOR ALL OTHER DRAINAGE AREAS.
COL. 6 = (1000/COL. 5)-10
COL. 7 = (P-0.2*COL. 6)^2/(P+0.8*COL. 6)
COL. 8 = (COL. 1 * COL. 7)/12
COL. 9 = COL. 4 - COL. 8 - (INFLOW FROM UPSTREAM PLAYA FROM COL. 10)
COL. 10 = IF COL. 9 IS POSITIVE THEN PLAYA IS NON-DISCHARGING. IF COL. 9 IS NEGATIVE THEN COL. 10 IS THE DISCHARGE FROM THAT PLAYA
COL. 11 = SUB-BASIN ID
COL. 12 = PLAYA LAKE ID

Checked

Runoff volume to Point 31 is the total runoff minus runoff from Lake 30 minus Lake 29 storage minus Lake 88 storage = 2998.95

Round to 2999

Table 5-13
Discharge Point 31, 54-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 0.5-Inch Precipitation

SLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af	Total Vol Out af
0.5-Inch	MH-T01	LINE_T	0.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	1.03	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	2.07	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	3.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	4.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	5.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	6.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	7.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	8.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	9.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	10.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	11.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	12.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	13.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	14.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	15.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	16.01	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	17.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	18.01	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	19.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	20.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	21.01	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	22.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	23.01	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	24.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	25.01	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
0.5-Inch	MH-T01	LINE_T	26.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.324	2.324	-3.890	0.1	-0.2
0.5-Inch	MH-T01	LINE_T	27.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.598	2.598	-3.402	0.3	-0.5
0.5-Inch	MH-T01	LINE_T	28.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.603	2.603	-3.389	0.5	-0.7
0.5-Inch	MH-T01	LINE_T	29.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.607	2.607	-3.378	0.7	-1.0
0.5-Inch	MH-T01	LINE_T	30.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.583	2.583	-3.443	0.9	-1.3
0.5-Inch	MH-T01	LINE_T	31.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.523	2.523	-3.577	1.2	-1.6
0.5-Inch	MH-T01	LINE_T	32.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.503	2.503	-3.615	1.4	-1.9
0.5-Inch	MH-T01	LINE_T	33.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.493	2.493	-3.633	1.6	-2.2
0.5-Inch	MH-T01	LINE_T	34.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.492	2.492	-3.636	1.8	-2.5
0.5-Inch	MH-T01	LINE_T	35.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.481	2.481	-3.655	2.0	-2.8
0.5-Inch	MH-T01	LINE_T	36.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.466	2.466	-3.683	2.2	-3.1
0.5-Inch	MH-T01	LINE_T	37.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.457	2.457	-3.696	2.4	-3.4
0.5-Inch	MH-T01	LINE_T	38.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.461	2.461	-3.690	2.6	-3.7
0.5-Inch	MH-T01	LINE_T	39.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.449	2.449	-3.711	2.8	-4.0
0.5-Inch	MH-T01	LINE_T	40.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.427	2.427	-3.745	3.0	-4.3
0.5-Inch	MH-T01	LINE_T	41.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.412	2.412	-3.769	3.2	-4.6
0.5-Inch	MH-T01	LINE_T	42.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.382	2.382	-3.813	3.4	-4.9
0.5-Inch	MH-T01	LINE_T	43.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.368	2.368	-3.832	3.6	-5.3
0.5-Inch	MH-T01	LINE_T	44.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.356	2.356	-3.847	3.8	-5.6
0.5-Inch	MH-T01	LINE_T	45.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.345	2.345	-3.862	4.0	-5.9
0.5-Inch	MH-T01	LINE_T	46.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.335	2.335	-3.876	4.2	-6.2
0.5-Inch	MH-T01	LINE_T	47.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.325	2.325	-3.889	4.4	-6.5
0.5-Inch	MH-T01	LINE_T	48.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.316	2.316	-3.900	4.6	-6.9
0.5-Inch	MH-T01	LINE_T	49.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.308	2.308	-3.910	4.7	-7.2
0.5-Inch	MH-T01	LINE_T	50.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.301	2.301	-3.920	4.9	-7.5
0.5-Inch	MH-T01	LINE_T	51.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.294	2.294	-3.928	5.1	-7.8
0.5-Inch	MH-T01	LINE_T	52.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.289	2.289	-3.935	5.3	-8.2
0.5-Inch	MH-T01	LINE_T	53.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.285	2.285	-3.939	5.5	-8.5
0.5-Inch	MH-T01	LINE_T	54.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.282	2.282	-3.943	5.7	-8.8
0.5-Inch	MH-T01	LINE_T	55.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.278	2.278	-3.949	5.9	-9.1
0.5-Inch	MH-T01	LINE_T	56.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.273	2.273	-3.954	6.1	-9.5
0.5-Inch	MH-T01	LINE_T	57.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.267	2.267	-3.961	6.3	-9.8
0.5-Inch	MH-T01	LINE_T	58.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.262	2.262	-3.968	6.4	-10.1
0.5-Inch	MH-T01	LINE_T	59.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.256	2.256	-3.974	6.6	-10.4
0.5-Inch	MH-T01	LINE_T	60.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.251	2.251	-3.981	6.8	-10.8
0.5-Inch	MH-T01	LINE_T	61.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.246	2.246	-3.987	7.0	-11.1
0.5-Inch	MH-T01	LINE_T	62.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.241	2.241	-3.992	7.2	-11.4
0.5-Inch	MH-T01	LINE_T	63.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.236	2.236	-3.998	7.4	-11.8
0.5-Inch	MH-T01	LINE_T	64.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.232	2.232	-4.003	7.6	-12.1
0.5-Inch	MH-T01	LINE_T	65.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.228	2.228	-4.008	7.7	-12.4
0.5-Inch	MH-T01	LINE_T	66.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.223	2.223	-4.013	7.9	-12.7
0.5-Inch	MH-T01	LINE_T	67.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.220	2.220	-4.017	8.1	-13.1
0.5-Inch	MH-T01	LINE_T	68.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.217	2.217	-4.021	8.3	-13.4
0.5-Inch	MH-T01	LINE_T	69.00	3109.998	3119.870	274	0.000	0.000	0.000	0.000	2.214	2.214	-4.024	8.5	-13.7

Table 5-14
Discharge Point 31, 54-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 1.0-Inch Precipitation

SLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af	Total Vol Out af
1-Inch	MH-T01	LINE_T	0.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	1.03	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	2.07	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	3.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	4.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	5.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	6.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	7.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	8.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	9.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	10.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	11.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	12.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	13.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	14.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	15.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1-Inch	MH-T01	LINE_T	16.00	3110.158	3119.870	274	0.000	0.000	0.000	0.000	33.892	33.892	33.877	1.4	1.4
1-Inch	MH-T01	LINE_T	17.00	3110.266	3119.870	274	0.000	0.000	0.000	0.000	43.938	43.938	43.942	4.6	4.6
1-Inch	MH-T01	LINE_T	18.00	3110.249	3119.870	274	0.000	0.000	0.000	0.000	42.548	42.548	42.547	8.2	8.2
1-Inch	MH-T01	LINE_T	19.00	3110.264	3119.870	274	0.000	0.000	0.000	0.000	43.792	43.792	43.792	11.8	11.8
1-Inch	MH-T01	LINE_T	20.00	3110.266	3119.870	274	0.000	0.000	0.000	0.000	43.900	43.900	43.900	15.4	15.4
1-Inch	MH-T01	LINE_T	21.00	3110.261	3119.870	274	0.000	0.000	0.000	0.000	43.549	43.549	43.549	19.0	19.0
1-Inch	MH-T01	LINE_T	22.00	3110.253	3119.870	274	0.000	0.000	0.000	0.000	42.834	42.834	42.835	22.6	22.6
1-Inch	MH-T01	LINE_T	23.00	3110.240	3119.870	274	0.000	0.000	0.000	0.000	41.726	41.726	41.727	26.1	26.1
1-Inch	MH-T01	LINE_T	24.00	3110.228	3119.870	274	0.000	0.000	0.000	0.000	40.681	40.681	40.682	29.5	29.5
1-Inch	MH-T01	LINE_T	25.00	3110.215	3119.870	274	0.000	0.000	0.000	0.000	39.555	39.555	39.557	32.8	32.8
1-Inch	MH-T01	LINE_T	26.00	3110.199	3119.870	274	0.000	0.000	0.000	0.000	38.092	38.092	38.093	36.0	36.0
1-Inch	MH-T01	LINE_T	27.00	3110.169	3119.870	274	0.000	0.000	0.000	0.000	35.038	35.038	35.038	39.0	39.0
1-Inch	MH-T01	LINE_T	28.00	3110.134	3119.870	274	0.000	0.000	0.000	0.000	31.266	31.266	31.268	41.8	41.8
1-Inch	MH-T01	LINE_T	29.00	3110.102	3119.870	274	0.000	0.000	0.000	0.000	27.351	27.351	27.353	44.2	44.2
1-Inch	MH-T01	LINE_T	30.00	3110.081	3119.870	274	0.000	0.000	0.000	0.000	24.336	24.336	24.332	46.3	46.3
1-Inch	MH-T01	LINE_T	31.00	3110.065	3119.870	274	0.000	0.000	0.000	0.000	21.817	21.817	21.818	48.2	48.2
1-Inch	MH-T01	LINE_T	32.00	3110.053	3119.870	274	0.000	0.000	0.000	0.000	19.623	19.623	19.615	49.9	49.9
1-Inch	MH-T01	LINE_T	33.00	3110.043	3119.870	274	0.000	0.000	0.000	0.000	17.754	17.754	17.754	51.5	51.5
1-Inch	MH-T01	LINE_T	34.00	3110.036	3119.870	274	0.000	0.000	0.000	0.000	16.122	16.122	16.123	52.9	52.9
1-Inch	MH-T01	LINE_T	35.00	3110.029	3119.870	274	0.000	0.000	0.000	0.000	14.693	14.693	14.694	54.1	54.1
1-Inch	MH-T01	LINE_T	36.00	3110.025	3119.870	274	0.000	0.000	0.000	0.000	13.441	13.441	13.413	55.3	55.3
1-Inch	MH-T01	LINE_T	37.00	3110.021	3119.870	274	0.000	0.000	0.000	0.000	12.335	12.335	12.336	56.4	56.4
1-Inch	MH-T01	LINE_T	38.00	3110.018	3119.870	274	0.000	0.000	0.000	0.000	11.356	11.356	11.356	57.4	57.3
1-Inch	MH-T01	LINE_T	39.00	3110.015	3119.870	274	0.000	0.000	0.000	0.000	10.471	10.471	10.471	58.3	58.3
1-Inch	MH-T01	LINE_T	40.00	3110.013	3119.870	274	0.000	0.000	0.000	0.000	9.683	9.683	9.683	59.1	59.1
1-Inch	MH-T01	LINE_T	41.00	3110.011	3119.870	274	0.000	0.000	0.000	0.000	8.973	8.973	8.973	59.9	59.9
1-Inch	MH-T01	LINE_T	42.00	3110.009	3119.870	274	0.000	0.000	0.000	0.000	8.338	8.338	8.334	60.6	60.6
1-Inch	MH-T01	LINE_T	43.00	3110.008	3119.870	274	0.000	0.000	0.000	0.000	7.741	7.741	7.748	61.2	61.2
1-Inch	MH-T01	LINE_T	44.00	3110.007	3119.870	274	0.000	0.000	0.000	0.000	7.229	7.229	7.229	61.9	61.9
1-Inch	MH-T01	LINE_T	45.00	3110.006	3119.870	274	0.000	0.000	0.000	0.000	6.750	6.750	6.750	62.4	62.4
1-Inch	MH-T01	LINE_T	46.00	3110.005	3119.870	274	0.000	0.000	0.000	0.000	6.325	6.325	6.325	63.0	63.0
1-Inch	MH-T01	LINE_T	47.00	3110.005	3119.870	274	0.000	0.000	0.000	0.000	5.914	5.914	5.914	63.5	63.5
1-Inch	MH-T01	LINE_T	48.00	3110.004	3119.870	274	0.000	0.000	0.000	0.000	5.540	5.540	5.540	64.0	64.0
1-Inch	MH-T01	LINE_T	49.00	3110.004	3119.870	274	0.000	0.000	0.000	0.000	5.222	5.222	5.223	64.4	64.4
1-Inch	MH-T01	LINE_T	50.00	3110.003	3119.870	274	0.000	0.000	0.000	0.000	4.897	4.897	4.898	64.8	64.8
1-Inch	MH-T01	LINE_T	51.00	3110.003	3119.870	274	0.000	0.000	0.000	0.000	4.614	4.614	4.614	65.2	65.2
1-Inch	MH-T01	LINE_T	52.00	3110.003	3119.870	274	0.000	0.000	0.000	0.000	4.361	4.361	4.362	65.6	65.6
1-Inch	MH-T01	LINE_T	53.00	3110.002	3119.870	274	0.000	0.000	0.000	0.000	4.188	4.188	3.729	65.9	65.9
1-Inch	MH-T01	LINE_T	54.00	3110.002	3119.870	274	0.000	0.000	0.000	0.000	3.890	3.890	3.890	66.3	66.2
1-Inch	MH-T01	LINE_T	55.00	3110.002	3119.870	274	0.000	0.000	0.000	0.000	3.679	3.679	3.679	66.6	66.5
1-Inch	MH-T01	LINE_T	56.00	3110.002	3119.870	274	0.000	0.000	0.000	0.000	3.479	3.479	3.479	66.9	66.8
1-Inch	MH-T01	LINE_T	57.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	3.753	3.753	0.295	67.2	67.0
1-Inch	MH-T01	LINE_T	58.00	3110.001	3119.870	274	0.000	0.000	0.000	0.000	3.138	3.138	3.138	67.5	67.1
1-Inch	MH-T01	LINE_T	59.00	3110.001	3119.870	274	0.000	0.000	0.000	0.000	2.984	2.984	2.936	67.7	67.4
1-Inch	MH-T01	LINE_T	60.00	3109.999	3119.870	274	0.000	0.000	0.000	0.000	3.448	3.448	-2.436	68.0	67.4
1-Inch	MH-T01	LINE_T	61.00	3110.001	3119.870	274	0.000	0.000	0.000	0.000	2.695	2.695	2.695	68.2	67.4
1-Inch	MH-T01	LINE_T	62.00	3110.001	3119.870	274	0.000	0.000	0.000	0.000	2.606	2.606	2.607	68.5	67.6
1-Inch	MH-T01	LINE_T	63.00	3110.001	3119.870	274	0.000	0.000	0.000	0.000	2.449	2.449	2.449	68.7	67.8
1-Inch	MH-T01	LINE_T	64.00	3110.001	3119.870	274	0.000	0.000	0.000	0.000	2.342	2.342	2.342	68.9	68.0
1-Inch	MH-T01	LINE_T	65.00	3110.001	3119.870	274	0.000	0.000	0.000	0.000	2.246	2.246	2.247	69.0	68.2
1-Inch	MH-T01	LINE_T	66.00	3110.001	3119.870	274	0.000	0.000	0.000	0.000	2.142	2.142	2.043	69.2	68.4
1-Inch	MH-T01	LINE_T	67.00	3109.999	3119.870	274	0.000	0.000	0.000	0.000	2.733	2.733	-2.031	69.4	68.4
1-Inch	MH-T01	LINE_T	68.00	3110.003	3119.870	274	0.000	0.000	0.000	0.000	-0.417	-0.417	5.160	69.5	68.5
1-Inch	MH-T01	LINE_T	69.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	2.168	2.168	1.184	69.6	68.8

Table 5-15
Discharge Point 31, 54-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 1.5-Inch Precipitation

SLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af	Total Vol Out af
1.5-Inch	MH-T01	LINE_T	0.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	1.03	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	2.07	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	3.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	4.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	5.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	6.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	7.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	8.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	9.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	10.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	11.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	12.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	13.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	14.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
1.5-Inch	MH-T01	LINE_T	15.00	3110.545	3119.870	274	0.000	0.000	0.000	0.000	61.872	61.872	61.846	2.6	2.6
1.5-Inch	MH-T01	LINE_T	16.00	3110.722	3119.870	274	0.000	0.000	0.000	0.000	70.570	70.570	70.565	8.0	8.0
1.5-Inch	MH-T01	LINE_T	17.00	3110.758	3119.870	274	0.000	0.000	0.000	0.000	72.228	72.228	72.226	13.9	13.9
1.5-Inch	MH-T01	LINE_T	18.00	3110.767	3119.870	274	0.000	0.000	0.000	0.000	72.643	72.643	72.643	19.9	19.9
1.5-Inch	MH-T01	LINE_T	19.00	3110.763	3119.870	274	0.000	0.000	0.000	0.000	72.462	72.462	72.463	25.9	25.9
1.5-Inch	MH-T01	LINE_T	20.00	3110.757	3119.870	274	0.000	0.000	0.000	0.000	72.206	72.206	72.207	31.9	31.9
1.5-Inch	MH-T01	LINE_T	21.00	3110.751	3119.870	274	0.000	0.000	0.000	0.000	71.930	71.930	71.930	37.8	37.8
1.5-Inch	MH-T01	LINE_T	22.00	3110.746	3119.870	274	0.000	0.000	0.000	0.000	71.674	71.674	71.675	43.8	43.8
1.5-Inch	MH-T01	LINE_T	23.00	3110.742	3119.870	274	0.000	0.000	0.000	0.000	71.511	71.511	71.511	49.7	49.7
1.5-Inch	MH-T01	LINE_T	24.00	3110.738	3119.870	274	0.000	0.000	0.000	0.000	71.322	71.322	71.323	55.6	55.6
1.5-Inch	MH-T01	LINE_T	25.00	3110.734	3119.870	274	0.000	0.000	0.000	0.000	71.120	71.120	71.120	61.5	61.5
1.5-Inch	MH-T01	LINE_T	26.00	3110.736	3119.870	274	0.000	0.000	0.000	0.000	71.195	71.195	71.196	67.4	67.4
1.5-Inch	MH-T01	LINE_T	27.00	3110.730	3119.870	274	0.000	0.000	0.000	0.000	70.953	70.953	70.954	73.2	73.2
1.5-Inch	MH-T01	LINE_T	28.00	3110.722	3119.870	274	0.000	0.000	0.000	0.000	70.544	70.544	70.545	79.1	79.1
1.5-Inch	MH-T01	LINE_T	29.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.217	70.217	70.217	84.9	84.9
1.5-Inch	MH-T01	LINE_T	30.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.215	70.215	70.215	90.7	90.7
1.5-Inch	MH-T01	LINE_T	31.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.216	70.216	70.216	96.5	96.5
1.5-Inch	MH-T01	LINE_T	32.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.210	70.210	70.210	102.3	102.3
1.5-Inch	MH-T01	LINE_T	33.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.215	70.215	70.215	108.1	108.1
1.5-Inch	MH-T01	LINE_T	34.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.216	70.216	70.216	113.9	113.9
1.5-Inch	MH-T01	LINE_T	35.00	3110.655	3119.870	274	0.000	0.000	0.000	0.000	67.643	67.643	67.671	119.6	119.6
1.5-Inch	MH-T01	LINE_T	36.00	3110.288	3119.870	274	0.000	0.000	0.000	0.000	45.200	45.200	45.202	124.3	124.3
1.5-Inch	MH-T01	LINE_T	37.00	3110.254	3119.870	274	0.000	0.000	0.000	0.000	42.910	42.910	42.911	127.9	127.9
1.5-Inch	MH-T01	LINE_T	38.00	3110.236	3119.870	274	0.000	0.000	0.000	0.000	41.381	41.381	41.382	131.4	131.4
1.5-Inch	MH-T01	LINE_T	39.00	3110.222	3119.870	274	0.000	0.000	0.000	0.000	40.176	40.176	40.176	134.8	134.8
1.5-Inch	MH-T01	LINE_T	40.00	3110.214	3119.870	274	0.000	0.000	0.000	0.000	39.477	39.477	39.478	138.1	138.1
1.5-Inch	MH-T01	LINE_T	41.00	3110.211	3119.870	274	0.000	0.000	0.000	0.000	39.158	39.158	39.158	141.3	141.3
1.5-Inch	MH-T01	LINE_T	42.00	3110.207	3119.870	274	0.000	0.000	0.000	0.000	38.821	38.821	38.821	144.5	144.5
1.5-Inch	MH-T01	LINE_T	43.00	3110.202	3119.870	274	0.000	0.000	0.000	0.000	38.305	38.305	38.306	147.7	147.7
1.5-Inch	MH-T01	LINE_T	44.00	3110.188	3119.870	274	0.000	0.000	0.000	0.000	37.029	37.029	37.030	150.8	150.8
1.5-Inch	MH-T01	LINE_T	45.00	3110.182	3119.870	274	0.000	0.000	0.000	0.000	36.357	36.357	36.357	153.9	153.9
1.5-Inch	MH-T01	LINE_T	46.00	3110.177	3119.870	274	0.000	0.000	0.000	0.000	35.864	35.864	35.864	156.9	156.9
1.5-Inch	MH-T01	LINE_T	47.00	3110.172	3119.870	274	0.000	0.000	0.000	0.000	35.438	35.438	35.438	159.8	159.8
1.5-Inch	MH-T01	LINE_T	48.00	3110.169	3119.870	274	0.000	0.000	0.000	0.000	35.072	35.072	35.072	162.7	162.7
1.5-Inch	MH-T01	LINE_T	49.00	3110.166	3119.870	274	0.000	0.000	0.000	0.000	34.736	34.736	34.773	165.6	165.6
1.5-Inch	MH-T01	LINE_T	50.00	3110.163	3119.870	274	0.000	0.000	0.000	0.000	34.442	34.442	34.443	168.5	168.5
1.5-Inch	MH-T01	LINE_T	51.00	3110.160	3119.870	274	0.000	0.000	0.000	0.000	34.184	34.184	34.187	171.3	171.3
1.5-Inch	MH-T01	LINE_T	52.00	3110.158	3119.870	274	0.000	0.000	0.000	0.000	33.952	33.952	33.953	174.1	174.1
1.5-Inch	MH-T01	LINE_T	53.00	3110.156	3119.870	274	0.000	0.000	0.000	0.000	33.741	33.741	33.741	176.9	176.9
1.5-Inch	MH-T01	LINE_T	54.00	3110.154	3119.870	274	0.000	0.000	0.000	0.000	33.531	33.531	33.531	179.7	179.7
1.5-Inch	MH-T01	LINE_T	55.00	3110.150	3119.870	274	0.000	0.000	0.000	0.000	33.024	33.024	33.025	182.4	182.4
1.5-Inch	MH-T01	LINE_T	56.00	3110.138	3119.870	274	0.000	0.000	0.000	0.000	31.697	31.697	31.698	185.1	185.1
1.5-Inch	MH-T01	LINE_T	57.00	3110.124	3119.870	274	0.000	0.000	0.000	0.000	30.033	30.033	30.034	187.7	187.7
1.5-Inch	MH-T01	LINE_T	58.00	3110.110	3119.870	274	0.000	0.000	0.000	0.000	28.335	28.335	28.334	190.1	190.1
1.5-Inch	MH-T01	LINE_T	59.00	3110.086	3119.870	274	0.000	0.000	0.000	0.000	25.090	25.090	25.094	192.3	192.3
1.5-Inch	MH-T01	LINE_T	60.00	3110.046	3119.870	274	0.000	0.000	0.000	0.000	18.398	18.398	18.399	194.1	194.1
1.5-Inch	MH-T01	LINE_T	61.00	3110.035	3119.870	274	0.000	0.000	0.000	0.000	15.929	15.929	15.950	195.5	195.5
1.5-Inch	MH-T01	LINE_T	62.00	3110.028	3119.870	274	0.000	0.000	0.000	0.000	14.361	14.361	14.360	196.7	196.8
1.5-Inch	MH-T01	LINE_T	63.00	3110.023	3119.870	274	0.000	0.000	0.000	0.000	13.011	13.011	13.012	197.9	197.9
1.5-Inch	MH-T01	LINE_T	64.00	3110.019	3119.870	274	0.000	0.000	0.000	0.000	11.841	11.841	11.841	198.9	198.9
1.5-Inch	MH-T01	LINE_T	65.00	3110.016	3119.870	274	0.000	0.000	0.000	0.000	10.770	10.770	10.771	199.8	199.8
1.5-Inch	MH-T01	LINE_T	66.00	3110.013	3119.870	274	0.000	0.000	0.000	0.000	9.847	9.847	9.848	200.7	200.7
1.5-Inch	MH-T01	LINE_T	67.00	3110.011	3119.870	274	0.000	0.000	0.000	0.000	9.048	9.048	9.048	201.5	201.5
1.5-Inch	MH-T01	LINE_T	68.00	3110.010	3119.870	274	0.000	0.000	0.000	0.000	8.343	8.343	8.343	202.2	202.2
1.5-Inch	MH-T01	LINE_T	69.00	3110.008	3119.870	274	0.000	0.000	0.000	0.000	7.773	7.773	7.773	202.9	202.9

Table 5-16
Discharge Point 31, 54-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 2.0-Inch Precipitation

SLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af	Total Vol Out af
2.0-Inch	MH-T01	LINE_T	0.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	1.03	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	2.07	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	3.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	4.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	5.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	6.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	7.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	8.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	9.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	10.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	11.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	12.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	13.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	14.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.0-Inch	MH-T01	LINE_T	15.00	3110.736	3119.870	274	0.000	0.000	0.000	0.000	71.207	71.207	71.200	2.9	2.9
2.0-Inch	MH-T01	LINE_T	16.00	3110.797	3119.870	274	0.000	0.000	0.000	0.000	74.023	74.023	74.021	8.9	8.9
2.0-Inch	MH-T01	LINE_T	17.00	3110.810	3119.870	274	0.000	0.000	0.000	0.000	74.586	74.586	74.586	15.1	15.1
2.0-Inch	MH-T01	LINE_T	18.00	3110.811	3119.870	274	0.000	0.000	0.000	0.000	74.648	74.648	74.648	21.3	21.3
2.0-Inch	MH-T01	LINE_T	19.00	3110.811	3119.870	274	0.000	0.000	0.000	0.000	74.633	74.633	74.633	27.4	27.4
2.0-Inch	MH-T01	LINE_T	20.00	3110.810	3119.870	274	0.000	0.000	0.000	0.000	74.605	74.605	74.605	33.6	33.6
2.0-Inch	MH-T01	LINE_T	21.00	3110.809	3119.870	274	0.000	0.000	0.000	0.000	74.567	74.567	74.567	39.7	39.7
2.0-Inch	MH-T01	LINE_T	22.00	3110.808	3119.870	274	0.000	0.000	0.000	0.000	74.512	74.512	74.512	45.9	45.9
2.0-Inch	MH-T01	LINE_T	23.00	3110.805	3119.870	274	0.000	0.000	0.000	0.000	74.362	74.362	74.362	52.1	52.1
2.0-Inch	MH-T01	LINE_T	24.00	3110.793	3119.870	274	0.000	0.000	0.000	0.000	73.826	73.826	73.827	58.2	58.2
2.0-Inch	MH-T01	LINE_T	25.00	3110.781	3119.870	274	0.000	0.000	0.000	0.000	73.300	73.300	73.301	64.3	64.3
2.0-Inch	MH-T01	LINE_T	26.00	3110.773	3119.870	274	0.000	0.000	0.000	0.000	72.913	72.913	72.913	70.3	70.3
2.0-Inch	MH-T01	LINE_T	27.00	3110.762	3119.870	274	0.000	0.000	0.000	0.000	72.417	72.417	72.417	76.3	76.3
2.0-Inch	MH-T01	LINE_T	28.00	3110.757	3119.870	274	0.000	0.000	0.000	0.000	72.178	72.178	72.179	82.3	82.3
2.0-Inch	MH-T01	LINE_T	29.00	3110.749	3119.870	274	0.000	0.000	0.000	0.000	71.830	71.830	71.830	88.2	88.2
2.0-Inch	MH-T01	LINE_T	30.00	3110.746	3119.870	274	0.000	0.000	0.000	0.000	71.667	71.667	71.667	94.2	94.2
2.0-Inch	MH-T01	LINE_T	31.00	3110.743	3119.870	274	0.000	0.000	0.000	0.000	71.552	71.552	71.552	100.1	100.1
2.0-Inch	MH-T01	LINE_T	32.00	3110.741	3119.870	274	0.000	0.000	0.000	0.000	71.454	71.454	71.454	106.0	106.0
2.0-Inch	MH-T01	LINE_T	33.00	3110.739	3119.870	274	0.000	0.000	0.000	0.000	71.354	71.354	71.355	111.9	111.9
2.0-Inch	MH-T01	LINE_T	34.00	3110.734	3119.870	274	0.000	0.000	0.000	0.000	71.109	71.109	71.109	117.8	117.8
2.0-Inch	MH-T01	LINE_T	35.00	3110.733	3119.870	274	0.000	0.000	0.000	0.000	71.054	71.054	71.055	123.7	123.7
2.0-Inch	MH-T01	LINE_T	36.00	3110.729	3119.870	274	0.000	0.000	0.000	0.000	70.878	70.878	70.878	129.5	129.5
2.0-Inch	MH-T01	LINE_T	37.00	3110.721	3119.870	274	0.000	0.000	0.000	0.000	70.506	70.506	70.507	135.4	135.4
2.0-Inch	MH-T01	LINE_T	38.00	3110.716	3119.870	274	0.000	0.000	0.000	0.000	70.276	70.276	70.276	141.2	141.2
2.0-Inch	MH-T01	LINE_T	39.00	3110.712	3119.870	274	0.000	0.000	0.000	0.000	70.068	70.068	70.068	147.0	147.0
2.0-Inch	MH-T01	LINE_T	40.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.210	70.210	70.210	152.8	152.8
2.0-Inch	MH-T01	LINE_T	41.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.230	70.230	70.230	158.6	158.6
2.0-Inch	MH-T01	LINE_T	42.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.218	70.218	70.218	164.4	164.4
2.0-Inch	MH-T01	LINE_T	43.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.219	70.219	70.219	170.2	170.2
2.0-Inch	MH-T01	LINE_T	44.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.199	70.199	70.199	176.0	176.0
2.0-Inch	MH-T01	LINE_T	45.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.214	70.214	70.214	181.8	181.8
2.0-Inch	MH-T01	LINE_T	46.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.209	70.209	70.209	187.6	187.6
2.0-Inch	MH-T01	LINE_T	47.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.215	70.215	70.215	193.4	193.4
2.0-Inch	MH-T01	LINE_T	48.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.215	70.215	70.215	199.2	199.2
2.0-Inch	MH-T01	LINE_T	49.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.216	70.216	70.216	205.0	205.0
2.0-Inch	MH-T01	LINE_T	50.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.216	70.216	70.216	210.8	210.8
2.0-Inch	MH-T01	LINE_T	51.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.216	70.216	70.216	216.6	216.6
2.0-Inch	MH-T01	LINE_T	52.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.216	70.216	70.216	222.4	222.4
2.0-Inch	MH-T01	LINE_T	53.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.202	70.202	70.202	228.2	228.2
2.0-Inch	MH-T01	LINE_T	54.00	3110.440	3119.870	274	0.000	0.000	0.000	0.000	55.656	55.656	55.685	233.4	233.4
2.0-Inch	MH-T01	LINE_T	55.00	3110.340	3119.870	274	0.000	0.000	0.000	0.000	49.068	49.068	49.071	237.7	237.7
2.0-Inch	MH-T01	LINE_T	56.00	3110.293	3119.870	274	0.000	0.000	0.000	0.000	45.618	45.618	45.621	241.7	241.7
2.0-Inch	MH-T01	LINE_T	57.00	3110.261	3119.870	274	0.000	0.000	0.000	0.000	43.512	43.512	43.513	245.3	245.3
2.0-Inch	MH-T01	LINE_T	58.00	3110.244	3119.870	274	0.000	0.000	0.000	0.000	42.058	42.058	42.059	248.9	248.9
2.0-Inch	MH-T01	LINE_T	59.00	3110.230	3119.870	274	0.000	0.000	0.000	0.000	40.850	40.850	40.851	252.3	252.3
2.0-Inch	MH-T01	LINE_T	60.00	3110.218	3119.870	274	0.000	0.000	0.000	0.000	39.853	39.853	39.854	255.6	255.6
2.0-Inch	MH-T01	LINE_T	61.00	3110.215	3119.870	274	0.000	0.000	0.000	0.000	39.556	39.556	39.556	258.9	258.9
2.0-Inch	MH-T01	LINE_T	62.00	3110.211	3119.870	274	0.000	0.000	0.000	0.000	39.178	39.178	39.179	262.2	262.2
2.0-Inch	MH-T01	LINE_T	63.00	3110.208	3119.870	274	0.000	0.000	0.000	0.000	38.863	38.863	38.843	265.4	265.4
2.0-Inch	MH-T01	LINE_T	64.00	3110.201	3119.870	274	0.000	0.000	0.000	0.000	38.249	38.249	38.250	268.6	268.6
2.0-Inch	MH-T01	LINE_T	65.00	3110.190	3119.870	274	0.000	0.000	0.000	0.000	37.215	37.215	37.216	271.7	271.7
2.0-Inch	MH-T01	LINE_T	66.00	3110.184	3119.870	274	0.000	0.000	0.000	0.000	36.646	36.646	36.623	274.8	274.8
2.0-Inch	MH-T01	LINE_T	67.00	3110.180	3119.870	274	0.000	0.000	0.000	0.000	36.211	36.211	36.185	277.8	277.8
2.0-Inch	MH-T01	LINE_T	68.00	3110.176	3119.870	274	0.000	0.000	0.000	0.000	35.824	35.824	35.827	280.7	280.7
2.0-Inch	MH-T01	LINE_T	69.00	3110.173	3119.870	274	0.000	0.000	0.000	0.000	35.485	35.485	35.485	283.7	283.7

SLDIP

Table 5-17
Discharge Point 31, 54-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 2.5-Inch Precipitation

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af	Total Vol Out af
2.5-Inch	MH-T01	LINE_T	0.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	1.03	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	2.07	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	3.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	4.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	5.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	6.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	7.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	8.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	9.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	10.03	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	11.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	12.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	13.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.0
2.5-Inch	MH-T01	LINE_T	14.00	3110.263	3119.870	274	0.000	0.000	0.000	0.000	43.841	43.841	43.621	1.8	1.8
2.5-Inch	MH-T01	LINE_T	15.00	3110.771	3119.870	274	0.000	0.000	0.000	0.000	72.863	72.863	72.856	6.6	6.6
2.5-Inch	MH-T01	LINE_T	16.00	3110.818	3119.870	274	0.000	0.000	0.000	0.000	74.939	74.939	74.938	12.7	12.7
2.5-Inch	MH-T01	LINE_T	17.00	3110.825	3119.870	274	0.000	0.000	0.000	0.000	75.268	75.268	75.268	18.9	18.9
2.5-Inch	MH-T01	LINE_T	18.00	3110.826	3119.870	274	0.000	0.000	0.000	0.000	75.325	75.325	75.325	25.2	25.2
2.5-Inch	MH-T01	LINE_T	19.00	3110.826	3119.870	274	0.000	0.000	0.000	0.000	75.326	75.326	75.326	31.4	31.4
2.5-Inch	MH-T01	LINE_T	20.00	3110.826	3119.870	274	0.000	0.000	0.000	0.000	75.310	75.310	75.310	37.6	37.6
2.5-Inch	MH-T01	LINE_T	21.00	3110.825	3119.870	274	0.000	0.000	0.000	0.000	75.284	75.284	75.284	43.8	43.8
2.5-Inch	MH-T01	LINE_T	22.00	3110.825	3119.870	274	0.000	0.000	0.000	0.000	75.250	75.250	75.250	50.1	50.0
2.5-Inch	MH-T01	LINE_T	23.00	3110.824	3119.870	274	0.000	0.000	0.000	0.000	75.212	75.212	75.212	56.3	56.3
2.5-Inch	MH-T01	LINE_T	24.00	3110.823	3119.870	274	0.000	0.000	0.000	0.000	75.173	75.173	75.173	62.5	62.5
2.5-Inch	MH-T01	LINE_T	25.00	3110.822	3119.870	274	0.000	0.000	0.000	0.000	75.129	75.129	75.129	68.7	68.7
2.5-Inch	MH-T01	LINE_T	26.00	3110.820	3119.870	274	0.000	0.000	0.000	0.000	75.063	75.063	75.063	74.9	74.9
2.5-Inch	MH-T01	LINE_T	27.00	3110.818	3119.870	274	0.000	0.000	0.000	0.000	74.961	74.961	74.962	81.1	81.1
2.5-Inch	MH-T01	LINE_T	28.00	3110.815	3119.870	274	0.000	0.000	0.000	0.000	74.840	74.840	74.841	87.3	87.3
2.5-Inch	MH-T01	LINE_T	29.00	3110.813	3119.870	274	0.000	0.000	0.000	0.000	74.745	74.745	74.745	93.5	93.5
2.5-Inch	MH-T01	LINE_T	30.00	3110.811	3119.870	274	0.000	0.000	0.000	0.000	74.658	74.658	74.659	99.7	99.6
2.5-Inch	MH-T01	LINE_T	31.00	3110.808	3119.870	274	0.000	0.000	0.000	0.000	74.508	74.508	74.509	105.8	105.8
2.5-Inch	MH-T01	LINE_T	32.00	3110.792	3119.870	274	0.000	0.000	0.000	0.000	73.808	73.808	73.809	112.0	111.9
2.5-Inch	MH-T01	LINE_T	33.00	3110.778	3119.870	274	0.000	0.000	0.000	0.000	73.155	73.155	73.156	118.0	118.0
2.5-Inch	MH-T01	LINE_T	34.00	3110.767	3119.870	274	0.000	0.000	0.000	0.000	72.666	72.666	72.667	124.0	124.0
2.5-Inch	MH-T01	LINE_T	35.00	3110.765	3119.870	274	0.000	0.000	0.000	0.000	72.574	72.574	72.575	130.1	130.0
2.5-Inch	MH-T01	LINE_T	36.00	3110.755	3119.870	274	0.000	0.000	0.000	0.000	72.082	72.082	72.083	136.0	136.0
2.5-Inch	MH-T01	LINE_T	37.00	3110.750	3119.870	274	0.000	0.000	0.000	0.000	71.886	71.886	71.886	142.0	142.0
2.5-Inch	MH-T01	LINE_T	38.00	3110.747	3119.870	274	0.000	0.000	0.000	0.000	71.732	71.732	71.732	147.9	147.9
2.5-Inch	MH-T01	LINE_T	39.00	3110.745	3119.870	274	0.000	0.000	0.000	0.000	71.640	71.640	71.640	153.8	153.8
2.5-Inch	MH-T01	LINE_T	40.00	3110.744	3119.870	274	0.000	0.000	0.000	0.000	71.578	71.578	71.578	159.8	159.7
2.5-Inch	MH-T01	LINE_T	41.00	3110.743	3119.870	274	0.000	0.000	0.000	0.000	71.525	71.525	71.525	165.7	165.6
2.5-Inch	MH-T01	LINE_T	42.00	3110.742	3119.870	274	0.000	0.000	0.000	0.000	71.478	71.478	71.478	171.6	171.6
2.5-Inch	MH-T01	LINE_T	43.00	3110.741	3119.870	274	0.000	0.000	0.000	0.000	71.438	71.438	71.438	177.5	177.5
2.5-Inch	MH-T01	LINE_T	44.00	3110.740	3119.870	274	0.000	0.000	0.000	0.000	71.403	71.403	71.403	183.4	183.4
2.5-Inch	MH-T01	LINE_T	45.00	3110.739	3119.870	274	0.000	0.000	0.000	0.000	71.357	71.357	71.357	189.3	189.3
2.5-Inch	MH-T01	LINE_T	46.00	3110.735	3119.870	274	0.000	0.000	0.000	0.000	71.156	71.156	71.156	195.2	195.2
2.5-Inch	MH-T01	LINE_T	47.00	3110.735	3119.870	274	0.000	0.000	0.000	0.000	71.174	71.174	71.175	201.1	201.0
2.5-Inch	MH-T01	LINE_T	48.00	3110.731	3119.870	274	0.000	0.000	0.000	0.000	70.959	70.959	70.959	206.9	206.9
2.5-Inch	MH-T01	LINE_T	49.00	3110.724	3119.870	274	0.000	0.000	0.000	0.000	70.643	70.643	70.643	212.8	212.8
2.5-Inch	MH-T01	LINE_T	50.00	3110.718	3119.870	274	0.000	0.000	0.000	0.000	70.384	70.384	70.385	218.6	218.6
2.5-Inch	MH-T01	LINE_T	51.00	3110.716	3119.870	274	0.000	0.000	0.000	0.000	70.243	70.243	70.243	224.4	224.4
2.5-Inch	MH-T01	LINE_T	52.00	3110.712	3119.870	274	0.000	0.000	0.000	0.000	70.094	70.094	70.094	230.2	230.2
2.5-Inch	MH-T01	LINE_T	53.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.231	70.231	70.231	236.0	236.0
2.5-Inch	MH-T01	LINE_T	54.00	3110.714	3119.870	274	0.000	0.000	0.000	0.000	70.182	70.182	70.182	241.8	241.8
2.5-Inch	MH-T01	LINE_T	55.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.233	70.233	70.233	247.6	247.6
2.5-Inch	MH-T01	LINE_T	56.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.216	70.216	70.216	253.4	253.4
2.5-Inch	MH-T01	LINE_T	57.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.224	70.224	70.224	259.2	259.2
2.5-Inch	MH-T01	LINE_T	58.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.224	70.224	70.224	265.0	265.0
2.5-Inch	MH-T01	LINE_T	59.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.216	70.216	70.216	270.8	270.8
2.5-Inch	MH-T01	LINE_T	60.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.203	70.203	70.203	276.6	276.6
2.5-Inch	MH-T01	LINE_T	61.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.203	70.203	70.203	282.4	282.4
2.5-Inch	MH-T01	LINE_T	62.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.215	70.215	70.215	288.2	288.2
2.5-Inch	MH-T01	LINE_T	63.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.213	70.213	70.213	294.0	294.0
2.5-Inch	MH-T01	LINE_T	64.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.208	70.208	70.208	299.8	299.8
2.5-Inch	MH-T01	LINE_T	65.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.214	70.214	70.214	305.7	305.6
2.5-Inch	MH-T01	LINE_T	66.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.216	70.216	70.216	311.5	311.4
2.5-Inch	MH-T01	LINE_T	67.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.216	70.216	70.216	317.3	317.2
2.5-Inch	MH-T01	LINE_T	68.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.215	70.215	70.215	323.1	323.0
2.5-Inch	MH-T01	LINE_T	69.00	3110.715	3119.870	274	0.000	0.000	0.000	0.000	70.216	70.216	70.216	328.9	328.8

Table 5-18
Discharge Point 31, 54-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 2-Year 24-Hour Precipitation (2.8 Inches)

SLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af
002_YEAR	MH-T01	LINE_T	0.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	1.03	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	2.07	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	3.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	4.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	5.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	6.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	7.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	8.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	9.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	10.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	11.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	12.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	13.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
002_YEAR	MH-T01	LINE_T	14.00	3110.579	3119.870	274	0.000	0.000	0.000	0.000	63.797	63.797	63.740	2.6
002_YEAR	MH-T01	LINE_T	15.00	3110.787	3119.870	274	0.000	0.000	0.000	0.000	73.553	73.553	73.546	8.3
002_YEAR	MH-T01	LINE_T	16.00	3110.827	3119.870	274	0.000	0.000	0.000	0.000	75.330	75.330	75.329	14.5
002_YEAR	MH-T01	LINE_T	17.00	3110.833	3119.870	274	0.000	0.000	0.000	0.000	75.634	75.634	75.634	20.7
002_YEAR	MH-T01	LINE_T	18.00	3110.835	3119.870	274	0.000	0.000	0.000	0.000	75.692	75.692	75.692	27.0
002_YEAR	MH-T01	LINE_T	19.00	3110.835	3119.870	274	0.000	0.000	0.000	0.000	75.688	75.688	75.688	33.2
002_YEAR	MH-T01	LINE_T	20.00	3110.834	3119.870	274	0.000	0.000	0.000	0.000	75.672	75.672	75.672	39.5
002_YEAR	MH-T01	LINE_T	21.00	3110.834	3119.870	274	0.000	0.000	0.000	0.000	75.651	75.651	75.651	45.7
002_YEAR	MH-T01	LINE_T	22.00	3110.833	3119.870	274	0.000	0.000	0.000	0.000	75.624	75.624	75.624	52.0
002_YEAR	MH-T01	LINE_T	23.00	3110.832	3119.870	274	0.000	0.000	0.000	0.000	75.591	75.591	75.591	58.2
002_YEAR	MH-T01	LINE_T	24.00	3110.832	3119.870	274	0.000	0.000	0.000	0.000	75.557	75.557	75.557	64.5
002_YEAR	MH-T01	LINE_T	25.00	3110.831	3119.870	274	0.000	0.000	0.000	0.000	75.519	75.519	75.519	70.7
002_YEAR	MH-T01	LINE_T	26.00	3110.829	3119.870	274	0.000	0.000	0.000	0.000	75.458	75.458	75.459	76.9
002_YEAR	MH-T01	LINE_T	27.00	3110.828	3119.870	274	0.000	0.000	0.000	0.000	75.384	75.384	75.384	83.2
002_YEAR	MH-T01	LINE_T	28.00	3110.826	3119.870	274	0.000	0.000	0.000	0.000	75.294	75.294	75.294	89.4
002_YEAR	MH-T01	LINE_T	29.00	3110.824	3119.870	274	0.000	0.000	0.000	0.000	75.207	75.207	75.207	95.6
002_YEAR	MH-T01	LINE_T	30.00	3110.822	3119.870	274	0.000	0.000	0.000	0.000	75.120	75.120	75.120	101.8
002_YEAR	MH-T01	LINE_T	31.00	3110.820	3119.870	274	0.000	0.000	0.000	0.000	75.023	75.023	75.023	108.0
002_YEAR	MH-T01	LINE_T	32.00	3110.817	3119.870	274	0.000	0.000	0.000	0.000	74.908	74.908	74.908	114.2
002_YEAR	MH-T01	LINE_T	33.00	3110.815	3119.870	274	0.000	0.000	0.000	0.000	74.809	74.809	74.809	120.4
002_YEAR	MH-T01	LINE_T	34.00	3110.813	3119.870	274	0.000	0.000	0.000	0.000	74.727	74.727	74.728	126.6
002_YEAR	MH-T01	LINE_T	35.00	3110.811	3119.870	274	0.000	0.000	0.000	0.000	74.646	74.646	74.646	132.8
002_YEAR	MH-T01	LINE_T	36.00	3110.803	3119.870	274	0.000	0.000	0.000	0.000	74.303	74.303	74.304	138.9
002_YEAR	MH-T01	LINE_T	37.00	3110.788	3119.870	274	0.000	0.000	0.000	0.000	73.600	73.600	73.602	145.0
002_YEAR	MH-T01	LINE_T	38.00	3110.776	3119.870	274	0.000	0.000	0.000	0.000	73.073	73.073	73.074	151.1
002_YEAR	MH-T01	LINE_T	39.00	3110.766	3119.870	274	0.000	0.000	0.000	0.000	72.629	72.629	72.629	157.1
002_YEAR	MH-T01	LINE_T	40.00	3110.766	3119.870	274	0.000	0.000	0.000	0.000	72.611	72.611	72.612	163.1
002_YEAR	MH-T01	LINE_T	41.00	3110.757	3119.870	274	0.000	0.000	0.000	0.000	72.173	72.173	72.173	169.1
002_YEAR	MH-T01	LINE_T	42.00	3110.753	3119.870	274	0.000	0.000	0.000	0.000	71.992	71.992	71.992	175.1
002_YEAR	MH-T01	LINE_T	43.00	3110.750	3119.870	274	0.000	0.000	0.000	0.000	71.847	71.847	71.848	181.0
002_YEAR	MH-T01	LINE_T	44.00	3110.747	3119.870	274	0.000	0.000	0.000	0.000	71.745	71.745	71.745	186.9
002_YEAR	MH-T01	LINE_T	45.00	3110.746	3119.870	274	0.000	0.000	0.000	0.000	71.672	71.672	71.672	192.9
002_YEAR	MH-T01	LINE_T	46.00	3110.745	3119.870	274	0.000	0.000	0.000	0.000	71.626	71.626	71.627	198.8
002_YEAR	MH-T01	LINE_T	47.00	3110.744	3119.870	274	0.000	0.000	0.000	0.000	71.585	71.585	71.585	204.7
002_YEAR	MH-T01	LINE_T	48.00	3110.743	3119.870	274	0.000	0.000	0.000	0.000	71.550	71.550	71.550	210.6
002_YEAR	MH-T01	LINE_T	49.00	3110.743	3119.870	274	0.000	0.000	0.000	0.000	71.521	71.521	71.521	216.5
002_YEAR	MH-T01	LINE_T	50.00	3110.742	3119.870	274	0.000	0.000	0.000	0.000	71.493	71.493	71.493	222.4
002_YEAR	MH-T01	LINE_T	51.00	3110.741	3119.870	274	0.000	0.000	0.000	0.000	71.470	71.470	71.470	228.4
002_YEAR	MH-T01	LINE_T	52.00	3110.741	3119.870	274	0.000	0.000	0.000	0.000	71.447	71.447	71.447	234.3
002_YEAR	MH-T01	LINE_T	53.00	3110.740	3119.870	274	0.000	0.000	0.000	0.000	71.396	71.396	71.396	240.2
002_YEAR	MH-T01	LINE_T	54.00	3110.734	3119.870	274	0.000	0.000	0.000	0.000	71.135	71.135	71.136	246.0
002_YEAR	MH-T01	LINE_T	55.00	3110.734	3119.870	274	0.000	0.000	0.000	0.000	71.126	71.126	71.127	251.9
002_YEAR	MH-T01	LINE_T	56.00	3110.730	3119.870	274	0.000	0.000	0.000	0.000	70.951	70.951	70.951	257.8
002_YEAR	MH-T01	LINE_T	57.00	3110.724	3119.870	274	0.000	0.000	0.000	0.000	70.655	70.655	70.655	263.7
002_YEAR	MH-T01	LINE_T	58.00	3110.719	3119.870	274	0.000	0.000	0.000	0.000	70.413	70.413	70.413	269.5

Table 5-19
Discharge Point 31, 54-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 5-Year 24-Hour Precipitation (3.8 Inches)

SLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af
005_YEAR	MH-T01	LINE_T	0.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	1.03	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	2.07	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	3.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	4.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	5.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	6.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	7.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	8.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	9.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	10.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	11.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	12.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
005_YEAR	MH-T01	LINE_T	13.00	3110.155	3119.870	274	0.000	0.000	0.000	0.000	33.567	33.567	33.556	1.4
005_YEAR	MH-T01	LINE_T	14.00	3110.717	3119.870	274	0.000	0.000	0.000	0.000	70.349	70.349	70.333	5.7
005_YEAR	MH-T01	LINE_T	15.00	3110.831	3119.870	274	0.000	0.000	0.000	0.000	75.522	75.522	75.519	11.7
005_YEAR	MH-T01	LINE_T	16.00	3110.855	3119.870	274	0.000	0.000	0.000	0.000	76.562	76.562	76.561	18.0
005_YEAR	MH-T01	LINE_T	17.00	3110.861	3119.870	274	0.000	0.000	0.000	0.000	76.828	76.828	76.828	24.3
005_YEAR	MH-T01	LINE_T	18.00	3110.863	3119.870	274	0.000	0.000	0.000	0.000	76.906	76.906	76.905	30.7
005_YEAR	MH-T01	LINE_T	19.00	3110.863	3119.870	274	0.000	0.000	0.000	0.000	76.929	76.929	76.929	37.0
005_YEAR	MH-T01	LINE_T	20.00	3110.863	3119.870	274	0.000	0.000	0.000	0.000	76.930	76.930	76.930	43.4
005_YEAR	MH-T01	LINE_T	21.00	3110.863	3119.870	274	0.000	0.000	0.000	0.000	76.917	76.917	76.917	49.8
005_YEAR	MH-T01	LINE_T	22.00	3110.862	3119.870	274	0.000	0.000	0.000	0.000	76.893	76.893	76.894	56.1
005_YEAR	MH-T01	LINE_T	23.00	3110.862	3119.870	274	0.000	0.000	0.000	0.000	76.865	76.865	76.865	62.5
005_YEAR	MH-T01	LINE_T	24.00	3110.861	3119.870	274	0.000	0.000	0.000	0.000	76.832	76.832	76.832	68.8
005_YEAR	MH-T01	LINE_T	25.00	3110.860	3119.870	274	0.000	0.000	0.000	0.000	76.795	76.795	76.795	75.2
005_YEAR	MH-T01	LINE_T	26.00	3110.859	3119.870	274	0.000	0.000	0.000	0.000	76.733	76.733	76.733	81.5
005_YEAR	MH-T01	LINE_T	27.00	3110.857	3119.870	274	0.000	0.000	0.000	0.000	76.643	76.643	76.643	87.8
005_YEAR	MH-T01	LINE_T	28.00	3110.854	3119.870	274	0.000	0.000	0.000	0.000	76.545	76.545	76.545	94.2
005_YEAR	MH-T01	LINE_T	29.00	3110.852	3119.870	274	0.000	0.000	0.000	0.000	76.443	76.443	76.444	100.5
005_YEAR	MH-T01	LINE_T	30.00	3110.850	3119.870	274	0.000	0.000	0.000	0.000	76.353	76.353	76.353	106.8
005_YEAR	MH-T01	LINE_T	31.00	3110.848	3119.870	274	0.000	0.000	0.000	0.000	76.281	76.281	76.281	113.1
005_YEAR	MH-T01	LINE_T	32.00	3110.846	3119.870	274	0.000	0.000	0.000	0.000	76.196	76.196	76.197	119.4
005_YEAR	MH-T01	LINE_T	33.00	3110.844	3119.870	274	0.000	0.000	0.000	0.000	76.113	76.113	76.114	125.7
005_YEAR	MH-T01	LINE_T	34.00	3110.843	3119.870	274	0.000	0.000	0.000	0.000	76.031	76.031	76.031	132.0
005_YEAR	MH-T01	LINE_T	35.00	3110.841	3119.870	274	0.000	0.000	0.000	0.000	75.948	75.948	75.948	138.3
005_YEAR	MH-T01	LINE_T	36.00	3110.839	3119.870	274	0.000	0.000	0.000	0.000	75.865	75.865	75.866	144.6
005_YEAR	MH-T01	LINE_T	37.00	3110.837	3119.870	274	0.000	0.000	0.000	0.000	75.783	75.783	75.784	150.8
005_YEAR	MH-T01	LINE_T	38.00	3110.835	3119.870	274	0.000	0.000	0.000	0.000	75.701	75.701	75.701	157.1
005_YEAR	MH-T01	LINE_T	39.00	3110.833	3119.870	274	0.000	0.000	0.000	0.000	75.620	75.620	75.620	163.3
005_YEAR	MH-T01	LINE_T	40.00	3110.831	3119.870	274	0.000	0.000	0.000	0.000	75.539	75.539	75.539	169.6
005_YEAR	MH-T01	LINE_T	41.00	3110.830	3119.870	274	0.000	0.000	0.000	0.000	75.461	75.461	75.461	175.8
005_YEAR	MH-T01	LINE_T	42.00	3110.828	3119.870	274	0.000	0.000	0.000	0.000	75.389	75.389	75.389	182.1
005_YEAR	MH-T01	LINE_T	43.00	3110.826	3119.870	274	0.000	0.000	0.000	0.000	75.306	75.306	75.306	188.3
005_YEAR	MH-T01	LINE_T	44.00	3110.824	3119.870	274	0.000	0.000	0.000	0.000	75.227	75.227	75.227	194.5
005_YEAR	MH-T01	LINE_T	45.00	3110.822	3119.870	274	0.000	0.000	0.000	0.000	75.147	75.147	75.147	200.7
005_YEAR	MH-T01	LINE_T	46.00	3110.820	3119.870	274	0.000	0.000	0.000	0.000	75.057	75.057	75.057	206.9
005_YEAR	MH-T01	LINE_T	47.00	3110.818	3119.870	274	0.000	0.000	0.000	0.000	74.960	74.960	74.961	213.1
005_YEAR	MH-T01	LINE_T	48.00	3110.816	3119.870	274	0.000	0.000	0.000	0.000	74.881	74.881	74.881	219.3
005_YEAR	MH-T01	LINE_T	49.00	3110.815	3119.870	274	0.000	0.000	0.000	0.000	74.811	74.811	74.811	225.5
005_YEAR	MH-T01	LINE_T	50.00	3110.813	3119.870	274	0.000	0.000	0.000	0.000	74.743	74.743	74.743	231.7
005_YEAR	MH-T01	LINE_T	51.00	3110.811	3119.870	274	0.000	0.000	0.000	0.000	74.643	74.643	74.643	237.9
005_YEAR	MH-T01	LINE_T	52.00	3110.803	3119.870	274	0.000	0.000	0.000	0.000	74.264	74.264	74.264	244.0
005_YEAR	MH-T01	LINE_T	53.00	3110.793	3119.870	274	0.000	0.000	0.000	0.000	73.825	73.825	73.826	250.1
005_YEAR	MH-T01	LINE_T	54.00	3110.785	3119.870	274	0.000	0.000	0.000	0.000	73.468	73.468	73.468	256.2
005_YEAR	MH-T01	LINE_T	55.00	3110.779	3119.870	274	0.000	0.000	0.000	0.000	73.179	73.179	73.180	262.3
005_YEAR	MH-T01	LINE_T	56.00	3110.773	3119.870	274	0.000	0.000	0.000	0.000	72.917	72.917	72.917	268.3
005_YEAR	MH-T01	LINE_T	57.00	3110.767	3119.870	274	0.000	0.000	0.000	0.000	72.639	72.639	72.640	274.3
005_YEAR	MH-T01	LINE_T	58.00	3110.762	3119.870	274	0.000	0.000	0.000	0.000	72.419	72.419	72.419	280.3

Table 5-20
Discharge Point 31, 54-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 10-Year 24-Hour Precipitation (4.6 Inches)

SLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af
010_YEAR	MH-T01	LINE_T	0.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
010_YEAR	MH-T01	LINE_T	1.03	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
010_YEAR	MH-T01	LINE_T	2.07	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
010_YEAR	MH-T01	LINE_T	3.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
010_YEAR	MH-T01	LINE_T	4.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
010_YEAR	MH-T01	LINE_T	5.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
010_YEAR	MH-T01	LINE_T	6.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
010_YEAR	MH-T01	LINE_T	7.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
010_YEAR	MH-T01	LINE_T	8.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
010_YEAR	MH-T01	LINE_T	9.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
010_YEAR	MH-T01	LINE_T	10.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
010_YEAR	MH-T01	LINE_T	11.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
010_YEAR	MH-T01	LINE_T	12.00	3110.124	3119.870	274	0.000	0.000	0.000	0.000	30.040	30.040	30.042	1.2
010_YEAR	MH-T01	LINE_T	13.00	3110.495	3119.870	274	0.000	0.000	0.000	0.000	59.066	59.066	59.023	4.9
010_YEAR	MH-T01	LINE_T	14.00	3110.785	3119.870	274	0.000	0.000	0.000	0.000	73.464	73.464	73.451	10.4
010_YEAR	MH-T01	LINE_T	15.00	3110.856	3119.870	274	0.000	0.000	0.000	0.000	76.632	76.632	76.629	16.6
010_YEAR	MH-T01	LINE_T	16.00	3110.873	3119.870	274	0.000	0.000	0.000	0.000	77.345	77.345	77.344	23.0
010_YEAR	MH-T01	LINE_T	17.00	3110.878	3119.870	274	0.000	0.000	0.000	0.000	77.559	77.559	77.559	29.4
010_YEAR	MH-T01	LINE_T	18.00	3110.880	3119.870	274	0.000	0.000	0.000	0.000	77.633	77.633	77.633	35.8
010_YEAR	MH-T01	LINE_T	19.00	3110.880	3119.870	274	0.000	0.000	0.000	0.000	77.665	77.665	77.665	42.2
010_YEAR	MH-T01	LINE_T	20.00	3110.881	3119.870	274	0.000	0.000	0.000	0.000	77.681	77.681	77.681	48.6
010_YEAR	MH-T01	LINE_T	21.00	3110.881	3119.870	274	0.000	0.000	0.000	0.000	77.685	77.685	77.685	55.0
010_YEAR	MH-T01	LINE_T	22.00	3110.881	3119.870	274	0.000	0.000	0.000	0.000	77.681	77.681	77.681	61.5
010_YEAR	MH-T01	LINE_T	23.00	3110.881	3119.870	274	0.000	0.000	0.000	0.000	77.670	77.670	77.670	67.9
010_YEAR	MH-T01	LINE_T	24.00	3110.880	3119.870	274	0.000	0.000	0.000	0.000	77.658	77.658	77.658	74.3
010_YEAR	MH-T01	LINE_T	25.00	3110.880	3119.870	274	0.000	0.000	0.000	0.000	77.640	77.640	77.640	80.7
010_YEAR	MH-T01	LINE_T	26.00	3110.879	3119.870	274	0.000	0.000	0.000	0.000	77.603	77.603	77.603	87.1
010_YEAR	MH-T01	LINE_T	27.00	3110.878	3119.870	274	0.000	0.000	0.000	0.000	77.544	77.544	77.544	93.5
010_YEAR	MH-T01	LINE_T	28.00	3110.876	3119.870	274	0.000	0.000	0.000	0.000	77.476	77.476	77.477	99.9
010_YEAR	MH-T01	LINE_T	29.00	3110.874	3119.870	274	0.000	0.000	0.000	0.000	77.403	77.403	77.403	106.3
010_YEAR	MH-T01	LINE_T	30.00	3110.872	3119.870	274	0.000	0.000	0.000	0.000	77.324	77.324	77.325	112.7
010_YEAR	MH-T01	LINE_T	31.00	3110.871	3119.870	274	0.000	0.000	0.000	0.000	77.240	77.240	77.241	119.1
010_YEAR	MH-T01	LINE_T	32.00	3110.868	3119.870	274	0.000	0.000	0.000	0.000	77.153	77.153	77.153	125.5
010_YEAR	MH-T01	LINE_T	33.00	3110.866	3119.870	274	0.000	0.000	0.000	0.000	77.062	77.062	77.062	131.9
010_YEAR	MH-T01	LINE_T	34.00	3110.864	3119.870	274	0.000	0.000	0.000	0.000	76.970	76.970	76.970	138.2
010_YEAR	MH-T01	LINE_T	35.00	3110.862	3119.870	274	0.000	0.000	0.000	0.000	76.876	76.876	76.876	144.6
010_YEAR	MH-T01	LINE_T	36.00	3110.860	3119.870	274	0.000	0.000	0.000	0.000	76.784	76.784	76.784	150.9
010_YEAR	MH-T01	LINE_T	37.00	3110.858	3119.870	274	0.000	0.000	0.000	0.000	76.699	76.699	76.699	157.3
010_YEAR	MH-T01	LINE_T	38.00	3110.856	3119.870	274	0.000	0.000	0.000	0.000	76.623	76.623	76.623	163.6
010_YEAR	MH-T01	LINE_T	39.00	3110.854	3119.870	274	0.000	0.000	0.000	0.000	76.546	76.546	76.546	170.0
010_YEAR	MH-T01	LINE_T	40.00	3110.853	3119.870	274	0.000	0.000	0.000	0.000	76.468	76.468	76.468	176.3
010_YEAR	MH-T01	LINE_T	41.00	3110.851	3119.870	274	0.000	0.000	0.000	0.000	76.389	76.389	76.390	182.6
010_YEAR	MH-T01	LINE_T	42.00	3110.849	3119.870	274	0.000	0.000	0.000	0.000	76.315	76.315	76.315	188.9
010_YEAR	MH-T01	LINE_T	43.00	3110.847	3119.870	274	0.000	0.000	0.000	0.000	76.238	76.238	76.238	195.2
010_YEAR	MH-T01	LINE_T	44.00	3110.845	3119.870	274	0.000	0.000	0.000	0.000	76.156	76.156	76.157	201.5
010_YEAR	MH-T01	LINE_T	45.00	3110.844	3119.870	274	0.000	0.000	0.000	0.000	76.076	76.076	76.077	207.8
010_YEAR	MH-T01	LINE_T	46.00	3110.842	3119.870	274	0.000	0.000	0.000	0.000	75.997	75.997	75.997	214.1
010_YEAR	MH-T01	LINE_T	47.00	3110.840	3119.870	274	0.000	0.000	0.000	0.000	75.918	75.918	75.918	220.4
010_YEAR	MH-T01	LINE_T	48.00	3110.838	3119.870	274	0.000	0.000	0.000	0.000	75.840	75.840	75.840	226.6
010_YEAR	MH-T01	LINE_T	49.00	3110.836	3119.870	274	0.000	0.000	0.000	0.000	75.763	75.763	75.763	232.9
010_YEAR	MH-T01	LINE_T	50.00	3110.835	3119.870	274	0.000	0.000	0.000	0.000	75.687	75.687	75.687	239.2
010_YEAR	MH-T01	LINE_T	51.00	3110.833	3119.870	274	0.000	0.000	0.000	0.000	75.611	75.611	75.611	245.4
010_YEAR	MH-T01	LINE_T	52.00	3110.831	3119.870	274	0.000	0.000	0.000	0.000	75.537	75.537	75.537	251.6
010_YEAR	MH-T01	LINE_T	53.00	3110.830	3119.870	274	0.000	0.000	0.000	0.000	75.466	75.466	75.466	257.9
010_YEAR	MH-T01	LINE_T	54.00	3110.828	3119.870	274	0.000	0.000	0.000	0.000	75.401	75.401	75.402	264.1
010_YEAR	MH-T01	LINE_T	55.00	3110.826	3119.870	274	0.000	0.000	0.000	0.000	75.325	75.325	75.325	270.4
010_YEAR	MH-T01	LINE_T	56.00	3110.825	3119.870	274	0.000	0.000	0.000	0.000	75.253	75.253	75.254	276.6
010_YEAR	MH-T01	LINE_T	57.00	3110.823	3119.870	274	0.000	0.000	0.000	0.000	75.180	75.180	75.180	282.8
010_YEAR	MH-T01	LINE_T	58.00	3110.821	3119.870	274	0.000	0.000	0.000	0.000	75.101	75.101	75.101	289.0

Table 5-21
Discharge Point 31, 54-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 25-Year 24-Hour Precipitation (5.3 Inches)

SLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af
025_YEAR	MH-T01	LINE_T	0.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
025_YEAR	MH-T01	LINE_T	1.03	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
025_YEAR	MH-T01	LINE_T	2.07	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
025_YEAR	MH-T01	LINE_T	3.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
025_YEAR	MH-T01	LINE_T	4.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
025_YEAR	MH-T01	LINE_T	5.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
025_YEAR	MH-T01	LINE_T	6.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
025_YEAR	MH-T01	LINE_T	7.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
025_YEAR	MH-T01	LINE_T	8.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
025_YEAR	MH-T01	LINE_T	9.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
025_YEAR	MH-T01	LINE_T	10.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
025_YEAR	MH-T01	LINE_T	11.00	3110.021	3119.870	274	0.000	0.000	0.000	0.000	12.460	12.460	12.428	0.5
025_YEAR	MH-T01	LINE_T	12.00	3110.296	3119.870	274	0.000	0.000	0.000	0.000	45.861	45.861	45.825	2.9
025_YEAR	MH-T01	LINE_T	13.00	3110.682	3119.870	274	0.000	0.000	0.000	0.000	69.024	69.024	69.008	7.7
025_YEAR	MH-T01	LINE_T	14.00	3110.829	3119.870	274	0.000	0.000	0.000	0.000	75.446	75.446	75.440	13.6
025_YEAR	MH-T01	LINE_T	15.00	3110.872	3119.870	274	0.000	0.000	0.000	0.000	77.295	77.295	77.294	20.0
025_YEAR	MH-T01	LINE_T	16.00	3110.884	3119.870	274	0.000	0.000	0.000	0.000	77.833	77.833	77.832	26.4
025_YEAR	MH-T01	LINE_T	17.00	3110.888	3119.870	274	0.000	0.000	0.000	0.000	78.004	78.004	78.004	32.8
025_YEAR	MH-T01	LINE_T	18.00	3110.890	3119.870	274	0.000	0.000	0.000	0.000	78.073	78.073	78.073	39.3
025_YEAR	MH-T01	LINE_T	19.00	3110.891	3119.870	274	0.000	0.000	0.000	0.000	78.108	78.108	78.108	45.7
025_YEAR	MH-T01	LINE_T	20.00	3110.891	3119.870	274	0.000	0.000	0.000	0.000	78.127	78.127	78.127	52.2
025_YEAR	MH-T01	LINE_T	21.00	3110.892	3119.870	274	0.000	0.000	0.000	0.000	78.136	78.136	78.136	58.6
025_YEAR	MH-T01	LINE_T	22.00	3110.892	3119.870	274	0.000	0.000	0.000	0.000	78.137	78.137	78.137	65.1
025_YEAR	MH-T01	LINE_T	23.00	3110.892	3119.870	274	0.000	0.000	0.000	0.000	78.134	78.134	78.134	71.5
025_YEAR	MH-T01	LINE_T	24.00	3110.891	3119.870	274	0.000	0.000	0.000	0.000	78.129	78.129	78.129	78.0
025_YEAR	MH-T01	LINE_T	25.00	3110.891	3119.870	274	0.000	0.000	0.000	0.000	78.122	78.122	78.122	84.4
025_YEAR	MH-T01	LINE_T	26.00	3110.891	3119.870	274	0.000	0.000	0.000	0.000	78.099	78.099	78.099	90.9
025_YEAR	MH-T01	LINE_T	27.00	3110.890	3119.870	274	0.000	0.000	0.000	0.000	78.059	78.059	78.059	97.4
025_YEAR	MH-T01	LINE_T	28.00	3110.889	3119.870	274	0.000	0.000	0.000	0.000	78.012	78.012	78.012	103.8
025_YEAR	MH-T01	LINE_T	29.00	3110.887	3119.870	274	0.000	0.000	0.000	0.000	77.961	77.961	77.961	110.3
025_YEAR	MH-T01	LINE_T	30.00	3110.886	3119.870	274	0.000	0.000	0.000	0.000	77.908	77.908	77.908	116.7
025_YEAR	MH-T01	LINE_T	31.00	3110.885	3119.870	274	0.000	0.000	0.000	0.000	77.852	77.852	77.852	123.1
025_YEAR	MH-T01	LINE_T	32.00	3110.884	3119.870	274	0.000	0.000	0.000	0.000	77.795	77.795	77.795	129.6
025_YEAR	MH-T01	LINE_T	33.00	3110.882	3119.870	274	0.000	0.000	0.000	0.000	77.739	77.739	77.739	136.0
025_YEAR	MH-T01	LINE_T	34.00	3110.881	3119.870	274	0.000	0.000	0.000	0.000	77.677	77.677	77.677	142.4
025_YEAR	MH-T01	LINE_T	35.00	3110.879	3119.870	274	0.000	0.000	0.000	0.000	77.613	77.613	77.613	148.8
025_YEAR	MH-T01	LINE_T	36.00	3110.878	3119.870	274	0.000	0.000	0.000	0.000	77.546	77.546	77.546	155.2
025_YEAR	MH-T01	LINE_T	37.00	3110.876	3119.870	274	0.000	0.000	0.000	0.000	77.475	77.475	77.475	161.6
025_YEAR	MH-T01	LINE_T	38.00	3110.874	3119.870	274	0.000	0.000	0.000	0.000	77.400	77.400	77.401	168.0
025_YEAR	MH-T01	LINE_T	39.00	3110.872	3119.870	274	0.000	0.000	0.000	0.000	77.321	77.321	77.321	174.4
025_YEAR	MH-T01	LINE_T	40.00	3110.870	3119.870	274	0.000	0.000	0.000	0.000	77.235	77.235	77.236	180.8
025_YEAR	MH-T01	LINE_T	41.00	3110.868	3119.870	274	0.000	0.000	0.000	0.000	77.154	77.154	77.154	187.2
025_YEAR	MH-T01	LINE_T	42.00	3110.867	3119.870	274	0.000	0.000	0.000	0.000	77.083	77.083	77.083	193.6
025_YEAR	MH-T01	LINE_T	43.00	3110.865	3119.870	274	0.000	0.000	0.000	0.000	77.014	77.014	77.014	199.9
025_YEAR	MH-T01	LINE_T	44.00	3110.864	3119.870	274	0.000	0.000	0.000	0.000	76.942	76.942	76.942	206.3
025_YEAR	MH-T01	LINE_T	45.00	3110.862	3119.870	274	0.000	0.000	0.000	0.000	76.869	76.869	76.869	212.7
025_YEAR	MH-T01	LINE_T	46.00	3110.860	3119.870	274	0.000	0.000	0.000	0.000	76.795	76.795	76.795	219.0
025_YEAR	MH-T01	LINE_T	47.00	3110.858	3119.870	274	0.000	0.000	0.000	0.000	76.723	76.723	76.723	225.4
025_YEAR	MH-T01	LINE_T	48.00	3110.857	3119.870	274	0.000	0.000	0.000	0.000	76.646	76.646	76.646	231.7
025_YEAR	MH-T01	LINE_T	49.00	3110.855	3119.870	274	0.000	0.000	0.000	0.000	76.569	76.569	76.569	238.0
025_YEAR	MH-T01	LINE_T	50.00	3110.853	3119.870	274	0.000	0.000	0.000	0.000	76.491	76.491	76.492	244.3
025_YEAR	MH-T01	LINE_T	51.00	3110.851	3119.870	274	0.000	0.000	0.000	0.000	76.414	76.414	76.414	250.7
025_YEAR	MH-T01	LINE_T	52.00	3110.850	3119.870	274	0.000	0.000	0.000	0.000	76.343	76.343	76.343	257.0
025_YEAR	MH-T01	LINE_T	53.00	3110.848	3119.870	274	0.000	0.000	0.000	0.000	76.269	76.269	76.269	263.3
025_YEAR	MH-T01	LINE_T	54.00	3110.846	3119.870	274	0.000	0.000	0.000	0.000	76.189	76.189	76.189	269.6
025_YEAR	MH-T01	LINE_T	55.00	3110.844	3119.870	274	0.000	0.000	0.000	0.000	76.112	76.112	76.112	275.9
025_YEAR	MH-T01	LINE_T	56.00	3110.843	3119.870	274	0.000	0.000	0.000	0.000	76.036	76.036	76.036	282.2
025_YEAR	MH-T01	LINE_T	57.00	3110.841	3119.870	274	0.000	0.000	0.000	0.000	75.961	75.961	75.961	288.4
025_YEAR	MH-T01	LINE_T	58.00	3110.839	3119.870	274	0.000	0.000	0.000	0.000	75.887	75.887	75.887	294.7

Table 5-22
Discharge Point 31, 54-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 50-Year 24-Hour Precipitation (6.0 Inches)

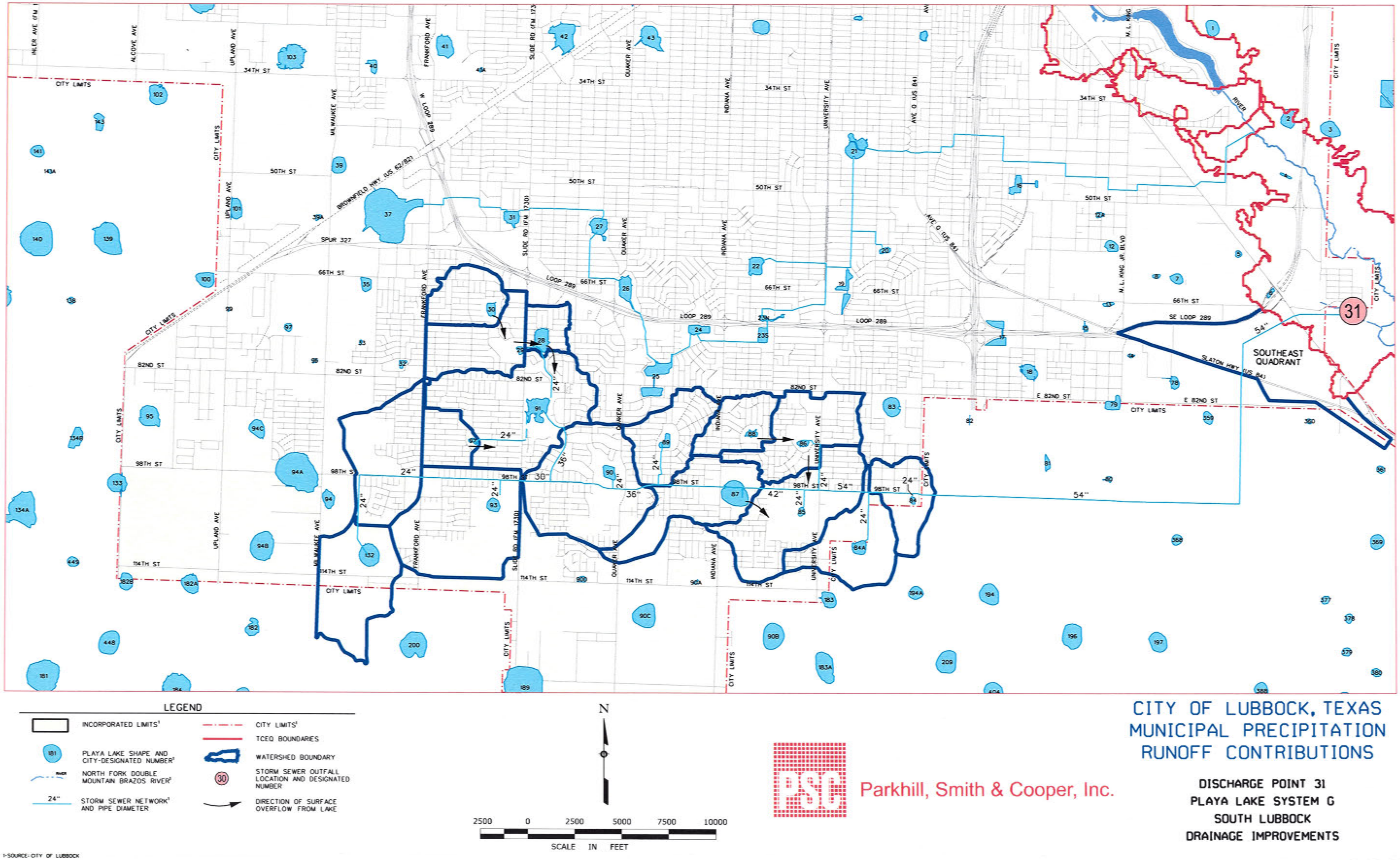
SLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af
050_YEAR	MH-T01	LINE_T	0.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
050_YEAR	MH-T01	LINE_T	1.03	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
050_YEAR	MH-T01	LINE_T	2.07	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
050_YEAR	MH-T01	LINE_T	3.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
050_YEAR	MH-T01	LINE_T	4.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
050_YEAR	MH-T01	LINE_T	5.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
050_YEAR	MH-T01	LINE_T	6.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
050_YEAR	MH-T01	LINE_T	7.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
050_YEAR	MH-T01	LINE_T	8.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
050_YEAR	MH-T01	LINE_T	9.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
050_YEAR	MH-T01	LINE_T	10.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
050_YEAR	MH-T01	LINE_T	11.00	3110.151	3119.870	274	0.000	0.000	0.000	0.000	33.175	33.175	33.156	1.4
050_YEAR	MH-T01	LINE_T	12.00	3110.562	3119.870	274	0.000	0.000	0.000	0.000	62.825	62.825	62.799	5.3
050_YEAR	MH-T01	LINE_T	13.00	3110.755	3119.870	274	0.000	0.000	0.000	0.000	72.111	72.111	72.101	10.9
050_YEAR	MH-T01	LINE_T	14.00	3110.852	3119.870	274	0.000	0.000	0.000	0.000	76.435	76.435	76.431	17.1
050_YEAR	MH-T01	LINE_T	15.00	3110.883	3119.870	274	0.000	0.000	0.000	0.000	77.769	77.769	77.768	23.4
050_YEAR	MH-T01	LINE_T	16.00	3110.893	3119.870	274	0.000	0.000	0.000	0.000	78.179	78.179	78.179	29.9
050_YEAR	MH-T01	LINE_T	17.00	3110.896	3119.870	274	0.000	0.000	0.000	0.000	78.325	78.325	78.324	36.3
050_YEAR	MH-T01	LINE_T	18.00	3110.897	3119.870	274	0.000	0.000	0.000	0.000	78.384	78.384	78.384	42.8
050_YEAR	MH-T01	LINE_T	19.00	3110.898	3119.870	274	0.000	0.000	0.000	0.000	78.412	78.412	78.412	49.3
050_YEAR	MH-T01	LINE_T	20.00	3110.898	3119.870	274	0.000	0.000	0.000	0.000	78.428	78.428	78.428	55.8
050_YEAR	MH-T01	LINE_T	21.00	3110.899	3119.870	274	0.000	0.000	0.000	0.000	78.438	78.438	78.438	62.3
050_YEAR	MH-T01	LINE_T	22.00	3110.899	3119.870	274	0.000	0.000	0.000	0.000	78.443	78.443	78.443	68.7
050_YEAR	MH-T01	LINE_T	23.00	3110.899	3119.870	274	0.000	0.000	0.000	0.000	78.444	78.444	78.444	75.2
050_YEAR	MH-T01	LINE_T	24.00	3110.899	3119.870	274	0.000	0.000	0.000	0.000	78.444	78.444	78.444	81.7
050_YEAR	MH-T01	LINE_T	25.00	3110.899	3119.870	274	0.000	0.000	0.000	0.000	78.442	78.442	78.442	88.2
050_YEAR	MH-T01	LINE_T	26.00	3110.899	3119.870	274	0.000	0.000	0.000	0.000	78.429	78.429	78.429	94.7
050_YEAR	MH-T01	LINE_T	27.00	3110.898	3119.870	274	0.000	0.000	0.000	0.000	78.403	78.403	78.403	101.1
050_YEAR	MH-T01	LINE_T	28.00	3110.897	3119.870	274	0.000	0.000	0.000	0.000	78.367	78.367	78.367	107.6
050_YEAR	MH-T01	LINE_T	29.00	3110.896	3119.870	274	0.000	0.000	0.000	0.000	78.330	78.330	78.330	114.1
050_YEAR	MH-T01	LINE_T	30.00	3110.895	3119.870	274	0.000	0.000	0.000	0.000	78.292	78.292	78.293	120.6
050_YEAR	MH-T01	LINE_T	31.00	3110.894	3119.870	274	0.000	0.000	0.000	0.000	78.254	78.254	78.254	127.0
050_YEAR	MH-T01	LINE_T	32.00	3110.893	3119.870	274	0.000	0.000	0.000	0.000	78.214	78.214	78.214	133.5
050_YEAR	MH-T01	LINE_T	33.00	3110.892	3119.870	274	0.000	0.000	0.000	0.000	78.172	78.172	78.172	140.0
050_YEAR	MH-T01	LINE_T	34.00	3110.891	3119.870	274	0.000	0.000	0.000	0.000	78.130	78.130	78.130	146.4
050_YEAR	MH-T01	LINE_T	35.00	3110.890	3119.870	274	0.000	0.000	0.000	0.000	78.086	78.086	78.087	152.9
050_YEAR	MH-T01	LINE_T	36.00	3110.889	3119.870	274	0.000	0.000	0.000	0.000	78.038	78.038	78.038	159.3
050_YEAR	MH-T01	LINE_T	37.00	3110.888	3119.870	274	0.000	0.000	0.000	0.000	77.987	77.987	77.987	165.8
050_YEAR	MH-T01	LINE_T	38.00	3110.887	3119.870	274	0.000	0.000	0.000	0.000	77.935	77.935	77.935	172.2
050_YEAR	MH-T01	LINE_T	39.00	3110.886	3119.870	274	0.000	0.000	0.000	0.000	77.880	77.880	77.880	178.7
050_YEAR	MH-T01	LINE_T	40.00	3110.884	3119.870	274	0.000	0.000	0.000	0.000	77.823	77.823	77.823	185.1
050_YEAR	MH-T01	LINE_T	41.00	3110.883	3119.870	274	0.000	0.000	0.000	0.000	77.767	77.767	77.767	191.5
050_YEAR	MH-T01	LINE_T	42.00	3110.881	3119.870	274	0.000	0.000	0.000	0.000	77.708	77.708	77.708	198.0
050_YEAR	MH-T01	LINE_T	43.00	3110.880	3119.870	274	0.000	0.000	0.000	0.000	77.655	77.655	77.655	204.4
050_YEAR	MH-T01	LINE_T	44.00	3110.879	3119.870	274	0.000	0.000	0.000	0.000	77.606	77.606	77.606	210.8
050_YEAR	MH-T01	LINE_T	45.00	3110.878	3119.870	274	0.000	0.000	0.000	0.000	77.555	77.555	77.555	217.2
050_YEAR	MH-T01	LINE_T	46.00	3110.877	3119.870	274	0.000	0.000	0.000	0.000	77.500	77.500	77.501	223.6
050_YEAR	MH-T01	LINE_T	47.00	3110.875	3119.870	274	0.000	0.000	0.000	0.000	77.442	77.442	77.442	230.0
050_YEAR	MH-T01	LINE_T	48.00	3110.874	3119.870	274	0.000	0.000	0.000	0.000	77.378	77.378	77.378	236.4
050_YEAR	MH-T01	LINE_T	49.00	3110.872	3119.870	274	0.000	0.000	0.000	0.000	77.310	77.310	77.310	242.8
050_YEAR	MH-T01	LINE_T	50.00	3110.870	3119.870	274	0.000	0.000	0.000	0.000	77.239	77.239	77.239	249.2
050_YEAR	MH-T01	LINE_T	51.00	3110.869	3119.870	274	0.000	0.000	0.000	0.000	77.168	77.168	77.168	255.6
050_YEAR	MH-T01	LINE_T	52.00	3110.867	3119.870	274	0.000	0.000	0.000	0.000	77.096	77.096	77.096	261.9
050_YEAR	MH-T01	LINE_T	53.00	3110.865	3119.870	274	0.000	0.000	0.000	0.000	77.024	77.024	77.024	268.3
050_YEAR	MH-T01	LINE_T	54.00	3110.864	3119.870	274	0.000	0.000	0.000	0.000	76.950	76.950	76.950	274.7
050_YEAR	MH-T01	LINE_T	55.00	3110.862	3119.870	274	0.000	0.000	0.000	0.000	76.876	76.876	76.876	281.0
050_YEAR	MH-T01	LINE_T	56.00	3110.860	3119.870	274	0.000	0.000	0.000	0.000	76.801	76.801	76.801	287.4
050_YEAR	MH-T01	LINE_T	57.00	3110.859	3119.870	274	0.000	0.000	0.000	0.000	76.729	76.729	76.729	293.7
050_YEAR	MH-T01	LINE_T	58.00	3110.857	3119.870	274	0.000	0.000	0.000	0.000	76.653	76.653	76.653	300.1

Table 5-23
Discharge Point 31, 54-Inch Diameter Outfall
ICPR Time-Node Peak Discharge to River, 100-Year 24-Hour Precipitation (6.8 Inches)

SLDIP

Simulation	Node	Group	Time hrs	Stage ft	Warning Stage ft	Surface Area ft2	Base Flow cfs	Onsite Runoff cfs	Offsite Runoff cfs	Boundary Inflows cfs	Link Flows In cfs	Total Inflow cfs	Link Flows Out cfs	Total Vol In af
100_YEAR	MH-T01	LINE_T	0.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
100_YEAR	MH-T01	LINE_T	1.03	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
100_YEAR	MH-T01	LINE_T	2.07	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
100_YEAR	MH-T01	LINE_T	3.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
100_YEAR	MH-T01	LINE_T	4.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
100_YEAR	MH-T01	LINE_T	5.06	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
100_YEAR	MH-T01	LINE_T	6.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
100_YEAR	MH-T01	LINE_T	7.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
100_YEAR	MH-T01	LINE_T	8.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
100_YEAR	MH-T01	LINE_T	9.00	3110.000	3119.870	274	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0
100_YEAR	MH-T01	LINE_T	10.00	3110.122	3119.870	274	0.000	0.000	0.000	0.000	29.779	29.779	29.780	1.2
100_YEAR	MH-T01	LINE_T	11.00	3110.402	3119.870	274	0.000	0.000	0.000	0.000	53.290	53.290	53.254	4.7
100_YEAR	MH-T01	LINE_T	12.00	3110.698	3119.870	274	0.000	0.000	0.000	0.000	69.424	69.424	69.414	9.7
100_YEAR	MH-T01	LINE_T	13.00	3110.802	3119.870	274	0.000	0.000	0.000	0.000	74.249	74.249	74.240	15.7
100_YEAR	MH-T01	LINE_T	14.00	3110.867	3119.870	274	0.000	0.000	0.000	0.000	77.106	77.106	77.103	21.9
100_YEAR	MH-T01	LINE_T	15.00	3110.892	3119.870	274	0.000	0.000	0.000	0.000	78.142	78.142	78.141	28.3
100_YEAR	MH-T01	LINE_T	16.00	3110.899	3119.870	274	0.000	0.000	0.000	0.000	78.465	78.465	78.465	34.8
100_YEAR	MH-T01	LINE_T	17.00	3110.902	3119.870	274	0.000	0.000	0.000	0.000	78.576	78.576	78.576	41.3
100_YEAR	MH-T01	LINE_T	18.00	3110.903	3119.870	274	0.000	0.000	0.000	0.000	78.628	78.628	78.628	47.8
100_YEAR	MH-T01	LINE_T	19.00	3110.904	3119.870	274	0.000	0.000	0.000	0.000	78.666	78.666	78.666	54.3
100_YEAR	MH-T01	LINE_T	20.00	3110.905	3119.870	274	0.000	0.000	0.000	0.000	78.686	78.686	78.686	60.8
100_YEAR	MH-T01	LINE_T	21.00	3110.905	3119.870	274	0.000	0.000	0.000	0.000	78.699	78.699	78.699	67.3
100_YEAR	MH-T01	LINE_T	22.00	3110.905	3119.870	274	0.000	0.000	0.000	0.000	78.706	78.706	78.706	73.8
100_YEAR	MH-T01	LINE_T	23.00	3110.905	3119.870	274	0.000	0.000	0.000	0.000	78.710	78.710	78.710	80.3
100_YEAR	MH-T01	LINE_T	24.00	3110.905	3119.870	274	0.000	0.000	0.000	0.000	78.712	78.712	78.712	86.8
100_YEAR	MH-T01	LINE_T	25.00	3110.905	3119.870	274	0.000	0.000	0.000	0.000	78.712	78.712	78.712	93.3
100_YEAR	MH-T01	LINE_T	26.00	3110.905	3119.870	274	0.000	0.000	0.000	0.000	78.701	78.701	78.701	99.8
100_YEAR	MH-T01	LINE_T	27.00	3110.904	3119.870	274	0.000	0.000	0.000	0.000	78.676	78.676	78.676	106.3
100_YEAR	MH-T01	LINE_T	28.00	3110.904	3119.870	274	0.000	0.000	0.000	0.000	78.647	78.647	78.647	112.8
100_YEAR	MH-T01	LINE_T	29.00	3110.903	3119.870	274	0.000	0.000	0.000	0.000	78.625	78.625	78.625	119.3
100_YEAR	MH-T01	LINE_T	30.00	3110.903	3119.870	274	0.000	0.000	0.000	0.000	78.599	78.599	78.599	125.8
100_YEAR	MH-T01	LINE_T	31.00	3110.902	3119.870	274	0.000	0.000	0.000	0.000	78.572	78.572	78.572	132.3
100_YEAR	MH-T01	LINE_T	32.00	3110.901	3119.870	274	0.000	0.000	0.000	0.000	78.544	78.544	78.544	138.8
100_YEAR	MH-T01	LINE_T	33.00	3110.901	3119.870	274	0.000	0.000	0.000	0.000	78.515	78.515	78.515	145.3
100_YEAR	MH-T01	LINE_T	34.00	3110.900	3119.870	274	0.000	0.000	0.000	0.000	78.485	78.485	78.485	151.8
100_YEAR	MH-T01	LINE_T	35.00	3110.899	3119.870	274	0.000	0.000	0.000	0.000	78.453	78.453	78.454	158.3
100_YEAR	MH-T01	LINE_T	36.00	3110.898	3119.870	274	0.000	0.000	0.000	0.000	78.421	78.421	78.421	164.8
100_YEAR	MH-T01	LINE_T	37.00	3110.897	3119.870	274	0.000	0.000	0.000	0.000	78.384	78.384	78.384	171.2
100_YEAR	MH-T01	LINE_T	38.00	3110.897	3119.870	274	0.000	0.000	0.000	0.000	78.347	78.347	78.348	177.7
100_YEAR	MH-T01	LINE_T	39.00	3110.896	3119.870	274	0.000	0.000	0.000	0.000	78.310	78.310	78.310	184.2
100_YEAR	MH-T01	LINE_T	40.00	3110.895	3119.870	274	0.000	0.000	0.000	0.000	78.271	78.271	78.271	190.7
100_YEAR	MH-T01	LINE_T	41.00	3110.894	3119.870	274	0.000	0.000	0.000	0.000	78.231	78.231	78.231	197.1
100_YEAR	MH-T01	LINE_T	42.00	3110.893	3119.870	274	0.000	0.000	0.000	0.000	78.192	78.192	78.192	203.6
100_YEAR	MH-T01	LINE_T	43.00	3110.892	3119.870	274	0.000	0.000	0.000	0.000	78.159	78.159	78.160	210.1
100_YEAR	MH-T01	LINE_T	44.00	3110.891	3119.870	274	0.000	0.000	0.000	0.000	78.130	78.130	78.130	216.5
100_YEAR	MH-T01	LINE_T	45.00	3110.891	3119.870	274	0.000	0.000	0.000	0.000	78.098	78.098	78.098	223.0
100_YEAR	MH-T01	LINE_T	46.00	3110.890	3119.870	274	0.000	0.000	0.000	0.000	78.062	78.062	78.062	229.4
100_YEAR	MH-T01	LINE_T	47.00	3110.889	3119.870	274	0.000	0.000	0.000	0.000	78.024	78.024	78.024	235.9
100_YEAR	MH-T01	LINE_T	48.00	3110.888	3119.870	274	0.000	0.000	0.000	0.000	77.985	77.985	77.985	242.3
100_YEAR	MH-T01	LINE_T	49.00	3110.887	3119.870	274	0.000	0.000	0.000	0.000	77.943	77.943	77.943	248.8
100_YEAR	MH-T01	LINE_T	50.00	3110.886	3119.870	274	0.000	0.000	0.000	0.000	77.900	77.900	77.901	255.2
100_YEAR	MH-T01	LINE_T	51.00	3110.885	3119.870	274	0.000	0.000	0.000	0.000	77.855	77.855	77.855	261.6
100_YEAR	MH-T01	LINE_T	52.00	3110.884	3119.870	274	0.000	0.000	0.000	0.000	77.808	77.808	77.808	268.1
100_YEAR	MH-T01	LINE_T	53.00	3110.883	3119.870	274	0.000	0.000	0.000	0.000	77.761	77.761	77.761	274.5
100_YEAR	MH-T01	LINE_T	54.00	3110.882	3119.870	274	0.000	0.000	0.000	0.000	77.711	77.711	77.711	280.9
100_YEAR	MH-T01	LINE_T	55.00	3110.880	3119.870	274	0.000	0.000	0.000	0.000	77.656	77.656	77.656	287.3
100_YEAR	MH-T01	LINE_T	56.00	3110.879	3119.870	274	0.000	0.000	0.000	0.000	77.599	77.599	77.599	293.8
100_YEAR	MH-T01	LINE_T	57.00	3110.877	3119.870	274	0.000	0.000	0.000	0.000	77.538	77.538	77.538	300.2
100_YEAR	MH-T01	LINE_T	58.00	3110.876	3119.870	274	0.000	0.000	0.000	0.000	77.474	77.474	77.474	306.6



PSC Parkhill, Smith & Cooper, Inc.

CITY OF LUBBOCK, TEXAS MUNICIPAL PRECIPITATION RUNOFF CONTRIBUTIONS

DISCHARGE POINT 31
PLAYA LAKE SYSTEM G
SOUTH LUBBOCK
DRAINAGE IMPROVEMENTS

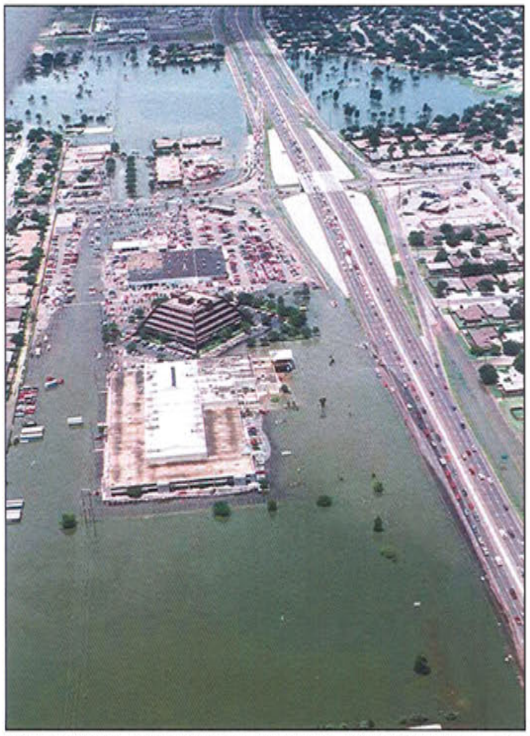
FIGURE 5-1

PHOTOGRAPHS

TAB

APPENDIX A

PHOTOGRAPHS
DISCHARGE POINT 30
SOUTH CENTRAL LUBBOCK DRAINAGE IMPROVEMENTS



Flooding overflow from Lake 24 (top of picture) to Lake 23S (bottom of picture). Rectangular white roof in picture is the Holiday Inn. June 1999.

Looking east (downstream) at flooding overflow from Lake 24 to Lake 23S. Holiday Inn sign is in the motel's parking lot. June 1999.

Discharge Point 30
South Central Lubbock Drainage Improvements
Construction Photographs

Water level surrounding Lake 23S. June 1999.

Overflow reach from Lake 19 to Lake 20. June 1999.

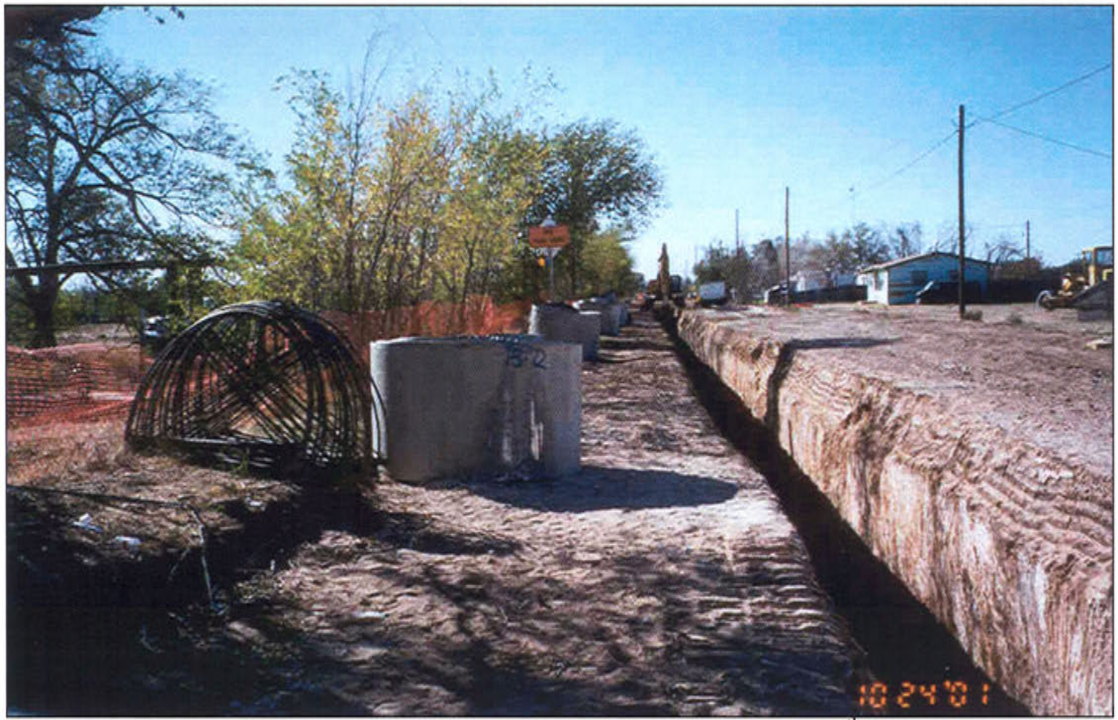
Discharge Point 30
South Central Lubbock Drainage Improvements
Construction Photographs

Outlet from South Central Lubbock Drainage Improvements at the North Fork of the Double Mountain Fork of the Brazos River on September 18, 2002.

Outlet from storm sewer system at river on April 9, 2004.

72-inch outfall construction. Tree at center of photograph beyond excavators is on opposite bank of the river.

Unloading tunnel boring machine. Approximately three miles of the storm sewer system were installed by tunnel methods.



Installing 72-inch cast-in-place nonreinforced concrete pipe in 48th Street between Vanda Avenue and Southeast Drive

72-inch cast-in-place nonreinforced concrete pipe extruded from rear of casting machinery.

Installing internal form bracing in 72-inch nonreinforced cast-in-place concrete pipe.

72-inch precast reinforced concrete pipe stockpiled in 43rd Street just east of Lake 21.

Typical raw tunnel with muck cart tracks, ventilation pipe and power cables.

Installing 72-inch fiberglass reinforced mortar pipe in tunnel.

Retrieving tunnel boring machine at 42nd Street and IH-27.
Pipe invert at this location is 50 feet below surface grade.

Installing 72-inch precast reinforced concrete pipe near Lake 21.
This is the final outfall pipeline.

Installing 72-inch cast-in-place nonreinforced concrete pipe in 44th Street between Avenue A and Avenue D.

Installing 48-inch cast-in-place nonreinforced concrete pipe in 69th Street west of University Avenue.

Some construction reaches required the use of a rock trencher.

48-inch cast-in-place nonreinforced concrete pipe being placed between Lake 24 and Lake 25.

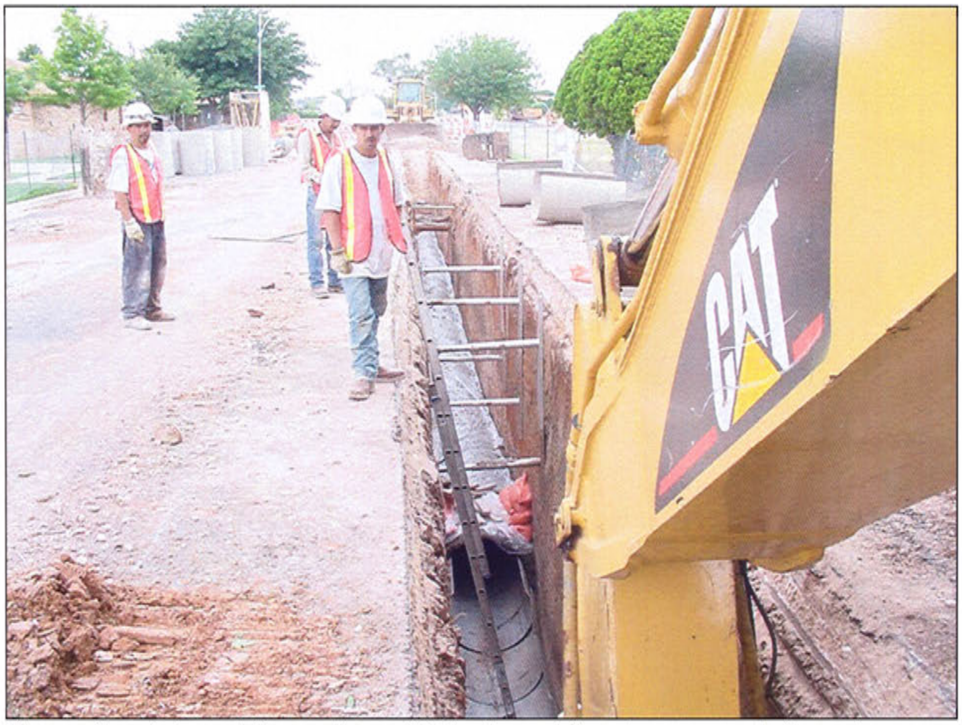
Direct-push hand mining for 42-inch fiberglass reinforced mortar pipe under South Loop 289.

Direct-push hand mining had to be abandoned because of subsurface conditions. This timber-shored box tunnel was hand-mined for 42-inch pipe installation under South Loop 289 between Lake 25 and Lake 26.

Timber-shored box tunnel being hand mined under South Loop 289 between Lake 25 and Lake 26 for 42-inch pipe.

Installing 36-inch storm sewer pipe at Lake 27. Inlet is to the right of the excavator.

Discharge Point 30
South Central Lubbock Drainage Improvements
Construction Photographs



Removing internal forms from 36-inch cast-in-place nonreinforced concrete pipe in Toledo Avenue between Lake 26 and Lake 27.

Pavement repair strip marks 30-inch storm sewer route in 55th Street between Vicksburg Avenue and Slide Road. This reach connects Lake 27 and Lake 31.

Tunneling 24-inch pipe under West Loop 289 at 53rd Street, between Lake 31 and Lake 37.

Auger boring under Frankford Avenue just east of Lake 37 for 24-inch storm sewer.

Discharge Point 30
South Central Lubbock Drainage Improvements
Construction Photographs

Pavement repair strip marks route of 24-inch storm sewer pipe from Lake 22.

Typical Vanda area inlet connected to 72-inch storm sewer outfall.

Completed inlet at Lake 21. This inlet delivers water to the 72-inch final outfall to the river.

Inflow to Lake 21 from upstream connected lakes. Boil in water surface marks headwall and wingwall at end of 60-inch storm sewer.

Sheet pile cofferdam at Lake 19.

Lake 19 inlet is a headwall and wingwall end section to a 30-inch diameter pipeline that in turn ties to 60-inch storm sewer.

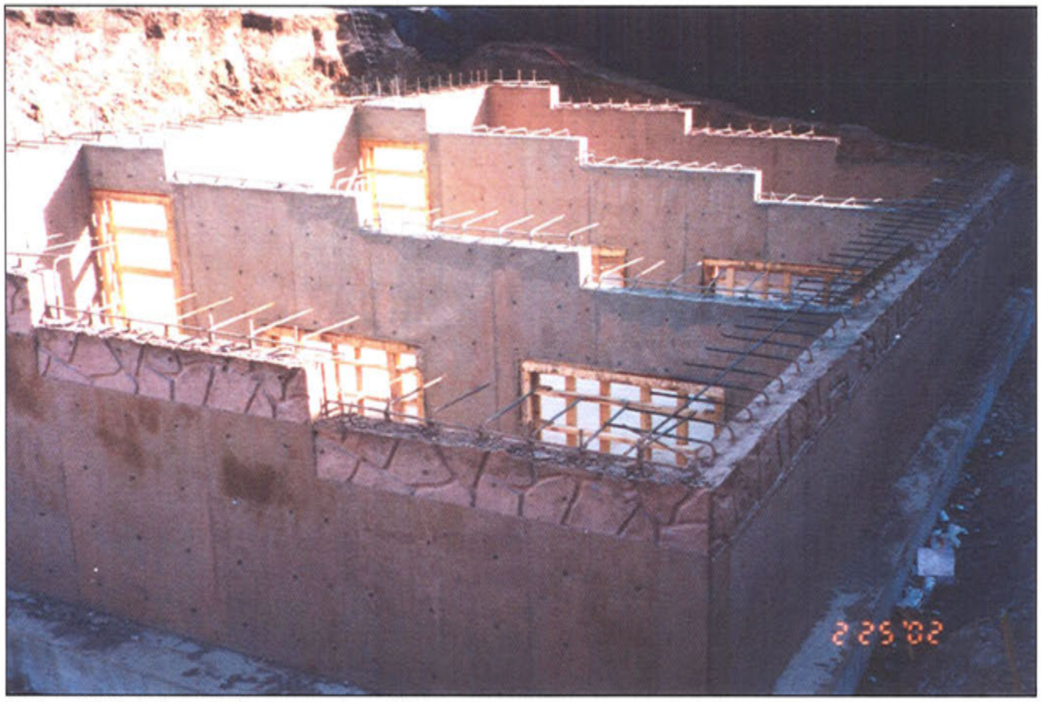
Completed inlet structure at Lake 19. Headwall and pipe end are submerged at rock riprap shown in picture at water's edge.
Tower structure provides access to an elastomeric check valve.

Interior of Lake 19 check valve tower structure.
Check valve is lying on floor ready for installation crew.

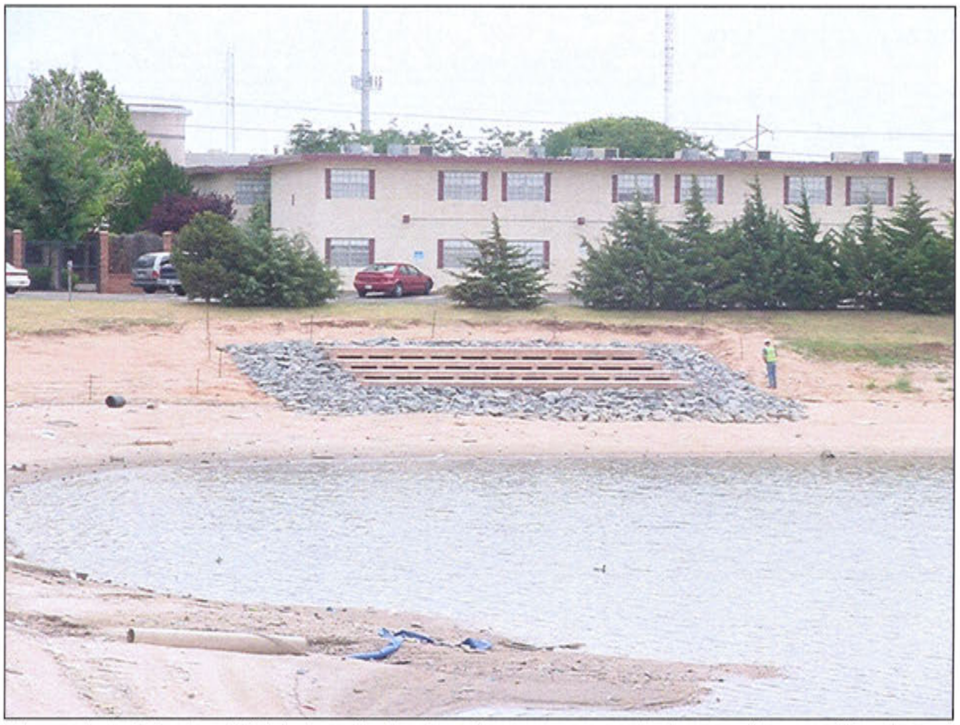
Discharge Point 30
South Central Lubbock Drainage Improvements
Construction Photographs


Lake 23N inlet under construction. Lake has been pumped down for construction purposes.


Completed Lake 23N inlet. Low row of ports are submerged and functioning.


2 25 '02

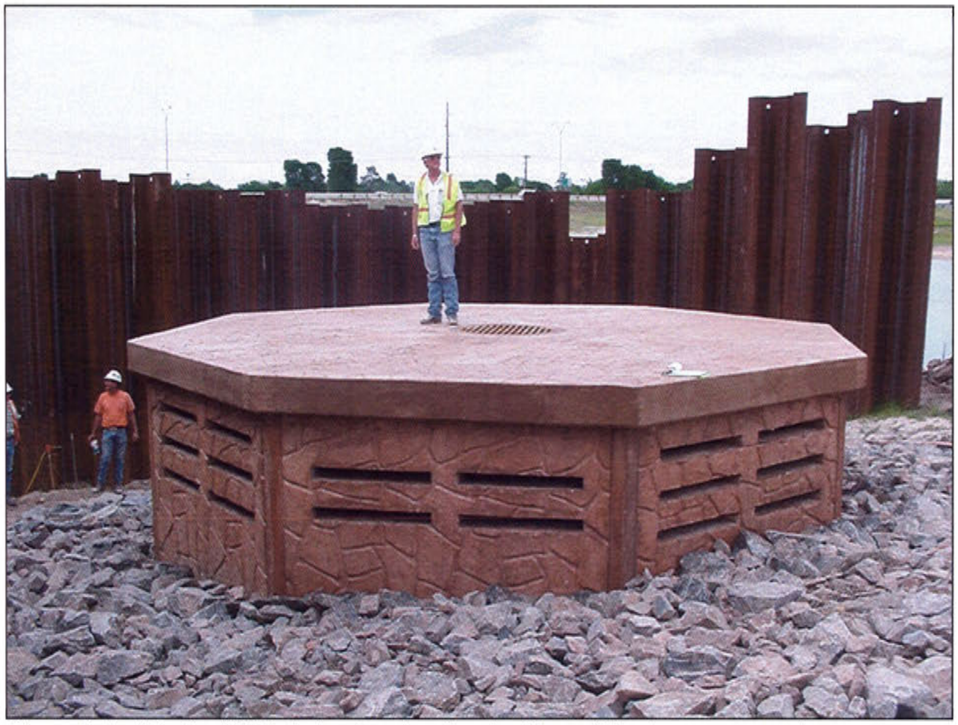
Lake 23S inlet under construction.



Completed Lake 23S inlet. Lake has been pumped down after cofferdam removal for unanticipated remedial work on opposite site of lake.

Completed Lake 23S inlet functioning. The lower two rows of ports are submerged.

Lake 24 inlet under construction. Note blockouts being installed to form the inlet ports. Sheet pile cofferdam allows for work "in the dry".



Completed Lake 24 inlet prior to sheet pile cofferdam removal.

Lake 24 inlet functioning. All ports are submerged with lake water level at roof slab.

Lake 25 inlet under construction. Sheet pile cofferdam is out of the picture to the left.

Lake 25 inlet functioning through the lowest row of ports.

Lake 26 inlet is functioning with lake water level nearly submerging the roof slab.

Lake 27 inlet nearing completion behind steel sheet pile cofferdam.
Rock riprap not yet completely installed.

Completed Lake 27 inlet. Lake level is at its permanent elevation at the invert of the lowest row of ports.

Installing sheet pile cofferdam at Lake 31 for inlet construction.

Lake 31 inlet under construction behind the protection of the sheet pile cofferdam.

Completed Lake 31 inlet. Lake water surface is at its permanent elevation at the invert of the lowest row of ports.

Lake 37 inlet functioning through its lowest row of ports.

Installing sheet pile cofferdam at Lake 19.

Completed Lake 19 inlet showing both rows of ports and permanent water level.

Installing Port-a-Dam cofferdam at Lake 22.

Lake 22 Port-a-Dam cofferdam at Lake 22 prior to evacuating water from work area.

Lake 22 inlet under construction.

Discharge Point 30
South Central Lubbock Drainage Improvements
Construction Photographs

Completed Lake 22 inlet with lake at its permanent water surface elevation.

APPENDIX B

PHOTOGRAPHS
DISCHARGE POINT 31
SOUTH LUBBOCK DRAINAGE IMPROVEMENTS

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Lake 91 after June 1999 flooding precipitation. View looking northeast.

Lake 91 after June 1999 flooding precipitation. View looking south or southeast.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Outlet wingwalls under construction.

Placing 54-inch diameter outfall pipeline east of BNSF railroad.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Tunnel access shaft with 54-inch diameter pipeline and smaller grouting pipe in place. This tunnel is under the BNSF railway.

Placing 54-inch diameter pipeline in segment between US 84 and 98th Street.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Typical pipeline open cut construction. This reach is between US 84 and 98th Street.

Backfilling over 54-inch diameter pipeline just west of US 87.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Tunnel access shaft and installed pipe at 98th Street and Avenue P.

Tunnel excavation. Locomotive on rails to pull muck carts.
Power and ventilation lines at right. Reach between Avenue S and University Avenue.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Typical tunnel excavation with rails in place.
74-inch diameter raw tunnel between Avenue S and University Avenue.

Lateral pipeline construction to Lake 84A, 24-inch diameter pipeline.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Transition tie from fiberglass reinforced mortar pipe to precast reinforced concrete pipe. Closure piece not yet installed. 98th Street at University Avenue.

Lake 84 inlet under construction behind earthen cofferdam. Rainfall has affected construction progress.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Lake 85 inlet under construction behind earthen cofferdam.

Lake 87 inlet under construction behind sheet pile cofferdam.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Lake 87 inlet topped-out and before backfilling.

Storm sewer under construction in 98th Street between Indiana Avenue and Memphis Avenue.

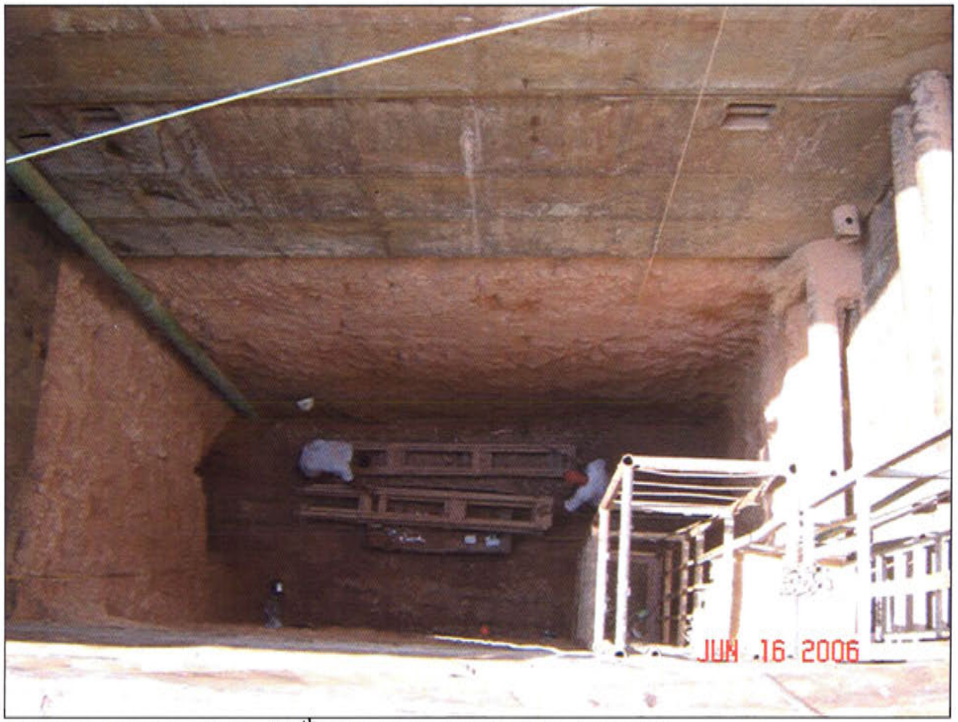
Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Placing fiberglass reinforced mortar pipe on bottom half of manhole base. Top of pipe later removed for access.

Preparing subgrade for pavement restoration after pipeline construction. Signal intersection is 98th Street and Indiana Avenue.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Placing first layer of asphalt stabilized base over trench backfill between Memphis Avenue and Orlando Avenue.



Tunnel access shaft, 98th Street at Memphis Avenue.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Tunnel boring machine used at 98th Street and Memphis Avenue vicinity.

Stockpiled fiberglass reinforced mortar pipe, south side of 98th Street and just west of Miami Avenue.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

CAT 5110B excavator used for excavation of storm sewer open cut installation.

Tunnel access shaft for lateral pipeline to Lake 90.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Cofferdam and excavation for Lake 90 inlet.

Placing lateral pipeline down Vicksburg Avenue to Lake 91 inlet.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Placing lateral pipeline in Vicksburg Avenue to Lake 91 inlet.

Lake 91 inlet under construction.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Top slabs on Lake 91 inlet, concrete being placed by pumper.

Lateral pipeline construction to Lake 93.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Lake 89 inlet base slab concrete being placed.

Lake 89 inlet after backfill and before rock riprap placement.

Discharge Point 31
South Lubbock Drainage Improvements
Typical Construction Photographs

Outlet for South Lubbock Drainage Improvements system.
This is City of Lubbock Discharge Point 31, 54-inch outfall pipeline

Lloyd
Gosselink
ATTORNEYS AT LAW

816 Congress Avenue, Suite 1900
Austin, Texas 78701
Telephone: (512) 322-5800
Facsimile: (512) 472-0532
www.lglawfirm.com

Mr. Rochelle's Direct Line:
[redacted]

July 28, 2008

Mr. Ron Ellis (MC 160)
Water Supply Division
Water Rights Team
Texas Commission on Environmental Quality
Bldg. F, Room 3101
Austin, Texas 78711-3087

VIA HAND DELIVERY

RECEIVED
TCEQ
WATER SUPPLY DIV.
2008 JUL 28 PM 3 59

Re: City of Lubbock
Application for Water Use Permit No. 5921 (2020-2)

Dear Mr. Ellis:

This letter is submitted on behalf of my client, the City of Lubbock (the "City"), in response to your Request for Information ("RFI") dated June 23, 2008, and in connection with the above-referenced application (the "Application"). The following responses are numbered in accordance with the RFI inquiries included in your June 23, 2008 letter.

Response to Question No. 1:

Confirm whether the City still requests authorization to use the Town of Ransom Canyon's return flows. If so, provide:

a. an explanation of how the discharged return flows will be routed to Dam 7;
b. the last five years of discharge records for the Town of Ransom Canyon TPDES Permit No. 10778 in electronic format.

1. The City no longer seeks authorization to appropriate the Town of Ransom Canyon's return flows in the Application.

Response to Question No. 2:

Indicate the status of any amendments to TPDES Permit No. 10353. If any amendment has been approved, provide the following:

a. a copy of the amended TPDES permit;
b. the amount of any increases in the authorized discharge into the North Fork Double Mountain Fork Brazos River;

c. ***any additional discharge point authorized;***
d. ***the amount of any additional discharge requested in the application.***

2. The City has not filed an application to amend TPDES Permit No. 10353. Please find as Attachment 1 the most current version of this permit.

Response to Question No. 3:

Indicate whether the City will be amending the application to request use of waters captured in specific playa lakes and then discharged into the North Fork Double Mountain Fork of the Brazos River for subsequent storage and use from Dam 7. If the new discharge points are in addition to the 33 discharge points listed in Attachment 1, Table 1, originally provided on January 31, 2006, then the following information will be needed for each point:

a. ***a completed Supplemental Discharge Point Information Sheet (enclosed) for each point;***
b. ***the name of the stream and the locations of the point of discharge identified on a USGS 7.5 minute topographical map(s) for all points;***
c. ***the distance in river miles from the point of discharge to the point of diversion;***
d. ***the source, amount, and rates of discharge and subsequent diversion, including the method used to calculate the discharge;***
e. ***a description of the water quality of the water discharged and, if applicable, the permit number and name of any related discharge permit;***
f. ***the estimated travel time from the point of discharge to the point of diversion;***
g. ***the estimated amount of water that will be lost to transportation, evaporation, seepage, channel or other associated carriage losses from the point of discharge to the point of diversion. Include the method for calculation of these losses;***

3(a)-(g). The City seeks the recognition, appropriation, and use of water captured in those playa lakes that subsequently discharge to the North Fork through the discharge points identified as Nos. 30 and 31 in Attachment 2, Table 1, in addition to the discharge of treated effluent at point No. 32 and unappropriated state water. The City requests that the remaining discharge points be removed from the Application. The City does not seek the recognition, appropriation, or use of rights associated with these remaining discharge points as "developed water," but instead continues to seek the right to divert and use those discharges as "unappropriated state water," to the extent such water may be available from time to time for storage in, and diversion from, Lake 7. Please find as Attachment 2 to this letter a revised Table 1 and Table 2, accordingly.

h. ***an assessment of the adequacy of the quantity and quality of flows remaining after the proposed diversion to meet instream uses and bay and estuary freshwater inflow needs; and***

3(h) See response to Question No. 4(h) below.

i. ***the manner in which the water being conveyed will be measured to ensure that only the water being discharged is being diverted at the point of delivery, less any losses identified in Item g. above.***

3(i) See response to Question No. 4(i) below.

Response to Question No. 4:

If the information requested in Item 3 (a)-(i) has not been provided for the 33 existing discharge points, provide that information.

4 (a-g). Please find as Attachment 3 to this letter completed Supplemental Discharge Point Information Sheets for the remaining three discharge points, including supplemental information required under Item No. 8 of the sheet. Additionally, included herein as Attachment 4 to this letter is a package of two (2) USGS 7.5-minute topographical maps showing the three remaining discharge locations and the location of Lake 7.

4 (h). The North Fork Double Mountain Fork River at the location of Lake 7 is an intermittent stream. Extended periods of zero flow result in a computed 7-day, 2-year (7Q2) low flow of zero. This assessment is based on a drainage area ratio with the nearest USGS stream gage at Aspermont (08080500). Thus, instream uses are accustomed to extended periods of zero flow and, as such, the proposed diversions will have no impact on instream uses. The Lake 7 dam site is located a distance greater than 1,100 river miles from the mouth of the Brazos River at the Gulf of Mexico. In addition, three major reservoirs (Possum Kingdom Lake, Lake Granbury and Lake Whitney) lie between Lake 7 and the Gulf of Mexico. Due to the distance from Lake 7 to the Gulf and the presence of the intervening three major reservoirs, this proposed project will have no impact on bay and estuary freshwater inflows.

4 (i). The City will utilize meters to account for the amount of water being discharged and diverted. These meter readings, in conjunction with an accounting plan, will be used by the City to ensure that all diversions are authorized pursuant to the terms and conditions of the permit, once issued.

Response to Question No. 5:

Identify the source and character of the water captured in and directed to the playa lakes for subsequent discharge into the North Fork Double Mountain Fork of the Brazos River.

5. The water captured in the playa lakes originates as diffused stormwater runoff that flows to the playa lakes. There are no natural outlets to the North Fork from these lakes. The City has constructed pipelines that connect the playa lakes with two storm drainage systems, which ultimately discharge into the North Fork at discharge point Nos. 30 and 31. The City would note that the North System (South Central Drainage Project – Discharge Point No. 30) was completed in 2003. The South System (South Lubbock Drainage Project – Discharge Point No. 31) became operational in April 2008, but is still undergoing some construction. Prior to the City's actions in pursuing these drainage projects, water captured in the playa lakes was retained until depleted by evaporation and seepage.

Response to Question No. 6:

Provide copies of any amendments to the 2006 Llano Estacado Regional Water Plan that are related to the City's application and have been approved by the Texas Water Development Board.

6. The project proposed in the Application is included within the 2006 Llano Estacado Regional Water Plan (the "Regional Plan") and the 2007 State Water Plan. The City is in the process of preparing a request to amend the Regional Plan to remove Lake 8, consistent with its request to TCEQ, but said application to amend the Regional Plan has not yet been filed.

Response to Question No. 7:

Verify the following:

a. the total amount of water requested for diversion by this application;

7a. The City continues to request an annual maximum diversion of 50,000 acre-feet per annum. The City requests this annual amount as an interruptible diversion, not as a firm yield diversion. Water available for diversion in any given year will depend upon the volume of developed water discharged from point Nos. 30 and 31, the volume of treated effluent discharged upstream of Lake 7 at discharge point No. 32, and the volume of unappropriated state water available for the City's impoundment and diversion. Lake 7 is intended to be a supplemental supply for the City. The City has alternative sources of supply available.

b. the location of Diversion Point 1 on Dam 7 and the maximum diversion rate from that point.

7b. The City seeks authorization to divert from the perimeter of Lake 7. The City requests authorization to divert up to 138.12 cubic feet per second (62,000 gallons per minute) from anywhere along the perimeter of Lake 7.

Response to Question No. 8:

Provide an updated "Environmental Information Document in Support of Water Use Permit Application No. 5921". The original document was submitted January 31, 2006, and supplemental information was received on September 6, 2006. The information submitted in January and September of 2006 addresses items 7, 8, and 10 of TCEQ's request for information letter dated December 1, 2005. An update is needed since the City requested on March 4, 2008, that Lake 8 be removed from the application. The updated information should reflect the amended application. Specific comments are provided below based on the original document and the September 6, 2006, supplemental information. Staff needs clarification of these issues and the comments should be addressed in the updated version of the Environmental Information Document.

8(a)-(n). The City is proceeding in an orderly manner to develop Lake 7. The City is pursuing the necessary geotechnical and environmental analysis for this project in two parts. Part A will include exploratory geotechnical core drilling at the proposed site to verify that the site conditions are appropriate for reservoir construction. The City is expected to commence the exploratory geotechnical analyses in October 2008. Part B will include additional geotechnical analyses to support project design and the environmental analyses described in the September 6, 2006 supplemental information. Following completion of the geotechnical work in Part A, Part B is expected to commence in May 2009. The Part B environmental analyses will address questions 8.a – 8.n, and will be pursued in consultation with TCEQ, TPWD and the U.S. Army Corps of Engineers. The City anticipates that the environmental analyses will require approximately six (6) months to complete.

The City appreciates the opportunity to provide this additional information, and looks forward to working with the Commission on this project. Should you have any questions regarding these responses, please feel free to call either Brad Castleberry [redacted] or me at your earliest convenience.

Sincerely,

Martin C. Rochelle

MCR/bbc
2020\02\ltr080728bbc
ENCLOSURES

cc: Mr. Thomas Adams
Mr. Aubrey Spear
Mr. Richard Casner
Mr. David D. Dunn
Mr. Brad B. Castleberry

Attachment 1

TPDES Permit No. 10353

Attachment 2, Table 1. Developed-Water Discharge Point Information

Outfall	Water Source	General Location	Tributary Discharged to in the Brazos River Basin	Latitude	Longitude	Nearest Section Corner	Section	Block	Original Survey	Abstract No.	County	Bearing to nearest Section Corner	Distance to nearest Section Corner feet	Method Used for Lat-Long	Maximum Discharge Rate cfs	Discharge Volume ac-ft/yr	Purpose of Use	Location from County Seat	Distance to Dam 7 Site miles	Delivery Factor to Dam 7[1]	Travel Time to Dam 7 hours	Full Description
30	Developed Stormwater	Southeast of the Water Rec Plant (North Outfall)	North Fork of the Double Mountain Fork of the Brazos River	33.55967	-101.79653	NW	1	Blk. B	T.T. & R.R. Co. Survey	Abstract 93	Lubbock	44.91695	1,913.61	GPS	See Table 2	See Table 2	Municipal Industrial & Agricultural Supply	3.3 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	7.11	95.69%	4.5	S44.91695 E, 1913.61 feet from the NW corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93.
31	Developed Stormwater	South Lubbock Drainage Improvements Outfall	North Fork of the Double Mountain Fork of the Brazos River	33.52361	-101.77578	NW	11	Blk. S	G.C. & SF. Ry Survey	Abstract 216	Lubbock	52.19500	566.64	Construction Plans	See Table 2	See Table 2	Municipal Industrial & Agricultural Supply	5.2 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	2.55	97.89%	1.8	S52.195 E, 566.64 feet from the NW corner of Blk. S of the G.C. & SF. Ry Survey 11, Abstract 216.
32	Treated Effluent	City of Lubbock - SEWRP (future)[2]	North Fork of the Double Mountain Fork of the Brazos River	33.55961	-101.79654	NW	11	Blk. S	G.C. & SF. Ry Survey	Abstract 216	Lubbock	25.62135	10,289.04	USGS 7.5 Minute Topo Map	See Table 2	See Table 2	Municipal Industrial & Agricultural Supply	3.3 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	7.12	95.60%	4.0	S25.62134 E, 10289.04 feet from the NW corner of Blk. S of the G.C. & SF. Ry Survey 11, Abstract 216.

[1] Channel losses and corresponding delivery factors calculated based on channel loss factors used in the development of the Brazos Basin Water Availability Model (WAM) for the North Fork Double Mountain Fork Brazos River. Delivery factor is the percentage of discharge that will reach the respective dam sites.

[2] TPDES Permit No. 10353. Discharges originate from developed water sources, consisting of 60% groundwater and 40% developed (out of basin) surface water.

Attachment 2, Table 2. Developed-Water Discharge Summary

Outfall	Discharge Point Description	2-Year 24-Hour Precipitation Event		5-Year 24-Hour Precipitation Event		10-Year 24-Hour Precipitation Event		25-Year 24-Hour Precipitation Event		50-Year 24-Hour Precipitation Event		100-Year 24-Hour Precipitation Event	
		peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)
30	Southeast of the Water Rec Plant (North Outfall) (SCLDIP Outfall)	185	1640	185	2,384	185	3,132	185	3,804	185	4,485	185	5,274
31	South Lubbock Drainage Improvements Outfall	77	720	77	1,181	77	1,580	77	1,937	77	2,307	77	2,728
32	City of Lubbock - SEWRP (future)	Future discharges, no data available											
Totals		262	2,360	262	3,565	262	4,712	262	5,741	262	6,792	262	8,002

Attachment 3

Supplemental Discharge Point Information Sheets
Points 30, 31 and 32

Supplemental Discharge Point Information Sheet

Discharge Point No. or Name: 30

1) Select the appropriate box for the source of water being discharged:

☐ Treated effluent
☐ Groundwater
☑ Other: Developed Playa Lake Stormwater

2) Location of discharge point will be/is at Latitude 33.55967°N, Longitude 101.79653°W, also bearing 44.9°, 1914 feet from the NW corner of the T.T. & R.R. Co Original Survey No. 1, Abstract No. 93, in Lubbock County, Texas. What method was used to determine the Latitude and Longitude for the discharge point? (i.e., GPS Unit, USGS 7.5 Topographic Map, etc.) GPS

3) Location from County Seat: 3.3 miles in a SE direction from the City of Lubbock, Lubbock County, Texas. Located from a nearby town (other then County Seat):2.7 miles in a NW direction from Burris, a nearby town shown on County highway map.

4) Water will be discharged into North Fork of the Double Mountain Fork steam/reservoir, (tributaries) Brazos River, Brazos River Basin.

5) Water will be discharged at a maximum rate of ___cfs (___gpm).

Discharge flows will be intermittent and vary from 0 to a peak flow of 185 cfs during a 100-year 24-hour frequency storm event. See Table 2 of Attachment 1 for addition frequency storm event peak flows.

6) The amount of water that will be discharged is ___acre-feet per year.

Annual discharge volumes will vary and be dependent on the number of storm events occurring throughout the year. See Table 2 of Attachment 1 for discharge volumes of varying storm event frequencies.

7) The purpose of use for the water being discharged will be ___.

The discharged water will be used for municipal, industrial, and agricultural supply when diverted.

8) Additional information required.

None.

Supplemental Discharge Point Information Sheet

Discharge Point No. or Name: 31

1) Select the appropriate box for the source of water being discharged:
- ☐ Treated effluent
- ☐ Groundwater
- ☑ Other: Developed Playa Lake Stormwater

2) Location of discharge point will be/is at Latitude 33.53361°N, Longitude 101.77878°W, also bearing 52.2°, 569 feet from the NW corner of the G.C. & S.F. Ry Original Survey No.11, Abstract No. 216, in Lubbock County, Texas. What method was used to determine the Latitude and Longitude for the discharge point? (i.e., GPS Unit, USGS 7.5 Topographic Map, etc.) Construction Plans

3) Location from County Seat: 5.2 miles in a SE direction from the City of Lubbock, Lubbock County, Texas. Located from a nearby town (other then County Seat):0.8 miles in a NW direction from Burris, a nearby town shown on County highway map.

4) Water will be discharged into North Fork of the Double Mountain Fork steam/reservoir, (tributaries) Brazos River, Brazos River Basin.

5) Water will be discharged at a maximum rate of ___cfs (___gpm).

Discharge flows will be intermittent and vary from 0 to a peak flow of 185 cfs during a 100-year 24-hour frequency storm event. See Table 2 of Attachment 1 for addition frequency storm event peak flows.

6) The amount of water that will be discharged is ___acre-feet per year.

Annual discharge volumes will vary and be dependent on the number of storm events occurring throughout the year. See Table 2 of Attachment 1 for discharge volumes of varying storm event frequencies.

7) The purpose of use for the water being discharged will be ___.

The discharged water will be used for municipal, industrial, and agricultural supply when diverted.

8) Additional information required.

None.

Supplemental Discharge Point Information Sheet

Discharge Point No. or Name: 32

1) Select the appropriate box for the source of water being discharged:

☑ Treated effluent
☐ Groundwater
☐ Other: _____

2) Location of discharge point will be/is at Latitude 33.55961°N, Longitude 101.79654°W, also bearing 26.6°, 10,389 feet from the NW corner of the G.C. & S.F. Ry Original Survey No.11, Abstract No. 216, in Lubbock County, Texas. What method was used to determine the Latitude and Longitude for the discharge point? (i.e., GPS Unit, USGS 7.5 Topographic Map, etc.) USGS 7.5 Topographic Map

3) Location from County Seat: 3.3 miles in a SE direction from the City of Lubbock, Lubbock County, Texas. Located from a nearby town (other then County Seat):2.8 miles in a NW direction from Burris, a nearby town shown on County highway map.

4) Water will be discharged into North Fork of the Double Mountain Fork steam/reservoir, (tributaries) Brazos River, Brazos River Basin.

5) Water will be discharged at a maximum rate of ___cfs (___gpm).

Discharge point 32 is a future wastewater outfall and discharge data are unavailable at this time.

6) The amount of water that will be discharged is ___acre-feet per year.

Discharge point 32 is a future wastewater outfall and discharge data are unavailable at this time.

7) The purpose of use for the water being discharged will be ___.

The discharged water will be used for municipal, industrial, and agricultural supply when diverted.

8) Additional information required.

None.

Attachment 4

USGS 7.5 Minute Topographic Maps Showing Locations of Discharge Points 30, 31 and 32
and
Lake 7

Buddy Garcia, *Chairman*
Larry R. Soward, *Commissioner*
Bryan W. Shaw, Ph.D., *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 23, 2008

Mr. Martin Rochelle
Lloyd Gosselink Blevins Rochelle & Townsend, P.C.
816 Congress Avenue, Suite 1900
Austin, TX 78701

CERTIFIED MAIL

RE: City of Lubbock
WRPERM 5921
CN 600130736
Application No. 5921 for a Water Use Permit
TWC §11.121, Requiring Published and Mailed Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

Dear Mr. Rochelle:

This acknowledges receipt, on March 5, 2008, of additional information for the referenced application.

Additional information is required to complete the technical review of the application.

1. Confirm whether the City still requests authorization to use the Town of Ransom Canyon's return flows. If so, provide:

   a. an explanation of how the discharged return flows will be routed to Dam 7;
   b. the last five years of discharge records for the Town of Ransom Canyon TPDES Permit No. 10778 in electronic format.

2. Indicate the status of any amendments to TPDES Permit No. 10353. If any amendment has been approved, provide the following:

   a. a copy of the amended TPDES permit;
   b. the amount of any increases in the authorized discharge into the North Fork Double Mountain Fork Brazos River;
   c. any additional discharge point authorized;
   d. the amount of any additional discharge requested in the application.

3. Indicate whether the City will be amending the application to request use of waters captured in specific playa lakes and then discharged into the North Fork Double Mountain Fork of the Brazos River for subsequent storage and use from Dam 7. If the new discharge points are in addition to the 33 discharge points listed in Attachment 1, Table 1, originally provided on January 31, 2006, then the following information will be needed for each point:

   a. a completed *Supplemental Discharge Point Information Sheet* (enclosed) for each point;

b. the name of the stream and the locations of the point of discharge identified on a USGS 7.5 minute topographical map(s) for all points;
c. the distance in river miles from the point of discharge to the point of diversion;
d. the source, amount, and rates of discharge and subsequent diversion, including the method used to calculate the discharge;
e. a description of the water quality of the water discharged and, if applicable, the permit number and name of any related discharge permit;
f. the estimated travel time from the point of discharge to the point of diversion;
g. the estimated amount of water that will be lost to transportation, evaporation, seepage, channel or other associated carriage losses from the point of discharge to the point of diversion. Include the method for calculation of these losses;
h. an assessment of the adequacy of the quantity and quality of flows remaining after the proposed diversion to meet instream uses and bay and estuary freshwater inflow needs; and
i. the manner in which the water being conveyed will be measured to ensure that only the water being discharged is being diverted at the point of delivery, less any losses identified in Item g. above.

4. If the information requested in Item 3 (a)-(i) has not been provided for the 33 existing discharge points, provide that information.

5. Identify the source and character of the water captured in and directed to the playa lakes for subsequent discharge into the North Fork Double Mountain Fork of the Brazos River.

6. Provide copies of any amendments to the 2006 Llano Estacado Regional Water Plan that are related to the City's application and have been approved by the Texas Water Development Board.

7. Verify the following:

   a. the total amount of water requested for diversion by this application;
   b. the location of Diversion Point 1 on Dam 7 and the maximum diversion rate from that point.

8. Provide an updated "Environmental Information Document in Support of Water Use Permit Application No. 5921". The original document was submitted January 31, 2006, and supplemental information was received on September 6, 2006. The information submitted in January and September of 2006 addresses items 7, 8, and 10 of TCEQ's request for information letter dated December 1, 2005. An update is needed since the City requested on March 4, 2008, that Lake 8 be removed from the application. The updated information should reflect the amended application. Specific comments are provided below based on the original document and the September 6, 2006, supplemental information. Staff needs clarification of these issues and the comments should be addressed in the updated version of the Environmental Information Document.

   a. Section 2.3.1, Terrestrial Habitats and Communities (p 2-4): The habitat types within Lake 7 are provided as percentages of the total area. Provide the delineation of habitat types in acres. Include this as part of the Vegetation, Habitats, and Wildlife studies described in the supplemental information received on September 6, 2006.

   b. Section 2.3.1, Terrestrial Habitats and Communities (p 2-5): On September 6, 2006 the City indicated that additional wetland delineations, based on actual field surveys, would be provided. When will the updated information be available?

c. Section 2.3.2, Aquatic Habitats and Communities (p 2-6): Identify adverse affects that are expected by the construction and operation of the proposed reservoir, i.e. reduced populations due to migratory barriers of dams and increasing salinities in instream water quality conditions.

d. Section 2.3.3, Important Species (p. 2-8): The document identifies several threatened or endangered species that may potentially utilize the habitats in or around the project area on either a temporary or permanent basis. The City proposes a methodology to determine the presence or absence of suitable habitat types for these species and/or their utilization. In the information submitted on September 6, 2006, the City proposes the use of Rapid Biological Assessment (RBA) procedures to evaluate aquatic habitats and fish communities. The RBA procedures alone are not adequate to evaluate the effect on aquatic communities. Staff recommends that the City consider use of a more comprehensive evaluation technique such as Habitat Evaluation Procedure (HEP), Wildlife Habitat Appraisal Procedure (WHAP), or the U.S. Army Corps of Engineers' Hydrogeomorphic (HGM) assessment model to further evaluate the functions and values of existing habitats.

e. Section 4.1, Effects of Project Construction and Reservoir Impoundment (pp. 4-1, 4-3): This section describes in very general terms the number of acres and frequencies of inundation within proposed Lake 7. Indicate whether the analysis included the areas affected by construction of the actual dam and explain what the City will propose as mitigation for these impacts.

f. Section 4.1.3, Important Species (p. 4-4): How did the City determine that no significant impact to horned lizard populations is expected to occur?

g. Section 4.2.2, Downstream Water Quantity and Quality (p. 4-5): The City utilizes the Consensus Criteria for Environmental Flow Needs to determine downstream instream flows. While this method can be used for general planning purposes, it is usually not used in the permitting process to determine instream flow needs. The flow recommendations generated by this method do not account for any site specific biological considerations. For a project of this magnitude, staff recommends using and/or developing site specific information to address the environmental flow requirements. Indicate how the City will develop site specific information and use that information in the determination of downstream instream flow needs.

h. Section 4.2.2, Downstream Water Quantity and Quality (p. 4-7): It is staff's opinion that there would be limited to no benefits since the lotic habitats of the North Fork would be further fragmented and altered from existing conditions by the proposed dams and reservoirs. Address how the proposed operation of the reservoir would provide a benefit to the lotic habitats in the area of the application.

i. Section 4.2.2, Downstream Water Quantity and Quality (p. 4-7): Identify the environmental affects of attenuated flood flows due to the project. Address the impact on channel maintenance in greater detail.

j. Section 4.2.2, Downstream Water Quantity and Quality (p. 4-7): Describe in detail the operations (i.e. frequency, duration, and magnitude of releases) of the proposed reservoir as well as the intended outlet structure design for Lake 7. Explain how the outlet works will mitigate water quality effects since the application indicates that the reservoir will function as a sediment and nutrient sink.

k. Section 4.2.2, Downstream Water Quantity and Quality (p. 4-7): The report states that other effects of the project include fragmentation of stream habitat, as well as the trapping of sediment, organic material and nutrients in the reservoir. The reservoir would function as a sink for materials and nutrients and result in reduced oxygen demand, nutrient and sediment loads downstream. While the report claims that reduced oxygen demand and nutrient loads would be beneficial to the North Fork downstream, it does not address the stream fragmentation and reduced sediment load issues except for stating that these types of adverse impacts have already occurred due to the existing structures and this project would not exacerbate these impacts. Provide an evaluation of the extent of water quality impacts including the sediment reduction and the associated erosion/stream downcutting. Stream habitat fragmentation would be an unavoidable impact if the project proceeds as proposed. Indicate the type of mitigation the City proposes to address stream habitat fragmentation.

l. Section 4.2.3, Lotic Community Impacts (p. 4-10): Explain the City's determination that expected changes in water quality due to the project operation would not result in significant impact to the downstream biota.

m. Section 4.2.3, Lotic Community Impacts (p. 4-10): The original report indicates that Lake 8 would be operated to allow a naturalized flow regime downstream. A naturalized flow regime would include medium to high pulse flows needed for periodic channel scour as well as other channel maintenance functions. Since the City requested that Lake 8 be removed from the application, would Lake 7 be operated to allow for a naturalized flow regime downstream? Indicate what the City would consider to be a naturalized flow regime.

n. Section 5.1, Field Study and Mitigation Planning Requirements (p. 5-1): This section of the report explains the additional field work and other evaluations that need to be performed to evaluate the project impacts and appropriate mitigation requirements. The City has engaged in some discussion with staff in these regards, but further discussion is needed if the project is to proceed as proposed.

Provide the requested information by July 28, 2008, or the application may be returned pursuant to 30 TAC §281.19. You have the option of having the question of sufficiency of the necessary requested data referred to the Commission for a decision instead of having the application returned; such referral shall be provided by July 28, 2008.

Please be aware that additional information may be required during further technical review of the application.

If you have any questions concerning this application, please contact me at (512) 239-1282 or by email at roellis@tceq.state.tx.us.

Sincerely,

REL

Ron Ellis, Project Manager
Mail Code 160
Water Rights Permitting & Availability Section, Water Supply Division

Enclosure

Supplemental Discharge Point Information Sheet

Discharge Point No. or Name:________________________

1) Select the appropriate box for the source of water being discharged:

☐ Treated effluent
☐ Groundwater
☐ Other ______________

2) Location of discharge point will be/is at Latitude __________° N, Longitude _________ °W, also bearing_____°___, _______feet from the ________________ corner of the _______________ Original Survey No.________, Abstract No. ____, in _____________County, Texas. What method was used to determine the Latitude and Longitude for the discharge point? (*i.e.*, GPS Unit, USGS 7.5 Topographic Map, etc.) ____.

3) Location from County Seat: _______miles in a ___________direction from the City of _____________, ___________County, Texas. Located from a nearby town (other then County Seat):_____ miles in a ___________ direction from__________________, a nearby town shown on County highway map.

4) Water will be discharged into ______________________________________ stream/reservoir, (tributaries)____, __________________River Basin.

5) Water will be discharged at a maximum rate of _________cfs (________gpm).

6) The amount of water that will be discharged is ______________acre-feet per year.

7) The purpose of use for the water being discharged will be _____________________________.

8) Additional information required:

For groundwater

- Provide water quality analysis and 24 hour pump test for the well if one has been conducted.
- Locate and label the groundwater well(s) on a USGS 7.5 Minute Topographic Map
- Provide a copy of the groundwater well permit if it is located in a Groundwater Conservation District.
- What aquifer the water is being pumped from?

For treated effluent

- What is the TPDES Permit Number? Provide a copy of the permit.
- Provide the monthly discharge data for the past 5 years.
- What % of treated water was groundwater, surface water?
- If any original water is surface water, provide the base water right number.

Lloyd
Gosselink
ATTORNEYS AT LAW

816 Congress Avenue, Suite 1900
Austin, Texas 78701
Telephone: (512) 322-5800
Facsimile: (512) 472-0532
www.lglawfirm.com

Mr. Rochelle's Direct Line: ([redacted]

March 4, 2008

Mr. Ron Ellis (MC 160)
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

VIA FACSIMILE TRANSMISSION
AND FIRST-CLASS MAIL

Re: Application No. 5921 of the City of Lubbock (2020-2)

Dear Mr. Ellis:

I am in receipt of the Request for Information ("RFI") dated February 15, 2008 from the Texas Commission on Environmental Quality ("Commission") in connection with the above-referenced application ("Application"). Please accept this letter as the response of my client, the City of Lubbock, Texas ("City"), to said RFI.

In the RFI, the Commission requested the City to confirm whether it intended to pursue the permitting of one of the two impoundments requested in the Application as originally filed—i.e., Lake No. 8, a proposed 49,930 acre-foot capacity reservoir. After careful consideration, the City has determined that it will not pursue the permitting or construction of Lake No. 8. Therefore, please consider this letter as the City's supplemental filing in connection with Application No. 5921, evidencing its intent to withdraw that portion of the Application related to the permitting and construction of Lake No. 8, including the Application's requested impoundment of not to exceed 49,930 acre-feet of water and the diversion point and diversion rate associated with Diversion Point No. 02, the Application's proposed diversion from the perimeter of Lake No. 8. The balance of the City's requested appropriations pursuant to Application No. 5921 remain unchanged by this supplemental filing.

If you have questions concerning this response, please feel free to call on me at your earliest convenience.

RECEIVED
TCEQ
WATER SUPPLY DIV.
2008 MAR 5 PM 1 37

Sincerely,

Martin C. Rochelle

MCR/ldp
2020\02\ltr080304mcr

cc: Mr. Tom Adams
Mr. Richard Casner
Mr. David Dunn
Mr. Brad B. Castleberry

Buddy Garcia, *Chairman*
Larry R. Soward, *Commissioner*
Bryan W. Shaw, Ph.D., *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

February 15, 2008

Mr. Martin Rochelle
Lloyd Gosselink Blevins Rochelle & Townsend, P.C.
816 Congress Avenue, Suite 1900
Austin, TX 78701

CERTIFIED MAIL

RE: City of Lubbock
WRPERM 5921
CN 600130736
Application No. 5921 for a Water Use Permit
TWC §11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

Dear Mr. Rochelle:

This letter concerns the referenced application in which the applicant is currently requesting authorization to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, tributary of the Brazos River, Brazos River Basin, in Lubbock County, known as Dam No. 7 and Dam No. 8.

Please provide written confirmation of whether the applicant seeks to withdraw the request for Dam No. 8 or continue with the application as submitted. Please respond by March 17, 2008, or staff will continue technical review of the application as submitted.

Be advised that your application for indirect reuse may be processed and analyzed under different policies than those used for other recent reuse applications.

If you have any questions concerning this application, please contact me at (512) 239-1282 or by email at roellis@tceq.state.tx.us.

Sincerely,

Ron Ellis, Project Manager
Mail Code 160
Water Rights Permitting & Availability Section
Water Supply Division

Buddy Garcia, *Chairman*
Larry R. Soward, *Commissioner*
Bryan W. Shaw, Ph.D., *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

January 30, 2008

Mr. Martin Rochelle
Lloyd Gosselink Blevins Rochelle & Townsend, P.C.
111 Congess Avenue, Suite 1800
Austin, TX 78701

CERTIFIED MAIL

RE: City of Lubbock
WRPERM 5921
CN 600130736
Application No. 5921 for a Water Use Permit
TWC §11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

Dear Mr. Rochelle:

This letter is in regard to the referenced application in which the applicant is currently requesting authorization to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, tributary of the Brazos River, Brazos River Basin, in Lubbock County, known as Dam No. 7 and Dam No. 8.

Please provide written confirmation of whether the applicant seeks to withdraw the request for Dam No. 8 or continue with the application as submitted by February 29, 2008 or staff will continue technical review of the application as submitted.

Be advised that your application for indirect reuse may be processed and analyzed under different policies than those used for other recent reuse applications.

If you have any questions concerning this application, please contact me at (512) 239-3678 or by email at idelgado@tceq.state.tx.us.

Sincerely,

Iliana Delgado - Mail Code 160
Water Rights Permitting Team

Letter returned
Undeliverable -
Re-sent on
2-15.08

Texas Commission on Environmental Quality

NOTICE OF WATER RIGHTS APPLICATION
APPLICATION NO. 5921

The City of Lubbock ("Applicant" or "City") has applied for a Water Use Permit to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, to divert and use water from those reservoirs, and to use the bed and banks of the North Fork Double Mountain Fork Brazos River, including certain specified tributaries, for the conveyance of water sought for diversion for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties. More information on the application and how to participate in the permitting process is given below.

APPLICATION. The City of Lubbock, P.O. Box 2000, Lubbock, TX 79457, seeks a Water Use Permit pursuant to Texas Water Code §§ 11.042, 11.046, and 11.121, and Texas Commission on Environmental Quality Rules 30 Texas Administrative Code (TAC) §§ 295.1, et seq. Notice is being published and mailed to the water right holders of record in the Brazos River Basin pursuant to 30 TAC § 295.151.

The Applicant seeks a Water Use Permit for authorization to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, tributary of the Brazos River, Brazos River Basin, in Lubbock County. Structure No. 1 (known as Dam No. 7) will be located 7.6 miles southeast from the City of Lubbock at Latitude 33.534°N, Longitude 101.730°W, bearing S4.166°E, 5,227.85 feet to the southeast corner of Blk. S, G.C. & S.F. R.R. Co. Survey 21, Abstract 217. It will have a capacity of 20,708 acre-feet and surface area of 801 acres. Structure No. 2 (known as Dam No. 8) will be located 15.4 miles east-southeast from the City of Lubbock at Latitude 33.486°N, Longitude 101.607°W, bearing N61.683°W, 5,514.77 feet to the northwest corner of Blk. S, G.C. & S.F. R.R. Co. Survey 35, Abstract 214. It will have a capacity of 49,930 acre-feet and surface area of 1,680 acres.

The Applicant seeks to divert and use water impounded in these reservoirs for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties in amount not to exceed 50,000 acre-feet of water per year, collectively, from the perimeter of the reservoir created by Dam No. 7 at a maximum diversion rate of 7.20 cfs (3,230 gpm) and from the perimeter of the reservoir created by Dam No. 8 at a maximum diversion rate of 44.56 cfs (20,000 gpm).

The Applicant seeks authorization to impound, divert, and use water requested by the application based upon a recognition of rights related to: i) the City's claim to developed water-based stormwater discharges from the City's storm sewer system to the North Fork Double Mountain Fork Brazos River and its tributaries; ii) unappropriated state water; iii) future surface water-based return flows and developed water-based return flows resulting from the City's use of groundwater and its use of other developed waters, excluding return flows previously sought by the City pursuant to concurrent Application Nos. 12-3705B and 3985A; and iv) any and all wastewater return flows that are discharged upstream of the proposed reservoirs by third parties for the uses stated above.

TPDES Permit No. 10778, issued to the Town of Ransom Canyon, authorizes the treatment and disposal of up to 0.41 MGD of return flows. The Applicant is seeking the authorization and recognition of both historical and future return flows of the Town of Ransom Canyon.

TPDES Permit No. 10353, issued to the City of Lubbock, authorizes the City to treat and dispose of 31.5 MGD of treated effluent. The Applicant is seeking the authorization and recognition of the difference between the City's current 31.5 MGD authorization and the 9.0 MGD of return flows that are the subject of concurrent Application No. 3985A.

The Applicant has requested authorization to use the bed and banks of the North Fork Double Mountain Fork Brazos River, including certain of its tributaries, to convey water requested by the application from the points of discharge identified as follows to the points of diversion requested herein:

0 Discharges of developed stormwater at Canyon at the Duke Street (University Avenue outfall) to Yellow House Draw, tributary of the North Fork Double Mountain Fork Brazos River, tributary of the Brazos River, Brazos River Basin, 1.6 miles northwest of the City of Lubbock, located at Latitude 33.60523°N, Longitude 101.86032°W and bearing S77.46222°E, 2,280.76 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The Applicant indicates the outfall is 14.23 miles upstream of Dam 7, with 91.78% of the discharged water reaching the dam, and 24.56 miles upstream of Dam 8, with 86.24% of the water reaching that dam.

1 Discharges of developed stormwater north of Cornell & Ave Q to Yellow House Draw, 1.4 miles north/northwest of the City of Lubbock, located at Latitude 33.60388°N, Longitude 101.85564°W and bearing S38.49°E, 1,317.9 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The Applicant indicates the outfall is 13.91 miles upstream of Dam 7, with 91.96% of the discharged water reaching the dam, and 24.24 miles upstream of Dam 8, with 86.41% of the water reaching that dam.

2 Discharges of developed stormwater at Ave P between Erskine & Cornell to Yellow House Draw, 1.4 miles north/northwest of the City of Lubbock, located at Latitude 33.60439°N, Longitude 101.85315°W and bearing S3.68611°E, 871.68 feet from the northeast corner of Blk A of theT.T. & R.R. Co. Survey 19, Abstract 92. The Applicant indicates the outfall is 13.79 miles upstream of Dam 7, with 92.02% of the discharged water reaching the dam, and 24.12 miles upstream of Dam 8, with 86.47% of the water reaching that dam.

3 Discharges of developed stormwater at Aztlan Park (at Canyon about 300 feet west of outfall #4) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59928°N, Longitude 101.84506°W and bearing S45.79056°E, 3,528.02 feet from the southwest corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Applicant indicates the outfall is 13.17 miles upstream of Dam 7, with 92.37% of the discharged water reaching the dam, and 23.50 miles upstream of Dam 8, with 86.79% of the water reaching that dam.

4 Discharges of developed stormwater at Aztlan Park (at Canyon under I-27 southbound frontage road) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59908°N, Longitude 101.84420°W and bearing S44.32167°E, 3,562.48 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Applicant indicates the outfall is 13.12 miles upstream of Dam 7, with 92.40% of the discharged water reaching the dam, and 23.45 miles upstream of Dam 8, with 86.82% of the water reaching that dam.

5 Discharges of developed stormwater at Aztlan Park (at Canyon under I-27 southbound frontage road) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59908°N, Longitude 101.84416°W and bearing S44.32167°E, 3,562.48 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Applicant indicates the outfall is 13.12 miles upstream of Dam 7, with 92.40% of the discharged water reaching the dam, and 23.45 miles upstream of Dam 8, with 86.82% of the water reaching that dam.

6 Discharges of developed stormwater at Aztlan Park (at Canyon northeast of outfall #5) to an unnamed tributary of Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59970°N, Longitude 101.84401°W and bearing S46.22444°E, 3,608 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Applicant indicates the outfall is 13.16 miles upstream of Dam 7, with 92.37% of the discharged water reaching the dam, and 23.49 miles upstream of Dam 8, with 86.80% of the water reaching that dam.

7 Discharges of developed stormwater at McKenzie State Park (just west of Joyland) to an unnamed tributary to Yellow House Draw, 0.8 mile northeast of the City of Lubbock, located at Latitude 33.59227°N, Longitude 101.83507°W and bearing S84.91861°E, 211.81 feet from the northwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Applicant indicates the outfall is 12.36 miles upstream of Dam 7, with 92.82% of the discharged water reaching the dam, and 22.69 miles upstream of Dam 8, with 87.22% of the water reaching that dam.

8 Discharges of developed stormwater at McKenzie State Park (just east of Joyland, north of overpass) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile east/northeast of the City of Lubbock, located at Latitude 33.59180°N, Longitude 101.82975°W and bearing S82.4825°E, 1,841.28 feet from the northwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Applicant indicates the outfall is 12.05 miles upstream of Dam 7, with 92.99% of the discharged water reaching the dam, and 22.38 miles upstream of Dam 8, with 87.38% of the water reaching that dam.

9 Discharges of developed stormwater 300 feet West of Compress Ave. on E. 19th to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57822°N, Longitude 101.83005°W and bearing S86.90111°E, 1,760.48 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Applicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

10 Discharges of developed stormwater 300 feet West of Compress Ave. on E. 19th to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57822°N, Longitude 101.83005°W and bearing S86.90111°E, 1,760.48 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Applicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

11 Discharges of developed stormwater at East 26th & Southeast Dr. to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57139°N, Longitude 101.82472°W and bearing S86.57444°E, 1,729.81 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Applicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

12 Discharges of developed stormwater at Canyon Lake, East of MLK (south of Vanda Ave.) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.5 miles southeast of the City of Lubbock, located at Latitude 33.57243°N, Longitude 101.82461°W and bearing S47.46139°E, 2,702.28 feet from the northeast corner of Blk B of the T.T. & R.R. Co. Survey 5, Abstract 96. The Applicant indicates the outfall is 9.67 miles upstream of Dam 7, with 94.34% of the discharged water reaching the dam, and 20.00 miles upstream of Dam 8, with 88.64% of the water reaching that dam.

13 Discharges of developed stormwater at Canyon Lake, East of MLK (south of Zenith Ave.) to the North Fork Double Mountain Fork Brazos River, 2.0 miles southeast of the City of Lubbock, located at Latitude 33.57558°N, Longitude 101.81202°W and bearing S66.78667°E, 2,043.69 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 3, Abstract 95. The Applicant indicates the outfall is 8.77 miles upstream of Dam 7, with 94.85% of the discharged water reaching the dam, and 19.10 miles upstream of Dam 8, with 89.13% of the water reaching that dam.

14 Discharges of developed stormwater at the Lift Station at I-27 & Loop 289 to Blackwater Draw, tributary of the North Fork Double Mountain Fork Brazos River, 2.2 miles north of the City of Lubbock, located at Latitude

33.61712°N, Longitude 101.84157°W and bearing S52.42056°E, 2,327.25 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 15, Abstract 85. The Applicant indicates the outfall is 14.77 miles upstream of Dam 7, with 91.48% of the discharged water reaching the dam, and 25.10 miles upstream of Dam 8, with 85.96% of the water reaching that dam.

15 Discharges of developed stormwater Southeast of Municipal Dr & Northbound I-27 Frontage Rd. (Canyon) to an unnamed tributary to Yellow House Draw, 1.1 miles north of the City of Lubbock, located at Latitude 33.60099°N, Longitude 101.84333°W and bearing S49.53694°E, 3,135.68 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Applicant indicates the outfall is 13.23 miles upstream of Dam 7, with 92.34% of the discharged water reaching the dam, and 23.56 miles upstream of Dam 8, with 86.76% of the water reaching that dam.

16 Discharges of developed stormwater under Northbound I-27 at Canyon Lakes Dr. (Canyon) to Yellow House Draw, 0.9 mile north of the City of Lubbock, located at Latitude 33.59749°N, Longitude 101.84161°W and bearing S41.47°E, 2,595.4 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Applicant indicates the outfall is 12.93 miles upstream of Dam 7, with 92.50% of the discharged water reaching the dam, and 23.26 miles upstream of Dam 8, with 86.92% of the water reaching that dam.

17 Discharges of developed stormwater Southwest of Northbound I-27 frontage Rd. & Municipal Dr (Canyon) to an unnamed tributary to Yellow House Draw 0.9 mile north of the City of Lubbock, located at Latitude 33.59972°N, Longitude 100.16000°W and bearing S49.53694°E, 3,135.68 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Applicant indicates the outfall is 13.00 miles upstream of Dam 7, with 92.46% of the discharged water reaching the dam, and 23.33 miles upstream of Dam 8, with 86.88% of the water reaching that dam.

18 Discharges of developed stormwater at Canyon Lakes Dr. under I-27 to an unnamed tributary to Yellow House Draw, 0.9 mile north of the City of Lubbock, located at Latitude 33.59861°N, Longitude 101.84264°W and bearing S40.53222°E, 3,106.5 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Applicant indicates the outfall is 13.06 miles upstream of Dam 7, with 92.43% of the discharged water reaching the dam, and 23.39 miles upstream of Dam 8, with 86.85% of the water reaching that dam.

19 Discharges of developed stormwater at the entrance to I-27 Northbound, North of Municipal Dr. to an unnamed tributary to Yellow House Draw, 1.1 miles north of the City of Lubbock, located at Latitude 33.60054°N, Longitude 101.84314°W and bearing S46.07444°E, 3,143.07 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Applicant indicates the outfall is 13.20 miles upstream of Dam 7, with 92.35% of the discharged water reaching the dam, and 23.53 miles upstream of Dam 8, with 86.78% of the water reaching that dam.

20 Discharges of developed stormwater Southeast of Compress and E. 19th, to the North Fork Double Mountain Fork Brazos River, 1.2 miles southeast of the City of Lubbock, located at Latitude 33.57781°N, Longitude 101.82668°W and bearing S88.36028°E, 2,747.95 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 5, Abstract 96. The Applicant indicates the outfall is 9.78 miles upstream of Dam 7, with 94.28% of the discharged water reaching the dam, and 20.11 miles upstream of Dam 8, with 88.58% of the water reaching that dam.

24 Discharges of developed stormwater at East Loop 289 & E. 50th (northeast corner) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 4.2 miles southeast of the City of Lubbock, located at Latitude 33.54905°N, Longitude 101.78690°W and bearing S82.34028°E, 914.11 feet from the southeast corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The Applicant indicates the outfall is 6.08 miles

upstream of Dam 7, with 96.40% of the discharged water reaching the dam, and 16.41 miles upstream of Dam 8, with 90.58% of the water reaching that dam.

27 Discharges of developed stormwater Southeast of the Water Rec Plant (South Outfall) to the North Fork Double Mountain Fork Brazos River 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55945°N, Longitude 101.79633°W and bearing S44.395°E, 2,013.56 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The Applicant indicates the outfall is 7.09 miles upstream of Dam 7, with 95.82% of the discharged water reaching the dam, and 17.42 miles upstream of Dam 8, with 90.03% of the water reaching that dam.

28 Discharges of developed stormwater South of E. 14th and Date Ave. (West of Warehouse) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 0.7 mile east/southeast of the City of Lubbock, located at Latitude 33.58224°N, Longitude 101.83307°W and bearing S27.23306°E, 1,812.26 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Applicant indicates the outfall is 10.27 miles upstream of Dam 7, with 94.00% of the discharged water reaching the dam, and 20.60 miles upstream of Dam 8, with 88.32% of the water reaching that dam.

29 Discharges of developed stormwater at I-27 Northbound Frontage Rd at the Canyon (South of N. Loop) to Blackwater Draw, 2.1 miles north of the City of Lubbock, located at Latitude 33.61496°N, Longitude 101.84373°W and bearing S49.26833°E, 3,317.43 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 15, Abstract 85. The Applicant indicates the outfall is 14.63 miles upstream of Dam 7, with 91.56% of the discharged water reaching the dam, and 24.96 miles upstream of Dam 8, with 86.03% of the water reaching that dam.

30 Discharges of developed stormwater Southeast of the Water Rec Plant (North Outfall) to the North Fork Double Mountain Fork Brazos River, 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55967°N, Longitude 101.79653°W and bearing S44.91889°E, 1,913.61 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The Applicant indicates the outfall is 7.11 miles upstream of Dam 7, with 95.81% of the discharged water reaching the dam, and 17.44 miles upstream of Dam 8, with 90.02% of the water reaching that dam.

31 Discharges of developed stormwater at South Lubbock Drainage Improvements Outfall to the North Fork Double Mountain Fork Brazos River, 5.2 miles southeast of the City of Lubbock, located at Latitude 33.53361°N, Longitude 101.77878°W and bearing S52.195°E, 568.64 feet from the northwest corner of Blk S of the G.C. & S.F. R.R. Survey 11, Abstract 216. The Applicant indicates the outfall is 3.55 miles upstream of Dam 7, with 97.88% of the discharged water reaching the dam, and 13.88 miles upstream of Dam 8, with 91.97% of the water reaching that dam.

32 Discharges of treated effluent at the City of Lubbock - SEWRP to the North Fork Double Mountain Fork Brazos River, 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55961°N, Longitude 101.79654°W and bearing S26.62139°E, 10,389.04 feet from the northwest corner of Blk S of the G.C. & S.F. R.R. Survey 11, Abstract 216. The Applicant indicates the outfall is 7.12 miles upstream of Dam 7, with 95.80% of the discharged water reaching the dam, and 17.45 miles upstream of Dam 8, with 90.02% of the water reaching that dam.

33 Discharges of treated effluent at the Town of Ransom Canyon to the North Fork Double Mountain Fork Brazos River, 10.5 miles southeast of the City of Lubbock, located at Latitude 31.43567°N, Longitude 101.67819°W and bearing S61.96722°E, 7,326.72 feet from the northeast corner of Blk I of the J.M. Kidwell Survey 4, Abstract 437. The Applicant indicates the outfall is downstream of Dam 7 and 5.64 miles upstream of Dam 8, with 96.66% of the water reaching that dam.

The Applicant indicates land will be purchased in the event that permits authorizing the construction of the proposed works are issued.

The Commission will review the application as submitted by the Applicant and may or may not grant the application as requested.

The application and partial fees were received on October 17, 2005. Additional information and fees were received on January 31, March 24, and April 13, 2006. The application was declared administratively complete and accepted for filing with the Office of the Chief Clerk on April 17, 2006.

PUBLIC COMMENT / PUBLIC MEETING. Written public comments and requests for a public meeting should be submitted to the Office of Chief Clerk, at the address provided in the information section below, within 30 days of the date of newspaper publication of the notice. A public meeting is intended for the taking of public comment, and is not a contested case hearing. A public meeting will be held if the Executive Director determines that there is a significant degree of public interest in the application.

CONTESTED CASE HEARING. The TCEQ may grant a contested case hearing on this application if a written hearing request is filed within 30 days from the date of newspaper publication of this notice. The Executive Director may approve the application unless a written request for a contested case hearing is filed within 30 days after newspaper publication of this notice.

To request a contested case hearing, you must submit the following: (1) your name (or for a group or association, an official representative), mailing address, daytime phone number, and fax number, if any; (2) applicant's name and permit number; (3) the statement "[I/we] request a contested case hearing;" (4) a brief and specific description of how you would be affected by the application in a way not common to the general public; and (5) the location and distance of your property relative to the proposed activity. You may also submit proposed conditions for the requested permit which would satisfy your concerns. Requests for a contested case hearing must be submitted in writing to the Office of the Chief Clerk at the address provided in the information section below.

If a hearing request is filed, the Executive Director will not issue the permit and will forward the application and hearing request to the TCEQ Commissioners for their consideration at a scheduled Commission meeting.

INFORMATION. Written hearing requests, public comments or requests for a public meeting should be submitted to the Office of the Chief Clerk, MC 105, TCEQ, P.O. Box 13087, Austin, TX 78711-3087. For information concerning the hearing process, please contact the Public Interest Counsel, MC 103, the same address. For additional information, individual members of the general public may contact the Office of Public Assistance at 1-800-687-4040. General information regarding the TCEQ can be found at our web site at www.tceq.state.tx.us. Si desea información en Español, puede llamar al 1-800-687-4040.

Issued: July 7, 2006

Iliana Delgado - RE: City of Lubbock : Application for Water Use Permit No. 5921 (2020 -02)

From: "Brad B. Castleberry" [redacted]
To: 'Iliana Delgado' <IDelgado@tceq.state.tx.us>
Date: 6/29/2006 1:17 PM
Subject: RE: City of Lubbock : Application for Water Use Permit No. 5921 (2020 -02)

Thanks, Iliana. We will be looking for the notice package from the Chief Clerk.

From: Iliana Delgado [mailto:IDelgado@tceq.state.tx.us]
Sent: Thursday, June 29, 2006 1:08 PM
To: Brad B. Castleberry
Subject: Re: City of Lubbock : Application for Water Use Permit No. 5921 (2020 -02)

Brad,

I have made the changes you suggested including the removal of recreational purposes.
See attached revised draft. I will forward the notice to the Office of the Chief Clerk later this afternoon.

-Iliana

>>> "Brad B. Castleberry" <[redacted] 6/19/2006 1:29 PM >>>
Iliana,

This email is in response to your letter of June 14, 2006 enclosing a revised draft notice on the above-referenced application. As we discussed, the City offers the following final comments regarding this matter.

For further clarification and evidence of the City's intentions, the City again submits that it is not requesting a recreational purpose of use for either of the reservoirs that are the subject of the above-referenced application. While one or more figures submitted by the City with the application may have inadvertently included references to a proposed park boundary for each of the reservoirs, said figures were from a previous engineering study, unrelated to this pending water rights application, and are not indicative of the City's current intentions for these reservoirs.
At this time, the City reiterates that it does not seek to include a recreational purpose of use for the proposed reservoirs. Should the City seek to add a recreational purpose of use for the proposed reservoirs in the future, it will do so by virtue of an amendment to Water Use Permit No. 5921.

In light of this clarification, please delete the following phrases as previously requested: i) "for in-place recreational purposes, " in the first paragraph on p. 1; and ii) "use the impounded water for in-place recreational purposes and" in the fourth paragraph on p. 1. Please also note that the word "points" is misspelled in paragraph 2 on p.2, and there is an extra space included within the paragraph associated with Outfall 9 on p.3.

Please confirm receipt of this email memorandum, and acknowledge that you will make these final changes/corrections requested to the notice before submission to the Office of Chief Clerk. If you have any questions, please do not hesitate to call either Martin (322-5810) or me at your convenience.

Thanks,

Brad B. Castleberry
Lloyd Gosselink Blevins Rochelle, & Townsend, P.C.

816 Congress Avenue, Suite 1900
Austin, Texas 78701
(512) 322-5856 direct line
(512) 472-0532 fax

If you would like more information about the firm, please visit our website at http://www.LGlawfirm.com/; or about our Water Practice Group, please visit http://lglawfirm.com/PracticeAreas_Water.asp

From: "Brad B. Castleberry" [redacted]
To: 'Iliana Delgado' <IDelgado@tceq.state.tx.us>
Date: 6/19/2006 1:30:09 PM
Subject: City of Lubbock : Application for Water Use Permit No. 5921 (2020 -02)

Iliana,

This email is in response to your letter of June 14, 2006 enclosing a revised draft notice on the above-referenced application. As we discussed, the City offers the following final comments regarding this matter.

For further clarification and evidence of the City's intentions, the City again submits that it is not requesting a recreational purpose of use for either of the reservoirs that are the subject of the above-referenced application. While one or more figures submitted by the City with the application may have inadvertently included references to a proposed park boundary for each of the reservoirs, said figures were from a previous engineering study, unrelated to this pending water rights application, and are not indicative of the City's current intentions for these reservoirs. At this time, the City reiterates that it does not seek to include a recreational purpose of use for the proposed reservoirs. Should the City seek to add a recreational purpose of use for the proposed reservoirs in the future, it will do so by virtue of an amendment to Water Use Permit No. 5921.

In light of this clarification, please delete the following phrases as previously requested: i) "for in-place recreational purposes, " in the first paragraph on p. 1; and ii) "use the impounded water for in-place recreational purposes and" in the fourth paragraph on p. 1. Please also note that the word "points" is misspelled in paragraph 2 on p.2, and there is an extra space included within the paragraph associated with Outfall 9 on p.3.

Please confirm receipt of this email memorandum, and acknowledge that you will make these final changes/corrections requested to the notice before submission to the Office of Chief Clerk. If you have any questions, please do not hesitate to call either Martin (322-5810) or me at your convenience.

Thanks,

Brad B. Castleberry
Lloyd Gosselink Blevins Rochelle, & Townsend, P.C.
816 Congress Avenue, Suite 1900
Austin, Texas 78701
(512) 322-5856 direct line
(512) 472-0532 fax

the sender by e-mail and destroy all copies of the original message. Thank you.

CC: 'Thomas Adams' <[redacted], 'Richard Casner' <[redacted]>, Martin Rochelle <[redacted], Jeff Goldstein <[redacted]

Kathleen Hartnett White, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 14, 2006

Mr. Brad B. Castleberry
Lloyd Gosselink
816 Congress Avenue, Suite 1900
Austin, TX 78701

RE: City of Lubbock
WRPERM 5921
CN 600130736
Application No. 5921 for a Water Use Permit
TWC §11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

Dear Mr. Castleberry:

This acknowledges receipt of the revisions to the notice for the reference application on May 23, 2006.

Enclosed is a revised draft notice in response to your revisions. Please review and provide any comments no later than June 19, 2006 as it will be forwarded to the Office of the Chief Clerk for mailing after that date.

Please note, in a letter dated December 1, 2005 it is stated, "The applicant indicates the reservoirs will be within a park area in Figures 2 and 3. The applicant shall therefore request recreation use for both reservoirs." While the applicant has stated the City of Lubbock did not request a recreational purpose use in the application, evidence has not been provided that the proposed reservoirs do not require recreational use.

If you have any questions concerning this application, please contact me at (512) 239-3678 or by email at idelgado@tceq.state.tx.us.

Sincerely,

Iliana Delgado - Mail Code 160
Water Rights Permitting Team

Enclosure

P.O. Box 13087 • Austin, Texas 78711-3087 • 512/239-1000 • Internet address: www.tceq.state.tx.us

<u>*Revised 6/14/2006*</u>

NOTICE OF WATER RIGHTS APPLICATION

APPLICATION NO. 5921

The City of Lubbock ("Applicant" or "City") has applied for a Water Use Permit to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, for in-place recreational purposes, to divert and use water from those reservoirs, and to use the bed and banks of the North Fork Double Mountain Fork Brazos River, including certain specified tributaries, for the conveyance of water sought for diversion for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties. More information on the application and how to participate in the permitting process is given below.

APPLICATION. The City of Lubbock, P.O. Box 2000, Lubbock, TX 79457, seeks a Water Use Permit pursuant to Texas Water Code §§ 11.042, 11.046, and 11.121, and Texas Commission on Environmental Quality Rules 30 Texas Administrative Code (TAC) §§ 295.1, *et seq*. Notice is being published and mailed to the water right holders of record in the Brazos River Basin pursuant to 30 TAC § 295.151.

The Applicant seeks a Water Use Permit for authorization to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, tributary of the Brazos River, Brazos River Basin, in Lubbock County. Structure No. 1 (known as Dam No. 7) will be located 7.6 miles southeast from the City of Lubbock at Latitude 33.534°N, Longitude 101.730°W, bearing S4.166°E, 5,227.85 feet to the southeast corner of Blk. S, G.C. & S.F. R.R. Co. Survey 21, Abstract 217. It will have a capacity of 20,708 acre-feet and surface area of 801 acres. Structure No. 2 (known as Dam No. 8) will be located 15.4 miles east-southeast from the City of Lubbock at Latitude 33.486°N, Longitude 101.607°W, bearing N61.683°W, 5,514.77 feet to the northwest corner of Blk. S, G.C. & S.F. R.R. Co. Survey 35, Abstract 214. It will have a capacity of 49,930 acre-feet and surface area of 1,680 acres.

The Applicant seeks to use the impounded water for in-place recreational purposes and divert and use water impounded in these reservoirs for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties in amount not to exceed 50,000 acre-feet of water per year, collectively, from the perimeter of the reservoir created by Dam No. 7 at a maximum diversion rate of 7.20 cfs (3,230 gpm) and from the perimeter of the reservoir created by Dam No. 8 at a maximum diversion rate of 44.56 cfs (20,000 gpm).

The Applicant seeks authorization to impound, divert, and use water requested by the application based upon a recognition of related to: i) the City's claim to developed water-based stormwater discharges from the City's storm sewer system to the North Fork Double Mountain Fork Brazos River and its tributaries; ii) unappropriated state water; iii) future surface water-based return flows and developed water-based return flows resulting from the City's use of groundwater and its use of other developed waters, excluding return flows previously sought by the City pursuant to concurrent Application Nos. 12-3705B and 3985A; and iv) any and all wastewater return flows that are discharged upstream of the proposed reservoirs by third parties for the uses stated above.

TPDES Permit No. 10778, issued to the Town of Ransom Canyon, authorizes the treatment and disposal of up to 0.41 MGD of return flows. The Applicant is seeking the authorization and recognition of both historical and future return flows of the Town of Ransom Canyon.

TPDES Permit No. 10353, issued to the City of Lubbock, authorizes the City to treat and dispose of 31.5 MGD of treated effluent. The Applicant is seeking the authorization and recognition of the difference between the City's current 31.5 MGD authorization and the 9.0 MGD of return flows that are the subject of concurrent Application No. 3985A.

The Applicant has requested authorization to use the bed and banks of the North Fork Double Mountain Fork Brazos River, including certain of its tributaries, to convey water requested by the application from the poins of discharge identified as follows to the points of diversion requested herein:

0 Discharges of developed stormwater at Canyon at the Duke Street (University Avenue outfall) to Yellow House Draw, tributary of the North Fork Double Mountain Fork Brazos River, tributary of the Brazos River, Brazos River Basin, 1.6 miles northwest of the City of Lubbock, located at Latitude 33.60523°N, Longitude 101.86032°W and bearing S77.46222°E, 2,280.76 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The Applicant indicates the outfall is 14.23 miles upstream of Dam 7, with 91.78% of the discharged water reaching the dam, and 24.56 miles upstream of Dam 8, with 86.24% of the water reaching that dam.

1 Discharges of developed stormwater north of Cornell & Ave Q to Yellow House Draw, 1.4 miles north/northwest of the City of Lubbock, located at Latitude 33.60388°N, Longitude 101.85564°W and bearing S38.49°E, 1,317.9 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The Applicant indicates the outfall is 13.91 miles upstream of Dam 7, with 91.96% of the discharged water reaching the dam, and 24.24 miles upstream of Dam 8, with 86.41% of the water reaching that dam.

2 Discharges of developed stormwater at Ave P between Erskine & Cornell to Yellow House Draw, 1.4 miles north/northwest of the City of Lubbock, located at Latitude 33.60439°N, Longitude 101.85315°W and bearing S3.68611°E, 871.68 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The Applicant indicates the outfall is 13.79 miles upstream of Dam 7, with 92.02% of the discharged water reaching the dam, and 24.12 miles upstream of Dam 8, with 86.47% of the water reaching that dam.

3 Discharges of developed stormwater at Aztlan Park (at Canyon about 300 feet west of outfall #4) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59928°N, Longitude 101.84506°W and bearing S45.79056°E, 3,528.02 feet from the southwest corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Applicant indicates the outfall is 13.17 miles upstream of Dam 7, with 92.37% of the discharged water reaching the dam, and 23.50 miles upstream of Dam 8, with 86.79% of the water reaching that dam.

4 Discharges of developed stormwater at Aztlan Park (at Canyon under I-27 southbound frontage road) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59908°N, Longitude 101.84420°W and bearing S44.32167°E, 3,562.48 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Applicant indicates the outfall is 13.12 miles upstream of Dam 7, with 92.40% of the discharged water reaching the dam, and 23.45 miles upstream of Dam 8, with 86.82% of the water reaching that dam.

5 Discharges of developed stormwater at Aztlan Park (at Canyon under I-27 southbound frontage road)

to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59908°N, Longitude 101.84416°W and bearing S44.32167°E, 3,562.48 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Applicant indicates the outfall is 13.12 miles upstream of Dam 7, with 92.40% of the discharged water reaching the dam, and 23.45 miles upstream of Dam 8, with 86.82% of the water reaching that dam.

6 Discharges of developed stormwater at Aztlan Park (at Canyon northeast of outfall #5) to an unnamed tributary of Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59970°N, Longitude 101.84401°W and bearing S46.22444°E, 3,608 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Applicant indicates the outfall is 13.16 miles upstream of Dam 7, with 92.37% of the discharged water reaching the dam, and 23.49 miles upstream of Dam 8, with 86.80% of the water reaching that dam.

7 Discharges of developed stormwater at McKenzie State Park (just west of Joyland) to an unnamed tributary to Yellow House Draw, 0.8 mile northeast of the City of Lubbock, located at Latitude 33.59227°N, Longitude 101.83507°W and bearing S84.91861°E, 211.81 feet from the northwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Applicant indicates the outfall is 12.36 miles upstream of Dam 7, with 92.82% of the discharged water reaching the dam, and 22.69 miles upstream of Dam 8, with 87.22% of the water reaching that dam.

8 Discharges of developed stormwater at McKenzie State Park (just east of Joyland, north of overpass) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile east/northeast of the City of Lubbock, located at Latitude 33.59180°N, Longitude 101.82975°W and bearing S82.4825°E, 1,841.28 feet from the northwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Applicant indicates the outfall is 12.05 miles upstream of Dam 7, with 92.99% of the discharged water reaching the dam, and 22.38 miles upstream of Dam 8, with 87.38% of the water reaching that dam.

9 Discharges of developed stormwater 300 feet West of Compress Ave. on E. 19th to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57822°N, Longitude 101.83005°W and bearing S86.90111°E, 1,760.48 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Applicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

10 Discharges of developed stormwater 300 feet West of Compress Ave. on E. 19th to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57822°N, Longitude 101.83005°W and bearing S86.90111°E, 1,760.48 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Applicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

11 Discharges of developed stormwater at East 26th & Southeast Dr. to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57139°N, Longitude 101.82472°W and bearing S86.57444°E, 1,729.81 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Applicant indicates

the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

12 Discharges of developed stormwater at Canyon Lake, East of MLK (south of Vanda Ave.) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.5 miles southeast of the City of Lubbock, located at Latitude 33.57243°N, Longitude 101.82461°W and bearing S47.46139°E, 2,702.28 feet from the northeast corner of Blk B of the T.T. & R.R. Co. Survey 5, Abstract 96. The Applicant indicates the outfall is 9.67 miles upstream of Dam 7, with 94.34% of the discharged water reaching the dam, and 20.00 miles upstream of Dam 8, with 88.64% of the water reaching that dam.

13 Discharges of developed stormwater at Canyon Lake, East of MLK (south of Zenith Ave.) to the North Fork Double Mountain Fork Brazos River, 2.0 miles southeast of the City of Lubbock, located at Latitude 33.57558°N, Longitude 101.81202°W and bearing S66.78667°E, 2,043.69 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 3, Abstract 95. The Applicant indicates the outfall is 8.77 miles upstream of Dam 7, with 94.85% of the discharged water reaching the dam, and 19.10 miles upstream of Dam 8, with 89.13% of the water reaching that dam.

14 Discharges of developed stormwater at the Lift Station at I-27 & Loop 289 to Blackwater Draw, tributary of the North Fork Double Mountain Fork Brazos River, 2.2 miles north of the City of Lubbock, located at Latitude 33.61712°N, Longitude 101.84157°W and bearing S52.42056°E, 2,327.25 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 15, Abstract 85. The Applicant indicates the outfall is 14.77 miles upstream of Dam 7, with 91.48% of the discharged water reaching the dam, and 25.10 miles upstream of Dam 8, with 85.96% of the water reaching that dam.

15 Discharges of developed stormwater Southeast of Municipal Dr & Northbound I-27 Frontage Rd. (Canyon) to an unnamed tributary to Yellow House Draw, 1.1 miles north of the City of Lubbock, located at Latitude 33.60099°N, Longitude 101.84333°W and bearing S49.53694°E, 3,135.68 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Applicant indicates the outfall is 13.23 miles upstream of Dam 7, with 92.34% of the discharged water reaching the dam, and 23.56 miles upstream of Dam 8, with 86.76% of the water reaching that dam.

16 Discharges of developed stormwater under Northbound I-27 at Canyon Lakes Dr. (Canyon) to Yellow House Draw, 0.9 mile north of the City of Lubbock, located at Latitude 33.59749°N, Longitude 101.84161°W and bearing S41.47°E, 2,595.4 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Applicant indicates the outfall is 12.93 miles upstream of Dam 7, with 92.50% of the discharged water reaching the dam, and 23.26 miles upstream of Dam 8, with 86.92% of the water reaching that dam.

17 Discharges of developed stormwater Southwest of Northbound I-27 frontage Rd. & Municipal Dr (Canyon) to an unnamed tributary to Yellow House Draw 0.9 mile north of the City of Lubbock, located at Latitude 33.59972°N, Longitude 100.16000°W and bearing S49.53694°E, 3,135.68 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Applicant indicates the outfall is 13.00 miles upstream of Dam 7, with 92.46% of the discharged water reaching the dam, and 23.33 miles upstream of Dam 8, with 86.88% of the water reaching that dam.

18 Discharges of developed stormwater at Canyon Lakes Dr. under I-27 to an unnamed tributary to Yellow House Draw, 0.9 mile north of the City of Lubbock, located at Latitude 33.59861°N, Longitude 101.84264°W and bearing S40.53222°E, 3,106.5 feet from the southeast corner of Blk A of

the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Applicant indicates the outfall is 13.06 miles upstream of Dam 7, with 92.43% of the discharged water reaching the dam, and 23.39 miles upstream of Dam 8, with 86.85% of the water reaching that dam.

19 Discharges of developed stormwater at the entrance to I-27 Northbound, North of Municipal Dr. to an unnamed tributary to Yellow House Draw, 1.1 miles north of the City of Lubbock, located at Latitude 33.60054°N, Longitude 101.84314°W and bearing S46.07444°E, 3,143.07 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Applicant indicates the outfall is 13.20 miles upstream of Dam 7, with 92.35% of the discharged water reaching the dam, and 23.53 miles upstream of Dam 8, with 86.78% of the water reaching that dam.

20 Discharges of developed stormwater Southeast of Compress and E. 19th, to the North Fork Double Mountain Fork Brazos River, 1.2 miles southeast of the City of Lubbock, located at Latitude 33.57781°N, Longitude 101.82668°W and bearing S88.36028°E, 2,747.95 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 5, Abstract 96. The Applicant indicates the outfall is 9.78 miles upstream of Dam 7, with 94.28% of the discharged water reaching the dam, and 20.11 miles upstream of Dam 8, with 88.58% of the water reaching that dam.

24 Discharges of developed stormwater at East Loop 289 & E. 50th (northeast corner) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 4.2 miles southeast of the City of Lubbock, located at Latitude 33.54905°N, Longitude 101.78690°W and bearing S82.34028°E, 914.11 feet from the southeast corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The Applicant indicates the outfall is 6.08 miles upstream of Dam 7, with 96.40% of the discharged water reaching the dam, and 16.41 miles upstream of Dam 8, with 90.58% of the water reaching that dam.

27 Discharges of developed stormwater Southeast of the Water Rec Plant (South Outfall) to the North Fork Double Mountain Fork Brazos River 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55945°N, Longitude 101.79633°W and bearing S44.395°E, 2,013.56 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The Applicant indicates the outfall is 7.09 miles upstream of Dam 7, with 95.82% of the discharged water reaching the dam, and 17.42 miles upstream of Dam 8, with 90.03% of the water reaching that dam.

28 Discharges of developed stormwater South of E. 14th and Date Ave. (West of Warehouse) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 0.7 mile east/southeast of the City of Lubbock, located at Latitude 33.58224°N, Longitude 101.83307°W and bearing S27.23306°E, 1,812.26 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Applicant indicates the outfall is 10.27 miles upstream of Dam 7, with 94.00% of the discharged water reaching the dam, and 20.60 miles upstream of Dam 8, with 88.32% of the water reaching that dam.

29 Discharges of developed stormwater at I-27 Northbound Frontage Rd at the Canyon (South of N. Loop) to Blackwater Draw, 2.1 miles north of the City of Lubbock, located at Latitude 33.61496°N, Longitude 101.84373°W and bearing S49.26833°E, 3,317.43 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 15, Abstract 85. The Applicant indicates the outfall is 14.63 miles upstream of Dam 7, with 91.56% of the discharged water reaching the dam, and 24.96 miles upstream of Dam 8, with 86.03% of the water reaching that dam.

30 Discharges of developed stormwater Southeast of the Water Rec Plant (North Outfall) to the North

Fork Double Mountain Fork Brazos River, 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55967°N, Longitude 101.79653°W and bearing S44.91889°E, 1,913.61 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The Applicant indicates the outfall is 7.11 miles upstream of Dam 7, with 95.81% of the discharged water reaching the dam, and 17.44 miles upstream of Dam 8, with 90.02% of the water reaching that dam.

31 Discharges of developed stormwater at South Lubbock Drainage Improvements Outfall to the North Fork Double Mountain Fork Brazos River, 5.2 miles southeast of the City of Lubbock, located at Latitude 33.53361°N, Longitude 101.77878°W and bearing S52.195°E, 568.64 feet from the northwest corner of Blk S of the G.C. & S.F. R.R. Survey 11, Abstract 216. The Applicant indicates the outfall is 3.55 miles upstream of Dam 7, with 97.88% of the discharged water reaching the dam, and 13.88 miles upstream of Dam 8, with 91.97% of the water reaching that dam.

32 Discharges of treated effluent at the City of Lubbock - SEWRP to the North Fork Double Mountain Fork Brazos River, 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55961°N, Longitude 101.79654°W and bearing S26.62139°E, 10,389.04 feet from the northwest corner of Blk S of the G.C. & S.F. R.R. Survey 11, Abstract 216. The Applicant indicates the outfall is 7.12 miles upstream of Dam 7, with 95.80% of the discharged water reaching the dam, and 17.45 miles upstream of Dam 8, with 90.02% of the water reaching that dam.

33 Discharges of treated effluent at the Town of Ransom Canyon to the North Fork Double Mountain Fork Brazos River, 10.5 miles southeast of the City of Lubbock, located at Latitude 31.43567°N, Longitude 101.67819°W and bearing S61.96722°E, 7,326.72 feet from the northeast corner of Blk I of the J.M. Kidwell Survey 4, Abstract 437. The Applicant indicates the outfall is downstream of Dam 7 and 5.64 miles upstream of Dam 8, with 96.66% of the water reaching that dam.

The Applicant indicates land will be purchased in the event that permits authorizing the construction of the proposed works are issued.

The Commission will review the application as submitted by the Applicant and may or may not grant the application as requested.

The application and partial fees were received on October 17, 2005. Additional information and fees were received on January 31, March 24, and April 13, 2006. The application was declared administratively complete and accepted for filing with the Office of the Chief Clerk on April 17, 2006.

PUBLIC COMMENT / PUBLIC MEETING. Written public comments and requests for a public meeting should be submitted to the Office of Chief Clerk, at the address provided in the information section below, within 30 days of the date of newspaper publication of the notice. A public meeting is intended for the taking of public comment, and is not a contested case hearing. A public meeting will be held if the Executive Director determines that there is a significant degree of public interest in the application.

CONTESTED CASE HEARING. The TCEQ may grant a contested case hearing on this application if a written hearing request is filed within 30 days from the date of newspaper publication of this notice. The Executive Director may approve the application unless a written request for a contested case hearing is filed within 30 days after newspaper publication of this notice.

To request a contested case hearing, you must submit the following: (1) your name (or for a group or association, an official representative), mailing address, daytime phone number, and fax number, if any; (2) applicant's name and permit number; (3) the statement "[*I/we*] request a contested case hearing;" (4) a brief and specific description of how you would be affected by the application in a way not common to the general public; and (5) the location and distance of your property relative to the proposed activity. You may also submit proposed conditions for the requested permit which would satisfy your concerns. Requests for a contested case hearing must be submitted in writing to the Office of the Chief Clerk at the address provided in the information section below.

If a hearing request is filed, the Executive Director will not issue the permit and will forward the application and hearing request to the TCEQ Commissioners for their consideration at a scheduled Commission meeting.

INFORMATION. Written hearing requests, public comments or requests for a public meeting should be submitted to the Office of the Chief Clerk, MC 105, TCEQ, P.O. Box 13087, Austin, TX 78711-3087. For information concerning the hearing process, please contact the Public Interest Counsel, MC 103, the same address. For additional information, individual members of the general public may contact the Office of Public Assistance at 1-800-687-4040. General information regarding the TCEQ can be found at our web site at www.tceq.state.tx.us. Si desea información en Español, puede llamar al 1-800-687-4040.

Issued:

Lloyd
Gosselink
ATTORNEYS AT LAW

816 Congress Avenue, Suite 1900
Austin, Texas 78701
Telephone: (512) 322-5800
Facsimile: (512) 472-0532
www.lglawfirm.com

RECEIVED

MAY 23 2006

WATER RIGHTS PERMITTING

Mr. Castleberry's Direct Line: (512) 322-5856
[redacted]

May 22, 2006

Ms. Iliana Delgado (MC 160)
Texas Commission on Environmental Quality
Building F, Room 359
Austin, Texas 78711-3087

VIA FACSIMILE
AND FIRST-CLASS MAIL

Re: City of Lubbock
WRPERM 5921
CN 600130736
Application No. 5921 for a Water Use Permit
TWC §11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties (2020-02)

Dear Ms. Delgado:

This letter is submitted on behalf of the City of Lubbock (the "City") in response to your letter of April 28, 2006 wherein you provided a draft notice for the above-referenced application. Please find enclosed certain revisions to the draft notice requested by the City. Please confirm acceptance of these revisions by providing a final notice prior to issuance by the Office of Chief Clerk.

Also enclosed is a revised Table 2 from our January 31, 2006 letter. The City has identified a change to the 50-year, 24 hour volume specified for Outfall 30. Please use this revised Table 2 in performing your technical review of the above-referenced application.

If you have any questions regarding these materials, please feel free to call either Martin Rochelle (512-322-5810) or me at your convenience.

Sincerely,

Brad B. Castleberry

BBC/ldp

Enclosure as noted

cc: Mr. Thomas Adams
Mr. Richard Casner
Mr. Martin C. Rochelle (without enclosure)

Revised May 8, 2006

NOTICE OF WATER RIGHTS APPLICATION

APPLICATION NO. 5921

The City of Lubbock ("Applicant" or "City") has applied for a Water Use Permit to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, Brazos River Basin~~. for in-place recreational purposes, . The Applicant further seeks~~ to divert and use water from those reservoirs, and to use the bed and banks of ~~tributaries of~~ the North Fork Double Mountain Fork Brazos River, including certain specified tributaries, for the conveyance, ~~subsequent diversion and use~~ of water sought for diversion for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties. More information on the application and how to participate in the permitting process is given below.

APPLICATION. The City of Lubbock~~, applicant or City~~, P.O. Box 2000, Lubbock, TX 79457, seeks a Water Use Permit pursuant to Texas Water Code §§ 11.042, 11.046, and 11.121, and Texas Commission on Environmental Quality Rules 30 Texas Administrative Code (TAC) §§ 295.1, *et seq*. Notice is being published and mailed to the water right holders of record in the Brazos River Basin pursuant to 30 TAC § 295.151.

The Aapplicant seeks a Water Use Permit for authorization to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, tributary of the Brazos River, Brazos River Basin, in Lubbock County. Structure No. 1 (known as Dam No. 7) will be located 7.6 miles southeast from the City of Lubbock at Latitude 33.534°N, Longitude 101.730°W, bearing S4.166°E, 5,227.85 feet to the southeast corner of Blk. S,~~the~~ G.C. & S.F. R.R. Co. Survey 21, Abstract 217. It will have a capacity of 20,708 acre-feet and surface area of 801 acres. Structure No. 2 (known as Dam No. 8) will be located 15.4 miles east-southeast from the City of Lubbock at Latitude 33.486°N, Longitude 101.607°W, bearing N61.683°W, 5,514.77 feet to the northwest corner of Blk. S,~~the~~ G.C. & S.F. R.R. Co. Survey 35, Abstract 214. It will have a capacity of 49,930 acre-feet and surface area of 1,680 acres.

The Aapplicant ~~also~~ seeks to ~~use the impounded water for in-place recreational purposes and~~ divert and use water impounded in these reservoirs for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties in amount not to exceed 50,000 acre-feet of water per year, collectively, from the perimeter of the reservoir created by Dam No. 7 at a maximum diversion rate of 7.20 cfs (3,230 gpm) and from the perimeter of the reservoir created by Dam No. 8 at a maximum diversion rate of 44.56 cfs (20,000 gpm)~~ for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties~~.

The Aapplicant ~~further~~ seeks authorization to impound, divert, and use water requested by the application based upon a recognition of rights ~~to the City including rights~~ related to: i)~~,~~ the City'=s claim to developed water-based stormwater discharges from the City's storm sewer system to the North Fork Double Mountain Fork Brazos River and its tributaries; ii)~~,~~ unappropriated state water; iii)~~,~~ future surface water-based return flows and developed water-based return flows resulting from the City'=s use of groundwater and its use of other developed waters, excluding return flows previously sought by the City pursuant to concurrent Application Nos. 12-3705B and 3985A; and iv)~~,~~ any and all wastewater return flows that are discharged upstream of the proposed reservoirs by third parties for the uses stated above.

TPDES Permit No. 10778, issued to the Town of Ransom Canyon, authorizes the treatment and disposale of up to 0.41 MGD of return flows~~treated effluent~~. The Aapplicant is seeking the authorization and recognition of both historical and future return flows of the Town of Ransom Canyon.

TPDES Permit No. 10353, issued to the City of Lubbock, authorizes the City to treat and dispose of 31.5 MGD of treated effluent. The Aapplicant is seeking the authorization and recognition of the difference between the City's current 31.5 MGD authorization and the 9.0 MGD of return flows that are the subject of concurrent Application No. 3985A~~, 9.0 MGD~~.

The Aapplicant has requested authorization to use the bed and banks of the North Fork Double Mountain Fork Brazos River, including certain of its tributaries, to convey water requested by the application from the points of discharge identified as follows to the points of diversion requested herein~~provided information for the proposed discharge points in Lubbock County as follows~~:

0 Discharges of developed stormwater at Canyon at the Duke Street (University Avenue outfall) to Yellow House Draw, tributary of the North Fork Double Mountain Fork Brazos River, tributary of the Brazos River, Brazos River Basin, 1.6 miles northwest of the City of Lubbock, located at Latitude 33.60523°N, Longitude 101.86032°W and bearing S77.46222°E, 2,280.76 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The Aapplicant indicates the outfall is 14.23 miles upstream of Dam 7, with 91.78% of the discharged water reaching the dam, and 24.56 miles upstream of Dam 8, with 86.24% of the water reaching that dam.

1 Discharges of developed stormwater north of Cornell & Ave Q to Yellow House Draw, 1.4 miles north/northwest of the City of Lubbock, located at Latitude 33.60388°N, Longitude 101.85564°W and bearing S38.49°E, 1,317.9 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The Aapplicant indicates the outfall is 13.91 miles upstream of Dam 7, with 91.96% of the discharged water reaching the dam, and 24.24 miles upstream of Dam 8, with 86.41% of the water reaching that dam.

2 Discharges of developed stormwater at Ave P between Erskine & Cornell to Yellow House Draw, 1.4 miles north/northwest of the City of Lubbock, located at Latitude 33.60439°N, Longitude 101.85315°W and bearing S3.68611°E, 871.68 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The Aapplicant indicates the outfall is 13.79 miles upstream of Dam 7, with 92.02% of the discharged water reaching the dam, and 24.12 miles upstream of Dam 8, with 86.47% of the water reaching that dam.

3 Discharges of developed stormwater at Aztlan Park (at Canyon about 300 feet west of outfall #4) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59928°N, Longitude 101.84506°W and bearing S45.79056°E, 3,528.02 feet from the southwest corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Aapplicant indicates the outfall is 13.17 miles upstream of Dam 7, with 92.37% of the discharged water reaching the dam, and 23.50 miles upstream of Dam 8, with 86.79% of the water reaching that dam.

4 Discharges of developed stormwater at Aztlan Park (at Canyon under I-27 southbound frontage road) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59908°N, Longitude 101.84420°W and bearing S44.32167°E, 3,562.48 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Aapplicant indicates the outfall is 13.12 miles upstream of Dam 7, with 92.40% of the discharged water reaching the

dam, and 23.45 miles upstream of Dam 8, with 86.82% of the water reaching that dam.

5 Discharges of developed stormwater at Aztlan Park (at Canyon under I-27 southbound frontage road) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59908°N, Longitude 101.84416°W and bearing S44.32167°E, 3,562.48 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Aapplicant indicates the outfall is 13.12 miles upstream of Dam 7, with 92.40% of the discharged water reaching the dam, and 23.45 miles upstream of Dam 8, with 86.82% of the water reaching that dam.

6 Discharges of developed stormwater at Aztlan Park (at Canyon northeast of outfall #5~~-across canyon~~) to an unnamed tributary of Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59970°N, Longitude 101.84401°W and bearing S46.22444°E, 3,608 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Aapplicant indicates the outfall is 13.16 miles upstream of Dam 7, with 92.37% of the discharged water reaching the dam, and 23.49 miles upstream of Dam 8, with 86.80% of the water reaching that dam.

7 Discharges of developed stormwater at McKenzie State Park (just west of Joyland) to an unnamed tributary to Yellow House Draw, 0.8 mile northeast of the City of Lubbock, located at Latitude 33.59227°N, Longitude 101.83507°W and bearing S84.91861°E, 211.81 feet from the northwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Aapplicant indicates the outfall is 12.36 miles upstream of Dam 7, with 92.82% of the discharged water reaching the dam, and 22.69 miles upstream of Dam 8, with 87.22% of the water reaching that dam.

8 Discharges of developed stormwater at McKenzie State Park (just east of Joyland, north of overpass) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile east/northeast of the City of Lubbock, located at Latitude 33.59180°N, Longitude 101.82975°W and bearing S82.4825°E, 1,841.28 feet from the northwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Aapplicant indicates the outfall is 12.05 miles upstream of Dam 7, with 92.99% of the discharged water reaching the dam, and 22.38 miles upstream of Dam 8, with 87.38% of the water reaching that dam.

9 Discharges of developed stormwater 300 feet West of Compress Ave. on E. 19th to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57822°N, Longitude 101.83005°W and bearing S86.90111°E, 1,760.48 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Aapplicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

10 Discharges of developed stormwater 300 feet West of Compress Ave. on E. 19th to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57822°N, Longitude 101.83005°W and bearing S86.90111°E, 1,760.48 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Aapplicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

11 Discharges of developed stormwater at East 26th & Southeast Dr. to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57139°N, Longitude 101.82472°W and bearing S86.57444°E, 1,729.81 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Aapplicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

12 Discharges of developed stormwater at Canyon Lake, East of MLK (south of Vanda Ave.) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.5 miles southeast of the City of Lubbock, located at Latitude 33.57243°N, Longitude 101.82461°W and bearing S47.46139°E, 2,702.28 feet from the northeast corner of Blk B of the T.T. & R.R. Co. Survey 5, Abstract 96. The Aapplicant indicates the outfall is 9.67 miles upstream of Dam 7, with 94.34% of the discharged water reaching the dam, and 20.00 miles upstream of Dam 8, with 88.64% of the water reaching that dam.

13 Discharges of developed stormwater at Canyon Lake, East of MLK (south of Zenith Ave.) to the North Fork Double Mountain Fork Brazos River, 2.0 miles southeast of the City of Lubbock, located at Latitude 33.57558°N, Longitude 101.81202°W and bearing S66.78667°E, 2,043.69 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 3, Abstract 95. The Aapplicant indicates the outfall is 8.77 miles upstream of Dam 7, with 94.85% of the discharged water reaching the dam, and 19.10 miles upstream of Dam 8, with 89.13% of the water reaching that dam.

14 Discharges of developed stormwater at the Lift Station at I-27 & Loop 289 to Blackwater Draw, tributary of the North Fork Double Mountain Fork Brazos River, 2.2 miles north of the City of Lubbock, located at Latitude 33.61712°N, Longitude 101.84157°W and bearing S52.42056°E, 2,327.25 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 15, Abstract 85. The Aapplicant indicates the outfall is 14.77 miles upstream of Dam 7, with 91.48% of the discharged water reaching the dam, and 25.10 miles upstream of Dam 8, with 85.96% of the water reaching that dam.

15 Discharges of developed stormwater Southeast of Municipal Dr & Northbound I-27 Frontage Rd. (Canyon) to an unnamed tributary to Yellow House Draw, 1.1 miles north of the City of Lubbock, located at Latitude 33.60099°N, Longitude 101.84333°W and bearing S49.53694°E, 3,135.68 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Aapplicant indicates the outfall is 13.23 miles upstream of Dam 7, with 92.34% of the discharged water reaching the dam, and 23.56 miles upstream of Dam 8, with 86.76% of the water reaching that dam.

16 Discharges of developed stormwater under Northbound I-27 at Canyon Lakes Dr. (Canyon) to Yellow House Draw, 0.9 mile north of the City of Lubbock, located at Latitude 33.59749°N, Longitude 101.84161°W and bearing S41.47°E, 2,595.4 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Aapplicant indicates the outfall is 12.93 miles upstream of Dam 7, with 92.50% of the discharged water reaching the dam, and 23.26 miles upstream of Dam 8, with 86.92% of the water reaching that dam.

17 Discharges of developed stormwater Southwest of Northbound I-27 frontage Rd. & Municipal Dr (Canyon) to an unnamed tributary to Yellow House Draw 0.9 mile north of the City of Lubbock,

located at Latitude 33.59972°N, Longitude 100.16000°W and bearing S49.53694°E, 3,135.68 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Aapplicant indicates the outfall is 13.00 miles upstream of Dam 7, with 92.46% of the discharged water reaching the dam, and 23.33 miles upstream of Dam 8, with 86.88% of the water reaching that dam.

18 Discharges of developed stormwater at Canyon Lakes Dr. under I-27 to an unnamed tributary to Yellow House Draw, 0.9 mile north of the City of Lubbock, located at Latitude 33.59861°N, Longitude 101.84264°W and bearing S40.53222°E, 3,106.5 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Aapplicant indicates the outfall is 13.06 miles upstream of Dam 7, with 92.43% of the discharged water reaching the dam, and 23.39 miles upstream of Dam 8, with 86.85% of the water reaching that dam.

19 Discharges of developed stormwater at the entrance to I-27 Northbound, North of Municipal Dr. to an unnamed tributary to Yellow House Draw, 1.1 miles north of the City of Lubbock, located at Latitude 33.60054°N, Longitude 101.84314°W and bearing S46.07444°E, 3,143.07 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Aapplicant indicates the outfall is 13.20 miles upstream of Dam 7, with 92.35% of the discharged water reaching the dam, and 23.53 miles upstream of Dam 8, with 86.78% of the water reaching that dam.

20 Discharges of developed stormwater Southeast of Compress and E. 19th to the North Fork Double Mountain Fork Brazos River, 1.2 miles southeast of the City of Lubbock, located at Latitude 33.57781°N, Longitude 101.82668°W and bearing S88.36028°E, 2,747.95 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 5, Abstract 96. The Aapplicant indicates the outfall is 9.78 miles upstream of Dam 7, with 94.28% of the discharged water reaching the dam, and 20.11 miles upstream of Dam 8, with 88.58% of the water reaching that dam.

24 Discharges of developed stormwater at East Loop 289 & E. 50th (northeast corner) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 4.2 miles southeast of the City of Lubbock, located at Latitude 33.54905°N, Longitude 101.78690°W and bearing S82.34028°E, 914.11 feet from the southeast corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The Aapplicant indicates the outfall is 6.08 miles upstream of Dam 7, with 96.40% of the discharged water reaching the dam, and 16.41 miles upstream of Dam 8, with 90.58% of the water reaching that dam.

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28 Discharges of developed stormwater South of E. 14th and Date Ave. (West of Warehouse) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 0.7 mile east/southeast of the City of Lubbock, located at Latitude 33.58224°N, Longitude 101.83307°W and bearing S27.23306°E, 1,812.26 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co.

Survey 3, Abstract 24. The A~~a~~pplicant indicates the outfall is 10.27 miles upstream of Dam 7, with 94.00% of the discharged water reaching the dam, and 20.60 miles upstream of Dam 8, with 88.32% of the water reaching that dam.

29 Discharges of developed stormwater at I-27 Northbound Frontage Rd at the Canyon (South of N. Loop) to Blackwater Draw, 2.1 miles north of the City of Lubbock, located at Latitude 33.61496°N, Longitude 101.84373°W and bearing S49.26833°E, 3,317.43 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 15, Abstract 85. The A~~a~~pplicant indicates the outfall is 14.63 miles upstream of Dam 7, with 91.56% of the discharged water reaching the dam, and 24.96 miles upstream of Dam 8, with 86.03% of the water reaching that dam.

30 Discharges of developed stormwater Southeast of the Water Rec Plant (North Outfall) to the North Fork Double Mountain Fork Brazos River, 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55967°N, Longitude 101.79653°W and bearing S44.91889°E, 1,913.61 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The A~~a~~pplicant indicates the outfall is 7.11 miles upstream of Dam 7, with 95.81% of the discharged water reaching the dam, and 17.44 miles upstream of Dam 8, with 90.02% of the water reaching that dam.

31 Discharges of developed stormwater at South Lubbock Drainage Improvements Outfall to the North Fork Double Mountain Fork Brazos River, 5.2 miles southeast of the City of Lubbock, located at Latitude 33.53361°N, Longitude 101.77878°W and bearing S52.195°E, 568.64 feet from the northwest corner of Blk. S of the G.C. & S.F. Ry~~.R.~~ Survey 11, Abstract 216. The A~~a~~pplicant indicates the outfall is 3.55 miles upstream of Dam 7, with 97.88% of the discharged water reaching the dam, and 13.88 miles upstream of Dam 8, with 91.97% of the water reaching that dam.

32 Discharges of treated effluent at the City of Lubbock - SEWRP to the North Fork Double Mountain Fork Brazos River, 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55961°N, Longitude 101.79654°W and bearing S26.62139°E, 10,389.04 feet from the northwest corner of Blk S of the G.C. & S.F. Ry~~.R.~~ Survey 11, Abstract 216. The A~~a~~pplicant indicates the outfall is 7.12 miles upstream of Dam 7, with 95.80% of the discharged water reaching the dam, and 17.45 miles upstream of Dam 8, with 90.02% of the water reaching that dam.

33 Discharges of treated effluent at the Town of Ransom Canyon to the North Fork Double Mountain Fork Brazos River, 10.5 miles southeast of the City of Lubbock, located at Latitude 31.43567°N, Longitude 101.67819°W and bearing S61.96722°E, 7,326.72 feet from the northeast corner of Blk I of the J.M. Kidwell Survey 4, Abstract 437. The A~~a~~pplicant indicates the outfall is downstream of Dam 7 and 5.64 miles upstream of Dam 8, with 96.66% of the water reaching that dam.

The A~~a~~pplicant indicates land will be purchased in the event that permits authorizing the construction of the proposed works are issued.

The Commission will review the application as submitted by the applicant and may or may not grant the application as requested.

The application and partial fees were received on October 17, 2005. Additional information and fees were received on January 31, March 24, and April 13, 2006. The application was declared administratively complete and accepted for filing with the Office of the Chief Clerk on April 17, 2006.

PUBLIC COMMENT / PUBLIC MEETING. Written public comments and requests for a public meeting should be submitted to the Office of Chief Clerk, at the address provided in the information section below, within 30 days of the date of newspaper publication of the notice. A public meeting is intended for the taking of public comment, and is not a contested case hearing. A public meeting will be held if the Executive Director determines that there is a significant degree of public interest in the application.

CONTESTED CASE HEARING. The TCEQ may grant a contested case hearing on this application if a written hearing request is filed within 30 days from the date of newspaper publication of this notice. The Executive Director may approve the application unless a written request for a contested case hearing is filed within 30 days after newspaper publication of this notice.

To request a contested case hearing, you must submit the following: (1) your name (or for a group or association, an official representative), mailing address, daytime phone number, and fax number, if any; (2) applicant's name and permit number; (3) the statement "[*I/we*] request a contested case hearing;" (4) a brief and specific description of how you would be affected by the application in a way not common to the general public; and (5) the location and distance of your property relative to the proposed activity. You may also submit proposed conditions for the requested permit which would satisfy your concerns. Requests for a contested case hearing must be submitted in writing to the Office of the Chief Clerk at the address provided in the information section below.

If a hearing request is filed, the Executive Director will not issue the permit and will forward the application and hearing request to the TCEQ Commissioners for their consideration at a scheduled Commission meeting.

INFORMATION. Written hearing requests, public comments or requests for a public meeting should be submitted to the Office of the Chief Clerk, MC 105, TCEQ, P.O. Box 13087, Austin, TX 78711-3087. For information concerning the hearing process, please contact the Public Interest Counsel, MC 103, the same address. For additional information, individual members of the general public may contact the Office of Public Assistance at 1-800-687-4040. General information regarding the TCEQ can be found at our web site at www.tceq.state.tx.us. Si desea información en Español, puede llamar al 1-800-687-4040.

Issued:

Attachment 1, Table 2. Developed-Water Discharge Summary

Outfall	Discharge Point Description	2-Year 24-Hour Precipitation Event		5-Year 24-Hour Precipitation Event		10-Year 24-Hour Precipitation Event		25-Year 24-Hour Precipitation Event		50-Year 24-Hour Precipitation Event		100-Year 24-Hour Precipitation Event	
		peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)
0	Canyon at Duke Street (University Avenue outfall)	645	157	645	255	645	337	645	411	645	487	645	573
1	North of Cornell & Ave Q (Avenue R outfall)	452	110	452	179	452	347	452	521	452	700	452	907
2	Ave P between Erskine & Cornell	372	90	372	147	372	194	372	237	372	280	372	330
3	Aztlan Park (at Canyon) about 300 feet west of outfall #4)	106	13	142	20	171	26	221	32	262	37	310	56
4	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	31	2	42	3	49	4	63	5	76	6	91	7
5	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	20	2.5	27	4.4	32	6	41	8	51	9	60	11
6	Aztlan Park (at Canyon northeast of outfall #5 across canyon)	189	22	239	33	290	43	374	51	454	59	535	69
7	McKenzie State Park (just west of Joyland)	60	2.6	60	3.8	60	4.8	60	5.7	60	6.6	60	7.6
8	McKenzie State Park (just east of Joyland, north of overpass)	16	1	21	1.3	25	1.7	33	2	39	2.3	46.7	2.6
9	300 feet West of Compress Ave.on E. 19th	36	25	46	41	56	55	72	68	87	80	103	95
10	300 feet West of Compress Ave.on E. 19th	54	38	69	62	84	83	109	101	130	120	154	142
11	East 26th & Southeast Dr	408	134	408	229	408	310	408	412	408	461	408	549
12	Canyon Lake, East of MLK (south of Vanda Ave.) (SH 114 outfall)	40	27	40	44	40	57	40	70	40	82	40	97
13	Canyon Lake, East of MLK (south of Zenith Ave.) (Lake L069 outfall)	300	74	300	120	300	159	300	194	300	229	300	270
14	Lift Station at IH-27 and N. Loop 289	74	2.4	74	3.4	74	4.2	74	5	74	5.7	74	6.5
15	Southeast of Municipal Dr & Northbound I-27 Frontage Rd.(Canyon)	11	0.5	14	0.7	16	1	21	1.2	25	1.4	32	1.7
16	Under Northbound I-27 at Canyon Lakes Dr (Canyon)	321	23	321	34	321	42	321	50	321	57	321	66
17	Southwest of Northbound I-27 frontage Rd. & Municipal Dr (Canyon)	19	1	25	1.6	30	2.2	35	2.7	39	3.2	44	3.9
18	At Canyon Lakes Dr Under I-27	30	24	41	39	48	51	61	62	74	73	88	86
19	Entrance to I-27 Northbound, North of Municipal Dr.	14	1	18	1.3	22	1.7	28	2.1	34	2.5	40	3
20	Southeast of Compress and E. 19th (IH-27 Section 2 Outfall)	240	31	240	47	240	60	240	72	240	83	240	97
24	East Loop 289 and East 50th Street, North side	32	162	32	295	32	422	32	545	32	672	32	822
27	Southeast of the Water Rec Plant (South Outfall) (Playa System D Outfall)	265	410	265	684	265	930	265	1,191	265	1,452	265	1,723
28	South of E. 14th and Date Ave. (West of Warehouse)	543	132	543	215	543	284	543	346	543	410	543	483
29	I-27 Northbound Frontage Rd at the Canyon (South of North Loop)	17	2	22	3	27	3.5	35	4	41	4.7	50	5.4
30	Southeast of the Water Rec Plant (North Outfall) (SCLDIP Outfall)	185	1640	185	2,384	185	3,132	185	3,804	185	4,485	185	5,274
31	South Lubbock Drainage Improvements Outfall	77	720	77	1,181	77	1,580	77	1,937	77	2,307	77	2,728
32	City of Lubbock - SEWRP (future)	Future discharges, no data available											
33	Town of Ransom Canyon	Discharges shown on Attachment No. 3											
	Totals	4,557	3,847	4,720	6,032	4,864	8,141	5,107	10,140	5,326	12,115	5,568	14,416

Lloyd Gosselink
ATTORNEYS AT LAW

816 Congress Avenue, Suite 1900
Austin, Texas 78701
Telephone: (512) 322-5800
Facsimile: (512) 472-0532
www.lglawfirm.com

TELECOPIER COVER SHEET

May 22, 2006

PLEASE DELIVER THE FOLLOWING PAGES:

To:	Iliana Delgado
Firm:	TCEQ
Telecopy No.:	(512) 239-4770
Verification No.:	(512) 239-3678
Client No.:	2020-02
From:	Brad Castleberry
No. of Pages:	10 + cover sheet
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IF YOU DO NOT RECEIVE ALL PAGES, PLEASE CALL US AS SOON AS POSSIBLE AT (512) 322-5800

Lloyd
Gosselink
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816 Congress Avenue, Suite 1900
Austin, Texas 78701
Telephone (512) 322-5800
Facsimile: (512) 472-0532
www.lglawfirm.com

Mr. Castleberry's Direct Line: (512) 322-5856
[redacted]

May 22, 2006

Ms. Iliana Delgado (MC 160)
Texas Commission on Environmental Quality
Building F, Room 359
Austin, Texas 78711-3087

VIA FACSIMILE
AND FIRST-CLASS MAIL

Re: City of Lubbock
WRPERM 5921
CN 600130736
Application No. 5921 for a Water Use Permit
TWC §11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties (2020-02)

Dear Ms. Delgado:

This letter is submitted on behalf of the City of Lubbock (the "City") in response to your letter of April 28, 2006 wherein you provided a draft notice for the above-referenced application. Please find enclosed certain revisions to the draft notice requested by the City. Please confirm acceptance of these revisions by providing a final notice prior to issuance by the Office of Chief Clerk.

Also enclosed is a revised Table 2 from our January 31, 2006 letter. The City has identified a change to the 50-year, 24 hour volume specified for Outfall 30. Please use this revised Table 2 in performing your technical review of the above-referenced application.

If you have any questions regarding these materials, please feel free to call either Martin Rochelle (512-322-5810) or me at your convenience.

Sincerely,

Brad B. Castleberry

BBC/ldp

Enclosure as noted

cc: Mr. Thomas Adams
Mr. Richard Casner
Mr. Martin C. Rochelle (without enclosure)

Revised May 8, 2006

NOTICE OF WATER RIGHTS APPLICATION

APPLICATION NO. 5921

The City of Lubbock ("Applicant" or "City") has applied for a Water Use Permit to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, Brazos River Basin~~, for in-place recreational purposes~~, ~~The Applicant further seeks~~ to divert and use water from those reservoirs, and to use the bed and banks of ~~tributaries of~~ the North Fork Double Mountain Fork Brazos River, including certain specified tributaries, for the conveyance, ~~subsequent diversion and use~~ of water sought for diversion for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties. More information on the application and how to participate in the permitting process is given below.

APPLICATION. The City of Lubbock~~, applicant or City~~, P.O. Box 2000, Lubbock, TX 79457, seeks a Water Use Permit pursuant to Texas Water Code §§ 11.042, 11.046, and 11.121, and Texas Commission on Environmental Quality Rules 30 Texas Administrative Code (TAC) §§ 295.1, *et seq.* Notice is being published and mailed to the water right holders of record in the Brazos River Basin pursuant to 30 TAC § 295.151.

The ~~A~~applicant seeks a Water Use Permit for authorization to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, tributary of the Brazos River, Brazos River Basin, in Lubbock County. Structure No. 1 (known as Dam No. 7) will be located 7.6 miles southeast from the City of Lubbock at Latitude 33.534°N, Longitude 101.730°W, bearing S4.166°E, 5,227.85 feet to the southeast corner of Blk. S, ~~the~~ G.C. & S.F. R.R. Co. Survey 21, Abstract 217. It will have a capacity of 20,708 acre-feet and surface area of 801 acres. Structure No. 2 (known as Dam No. 8) will be located 15.4 miles east-southeast from the City of Lubbock at Latitude 33.486°N, Longitude 101.607°W, bearing N61.683°W, 5,514.77 feet to the northwest corner of Blk. S, ~~the~~ G.C. & S.F. R.R. Co. Survey 35, Abstract 214. It will have a capacity of 49,930 acre-feet and surface area of 1,580 acres.

The ~~A~~applicant ~~also~~ seeks to ~~use the impounded water for in-place recreational purposes and~~ divert and use water impounded in these reservoirs for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties in amount not to exceed 50,000 acre-feet of water per year, collectively, from the perimeter of the reservoir created by Dam No. 7 at a maximum diversion rate of 7.20 cfs (3,230 gpm) and from the perimeter of the reservoir created by Dam No. 8 at a maximum diversion rate of 44.56 cfs (20,000 gpm) ~~for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties~~.

The ~~A~~applicant ~~further~~ seeks authorization to impound, divert, and use water requested by the application based upon a recognition of rights ~~to the City including rights~~ related to: i) the City's claim to developed water-based stormwater discharges from the City's storm sewer system to the North Fork Double Mountain Fork Brazos River and its tributaries; ii) unappropriated state water; iii) future surface water-based return flows and developed water-based return flows resulting from the City's use of groundwater and its use of other developed waters, excluding return flows previously sought by the City pursuant to concurrent Application Nos. 12-3705B and 3985A; and iv) any and all wastewater return flows that are discharged upstream of the proposed reservoirs by third parties for the uses stated above.

TPDES Permit No. 10778, issued to the Town of Ransom Canyon, authorizes the treatment and disposale of up to 0.41 MGD of return flows~~treated effluent~~. The Aapplicant is seeking the authorization and recognition of both historical and future return flows of the Town of Ransom Canyon.

TPDES Permit No. 10353, issued to the City of Lubbock, authorizes the City to treat and dispose of 31.5 MGD of treated effluent. The Aapplicant is seeking the authorization and recognition of the difference between the City's current 31.5 MGD authorization and the 9.0 MGD of return flows that are the subject of concurrent Application No. 3985A~~, 9.0 MGD~~.

The Aapplicant has requested authorization to use the bed and banks of the North Fork Double Mountain Fork Brazos River, including certain of its tributaries, to convey water requested by the application from the points of discharge identified as follows to the points of diversion requested herein~~provided information for the proposed discharge points in Lubbock County as~~ follows:

0 Discharges of developed stormwater at Canyon at the Duke Street (University Avenue outfall) to Yellow House Draw, tributary of the North Fork Double Mountain Fork Brazos River, tributary of the Brazos River, Brazos River Basin, 1.6 miles northwest of the City of Lubbock, located at Latitude 33.60523°N, Longitude 101.86032°W and bearing S77.46222'E, 2,280.76 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The Aapplicant indicates the outfall is 14.23 miles upstream of Dam 7, with 91.78% of the discharged water reaching the dam, and 24.56 miles upstream of Dam 8, with 86.24% of the water reaching that dam.

1 Discharges of developed stormwater north of Cornell & Ave Q to Yellow House Draw, 1.4 miles north/northwest of the City of Lubbock, located at Latitude 33.60388°N, Longitude 101.85564°W and bearing S38.49'E, 1,317.9 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The Aapplicant indicates the outfall is 13.91 miles upstream of Dam 7, with 91.96% of the discharged water reaching the dam, and 24.24 miles upstream of Dam 8, with 86.41% of the water reaching that dam.

2 Discharges of developed stormwater at Ave P between Erskine & Cornell to Yellow House Draw, 1.4 miles north/northwest of the City of Lubbock, located at Latitude 33.60439°N, Longitude 101.85315°W and bearing S3.68611'E, 871.68 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The Aapplicant indicates the outfall is 13.79 miles upstream of Dam 7, with 92.02% of the discharged water reaching the dam, and 24.12 miles upstream of Dam 8, with 86.47% of the water reaching that dam.

3 Discharges of developed stormwater at Aztlan Park (at Canyon about 300 feet west of outfall #4) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59928°N, Longitude 101.84506°W and bearing S45.79056'E, 3,528.03 feet from the southwest corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Aapplicant indicates the outfall is 13.17 miles upstream of Dam 7, with 92.37% of the discharged water reaching the dam, and 23.50 miles upstream of Dam 8, with 86.79% of the water reaching that dam.

4 Discharges of developed stormwater at Aztlan Park (at Canyon under I-27 southbound frontage road) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59908°N, Longitude 101.84420°W and bearing S44.32167'E, 3,562.48 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Aapplicant indicates the outfall is 13.12 miles upstream of Dam 7, with 92.40% of the discharged water reaching the

dam, and 23.45 miles upstream of Dam 8, with 86.82% of the water reaching that dam.

5 Discharges of developed stormwater at Aztlan Park (at Canyon under I-27 southbound frontage road) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59908°N, Longitude 101.84416°W and bearing S44.32167'E, 3,562.48 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Aapplicant indicates the outfall is 13.12 miles upstream of Dam 7, with 92.40% of the discharged water reaching the dam, and 23.45 miles upstream of Dam 8, with 86.82% of the water reaching that dam.

6 Discharges of developed stormwater at Aztlan Park (at Canyon northeast of outfall #5-~~across canyon~~) to an unnamed tributary of Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59970°N, Longitude 101.84401°W and bearing S46.22444'E, 3,608 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Aapplicant indicates the outfall is 13.16 miles upstream of Dam 7, with 92.37% of the discharged water reaching the dam, and 23.49 miles upstream of Dam 8, with 86.80% of the water reaching that dam.

7 Discharges of developed stormwater at McKenzie State Park (just west of Joyland) to an unnamed tributary to Yellow House Draw, 0.8 mile northeast of the City of Lubbock, located at Latitude 33.59227°N, Longitude 101.83507°W and bearing S84.91861'E, 211.81 feet from the northwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Aapplicant indicates the outfall is 12.36 miles upstream of Dam 7, with 92.82% of the discharged water reaching the dam, and 22.69 miles upstream of Dam 8, with 87.22% of the water reaching that dam.

8 Discharges of developed stormwater at McKenzie State Park (just east of Joyland, north of overpass) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile east/northeast of the City of Lubbock, located at Latitude 33.59180°N, Longitude 101.82975°W and bearing S82.4825'E, 1,841.28 feet from the northwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Aapplicant indicates the outfall is 12.05 miles upstream of Dam 7, with 92.99% of the discharged water reaching the dam, and 22.38 miles upstream of Dam 8, with 87.38% of the water reaching that dam.

9 Discharges of developed stormwater 300 feet West of Compress Ave. on E. 19th to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57822°N, Longitude 101.83005°W and bearing S86.90111'E, 1,760.48 feet from the southwest corner of Blk O of the E.L & R.R.R.R. Co. Survey 3, Abstract 24. The Aapplicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

10 Discharges of developed stormwater 300 feet West of Compress Ave. on E. 19th to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57822°N, Longitude 101.83005°W and bearing S86.90111'E, 1,760.48 feet from the southwest corner of Blk O of the E.L & R.R.R.R. Co. Survey 3, Abstract 24. The Aapplicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

11 Discharges of developed stormwater at East 26th & Southeast Dr. to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57139°N, Longitude 101.82472°W and bearing S86.57444°E, 1,729.81 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The Aapplicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

12 Discharges of developed stormwater at Canyon Lake, East of MLK (south of Vanda Ave.) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.5 miles southeast of the City of Lubbock, located at Latitude 33.57243°N, Longitude 101.82461°W and bearing S47.46139°E, 2,702.28 feet from the northeast corner of Blk B of the T.T. & R.R. Co. Survey 5, Abstract 96. The Aapplicant indicates the outfall is 9.67 miles upstream of Dam 7, with 94.34% of the discharged water reaching the dam, and 20.00 miles upstream of Dam 8, with 88.64% of the water reaching that dam.

13 Discharges of developed stormwater at Canyon Lake, East of MLK (south of Zenith Ave.) to the North Fork Double Mountain Fork Brazos River, 2.0 miles southeast of the City of Lubbock, located at Latitude 33.57558°N, Longitude 101.81202°W and bearing S66.78667°E, 2,043.69 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 3, Abstract 95. The Aapplicant indicates the outfall is 8.77 miles upstream of Dam 7, with 94.85% of the discharged water reaching the dam, and 19.10 miles upstream of Dam 8, with 89.13% of the water reaching that dam.

14 Discharges of developed stormwater at the Lift Station at I-27 & Loop 289 to Blackwater Draw, tributary of the North Fork Double Mountain Fork Brazos River, 2.2 miles north of the City of Lubbock, located at Latitude 33.61712°N, Longitude 101.84157°W and bearing S52.42056°E, 2,327.25 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 15, Abstract 85. The Aapplicant indicates the outfall is 14.77 miles upstream of Dam 7, with 91.48% of the discharged water reaching the dam, and 25.10 miles upstream of Dam 8, with 85.96% of the water reaching that dam.

15 Discharges of developed stormwater Southeast of Municipal Dr & Northbound I-27 Frontage Rd. (Canyon) to an unnamed tributary to Yellow House Draw, 1.1 miles north of the City of Lubbock, located at Latitude 33.60099°N, Longitude 101.84333°W and bearing S49.53694°E, 3,135.68 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Aapplicant indicates the outfall is 13.23 miles upstream of Dam 7, with 92.34% of the discharged water reaching the dam, and 23.56 miles upstream of Dam 8, with 86.76% of the water reaching that dam.

16 Discharges of developed stormwater under Northbound I-27 at Canyon Lakes Dr. (Canyon) to Yellow House Draw, 0.9 mile north of the City of Lubbock, located at Latitude 33.59749°N, Longitude 101.84161°W and bearing S41.47°E, 2,595.4 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Aapplicant indicates the outfall is 12.93 miles upstream of Dam 7, with 92.50% of the discharged water reaching the dam, and 23.26 miles upstream of Dam 8, with 86.92% of the water reaching that dam.

17 Discharges of developed stormwater Southwest of Northbound I-27 frontage Rd. & Municipal Dr (Canyon) to an unnamed tributary to Yellow House Draw 0.9 mile north of the City of Lubbock,

located at Latitude 33.59972°N, Longitude 100.16000°W and bearing S49.53694°E, 3,135.68 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Aapplicant indicates the outfall is 13.00 miles upstream of Dam 7, with 92.46% of the discharged water reaching the dam, and 23.33 miles upstream of Dam 8, with 86.88% of the water reaching that dam.

18 Discharges of developed stormwater at Canyon Lakes Dr. under I-27 to an unnamed tributary to Yellow House Draw, 0.9 mile north of the City of Lubbock, located at Latitude 33.59861°N, Longitude 101.84264°W and bearing S40.53222°E, 3,106.5 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The Aapplicant indicates the outfall is 13.06 miles upstream of Dam 7, with 92.43% of the discharged water reaching the dam, and 23.39 miles upstream of Dam 8, with 86.85% of the water reaching that dam.

19 Discharges of developed stormwater at the entrance to I-27 Northbound, North of Municipal Dr. to an unnamed tributary to Yellow House Draw, 1.1 miles north of the City of Lubbock, located at Latitude 33.60054°N, Longitude 101.84314°W and bearing S46.07444°E, 3,143.07 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The Aapplicant indicates the outfall is 13.20 miles upstream of Dam 7, with 92.35% of the discharged water reaching the dam, and 23.53 miles upstream of Dam 8, with 86.78% of the water reaching that dam.

20 Discharges of developed stormwater Southeast of Compress and E. 19th , to the North Fork Double Mountain Fork Brazos River, 1.2 miles southeast of the City of Lubbock, located at Latitude 33.57781°N, Longitude 101.82668°W and bearing S88.36028°E, 2,747.95 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 5, Abstract 96. The Aapplicant indicates the outfall is 9.78 miles upstream of Dam 7, with 94.28% of the discharged water reaching the dam, and 20.11 miles upstream of Dam 8, with 88.58% of the water reaching that dam.

24 Discharges of developed stormwater at East Loop 289 & E. 50th (northeast corner) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 4.2 miles southeast of the City of Lubbock, located at Latitude 33.54905°N, Longitude 101.78690°W and bearing S82.34028°E, 914.11 feet from the southeast corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The Aapplicant indicates the outfall is 6.08 miles upstream of Dam 7, with 96.40% of the discharged water reaching the dam, and 16.41 miles upstream of Dam 8, with 90.58% of the water reaching that dam.

27 Discharges of developed stormwater Southeast of the Water Rec Plant (South Outfall) to the North Fork Double Mountain Fork Brazos River 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55945°N, Longitude 101.79633°W and bearing S44.395°E, 2,013.56 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The Aapplicant indicates the outfall is 7.09 miles upstream of Dam 7, with 95.82% of the discharged water reaching the dam, and 17.42 miles upstream of Dam 8, with 90.03% of the water reaching that dam.

28 Discharges of developed stormwater South of E. 14th and Date Ave. (West of Warehouse) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 0.7 mile east/southeast of the City of Lubbock, located at Latitude 33.58224°N, Longitude 101.83307°W and bearing S27.23306°E, 1,812.26 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co.

Survey 3, Abstract 24. The Aapplicant indicates the outfall is 10.27 miles upstream of Dam 7, with 94.00% of the discharged water reaching the dam, and 20.60 miles upstream of Dam 8, with 88.32% of the water reaching that dam.

29 Discharges of developed stormwater at I-27 Northbound Frontage Rd at the Canyon (South of N. Loop) to Blackwater Draw, 2.1 miles north of the City of Lubbock, located at Latitude 33.61496°N, Longitude 101.84373°W and bearing S49.26833°E, 3,317.43 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 15, Abstract 85. The Aapplicant indicates the outfall is 14.63 miles upstream of Dam 7, with 91.56% of the discharged water reaching the dam, and 24.96 miles upstream of Dam 8, with 86.03% of the water reaching that dam.

30 Discharges of developed stormwater Southeast of the Water Rec Plant (North Outfall) to the North Fork Double Mountain Fork Brazos River, 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55967°N, Longitude 101.79653°W and bearing S44.91889°E, 1,913.61 feet from the northwest corner of Blk B of the T.T. & R.R Co. Survey 1, Abstract 93. The Aapplicant indicates the outfall is 7.11 miles upstream of Dam 7, with 95.81% of the discharged water reaching the dam, and 17.44 miles upstream of Dam 8, with 90.02% of the water reaching that dam.

31 Discharges of developed stormwater at South Lubbock Drainage Improvements Outfall to the North Fork Double Mountain Fork Brazos River, 5.2 miles southeast of the City of Lubbock, located at Latitude 33.53361°N, Longitude 101.77878°W and bearing S52.195°E, 568.64 feet from the northwest corner of Blk. S of the G.C. & S.F. Ry~~-R.~~ Survey 11, Abstract 216. The Aapplicant indicates the outfall is 3.55 miles upstream of Dam 7, with 97.88% of the discharged water reaching the dam, and 13.88 miles upstream of Dam 8, with 91.97% of the water reaching that dam.

32 Discharges of treated effluent at the City of Lubbock - SEWRP to the North Fork Double Mountain Fork Brazos River, 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55961°N, Longitude 101.79654°W and bearing S26.02139°E, 10,389.04 feet from the northwest corner of Blk S of the G.C. & S.F. Ry-R. Survey 11, Abstract 216. The Aapplicant indicates the outfall is 7.12 miles upstream of Dam 7, with 95.80% of the discharged water reaching the dam, and 17.45 miles upstream of Dam 8, with 90.02% of the water reaching that dam.

33 Discharges of treated effluent at the Town of Ransom Canyon to the North Fork Double Mountain Fork Brazos River, 10.5 miles southeast of the City of Lubbock, located at Latitude 31.43567°N, Longitude 101.67819°W and bearing S61.96722°E, 7,326.72 feet from the northeast corner of Blk I of the J.M. Kidwell Survey 4, Abstract 437. The Aapplicant indicates the outfall is downstream of Dam 7 and 5.64 miles upstream of Dam 8 with 96.66% of the water reaching that dam.

The Aapplicant indicates land will be purchased in the event that permits authorizing the construction of the proposed works are issued.

The Commission will review the application as submitted by the applicant and may or may not grant the application as requested.

The application and partial fees were received on October 17, 200. Additional information and fees were received on January 31, March 24, and April 13, 2006. The application was declared administratively complete and accepted for filing with the Office of the Chief Clerk on April 17, 2006.

PUBLIC COMMENT / PUBLIC MEETING. Written public comments and requests for a public meeting should be submitted to the Office of Chief Clerk, at the address provided in the information section below, within 30 days of the date of newspaper publication of the notice. A public meeting is intended for the taking of public comment, and is not a contested case hearing. A public meeting will be held if the Executive Director determines that there is a significant degree of public interest in the application.

CONTESTED CASE HEARING. The TCEQ may grant a contested case hearing on this application if a written hearing request is filed within 30 days from the date of newspaper publication of this notice. The Executive Director may approve the application unless a written request for a contested case hearing is filed within 30 days after newspaper publication of this notice.

To request a contested case hearing, you must submit the following: (1) your name (or for a group or association, an official representative), mailing address, daytime phone number, and fax number, if any; (2) applicant's name and permit number; (3) the statement "[*I/we*] request a contested case hearing;" (4) a brief and specific description of how you would be affected by the application in a way not common to the general public; and (5) the location and distance of your property relative to the proposed activity. You may also submit proposed conditions for the requested permit which would satisfy your concerns. Requests for a contested case hearing must be submitted in writing to the Office of the Chief Clerk at the address provided in the information section below.

If a hearing request is filed, the Executive Director will not issue the permit and will forward the application and hearing request to the TCEQ Commissioners for their consideration at a scheduled Commission meeting.

INFORMATION. Written hearing requests, public comments or requests for a public meeting should be submitted to the Office of the Chief Clerk, MC 105, TCEQ, P.O. Box 13087, Austin, TX 78711-3087. For information concerning the hearing process, please contact the Public Interest Counsel, MC 103, the same address. For additional information, individual members of the general public may contact the Office of Public Assistance at 1-800-687-4040. General information regarding the TCEQ can be found at our web site at www.tceq.state.tx.us. Si desea información en Español, puede llamar al 1-800-687-4040.

Issued:

Attachment 1, Table 2. Developed-Water Discharge Summary

Outfall	Discharge Point Description	2-Year 24-Hour Precipitation Event		5-Year 24-Hour Precipitation Event		10-Year 24-Hour Precipitation Event		25-Year 24-Hour Precipitation Event		50-Year 24-Hour Precipitation Event		100-Year 24-Hour Precipitation Event	
		peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)
0	Canyon at Duke Street (University Avenue outfall)	645	157	645	255	645	337	645	411	645	487	645	573
1	North of Cornell & Ave Q (Avenue R outfall)	452	110	452	179	452	347	452	521	452	700	452	907
2	Ave P between Erskine & Cornell	372	90	372	147	372	194	372	237	372	280	372	330
3	Aztlan Park (at Canyon) about 300 feet west of outfall #4	106	13	142	20	171	20	221	32	262	37	310	56
4	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	31	2	42	3	49	4	63	5	78	6	91	7
5	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	20	2.5	27	4.4	32	6	41	8	51	9	60	11
6	Aztlan Park (at Canyon northeast of outfall #5 across canyon)	189	22	239	33	290	43	374	51	454	59	535	69
7	McKenzie State Park (just west of Joyland)	60	2.8	60	3.8	60	4.8	60	5.7	60	6.6	60	7.6
8	McKenzie State Park (just east of Joyland, north of overpass)	18	1	21	1.3	25	1.7	33	2	39	2.3	46.7	2.6
9	300 feet West of Compress Ave.on E. 19th	36	25	48	41	56	55	72	68	87	80	103	95
10	300 feet West of Compress Ave.on E. 19th	54	38	69	62	84	83	109	101	130	120	154	142
11	East 26th & Southeast Dr	408	134	408	229	408	310	408	412	408	461	408	549
12	Canyon Lake, East of MLK (south of Vanda Ave.) (SH 114 outfall)	40	27	40	44	40	57	40	70	40	82	40	97
13	Canyon Lake, East of MLK (south of Zenith Ave.) (Lake L069 outfall)	300	74	300	120	300	159	300	194	300	229	300	270
14	Lift Station at IH-27 and N. Loop 289	74	2.4	74	3.4	74	4.2	74	5	74	5.7	74	6.5
15	Southeast of Municipal Dr & Northbound I-27 Frontage Rd.(Canyon)	11	0.5	14	0.7	16	1	21	1.2	25	1.4	32	1.7
16	Under Northbound I-27 at Canyon Lakes Dr (Canyon)	321	23	321	34	321	42	321	50	321	57	321	66
17	Southwest of Northbound I-27 frontage Rd. & Municipal Dr (Canyon)	19	1	25	1.6	30	2.2	35	2.7	39	3.2	44	3.8
18	At Canyon Lakes Dr Under I-27	30	24	41	39	48	51	61	62	74	73	88	86
19	Entrance to I-27 Northbound, North of Municipal Dr.	14	1	18	1.3	22	1.7	28	2.1	34	2.5	40	3
20	Southeast of Compress and E. 19th (IH-27 Section 2 Outfall)	240	31	240	47	240	60	240	72	240	83	240	97
24	East Loop 289 and East 50th Street, North side	32	162	32	295	32	422	32	545	32	672	32	822
27	Southeast of the Water Rec Plant (South Outfall) (Playa System D Outfall)	265	410	265	684	265	930	265	1,191	265	1,452	265	1,723
28	South of E. 14th and Date Ave. (West of Warehouse)	543	132	543	215	543	284	543	346	543	410	543	483
29	I-27 Northbound Frontage Rd at the Canyon (South of North Loop)	17	2	22	3	27	3.5	35	4	41	4.7	50	5.4
30	Southeast of the Water Rec Plant (North Outfall) (SCLDIP Outfall)	185	1840	185	2,384	185	3,132	185	3,804	185	4,405	185	5,274
[illegible]	[illegible]	77	720	77	1,161	77	1,560	77	1,937	77	2,307	77	2,728
32	City of Lubbock - SEWRP (future)	Future discharges, no data available											
33	Town of Ransom Canyon	Discharges shown on Attachment No. 3											
	Totals	4,557	3,847	4,720	6,032	4,864	8,141	5,107	10,140	5,326	12,115	5,568	14,416

Kathleen Hartnett White, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
Protecting Texas by Reducing and Preventing Pollution

April 28, 2006

Mr. Brad B. Castleberry
Lloyd Gosselink
816 Congress Avenue, Suite 1900
Austin, TX 78701

RE: City of Lubbock
WRPERM 5921
CN 600130736
Application No. 5921 for a Water Use Permit
TWC §11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

Dear Mr. Castleberry:

Enclosed is the draft notice, subject to revision, for the referenced application. Please review and provide any comments no later than May 10, 2006 as it will be forwarded to the Office of the Chief Clerk for mailing after that date.

Please note I have referenced page 621 of the General Land Office's *Abstract of all Original Texas Land Titles Comprising Grants and Locations to August 31, 1942*, copy enclosed, and edited the bearing and distances provided in your April 13, 2006 letter.

If you have any questions concerning this application, please contact me at (512) 239-3678 or by email at idelgado@tceq.state.tx.us.

Sincerely,

Iliana Delgado Mail Code 160
Water Rights Permitting Team

Enclosures

DRAFT

NOTICE OF WATER RIGHTS APPLICATION
APPLICATION NO. 5921

The City of Lubbock has applied for a Water Use Permit to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, for in-place recreational purposes. The Applicant further seeks to divert and use water from those reservoirs and use the bed and banks of tributaries of the North Fork Double Mountain Fork Brazos River for subsequent diversion and use of water for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties. More information on the application and how to participate in the permitting process is given below.

APPLICATION. The City of Lubbock, applicant or City, P.O. Box 2000, Lubbock, TX 79457, seeks a Water Use Permit pursuant to Texas Water Code §§11.042, 11.046, and 11.121, and Texas Commission on Environmental Quality Rules 30 Texas Administrative Code (TAC) §§295.1, *et seq.* Notice is being published and mailed to the water right holders of record in the Brazos River Basin pursuant to 30 TAC §295.151.

The applicant seeks a Water Use Permit for authorization to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, tributary of the Brazos River, Brazos River Basin, in Lubbock County. Structure No. 1 (known as Dam No. 7) will be located 7.6 miles southeast from the City of Lubbock at Latitude 33.534°N, Longitude 101.730°W, bearing S4.166°E, 5,227.85 feet to the southeast corner of the G.C. & S.F. R.R. Co. Survey 21, Abstract 217. It will have a capacity of 20,708 acre-feet and surface area of 801 acres. Structure No. 2 (known as Dam No. 8) will be located 15.4 miles southeast from the City of Lubbock at Latitude 33.486°N, Longitude 101.607°W, bearing N61.683°W, 5,514.77 feet to the northwest corner of the G.C. & S.F. R.R. Co. Survey 35, Abstract 214. It will have a capacity of 49,930 acre-feet and surface area of 1,680 acres.

The applicant also seeks to use the impounded water for in-place recreational purposes and divert and use not to exceed 50,000 acre-feet of water per year from the perimeter of the reservoir created by Dam No. 7 at a maximum diversion rate of 7.20 cfs (3,230 gpm) and from the perimeter of the reservoir created by Dam No. 8 at a maximum diversion rate of 44.56 cfs (20,000 gpm) for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties.

The applicant further seeks recognition of rights to the City including rights related to: i. the City's claim to developed water-based stormwater discharges from the City's storm sewer system to the North Fork Double Mountain Fork Brazos River and its tributaries; ii. unappropriated state water; iii. future surface water-based return flows and developed water-based return flows resulting from the City's use of groundwater and its use of other developed waters, excluding return flows previously sought by the City pursuant to concurrent Application Nos. 12-3705B and 3985A; and iv. any and all wastewater return flows that are discharged upstream of the proposed reservoirs by third parties for the uses stated above.

TPDES Permit No. 10778, issued to the Town of Ransom Canyon, authorizes the treat and dispose of 0.41 MGD of treated effluent. The applicant is seeking the authorization and recognition of both historical and future return flows of the Town of Ransom Canyon.

TPDES Permit No. 10353, issued to the City of Lubbock, authorizes the City to treat and dispose of 31.5 MGD of treated effluent. The applicant is seeking the authorization and recognition of the difference between the City's current 31.5 MGD authorization and the flows that are the subject of concurrent Application No. 3985A, 9.0 MGD.

The applicant has provided information for the proposed discharge points in Lubbock County as follows:

0 Discharges of developed stormwater at Canyon at the Duke Street (University Avenue outfall) to Yellow House Draw, tributary of the North Fork Double Mountain Fork Brazos River, tributary of the Brazos River, Brazos River Basin, 1.6 miles northwest of the City of Lubbock, located at Latitude 33.60523°N, Longitude 101.86032°W and bearing S77.46222°E, 2,280.76 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The applicant indicates the outfall is 14.23 miles upstream of Dam 7, with 91.78% of the discharged water reaching the dam, and 24.56 miles upstream of Dam 8, with 86.24% of the water reaching that dam.

1 Discharges of developed stormwater north of Cornell & Ave Q to Yellow House Draw, 1.4 miles north/northwest of the City of Lubbock, located at Latitude 33.60388°N, Longitude 101.85564°W and bearing S38.49°E, 1,317.9 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The applicant indicates the outfall is 13.91 miles upstream of Dam 7, with 91.96% of the discharged water reaching the dam, and 24.24 miles upstream of Dam 8, with 86.41% of the water reaching that dam.

2 Discharges of developed stormwater at Ave P between Erskine & Cornell to Yellow House Draw, 1.4 miles north/northwest of the City of Lubbock, located at Latitude 33.60439°N, Longitude 101.85315°W and bearing S3.68611°E, 871.68 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92. The applicant indicates the outfall is 13.79 miles upstream of Dam 7, with 92.02% of the discharged water reaching the dam, and 24.12 miles upstream of Dam 8, with 86.47% of the water reaching that dam.

3 Discharges of developed stormwater at Aztlan Park (at Canyon about 300 feet west of outfall #4) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59928°N, Longitude 101.84506°W and bearing S45.79056°E, 3,528.02 feet from the southwest corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The applicant indicates the outfall is 13.17 miles upstream of Dam 7, with 92.37% of the discharged water reaching the dam, and 23.50 miles upstream of Dam 8, with 86.79% of the water reaching that dam.

4 Discharges of developed stormwater at Aztlan Park (at Canyon under I-27 southbound frontage road) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59908°N, Longitude 101.84420°W and bearing S44.32167°E, 3,562.48 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The applicant indicates the outfall is 13.12 miles upstream of Dam 7, with 92.40% of the discharged water reaching the dam, and 23.45 miles upstream of Dam 8, with 86.82% of the water reaching that dam.

5 Discharges of developed stormwater at Aztlan Park (at Canyon under I-27 southbound frontage road) to Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59908°N, Longitude 101.84416°W and bearing S44.32167°E, 3,562.48 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The applicant indicates the outfall is 13.12

miles upstream of Dam 7, with 92.40% of the discharged water reaching the dam, and 23.45 miles upstream of Dam 8, with 86.82% of the water reaching that dam.

6 Discharges of developed stormwater at Aztlan Park (at Canyon northeast of outfall #5 across canyon) to an unnamed tributary of Yellow House Draw, 1.0 mile north of the City of Lubbock, located at Latitude 33.59970°N, Longitude 101.84401°W and bearing S46.22444°E, 3,608 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The applicant indicates the outfall is 13.16 miles upstream of Dam 7, with 92.37% of the discharged water reaching the dam, and 23.49 miles upstream of Dam 8, with 86.80% of the water reaching that dam.

7 Discharges of developed stormwater at McKenzie State Park (just west of Joyland) to an unnamed tributary to Yellow House Draw, 0.8 mile northeast of the City of Lubbock, located at Latitude 33.59227°N, Longitude 101.83507°W and bearing S84.91861°E, 211.81 feet from the northwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The applicant indicates the outfall is 12.36 miles upstream of Dam 7, with 92.82% of the discharged water reaching the dam, and 22.69 miles upstream of Dam 8, with 87.22% of the water reaching that dam.

8 Discharges of developed stormwater at McKenzie State Park (just east of Joyland, north of overpass) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile east/northeast of the City of Lubbock, located at Latitude 33.59180°N, Longitude 101.82975°W and bearing S82.4825°E, 1,841.28 feet from the northwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The applicant indicates the outfall is 12.05 miles upstream of Dam 7, with 92.99% of the discharged water reaching the dam, and 22.38 miles upstream of Dam 8, with 87.38% of the water reaching that dam.

9 Discharges of developed stormwater 300 feet West of Compress Ave. on E. 19th to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57822°N, Longitude 101.83005°W and bearing S86.90111°E, 1,760.48 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The applicant indicates the outfall is 10.04 miles upstream of Dam 7, with94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

10 Discharges of developed stormwater 300 feet West of Compress Ave. on E. 19th to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57822°N, Longitude 101.83005°W and bearing S86.90111°E, 1,760.48 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The applicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

11 Discharges of developed stormwater at East 26th & Southeast Dr. to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.0 mile southeast of the City of Lubbock, located at Latitude 33.57139°N, Longitude 101.82472°W and bearing S86.57444°E, 1,729.81 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The applicant indicates the outfall is 10.04 miles upstream of Dam 7, with 94.13% of the discharged water reaching the dam, and 20.37 miles upstream of Dam 8, with 88.45% of the water reaching that dam.

12 Discharges of developed stormwater at Canyon Lake, East of MLK (south of Vanda Ave.) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 1.5 miles southeast of the City of Lubbock, located at Latitude 33.57243°N, Longitude 101.82461°W and bearing S47.46139°E, 2,702.28 feet from the northeast corner of Blk B of the T.T. & R.R. Co. Survey 5, Abstract 96. The applicant indicates the outfall is 9.67 miles upstream of Dam 7, with 94.34% of the discharged water reaching the dam, and 20.00 miles upstream of Dam 8, with 88.64% of the water reaching that dam.

13 Discharges of developed stormwater at Canyon Lake, East of MLK (south of Zenith Ave.) to the North Fork Double Mountain Fork Brazos River, 2.0 miles southeast of the City of Lubbock, located at Latitude 33.57558°N, Longitude 101.81202°W and bearing S66.78667°E, 2,043.69 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 3, Abstract 95. The applicant indicates the outfall is 8.77 miles upstream of Dam 7, with 94.85% of the discharged water reaching the dam, and 19.10 miles upstream of Dam 8, with 89.13% of the water reaching that dam.

14 Discharges of developed stormwater at the Lift Station at I-27 & Loop 289 to Blackwater Draw, tributary of the North Fork Double Mountain Fork Brazos River, 2.2 miles north of the City of Lubbock, located at Latitude 33.61712°N, Longitude 101.84157°W and bearing S52.42056°E, 2,327.25 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 15, Abstract 85. The applicant indicates the outfall is 14.77 miles upstream of Dam 7, with 91.48% of the discharged water reaching the dam, and 25.10 miles upstream of Dam 8, with 85.96% of the water reaching that dam.

15 Discharges of developed stormwater Southeast of Municipal Dr & Northbound I-27 Frontage Rd. (Canyon) to an unnamed tributary to Yellow House Draw, 1.1 miles north of the City of Lubbock, located at Latitude 33.60099°N, Longitude 101.84333°W and bearing S49.53694°E, 3,135.68 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The applicant indicates the outfall is 13.23 miles upstream of Dam 7, with 92.34% of the discharged water reaching the dam, and 23.56 miles upstream of Dam 8, with 86.76% of the water reaching that dam.

16 Discharges of developed stormwater under Northbound I-27 at Canyon Lakes Dr. (Canyon) to Yellow House Draw, 0.9 mile north of the City of Lubbock, located at Latitude 33.59749°N, Longitude 101.84161°W and bearing S41.47°E, 2,595.4 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The applicant indicates the outfall is 12.93 miles upstream of Dam 7, with 92.50% of the discharged water reaching the dam, and 23.26 miles upstream of Dam 8, with 86.92% of the water reaching that dam.

17 Discharges of developed stormwater Southwest of Northbound I-27 frontage Rd. & Municipal Dr (Canyon) to an unnamed tributary to Yellow House Draw 0.9 mile north of the City of Lubbock, located at Latitude 33.59972°N, Longitude 100.16000°W and bearing S49.53694°E, 3,135.68 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The applicant indicates the outfall is 13.00 miles upstream of Dam 7, with 92.46% of the discharged water reaching the dam, and 23.33 miles upstream of Dam 8, with 86.88% of the water reaching that dam.

18 Discharges of developed stormwater at Canyon Lakes Dr. under I-27 to an unnamed tributary to Yellow House Draw, 0.9 mile north of the City of Lubbock, located at Latitude 33.59861°N, Longitude 101.84264°W and bearing S40.53222°E, 3,106.5 feet from the southeast corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331. The applicant indicates the outfall is 13.06 miles upstream of Dam 7, with 92.43% of the discharged water reaching the dam, and 23.39 miles upstream of Dam 8, with 86.85% of the water reaching that dam.

19 Discharges of developed stormwater at the entrance to I-27 Northbound, North of Municipal Dr. to an unnamed tributary to Yellow House Draw, 1.1 miles north of the City of Lubbock, located at Latitude 33.60054°N, Longitude 101.84314°W and bearing S46.07444°E, 3,143.07 feet from the northeast corner of Blk A of the W.E. Penny Survey 80, Abstract 995. The applicant indicates the outfall is 13.20 miles upstream of Dam 7, with 92.35% of the discharged water reaching the dam, and 23.53 miles upstream of Dam 8, with 86.78% of the water reaching that dam.

20 Discharges of developed stormwater Southeast of Compress and E. 19th, to the North Fork Double Mountain Fork Brazos River, 1.2 miles southeast of the City of Lubbock, located at Latitude 33.57781°N, Longitude 101.82668°W and bearing S88.36028°E, 2,747.95 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 5, Abstract 96. The applicant indicates the outfall is 9.78 miles upstream of Dam 7, with 94.28% of the discharged water reaching the dam, and 20.11 miles upstream of Dam 8, with 88.58% of the water reaching that dam.

24 Discharges of developed stormwater at East Loop 289 & E. 50th (northeast corner) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 4.2 miles southeast of the City of Lubbock, located at Latitude 33.54905°N, Longitude 101.78690°W and bearing S82.34028°E, 914.11 feet from the southeast corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The applicant indicates the outfall is 6.08 miles upstream of Dam 7, with 96.40% of the discharged water reaching the dam, and 16.41 miles upstream of Dam 8, with 90.58% of the water reaching that dam.

27 Discharges of developed stormwater Southeast of the Water Rec Plant (South Outfall) to the North Fork Double Mountain Fork Brazos River 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55945°N, Longitude 101.79633°W and bearing S44.395°E, 2,013.56 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The applicant indicates the outfall is 7.09 miles upstream of Dam 7, with 95.82% of the discharged water reaching the dam, and 17.42 miles upstream of Dam 8, with 90.03% of the water reaching that dam.

28 Discharges of developed stormwater South of E. 14th and Date Ave. (West of Warehouse) to an unnamed tributary to the North Fork Double Mountain Fork Brazos River, 0.7 mile east/southeast of the City of Lubbock, located at Latitude 33.58224°N, Longitude 101.83307°W and bearing S27.23306°E, 1,812.26 feet from the southwest corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24. The applicant indicates the outfall is 10.27 miles upstream of Dam 7, with 94.00% of the discharged water reaching the dam, and 20.60 miles upstream of Dam 8, with 88.32% of the water reaching that dam.

29 Discharges of developed stormwater at I-27 Northbound Frontage Rd at the Canyon (South of N. Loop) to Blackwater Draw, 2.1 miles north of the City of Lubbock, located at Latitude 33.61496°N, Longitude 101.84373°W and bearing S49.26833°E, 3,317.43 feet from the northeast corner of Blk A of the T.T. & R.R. Co. Survey 15, Abstract 85. The applicant indicates the outfall is 14.63 miles upstream of Dam 7, with 91.56% of the discharged water reaching the dam, and 24.96 miles upstream of Dam 8, with 86.03% of the water reaching that dam.

30 Discharges of developed stormwater Southeast of the Water Rec Plant (North Outfall) to the North Fork Double Mountain Fork Brazos River, 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55967°N, Longitude 101.79653°W and bearing S44.91889°E, 1,913.61 feet from the northwest corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93. The applicant indicates the

outfall is 7.11 miles upstream of Dam 7, with 95.81% of the discharged water reaching the dam, and 17.44 miles upstream of Dam 8, with 90.02% of the water reaching that dam.

31 Discharges of developed stormwater at South Lubbock Drainage Improvements Outfall to the North Fork Double Mountain Fork Brazos River, 5.2 miles southeast of the City of Lubbock, located at Latitude 33.53361°N, Longitude 101.77878°W and bearing S52.195°E, 568.64 feet from the northwest corner of Blk. S of the G.C. & S.F. R.R. Survey 11, Abstract 216. The applicant indicates the outfall is 3.55 miles upstream of Dam 7, with 97.88% of the discharged water reaching the dam, and 13.88 miles upstream of Dam 8, with 91.97% of the water reaching that dam.

32 Discharges of treated effluent at the City of Lubbock - SEWRP to the North Fork Double Mountain Fork Brazos River, 3.3 miles southeast of the City of Lubbock, located at Latitude 33.55961°N, Longitude 101.79654°W and bearing S26.62139°E, 10,389.04 feet from the northwest corner of Blk S of the G.C. & S.F. R.R. Survey 11, Abstract 216. The applicant indicates the outfall is 7.12 miles upstream of Dam 7, with 95.80% of the discharged water reaching the dam, and 17.45 miles upstream of Dam 8, with 90.02% of the water reaching that dam.

33 Discharges of treated effluent at the Town of Ransom Canyon to the North Fork Double Mountain Fork Brazos River, 10.5 miles southeast of the City of Lubbock, located at Latitude 31.43567°N, Longitude 101.67819°W and bearing S61.96722°E, 7,326.72 feet from the northeast corner of Blk I of the J.M. Kidwell Survey 4, Abstract 437. The applicant indicates the outfall is downstream of Dam 7 and 5.64 miles upstream of Dam 8, with 96.66% of the water reaching that dam.

The applicant indicates land will be purchased in the event that permits authorizing the construction of the proposed works are issued.

The Commission will review the application as submitted by the applicant and may or may not grant the application as requested.

The application and partial fees were received on October 17, 2005. Additional information and fees were received on January 31, March 24, and April 13, 2006. The application was declared administratively complete and accepted for filing with the Office of the Chief Clerk on April 17, 2006.

PUBLIC COMMENT / PUBLIC MEETING. Written public comments and requests for a public meeting should be submitted to the Office of Chief Clerk, at the address provided in the information section below, within 30 days of the date of newspaper publication of the notice. A public meeting is intended for the taking of public comment, and is not a contested case hearing. A public meeting will be held if the Executive Director determines that there is a significant degree of public interest in the application.

CONTESTED CASE HEARING. The TCEQ may grant a contested case hearing on this application if a written hearing request is filed within 30 days from the date of newspaper publication of this notice. The Executive Director may approve the application unless a written request for a contested case hearing is filed within 30 days after newspaper publication of this notice.

To request a contested case hearing, you must submit the following: (1) your name (or for a group or association, an official representative), mailing address, daytime phone number, and fax number, if any; (2) applicant's name and permit number; (3) the statement "[*I/we*] request a contested case hearing;" (4) a brief and specific description of how you would be affected by the application in a way not common to the general public; and (5) the location and distance of your property relative to the proposed activity. You may also submit proposed conditions for the requested permit which would satisfy your concerns. Requests for a contested case hearing must be submitted in writing to the Office of the Chief Clerk at the address provided in the information section below.

If a hearing request is filed, the Executive Director will not issue the permit and will forward the application and hearing request to the TCEQ Commissioners for their consideration at a scheduled Commission meeting.

INFORMATION. Written hearing requests, public comments or requests for a public meeting should be submitted to the Office of the Chief Clerk, MC 105, TCEQ, P.O. Box 13087, Austin, TX 78711-3087. For information concerning the hearing process, please contact the Public Interest Counsel, MC 103, the same address. For additional information, individual members of the general public may contact the Office of Public Assistance at 1-800-687-4040. General information regarding the TCEQ can be found at our web site at www.tceq.state.tx.us. Si desea información en Español, puede llamar al 1-800-687-4040.

Issued: DRAFT

Kathleen Hartnett White, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

April 17, 2006

Mr. Martin Rochelle
Lloyd Gosselink Blevins Rochelle & Townsend, P.C.
111 Congess Avenue, Suite 1800
Austin, TX 78701

RE: City of Lubbock
WRPERM 5921
CN 600130736
Application No. 5921 for a Water Use Permit
TWC §11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

Dear Mr. Rochelle:

This acknowledges receipt of additional information and fees on March 24 and April 13, 2006.

The application was declared administratively complete and filed with the Office of the Chief Clerk on April 17, 2006. I will begin processing the application for consideration by the Executive Director.

Please be advised that additional information may be requested during the technical review phase of the application process.

If you have any questions concerning the application, please contact me at (512) 239-3678 or at idelgado@tceq.state.tx.us.

Sincerely,

Iliana Delgado - Mail Code 160
Water Rights Permitting Team
Water Rights Permitting & Availability Section

P.O. Box 13087 • Austin, Texas 78711-3087 • 512/239-1000 • Internet address: www.tceq.state.tx.us

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Chief Clerk

Date: April 17, 2006

Thru: Kellye Rila KR
Team Leader
Water Rights Permitting Team

From: Iliana Delgado
Water Rights Permitting Team

Subject: City of Lubbock
WRPERM 5921
CN 600130736, RN – see attached list
Application No. 5921 for a Water Use Permit
TWC §11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

TEXAS
COMMISSION
ON ENVIRONMENTAL
QUALITY
2006 APR 17 PM 1:59
CHIEF CLERKS OFFICE

The application and partial fees were received on October 17, 2005. Additional information and fees were received on January 31, March 24, and April 13, 2006. The application was declared administratively complete and accepted for filing on April 17, 2006. Mailed and published notice of the application is required pursuant to 30 TAC §295.151.

The City of Lubbock has applied for a Water Use Permit to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, for in-place recreational purposes. The Applicant further seeks to divert and use water from those reservoirs and use the bed and banks of tributaries of the North Fork Double Mountain Fork Brazos River for subsequent diversion and use of water for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties.

All fees have been paid, and the application is sufficient for filing.

Iliana Delgado
Water Rights Permitting Team
Water Supply Division

CN600130736	City of Lubbock
RN104917984	11205921501 DL1 WRPERM 5921
RN104917992	11205921502 DL2 WRPERM 5921
RN104918008	11205921503 DL3 WRPERM 5921
RN104918016	11205921504 DL4 WRPERM 5921
RN104918024	11205921505 DL5 WRPERM 5921
RN104918032	11205921506 DL6 WRPERM 5921
RN104918040	11205921507 DL7 WRPERM 5921
RN104918057	11205921508 DL8 WRPERM 5921
RN104918065	11205921509 DL9 WRPERM 5921
RN104918073	11205921510 DL10 WRPERM 5921
RN104918081	11205921511 DL11 WRPERM 5921
RN104918099	11205921512 DL12 WRPERM 5921
RN104918107	11205921513 DL13 WRPERM 5921
RN104918115	11205921514 DL14 WRPERM 5921
RN104918131	11205921515 DL15 WRPERM 5921
RN104918149	11205921516 DL16 WRPERM 5921
RN104918156	11205921517 DL17 WRPERM 5921
RN104918164	11205921518 DL18 WRPERM 5921
RN104918172	11205921519 DL19 WRPERM 5921
RN104918180	11205921520 DL20 WRPERM 5921
RN104918198	11205921521 DL21 WRPERM 5921
RN104918206	11205921522 DL22 WRPERM 5921
RN104918214	11205921523 DL23 WRPERM 5921
RN104918222	11205921524 DL24 WRPERM 5921
RN104918230	11205921525 DL25 WRPERM 5921
RN104918248	11205921526 DL26 WRPERM 5921
RN104918255	11205921527 DL27 WRPERM 5921
RN104918263	11205921528 DL28 WRPERM 5921
RN104918271	11205921301 DR1 WRPERM 5921
RN104918289	11205921302 DR2 WRPERM 5921
RN104918297	11205921001 DP1 WRPERM 5921
RN104918313	11205921002 DP2 WRPERM 5921

WRPERM 5921

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
APPLICATION FOR PERMIT TO APPROPRIATE PUBLIC WATER

Texas Water Code Section Nos. 11.042, 11.046, and 11.121
TAC Chapters 30, 50, 281, 287, 288, 295, 297 AND 299
Water Supply Division, Water Rights Permitting MC-160
***P.O. Box 13087**
Austin, Texas 78711-3087
Telephone (512) 239-4691, FAX (512) 239-4770

If including a check, mail directly to P.O. Box 13088; ZIP 78711-3088

1. **Name:** City of Lubbock, Texas

MailingAddress: P.O. Box 2000
Lubbock, Texas 79457

Email Address: [redacted]

A. **Customer Reference Number (if issued):** CN600130736

Note: If you do not have a Customer Reference Number, complete Section II of the Core Data Form (TCEQ-10400) and submit it with this application.

B. Lienholder Information (provide this information on the holder of any liens on any land to which the water right would be appurtenant): Not Applicable

2. Dam (structure), Reservoir and Watercourse Data: The City proposes to construct two (2) reservoirs. The engineering assessment and relevant data for these reservoirs is provided as Attachment A.

2.1 Structure No. 1: Dam No. 7

A. Type of Storage Reservoir (indicate by checking () all applicable)

☒ On-Channel ☐ Off-Channel ☐ Existing Structure ☒ Proposed Structure ☐ Exempt Structure*

(TWC Section 11.143 for uses of water for other than domestic or livestock use from an existing reservoir, with a capacity of 200 acre-feet or less.) Please complete Paragraph 6 below if proceeding under TWC 11.143.

Date of Construction: Commencing within two (2) years of permit issuance.

B. Location of Structure:

1) Watercourse: **North Fork Double Mountain Fork Brazos River**

2) Location from County Seat: 7.6 miles in a southeasterly direction from Lubbock, County, Texas. **(See Figure 1)**

3) Location from nearby town (if other than County Seat): N/A miles in a _____ direction from ______, a nearby town shown on county highway map.

4) The dam will be located in Lubbock County, Texas. **(See Figure 2)**

5) Station _______ on the centerline of the dam is N _____ W, _____ feet from the _______ corner of ________ Survey, Abstract No._____, in Lubbock County, Texas, also being at Latitude ________ N, Longitude _________ W.

C. Reservoir:

1) Acre-feet of water impounded by structure at normal maximum operating level: 20,708 acre-feet

2) Surface area in acres of reservoir at normal maximum operating level: 801 acres

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[illegible] 17 2005

D. 1) If this is a U.S. Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service (SCS)) floodwater-retarding structure, provide the Site No. ______________ and watershed project name **Not Applicable.**

2) Do you request authorization to close the "ports" or "windows" in the service spillway? **Not Applicable.**

☐ Yes ☐ No

E. The drainage area above the dam and/or diversion point is _________ acres or 378 square miles.

2.2 Structure No. 2: Dam No. 8

A. Type of Storage Reservoir (indicate by checking () all applicable)

☒ On-Channel ☐ Off-Channel ☐ Existing Structure ☒ Proposed Structure ☐ Exempt Structure*

(TWC Section 11.143 for uses of water for other than domestic or livestock use from an existing reservoir, with a capacity of 200 acre-feet or less.) Please complete Paragraph 6 below if proceeding under TWC 11.143.

Date of Construction: Commencing within two (2) years of permit issuance.

B. Location of Structure:

1) Watercourse: **North Fork Double Mountain Fork Brazos River**

2) Location from County Seat: 15.4 miles east-southeast from Lubbock, County, Texas. **(See Figure 1)**

3) Location from nearby town (if other than County Seat): N/A miles in a _____ direction from ______, a nearby town shown on county highway map.

4) The dam will be located in Lubbock County, Texas. **(See Figure 3)**

5) Station _______ on the centerline of the dam is N ____ W, ____ feet from the ______ corner of ________ Survey, Abstract No._____, in Lubbock County, Texas, also being at Latitude ________ N, Longitude _________ W.

C. Reservoir:

3) Acre-feet of water impounded by structure at normal maximum operating level: 49,930 acre-feet

4) Surface area in acres of reservoir at normal maximum operating level: 1,680 acres

D. 1) If this is a U.S. Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service (SCS)) floodwater-retarding structure, provide the Site No. ______________ and watershed project name **Not Applicable.**

2) Do you request authorization to close the "ports" or "windows" in the service spillway? **Not Applicable.**

☐ Yes ☐ No

E. The drainage area above the dam and/or diversion point is _________ acres or 408 square miles.*

***The drainage area for Dam No. 8 encompasses the drainage area for Dam No. 7.**

3. **Appropriation Request (total amount of water needed, including maximum projected uses and accounting for evaporative losses for off-channel storage, if applicable).**

A. Appropriated water will be used as follows:

	Purpose*	Place of Use	Acre-feet per year
1)	**Municipal/Industrial/ Agricultural**	**All or a part of Lubbock and Lynn Counties**	**50,000**[1]
2)			
3)			

(1) This application is filed pursuant to Water Code § § 11.121, 11.042 and 11.046 and proposes the recognition of rights to the City under any and all theories of water rights law, including rights related to i) the City's claim to developed water-based storm water discharges from the City's storm sewer system to the North Fork Double Mountain Fork Brazos River and its tributaries, ii) unappropriated state water, iii) future surface water-based return flows and developed water-based return flows resulting from the City's use of groundwater and its use of other developed waters, excluding return flows previously sought by the City pursuant to Application Nos. CA 12-3705B and Permit 3985A, which are currently pending at the Commission, and iv) any and all wastewater return flows that are discharged upstream of Lakes 7 or 8 by third parties.

*If agricultural use, list crops(s) to be irrigated: No commercial crops to be irrigated.

B. Lands to be irrigated (if applicable):

The City proposes to make raw water available to golf courses, other commercial, and other domestic irrigation users to support the City's conservation initiatives.

C. Diversion Point **No. 01.**

1) Watercourse: **North Fork Double Mountain Fork Brazos River**

2) Location of point of diversion: **Anywhere along the perimeter of the reservoir created by Dam No. 7.**

3) Location from County Seat: 7.6 miles in a southeasterly direction from Lubbock County, Texas. Location from nearby town (if other than County Seat): ______ miles in a ______ direction from _______, a nearby town shown on county highway map.

4) The diversion will be (check all appropriate boxes and if applicable, indicate whether existing or proposed):

		Existing	Proposed
	Directly from stream		
X	From an on-channel reservoir		X
	From stream to an off-channel reservoir		
	From a stream to an on-channel reservoir		
	From an off-channel reservoir		
	Other method (explain fully, use additional sheets if necessary)		

5) Rate of Diversion (Check () applicable provision):
_X_ 1. Diversion Facility:
A. 3,230 Maximum gpm (gallons per minute)
1) Number of pumps: 4

2) Type of pump: Unknown at this time
3) Pump capacity of each pump: 2 @ 1,100 gpm; 2 @ 550 gpm
4) Portable pump __ Yes or X__ No.

___2. If by gravity: **Not Applicable.**
A.____ Headgate _____ Diversion Dam _____ Maximum gpm
B.____ Other method (explain fully - use additional sheets if necessary)

D. Diversion Point **No. 02.**

2) Watercourse: **North Fork Double Mountain Fork Brazos River**

2) Location of point of diversion: **Anywhere along the perimeter of the reservoir created by Dam No. 8.**

3) Location from County Seat: 15.4 miles east-southeast from Lubbock County, Texas. Location from nearby town (if other than County Seat): ______ miles in a ______ direction from _______, a nearby town shown on county highway map.

4) The diversion will be (check all appropriate boxes and if applicable, indicate whether existing or proposed):

	Directly from stream	Existing	Proposed
X	From an on-channel reservoir		X
	From stream to an off-channel reservoir		
	From a stream to an on-channel reservoir		
	From an off-channel reservoir		
	Other method (explain fully, use additional sheets if necessary)		

5) Rate of Diversion (Check () applicable provision):
__X_1. Diversion Facility:
A. 20,000 Maximum gpm (gallons per minute)
1) Number of pumps: 9
2) Type of pump: Unknown at this time
3) Pump capacity of each pump: 7 @ 2,500 gpm; 2 @ 1,250 gpm
4) Portable pump __ Yes or X__ No.

___2. If by gravity: **Not Applicable.**
A.____ Headgate _____ Diversion Dam _____ Maximum gpm
B.____ Other method (explain fully - use additional sheets if necessary)

E. Return Water or Return Flow (location and quantity information): **To the extent that they may exist, return flows will be returned to the tributaries of the North Fork Double Mountain Fork Brazos River and are sought to be appropriated by the City pursuant to this application.**

F. Surplus Water: **Not Applicable.**

4. **General Information:**
A. The proposed X___ or existing _____ works will be (are) located on: **land that will be purchased by the City. Such properties will be acquired in the event that permits authorizing the construction of the proposed works are issued.**

B. If an application for the appropriation is granted, either in whole or in part, construction works will begin within two years after such permit is issued. The proposed work will be completed within five years from the date the permit is issued.

C. A Water Conservation Plan is attached? X Yes __ No

D. X Interbasin transfer is not requested.

E. Is this project located within 200 river miles of the coast? ___Yes X No __ Unknown

5. **Bed and Banks Authorization**. **By this application and pursuant to Water Code Section 11.042, the City also seeks to convey the water requested by this application within the bed and banks of the North Fork Double Mountain Fork Brazos River, including all tributaries named or unnamed, from the points of discharge to the diversion points proposed herein.**

6. **Maps, plats, plans, and drawings accompany this application as required by applicable TAC Sections.** X Yes __ No. **See figures and attachments.**

7. **Consistency.** Provide information describing how this application addresses a water supply need in a manner that is consistent with the state water plan or the applicable approved regional water plan for any area in which the proposed appropriation is located or, in the alternative, describe conditions that warrant a waiver of this requirement.

   See attached letter and associated materials dated October 10, 2005 to H.P. Brown from Thomas Adams.

Witness by my hand in LUBBOCK, Texas, this the 13th day of October, 2005.

Thomas L. Adams
Name (Printed)

Name (Printed)

SWORN TO AND SUBSCRIBED before me this 13th day of October, 2005.

REBECCA L. VEACH
MY COMMISSION EXPIRES
February 7, 2006

Rebecca L. Veach
Notary Public for the State of Texas

Lloyd
Gosselink
ATTORNEYS AT LAW

816 Congress Avenue, Suite 1900
Austin, Texas 78701
Telephone: (512) 322-5800
Facsimile: (512) 472-0532
www.lglawfirm.com

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WATER RIGHTS PERMITTING

Mr. Castleberry's Direct Line: (512) 322-5856
[redacted]

April 13, 2006

Ms. Iliana Delgado (MC 160)
Texas Commission on Environmental Quality
Building F, Room 359
Austin, Texas 78711-3087

VIA FACSIMILE
AND FIRST-CLASS MAIL

Re: City of Lubbock
WRPERM 5921
CN 600130736
Application No. 5921 for a Water Use Permit
TWC § 11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties (2020-02)

Dear Ms. Delgado:

This letter is submitted on behalf of the City of Lubbock, Texas (the "City"), in response to your electronic mail, dated April 6, 2006, and in connection with the above-referenced application (the "Application"). In response to your request for additional clarification regarding the Application, the City requests that you replace Response No. 3 from our January 31, 2006 letter with the following language. This revised response should address your request for clarification.

Response to Question No. 3:

The latitude and longitude in decimal degrees as well as the bearing and distance from an original survey corner for each reservoir.

3. This response is submitted as a supplement to Section Nos. 2.1(B)(5) and 2.2(B)(5) of the Application, respectively. The centerline of Dam No. 7 is at a point bearing South 4.166° East, 5,227.85 feet to the Southeast Corner, Section 21, Blk. S of the G.C. & SF. Ry Survey, Abstract 214, in Lubbock County, also being at Latitude 33.534°N, Longitude –101.730°W. The centerline of Dam No. 8 is at a point bearing North 61.683° West, 5,514.77 feet to the Northwest Corner of Section 35, Blk. S. of the G.C. & SF. Ry Survey, Abstract 217, in Lubbock County, also being at Latitude 33.486°N, Longitude –101.607°W.

The City looks forward to your completion of the administrative review process for this Application. If for some reason you have additional questions or need clarification regarding additional aspects of the Application, please do not hesitate to call at your convenience.

Sincerely,

Brad B. Castleberry

BBC/jlw
2020\02\ltr060412jlw

cc: Mr. Tom Adams
Ms. Sherry Stephens
Mr. David Dunn
Mr. Paul McMillen
Mr. Richard Casner
Mr. Martin C. Rochelle

LLOYD GOSSELINK BLEVINS
ROCHELLE & TOWNSEND, P.C.
P.O. Box 1725
Austin, Texas 78767
Telephone: (512) 322-5800
Facsimile: (512) 472-0532

TELECOPIER COVER SHEET

April 13, 2006

PLEASE DELIVER THE FOLLOWING PAGES TO:

NAME: Ms. Iliana Delgado (MC 160)

FIRM: TCEQ

TELECOPY PHONE NUMBER: 239-4770

VERIFICATION PHONE NUMBER: 239-3678

CLIENT NUMBER: 2020-2

FROM: Brad B. Castleberry

NUMBER OF PAGES: 2 + Cover Sheet

COMMENTS:

Lloyd
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Mr. Castleberry's Direct Line: (512) 322-5856
[redacted]

April 13, 2006

Ms. Iliana Delgado (MC 160)
Texas Commission on Environmental Quality
Building F, Room 359
Austin, Texas 78711-3087

VIA FACSIMILE
AND FIRST-CLASS MAIL

Re: City of Lubbock
WRPERM 5921
CN 600130736
Application No. 5921 for a Water Use Permit
TWC § 11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties (2020-02)

Dear Ms. Delgado:

This letter is submitted on behalf of the City of Lubbock, Texas (the "City"), in response to your electronic mail, dated April 6, 2006, and in connection with the above-referenced application (the "Application"). In response to your request for additional clarification regarding the Application, the City requests that you replace Response No. 3 from our January 31, 2006 letter with the following language. This revised response should address your request for clarification.

Response to Question No. 3:

The latitude and longitude in decimal degrees as well as the bearing and distance from an original survey corner for each reservoir.

3. This response is submitted as a supplement to Section Nos. 2.1(B)(5) and 2.2(B)(5) of the Application, respectively. The centerline of Dam No. 7 is at a point bearing South 4.166° East, 5,227.85 feet to the Southeast Corner, Section 21, Blk. S of the G.C. & SF. Ry Survey, Abstract 214, in Lubbock County, also being at Latitude 33.534°N, Longitude –101.730°W. The centerline of Dam No. 8 is at a point bearing North 61.683° West, 5,514.77 feet to the Northwest Corner of Section 35, Blk. S. of the G.C. & SF. Ry Survey, Abstract 217, in Lubbock County, also being at Latitude 33.486°N, Longitude –101.607°W.

The City looks forward to your completion of the administrative review process for this Application. If for some reason you have additional questions or need clarification regarding additional aspects of the Application, please do not hesitate to call at your convenience.

Sincerely,

Brad B. Castleberry

BBC/jlw
2020\02\ltr060412jlw

cc: Mr. Tom Adams
Ms. Sherry Stephens
Mr. David Dunn
Mr. Paul McMillen
Mr. Richard Casner
Mr. Martin C. Rochelle

Iliana Delgado - RE: City of Lubbock Application No.5921 (2020-02)

From: "Brad B. Castleberry" [redacted]
To: 'Iliana Delgado' <IDelgado@tceq.state.tx.us>
Date: 3/24/2006 10:27 AM
Subject: RE: City of Lubbock Application No.5921 (2020-02)
CC: Jennifer Waits [redacted], Martin Rochelle [redacted], Richard Casner [redacted] Thomas Adams [redacted], Paul McMillen [redacted], David Dunn [redacted], Sherry Stephens [redacted] Wood Franklin [redacted]

Iliana,

Attached is the revised survey data. As you requested, we've provided this in electronic format. Please confirm receipt of this email. If you have any other questions or need anything else, please call.

Thanks,

Brad B. Castleberry
Lloyd Gosselink Blevins Rochelle, & Townsend, P.C.
816 Congress Avenue, Suite 1900
Austin, Texas 78701
(512) 322-5856 direct line
(512) 472-0532 fax

If you would like more information about the firm, please visit our website at http://www.LGlawfirm.com/; or about our Water Practice Group, please visit http://lglawfirm.com/PracticeAreas_Water.asp

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From: Iliana Delgado [mailto:IDelgado@tceq.state.tx.us]
Sent: Tuesday, March 07, 2006 11:43 AM
To: Brad B. Castleberry
Subject: City of Lubbock

Brad,

The bearings provided are not complete; the directions were omitted, and the full survey names and numbers as well as the abstract numbers were not provided.

For example (taken from Attachment 1 for Outfall 31): bearing 52.19500°, 568.64 feet from the NW corner of Section 11, Block S.

The full description should be: bearing S52.19500°E, 568.64 feet from the NW corner of the GC & SF RR Co. Survey 11, Abstract 216 -- or -- S52.19500°E, 568.64 feet from the NW corner of Block S out of the GC & SF RR Co. Survey 11, Abstract 216.

Please provide the requested information and fees by March 28, 2006 or the application may be returned pursuant to 30 Texas Administrative Code §281.18.

-Iliana
Iliana Delgado
Water Rights Permitting Team

Iliana Delgado - city of lubbock

From: Iliana Delgado
To: Castleberry, Brad B.
Date: 4/6/2006 10:55 AM
Subject: city of lubbock

Brad,

I need just one last piece of information - which corner (the NW, SW, etc.) of the survey was the bearing and distance taken from for Structure 2 (Dam 8)?

After that I can declare this administratively complete and get the draft notice to you for review.

Thanks again,
Iliana

Iliana Delgado
Water Rights Permitting Team
Water Supply Division
(512) 239-3678 phone
(512) 239-4770 fax

Attachment 1, Table 1. Developed-Water Discharge ‹ oint Information

Outfall	Water Source	General Location	Tributary Discharged to in the Brazos River Basin	Latitude	Longitude	Nearest Section Corner	Section	Block	Original Survey	Abstract No.	County	Bearing to nearest Section Corner	Distance to nearest Section Corner feet	Method Used for Lat-Long	Maximum Discharge Rate cfs	Discharge Volume acft/yr	Purpose of Use	Location from County Seat	Distance to Dam 7 Site miles	Delivery Factor to Dam 7[1]	Distance to Dam 8 Site miles	Delivery Factor to Dam 8[1]	Full Description
0	Developed Stormwater	Canyon at Duke Street (University Avenue outfall)	Yellow House Draw	33.60523	-101.86032	NE	19	Blk A	T.T. & R.R. Co. Survey	Abstract 92	Lubbock	77.46222	2,280.76	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.6 miles in a NW direction from the city of Lubbock, Lubbock County, Texas.	14.23	91.78%	24.56	86.24%	S77.46222'E, 2280.76 feet from the NE corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92
1	Developed Stormwater	North of Cornell & Ave Q	Yellow House Draw	33.60388	-101.85564	NE	19	Blk A	T.T. & R.R. Co. Survey	Abstract 92	Lubbock	38.49000	1,317.90	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.4 miles in a N/NW direction from the city of Lubbock, Lubbock County, Texas.	13.91	91.96%	24.24	86.41%	S38.49'E, 1317.9 feet from the NE corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92.
2	Developed Stormwater	Ave P between Erskine & Cornell	Yellow House Draw	33.60439	-101.85315	NE	19	Blk A	T.T. & R.R. Co. Survey	Abstract 92	Lubbock	3.68611	871.68	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.4 miles in a N/NW direction from the city of Lubbock, Lubbock County, Texas.	13.79	92.02%	24.12	86.47%	S3.68611'E, 871.68 feet from the NE corner of Blk A of the T.T. & R.R. Co. Survey 19, Abstract 92.
3	Developed Stormwater	Aztlan Park (at Canyon) about 300 feet west of outfall #4)	Yellow House Draw	33.59928	-101.84506	SW	79	Blk A	E.L. & R.R.R.R. Co. Survey	Abstract 331	Lubbock	45.79056	3,528.02	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.0 miles in a N direction from the city of Lubbock, Lubbock County, Texas	13.17	92.37%	23.50	86.79%	S45.79056'E, 3528.02 feet from the SW corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331
4	Developed Stormwater	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	Yellow House Draw	33.59908	-101.84420	SE	79	Blk A	E.L. & R.R.R.R. Co. Survey	Abstract 331	Lubbock	44.32167	3,562.48	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.0 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.12	92.40%	23.45	86.82%	S44.32167'E, 3562.48 feet from the SE corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331.
5	Developed Stormwater	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	Yellow House Draw	33.59908	-101.84416	SE	79	Blk A	E.L. & R.R.R.R. Co. Survey	Abstract 331	Lubbock	44.32167	3,562.48	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.0 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.12	92.40%	23.45	86.82%	S44.32167'E, 3562.48 feet from the SE corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331
6	Developed Stormwater	Aztlan Park (at Canyon northeast of outfall #5 across canyon)	Unnamed tributary to Yellow House Draw	33.59970	-101.84401	NE	80	Blk A	W.E. Penny Survey	Abstract 995	Lubbock	46.22444	3,608.00	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.0 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.16	92.37%	23.49	86.80%	S46.22444'E, 3608 feet from the NE corner of Blk A of the W.E. Penny Survey 80, Abstract 995.
7	Developed Stormwater	McKenzie State Park (just west of Joyland)	Unnamed tributary to Yellow House Draw	33.59227	-101.83507	NW	3	Blk O	E.L. & R.R.R.R. Co. Survey	Abstract 24	Lubbock	84.91861	211.81	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	0.8 miles in a NE direction from the city of Lubbock, Lubbock County, Texas.	12.36	92.82%	22.69	87.22%	S84.91861'E, 211.81 feet from the NW corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24.
8	Developed Stormwater	McKenzie State Park (just east of Joyland, north of overpass)	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.59180	-101.82975	NW	3	Blk O	E.L. & R.R.R.R. Co. Survey	Abstract 24	Lubbock	82.48250	1,841.28	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.0 miles in a E/NE direction from the city of Lubbock, Lubbock County, Texas.	12.05	92.99%	22.38	87.38%	S82.4825'E, 1841.28 feet from the NW corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24.
9	Developed Stormwater	300 feet West of Compress Ave.on E. 19th	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.57822	-101.83005	SW	3	Blk O	E.L. & R.R.R.R. Co. Survey	Abstract 24	Lubbock	86.90111	1,760.48	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.0 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	10.04	94.13%	20.37	88.45%	S86.90111'E, 1760.48 feet from the SW corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24.
10	Developed Stormwater	300 feet West of Compress Ave.on E. 19th	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.57822	-101.83005	SW	3	Blk O	E.L. & R.R.R.R. Co. Survey	Abstract 24	Lubbock	86.90111	1,760.48	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.0 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	10.04	94.13%	20.37	88.45%	S86.90111'E, 1760.48 feet from the SW corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24.
11	Developed Stormwater	East 26th & Southeast Dr	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.57139	-101.82472	SW	3	Blk O	E.L. & R.R.R.R. Co. Survey	Abstract 24	Lubbock	86.57444	1,729.81	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.0 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	10.04	94.13%	20.37	88.45%	S86.57444'E, 1729.81 feet from the SW corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24.
12	Developed Stormwater	Canyon Lake, East of MLK (south of Vanda Ave.)	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.57243	-101.82461	NE	5	Blk B	T.T. & R.R. Co. Survey	Abstract 96	Lubbock	47.46139	2,702.28	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.5 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	9.67	94.34%	20.00	88.64%	S47.46139'E, 2702.28 feet from the NE corner of Blk B of the T.T. & R.R. Co. Survey 5, Abstract 96.
13	Developed Stormwater	Canyon Lake, East of MLK (south of Zenith Ave.)	North Fork of the Double Mountain Fork of the Brazos River	33.57558	-101.81202	NW	3	Blk B	T.T. & R.R. Co. Survey	Abstract 95	Lubbock	66.78667	2,043.69	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	2.0 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	8.77	94.85%	19.10	89.13%	S66.78667'E, 2043.69 feet from the NW corner of Blk B of the T.T. & R.R. Co. Survey 3, Abstract 95.
14	Developed Stormwater	Lift Station at I-27 & Lp 289	Blackwater Draw	33.61712	-101.84157	NE	15	Blk A	T.T. & R.R. Co. Survey	Abstract 85	Lubbock	52.42056	2,327.25	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	2.2 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	14.77	91.48%	25.10	85.96%	S52.42056'E, 2327.25 feet from the NE corner of Blk A of the T.T. & R.R. Co. Survey 15, Abstract 85.
15	Developed Stormwater	Southeast of Municipal Dr & Northbound I-27 Frontage Rd.(Canyon)	Unnamed tributary to Yellow House Draw	33.60099	-101.84333	NE	80	Blk A	W.E. Penny Survey	Abstract 995	Lubbock	49.53694	3,135.68	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.1 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.23	92.34%	23.56	86.76%	S49.53694'E, 3135.68 feet from the NE corner of Blk A of the W.E. Penny Survey 80, Abstract 995.
16	Developed Stormwater	Under Northbound I-27 at Canyon Lakes Dr (Canyon)	Yellow House Draw	33.59749	-101.84161	SE	79	Blk A	E.L. & R.R.R.R. Co. Survey	Abstract 331	Lubbock	41.47000	2,595.40	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	0.9 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	12.93	92.50%	23.26	86.92%	S41.47'E, 2595.4 feet from the SE corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331.
17	Developed Stormwater	Southwest of Northbound I-27 frontage Rd. & Municipal Dr (Canyon)	Unnamed tributary to Yellow House Draw	33.59972	100.16000	NE	80	Blk A	W.E. Penny Survey	Abstract 995	Lubbock	49.53694	3,135.68	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	0.9 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.00	92.46%	23.33	86.88%	S49.53694'E, 3135.68 feet from the NE corner of Blk A of the W.E. Penny Survey 80, Abstract 995.
18	Developed Stormwater	At Canyon Lakes Dr Under I-27	Unnamed tributary to Yellow House Draw	33.59861	-101.84264	SE	79	Blk A	E.L. & R.R.R.R. Co. Survey	Abstract 331	Lubbock	40.53222	3,106.50	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	0.9 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.06	92.43%	23.39	86.85%	S40.53222'E, 3106.5 feet from the SE corner of Blk A of the E.L. & R.R.R.R. Co. Survey 79, Abstract 331.
19	Developed Stormwater	Entrance to I-27 Northbound, North of Municipal Dr.	Unnamed tributary to Yellow House Draw	33.60054	-101.84314	NE	80	Blk A	W.E. Penny Survey	Abstract 995	Lubbock	46.07444	3,143.07	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.1 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.20	92.35%	23.53	86.78%	S46.07444'E, 3143.07 feet from the NE corner of Blk A of the W.E. Penny Survey 80, Abstract 995.
20	Developed Stormwater	Southeast of Compress and E. 19th	North Fork of the Double Mountain Fork of the Brazos River	33.57781	-101.82668	NW	5	Blk B	T.T. & R.R. Co. Survey	Abstract 96	Lubbock	88.36028	2,747.95	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.2 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	9.78	94.26%	20.11	88.58%	S88.36028'E, 2747.95 feet from the NW corner of Blk B of the T.T. & R.R. Co. Survey 5, Abstract 96.
24	Developed Stormwater	East Loop 289 & E. 50th (northeast corner)	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.54905	-101.76690	SE	1	Blk B	T.T. & R.R. Co. Survey	Abstract 93	Lubbock	82.34028	914.11	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	4.2 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	6.08	96.40%	16.41	90.58%	S82.34028'E, 914.11 feet from the SE corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93.
27	Developed Stormwater	Southeast of the Water Rec Plant (South Outfall)	North Fork of the Double Mountain Fork of the Brazos River	33.55945	-101.79633	NW	1	Blk B	T.T. & R.R. Co. Survey	Abstract 93	Lubbock	44.39500	2,013.56	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	3.3 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	7.09	95.82%	17.42	90.03%	S44.395'E, 2013.56 feet from the NW corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93.
28	Developed Stormwater	South of E. 14th and Date Ave. (West of Warehouse)	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.58224	-101.83307	Sw	3	Blk O	E.L. & R.R.R.R. Co. Survey	Abstract 24	Lubbock	27.23306	1,812.26	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	0.7 miles in a E/SE direction from the city of Lubbock, Lubbock County, Texas.	10.27	94.00%	20.60	88.32%	S27.23306'E, 1812.26 feet from the Sw corner of Blk O of the E.L. & R.R.R.R. Co. Survey 3, Abstract 24.
29	Developed Stormwater	I-27 Northbound Frontage Rd at the Canyon (South of N. Loop)	Blackwater Draw	33.61490	-101.84373	NE	15	Blk A	T.T. & R.R. Co. Survey	Abstract 85	Lubbock	49.26833	3,317.43	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	2.1 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	14.63	91.56%	24.96	86.03%	S49.26833'E, 3317.43 feet from the NE corner of Blk A of the T.T. & R.R. Co. Survey 15, Abstract 85.
30	Developed Stormwater	Southeast of the Water Rec Plant (North Outfall)	North Fork of the Double Mountain Fork of the Brazos River	33.55967	-101.79653	NW	1	Blk B	T.T. & R.R. Co. Survey	Abstract 93	Lubbock	44.91889	1,913.61	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	3.3 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	7.11	95.81%	17.44	90.02%	S44.91889'E, 1913.61 feet from the NW corner of Blk B of the T.T. & R.R. Co. Survey 1, Abstract 93.
31	Developed Stormwater	South Lubbock Drainage Improvements Outfall	North Fork of the Double Mountain Fork of the Brazos River	33.53361	-101.77878	NW	11	Blk. S	G.C. & SF. Ry Survey	Abstract 216	Lubbock	52.19500	568.64	Construction Plans	See Table 2	See Table 2	Municipal & Industrial Supply	5.2 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	3.55	97.88%	13.88	91.97%	S52.195'E, 568.64 feet from the NW corner of Blk. S of the G.C. & SF. Ry Survey 11, Abstract 216.
32	Treated Effluent	City of Lubbock - SEWRP (future)[2]	North Fork of the Double Mountain Fork of the Brazos River	33.55961	-101.79654	NW	11	Blk S	G.C. & SF. Ry Survey	Abstract 216	Lubbock	26.62139	10,389.04	USGS 7.5 Minute Topo Map	See Table 2	See Table 2	Municipal & Industrial Supply	3.3 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	7.12	95.80%	17.45	90.02%	S26.62139'E, 10389.04 feet from the NW corner of Blk S of the G.C. & SF. Ry Survey 11, Abstract 216.
33	Treated Effluent	Town of Ransom Canyon[3]	North Fork of the Double Mountain Fork of the Brazos River	31.43567	-101.67819	NE	4	Blk I	J.M. Kidwell Survey	Abstract 437	Lubbock	61.96722	7,326.72	USGS 7.5 Minute Topo Map	See Table 2	See Table 2	Municipal & Industrial Supply	10.5 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	Downstream of Dam 7		5.64	96.66%	S61.96722'E, 7326.72 feet from the NE corner of Blk I of the J.M. Kidwell Survey 4, Abstract 437.

[1] Channel losses and corresponding delivery factors calculated based on channel loss factors used in the development of the Brazos Basin Water Availability Model (WAM) for the North Fork Double Mountain Fork Brazos River. Delivery factor is the percentage of discharge that will reach the respective dam sites.

[2] TPDES Permit No. 10353; Discharges originate from developed water sources, consisting of 60% groundwater and 40% developed (out of basin) surface water.

[3] TPDES Permit No. 10778; Discharges originate from developed water sources, consisting of 60% groundwater and 40% developed (out of basin) surface water.

Attachment 1, Table 2. Developed-Water Discharge Summary

Outfall	Discharge Point Description	2-Year 24-Hour Precipitation Event		5-Year 24-Hour Precipitation Event		10-Year 24-Hour Precipitation Event		25-Year 24-Hour Precipitation Event		50-Year 24-Hour Precipitation Event		100-Year 24-Hour Precipitation Event	
		peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)
0	Canyon at Duke Street (University Avenue outfall)	645	157	645	255	645	337	645	411	645	487	645	573
1	North of Cornell & Ave Q (Avenue R outfall)	452	110	452	179	452	347	452	521	452	700	452	907
2	Ave P between Erskine & Cornell	372	90	372	147	372	194	372	237	372	280	372	330
3	Aztlan Park (at Canyon) about 300 feet west of outfall #4)	106	13	142	20	171	26	221	32	262	37	310	56
4	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	31	2	42	3	49	4	63	5	76	6	91	7
5	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	20	2.5	27	4.4	32	6	41	8	51	9	60	11
6	Aztlan Park (at Canyon northeast of outfall #5 across canyon)	189	22	239	33	290	43	374	51	454	59	535	69
7	McKenzie State Park (just west of Joyland)	60	2.6	60	3.8	60	4.8	60	5.7	60	6.6	60	7.6
8	McKenzie State Park (just east of Joyland, north of overpass)	16	1	21	1.3	25	1.7	33	2	39	2.3	46.7	2.6
9	300 feet West of Compress Ave.on E. 19th	36	25	46	41	56	55	72	68	87	80	103	95
10	300 feet West of Compress Ave.on E. 19th	54	38	69	62	84	83	109	101	130	120	154	142
11	East 26th & Southeast Dr	408	134	408	229	408	310	408	412	408	461	408	549
12	Canyon Lake, East of MLK (south of Vanda Ave.) (SH 114 outfall)	40	27	40	44	40	57	40	70	40	82	40	97
13	Canyon Lake, East of MLK (south of Zenith Ave.) (Lake L069 outfall)	300	74	300	120	300	159	300	194	300	229	300	270
14	Lift Station at IH-27 and N. Loop 289	74	2.4	74	3.4	74	4.2	74	5	74	5.7	74	6.5
15	Southeast of Municipal Dr & Northbound I-27 Frontage Rd.(Canyon)	11	0.5	14	0.7	16	1	21	1.2	25	1.4	32	1.7
16	Under Northbound I-27 at Canyon Lakes Dr (Canyon)	321	23	321	34	321	42	321	50	321	57	321	66
17	Southwest of Northbound I-27 frontage Rd. & Municipal Dr (Canyon)	19	1	25	1.6	30	2.2	35	2.7	39	3.2	44	3.9
18	At Canyon Lakes Dr Under I-27	30	24	41	39	48	51	61	62	74	73	88	86
19	Entrance to I-27 Northbound, North of Municipal Dr.	14	1	18	1.3	22	1.7	28	2.1	34	2.5	40	3
20	Southeast of Compress and E. 19th (IH-27 Section 2 Outfall)	240	31	240	47	240	60	240	72	240	83	240	97
24	East Loop 289 and East 50th Street, North side	32	162	32	295	32	422	32	545	32	672	32	822
27	Southeast of the Water Rec Plant (South Outfall) (Playa System D Outfall)	265	410	265	684	265	930	265	1,191	265	1,452	265	1,723
28	South of E. 14th and Date Ave. (West of Warehouse)	543	132	543	215	543	284	543	346	543	410	543	483
29	I-27 Northbound Frontage Rd at the Canyon (South of North Loop)	17	2	22	3	27	3.5	35	4	41	4.7	50	5.4
30	Southeast of the Water Rec Plant (North Outfall) (SCLDIP Outfall)	185	1640	185	2,384	185	3,132	185	3,804	185	3,385	185	5,274
31	South Lubbock Drainage Improvements Outfall	77	720	77	1,181	77	1,580	77	1,937	77	2,307	77	2,728
32	City of Lubbock - SEWRP (future)	Future discharges, no data available											
33	Town of Ransom Canyon	Discharges shown on Attachment No. 3											
	Totals	4,557	3,847	4,720	6,032	4,864	8,141	5,107	10,140	5,326	11,015	5,568	14,416

Lloyd
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Mr. Rochelle's Direct Line: (512) 322-5810
[redacted]

January 31, 2006

Ms. Iliana Delgado (MC 160)
Texas Commission on Environmental Quality
Building F, Room 359
Austin, Texas 78711-3087

VIA HAND DELIVERY

RECEIVED
JAN 31 2006
TEXAS COMMISSION
ON
ENVIRONMENTAL QUALITY

Re: City of Lubbock
WRPERM 5921
CN 600130736
Application No. 5921 for a Water Use Permit
TWC § 11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties (2020-02)

Dear Ms. Delgado:

This letter is submitted on behalf of my client, the City of Lubbock, Texas (the "City"), in response to your Request for Information ("RFI"), dated December 1, 2005, and in connection with the above-referenced application (the "Application"). The City appreciates your correspondence of January 9, 2006 granting additional time needed to respond to the RFI. The following responses are numbered in accordance with the RFI inquiries included in your December 1, 2005 letter.

Response to Question No. 1:

A completed Supplemental Discharge Point Information Sheet for each point as well as a list of third parties' wastewater plants; discharges for past five years; and the estimated amount of water that will be lost to transportation, evaporation, seepage, channel or other associated carriage losses from the points of discharge to the point(s) of diversion, including the method of calculation of carriage losses.

1. Attachment No. 1 is provided as a tabular summary of the information requested in the Supplemental Discharge Point Information Sheet for all discharge points associated with the Application. In order to provide a visual depiction of each of the proposed discharge points, a corresponding map is included as Attachment No. 2. Attachment No. 3 is a tabular summary of the historical discharge records associated with TPDES Permit No. 10778, together with a copy of said permit, authorized to the Town of Ransom Canyon.

Response to Question No. 2:

An elevation-area-capacity curve or data for each reservoir.

2. Attachment No. 4 is a memorandum from HDR Engineering, Inc. ("HDR") providing the elevation-area-capacity data for each of the proposed reservoirs.

Response to Question No. 3:

The latitude and longitude in decimal degrees as well as the bearing and distance from an original survey corner for each reservoir.

3. This response is submitted as a supplement to Section Nos. 2.1(B)(5) and 2.2(B)(5) of the Application, respectively. The centerline of Dam No. 7 is at a point bearing North 61.683° West, 5,514.77 feet to the Northwest Corner of Section 37, Blk. S. in Lubbock, County, also being at Latitude 31.534°N, Longitude -101.729°W. The centerline of Dam No. 8 is at a point bearing South 4.166° East, 5,227.85 feet to Section 21, Blk. S in Lubbock County, also being at Latitude 33.484°N, Longitude -101.609°W.

Response to Question No. 4:

Estimates of future return flows.

4. Pursuant to TPDES Permit No. 10353, a copy of which is provided as Attachment No. 5[1], the City is authorized to treat and dispose of 31.5 MGD of treated effluent. Of this 31.5 MGD, 9.0 MGD is currently authorized for discharge to the North Fork Double Mountain Fork Brazos River ("North Fork") and is the subject of the City's pending reuse application, Application No. 3985A. The Application contemplates the authorization and recognition of the difference between the City's current disposal and discharge authorization, 31.5 MGD, and the flows that are the subject of Application No. 3985A, 9.0 MGD. On November 9, 2005 the City met with Commission water quality staff to discuss stream standards issues (i.e., quality and quantity) related to the City's discharges to the North Fork. The City is currently in the process of providing all of the preliminary information and materials requested by Commission water quality staff at that meeting, and the information and materials compiled will be used to prepare and file an application to amend TPDES Permit No. 10353 within the next several months.

Additionally, pursuant to the information provided in the response to your Question No. 1, the City is seeking the authorization and recognition of both historical and future return flows of the Town of Ransom Canyon.

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[1] Please note that the term of the City's current TPDES permit authority has been administratively extended based upon a pending application. Copies of correspondence between the City and Commission staff regarding the pending application are included herein in Attachment 5 for reference.

Response to Question No. 5:

An explanation of what other future discharges of effluent would be available for consideration after excluding the effluent requested under the City's concurrent Application No. 3985A.

5. Please refer to the City's answer to your Question No. 4. In addition, the City anticipates that demands for its municipal wastewater services will continue to grow, and that at such time as the City needs to secure additional discharge, transfer, and reuse authorization in excess of 31.5 MGD, it will do so.

Response to Question No. 6:

A copy of an engineering study, or report, showing the conceptual design for the two dams.

6. Attachment No. 6, which is a technical memorandum prepared by HDR, is hereby provided as a conceptual design for the proposed reservoirs.

Response to Question No. 7:

A quantitative or qualitative evaluation of existing aquatic, riparian, wetland, and terrestrial habitats that will be subject to impact by the proposed reservoir projects, preferably performed by a qualified third party. Acceptable evaluation procedures to be used may include, but are not limited to, USFWS's Habitat Evaluation Procedures or TPWD's Wildlife Habitat Appraisal Procedure. Any habitat evaluation should include an assessment of the effects of the project on habitats in the river segment downstream as well.

7. Attachment No. 7, which is a report prepared by HDR, is hereby provided to address Question Nos. 7, 8 and 10.

Response to Question No. 8:

An analysis that characterizes and quantifies stream flow patterns needed to protect the instream uses of the North Fork Double Mountain Fork Brazos River. This analysis should include the frequency, magnitude, duration and timing of various components of the hydrograph for the North Fork needed to maintain annual/seasonal variability in flows, bankfull flows that generally occur every 1-2 years needed to maintain sediment transport of silt and sands, as well as higher flood flows which typically occur on the order of every 5-10 years needed for channel scour and maintenance of habitat features. Each component of the stream's hydrograph has specific ecological functions that collectively provide for processes that sustain the river ecosystem.

8. Attachment No. 7, which is a report prepared by HDR, is hereby provided to address Question Nos. 7, 8 and 10.

Response to Question No. 9:

Description of the alternatives that were examined to meet the water needs that the proposed project is intended to fulfill. Were other site locations examined that may result in less environmental impact? How were the sizes of the proposed reservoirs determined? Would smaller reservoirs be adequate to meet the projected water needs? Habitat mitigation shall be considered only after the complete sequencing (avoidance, minimization or modification, and compensation/replacement) process has been performed.

9. Attachment No. 8, which includes information excerpted from the Llano Estacado Regional Water Plan (the "Region O Plan"), provides an assessment of the alternative water management strategy that the proposed reservoirs represent, as identified in the Application, that was evaluated in the regional water planning efforts pursuant to Texas Water Development Board rules found in 31 TAC Chapter 357.[2] The City has evaluated the Application, and the project which is the subject of the Application has been incorporated into the Region O Plan, which was adopted on December 15, 2005. A complete copy of the Region O Plan can be obtained at *http://www.llanoplan.org*. With regard to your inquiry concerning sizing of the proposed reservoirs, the Llano Estacado Regional Water Planning Group determined that the proposed reservoirs, as identified in the Application, were adequate to meet a portion of the City's future water needs.

The City appreciates that the final details of the proposed reservoirs will be reviewed and may be potentially altered by Commission staff during its technical review process, especially as more information related to the Clean Water Act § 404 permitting becomes available.

Response to Question No. 10:

Should habitat losses be found to be unavoidable, a mitigation plan shall be developed that will compensate for lost or altered ecosystem functions and values imposed by the proposed project. This plan should address both the direct and indirect impacts to aquatic, riparian, and terrestrial habitats, as well as long- and short-term effects that may result from the proposed project. Habitat mitigation plans shall be ensured through binding legal contracts or conservation easements and shall include goals and schedules for completion of those goals. Mitigation areas shall be managed in perpetuity by a party approved by the Commission to maintain the habitat functions and values that will be effected by the proposed project.

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[2] Please note that pursuant to the provisions of 31 TAC §§ 357.5(e)(4), 357.7(a)(7), and 357.7(a)(8), the Llano Estacado Regional Water Planning Group has examined the alternative water management strategies of the City, and has approved the strategy that is represented by the City's Application.

10. Please refer to Attachment No. 7. The City concurs with this assessment and intends to work with Commission and USACE staff in developing and implementing all necessary habitat mitigation plans.

Response to Question No. 11:

Whether the U.S. Army Corps of Engineers has been notified of the proposed project in order to determine whether Federal authorization will be required under Section 404/401 of Clean Water Act.

11. Attachment No. 9 is a copy of a letter submitted by HDR to the USACE providing notice of the Application.

Response to Question No. 12:

On-ground color photographs of the stream at each dam site and downstream as well as several photographs of the stream and riparian areas within, upstream, and downstream of the reservoir inundation areas. Each photograph should include a description of what is depicted as well as be referenced to a map indicating the location and direction of the shot.

12. Attachment No. 10 includes color photographs of the requested areas.

Response to Question No. 13:

Identification of all the tributaries of the North Fork requested under the bed and banks portion of the application.

13. Please see the response to Question No. 1 for a complete listing of all tributaries of the North Fork that are the subject of the bed and banks transfer portion of the Application.

Response to Question No. 14:

Deeds, leases, and/or consents for the property where the proposed reservoirs will be located.

14. The Commission's regulations do not require public entities such as the City to have ownership of land (e.g., related to a reservoir site or a diversion point location) prior to authorization for the construction of facilities like dams and diversion facilities (see 30 TAC § 295.7, "Location of Diversion Point, Reservoir, and Dam," and 30 TAC § 297.41, "General Approval Criteria"). The Commission's rules at 30 TAC § 295.10 ("Proposed Installation or Reservoir") provide that if an applicant "*does not have the power of condemnation*" and proposes to "place any installation upon the land of another," the applicant must provide the Commission with evidence of an easement, consent or license from the landowner for the use of their land.

Under state law, the City has the power of condemnation. *See* TEX. LOCAL GOV'T CODE § 251.001 (Right of Eminent Domain). Thus, to the extent that the provisions of 30 TAC § 295.10 are not applicable to the City, it is not necessary for the City to provide the Commission with evidence of an easement, consent or license from the current landowners of the proposed reservoir sites. As an aside, the City plans to coordinate with the landowners of the proposed reservoir sites, and to attempt to enter into negotiated agreements for the purchase of the lands necessary to construct the proposed reservoirs, when that is appropriate.

Response to Question No. 15:

A completed Core Data Form.

15. Please find enclosed as Attachment No. 11, one complete Core Data Form.

Response to Question No. 16:

Fees in the amount of $122,567.28*, described below. Please make checks payable to the TCEQ or Texas Commission on Environmental Quality.

Filing (120,638 acre/feet)	***$ 1,000.00***
Recording ($1.25 * 6 pages)	***$ 7.50***
Use (maximum use fee)	***$ 50,000.00***
Recreation ($1.00 * 70,638 acre/feet)	***$ 70,638.00***
Postage (Brazos River Basin)	***$ 1,021.78***
TOTAL FEES	***$122,667.28***
FEES RECEIVED	***$ 100.00***
FEES DUE	***$122,567.28****

****Pursuant to TAC 295.133, if the total fee for a permit exceeds $1,000, the applicant shall pay at least one-half of the use fee when the application is filed, and one-half within 180 days after notice is mailed to the applicant that the permit is granted. If the applicant does not pay all of the amount owed before beginning to use state water under the permit, the permit is annulled and reverts to the status of a pending, filed application requiring notice, the payment of notice fees, and the balance of the use fees.***

Amount due prior to the application being declared administratively complete	***$62,348.28***
Amount due within 180 days after notice is mailed that the permit is granted	***$60,219.00***

16. Please find enclosed a check in the amount of $62,348.28. Please note that the City is submitting this check as requested, but pursuant to the provisions of 30 TAC § 295.135, it hereby protests the fee assessment. Not only did the City not request a recreational purpose of

use in the Application, but the storage and use fees should be applied only to that portion of the Application that is considered "state water." That portion of water identified in the Application as "developed water" should be exempt from fees inasmuch as the City is only seeking authorization to use the North Fork, and its tributaries, to convey said water to the point(s) of diversion requested in the Application.

In addition to the City's responses to the above-referenced questions, please also see Attachment No. 12, which is a copy of a letter, and associated affidavit, providing notice to the Lubbock County Judge and Commissioners, prepared and submitted to demonstrate compliance with the provisions of H.B. 2140, 79th Leg. Reg. Session.

The City appreciates the opportunity to provide these responses and looks forward to the Commission's further review of the Application. If for some reason you have additional questions or need clarification regarding any of the responses provided herein, please do not hesitate to call either Brad Castleberry (512/322-5856) or me at your convenience. As we have discussed in the past, the City would appreciate the opportunity to meet with you and/or other Commission staff to further clarify any issues regarding the Application. We would appreciate it if you would contact us to schedule such a meeting. Thank you for your attention to this important matter.

Sincerely,

Martin C. Rochelle

MCR/bbc
2020\02\ltr060131bbc

ENCLOSURE

cc: (w/ enclosure)
Mr. Tom Adams
Mr. Ches Carthel
Mr. David Dunn
Mr. Paul McMillen

(w/o enclosure)
The Honorable Senator Robert L. Duncan
Ms. Lee Ann Dumbauld
Ms. Anita Burgess
Mr. Richard Casner
Mr. Brad B. Castleberry

Attachment 1, Table 1. Developed-Water Discharge Point Information

Outfall	Water Source	General Location	Tributary Discharged to in the Brazos River Basin	Latitude	Longitude	Nearest Section Corner	Original Survey No.	Abstract No.	County	Bearing to nearest Section Corner	Distance to nearest Section Corner feet	Method Used for Lat-Long	Maximum Discharge Rate cfs	Discharge Volume acft/yr	Purpose of Use	Location from County Seat	Distance to Dam 7 Site miles	Delivery Factor to Dam 7[1]	Distance to Dam 8 Site miles	Delivery Factor to Dam 8[1]
0	Developed Stormwater	Canyon at Duke Street (University Avenue outfall)	Yellow House Draw	33.60523	-101.86032	NE Cor. Sec. 19, Blk A	N/A	N/A	Lubbock	77.46222	2280.76	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.6 miles in a NW direction from the city of Lubbock, Lubbock County, Texas.	14.23	91.78%	24.56	86.24%
1	Developed Stormwater	North of Cornell & Ave Q	Yellow House Draw	33.60388	-101.85564	NE Cor. Sec. 19, Blk A	N/A	N/A	Lubbock	38.49000	1317.9	GPS			Municipal & Industrial Supply	1.4 miles in a N/NW direction from the city of Lubbock, Lubbock County, Texas.	13.91	91.96%	24.24	86.41%
2	Developed Stormwater	Ave P between Erskine & Cornell	Yellow House Draw	33.60439	-101.85315	NE Cor. Sec. 19, Blk A	N/A	N/A	Lubbock	3.68611	871.68	GPS			Municipal & Industrial Supply	1.4 miles in a N/NW direction from the city of Lubbock, Lubbock County, Texas.	13.79	92.02%	24.12	86.47%
3	Developed Stormwater	Aztlan Park (at Canyon) about 300 feet west of outfall #4)	Yellow House Draw	33.59928	-101.84506	SW Cor. Sec 79, Blk A	N/A	N/A	Lubbock	45.79056	3528.02	GPS			Municipal & Industrial Supply	1.0 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.17	92.37%	23.50	86.79%
4	Developed Stormwater	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	Yellow House Draw	33.59908	-101.84420	SE Cor. Sec. 79, Blk A	N/A	N/A	Lubbock	44.32167	3562.48	GPS			Municipal & Industrial Supply	1.0 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.12	92.40%	23.45	86.82%
5	Developed Stormwater	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	Yellow House Draw	33.59908	-101.84416	SE Cor. Sec. 79, Blk A	N/A	N/A	Lubbock	44.32167	3562.48	GPS			Municipal & Industrial Supply	1.0 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.12	92.40%	23.45	86.82%
6	Developed Stormwater	Aztlan Park (at Canyon northeast of outfall #5 across canyon)	Unnamed tributary to Yellow House Draw	33.59970	-101.84401	NE Cor. Sec. 80, Blk A	N/A	N/A	Lubbock	46.22444	3608	GPS			Municipal & Industrial Supply	1.0 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.16	92.37%	23.49	86.80%
7	Developed Stormwater	McKenzie State Park (just west of Joyland)	Unnamed tributary to Yellow House Draw	33.59227	-101.83507	NW Cor. Sec. 3, Blk O	N/A	N/A	Lubbock	84.91861	211.81	GPS			Municipal & Industrial Supply	0.8 miles in a NE direction from the city of Lubbock, Lubbock County, Texas.	12.38	92.82%	22.69	87.22%
8	Developed Stormwater	McKenzie State Park (just east of Joyland, north of overpass)	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.59180	-101.82975	NW Cor. Sec. 3, Blk O	N/A	N/A	Lubbock	82.48750	1841.28	GPS			Municipal & Industrial Supply	1.0 miles in a E/NE direction from the city of Lubbock, Lubbock County, Texas.	12.05	92.99%	22.38	87.38%
9	Developed Stormwater	300 feet West of Compress Ave.on E. 19th	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.57822	-101.83005	SW Cor. Sec. 3, Blk O	N/A	N/A	Lubbock	86.90111	1760.48	GPS			Municipal & Industrial Supply	1.0 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	10.04	94.13%	20.37	88.45%
10	Developed Stormwater	300 feet West of Compress Ave.on E. 19th	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.57822	-101.83005	SW Cor. Sec. 3, Blk O	N/A	N/A	Lubbock	86.90111	1760.48	GPS			Municipal & Industrial Supply	1.0 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	10.04	94.13%	20.37	88.45%
11	Developed Stormwater	East 26th & Southeast Dr	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.57139	-101.82472	SW Cor. Sec. 3, Blk O	N/A	N/A	Lubbock	86.57444	1729.81	GPS			Municipal & Industrial Supply	1.0 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	10.04	94.13%	20.37	88.45%
12	Developed Stormwater	Canyon Lake, East of MLK (south of Vanda Ave.)	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.57243	-101.82461	NE Cor. Sec. 5, Blk B	N/A	N/A	Lubbock	47.46139	2702.28	GPS			Municipal & Industrial Supply	1.5 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	9.67	94.34%	20.00	88.64%
13	Developed Stormwater	Canyon Lake, East of MLK (south of Zenith Ave.)	North Fork of the Double Mountain Fork of the Brazos River	33.57558	-101.81202	NW Cor. Sec. 3, Blk B	N/A	N/A	Lubbock	68.78667	2043.69	GPS			Municipal & Industrial Supply	2.0 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	8.77	94.85%	19.10	89.13%
14	Developed Stormwater	Lift Station at I-27 & Lp 289	Blackwater Draw	33.61712	-101.84157	NE Cor. Sec. 15, Blk A	N/A	N/A	Lubbock	52.42056	2327.25	GPS			Municipal & Industrial Supply	2.2 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	14.77	91.48%	25.10	85.96%
15	Developed Stormwater	Southeast of Municipal Dr & Northbound I-27 Frontage Rd.(Canyon)	Unnamed tributary to Yellow House Draw	33.60099	-101.84333	NE Cor. Sec. 80, Blk A	N/A	N/A	Lubbock	49.53694	3135.68	GPS			Municipal & Industrial Supply	1.1 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.23	92.34%	23.56	86.76%
16	Developed Stormwater	Under Northbound I-27 at Canyon Lakes Dr (Canyon)	Yellow House Draw	33.59749	-101.84161	SE Cor. Sec. 79, Blk A	N/A	N/A	Lubbock	41.47000	2595.4	GPS			Municipal & Industrial Supply	0.9 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	12.93	92.50%	23.26	86.92%
17	Developed Stormwater	Southwest of Northbound I-27 frontage Rd. & Municipal Dr (Canyon)	Unnamed tributary to Yellow House Draw	33.59972	100.16000	NE Cor. Sec. 80, Blk A	N/A	N/A	Lubbock	49.53694	3135.68	GPS			Municipal & Industrial Supply	0.9 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.00	92.46%	23.33	86.88%
18	Developed Stormwater	At Canyon Lakes Dr Under I-27	Unnamed tributary to Yellow House Draw	33.59861	-101.84264	SE Cor. Sec. 79, Blk A	N/A	N/A	Lubbock	40.53222	3106.5	GPS			Municipal & Industrial Supply	0.9 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.06	92.43%	23.39	86.85%
19	Developed Stormwater	Entrance to I-27 Northbound, North of Municipal Dr.	Unnamed tributary to Yellow House Draw	33.60054	-101.84314	NE Cor. Sec. 80, Blk A	N/A	N/A	Lubbock	46.07444	3143.07	GPS			Municipal & Industrial Supply	1.1 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.20	92.35%	23.53	86.78%
20	Developed Stormwater	Southeast of Compress and E. 19th	North Fork of the Double Mountain Fork of the Brazos River	33.57781	-101.82668	NW Cor. Sec 5, Blk B	N/A	N/A	Lubbock	88.36028	2747.95	GPS			Municipal & Industrial Supply	1.2 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	9.78	94.28%	20.11	88.58%
24	Developed Stormwater	East Loop 289 & E. 50th (northeast corner)	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.54905	-101.78690	SE Cor. Sec 1, Blk B	N/A	N/A	Lubbock	82.34028	914.11	GPS			Municipal & Industrial Supply	4.2 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	6.08	96.40%	16.41	90.58%
27	Developed Stormwater	Southeast of the Water Rec Plant (South Outfall)	North Fork of the Double Mountain Fork of the Brazos River	33.55945	-101.79633	NW Cor. Sec. 1 Blk B	N/A	N/A	Lubbock	44.39500	2013.56	GPS			Municipal & Industrial Supply	3.3 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	7.09	95.82%	17.42	90.03%
28	Developed Stormwater	South of E. 14th and Date Ave. (West of Warehouse)	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.58224	-101.83307	Sw Cor. Sec. 3, Blk O	N/A	N/A	Lubbock	27.23306	1812.26	GPS			Municipal & Industrial Supply	0.7 miles in a E/SE direction from the city of Lubbock, Lubbock County, Texas.	10.27	94.00%	20.60	88.32%
29	Developed Stormwater	I-27 Northbound Frontage Rd at the Canyon (South of N. Loop)	Blackwater Draw	33.61496	-101.84373	NE Cor. Sec. 15, Blk A	N/A	N/A	Lubbock	49.26833	3317.43	GPS			Municipal & Industrial Supply	2.1 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	14.63	91.56%	24.96	86.03%
30	Developed Stormwater	Southeast of the Water Rec Plant (North Outfall)	North Fork of the Double Mountain Fork of the Brazos River	33.55967	-101.79653	NW Cor. Sec. 1 Blk B	N/A	N/A	Lubbock	44.91889	1913.61	GPS			Municipal & Industrial Supply	3.3 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	7.11	95.81%	17.44	90.02%
31	Developed Stormwater	South Lubbock Drainage Improvements Outfall	North Fork of the Double Mountain Fork of the Brazos River	33.53361	-101.77878	NW Cor. Sec. 11, Blk. S	N/A	N/A	Lubbock	52.19500	568.64	Construction Plans			Municipal & Industrial Supply	5.2 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	3.55	97.88%	13.88	91.97%
32	Treated Effluent	City of Lubbock - SEWRP (future)[2]	North Fork of the Double Mountain Fork of the Brazos River	33.55961	-101.79654	NW Cor. Sec. 11, Blk S	N/A	N/A	Lubbock	26.62139	10389.04	USGS 7.5 Minute Topo Map			Municipal & Industrial Supply	3.3 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	7.12	95.80%	17.45	90.02%
33	Treated Effluent	Town of Ransom Canyon[3]	North Fork of the Double Mountain Fork of the Brazos River	31.43567	-101.67819	NE Cor. Sec. 20, Blk 3	N/A	N/A	Lubbock	61.96722	7326.72	USGS 7.5 Minute Topo Map			Municipal & Industrial Supply	10.5 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	Downstream of Dam 7		5.64	96.66%

[1] Channel losses and corresponding delivery factors calculated based on channel loss factors used in the development of the Brazos Basin Water Availability Model (WAM) for the North Fork Double Mountain Fork Brazos River. Delivery factor is the percentage of discharge that will reach the respective dam sites.

[2] TPDES Permit No. 10353; Discharges originate from developed water sources, consisting of 60% groundwater and 40% developed (out of basin) surface water.

[3] TPDES Permit No. 10778; Discharges originate from developed water sources, consisting of 60% groundwater and 40% developed (out of basin) surface water.

Attachment 1, Table 2. Developed-Water Discharge Summary

Outfall	Discharge Point Description	2-Year 24-Hour Precipitation Event		5-Year 24-Hour Precipitation Event		10-Year 24-Hour Precipitation Event		25-Year 24-Hour Precipitation Event		50-Year 24-Hour Precipitation Event		100-Year 24-Hour Precipitation Event	
		peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)	peak rate (cfs)	volume (acft)
0	Canyon at Duke Street (University Avenue outfall)	645	157	645	255	645	337	645	411	645	487	645	573
1	North of Cornell & Ave Q (Avenue R outfall)	452	110	452	179	452	347	452	521	452	700	452	907
2	Ave P between Erskine & Cornell	372	90	372	147	372	194	372	237	372	280	372	330
3	Aztlan Park (at Canyon) about 300 feet west of outfall #4)	106	13	142	20	171	26	221	32	262	37	310	56
4	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	31	2	42	3	49	4	63	5	76	6	91	7
5	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	20	2.5	27	4.4	32	6	41	8	51	9	60	11
6	Aztlan Park (at Canyon northeast of outfall #5 across canyon)	189	22	239	33	290	43	374	51	454	59	535	69
7	McKenzie State Park (just west of Joyland)	60	2.6	60	3.8	60	4.8	60	5.7	60	6.6	60	7.6
8	McKenzie State Park (just east of Joyland, north of overpass)	16	1	21	1.3	25	1.7	33	2	39	2.3	46.7	2.6
9	300 feet West of Compress Ave.on E. 19th	36	25	46	41	56	55	72	68	87	80	103	95
10	300 feet West of Compress Ave.on E. 19th	54	38	69	62	84	83	109	101	130	120	154	142
11	East 26th & Southeast Dr	408	134	408	229	408	310	408	412	408	461	408	549
12	Canyon Lake, East of MLK (south of Vanda Ave.) (SH 114 outfall)	40	27	40	44	40	57	40	70	40	82	40	97
13	Canyon Lake, East of MLK (south of Zenith Ave.) (Lake L069 outfall)	300	74	300	120	300	159	300	194	300	229	300	270
14	Lift Station at IH-27 and N. Loop 289	74	2.4	74	3.4	74	4.2	74	5	74	5.7	74	6.5
15	Southeast of Municipal Dr & Northbound I-27 Frontage Rd.(Canyon)	11	0.5	14	0.7	16	1	21	1.2	25	1.4	32	1.7
16	Under Northbound I-27 at Canyon Lakes Dr (Canyon)	321	23	321	34	321	42	321	50	321	57	321	66
17	Southwest of Northbound I-27 frontage Rd. & Municipal Dr (Canyon)	19	1	25	1.6	30	2.2	35	2.7	39	3.2	44	3.9
18	At Canyon Lakes Dr Under I-27	30	24	41	39	48	51	61	62	74	73	88	86
19	Entrance to I-27 Northbound, North of Municipal Dr.	14	1	18	1.3	22	1.7	28	2.1	34	2.5	40	3
20	Southeast of Compress and E. 19th (IH-27 Section 2 Outfall)	240	31	240	47	240	60	240	72	240	83	240	97
24	East Loop 289 and East 50th Street, North side	32	162	32	295	32	422	32	545	32	672	32	822
27	Southeast of the Water Rec Plant (South Outfall) (Playa System D Outfall)	265	410	265	684	265	930	265	1,191	265	1,452	265	1,723
28	South of E. 14th and Date Ave. (West of Warehouse)	543	132	543	215	543	284	543	346	543	410	543	483
29	I-27 Northbound Frontage Rd at the Canyon (South of North Loop)	17	2	22	3	27	3.5	35	4	41	4.7	50	5.4
30	Southeast of the Water Rec Plant (North Outfall) (SCLDIP Outfall)	185	1640	185	2,384	185	3,132	185	3,804	185	3,385	185	5,274
31	South Lubbock Drainage Improvements Outfall	77	720	77	1,181	77	1,580	77	1,937	77	2,307	77	2,728
32	City of Lubbock - SEWRP (future)	Future discharges, no data available											
33	Town of Ransom Canyon	Discharges shown on Attachment No. 3											
	Totals	4,557	3,847	4,720	6,032	4,864	8,141	5,107	10,140	5,326	11,015	5,568	14,416

TPDES ID	EPA ID	MONITORING END DATE	OUTFALL	PARAMETER	QUAN AVG LIMIT	QUAN MAX LIMI	REPORTED QUAN AVG	REPORTED QUAN MAX	NO DISCHARGE INDICATOR
10778001	TX0075809	01/31/00	001A	FLOW, IN	0.41	ADDMON	0.148893	0.17	
10778001	TX0075809	02/29/00	001A	FLOW, IN	0.41	ADDMON	0.144251	0.165	
10778001	TX0075809	03/31/00	001A	FLOW, IN	0.41	ADDMON	0.147516	0.173	
10778001	TX0075809	04/30/00	001A	FLOW, IN	0.41	ADDMON	0.152533	0.174	
10778001	TX0075809	05/31/00	001A	FLOW, IN	0.41	ADDMON	0.149822	0.172	
10778001	TX0075809	06/30/00	001A	FLOW, IN	0.41	ADDMON	0.152063	0.176	
10778001	TX0075809	07/31/00	001A	FLOW, IN	0.41	ADDMON	0.147506	0.166	
10778001	TX0075809	08/31/00	001A	FLOW, IN	0.41	ADDMON	0.140835	0.176	
10778001	TX0075809	09/30/00	001A	FLOW, IN	0.41	ADDMON	0.14411	0.207	
10778001	TX0075809	10/31/00	001A	FLOW, IN	0.41	ADDMON	0.135645	0.167	
10778001	TX0075809	11/30/00	001A	FLOW, IN	0.41	ADDMON	0.145413	0.182	
10778001	TX0075809	12/31/00	001A	FLOW, IN	0.41	ADDMON	0.149587	0.19	
10778001	TX0075809	01/31/01	001A	FLOW, IN	0.41	ADDMON	0.145145	0.182	
10778001	TX0075809	02/28/01	001A	FLOW, IN	0.41	ADDMON	0.148528	0.181	
10778001	TX0075809	03/31/01	001A	FLOW, IN	0.41	ADDMON	0.146796	0.214	
10778001	TX0075809	04/30/01	001A	FLOW, IN	0.41	ADDMON	0.142176	0.171	
10778001	TX0075809	05/31/01	001A	FLOW, IN	0.41	ADDMON	0.147841	0.244	
10778001	TX0075809	06/30/01	001A	FLOW, IN	0.41	ADDMON	0.121069	0.172	
10778001	TX0075809	07/31/01	001A	FLOW, IN	0.41	ADDMON	0.140367	0.179	
10778001	TX0075809	08/31/01	001A	FLOW, IN	0.41	ADDMON	0.132829	0.151	
10778001	TX0075809	09/30/01	001A	FLOW, IN	0.41	ADDMON	0.1389	0.155	
10778001	TX0075809	10/31/01	001A	FLOW, IN	0.41	ADDMON	0.131709	0.147	
10778001	TX0075809	11/30/01	001A	FLOW, IN	0.41	ADDMON	0.145533	0.184	
10778001	TX0075809	12/31/01	001A	FLOW, IN	0.41	ADDMON	0.151045	0.18	
10778001	TX0075809	01/31/02	001A	FLOW, IN	0.41	ADDMON	0.149206	0.165	
10778001	TX0075809	02/28/02	001A	FLOW, IN	0.41	ADDMON	0.140476	0.188	
10778001	TX0075809	03/31/02	001A	FLOW, IN	0.41	ADDMON	0.144812	0.161	
10778001	TX0075809	04/30/02	001A	FLOW, IN	0.41	ADDMON	0.141241	0.189	
10778001	TX0075809	05/31/02	001A	FLOW, IN	0.41	ADDMON	0.141303	0.165	
10778001	TX0075809	06/30/02	001A	FLOW, IN	0.41	ADDMON	0.14369	0.162	
10778001	TX0075809	07/31/02	001A	FLOW, IN	0.41	ADDMON	0.144135	0.172	
10778001	TX0075809	08/31/02	001A	FLOW, IN	0.41	ADDMON	0.143725	0.163	
10778001	TX0075809	09/30/02	001A	FLOW, IN	0.41	ADDMON	0.37723	0.176	
10778001	TX0075809	10/31/02	001A	FLOW, IN	0.41	ADDMON	0.142222	0.211	

10778001	TX0075809	11/30/02	001A	FLOW, IN	0.41	ADDMON	0.148373	0.237	
10778001	TX0075809	12/31/02	001A	FLOW, IN	0.41	ADDMON	0.150287	0.196	
10778001	TX0075809	01/31/03	001A	FLOW, IN	0.41	ADDMON	0.140622	0.173	
10778001	TX0075809	02/28/03	001A	FLOW, IN	0.41	ADDMON	0.13685	0.166	
10778001	TX0075809	03/31/03	001A	FLOW, IN	0.41	ADDMON	0.137958	0.152	
10778001	TX0075809	04/30/03	001A	FLOW, IN	0.41	ADDMON	0.134737	0.179	
10778001	TX0075809	05/31/03	001A	FLOW, IN	0.41	ADDMON	0.126923	0.147	
10778001	TX0075809	06/30/03	001A	FLOW, IN	0.41	ADDMON	0.128367	0.146	
10778001	TX0075809	07/31/03	001A	FLOW, IN	0.41	ADDMON	0.129	0.185	
10778001	TX0075809	08/31/03	001A	FLOW, IN	0.41	ADDMON	0.11877	0.156	
10778001	TX0075809	09/30/03	001A	FLOW, IN	0.41	ADDMON	.114680 .	146	
10778001	TX0075809	10/31/03	001A	FLOW, IN	0.41	ADDMON	.121451 .	190	
10778001	TX0075809	11/30/03	001A	FLOW, IN	0.41	ADDMON	.131100 .	194	
10778001	TX0075809	12/31/03	001A	FLOW, IN	0.41	ADDMON	0.158581	0.358	
10778001	TX0075809	01/31/04	001A	FLOW, IN	0.41	ADDMON	0.150451	0.316	
10778001	TX0075809	02/29/04	001A	FLOW, IN	0.41	ADDMON	0.143724	0.211	
10778001	TX0075809	03/31/04	001A	FLOW, IN	0.41	ADDMON	0.135003		
10778001	TX0075809	04/30/04	001A	FLOW, IN	0.41	ADDMON	0.128133	0.197	
10778001	TX0075809	05/31/04	001A	FLOW, IN	0.41	ADDMON	0.121339	0.155	
10778001	TX0075809	06/30/04	001A	FLOW, IN	0.41	ADDMON	0.129966	0.198	
10778001	TX0075809	07/31/04	001A	FLOW, IN	0.41	ADDMON	0.126968	0.175	
10778001	TX0075809	08/31/04	001A	FLOW, IN	0.225	ADDMON	0.126097	0.151	
10778001	TX0075809	09/30/04	001A	FLOW, IN	0.225	ADDMON	0.123733	0.191	
10778001	TX0075809	10/31/04	001A	FLOW, IN	0.225	ADDMON	0.122645	0.151	
10778001	TX0075809	11/30/04	001A	FLOW, IN	0.225	ADDMON	0.1584	0.299	
10778001	TX0075809	12/31/04	001A	FLOW, IN	0.225	ADDMON	0.140161	0.218	
10778001	TX0075809	01/31/05	001A	FLOW, IN	0.225	ADDMON	0.147968	0.203	
10778001	TX0075809	02/28/05	001A	FLOW, IN	0.225	ADDMON	0.225	0.422	
10778001	TX0075809	03/31/05	001A	FLOW, IN	0.225	ADDMON	0.101193	0.189	
10778001	TX0075809	04/30/05	001A	FLOW, IN	0.225	ADDMON	0.98866	0.119	
10778001	TX0075809	05/31/05	001A	FLOW, IN	0.225	ADDMON	0.10629	0.132	
10778001	TX0075809	06/30/05	001A	FLOW, IN	0.225	ADDMON	0.103566	0.135	
10778001	TX0075809	07/31/05	001A	FLOW, IN	0.225	ADDMON	0.104903	0.13	
10778001	TX0075809	08/31/05	001A	FLOW, IN	0.225	ADDMON	0.104774	0.131	
10778001	TX0075809	09/30/05	001A	FLOW, IN	0.225	ADDMON	0.1054	0.13	

TPDES PERMIT NO. WQ0010778001
[For TCEQ Office Use Only:
EPA ID No. TX0075809]

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
P.O. Box 13087
Austin, Texas 78711-3087

This is a renewal that replaces
TPDES Permit No. 10778-001 issued
July 30, 1999.

PERMIT TO DISCHARGE WASTES

under provisions of
Section 402 of the Clean Water Act
and Chapter 26 of the Texas Water Code

Town of Ransom Canyon

whose mailing address is

24 Lee Kitchens Drive
Ransom Canyon, Texas 79366-2200

is authorized to treat and discharge wastes from the Ransom Canyon Wastewater Treatment Facility, SIC Code 4952

located approximately 1.2 miles west of Farm-to-Market Road 400 and approximately 4.8 miles south of Farm-to-Market Road 40, east of the City of Lubbock in Lubbock County, Texas

to the North Fork Double Mountain Fork Brazos River; thence to the Double Mountain Fork Brazos River in Segment No. 1241 of the Brazos River Basin

only according with effluent limitations, monitoring requirements and other conditions set forth in this permit, as well as the rules of the Texas Commission on Environmental Quality (TCEQ), the laws of the State of Texas, and other orders of the TCEQ. The issuance of this permit does not grant to the permittee the right to use private or public property for conveyance of wastewater along the discharge route described in this permit. This includes, but is not limited to, property belonging to any individual, partnership, corporation or other entity. Neither does this permit authorize any invasion of personal rights nor any violation of federal, state, or local laws or regulations. It is the responsibility of the permittee to acquire property rights as may be necessary to use the discharge route.

This permit shall expire at midnight, **March 1, 2009.**

ISSUED DATE: JUL 13 2004

L'Oreal Stepney
For the Commission

INTERIM EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Outfall Number 001

1. During the period beginning upon the date of issuance and lasting upon the completion of the 0.41 million gallons per day (MGD) facility, the permittee is authorized to discharge subject to the following effluent limitations:

   The daily average flow of effluent shall not exceed 0.225 MGD; nor shall the average discharge during any two-hour period (2-hour peak) exceed 469 gallons per minute (gpm).

Effluent Characteristic	Discharge Limitations				Minimum Self-Monitoring Requirements	
	Daily Avg mg/l(lbs/day)	7-day Avg mg/l	Daily Max mg/l	Single Grab mg/l	Report Daily Avg. & Max. Measurement Frequency	Single Grab Sample Type
Flow, MGD	Report	N/A	Report	N/A	Five/week	Instantaneous
Biochemical Oxygen Demand (5-day)	20 (38)	30	45	65	One/week	Grab
Total Suspended Solids	20 (38)	30	45	65	One/week	Grab

2. The effluent shall contain a chlorine residual of at least 1.0 mg/l and shall not exceed a chlorine residual of 4.0 mg/l after a detention time of at least 20 minutes (based on peak flow), and shall be monitored five times per week by grab sample. An equivalent method of disinfection may be substituted only with prior approval of the Executive Director.

3. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored once per month by grab sample.

4. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.

5. Effluent monitoring samples shall be taken at the following location(s): Following the final treatment unit.

6. The effluent shall contain a minimum dissolved oxygen of 2.0 mg/l and shall be monitored once per week by grab sample.

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS Outfall Number 001

1. During the period beginning upon completion of the 0.41 MGD facility and lasting through the date of expiration, the permittee is authorized to discharge subject to the following effluent limitations:

   The daily average flow of effluent shall not exceed 0.41 MGD; nor shall the average discharge during any two-hour period (2-hour peak) exceed 350 gallons per minute (gpm).

Effluent Characteristic	Discharge Limitations				Minimum Self-Monitoring Requirements	
	Daily Avg mg/l(lbs/day)	7-day Avg mg/l	Daily Max mg/l	Single Grab mg/l	Report Daily Avg. & Max. Measurement Frequency	Single Grab Sample Type
Flow, MGD	Report	N/A	Report	N/A	Five/week	Instantaneous
Biochemical Oxygen Demand (5-day)	10 (34)	15	25	35	One/week	Grab
Total Suspended Solids	15 (51)	25	40	60	One/week	Grab

2. The effluent shall contain a chlorine residual of at least 1.0 mg/l and shall not exceed a chlorine residual of 4.0 mg/l after a detention time of at least 20 minutes (based on peak flow), and shall be monitored five times per week by grab sample. An equivalent method of disinfection may be substituted only with prior approval of the Executive Director.

3. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored once per month by grab sample.

4. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.

5. Effluent monitoring samples shall be taken at the following location(s): Following the final treatment unit.

6. The effluent shall contain a minimum dissolved oxygen of 4.0 mg/l and shall be monitored once per week by grab sample.

DEFINITIONS AND STANDARD PERMIT CONDITIONS

As required by Title 30 Texas Administrative Code (TAC) Chapter 305, certain regulations appear as standard conditions in waste discharge permits. 30 TAC §§ 305.121 - 305.129 (relating to Permit Characteristics and Conditions) as promulgated under the Texas Water Code §§ 5.103 and 5.105, and the Texas Health and Safety Code §§ 361.017 and 361.024(a), establish the characteristics and standards for waste discharge permits, including sewage sludge, and those sections of 40 Code of Federal Regulations (CFR) Part 122 adopted by reference by the Commission. The following text includes these conditions and incorporates them into this permit. All definitions in Section 26.001 of the Texas Water Code and 30 TAC Chapter 305 shall apply to this permit and are incorporated by reference. Some specific definitions of words or phrases used in this permit are as follows:

1. Flow Measurements

   a. Annual average flow - the arithmetic average of all daily flow determinations taken within the preceding 12 consecutive calendar months. The annual average flow determination shall consist of daily flow volume determinations made by a totalizing meter, charted on a chart recorder and limited to major domestic wastewater discharge facilities with a 1 million gallons per day or greater permitted flow.

   b. Daily average flow - the arithmetic average of all determinations of the daily flow within a period of one calendar month. The daily average flow determination shall consist of determinations made on at least four separate days. If instantaneous measurements are used to determine the daily flow, the determination shall be the arithmetic average of all instantaneous measurements taken during that month. Daily average flow determination for intermittent discharges shall consist of a minimum of three flow determinations on days of discharge.

   c. Daily maximum flow - the highest total flow for any 24-hour period in a calendar month.

   d. Instantaneous flow - the measured flow during the minimum time required to interpret the flow measuring device.

   e. 2-hour peak flow (domestic wastewater treatment plants) - the maximum flow sustained for a two-hour period during the period of daily discharge. The average of multiple measurements of instantaneous maximum flow within a two-hour period may be used to calculate the 2-hour peak flow.

   f. Maximum 2-hour peak flow (domestic wastewater treatment plants) - the highest 2-hour peak flow for any 24-hour period in a calender month.

2. Concentration Measurements

   a. Daily average concentration - the arithmetic average of all effluent samples, composite or grab as required by this permit, within a period of one calendar month, consisting of at least four separate representative measurements.

      i. For domestic wastewater treatment plants - When four samples are not available in a calendar month, the arithmetic average (weighted by flow) of all values in the previous four consecutive month period consisting of at least four measurements shall be utilized as the daily average concentration.

      ii For all other wastewater treatment plants - When four samples are not available in a calender month, the arithmetic average (weighted by flow) of all values taken during the month shall be utilized as the daily average concentration.

   b. 7-day average concentration - the arithmetic average of all effluent samples, composite or grab as required by this permit, within a period of one calendar week, Sunday through Saturday.

   c. Daily maximum concentration - the maximum concentration measured on a single day, by the sample type specified in the permit, within a period of one calender month.

   d. Daily discharge - the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the sampling day.

The "daily discharge" determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the "daily discharge" determination of concentration shall be the arithmetic average (weighted by flow value) of all samples collected during that day.

e. Fecal coliform bacteria concentration - the number of colonies of fecal coliform bacteria per 100 milliliters effluent. The daily average fecal coliform bacteria concentration is a geometric mean of the values for the effluent samples collected in a calendar month. The geometric mean shall be determined by calculating the nth root of the product of all measurements made in a calender month, where n equals the number of measurements made; or, computed as the antilogarithm of the arithmetic mean of the logarithms of all measurements made in a calender month. For any measurement of fecal coliform bacteria equaling zero, a substituted value of one shall be made for input into either computation method. The 7-day average for fecal coliform bacteria is the geometric mean of the values for all effluent samples collected during a calender week.

f. Daily average loading (lbs/day) - the arithmetic average of all daily discharge loading calculations during a period of one calender month. These calculations must be made for each day of the month that a parameter is analyzed. The daily discharge, in terms of mass (lbs/day), is calculated as (Flow, MGD x Concentration, mg/l x 8.34).

g. Daily maximum loading (lbs/day) - the highest daily discharge, in terms of mass (lbs/day), within a period of one calender month.

3. Sample Type

a. Composite sample - For domestic wastewater, a composite sample is a sample made up of a minimum of three effluent portions collected in a continuous 24-hour period or during the period of daily discharge if less than 24 hours, and combined in volumes proportional to flow, and collected at the intervals required by 30 TAC § 319.9 (a). For industrial wastewater, a composite sample is a sample made up of a minimum of three effluent portions collected in a continuous 24-hour period or during the period of daily discharge if less than 24 hours, and combined in volumes proportional to flow, and collected at the intervals required by 30 TAC § 319.9 (b).

b. Grab sample - an individual sample collected in less than 15 minutes.

4. Treatment Facility (facility) - wastewater facilities used in the conveyance, storage, treatment, recycling, reclamation and/or disposal of domestic sewage, industrial wastes, agricultural wastes, recreational wastes, or other wastes including sludge handling or disposal facilities under the jurisdiction of the Commission.

5. The term "sewage sludge" is defined as solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in 30 TAC Chapter 312. This includes the solids which have not been classified as hazardous waste separated from wastewater by unit processes .

6. Bypass - the intentional diversion of a waste stream from any portion of a treatment facility.

MONITORING AND REPORTING REQUIREMENTS

1. Self-Reporting

Monitoring results shall be provided at the intervals specified in the permit. Unless otherwise specified in this permit or otherwise ordered by the Commission, the permittee shall conduct effluent sampling and reporting in accordance with 30 TAC §§ 319.4 - 319.12. Unless otherwise specified, a monthly effluent report shall be submitted each month, to the Enforcement Division (MC 224), by the 20th day of the following month for each discharge which is described by this permit whether or not a discharge is made for that month. Monitoring results must be reported on an approved self-report form, that is signed and certified as required by Monitoring and Reporting Requirements No. 10.

As provided by state law, the permittee is subject to administrative, civil and criminal penalties, as applicable, for negligently or knowingly violating the Clean Water Act, the Texas Water Code, Chapters 26, 27, and 28, and Texas Health and Safety Code, Chapter 361, including but not limited to knowingly making any false statement, representation, or certification on any report, record, or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, or falsifying, tampering with or knowingly rendering inaccurate any monitoring device or method required by this permit or violating any other requirement imposed by state or federal regulations.

2. Test Procedures

   Unless otherwise specified in this permit, test procedures for the analysis of pollutants shall comply with procedures specified in 30 TAC §§319.11 - 319.12. Measurements, tests and calculations shall be accurately accomplished in a representative manner.

3. Records of Results

   a. Monitoring samples and measurements shall be taken at times and in a manner so as to be representative of the monitored activity.

   b. Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR Part 503), monitoring and reporting records, including strip charts and records of calibration and maintenance, copies of all records required by this permit, records of all data used to complete the application for this permit, and the certification required by 40 CFR § 264.73(b)(9) shall be retained at the facility site, or shall be readily available for review by a TCEQ representative for a period of three years from the date of the record or sample, measurement, report, application or certification. This period shall be extended at the request of the Executive Director.

   c. Records of monitoring activities shall include the following:

      i. date, time and place of sample or measurement;
      ii. identity of individual who collected the sample or made the measurement.
      iii. date and time of analysis;
      iv. identity of the individual and laboratory who performed the analysis;
      v. the technique or method of analysis; and
      vi. the results of the analysis or measurement and quality assurance/quality control records.

   The period during which records are required to be kept shall be automatically extended to the date of the final disposition of any administrative or judicial enforcement action that maybe instituted against the permittee.

4. Additional Monitoring by Permittee

   If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit using approved analytical methods as specified above, all results of such monitoring shall be included in the calculation and reporting of the values submitted on the approved self-report form. Increased frequency of sampling shall be indicated on the self-report form.

5. Calibration of Instruments

   All automatic flow measuring or recording devices and all totalizing meters for measuring flows shall be accurately calibrated by a trained person at plant start-up and as often thereafter as necessary to ensure accuracy, but not less often than annually unless authorized by the Executive Director for a longer period. Such person shall verify in writing that the device is operating properly and giving accurate results. Copies of the verification shall be retained at the facility site and/or shall be readily available for review by a TCEQ representative for a period of three years.

6. Compliance Schedule Reports

   Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of the permit shall be submitted no later than 14 days following each schedule date to the Regional Office and the Enforcement Division (MC 224).

7. Noncompliance Notification

   a. In accordance with 30 TAC § 305.125(9) any noncompliance which may endanger human health or safety, or the environment shall be reported by the permittee to the TCEQ. Report of such information shall be provided orally or by facsimile transmission (FAX) to the Regional Office within 24 hours of becoming aware of the noncompliance. A written submission of such information shall also be provided by the permittee to the Regional Office and the Enforcement Division (MC 224) within five working days of becoming aware of the noncompliance. The written submission shall contain a description of the noncompliance and its cause; the potential danger to human health or safety, or the environment; the period of noncompliance, including exact dates and times; if the noncompliance has not been corrected, the time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance, and to mitigate its adverse effects.

b. The following violations shall be reported under Monitoring and Reporting Requirement 7.a.:

   i. Unauthorized discharges as defined in Permit Condition 2(g).

   ii. Any unanticipated bypass which exceeds any effluent limitation in the permit.

   iii. Violation of a permitted maximum daily discharge limitation for pollutants listed specifically in the Other Requirements section of an Industrial TPDES permit.

c. In addition to the above, any effluent violation which deviates from the permitted effluent limitation by more than 40% shall be reported by the permittee in writing to the Regional Office and the Enforcement Division (MC 224) within 5 working days of becoming aware of the noncompliance.

d. Any noncompliance other than that specified in this section, or any required information not submitted or submitted incorrectly, shall be reported to the Enforcement Division (MC 224) as promptly as possible. For effluent limitation violations, noncompliances shall be reported on the approved self-report form.

8. In accordance with the procedures described in 30 TAC §§ 35.301 - 35.303 (relating to Water Quality Emergency and Temporary Orders) if the permittee knows in advance of the need for a bypass, it shall submit prior notice by applying for such authorization.

9. Changes in Discharges of Toxic Substances

All existing manufacturing, commercial, mining, and silvicultural permittees shall notify the Regional Office, orally or by facsimile transmission within 24 hours, and both the Regional Office and the Enforcement Division (MC 224) in writing within five (5) working days, after becoming aware of or having reason to believe:

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant listed at 40 CFR Part 122, Appendix D, Tables II and III (excluding Total Phenols) which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

   i. One hundred micrograms per liter (100 μg/L);
   ii. Two hundred micrograms per liter (200 μg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 μg/L) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;
   iii. Five (5) times the maximum concentration value reported for that pollutant in the permit application; or
   iv. The level established by the TCEQ.

b. That any activity has occurred or will occur which would result in any discharge, on a nonroutine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":
   i. Five hundred micrograms per liter (500 μg/L);
   ii. One milligram per liter (1 mg/L) for antimony;
   iii. Ten (10) times the maximum concentration value reported for that pollutant in the permit application; or
   iv. The level established by the TCEQ.

10. Signatories to Reports

All reports and other information requested by the Executive Director shall be signed by the person and in the manner required by 30 TAC § 305.128 (relating to Signatories to Reports).

11. All Publicly Owned Treatment Works (POTWs) must provide adequate notice to the Executive Director of the following:

a. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of the CWA if it were directly discharging those pollutants;

b. Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit; and

c. For the purpose of this paragraph, adequate notice shall include information on:

   i. The quality and quantity of effluent introduced into the POTW; and
   ii. Any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

PERMIT CONDITIONS

1. General

   a. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in an application or in any report to the Executive Director, it shall promptly submit such facts or information.

   b. This permit is granted on the basis of the information supplied and representations made by the permittee during action on an application, and relying upon the accuracy and completeness of that information and those representations. After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked, in whole or in part, in accordance with 30 TAC Chapter 305, Subchapter D, during its term for good cause including, but not limited to, the following:

      i. Violation of any terms or conditions of this permit;
      ii. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or
      iii. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

   c. The permittee shall furnish to the Executive Director, upon request and within a reasonable time, any information to determine whether cause exists for amending, revoking, suspending or terminating the permit. The permittee shall also furnish to the Executive Director, upon request, copies of records required to be kept by the permit.

2. Compliance

   a. Acceptance of the permit by the person to whom it is issued constitutes acknowledgment and agreement that such person will comply with all the terms and conditions embodied in the permit, and the rules and other orders of the Commission.

   b. The permittee has a duty to comply with all conditions of the permit. Failure to comply with any permit condition constitutes a violation of the permit and the Texas Water Code or the Texas Health and Safety Code, and is grounds for enforcement action, for permit amendment, revocation or suspension, or for denial of a permit renewal application or an application for a permit for another facility.

   c. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit.

   d. The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal or other permit violation which has a reasonable likelihood of adversely affecting human health or the environment.

   e. Authorization from the Commission is required before beginning any change in the permitted facility or activity that may result in noncompliance with any permit requirements.

   f. A permit may be amended, suspended and reissued, or revoked for cause in accordance with 30 TAC §§ 305.62 and 305.66 and Texas Water Code Section 7.302. The filing of a request by the permittee for a permit amendment, suspension and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

   g. There shall be no unauthorized discharge of wastewater or any other waste. For the purpose of this permit, an unauthorized discharge is considered to be any discharge of wastewater into or adjacent to water in the state at any location not permitted as an outfall or otherwise defined in the Other Requirements section of this permit.

   h. In accordance with 30 TAC § 305.535(a), the permittee may allow any bypass to occur from a TPDES permitted facility which does not cause permitted effluent limitations to be exceeded or an unauthorized discharge to occur, but only if the bypass is also for essential maintenance to assure efficient operation.

   i. The permittee is subject to administrative, civil, and criminal penalties, as applicable, under Texas Water Code §§7.051 - 7.075 (relating to Administrative Penalties), 7.101 - 7.111 (relating to Civil Penalties), and 7.141 - 7.202 (relating to Criminal Offenses and Penalties) for violations including, but not limited to, negligently or knowingly violating the federal Clean Water Act, §§ 301, 302, 306, 307, 308, 318, or 405, or any condition or limitation implementing any sections in a permit issued under the CWA § 402, or any requirement imposed in a pretreatment program approved under the CWA §§ 402 (a)(3) or 402 (b)(8).

3. Inspections and Entry

   a. Inspection and entry shall be allowed as prescribed in the Texas Water Code Chapters 26, 27, and 28, and Texas Health and Safety Code Chapter 361.

   b. The members of the Commission and employees and agents of the Commission are entitled to enter any public or private property at any reasonable time for the purpose of inspecting and investigating conditions relating to the quality of water in the state or the compliance with any rule, regulation, permit or other order of the Commission. Members, employees, or agents of the Commission and Commission contractors are entitled to enter public or private property at any reasonable time to investigate or monitor or, if the responsible party is not responsive or there is an immediate danger to public health or the environment, to remove or remediate a condition related to the quality of water in the state. Members, employees, Commission contractors, or agents acting under this authority who enter private property shall observe the establishment's rules and regulations concerning safety, internal security, and fire protection, and if the property has management in residence, shall notify management or the person then in charge of his presence and shall exhibit proper credentials. If any member, employee, Commission contractor, or agent is refused the right to enter in or on public or private property under this authority, the Executive Director may invoke the remedies authorized in Texas Water Code Section 7.002. The statement above, that Commission entry shall occur in accordance with an establishment's rules and regulations concerning safety, internal security, and fire protection, is not grounds for denial or restriction of entry to any part of the facility, but merely describes the Commission's duty to observe appropriate rules and regulations during an inspection.

4. Permit Amendment and/or Renewal

   a. The permittee shall give notice to the Executive Director as soon as possible of any planned physical alterations or additions to the permitted facility if such alterations or additions would require a permit amendment or result in a violation of permit requirements. Notice shall also be required under this paragraph when:

      i. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in accordance with 30 TAC § 305.534 (relating to New Sources and New Dischargers); or

      ii. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements in Monitoring and Reporting Requirements No. 9;

      iii. The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

   b. Prior to any facility modifications, additions, or expansions that will increase the plant capacity beyond the permitted flow, the permittee must apply for and obtain proper authorization from the Commission before commencing construction.

   c. The permittee must apply for an amendment or renewal prior to expiration of the existing permit in order to continue a permitted activity after the expiration date of the permit. If an application is submitted prior to the expiration date of the permit, the existing permit shall remain in effect until the application is approved, denied, or returned. If the application is returned or denied, authorization to continue such activity shall terminate upon the effective date of the action. If an application is not submitted prior to the expiration date of the permit, the permit shall expire and authorization to continue such activity shall terminate.

   d. Prior to accepting or generating wastes which are not described in the permit application or which would result in a significant change in the quantity or quality of the existing discharge, the permittee must report the proposed changes to the Commission. The permittee must apply for a permit amendment reflecting any necessary changes in permit conditions, including effluent limitations for pollutants not identified and limited by this permit.

   e. In accordance with the Texas Water Code § 26.029(b), after a public hearing, notice of which shall be given to the permittee, the Commission may require the permittee, from time to time, for good cause, in accordance with applicable laws, to conform to new or additional conditions.

f. If any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the Clean Water Act for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that established those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

5. Permit Transfer

   a. Prior to any transfer of this permit, Commission approval must be obtained. The Commission shall be notified in writing of any change in control or ownership of facilities authorized by this permit. Such notification should be sent to the Water Quality Applications Team (MC 161) of the Registration, Review, and Reporting Division.

   b. A permit may be transferred only according to the provisions of 30 TAC § 305.64 (relating to Transfer of Permits) and 30 TAC § 50.133 (relating to Executive Director Action on Application or WQMP update).

6. Relationship to Hazardous Waste Activities

   This permit does not authorize any activity of hazardous waste storage, processing, or disposal which requires a permit or other authorization pursuant to the Texas Health and Safety Code.

7. Relationship to Water Rights

   Disposal of treated effluent by any means other than discharge directly to water in the state must be specifically authorized in this permit and may require a permit pursuant to Chapter 11 of the Texas Water Code.

8. Property Rights

   A permit does not convey any property rights of any sort, or any exclusive privilege.

9. Permit Enforceability

   The conditions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstances, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

OPERATIONAL REQUIREMENTS

1. The permittee shall at all times ensure that the facility and all of its systems of collection, treatment, and disposal are properly operated and maintained. This includes, but is not limited to, the regular, periodic examination of wastewater solids within the treatment plant by the operator in order to maintain an appropriate quantity and quality of solids inventory as described in the various operator training manuals and according to accepted industry standards for process control. Process control, maintenance, and operations records shall be retained at the facility site, or shall be readily available for review by a TCEQ representative, for a period of three years.

2. Upon request by the Executive Director, the permittee shall take appropriate samples and provide proper analysis in order to demonstrate compliance with Commission rules. Unless otherwise specified in this permit or otherwise ordered by the Commission, the permittee shall comply with all applicable provisions of 30 TAC Chapter 312 concerning sewage sludge use and disposal and 30 TAC §§ 319.21 - 319.29 concerning the discharge of certain hazardous metals.

3. Domestic wastewater treatment facilities shall comply with the following provisions:

   a. The permittee shall notify the Municipal Permits Team, Wastewater Permitting Section (MC 148) of the Water Quality Division, in writing, of any facility expansion at least 90 days prior to conducting such activity.

   b. The permittee shall submit a closure plan for review and approval to the Land Application Team, Wastewater Permitting Section (MC 148) of the Water Quality Division, for any closure activity at least 90 days prior to conducting such activity. Closure is the act of permanently taking a waste management unit or treatment facility out of service and includes the permanent removal from service of any pit, tank, pond, lagoon, surface impoundment and/or other treatment unit regulated by this permit.

4. The permittee is responsible for installing prior to plant start-up, and subsequently maintaining, adequate safeguards to prevent the discharge of untreated or inadequately treated wastes during electrical power failures by means of alternate power sources, standby generators, and/or retention of inadequately treated wastewater.

5. Unless otherwise specified, the permittee shall provide a readily accessible sampling point and, where applicable, an effluent flow measuring device or other acceptable means by which effluent flow may be determined.

6. The permittee shall remit an annual water quality fee to the Commission as required by 30 TAC Chapter 21. Failure to pay the fee may result in revocation of this permit under Texas Water Code § 7.302(b)(6).

7. Documentation

   For all written notifications to the Commission required of the permittee by this permit, the permittee shall keep and make available a copy of each such notification under the same conditions as self-monitoring data are required to be kept and made available. Except for information required for TPDES permit applications, effluent data, including effluent data in permits, draft permits and permit applications, and other information specified as not confidential in 30 TAC § 1.5(d), any information submitted pursuant to this permit may be claimed as confidential by the submitter. Any such claim must be asserted in the manner prescribed in the application form or by stamping the words "confidential business information" on each page containing such information. If no claim is made at the time of submission, information may be made available to the public without further notice. If the Commission or Executive Director agrees with the designation of confidentiality, the TCEQ will not provide the information for public inspection unless required by the Texas Attorney General or a court pursuant to an open records request. If the Executive Director does not agree with the designation of confidentiality, the person submitting the information will be notified.

8. Facilities which generate domestic wastewater shall comply with the following provisions; domestic wastewater treatment facilities at permitted industrial sites are excluded.

   a. Whenever flow measurements for any domestic sewage treatment facility reach 75 percent of the permitted daily average or annual average flow for three consecutive months, the permittee must initiate engineering and financial planning for expansion and/or upgrading of the domestic wastewater treatment and/or collection facilities. Whenever the flow reaches 90 percent of the permitted daily average or annual average flow for three consecutive months, the permittee shall obtain necessary authorization from the Commission to commence construction of the necessary additional treatment and/or collection facilities. In the case of a domestic wastewater treatment facility which reaches 75 percent of the permitted daily average or annual average flow for three consecutive months, and the planned population to be served or the quantity of waste produced is not expected to exceed the design limitations of the treatment facility, the permittee shall submit an engineering report supporting this claim to the Executive Director of the Commission.

      If in the judgement of the Executive Director the population to be served will not cause permit noncompliance, then the requirement of this section may be waived. To be effective, any waiver must be in writing and signed by the Director of the Enforcement Division (MC 149) of the Commission, and such waiver of these requirements will be reviewed upon expiration of the existing permit; however, any such waiver shall not be interpreted as condoning or excusing any violation of any permit parameter.

   b. The plans and specifications for domestic sewage collection and treatment works associated with any domestic permit must be approved by the Commission, and failure to secure approval before commencing construction of such works or making a discharge is a violation of this permit and each day is an additional violation until approval has been secured.

   c. Permits for domestic wastewater treatment plants are granted subject to the policy of the Commission to encourage the development of area-wide waste collection, treatment and disposal systems. The Commission reserves the right to amend any domestic wastewater permit in accordance with applicable procedural requirements to require the system covered by this permit to be integrated into an area-wide system, should such be developed; to require the delivery of the wastes authorized to be collected in, treated by or discharged from said system, to such area-wide system; or to amend this permit in any other particular to effectuate the Commission's policy. Such amendments may be made when the changes required are advisable for water quality control purposes and are feasible on the basis of waste treatment technology, engineering, financial, and related considerations existing at the time the changes are required, exclusive of the loss of investment in or revenues from any then existing or proposed waste collection, treatment or disposal system.

9. Domestic wastewater treatment plants shall be operated and maintained by sewage plant operators holding a valid certificate of competency at the required level as defined in 30 TAC Chapter 30.

10. For Publicly Owned Treatment Works (POTWs), the 30-day average (or monthly average) percent removal for BOD and TSS shall not be less than 85 percent, unless otherwise authorized by this permit.

11. Facilities which generate industrial solid waste as defined in 30 TAC § 335.1 shall comply with these provisions:

    a. Any solid waste, as defined in 30 TAC § 335.1 (including but not limited to such wastes as garbage, refuse, sludge from a waste treatment, water supply treatment plant or air pollution control facility, discarded materials, discarded materials to be recycled, whether the waste is solid, liquid, or semisolid), generated by the permittee during the management and treatment of wastewater, must be managed in accordance with all applicable provisions of 30 TAC Chapter 335, relating to Industrial Solid Waste Management.

    b. Industrial wastewater that is being collected, accumulated, stored, or processed before discharge through any final discharge outfall, specified by this permit, is considered to be industrial solid waste until the wastewater passes through the actual point source discharge and must be managed in accordance with all applicable provisions of 30 TAC Chapter 335.

    c. The permittee shall provide written notification, pursuant to the requirements of 30 TAC § 335.8(b)(1), to the Corrective Action Section (MC 127) of the Remediation Division informing the Commission of any closure activity involving an Industrial Solid Waste Management Unit, at least 90 days prior to conducting such an activity.

    d. Construction of any industrial solid waste management unit requires the prior written notification of the proposed activity to the Registration and Reporting Section (MC 129) of the Registration, Review, and Reporting Division. No person shall dispose of industrial solid waste, including sludge or other solids from wastewater treatment processes, prior to fulfilling the deed recordation requirements of 30 TAC § 335.5.

    e. The term "industrial solid waste management unit" means a landfill, surface impoundment, waste-pile, industrial furnace, incinerator, cement kiln, injection well, container, drum, salt dome waste containment cavern, or any other structure vessel, appurtenance, or other improvement on land used to manage industrial solid waste.

    f. The permittee shall keep management records for all sludge (or other waste) removed from any wastewater treatment process. These records shall fulfill all applicable requirements of 30 TAC Chapter 335 and must include the following, as it pertains to wastewater treatment and discharge:

        i. Volume of waste and date(s) generated from treatment process;
        ii. Volume of waste disposed of on-site or shipped off-site;
        iii. Date(s) of disposal;
        iv. Identity of hauler or transporter;
        v. Location of disposal site; and
        vi. Method of final disposal.

       The above records shall be maintained on a monthly basis. The records shall be retained at the facility site, or shall be readily available for review by authorized representatives of the TCEQ for at least five years.

12. For industrial facilities to which the requirements of 30 TAC Chapter 335 do not apply, sludge and solid wastes, including tank cleaning and contaminated solids for disposal, shall be disposed of in accordance with Chapter 361 of the Texas Health and Safety Code.

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SLUDGE PROVISIONS

The permittee is authorized to dispose of sludge only at a Texas Commission on Environmental Quality (TCEQ) registered or permitted land application site, commercial land application site or co-disposal landfill. **The disposal of sludge by land application on property owned, leased or under the direct control of the permittee is a violation of the permit unless the site is permitted or registered with the TCEQ. This provision does not authorize Distribution and Marketing of sludge. This provision does not authorize land application of Class A Sludge. This provision does not authorize the permittee to land apply sludge on property owned, leased or under the direct control of the permittee.**

SECTION I. REQUIREMENTS APPLYING TO ALL SEWAGE SLUDGE LAND APPLICATION

A. General Requirements

1. The permittee shall handle and dispose of sewage sludge in accordance with 30 TAC Chapter 312 and all other applicable state and federal regulations in a manner which protects public health and the environment from any reasonably anticipated adverse effects due to any toxic pollutants which may be present in the sludge.

2. In all cases, if the person (permit holder) who prepares the sewage sludge supplies the sewage sludge to another person for land application use or to the owner or lease holder of the land, the permit holder shall provide necessary information to the parties who receive the sludge to assure compliance with these regulations.

3. The permittee shall give 180 days prior notice to the Executive Director in care of the Wastewater Permitting Section (MC 148) of the Water Quality Division of any change planned in the sewage sludge disposal practice.

B. Testing Requirements

1. Sewage sludge shall be tested once during the term of this permit in accordance with the method specified in both 40 CFR Part 261, Appendix II and 40 CFR Part 268, Appendix I [Toxicity Characteristic Leaching Procedure (TCLP)] or other method, which receives the prior approval of the TCEQ for the contaminants listed in Table 1 of 40 CFR Section 261.24. Sewage sludge failing this test shall be managed according to RCRA standards for generators of hazardous waste, and the waste's disposition must be in accordance with all applicable requirements for hazardous waste processing, storage, or disposal. Following failure of any TCLP test, the management or disposal of sewage sludge at a facility other than an authorized hazardous waste processing, storage, or disposal facility shall be prohibited until such time as the permittee can demonstrate the sewage sludge no longer exhibits the hazardous waste toxicity characteristics (as demonstrated by the results of the TCLP tests). A written report shall be provided to both the TCEQ Registration and Reporting Section (MC 129) of the Registration, Review, and Reporting Division and the Regional Director (MC Region 2) within 7 days after failing the TCLP Test. The report shall contain test results, certification that unauthorized waste management has stopped and a summary of alternative disposal plans that comply with RCRA standards for the management of hazardous waste. The report shall be addressed to: Director, Registration, Review, and Reporting Division (MC 129), Texas Commission on Environmental Quality, P. O. Box 13087, Austin, Texas 78711-3087. In addition, the permittee shall prepare an annual report on the results of all sludge toxicity testing. This annual report shall be submitted to the TCEQ Regional Office (MC Region 2) and the Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division by September 1 of each year.

2. Sewage sludge shall not be applied to the land if the concentration of the pollutants exceed the pollutant concentration criteria in Table 1. The frequency of testing for pollutants in Table 1 is found in Section I.C.

TABLE 1

Pollutant	Ceiling Concentration (milligrams per kilogram)*
Arsenic	75
Cadmium	85
Chromium	3000
Copper	4300
Lead	840
Mercury	57
Molybdenum	75
Nickel	420
PCBs	49
Selenium	100
Zinc	7500

* Dry weight basis

3. Pathogen Control

All sewage sludge that is applied to agricultural land, forest, a public contact site, or a reclamation site shall be treated by one of the following methods to ensure that the sludge meets either the Class A or Class B pathogen requirements.

a. Six alternatives are available to demonstrate compliance with Class A sewage sludge. The first 4 options require either the density of fecal coliform in the sewage sludge be less than 1000 Most Probable Number (MPN) per gram of total solids (dry weight basis), or the density of Salmonella sp. bacteria in the sewage sludge be less than three MPN per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed. Below are the additional requirements necessary to meet the definition of a Class A sludge.

Alternative 1 - The temperature of the sewage sludge that is used or disposed shall be maintained at or above a specific value for a period of time. See 30 TAC Section 312.82(a)(2)(A) for specific information.

Alternative 2 - The pH of the sewage sludge that is used or disposed shall be raised to above 12 std. units and shall remain above 12 std. units for 72 hours.

The temperature of the sewage sludge shall be above 52 degrees Celsius for 12 hours or longer during the period that the pH of the sewage sludge is above 12 std. units.

At the end of the 72-hour period during which the pH of the sewage sludge is above 12 std. units, the sewage sludge shall be air dried to achieve a percent solids in the sewage sludge greater than 50 percent.

Alternative 3 - The sewage sludge shall be analyzed for enteric viruses prior to pathogen treatment. The limit for enteric viruses is less than one Plaque-forming Unit per four grams of total solids (dry weight basis) either before or following pathogen treatment. See 30 TAC Section 312.82(a)(2)(C)(i-iii) for specific information. The sewage sludge shall be analyzed for viable helminth ova prior to pathogen treatment. The limit for viable helminth ova is less than one per four grams of total solids (dry weight basis) either before or following pathogen treatment. See 30 TAC Section 312.82(a)(2)(C)(iv-vi) for specific information.

Alternative 4 - The density of enteric viruses in the sewage sludge shall be less than one Plaque-forming Unit per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed. The density of viable helminth ova in the sewage sludge shall be less than one per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed.

Alternative 5 (PFRP) - Sewage sludge that is used or disposed of shall be treated in one of the processes to Further Reduce Pathogens (PFRP) described in 40 CFR Part 503, Appendix B. PFRP include composting, heat drying, heat treatment, and thermophilic aerobic digestion.

Alternative 6 (PFRP Equivalent) - Sewage sludge that is used or disposed of shall be treated in a process that has been approved by the U. S. Environmental Protection Agency as being equivalent to those in Alternative 5.

b. Three alternatives are available to demonstrate compliance with Class B criteria for sewage sludge.

Alternative 1 -

i. A minimum of seven random samples of the sewage sludge shall be collected within 48 hours of the time the sewage sludge is used or disposed of during each monitoring episode for the sewage sludge.

ii. The geometric mean of the density of fecal coliform in the samples collected shall be less than either 2,000,000 MPN per gram of total solids (dry weight basis) or 2,000,000 Colony Forming Units per gram of total solids (dry weight basis).

Alternative 2 - Sewage sludge that is used or disposed of shall be treated in one of the Processes to Significantly Reduce Pathogens (PSRP) described in 40 CFR Part 503, Appendix B, so long as all of the following requirements are met by the generator of the sewage sludge.

i. Prior to use or disposal, all the sewage sludge must have been generated from a single location, except as provided in paragraph v. below;

ii. An independent Texas Licensed Professional Engineer must make a certification to the generator of a sewage sludge that the wastewater treatment facility generating the sewage sludge is designed to achieve one of the PSRP at the permitted design loading of the facility. The certification need only be repeated if the design loading of the facility is increased. The certification shall include a statement indicating the design meets all the applicable standards specified in Appendix B of 40 CFR Part 503;

iii. Prior to any off-site transportation or on-site use or disposal of any sewage sludge generated at a wastewater treatment facility, the chief certified operator of the wastewater treatment facility or other responsible official who manages the processes to significantly reduce pathogens at the wastewater treatment facility for the permittee, shall certify that the sewage sludge underwent at least the minimum operational requirements necessary in order to meet one of the PSRP. The acceptable processes and the minimum operational and record keeping requirements shall be in accordance with established U. S. Environmental Protection Agency final guidance;

iv. All certification records and operational records describing how the requirements of this paragraph were met shall be kept by the generator for a minimum of three years and be available for inspection by commission staff for review; and

v. If the sewage sludge is generated from a mixture of sources, resulting from a person who prepares sewage sludge from more than one wastewater treatment facility, the resulting derived product shall meet one of the PSRP, and shall meet the certification, operation, and record keeping requirements of this paragraph.

Alternative 3 - Sewage sludge shall be treated in an equivalent process that has been approved by the U. S. Environmental Protection Agency, so long as all of the following requirements are met by the generator of the sewage sludge.

i. Prior to use or disposal, all the sewage sludge must have been generated from a single location, except as provided in paragraph v. below;

ii. Prior to any off-site transportation or on-site use or disposal of any sewage sludge generated at a wastewater treatment facility, the chief certified operator of the wastewater treatment facility or other responsible official who manages the processes to significantly reduce pathogens at the wastewater treatment facility for the permittee, shall certify that the sewage sludge underwent at least the minimum operational requirements necessary in order to meet one of the PSRP. The acceptable processes and the minimum operational and record keeping requirements shall be in accordance with established U. S. Environmental Protection Agency final guidance;

iii. All certification records and operational records describing how the requirements of this paragraph were met shall be kept by the generator for a minimum of three years and be available for inspection by commission staff for review;

iv. The executive director will accept from the U. S. Environmental Protection Agency a finding of equivalency to the defined PSRP; and

v. If the sewage sludge is generated from a mixture of sources resulting from a person who prepares sewage sludge from more than one wastewater treatment facility, the resulting derived product shall meet one of the Processes to Significantly Reduce Pathogens, and shall meet the certification, operation, and record keeping requirements of this paragraph.

In addition, the following site restrictions must be met if Class B sludge is land applied:

i. Food crops with harvested parts that touch the sewage sludge/soil mixture and are totally above the land surface shall not be harvested for 14 months after application of sewage sludge.

ii. Food crops with harvested parts below the surface of the land shall not be harvested for 20 months after application of sewage sludge when the sewage sludge remains on the land surface for 4 months or longer prior to incorporation into the soil.

iii. Food crops with harvested parts below the surface of the land shall not be harvested for 38 months after application of sewage sludge when the sewage sludge remains on the land surface for less than 4 months prior to incorporation into the soil.

iv. Food crops, feed crops, and fiber crops shall not be harvested for 30 days after application of sewage sludge.

v. Animals shall not be allowed to graze on the land for 30 days after application of sewage sludge.

vi. Turf grown on land where sewage sludge is applied shall not be harvested for 1 year after application of the sewage sludge when the harvested turf is placed on either land with a high potential for public exposure or a lawn.

vii. Public access to land with a high potential for public exposure shall be restricted for 1 year after application of sewage sludge.

viii. Public access to land with a low potential for public exposure shall be restricted for 30 days after application of sewage sludge.

ix. Land application of sludge shall be in accordance with the buffer zone requirements found in 30 TAC Section 312.44.

4. Vector Attraction Reduction Requirements

All bulk sewage sludge that is applied to agricultural land, forest, a public contact site, or a reclamation site shall be treated by one of the following alternatives 1 through 10 for Vector Attraction Reduction.

<u>Alternative 1</u> - The mass of volatile solids in the sewage sludge shall be reduced by a minimum of 38 percent.

<u>Alternative 2</u> - If Alternative 1 cannot be met for an anaerobically digested sludge, demonstration can be made by digesting a portion of the previously digested sludge anaerobically in the laboratory in a bench-scale unit for 40 additional days at a temperature between 30 and 37 degrees Celsius. Volatile solids must be reduced by less than 17 percent to demonstrate compliance.

<u>Alternative 3</u> - If Alternative 1 cannot be met for an aerobically digested sludge, demonstration can be made by digesting a portion of the previously digested sludge with a percent solids of two percent or less aerobically in the laboratory in a bench-scale unit for 30 additional days at 20 degrees Celsius. Volatile solids must be reduced by less than 15 percent to demonstrate compliance.

<u>Alternative 4</u> - The specific oxygen uptake rate (SOUR) for sewage sludge treated in an aerobic process shall be equal to or less than 1.5 milligrams of oxygen per hour per gram of total solids (dry weight basis) at a temperature of 20 degrees Celsius.

Alternative 5 - Sewage sludge shall be treated in an aerobic process for 14 days or longer. During that time, the temperature of the sewage sludge shall be higher than 40 degrees Celsius and the average temperature of the sewage sludge shall be higher than 45 degrees Celsius.

Alternative 6 - The pH of sewage sludge shall be raised to 12 or higher by alkali addition and, without the addition of more alkali shall remain at 12 or higher for two hours and then remain at a pH of 11.5 or higher for an additional 22 hours at the time the sewage sludge is prepared for sale or given away in a bag or other container.

Alternative 7 - The percent solids of sewage sludge that does not contain unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 75 percent based on the moisture content and total solids prior to mixing with other materials. Unstabilized solids are defined as organic materials in sewage sludge that have not been treated in either an aerobic or anaerobic treatment process.

Alternative 8 - The percent solids of sewage sludge that contains unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 90 percent based on the moisture content and total solids prior to mixing with other materials at the time the sludge is used. Unstabilized solids are defined as organic materials in sewage sludge that have not been treated in either an aerobic or anaerobic treatment process.

Alternative 9 - i. Sewage sludge shall be injected below the surface of the land.

ii. No significant amount of the sewage sludge shall be present on the land surface within one hour after the sewage sludge is injected.

iii. When sewage sludge that is injected below the surface of the land is Class A with respect to pathogens, the sewage sludge shall be injected below the land surface within eight hours after being discharged from the pathogen treatment process.

Alternative 10- i. Sewage sludge applied to the land surface or placed on a surface disposal site shall be incorporated into the soil within six hours after application to or placement on the land.

ii. When sewage sludge that is incorporated into the soil is Class A with respect to pathogens, the sewage sludge shall be applied to or placed on the land within eight hours after being discharged from the pathogen treatment process.

C. Monitoring Requirements

Toxicity Characteristic Leaching Procedure (TCLP) Test	- once during the term of this permit
PCBs	- once during the term of this permit

All metal constituents and Fecal coliform or Salmonella sp. bacteria shall be monitored at the appropriate frequency shown below, pursuant to 30 TAC Section 312.46(a)(1):

Amount of sewage sludge (*) metric tons per 365-day period				Monitoring Frequency
0	≤ Sludge	<	290	Once/Year
290	≤ Sludge	<	1,500	Once/Quarter
1,500	≤ Sludge	<	15,000	Once/Two Months
15,000	≤ Sludge			Once/Month

(*) The amount of bulk sewage sludge applied to the land (dry weight basis).

Representative samples of sewage sludge shall be collected and analyzed in accordance with the methods referenced in 30 TAC Section 312.7.

SECTION II. REQUIREMENTS SPECIFIC TO BULK SEWAGE SLUDGE FOR APPLICATION TO THE LAND MEETING CLASS A or B PATHOGEN REDUCTION AND THE CUMULATIVE LOADING RATES IN TABLE 2, OR CLASS B PATHOGEN REDUCTION AND THE POLLUTANT CONCENTRATIONS IN TABLE 3

For those permittees meeting Class A or B pathogen reduction requirements and that meet the cumulative loading rates in Table 2 below, or the Class B pathogen reduction requirements and contain concentrations of pollutants below listed in Table 3, the following conditions apply:

A. Pollutant Limits

Table 2

Pollutant	Cumulative Pollutant Loading Rate (pounds per acre)
Arsenic	36
Cadmium	35
Chromium	2677
Copper	1339
Lead	268
Mercury	15
Molybdenum	Report Only
Nickel	375
Selenium	89
Zinc	2500

Table 3

Pollutant	Monthly Average Concentration (milligrams per kilogram)*
Arsenic	41
Cadmium	39
Chromium	1200
Copper	1500
Lead	300
Mercury	17
Molybdenum	Report Only
Nickel	420
Selenium	36
Zinc	2800

* Dry weight basis

B. Pathogen Control

All bulk sewage sludge that is applied to agricultural land, forest, a public contact site, a reclamation site, shall be treated by either Class A or Class B pathogen reduction requirements as defined above in Section I.B.3.

C. Management Practices

1. Bulk sewage sludge shall not be applied to agricultural land, forest, a public contact site, or a reclamation site that is flooded, frozen, or snow-covered so that the bulk sewage sludge enters a wetland or other waters in the State.

2. Bulk sewage sludge not meeting Class A requirements shall be land applied in a manner which complies with the Management Requirements in accordance with 30 TAC Section 312.44.

3. Bulk sewage sludge shall be applied at or below the agronomic rate of the cover crop.

4. An information sheet shall be provided to the person who receives bulk sewage sludge sold or given away. The information sheet shall contain the following information:

    a. The name and address of the person who prepared the sewage sludge that is sold or given away in a bag or other container for application to the land.

    b. A statement that application of the sewage sludge to the land is prohibited except in accordance with the instruction on the label or information sheet.

    c. The annual whole sludge application rate for the sewage sludge application rate for the sewage sludge that does not cause any of the cumulative pollutant loading rates in Table 2 above to be exceeded, unless the pollutant concentrations in Table 3 found in Section II above are met.

D. Notification Requirements

1. If bulk sewage sludge is applied to land in a State other than Texas, written notice shall be provided prior to the initial land application to the permitting authority for the State in which the bulk sewage sludge is proposed to be applied. The notice shall include:

    a. The location, by street address, and specific latitude and longitude, of each land application site.

    b. The approximate time period bulk sewage sludge will be applied to the site.

    c. The name, address, telephone number, and National Pollutant Discharge Elimination System permit number (if appropriate) for the person who will apply the bulk sewage sludge.

2. The permittee shall give 180 days prior notice to the Executive Director in care of the Wastewater Permitting Section (MC 148) of the Water Quality Division of any change planned in the sewage sludge disposal practice.

E. Record keeping Requirements

The sludge documents will be retained at the facility site and/or shall be readily available for review by a TCEQ representative. The person who prepares bulk sewage sludge or a sewage sludge material shall develop the following information and shall retain the information at the facility site and/or shall be readily available for review by a TCEQ representative for a period of five years. If the permittee supplies the sludge to another person who land applies the sludge, the permittee shall notify the land applier of the requirements for record keeping found in 30 TAC Section 312.47 for persons who land apply.

1. The concentration (mg/kg) in the sludge of each pollutant listed in Table 3 above and the applicable pollutant concentration criteria (mg/kg), <u>or</u> the applicable cumulative pollutant loading rate and the applicable cumulative pollutant loading rate limit (lbs/ac) listed in Table 2 above.

2. A description of how the pathogen reduction requirements are met (including site restrictions for Class B sludges, if applicable).

3. A description of how the vector attraction reduction requirements are met.

4. A description of how the management practices listed above in Section II.C are being met.

5. The following certification statement:

   "I certify, under penalty of law, that the applicable pathogen requirements in 30 TAC Section 312.82(a) or (b) and the vector attraction reduction requirements in 30 TAC Section 312.83(b) have been met for each site on which bulk sewage sludge is applied. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the management practices have been met. I am aware that there are significant penalties for false certification including fine and imprisonment."

6. The recommended agronomic loading rate from the references listed in Section II.C.3. above, as well as the actual agronomic loading rate shall be retained.

The person who applies bulk sewage sludge or a sewage sludge material shall develop the following information and shall retain the information at the facility site and/or shall be readily available for review by a TCEQ representative <u>indefinitely</u>. If the permittee supplies the sludge to another person who land applies the sludge, the permittee shall notify the land applier of the requirements for record keeping found in 30 TAC Section 312.47 for persons who land apply.

1. A certification statement that all applicable requirements (specifically listed) have been met, and that the permittee understands that there are significant penalties for false certification including fine and imprisonment. See 30 TAC Section 312.47(a)(4)(A)(ii) or 30 TAC Section 312.47(a)(5)(A)(ii), as applicable, and to the permittee's specific sludge treatment activities.

2. The location, by street address, and specific latitude and longitude, of each site on which sludge is applied.

3. The number of acres in each site on which bulk sludge is applied.

4. The date and time sludge is applied to each site.

5. The cumulative amount of each pollutant in pounds/acre listed in Table 2 applied to each site.

6. The total amount of sludge applied to each site in dry tons.

The above records shall be maintained on-site on a monthly basis and shall be made available to the Texas Commission on Environmental Quality upon request.

F. Reporting Requirements

The permittee shall report annually to the TCEQ Regional Office (MC Region 2) and Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division, by September 1 of each year the following information:

1. Results of tests performed for pollutants found in either Table 2 or 3 as appropriate for the permittee's land application practices.
2. The frequency of monitoring listed in Section I.C. which applies to the permittee.
3. Toxicity Characteristic Leaching Procedure (TCLP) results.
4. Identity of hauler(s) and TCEQ transporter number.
5. PCB concentration in sludge in mg/kg.
6. Date(s) of disposal.
7. Owner of disposal site(s).
8. Texas Commission on Environmental Quality registration number, if applicable.
9. Amount of sludge disposal dry weight (lbs/acre) at each disposal site.
10. The concentration (mg/kg) in the sludge of each pollutant listed in Table 1 (defined as a monthly average) as well as the applicable pollutant concentration criteria (mg/kg) listed in Table 3 above, or the applicable pollutant loading rate limit (lbs/acre) listed in Table 2 above if it exceeds 90% of the limit.
11. Level of pathogen reduction achieved (Class A or Class B).
12. Alternative used as listed in Section I.B.3.(a. or b.). Alternatives describe how the pathogen reduction requirements are met. If Class B sludge, include information on how site restrictions were met.
13. Vector attraction reduction alternative used as listed in Section I.B.4.
14. Annual sludge production in dry tons/year.
15. Amount of sludge land applied in dry tons/year.
16. The certification statement listed in either 30 TAC Section 312.47(a)(4)(A)(ii) or 30 TAC Section 312.47(a)(5)(A)(ii) as applicable to the permittee's sludge treatment activities, shall be attached to the annual reporting form.

17. When the amount of any pollutant applied to the land exceeds 90% of the cumulative pollutant loading rate for that pollutant, as described in Table 2, the permittee shall report the following information as an attachment to the annual reporting form.

    a. The location, by street address, and specific latitude and longitude.

    b. The number of acres in each site on which bulk sewage sludge is applied.

    c. The date and time bulk sewage sludge is applied to each site.

    d. The cumulative amount of each pollutant (i.e., pounds/acre) listed in Table 2 in the bulk sewage sludge applied to each site.

    e. The amount of sewage sludge (i.e., dry tons) applied to each site.

    The above records shall be maintained on a monthly basis and shall be made available to the Texas Commission on Environmental Quality upon request.

SECTION III. REQUIREMENTS APPLYING TO ALL SEWAGE SLUDGE DISPOSED IN A MUNICIPAL SOLID WASTE LANDFILL

A. The permittee shall handle and dispose of sewage sludge in accordance with 30 TAC Chapter 330 and all other applicable state and federal regulations to protect public health and the environment from any reasonably anticipated adverse effects due to any toxic pollutants that may be present. The permittee shall ensure that the sewage sludge meets the requirements in 30 TAC Chapter 330 concerning the quality of the sludge disposed in a municipal solid waste landfill.

B. If the permittee generates sewage sludge and supplies that sewage sludge to the owner or operator of a Municipal Solid Waste Landfill (MSWLF) for disposal, the permittee shall provide to the owner or operator of the MSWLF appropriate information needed to be in compliance with the provisions of this permit.

C. The permittee shall give 180 days prior notice to the Executive Director in care of the Wastewater Permitting Section (MC 148) of the Water Quality Division of any change planned in the sewage sludge disposal practice.

D. Sewage sludge shall be tested once during the term of this permit in accordance with the method specified in both 40 CFR Part 261, Appendix II and 40 CFR Part 268, Appendix I (Toxicity Characteristic Leaching Procedure) or other method, which receives the prior approval of the TCEQ for contaminants listed in Table 1 of 40 CFR Section 261.24. Sewage sludge failing this test shall be managed according to RCRA standards for generators of hazardous waste, and the waste's disposition must be in accordance with all applicable requirements for hazardous waste processing, storage, or disposal.

Following failure of any TCLP test, the management or disposal of sewage sludge at a facility other than an authorized hazardous waste processing, storage, or disposal facility shall be prohibited until such time as the permittee can demonstrate the sewage sludge no longer exhibits the hazardous waste toxicity characteristics (as demonstrated by the results of the TCLP tests). A written report shall be provided to both the TCEQ Registration and Reporting Section (MC 129) of the Registration, Review, and Reporting Division and the Regional Director (MC Region 2) of the appropriate TCEQ field office within 7 days after failing the TCLP Test. The report shall contain test results, certification that unauthorized waste management has stopped and a summary of alternative disposal plans that comply with RCRA standards for the management of hazardous waste. The report shall be addressed to: Director, Registration, Review, and Reporting Division (MC 129), Texas Commission on Environmental Quality, P. O. Box 13087, Austin, Texas 78711-3087. In addition, the permittee shall prepare an annual report on the results of all sludge toxicity testing. This annual report shall be submitted to the TCEQ Regional Office (MC Region 2) and the Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division by September 1 of each year.

E. Sewage sludge shall be tested as needed, in accordance with the requirements of 30 TAC Chapter 330.

F. Record keeping Requirements

The permittee shall develop the following information and shall retain the information for five years.

1. The description (including procedures followed and the results) of all liquid Paint Filter Tests performed.
2. The description (including procedures followed and results) of all TCLP tests performed.

The above records shall be maintained on-site on a monthly basis and shall be made available to the Texas Commission on Environmental Quality upon request.

G. Reporting Requirements

The permittee shall report annually to the TCEQ Regional Office (MC Region 2) and Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division by September 1 of each year the following information:

1. Toxicity Characteristic Leaching Procedure (TCLP) results.
2. Annual sludge production in dry tons/year.
3. Amount of sludge disposed in a municipal solid waste landfill in dry tons/year.
4. Amount of sludge transported interstate in dry tons/year.
5. A certification that the sewage sludge meets the requirements of 30 TAC Chapter 330 concerning the quality of the sludge disposed in a municipal solid waste landfill.
6. Identity of hauler(s) and transporter registration number.
7. Owner of disposal site(s).
8. Location of disposal site(s).
9. Date(s) of disposal.

The above records shall be maintained on-site on a monthly basis and shall be made available to the Texas Commission on Environmental Quality upon request.

OTHER REQUIREMENTS

1. The permittee shall employ or contract with one or more licensed wastewater treatment facility operators or wastewater system operations companies holding a valid license or registration according to the requirements of 30 TAC Chapter 30, Occupational Licenses and Registrations and in particular 30 TAC Chapter 30, Subchapter J, Wastewater Operators and Operations Companies.

   This Category C facility must be operated by a chief operator or an operator holding a Category C license or higher. The facility must be operated a minimum of five days per week by the licensed chief operator or an operator holding the required level of license or higher. The licensed chief operator or operator holding the required level of license or higher must be available by telephone or pager seven days per week. Where shift operation of the wastewater treatment facility is necessary, each shift which does not have the on-site supervision of the licensed chief operator must be supervised by an operator in charge who is licensed not less than one level below the category for the facility.

2. The facility is not located in the Coastal Management Program boundary.

3. The permittee is hereby placed on notice that this permit may be reviewed by the Texas Commission on Environmental Quality after the completion of any new intensive water quality survey on Segment No. 1241 of the Brazos River Basin and any subsequent updating of the water quality model for Segment No. 1241, in order to determine if the limitations and conditions contained herein are consistent with any such revised model. The permit may be amended, pursuant to 30 TAC Section 305.62, as a result of such review. The permittee is also hereby placed on notice that effluent limits may be made more stringent at renewal based on, for example, any change to modeling protocol approved in the TCEQ Continuing Planning Process.

4. Within sixty days of permit issuance, the permittee shall submit sufficient evidence of legal restrictions prohibiting residential structures within the part of the buffer zone not owned by the permittee according to 30 TAC Section 309.13(e)(3). The evidence of legal restrictions shall be submitted to the executive director in care of the TCEQ Wastewater Permitting Section (MC 148). The permittee shall comply with the requirements of 30 TAC Section 309.13(a) through (d). (See Attachment A.)

5. A certified operator shall inspect the facility daily and maintain at the plant site a record of these inspections. These records shall be available at the plant site for inspections by authorized representatives of the commission for at least three years.

6. Prior to construction of the final phase, the permittee shall submit to the TCEQ Wastewater Permitting Section (MC148) a summary submittal letter in accordance with the requirements in 30 TAC Section 317.1. If requested by the Wastewater Permitting Section, the permittee shall submit plans, specifications and a final engineering design report which comply with 30 TAC Chapter 317, Design Criteria for Sewerage Systems. The permittee shall clearly show how the treatment system will meet the final permitted effluent limitations required on Page 2a of the permit.

CONTRIBUTING INDUSTRIES AND PRETREATMENT REQUIREMENTS

1. The following pollutants may not be introduced into the treatment facility:

   a. Pollutants which create a fire or explosion hazard in the publicly owned treatment works (POTW), including, but not limited to, wastestreams with a closed cup flashpoint of less than 140 degrees Fahrenheit (60 degrees Celsius) using the test methods specified in 40 CFR §261.21;

   b. Pollutants which will cause corrosive structural damage to the POTW, but in no case shall there be discharges with pH lower than 5.0 standard units, unless the works are specifically designed to accommodate such discharges;

   c. Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW, resulting in Interference;

   d. Any pollutant, including oxygen demanding pollutants (e.g., BOD), released in a discharge at a flow rate and/or pollutant concentration which will cause Interference with the POTW;

   e. Heat in amounts which will inhibit biological activity in the POTW resulting in Interference but in no case shall there be heat in such quantities that the temperature at the POTW treatment plant exceeds 104 degrees Fahrenheit (40 degrees Celsius) unless the Executive Director, upon request of the POTW, approves alternate temperature limits;

   f. Petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause Interference or Pass Through;

   g. Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems; and

   h. Any trucked or hauled pollutants, except at discharge points designated by the POTW.

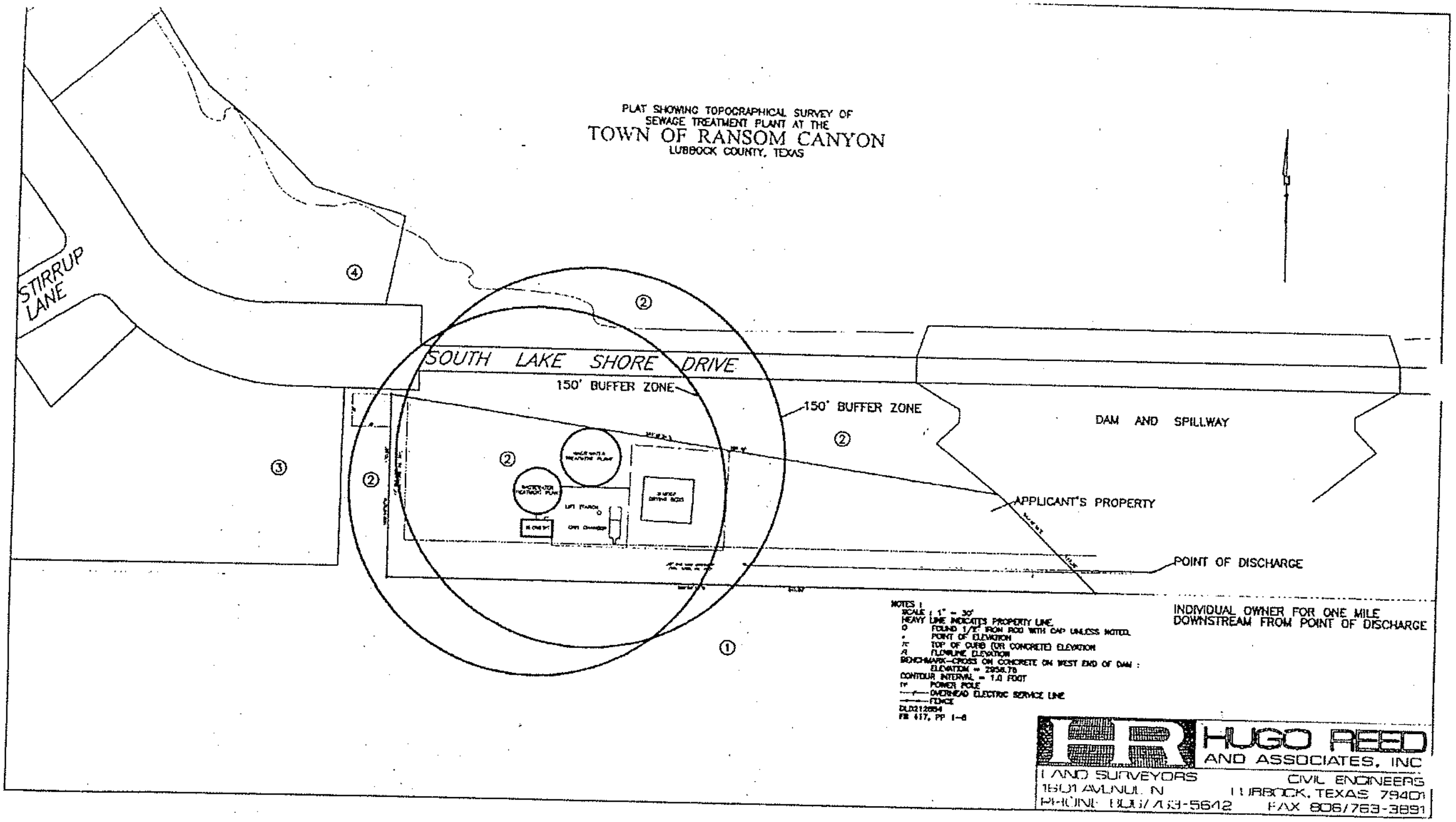
2. The permittee shall require any indirect discharger to the treatment works to comply with the reporting requirements of Sections 204(b), 307, and 308 of the Clean Water Act, including any requirements established under 40 CFR Part 403.

3. The permittee shall provide adequate notification to the Executive Director in care of the Wastewater Permitting Section (MC 148) of the Water Quality Division within 30 days subsequent to the permittee's knowledge of either of the following:

   a. Any new introduction of pollutants into the treatment works from an indirect discharger which would be subject to Sections 301 and 306 of the Clean Water Act if it were directly discharging those pollutants; and

   b. Any substantial change in the volume or character of pollutants being introduced into the treatment works by a source introducing pollutants into the treatment works at the time of issuance of the permit.

   Any notice shall include information on the quality and quantity of effluent to be introduced into the treatment works, and any anticipated impact of the change on the quality or quantity of effluent to be discharged from the POTW.



Town of Ransom Canyon
TPDES Permit No. WQ0010778001
Attachment A

HDR | ONE COMPANY
Many Solutions℠

Memo

To: Ches Carthel, P.E.	
From: Paula Lemonds, E.I.T.	Project: City of Lubbock Developed Water Permit
CC: David Dunn, P.E.	
Date: January 23, 2006	Job No: 34671

RE: Elevation-Area-Capacity Relationships for Lake 7 and Lake 8

The elevation, surface area, and capacity (EAC) relationships for the City of Lubbock's proposed Lake 7 and Lake 8 were determined in support of the water rights application submitted by the City of Lubbock to the Texas Commission on Environmental Quality (TCEQ). The EAC relationships for Lake 7 and Lake 8 are based on preliminary dam locations and heights from a 1969 feasibility report by Freese, Nichols, and Endress[1]. Equal-elevation polygons were digitized along topographic contours using USGS 7.5-minute quadrangle maps in a Geographic Information System (GIS), and the surface area of each polygon was calculated using spatial tools available in the GIS. Incremental reservoir volumes between each contour were computed using conical sections. The resulting EAC relationships for both reservoirs are shown in Table 1, and Figures 1 and 2. These relationships compare favorably with those presented in the 1969 report by Freese, Nichols, and Endress.

Table 1. Lake 7 and Lake 8 Elevation-Area-Capacity (EAC) Relationships.

Lake 7

Elevation (ft-msl)	Area (acres)	Capacity (acft)
3,022	0	0
3,025	5	5
3,030	15	52
3,035	23	147
3,040	38	298
3,045	72	566
3,050	110	1,015
3,055	144	1,646
3,060	171	2,432
3,065	251	3,480
3,070	307	4,875
3,075	373	6,574
3,080	460	8,654
3,085	536	11,141
3,090	611	14,006
3,095	695	17,269
3,100	801	20,708

Lake 8

Elevation (ft-msl)	Area (acres)	Capacity (acft)
2,854	0	0
2,855	7	3
2,860	154	325
2,865	216	1,246
2,870	278	2,478
2,875	357	4,062
2,880	440	6,051
2,885	644	8,745
2,890	784	12,309
2,895	938	16,607
2,900	1,089	21,668
2,905	1,224	27,447
2,910	1,387	33,972
2,915	1,521	41,239
2,920	1,677	49,231
2,921	1,680	49,930

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[1] Freese, Nichols and Endress, 1969, "Lubbock, Texas: Feasibility Report on the Canyon Lakes Project."

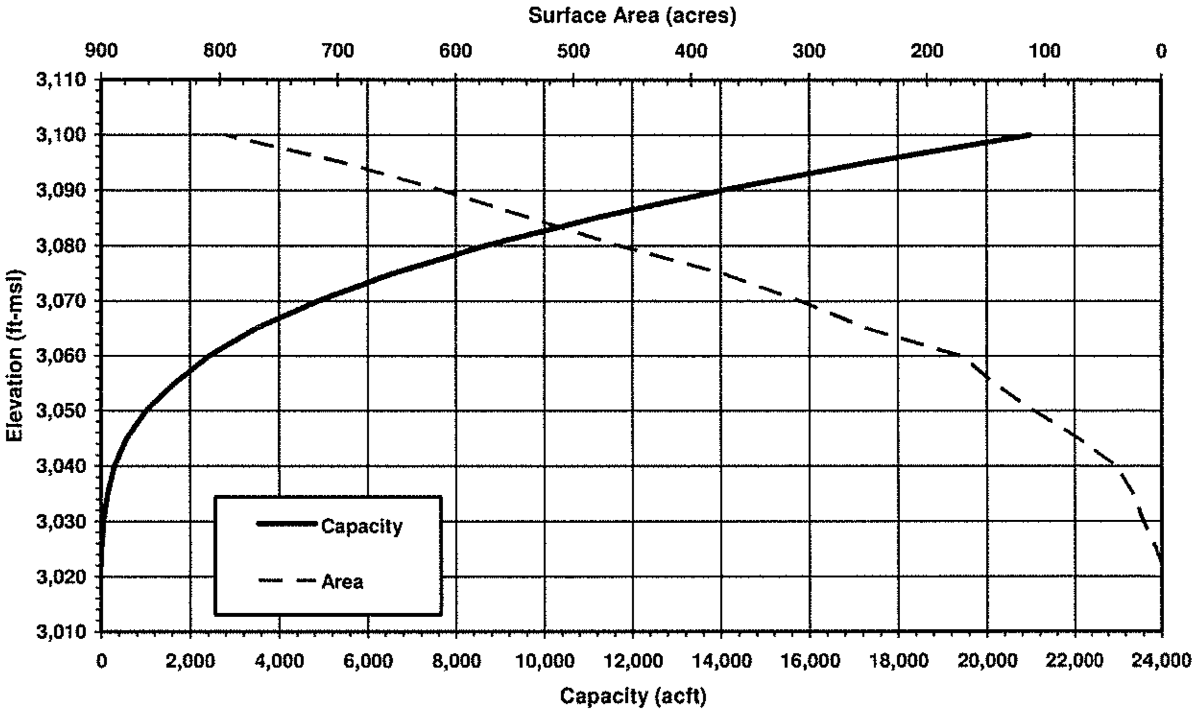


Figure 1. Elevation versus Capacity and Surface Area for Lake 7.

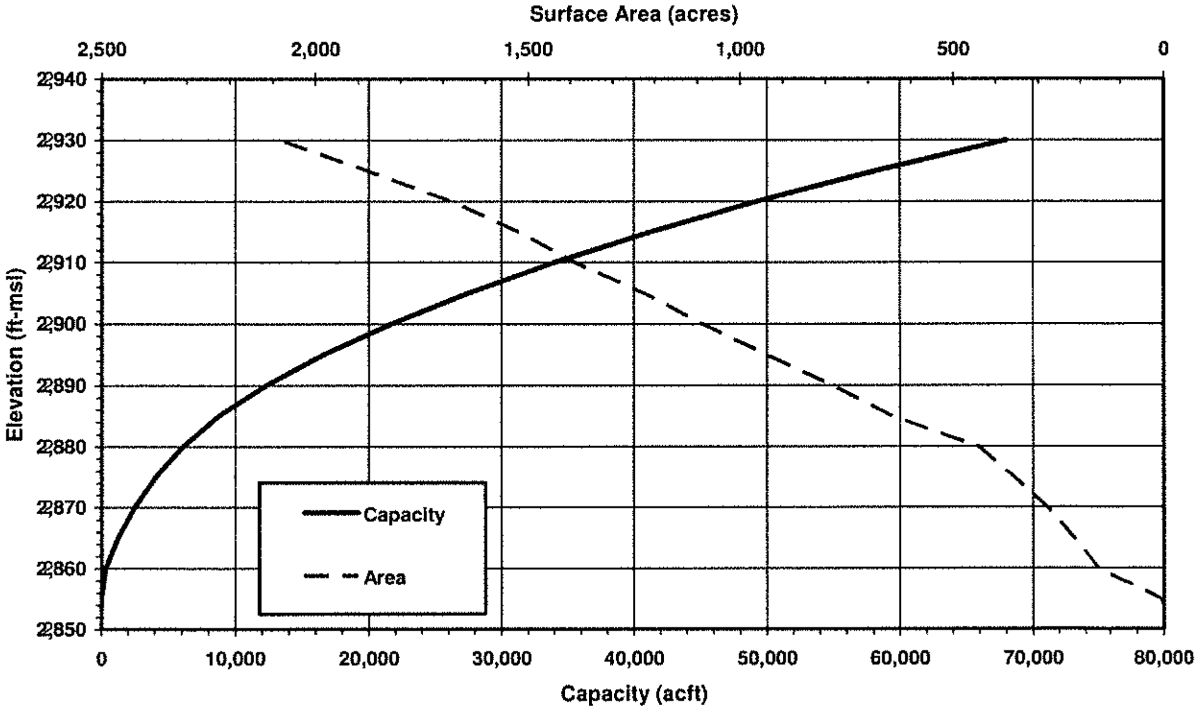


Figure 2. Elevation versus Capacity and Surface Area for Lake 8.

TPDES PERMIT NO. 10353-002
*[For TNRCC Office Use Only:
EPA ID No. TX0106071]*

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
P.O. Box 13087
Austin, Texas 78711-3087

This amendment supersedes and replaces TNRCC Permit No. 10353-002 issued May 31, 1991, TNRCC Permit No. 10353-008 issued October 31, 1991 and NPDES Permit No. TX0106071 issued May 6, 1994.

PERMIT TO DISPOSE OF WASTES

under provisions of
Section 402 of the Clean Water Act
and Chapter 26 of the Texas Water Code

RECEIVED
FEB 26 2003
CITY ATTORNEY

City of Lubbock

whose mailing address is

P.O. Box 2000
Lubbock, Texas 79457

is authorized to treat and dispose of wastes from the Southeast Water Reclamation Plant, SIC Code 4952

located at the eastern terminus of East 38th Street, south of the Fort Worth and Denver Railroad bridge crossing of the North Fork Double Mountain Fork Brazos River, approximately one mile northwest of the intersection of State Highway-Loop 289 and Farm-to-Market Road 835 (Buffalo Springs Lake Road), in the southeastern portion of the City of Lubbock, in Lubbock County, Texas

via a 27-inch pipeline extending approximately 14 miles to a point two miles downstream of Lake Ransom where Farm-to-Market Road 400 intersects the North Fork Double Mountain Fork Brazos River; thence to the North Fork Double Mountain Fork Brazos River; thence to the Double Mountain Fork Brazos River in Segment No. 1241 of the Brazos River Basin

only according with effluent limitations, monitoring requirements and other conditions set forth in this permit, as well as the rules of the Texas Natural Resource Conservation Commission (TNRCC), the laws of the State of Texas, and other orders of the TNRCC. The issuance of this permit does not grant to the permittee the right to use private or public property for conveyance of wastewater along the discharge route described in this permit. This includes, but is not limited to, property belonging to any individual, partnership, corporation or other entity. Neither does this permit authorize any invasion of personal rights nor any violation of federal, state, or local laws or regulations. It is the responsibility of the permittee to acquire property rights as may be necessary to use the discharge route.

This permit shall expire at midnight, March 1, 2004.

ISSUED DATE: APR 18 2001

For the Commission

Outfall Nu[illegible]er 002

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning upon the date of issuance and lasting through the date of expiration, the permittee is authorized to dispose of treated effluent subject to the following effluent limitations:

   The annual average flow of effluent shall not exceed 16.5 million gallons per day (MGD).

Effluent Characteristic	Discharge Limitations				Minimum Self-Monitoring Requirements	
	Daily Avg mg/l(lbs/day)	7-day Avg mg/l	Daily Max mg/l	Single Grab mg/l	Report Daily Avg. & Daily Max. Measurement Frequency	Sample Type
Flow, MGD	Report	N/A	Report	N/A	Continuous	Totalizing meter
Biochemical Oxygen Demand (5-day)	60	N/A	70	100	One/day	24-hr. Composite
Conductivity, mmhos/cm (*)	N/A	N/A	N/A	Report	One/day	Grab
Total Kjeldahl Nitrogen (TKN) (*)	Report	N/A	Report	N/A	One/week	Grab
Nitrate Nitrogen (NO_3-N) (*)	Report	N/A	Report	N/A	One/week	Grab
Ammonia Nitrogen (NH_3-N) (*)	Report	N/A	Report	N/A	One/week	Grab

(*) Monitoring samples for Nitrogen, Conductivity and pH shall be taken from the pump station located at the storage reservoir prior to irrigation use.

2. The pH (*) shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored once per day by grab sample. (*)

3. The annual average flow shall be reported monthly.

4. Effluent monitoring samples shall be taken at the following location(s): Following the final treatment unit and prior to irrigation disposal at the LAS at Effluent Pump Station No. 1 (EPS-1), and/or Effluent Pump Station No. 2 (EPS-2). **No discharge of pollutants into water in the State is authorized via this outfall.**

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning upon the date of issuance and lasting through the date of expiration, the permittee is authorized to dispose of treated effluent subject to the following effluent limitations:

Effluent Characteristic	Discharge Limitations				Minimum Self-Monitoring Requirements	
	Daily Avg mg/l(lbs/day)	7-day Avg mg/l	Daily Max mg/l	Single Grab mg/l	Report Daily Avg. & Daily Max. Measurement Frequency	Sample Type
Flow, MGD	Report	N/A	Report	N/A	Continuous	Totalizing meter
Biochemical Oxygen Demand (5-day)	Report	N/A	45	65	One/day	24.-hr Composite

2. The effluent shall contain a chlorine residual of at least 1.0 mg/l with a minimum detention time of 20 minutes and shall be monitored daily by grab sample. An equivalent method of disinfection may be substituted only with prior approval of the Commission.

3. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored once per day by grab sample.

4. The annual average flow shall be reported monthly.

5. Effluent monitoring samples shall be taken at the following location(s): Following the final treatment unit and prior to pumping to the Southwestern Public Service Jones Power Plant for industrial reuse (cooling make-up water) at Effluent Pump Station Nos. 1 and 2 (ESP-1 and ESP-2) except for chlorine residual which shall be monitored at the chlorine residual meter located at the Jones Power Plant. **No discharge of pollutants into water in the State is authorized via this outfall.**

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Outfall Number 006

1. During the period beginning upon the date of issuance and lasting through the date of expiration, the permittee is authorized to dispose of treated effluent subject to the following effluent limitations:

   The annual average flow of effluent shall not exceed 31.5 million gallons per day (MGD).

Effluent Characteristic	Discharge Limitations				Minimum Self-Monitoring Requirements	
	Daily Avg mg/l(lbs/day)	7-day Avg mg/l	Daily Max mg/l	Single Grab mg/l	Report Daily Avg. & Daily Max. Measurement Frequency	Sample Type
Flow, MGD (*)	Report	N/A	Report	N/A	Continuous	Totalizing meter

(*) The flow shall include the total discharge of treated effluent from Outfalls 001, 002, 003, 004 and 005.

2. The annual average flow shall be reported monthly.

3. Effluent monitoring samples shall be taken at the following location(s): Following the final treatment units at sampling points ESP-1, ESP-2, Outfall 001, the chlorine residual meter at the Jones Power Plant and the pump station at the reservoir.

DEFINITIONS AND STANDARD PERMIT CONDITIONS

As required by Title 30 Texas Administrative Code (TAC) Chapter 305, certain regulations appear as standard conditions in waste discharge permits. 30 TAC §§ 305.121 - 305.129, Subchapter F, "Permit Characteristics and Conditions" as promulgated under the Texas Water Code §§ 5.103 and 5.105, and the Texas Health and Safety Code §§ 361.017 and 361.024(a), establish the characteristics and standards for waste discharge permits, including sewage sludge, and those sections of 40 Code of Federal Regulations (CFR) 122 adopted by reference by the Commission. The following text includes these conditions and incorporates them into this permit. All definitions in Section 26.001 of the Texas Water Code and 30 TAC Chapter 305 shall apply to this permit and are incorporated by reference. Some Specific definitions of words or phrases used in this permit are as follows:

1. Flow Measurements

   a. Annual average flow - the arithmetic average of all daily flow determinations taken within the preceding 12 consecutive calendar months. The annual average flow determination shall consist of daily flow volume determinations made by a totalizing meter, charted on a chart recorder and limited to major domestic wastewater discharge facilities with a 1 million gallons per day or greater permitted flow.

   b. Daily average flow - the arithmetic average of all determinations of the daily discharge within a period of one calendar month. The daily average flow determination shall consist of determinations made on at least four separate days. If instantaneous measurements are used to determine the daily discharge, the determination shall be the arithmetic average of all instantaneous measurements taken during that month. Daily average flow determination for intermittent discharges shall consist of a minimum of three flow determinations on days of discharge.

   c. Daily maximum flow - the highest total flow for any 24-hour period in a calendar month.

   d. Instantaneous flow - the measured flow during the minimum time required to interpret the flow measuring device.

   e. 2-hour peak flow (domestic wastewater treatment plants) - the maximum flow sustained for a two-hour period during the period of daily discharge. Multiple measurements of instantaneous maximum flow within a two-hour period may be compared to the permitted 2-hour peak flow.

   f. Maximum 2-hour peak flow (domestic wastewater treatment plants) - the highest 2-hour peak flow for any 24-hour period in a calender month.

2. Concentration Measurements

   a. Daily average concentration - the arithmetic average of all effluent samples, composite or grab as required by this permit, within a period of one calendar month, consisting of at least four separate representative measurements. When four samples are not available in a calendar month, the arithmetic average of the four most recent measurements or the arithmetic average (weighted by flow) of all values taken during the month shall be used as the daily average concentration.

   b. 7-day average concentration - the arithmetic average of all effluent samples, composite or grab as required by this permit, within a period of one calendar week, Sunday through Saturday.

   c. Daily maximum concentration - the maximum concentration measured on a single day, by composite sample unless otherwise specified elsewhere in this permit, within a period of one calender month.

   d. Daily discharge - the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the sampling day.

      The "daily discharge" determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the "daily discharge" determination of concentration shall be the arithmetic average (weighted by flow value) of all samples collected during that day.

b. Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR Part 503), monitoring and reporting records, including strip charts and records of calibration and maintenance, copies of all records required by this permit, records of all data used to complete the application for this permit, and the certification required by 40 CFR § 264.73(b)(9) shall be retained at the facility site and/or shall be readily available for review by a TNRCC representative for a period of three years from the date of the record or sample, measurement, report, application or certification. This period shall be extended at the request of the Executive Director.

c. Records of monitoring activities shall include the following:

i. date, time and place of sample or measurement;
ii. identity of individual who collected the sample or made the measurement.
iii. date and time of analysis;
iv. identity of the individual and laboratory who performed the analysis;
v. the technique or method of analysis; and
vi. the results of the analysis or measurement and quality assurance/quality control records.

The period during which records are required to be kept shall be automatically extended to the date of the final disposition of any administrative or judicial enforcement action that maybe instituted against the permittee.

4. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit using approved analytical methods as specified above, all results of such monitoring shall be included in the calculation and reporting of the values submitted on the approved TPDES self-report form. Increased frequency of sampling shall be indicated on the self-report form.

5. Calibration of Instruments

All automatic flow measuring and/or recording devices and/or totalizing meters for measuring flows shall be accurately calibrated by a trained person at plant start-up and as often thereafter as necessary to ensure accuracy, but not less often than annually unless authorized by the Executive Director for a longer period. Such person shall verify in writing that the device is operating properly and giving accurate results. Copies of the verification shall be retained at the facility site and/or shall be readily available for review by a TNRCC representative for a period of three years.

6. Compliance Schedule Reports

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of the permit shall be submitted no later than 14 days following each schedule date to the Regional Office and the Manager of the Water and Multimedia Section (MC 149) of the Enforcement Division.

7. Noncompliance Notification

a. In accordance with 30 TAC § 305.125(9) any noncompliance which may endanger human health or safety, or the environment shall be reported by the permittee to the TNRCC. Report of such information shall be provided orally or by facsimile transmission (FAX) to the Regional Office within 24 hours of becoming aware of the noncompliance. A written submission of such information shall also be provided by the permittee to the Regional Office and the Manager of the Water and Multimedia Section (MC 149) of the Enforcement Division within five working days of becoming aware of the noncompliance. The written submission shall contain a description of the noncompliance and its cause; the potential danger to human health or safety, or the environment; the period of noncompliance, including exact dates and times; if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance, and to mitigate its adverse effects.

b. The following violations shall be reported under Monitoring and Reporting Requirement 7.a.:
i. Unauthorized discharges as defined in Permit Condition 2(g).
ii. Any unanticipated bypass which exceeds any effluent limitation in the permit.
iii. Violation of a permitted maximum daily discharge limitation for pollutants listed specifically in the Other Requirements section of an Industrial TPDES permit.

PERMIT CONDITIONS

1. General

a. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in an application or in any report to the Executive Director, it shall promptly submit such facts or information.

b. This permit is granted on the basis of the information supplied and representations made by the permittee during action on an application in accordance with 30 TAC Chapter 50 and the application process in accordance with 30 TAC Chapter 281, and relying upon the accuracy and completeness of that information and those representations in accordance with 30 TAC Chapter 305. After notice in accordance with 30 TAC Chapter 39 and opportunity for a hearing in accordance with 30 TAC §§ 55.21-55.31, Subchapter B, "Hearing Requests, Public Comment", this permit may be modified, suspended, or revoked, in whole or in part in accordance with 30 TAC Chapter 305 Subchapter D, during its term for cause including but not limited to, the following:

i. Violation of any terms or conditions of this permit;
ii. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or
iii. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

c. The permittee shall furnish to the Executive Director, upon request and within a reasonable time, any information to determine whether cause exists for amending, revoking, suspending or terminating the permit. The permittee shall also furnish to the Executive Director, upon request, copies of records required to be kept by the permit.

2. Compliance

a. Acceptance of the permit by the person to whom it is issued constitutes acknowledgment and agreement that such person will comply with all the terms and conditions embodied in the permit, and the rules and other orders of the Commission.

b. The permittee has a duty to comply with all conditions of the permit. Failure to comply with any permit condition constitutes a violation of the permit and the Texas Water Code or the Texas Health and Safety Code, and is grounds for enforcement action, for permit amendment, revocation or suspension, or for denial of a permit renewal application or of an application for a permit for another facility.

c. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit.

d. The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal or other permit violation which has a reasonable likelihood of adversely affecting human health or the environment.

e. Authorization from the Commission is required before beginning any change in the permitted facility or activity that may result in noncompliance with any permit requirements.

f. A permit may be amended, suspended and reissued, or revoked for cause in accordance with 30 TAC §§ 305.62 and 305.66 and the Texas Water Code Section 7.302. The filing of a request by the permittee for a permit amendment, suspension and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

g. There shall be no unauthorized discharge of wastewater or any other waste. For the purpose of this permit, an unauthorized discharge is considered to be any discharge of wastewater into or adjacent to waters in the state at any location not permitted as an outfall or otherwise defined in the Other Requirements section of this permit.

h. In accordance with 30 TAC § 305.535(a), the permittee may allow any bypass to occur from a TPDES permitted facility which does not cause permitted effluent limitations to be exceeded, but only if the diversion is also for essential maintenance to assure efficient operation.

f. If any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the Clean Water Act for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that established those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

5. Permit Transfer

a. Prior to any transfer of this permit, Commission approval must be obtained. The Commission shall be notified in writing of any change in control or ownership of facilities authorized by this permit. Such notification should be sent to the Wastewater Permits Section Application Team (MC 148) of the Water Quality Division.

b. A permit may be transferred only according to the provisions of 30 TAC § 305.64 (relating to Transfer of Permits) and 30 TAC § 50.33 (relating to Executive Director Action on Application for Transfer).

6. Relationship to Hazardous Waste Activities

This permit does not authorize any activity of hazardous waste storage, processing, or disposal which requires a permit or other authorization pursuant to the Texas Health and Safety Code.

7. Relationship to Water Rights

Disposal of treated effluent by any means other than discharge directly to the waters in the state must be specifically authorized in this permit and may require a permit pursuant to Chapter 11 of the Texas Water Code.

8. Property Rights

A permit does not convey any property rights of any sort, or any exclusive privilege.

9. Permit Enforceability

The conditions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstances, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

OPERATIONAL REQUIREMENTS

1. The permittee shall at all times ensure that the facility and all of its systems of collection, treatment, and disposal are properly operated and maintained. This includes the regular, periodic examination of wastewater solids within the treatment plant by the operator in order to maintain an appropriate quantity and quality of solids inventory as described in the various operator training manuals and according to accepted industry standards for process control such as the Commission's "Recommendations for Minimum Process Control Tests for Domestic Wastewater Treatment Facilities." Process control records shall be retained at the facility site and/or shall be readily available for review by a TNRCC representative for a period of three years.

2. Upon request by the Executive Director, the permittee shall take appropriate samples and provide proper analysis in order to demonstrate compliance with Commission rules. Unless otherwise specified in this permit or otherwise ordered by the Commission, the permittee shall comply with all provisions of 30 TAC §§ 312.1 - 312.13 concerning sewage sludge use and disposal and 30 TAC §§ 319.21 - 319.29 concerning the discharge of certain hazardous metals.

3. Domestic wastewater treatment facilities shall comply with the following provisions:

a. The permittee shall notify the Executive Director in care of the Wastewater Permits Section (MC 148) of the Water Quality Division, in writing of any closure activity or facility expansion at least 90 days prior to conducting such activity.

of waste treatment technology, engineering, financial, and related considerations existing at the time the changes are required, exclusive of the loss of investment in or revenues from any then existing or proposed waste collection, treatment or disposal system.

9. Domestic wastewater treatment plants shall be operated and maintained by sewage plant operators holding a valid certificate of competency at the required level as defined in 30 TAC Chapter 325.

10. For Publicly Owned Treatment Works (POTWs), the 30-day average (or monthly average) percent removal for BOD and TSS shall not be less than 85 percent, unless otherwise authorized by this permit.

11. Facilities which generate industrial solid waste as defined in 30 TAC § 335.1 shall comply with these provisions:

    a. Any solid waste generated by the permittee during the management and treatment of wastewater, as defined in 30 TAC § 335.1 (including but not limited to such wastes as garbage, refuse, sludge from a waste treatment, water supply treatment plant or air pollution control facility, discarded materials, discarded materials to be recycled, whether the waste is solid, liquid, or semisolid) must be managed in accordance with all applicable provisions of 30 TAC Chapter 335, relating to Industrial Solid Waste Management.

    b. Industrial wastewater that is being collected, accumulated, stored, or processed before discharge through any final discharge outfall, specified by this permit, is considered to be industrial solid waste until the wastewater passes through the actual point source discharge and must be managed in accordance with all applicable provisions of 30 TAC Chapter 335.

    c. The permittee shall provide written notification, pursuant to the requirements of 30 TAC § 335.6(g), to the Corrective Action Section (MC 127) of the Industrial and Hazardous Waste Division informing the Commission of any closure activity involving an Industrial Solid Waste Management Unit, at least 90 days prior to conducting such an activity.

    d. Construction of any industrial solid waste management unit requires the prior written notification of the proposed activity to the Waste Evaluation Section (MC 129) of the Industrial and Hazardous Waste Division. No person shall dispose of industrial solid waste, including sludge or other solids from wastewater treatment processes, prior to fulfilling the deed recordation requirements of 30 TAC § 335.5.

    e. The term "industrial solid waste management unit" means a landfill, surface impoundment, waste-pile, industrial furnace, incinerator, cement kiln, injection well, container, drum, salt dome waste containment cavern, or any other structure vessel, appurtenance, or other improvement on land used to manage industrial solid waste.

    f. The permittee shall keep management records for all sludge (or other waste) removed from any wastewater treatment process. These records shall fulfill all applicable requirements of 30 TAC Chapter 335 and must include the following, as it pertains to wastewater treatment and discharge:

        i. Volume of waste and date(s) generated from treatment process;
        ii. Volume of waste disposed of on-site or shipped off-site;
        iii. Date(s) of disposal;
        iv. Identity of hauler or transporter;
        v. Location of disposal site; and
        vi. Method of final disposal.

        The above records shall be maintained on a monthly basis. The records shall be retained at the facility site and/or shall be readily available for review by authorized representatives of the TNRCC for at least five years.

12. For industrial facilities to which the requirements of 30 TAC Chapter 335 do not apply, sludge and solid wastes, including tank cleaning and contaminated solids for disposal, shall be disposed of in accordance with Chapter 361 of the Health and Safety Code of Texas.

B. Testing Requirements

1. Sewage sludge shall be tested annually in accordance with the method specified in both 40 CFR Part 261, Appendix II and 40 CFR Part 268, Appendix I [Toxicity Characteristic Leaching Procedure (TCLP)] or other method, which receives the prior approval of the TNRCC for the contaminants listed in Table 1 of 40 CFR Section 261.24. Sewage sludge failing this test shall be managed according to RCRA standards for generators of hazardous waste, and the waste's disposition must be in accordance with all applicable requirements for hazardous waste processing, storage, or disposal. Following failure of any TCLP test, the management or disposal of sewage sludge at a facility other than an authorized hazardous waste processing, storage, or disposal facility shall be prohibited until such time as the permittee can demonstrate the sewage sludge no longer exhibits the hazardous waste toxicity characteristics (as demonstrated by the results of the TCLP tests). A written report shall be provided to both the TNRCC Registration and Evaluation Division (MC 129) and the Regional Director (MC Region 2) within 7 days after failing the TCLP Test. The report shall contain test results, certification that unauthorized waste management has stopped and a summary of alternative disposal plans that comply with RCRA standards for the management of hazardous waste. The report shall be addressed to: Director, Registration and Evaluation Division (MC 129), Texas Natural Resource Conservation Commission, P. O. Box 13087, Austin, Texas 78711-3087. In addition, the permittee shall prepare an annual report on the results of all sludge toxicity testing. This annual report shall be submitted to the TNRCC Regional Office (MC Region 2) and the Water Quality Management Information Systems Team (MC 224) of the Enforcement Division by September 1 of each year.

2. Sewage sludge shall not be applied to the land if the concentration of the pollutants exceed the pollutant concentration criteria in Table 1. The frequency of testing for pollutants in Table 1 is found in Section I.C.

TABLE 1

Pollutant	Ceiling Concentration (milligrams per kilogram)*
Arsenic	75
Cadmium	85
Chromium	3000
Copper	4300
Lead	840
Mercury	57
Molybdenum	75
Nickel	420
PCBs	49
Selenium	100
Zinc	7500

* Dry weight basis

3. Pathogen Control

All sewage sludge that is applied to agricultural land, forest, a public contact site, or a reclamation site shall be treated by one of the following methods to ensure that the sludge meets either the Class A or Class B pathogen requirements.

a. Six alternatives are available to demonstrate compliance with Class A sewage sludge. The first 4 options require either the density of fecal coliform in the sewage sludge be less than 1000 Most

ii. The geometric mean of the density of fecal coliform in the samples collected shall be less than either 2,000,000 MPN per gram of total solids (dry weight basis) or 2,000,000 Colony Forming Units per gram of total solids (dry weight basis).

Alternative 2 - Sewage sludge that is used or disposed of shall be treated in one of the Processes to Significantly Reduce Pathogens (PSRP) described in 40 CFR Part 503, Appendix B, so long as all of the following requirements are met by the generator of the sewage sludge.

i. Prior to use or disposal, all the sewage sludge must have been generated from a single location, except as provided in paragraph v. below;

ii. An independent Texas Licensed Professional Engineer must make a certification to the generator of a sewage sludge that the wastewater treatment facility generating the sewage sludge is designed to achieve one of the PSRP at the permitted design loading of the facility. The certification need only be repeated if the design loading of the facility is increased. The certification shall include a statement indicating the design meets all the applicable standards specified in Appendix B of 40 CFR Part 503;

iii. Prior to any off-site transportation or on-site use or disposal of any sewage sludge generated at a wastewater treatment facility, the chief certified operator of the wastewater treatment facility or other responsible official who manages the processes to significantly reduce pathogens at the wastewater treatment facility for the permittee, shall certify that the sewage sludge underwent at least the minimum operational requirements necessary in order to meet one of the PSRP. The acceptable processes and the minimum operational and record keeping requirements shall be in accordance with established U. S. Environmental Protection Agency final guidance;

iv. All certification records and operational records describing how the requirements of this paragraph were met shall be kept by the generator for a minimum of three years and be available for inspection by commission staff for review; and

v. If the sewage sludge is generated from a mixture of sources, resulting from a person who prepares sewage sludge from more than one wastewater treatment facility, the resulting derived product shall meet one of the PSRP, and shall meet the certification, operation, and record keeping requirements of this paragraph.

Alternative 3 - Sewage sludge shall be treated in an equivalent process that has been approved by the U. S. Environmental Protection Agency, so long as all of the following requirements are met by the generator of the sewage sludge.

i. Prior to use or disposal, all the sewage sludge must have been generated from a single location, except as provided in paragraph v. below;

ii. Prior to any off-site transportation or on-site use or disposal of any sewage sludge generated at a wastewater treatment facility, the chief certified operator of the wastewater treatment facility or other responsible official who manages the processes to significantly reduce pathogens at the wastewater treatment facility for the permittee, shall certify that the sewage sludge underwent at least the minimum operational requirements necessary in order to meet one of the PSRP. The acceptable processes and the minimum operational and record keeping

4. Vector Attraction Reduction Requirements

All bulk sewage sludge that is applied to agricultural land, forest, a public contact site, or a reclamation site shall be treated by one of the following alternatives 1 through 10 for Vector Attraction Reduction.

Alternative 1 - The mass of volatile solids in the sewage sludge shall be reduced by a minimum of 38 percent.

Alternative 2 - If Alternative 1 cannot be met for an anaerobically digested sludge, demonstration can be made by digesting a portion of the previously digested sludge anaerobically in the laboratory in a bench-scale unit for 40 additional days at a temperature between 30 and 37 degrees Celsius. Volatile solids must be reduced by less than 17 percent to demonstrate compliance.

Alternative 3 - If Alternative 1 cannot be met for an aerobically digested sludge, demonstration can be made by digesting a portion of the previously digested sludge with a percent solids of two percent or less aerobically in the laboratory in a bench-scale unit for 30 additional days at 20 degrees Celsius. Volatile solids must be reduced by less than 15 percent to demonstrate compliance.

Alternative 4 - The specific oxygen uptake rate (SOUR) for sewage sludge treated in an aerobic process shall be equal to or less than 1.5 milligrams of oxygen per hour per gram of total solids (dry weight basis) at a temperature of 20 degrees Celsius.

Alternative 5 - Sewage sludge shall be treated in an aerobic process for 14 days or longer. During that time, the temperature of the sewage sludge shall be higher than 40 degrees Celsius and the average temperature of the sewage sludge shall be higher than 45 degrees Celsius.

Alternative 6 - The pH of sewage sludge shall be raised to 12 or higher by alkali addition and, without the addition of more alkali shall remain at 12 or higher for two hours and then remain at a pH of 11.5 or higher for an additional 22 hours at the time the sewage sludge is prepared for sale or given away in a bag or other container.

Alternative 7 - The percent solids of sewage sludge that does not contain unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 75 percent based on the moisture content and total solids prior to mixing with other materials. Unstabilized solids are defined as organic materials in sewage sludge that have not been treated in either an aerobic or anaerobic treatment process.

Alternative 8 - The percent solids of sewage sludge that contains unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 90 percent based on the moisture content and total solids prior to mixing with other materials at the time the sludge is used. Unstabilized solids are defined as organic materials in sewage sludge that have not been treated in either an aerobic or anaerobic treatment process.

Alternative 9 - i. Sewage sludge shall be injected below the surface of the land.

ii. No significant amount of the sewage sludge shall be present on the land surface within one hour after the sewage sludge is injected.

SECTION II. REQUIREMENTS SPECIFIC TO BULK SEWAGE SLUDGE FOR APPLICATION TO THE LAND MEETING CLASS A or B PATHOGEN REDUCTION AND THE CUMULATIVE LOADING RATES IN TABLE 2, OR CLASS B PATHOGEN REDUCTION AND THE POLLUTANT CONCENTRATIONS IN TABLE 3

For those permittees meeting Class A or B pathogen reduction requirements and that meet the cumulative loading rates in Table 2 below, or the Class B pathogen reduction requirements and contain concentrations of pollutants below listed in Table 3, the following conditions apply:

A. Pollutant Limits

Table 2

Pollutant	Cumulative Pollutant Loading Rate (pounds per acre)
Arsenic	36
Cadmium	35
Chromium	2677
Copper	1339
Lead	268
Mercury	15
Molybdenum	Report Only
Nickel	375
Selenium	89
Zinc	2500

Table 3

Pollutant	Monthly Average Concentration (milligrams per kilogram)*
Arsenic	41
Cadmium	39
Chromium	1200
Copper	1500
Lead	300
Mercury	17
Molybdenum	Report Only
Nickel	420
Selenium	36
Zinc	2800

* Dry weight basis

B. Pathogen Control

All bulk sewage sludge that is applied to agricultural land, forest, a public contact site, a reclamation site, shall be treated by either Class A or Class B pathogen reduction requirements as defined above in Section I.B.3.

c. The name, address, telephone number, and National Pollutant Discharge Elimination System permit number (if appropriate) for the person who will apply the bulk sewage sludge.

2. The permittee shall give 180 days prior notice to the Executive Director in care of the Wastewater Permits Section (MC 148) of the Water Quality Division of any change planned in the sewage sludge disposal practice.

E. Record keeping Requirements

The sludge documents will be retained at the facility site and/or shall be readily available for review by a TNRCC representative. The person who prepares bulk sewage sludge or a sewage sludge material shall develop the following information and shall retain the information at the facility site and/or shall be readily available for review by a TNRCC representative for a period of five years. If the permittee supplies the sludge to another person who land applies the sludge, the permittee shall notify the land applier of the requirements for record keeping found in 30 TAC Section 312.47 for persons who land apply.

1. The concentration (mg/kg) in the sludge of each pollutant listed in Table 3 above and the applicable pollutant concentration criteria (mg/kg), or the applicable cumulative pollutant loading rate and the applicable cumulative pollutant loading rate limit (lbs/ac) listed in Table 2 above.

2. A description of how the pathogen reduction requirements are met (including site restrictions for Class B sludges, if applicable).

3. A description of how the vector attraction reduction requirements are met.

4. A description of how the management practices listed above in Section II.C are being met.

5. The following certification statement:

   "I certify, under penalty of law, that the applicable pathogen requirements in 30 TAC Section 312.82(a) or (b) and the vector attraction reduction requirements in 30 TAC Section 312.83(b) have been met for each site on which bulk sewage sludge is applied. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the management practices have been met. I am aware that there are significant penalties for false certification including fine and imprisonment."

6. The recommended agronomic loading rate from the references listed in Section II.C.3. above, as well as the actual agronomic loading rate shall be retained.

The person who applies bulk sewage sludge or a sewage sludge material shall develop the following information and shall retain the information at the facility site and/or shall be readily available for review by a TNRCC representative indefinitely. If the permittee supplies the sludge to another person who land applies the sludge, the permittee shall notify the land applier of the requirements for record keeping found in 30 TAC Section 312.47 for persons who land apply.

11. Level of pathogen reduction achieved (Class A or Class B).

12. Alternative used as listed in Section I.B.3.(a. or b.). Alternatives describe how the pathogen reduction requirements are met. If Class B sludge, include information on how site restrictions were met.

13. Vector attraction reduction alternative used as listed in Section I.B.4.

14. Annual sludge production in dry tons/year.

15. Amount of sludge land applied in dry tons/year.

16. The certification statement listed in either 30 TAC Section 312.47(a)(4)(A)(ii) or 30 TAC Section 312.47(a)(5)(A)(ii) as applicable to the permittee's sludge treatment activities, shall be attached to the annual reporting form.

17. The results of the soil sample analyses, as required in Other Requirement No. 27, with a map indicating the location of the soil samples.

18. When the amount of any pollutant applied to the land exceeds 90% of the cumulative pollutant loading rate for that pollutant, as described in Table 2, the permittee shall report the following information as an attachment to the annual reporting form.

    a. The location, by street address, and specific latitude and longitude.

    b. The number of acres in each site on which bulk sewage sludge is applied.

    c. The date and time bulk sewage sludge is applied to each site.

    d. The cumulative amount of each pollutant (i.e., pounds/acre) listed in Table 2 in the bulk sewage sludge applied to each site.

    e. The amount of sewage sludge (i.e., dry tons) applied to each site.

The above records shall be maintained on a monthly basis and shall be made available to the Texas Natural Resource Conservation Commission upon request.

F. Record keeping Requirements

The permittee shall develop the following information and shall retain the information for five years.

1. The description (including procedures followed and the results) of all liquid Paint Filter Tests performed.

2. The description (including procedures followed and results) of all TCLP tests performed.

   The above records shall be maintained on-site on a monthly basis and shall be made available to the Texas Natural Resource Conservation Commission upon request.

G. Reporting Requirements

The permittee shall report annually to the TNRCC Regional Office (MC Region 2) and Water Quality Management Information Systems Team (MC 224) of the Enforcement Division by September 1 of each year the following information:

1. Toxicity Characteristic Leaching Procedure (TCLP) results.
2. Annual sludge production in dry tons/year.
3. Amount of sludge disposed in a municipal solid waste landfill in dry tons/year.
4. Amount of sludge transported interstate in dry tons/year.
5. A certification that the sewage sludge meets the requirements of 30 TAC Chapter 330 concerning the quality of the sludge disposed in a municipal solid waste landfill.
6. Identity of hauler(s) and transporter registration number.
7. Owner of disposal site(s).
8. Location of disposal site(s).
9. Date(s) of disposal.

   The above records shall be maintained on-site on a monthly basis and shall be made available to the Texas Natural Resource Conservation Commission upon request.

STEP 2 - PLANT AVAILABLE NITROGEN (PAN) PROVIDED BY THE SLUDGE

(Use the values for Total N, NH_4-N, and NO_3-N from Step 1.)

lbs/ton

A. Organic Nitrogen = Total N - (NH_4-N) - (NO_3-N) = _____

(Multiply by percent values shown below for PAN) x _____ % = _____

<u>Estimated Sludge Organic Nitrogen Mineralization Rates for Year Following Application</u>
Unstabilized Primary and Waste Activated Sludges: 40 percent
Aerobically Digested Sludges: 30 percent
Anaerobically Digested Sludges: 20 percent
Composted Sludge: 10 percent

B. Ammonium Nitrogen (NH_4-N) x V = _____ x _____ = _____

Use Volatilization factor (V) = 0.5 if sludge is left on soil surface;
Use Volatilization factor (V) = 1.0 if sludge is worked into the soil.

C. Nitrate Nitrogen (NO_3-N) = _____

D. Total PAN = 3.A. + 3.B. + 3.C. (enter result in Step 4.B) = _____

STEP 5 - MAXIMUM SLUDGE APPLICATION RATE BASED ON METALS (SAR_M)

	A	B	C	D	E	F
	CUMULATIVE METAL LIMITS lbs/ac.	MAX METAL LOADING PER YEAR lbs/ac./yr	METALS IN SLUDGE lbs/ton	METALS APPLIED ANNUALLY AT SAR_N lbs/ac./yr	METALS * APPLIED ANNUALLY AT SAR_M lbs/ac./yr	MAX SLUDGE LOADING RATE tons/ac.
METAL	**Appendix C**	**Appendix C**	**Step 1**	**C x SAR_N**	**(B ÷ C)**	**(A ÷ C)**
Arsenic	**36**	**1.8**				
Cadmium	**35**	**1.7**				
Chromium	**2677**	**134.0**				
Copper	**1339**	**67.0**				
Lead	**268**	**13.0**				
Mercury	**15**	**0.76**				
Molybdenum	**Monitor**	**Monitor**				
Nickel	**375**	**18.7**				
Selenium	**89**	**4.5**				
Zinc	**2500**	**125.0**				
Other						

* For each metal, if the value for B > D, then SAR_N dictates the maximum sludge application rate; indicate N/A in Column E. If for any metal, the value for B < D, then SAR_M dictates and E = B ÷ C.

OTHER REQUIREMENTS

1. This Category A facility shall be operated and maintained by a chief operator or operator in responsible charge holding a valid Class A certificate of competency or higher issued pursuant to 30 TAC Chapter 325. All shift supervisors and other plant operators shall be certified in accordance with the applicable provisions of Chapter 325. Note, Class D certificates are not renewable at any activated sludge facility, regardless of size, or any trickling filter or RBC facility with a permitted flow greater than 100,000 gallons per day.

2. Chronic toxic criteria apply at the edge of the mixing zone. The mixing zone is defined as 300 feet downstream and 100 feet upstream from the point of discharge.

3. Prior to discharge to the North Fork Double Mountain Fork Brazos River, the permittee must flush, solely with treated wastewater compliant with the terms of this permit for Outfall 001, the 27-inch effluent pipeline that leads to the Hancock Land Application Site (HLAS). The amount of flush water required is approximately 1.1 million gallons and shall be directed to the HLAS. Upon completion of the flushing, the juncture of the 27-inch pipeline leading through a separate pipeline to the point of discharge may be opened; and the flow of stream quality effluent may be totally diverted or split with a portion going to the HLAS. The HLAS routinely receives effluent for irrigation use that is not acceptable for stream discharge. The 27-inch line must be flushed again in accordance with this requirement after any effluent which does not meet the effluent limitations for Outfall 001 is reintroduced into the 27-inch pipeline.

   The permittee shall notify the TNRCC Regional Office (MC Region 2) and the Water Quality Assessment Team (MC 150) of the Water Quality Division prior to a possible discharge to Outfall 001. Subsequent to the notification, a monthly report shall be submitted to the Water Quality Assessment Team (MC 150) which includes the dates and times for the following:

   a. initiation and completion of the flushing for the 27-inch pipeline leading the HLAS;
   b. opening of the separate pipeline leading to Outfall 001;
   c. actual discharge through Outfall 001;
   d. cessation of discharge; and,
   e. any subsequent discharge and cessation of discharge.

   The permittee shall keep records of these events and make them available for inspection by authorized TNRCC representatives.

4. Within 120 days of permit issuance, the permittee shall submit to the TNRCC Wastewater Permits Section (MC 148) a summary submittal letter in accordance with the requirements in 30 TAC Subsection 317.1. for the rerating of the Southeast Water Reclamation Plant. If requested by the Wastewater Permits Section, the permittee shall submit plans, specifications and a final engineering design report which comply with 30 TAC Chapter 317, Design Criteria for Sewerage Systems. The permittee shall clearly show how the treatment system will meet the final permitted effluent limitations required on Pages 2 through 2e of the permit.

In addition, there are three non-contiguous effluent application areas described as follows: 815 acres located 0.75 mile north of the Village of Ransom Canyon and east of the main site, 300 acres located east of Farm-to-Market Road 1729, 0.5 mile south of East 19th Street and 0.5 mile north of 50th Street and approximately 150 acres located north of the SEWRP and west of Loop 289. The LAS is located in Lubbock County, Texas. (See Attachment B.)

13. Irrigation practices shall be designed and managed so as to prevent ponding of effluent or contamination of ground and surface waters and to prevent the occurrence of nuisance conditions in the area. Tail-water control facilities shall be provided as necessary to prevent the discharge of any wastewater from the irrigated land, as required. Effluent shall not be applied for irrigation of the LAS during rainfall events or when the ground is frozen or saturated.

The Soil Conservation Service (SCS) Soil Survey of Lubbock County, Texas, indicates that soils of the Bippus and Randall series and soils of the Potter-Berda association and the Kimbrough series have severe limitations for wastewater application. Therefore, the permittee shall not apply wastewater effluent or sludge to the areas of the LAS where these soils are located. Within 120 days from permit issuance, the permittee shall verify the presence of these soils on the LAS as indicated by the SCS Soil Survey of Lubbock County and develop a map of the LAS that accurately indicates the location of these soils. The map shall be retained onsite and made available to TNRCC authorized personnel upon request.

14. The permittee is responsible for determining that the irrigation application rates are not excessive based on the nutrient levels in the wastewater, the nutrient requirements of the crop, precipitation, evapotranspiration and leaching requirements. The permittee shall determine the wastewater application rate annually for each crop or crop combination and shall retain these calculations on-site for five years. The permittee is responsible for providing equipment to determine the application rate for each crop and for maintaining accurate records of the volume of effluent applied as irrigation water to each independent irrigation plot.

The irrigation application rate shall not exceed an average of 4.8 acre-feet per year per acre irrigated for the total acreage irrigated in any year. In addition, the irrigation application rates shall not exceed the following:

Irrigated Crop	Maximum Irrigation Rate (acre-feet per year per acre irrigated)
Alfalfa	5.27
Wheat and Haygrazer	4.06
Corn and Wheat	4.28
Cotton and Wheat	4.08

The permittee shall also maintain accurate daily records for each irrigation plot for the actual precipitation and type of crop. The electrical conductivity and pH shall be measured on a daily basis at the reservoir. In addition, the general time frame of occurrence of precipitation events over each of the irrigation plots and the effect of precipitation events on irrigation application including shutdown or shifts in operation shall be recorded daily. These records shall be made available for review by authorized representatives of the TNRCC and shall be maintained on-site at least five years.

15. The permittee shall conduct soil sampling of the LAS, where wastewater is or has been disposed of via irrigation, once per year except for plot nos. 1, 6, 9, 13, and 16 where soil sampling shall be conducted twice per year. Soil sampling shall include the following:

   a. Composite or benchmark sampling techniques should be used when sampling the soils. Individual soil types, as defined by the USDA Soil Conservation Service Soil Survey, should be sampled individually at depth zones of 0-6, 6-18, and 18-30 inches. Sampling procedures shall employ accepted soil science techniques for obtaining representative analytical results. Each composite sample shall represent no more than 80 acres, with 10 - 15 random sample cores for each composite sample. Each benchmark sample shall represent no more than 80 acres with at least 7 subsamples for each benchmark composite sample. Subsamples shall be composited by individual site, zone and soil type for analysis and reporting purposes.

   b. Analyses of the soil samples shall be performed for pH (standard units), total nitrogen (mg/kg), nitrate nitrogen (mg/kg), potassium (mg/kg), phosphorus (mg/kg), sodium (mg/kg), magnesium (mg/kg), calcium (mg/kg), conductivity (micromhos/cm) and sodium adsorption ratio (SAR). The SAR shall not exceed 10. Nutritive parameters should be analyzed in extractable or available form. The application of wastewater shall not exceed the recommended fertilization requirements of the above parameters for the crops grown, less the existing soil fertility.

   c. The permittee shall submit a detailed report which contains, for each soil sample, the date and time of sampling, location of sample on each irrigation plot, how sample was obtained, means of conveyance to the analysis lab, date and time that the analysis was performed, and a detailed account of the procedures for each analysis.

   The permittee shall submit the results of the soil sample analyses and the report to the TNRCC Water Quality Management Information Systems Team (MC 224) of the Enforcement Division and the Region 2 Office (MC Region 2) during September of each year.

16. Within 120 days of permit issuance, the permittee shall submit a soil moisture monitoring plan for the irrigation area that includes acceptable agronomic devices for monitoring the amount of soil moisture, such as tensiometers, peizometers or gypsum blocks, to the TNRCC Groundwater Assessment Section (MC 147) of the Water Quality Division for review and approval. Soil moisture monitoring shall be used to ensure that over-application of effluent does not occur and to manage the leaching of salts beneath the root zone. Soil moisture monitoring shall be used to ensure that irrigation rates that do not exceed the crop requirements or the uptake capability of the soils. Soil moisture monitoring shall be implemented immediately following TNRCC approval and shall be incorporated into the irrigation scheduling and maintained at all times.

17. Within 120 days of permit issuance, the permittee shall submit a map which identifies the location of all wells, active and inactive, located on or within 150 feet the LAS and a report which indicates whether these wells are cased (for producing wells) or plugged (for non-producing wells). Any well which is plugged due to this permit requirement shall be plugged in accordance with 30 TAC Section 238.49. The map and report shall be submitted to the TNRCC Groundwater Assessment Section (MC 147) of the Water Quality Division, the Water Quality Management Information Systems Team (MC 224) of the Enforcement Division and the Region 2 Office (MC Region 2).

25. The permittee is responsible for the quality of effluent as well as the conveyance of effluent transferred to the Jones Electric Generation Plant. The Southwestern Public Service Co. is authorized for effluent disposal from the Jones Electric Generation Plant by irrigation under the provisions of Permit No. 01312.

26. Soil sampling for the areas of the LAS receiving both treated wastewater effluent and sludge application shall include the following:

Parameter		Monitoring Requirements	Measurement Frequency Sample Depth, inches		
			0-6	6-18	18-30
Nitrate Nitrogen (NO_3-N)		2/year	X	X	X
Ammonia Nitrogen (NH_4-N)		2/year	X	X	X
Total Nitrogen (TKN)	(a)	2/year	X	X	X
Phosphorus (extractable)		2/year	X	X	X
Potassium (extractable)		2/year	X	X	X
Sodium (extractable)		2/year	X	X	X
Magnesium (extractable)		2/year	X	X	X
Calcium (extractable)		2/year	X	X	X
Soluble Salts/EC	(b)	2/year	X	X	X
Soil Water pH (S.U.)	(c)	2/year	X	X	X
Sodium Adsorption Ration (SAR)	(d)	2/year	X	X	X
Total Arsenic (mg/kg)	(e)	1/5 years	X	N/A	N/A
Total Cadmium (mg/kg)	(e)	1/5 years	X	N/A	N/A
Total Chromium (mg/kg)	(e)	1/5 years	X	N/A	N/A
Total Copper (mg/kg)	(e)	1/5 years	X	N/A	N/A
Total Lead (mg/kg)	(e)	1/5 years	X	N/A	N/A
Total Mercury (mg/kg)	(e)	1/5 years	X	N/A	N/A
Total Molybdenum (mg/kg)	(e)	1/5 years	X	N/A	N/A
Total Nickel (mg/kg)	(e)	1/5 years	X	N/A	N/A
Total Selenium (mg/kg)	(e)	1/5 years	X	N/A	N/A
Total Zinc (mg/kg)	(e)	1/5 years	X	N/A	N/A

(a) Determined by Kjeldahl digestion or an equivalent accepted procedure. The use of methods that rely on Mercury as a catalyst are not acceptable.

(b) Electrical Conductivity (EC) - determine from extract of 2:1 (v/v) water/soil mixture.

(c) Soil pH shall be analyzed by the electrometric method in "Test Methods for Evaluating Solid Waste, EPA SW846, 40 CFR 260.11. Method 9040 is appropriate for determining pH.

(d) The SAR shall not exceed 10.

CONTRIBUTING INDUSTRIES AND PRETREATMENT REQUIREMENTS

1. The permittee shall operate an industrial pretreatment program in accordance with Section 402(b)(8) of the Clean Water Act, the General Pretreatment Regulations (40 CFR Part 403) and the approved POTW pretreatment program submitted by the permittee. The pretreatment program was approved on **November 22, 1996.** The POTW pretreatment program is hereby incorporated by reference and shall be implemented in a manner consistent with the following requirements:

   a. Industrial user information shall be updated at a frequency adequate to ensure that all Industrial Users (IUs) are properly characterized at all times;

   b. The frequency and nature of industrial user compliance monitoring activities by the permittee shall be commensurate with the character, consistency and volume of waste. However, in keeping with the requirements of 40 CFR §403.8 (f)(2)(v), the permittee must inspect and sample the effluent from each Significant Industrial User at least once a year. This is in addition to any industrial self-monitoring activities;

   c. The permittee shall enforce and obtain remedies for noncompliance by any industrial users with applicable pretreatment standards and requirements;

   d. The permittee shall control through permit, order, or similar means, the contribution to the POTW by each Industrial User to ensure compliance with applicable Pretreatment Standards and Requirements. In the case of Industrial Users identified as significant under 40 CFR §403.3(t), this control shall be achieved through permits or equivalent individual control mechanisms issued to each such user. Such control mechanisms must be enforceable and contain, at a minimum, the following conditions:

      (1) Statement of duration (in no case more than five years);
      (2) Statement of non-transferability without, at a minimum, prior notification to the POTW and provision of a copy of the existing control mechanism to the new owner or operator;
      (3) Effluent limits based on applicable general pretreatment standards, categorical pretreatment standards, local limits, and State and local law;
      (4) Self-monitoring, sampling, reporting, notification and recordkeeping requirements, including an identification of the pollutants to be monitored, sampling location, sampling frequency, and sample type, based on the applicable general pretreatment standards in 40 CFR Part 403, categorical pretreatment standards, local limits, and State and local law; and
      (5) Statement of applicable civil and criminal penalties for violation of pretreatment standards and requirements, and any applicable compliance schedule. Such schedules may not extend the compliance date beyond federal deadlines.

   e. The permittee shall evaluate, at least once every two years, whether each Significant Industrial User needs a plan to control slug discharges. If the POTW decides that a slug control plan is needed, the plan shall contain at least the minimum elements required in 40 CFR §403.8 (f)(2)(v);

4. The permittee shall prepare annually a list of Industrial Users which during the preceding twelve months were in significant noncompliance with applicable pretreatment requirements. For the purposes of this Part, significant noncompliance (SNC) shall be determined based upon the more stringent of either criteria established at 40 CFR §403.8(f)(2)(vii) [rev. 7/24/90] or criteria established in the approved POTW pretreatment program. This list is to be published annually in the largest daily newspaper in the municipality in which the POTW is located during the month of January.

In addition, during the month of January the permittee shall submit an updated pretreatment program status report to the TNRCC Pretreatment Team (MC 148) of the Water Quality Division containing the following information:

a. An updated list of all significant industrial users. For each industrial user listed the following information shall be included:

(1) Standard Industrial Classification (SIC) code and categorical determination;

(2) Control document status. Whether the user has an effective control document, and the date such document was last issued, reissued, or modified, (indicate which industrial users were added to the system (or newly identified) within the previous 12 months);

(3) A summary of all monitoring activities performed within the previous 12 months. The following information shall be reported:

* Total number of inspections performed; and
* Total number of sampling visits made.

(4) Status of compliance with both effluent limitations and reporting requirements. Compliance status shall be defined as follows:

* Compliant (C) - no violations during the previous 12 month period;

* Non-compliant (NC) - one or more violations during the previous 12 months but does not meet the criteria for significantly noncompliant industrial users; and

* Significant Noncompliance (SNC) - in accordance with requirements described in item 4.

(5) For significantly noncompliant industrial users, indicate the nature of the violations, the type and number of actions taken (notice of violation, administrative order, criminal or civil suit, fines or penalties collected, etc.) and current compliance status. If ANY industrial user was on a schedule to attain compliance with effluent limits, indicate the date the schedule was issued and the date compliance is to be attained.

b. A list of all significant industrial users whose authorization to discharge was terminated or revoked during the preceding 12 month period and the reason for termination.

c. A report on any interference, pass through, upset or POTW permit violations known or suspected to be caused by industrial contributors and actions taken by the permittee in response.

d. The results of all influent and effluent analyses performed pursuant to item 3.

TPDES Pretreatment Program Annual Report Form
for Updated Significant Industrial Users List

Reporting month/year: __________, ____ **to** __________, ____

TPDES Permit No. ________________ **Permittee:** ____________________________ **Treatment Plant:** ________________________

PRETREATMENT PROGRAM STATUS REPORT UPDATED SIGNIFICANT INDUSTRIAL USERS LIST

INDUSTRIAL USER	SIC CODE	CATEGORICAL DETERMINATION	CONTROL DOCUMENT		NEW USER	TIMES INSPECTED	TIMES SAMPLED	COMPLIANCE STATUS				
			Y/N	LAST ACTION				REPORTS				EFFLUENT LIMITS
								BMR	90-DAY COMPLIANCE	SEMI-ANNUAL	SELF MONITORING	

TPDES Pretreatment Program Annual Report Form for Influent and Effluent Monitoring Results [1]

Reporting month/year: __________, ____ to __________, ____

TPDES Permit No._________ Permittee: _______________ Treatment Plant: ____________________

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, IF APPLICABLE IN μg/L [2]	INFLUENT ACTUAL CONCENTRATION OR MAL MEASURED IN μg/L				EFFLUENT LIMIT IN μg/L [3]	EFFLUENT ACTUAL CONCENTRATION OR MAL MEASURED in μg/L [4]			
		DATE	DATE	DATE	DATE		DATE	DATE	DATE	DATE
METALS, CYANIDE AND PHENOLS										
Antimony										
Arsenic										
Beryllium										
Cadmium										
Chromium (Total)										
Chromium (Hex)										
Chromium (Tri)[5]										
Copper										
Lead										
Mercury										
Nickel										
Selenium										

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, IF APPLICABLE IN μg/L [2]	INFLUENT ACTUAL CONCENTRATION OR MAL MEASURED IN μg/L				EFFLUENT LIMIT IN μg/L [3]	EFFLUENT ACTUAL CONCENTRATION OR MAL MEASURED in μg/L [4]			
		DATE	DATE	DATE	DATE		DATE	DATE	DATE	DATE
Dichlorobromomethane						See TTHM				
1,1-Dichloroethane										
1,2-Dichloroethane										
1,1-Dichloroethylene										
1,2-Dichloropropane										
1,3-Dichloropropylene										
Ethyl benzene										
Methyl Bromide										
Methyl Chloride										
Methylene Chloride										
1,1,2,2-Tetrachloroethane										
Tetrachloroethylene										
Toluene										
1,2-Trans-Dichloroethylene										
1,1,1-Trichloroethane										
1,1,2-Trichloroethane										
Trichloroethylene										

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS									
POLLUTANT	MAHL, IF APPLICABLE IN µg/L [2]	INFLUENT ACTUAL CONCENTRATION OR MAL MEASURED IN µg/L				EFFLUENT LIMIT IN µg/L [3]	EFFLUENT ACTUAL CONCENTRATION OR MAL MEASURED in µg/L [4]			
		DATE	DATE	DATE	DATE		DATE	DATE	DATE	DATE
Benzidine										
Benzo(a)Anthracene										
Benzo(a)Pyrene										
3,4-Benzofluoranthene										
Benzo(ghi)Perylene										
Benzo(k)Fluoranthene										
Bis(2-Chloroethoxy) Methane										
Bis(2-Chloroethyl)Ether										
Bis(2-Chloroisopropyl) Ether										
Bis(2-Ethylhexyl) Phthalate										
4-Bromophenyl Phenyl Ether										
Butylbenzyl Phthalate										
2-Chloronaphthalene										
4-Chlorophenyl Phenyl Ether										
Chrysene										

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS										
POLLUTANT	MAHL, IF APPLICABLE IN µg/L [2]	INFLUENT ACTUAL CONCENTRATION OR MAL MEASURED IN µg/L				EFFLUENT LIMIT IN µg/L [3]	EFFLUENT ACTUAL CONCENTRATION OR MAL MEASURED in µg/L [4]			
		DATE	DATE	DATE	DATE		DATE	DATE	DATE	DATE
Hexachloroethane										
Indeno(1,2,3-cd)pyrene										
Isophorone										
Naphthalene										
Nitrobenzene										
N-Nitrosodimethylamine										
N-Nitrosodi-n-Propylamine										
N-Nitrosodiphenylamine										
Phenanthrene										
Pyrene										
1,2,4-Trichlorobenzene										
PESTICIDES										
Aldrin										
alpha-BHC										
beta-BHC										
gamma-BHC										
delta-BHC										

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, IF APPLICABLE IN µg/L [2]	INFLUENT ACTUAL CONCENTRATION OR MAL MEASURED IN µg/L				EFFLUENT LIMIT IN µg/L [3]	EFFLUENT ACTUAL CONCENTRATION OR MAL MEASURED in µg/L [4]			
		DATE	DATE	DATE	DATE		DATE	DATE	DATE	DATE
PCB-1016										
Toxaphene										
ADDITIONAL TOXIC POLLUTANTS REGULATED UNDER 30 TAC CHAPTER 307										
Aluminum										
Barium										
Bis(chloromethyl) ether[7]										
Carbaryl										
Chloropyrifos										
Cresols										
2,4-D										
Danitol[8]										
Demeton										
Diazinon										
Dicofol										
Dioxin/Furans[9]										
Fluoride										
Guthion										

Footnotes:

1. It is advised that the permittee collect the influent and effluent samples considering flow detention time through each plant.
2. Maximum Allowable Headworks Loading Limitation in μg/l, only complete for pollutants that have approved technically based local limits.
3. Daily average effluent limit as derived by the Texas Toxicity Modeling Program (TexTox). Effluent limits as calculated are designed to be protective of the Texas Surface Water Quality Standards. Shaded blocks need not be filled in unless the Permittee has received a permit requirement/limit for the particular parameter.
4. Minimum Analytical Levels and suggested analytical methods may be located in Table 1 of Attachment D of permittee's wastewater permit application.
5. Report result by subtracting Hexavalent Chromium from Total Chromium.
6. Cyanide, Amenable to Chlorination or Weak-Acid Dissociable methods.
7. Hydrolyzes in water. Will not require permittee to analyze at this time.
8. EPA procedure not approved. Will not require permittee to analyze at this time.
9. Analyses are not required at this time for these pollutants unless there is reason to believe that these pollutants may be present.

2. Required Toxicity Testing Conditions

a. Test Acceptance - The permittee shall repeat any toxicity test, including the control and all effluent dilutions, which fail to meet the following criteria:

1) a control mean survival of 80% or greater;

2) a control mean number of *C. dubia* neonates per surviving adult of 15 or greater;

3) a control mean dry weight of surviving fathead minnow larvae of 0.25 mg or greater;

4) a control Coefficient of Variation percent (CV%) of 40 or less in between replicates for the young of surviving females in the *Ceriodaphnia dubia* reproduction and survival test; and the growth and survival endpoints in the *Pimephales promelas* growth and survival test.

5) a critical dilution CV% of 40 or less for young of surviving females in the *Ceriodaphnia* reproduction and survival test; and the growth and survival endpoints for the *Pimephales promelas* growth and survival test. However, if statistically significant lethal or nonlethal effects are exhibited at the critical dilution, a CV% greater than 40 shall not invalidate the test.

b. Statistical Interpretation

1) If the conditions of test acceptability are met and the survival of the test organism is equal to or greater than 80% in the critical dilution and all dilutions below that, the test shall be considered a passing test. The permittee shall report an No Observed Effect Concentration (NOEC) of not less than the critical dilution for the reporting requirements.

2) For the *C. dubia* survival test, the statistical analyses used to determine if there is a significant difference between the control and the critical dilution shall be Fisher's Exact Test as described in the "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Third Edition" (EPA-600-4-91-002), or the most recent update.

3) For the *C. dubia* reproduction test and the fathead minnow larval survival and growth tests, the statistical analyses used to determine if there is a significant difference between the control and the critical dilution shall be in accordance with the methods for determining the NOEC as described in the "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Third Edition" (EPA-600-4-91-002), or the most recent update.

c. Dilution Water

1) Dilution water used in the toxicity tests shall be the receiving water collected at a point upstream of the discharge as close as possible to the discharge point, but unaffected by the discharge. Where the toxicity tests are conducted on effluent discharges to receiving waters that are classified as intermittent streams, or where the toxicity tests are conducted on effluent discharges where no receiving water is available due to zero flow conditions, the permittee shall; (a) substitute a synthetic dilution water that has a pH, hardness, and alkalinity similar to that of the closest downstream perennial water unaffected by the discharge, or (b) utilize the closest downstream perennial water unaffected by the discharge.

3. Reporting

All reports, tables, plans, summaries, and related correspondence required in any Part of this Section shall be submitted to the attention of the Water Quality Assessment Team (MC 150) of the Water Quality Division.

a. The permittee shall prepare a full report of the results of all tests conducted pursuant to this permit in accordance with the Report Preparation Section of "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Third Edition" (EPA 600-4-891-002, or the most recent update, for every valid and invalid toxicity test initiated whether carried to completion or not. All full reports shall be retained for 3 years at the plant site and shall be available for inspection by TNRCC personnel.

b. A full report must be submitted with the first valid biomonitoring test results for each test species and with the first test results any time the permittee subsequently employs a different test laboratory. Full reports need not be submitted for subsequent testing unless specifically requested. The permittee shall routinely report the results of each biomonitoring test on the Table 1 forms provided with this permit. All Table 1 reports must include the information specified in the Table 1 form attached to this permit.

   1) Annual biomonitoring test results are due on or before January 20th for biomonitoring conducted during the previous 12 month period.

   2) Semiannual biomonitoring test results are due on or before July 20th and January 20th for biomonitoring conducted during the previous 6 month period.

   3) Quarterly biomonitoring test results are due on or before April 20th, July 20th, October 20th, and January 20th, for biomonitoring conducted during the previous calendar quarter.

   4) Monthly biomonitoring test results are due on or before the 20th day of the month following sampling.

c. Enter the following codes on the DMR for the appropriate parameters for valid tests only:

   1) For the water flea (*Ceriodaphnia dubia*), Parameter TLP3B, enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

   2) For the water flea (*Ceriodaphnia dubia*), Parameter TOP3B, report the NOEC for survival.

   3) For the water flea (*Ceriodaphnia dubia*), Parameter TPP3B, report the NOEC for reproduction.

   4) For the fathead minnow (*Pimephales promelas*), Parameter TLP6C, enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

   5) For the fathead minnow (*Pimephales promelas*), Parameter TOP6C, report the NOEC for survival.

   6) For the fathead minnow (*Pimephales promelas*), Parameter TPP6C, report the NOEC for growth.

2) Sampling Plan - The TRE Action Plan should describe sampling locations, methods, holding times, chain of custody, and preservation techniques. The effluent sample volume collected for all tests shall be adequate to perform the toxicity characterization/ identification/ confirmation procedures, and chemical-specific analyses when the toxicity tests show significant lethality. Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical-specific analyses for the identified and/or suspected pollutant(s) and/or source(s) of effluent toxicity;

3) Quality Assurance Plan - The TRE Action Plan should address record keeping and data evaluation, calibration and standardization, baseline tests, system blanks, controls, duplicates, spikes, toxicity persistence in the samples, randomization, reference toxicant control charts, as well as mechanisms to detect artifactual toxicity; and

4) Project Organization - The TRE Action Plan should describe the project staff, project manager, consulting engineering services (where applicable), consulting analytical and toxicological services, etc.

c. Within 30 days of submittal of the TRE Action Plan and Schedule, the permittee shall implement the TRE with due diligence.

d. The permittee shall submit quarterly TRE Activities Reports concerning the progress of the TRE. The quarterly reports are due on or before April 20th, July 20th, October 20th, and January 20th. The report shall detail information regarding the TRE activities including:

1) results and interpretation of any chemical-specific analyses for the identified and/or suspected pollutant(s) performed during the quarter;

2) results and interpretation of any characterization, identification, and confirmation tests performed during the quarter;

3) any data and/or substantiating documentation which identifies the pollutant(s) and/or source(s) of effluent toxicity;

4) results of any studies/evaluations concerning the treatability of the facility's effluent toxicity;

5) any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to meet no significant lethality at the critical dilution; and

6) any changes to the initial TRE Plan and Schedule that are believed necessary as a result of the TRE findings.

Copies of the TRE Activities Report shall also be submitted to the U.S. EPA Region 6 office (6WQ-PM) and the TNRCC Region 2 office.

e. During the TRE, the permittee shall perform, at a minimum, quarterly testing using the more sensitive species; testing for the less sensitive species shall continue at the frequency specified in Part 1.b. If the effluent ceases to effect significant lethality (herein as defined below) the permittee may end the TRE. A "cessation of lethality" is defined as no significant lethality for a period of 12

24-HOUR ACUTE BIOMONITORING REQUIREMENTS: FRESHWATER

The provisions of this section apply individually and separately to Outfall 001 for whole effluent toxicity testing (biomonitoring). No samples or portions of samples from one outfall may be composited with samples or portions of samples from another outfall.

1. Scope, Frequency and Methodology

a. The permittee shall test the effluent for lethality in accordance with the provisions in this Section. Such testing will determine compliance with the Surface Water Quality Standard, 30 TAC §307.6(e)(2)(B), of greater than 50% survival of the appropriate test organisms in 100% effluent for a 24-hour period.

b. The toxicity tests specified shall be conducted once per six months or once per discharge event. The permittee shall conduct the following toxicity tests utilizing the test organisms, procedures, and quality assurance requirements specified in this section of the permit and in accordance with "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fourth Edition" (EPA 600/4-90/027F), or the most recent update thereof:

1) Acute 24-hour static toxicity test using the water flea (Daphnia pulex). A minimum of five replicates with eight organisms per replicate shall be used in the control and in each dilution.

2) Acute 24-hour static toxicity test using the fathead minnow (Pimephales promelas). A minimum of five replicates with eight organisms per replicate shall be used in the control and in each dilution.

A valid test result must be submitted for each reporting period. The permittee must report, then repeat, an invalid test during the same reporting period. The repeat test shall include the control and the 100% effluent dilution and use the appropriate number of organisms and replicates, as specified above. An invalid test is herein defined as any test failing to satisfy the test acceptability criteria, procedures, and quality assurance requirements specified in the test methods and permit.

c. In addition to an appropriate control, a 100% effluent concentration shall be used in the toxicity tests. Except as discussed in item 2.b., the control and/or dilution water shall consist of a standard, synthetic, moderately hard, reconstituted water.

d. This permit may be amended to require a Whole Effluent Toxicity (WET) limit, a Best Management Practice (BMP), Chemical-Specific (CS) limits, additional toxicity testing, and/or other appropriate actions to address toxicity. The permittee may be required to conduct additional biomonitoring tests and/or a Toxicity Reduction Evaluation (TRE) if biomonitoring data indicate multiple numbers of unconfirmed toxicity events.

e. If the dilution series specified in the Chronic Biomonitoring Requirements includes a 100% effluent concentration, the results from those tests may fulfill the requirements of this Section; any tests performed in the proper time interval may be substituted. Compliance will be evaluated as specified in item a. The 50% survival in 100% effluent for a 24-hour period standard applies to all tests utilizing a 100% effluent dilution, regardless of whether the results are submitted to comply with the minimum testing frequency defined in item b.

b. A full report must be submitted with the first valid biomonitoring test results for each test species and with the first test results any time the permittee subsequently employs a different test laboratory. Full reports need not be submitted for subsequent testing unless specifically requested. The permittee shall routinely report the results of each biomonitoring test on the Table 2 forms provided with this permit. All Table 2 reports must include the information specified in the Table 2 form attached to this permit.

1) Semiannual biomonitoring test results are due on or before January 20th and July 20th for biomonitoring conducted during the previous 6 month period.

2) Quarterly biomonitoring test results are due on or before January 20th, April 20th, July 20th, and October 20th, for biomonitoring conducted during the previous calendar quarter.

c. Enter the following codes on the DMR for the appropriate parameters for valid tests only:

1) For the water flea (*Daphnia pulex*), Parameter TIE3D, enter a "0" if the mean survival at 24-hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

2) For the fathead minnow (*Pimephales promelas*), Parameter TIE6C, enter a "0" if the mean survival at 24-hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

4. Persistent Mortality

The requirements of this Part apply when a toxicity test demonstrates significant lethality, here defined as a mean mortality of 50% or greater to organisms exposed to the 100% effluent concentration after 24-hours .

a. The permittee shall conduct 2 additional tests (retests) for each species that demonstrates significant lethality. The two retests shall be conducted once per week for 2 weeks. Five effluent dilution concentrations in addition to an appropriate control shall be used in the retests. These additional effluent concentrations are 6%, 13%, 25%, 50% and 100% effluent. The first retest shall be conducted within 15 days of the laboratory determination of significant lethality. All test results shall be submitted within 20 days of test completion of the second retest. Test completion is defined as the 24th hour.

b. If one or both of the two retests specified in item 4.a. demonstrates significant lethality, the permittee shall initiate the TRE requirements as specified in Part 5 of this Section.

5. Toxicity Reduction Evaluation

a. Within 45 days of the retest that demonstrates significant lethality, the permittee shall submit a General Outline for initiating a TRE. The outline shall include, but not be limited to, a description of project personnel, a schedule for obtaining consultants (if needed), a discussion of influent and/or effluent data available for review, a sampling and analytical schedule, and a proposed TRE initiation date.

2) results and interpretation of any characterization, identification, and confirmation tests performed during the quarter;

3) any data and/or substantiating documentation which identifies the pollutant(s) and/or source(s) of effluent toxicity;

4) results of any studies/evaluations concerning the treatability of the facility's effluent toxicity;

5) any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to eliminate significant lethality; and

6) any changes to the initial TRE Plan and Schedule that are believed necessary as a result of the TRE findings.

Copies of the TRE Activities Report shall also be submitted to the U.S. EPA Region 6 office (6WQ-PM) and the TNRCC Region 2 office.

e. During the TRE, the permittee shall perform, at a minimum, quarterly testing using the more sensitive species; testing for the less sensitive species shall continue at the frequency specified in Part 1.b. If the effluent ceases to effect significant lethality (herein as defined below) the permittee may end the TRE. A "cessation of lethality" is defined as no significant lethality at the critical dilution for a period of 12 consecutive weeks with at least weekly testing. At the end of the 12 weeks, the permittee shall submit a statement of intent to cease the TRE and may then resume the testing frequency specified in Part 1.b.

This provision does not apply as a result of corrective actions taken by the permittee. "Corrective actions" are herein defined as proactive efforts which eliminate or reduce effluent toxicity. These include, but are not limited to, source reduction or elimination, improved housekeeping, changes in chemical usage, and modifications of influent streams and/or effluent treatment.

The permittee may only apply this cessation of lethality provision once. If the effluent again demonstrates significant lethality to the same species, then this permit will be amended to add a WET limit with a compliance period, if appropriate. However, prior to the effective date of the WET limit, the permittee may apply for a permit amendment removing the WET limit, in lieu of an alternate toxicity control measure, by identifying and confirming the toxicant and/or an appropriate control measure.

f. The permittee shall complete the TRE and submit a Final Report on the TRE Activities no later than 18 months from the last test day of the retest that demonstrates significant lethality. The permittee may petition the Executive Director (in writing) for an extension of the 18-month limit. However, to warrant an extension the permittee must have demonstrated due diligence in their pursuit of the TIE/TRE and must prove that circumstances beyond their control stalled the TIE/TRE. The report shall specify the control mechanism(s) that will, when implemented, reduce effluent toxicity as specified in item 5.g. The report will also specify a corrective action schedule for implementing the selected control mechanism(s). The permittee shall also submit copies of the Final Report on the TRE Activities to the U.S. EPA Region 6 office (6WQ-PM) and the TNRCC Region 2 office.

g. Within 3 years of the last day of the test confirming toxicity, the permittee shall comply with 30 TAC 307.6.(e)(2)(B), which requires greater than 50% survival of the test organism in 100% effluent at the end of 24-hours. The permittee may petition the Executive Director (in writing) for an extension

TABLE 1 (SHEET 1 OF 4)

BIOMONITORING REPORTING

CERIODAPHNIA DUBIA SURVIVAL AND REPRODUCTION

			Date Time		Date Time
Dates and Times Composites Collected	No. 1	FROM:	______________	TO:	______________
	No. 2	FROM:	______________	TO:	______________
	No. 3	FROM:	______________	TO:	______________

Test initiated: ____________________ am/pm ____________________ date

Dilution water used: _______ Receiving water _______ Synthetic Dilution water

NUMBER OF YOUNG PRODUCED PER ADULT AT END OF TEST

	Percent effluent (%)					
REP	0%	29%	39%	52%	69%	92%
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
Surviv. Mean						
Total Mean						
CV%*						

*coefficient of variation = standard deviation x 100/mean (calculation based on young of the surviving adults)
Designate males (M), and dead females (D), along with number of neonates (x) released prior to death.

TABLE 1 (SHEET 3 OF 4)

BIOMONITORING REPORTING

FATHEAD MINNOW LARVAE GROWTH AND SURVIVAL

Dates and Times Composites Collected

No. 1 FROM: ______ (Date Time) TO: ______ (Date Time)

No. 2 FROM: ______ TO: ______

No. 3 FROM: ______ TO: ______

Test initiated: ______ am/pm ______ date

Dilution water used: ______ Receiving water ______ Synthetic Dilution water

FATHEAD MINNOW GROWTH DATA

Effluent Concentration (%)	Average Dry Weight in milligrams in replicate chambers					Mean Dry Weight	CV%*
	A	B	C	D	E		
0%							
29%							
39%							
52%							
69%							
92%							

* coefficient of variation = standard deviation x 100/mean

1. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

   Is the mean dry weight (growth) at 7 days significantly less (p=0.05) than the control's dry weight (growth) for the % effluent corresponding to significant nonlethal effects?

   CRITICAL DILUTION (92%): ______ YES ______ NO

TABLE 2 (SHEET 1 OF 2)

WATER FLEA SURVIVAL

GENERAL INFORMATION

	Time (am/pm)	Date
Composite Sample Collected		
Test Initiated		

PERCENT SURVIVAL

Time	Rep	Percent effluent (%)					
		0%	6%	13%	25%	50%	100%
24h	A						
	B						
	C						
	D						
	E						
	MEAN*						

Enter percent effluent corresponding to the LC50 below:

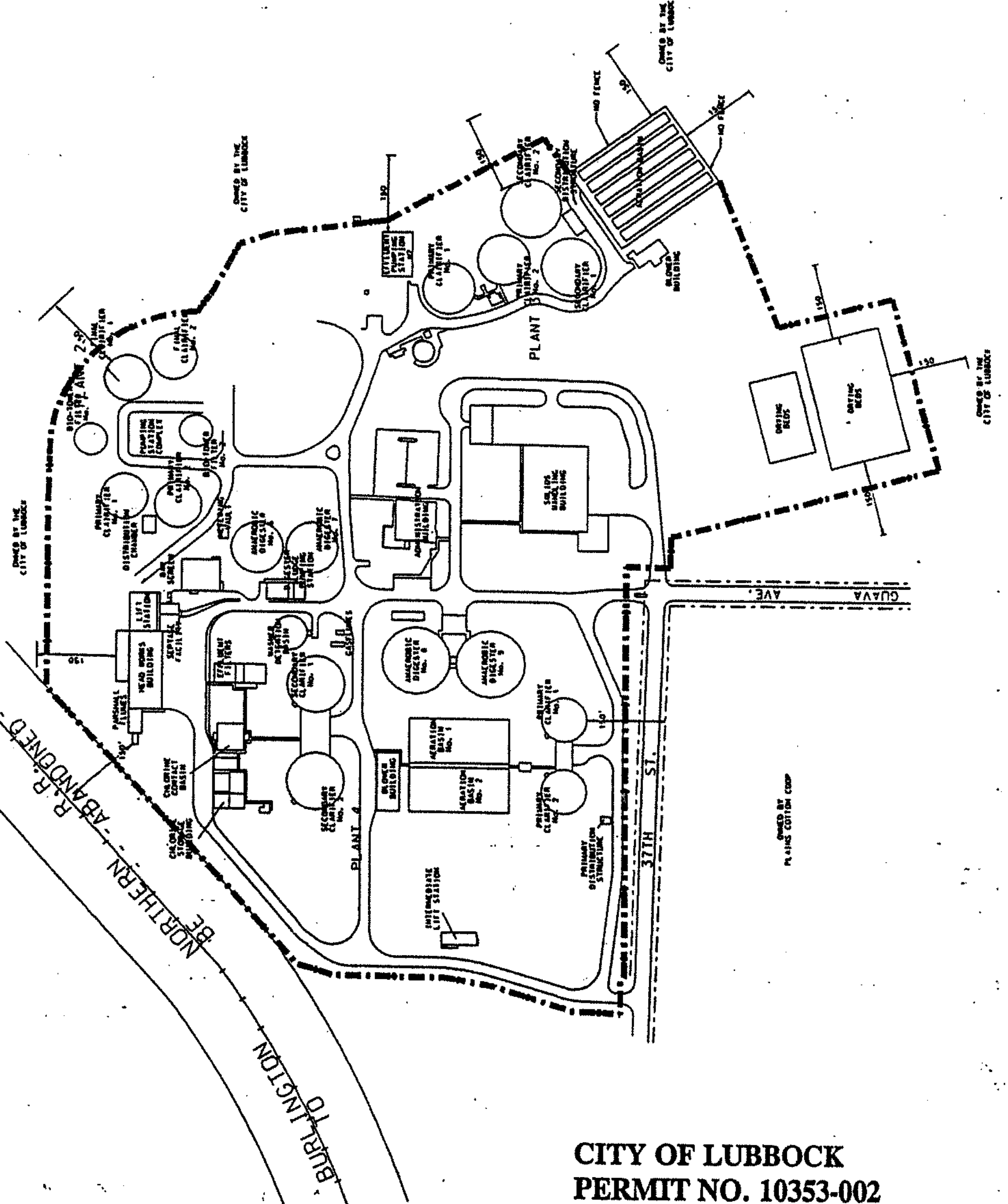
24 hour LC50 (Daphnia or Ceriodaphnia) = ________% effluent
(circle appropriate genus)

95% confidence limits: ________________

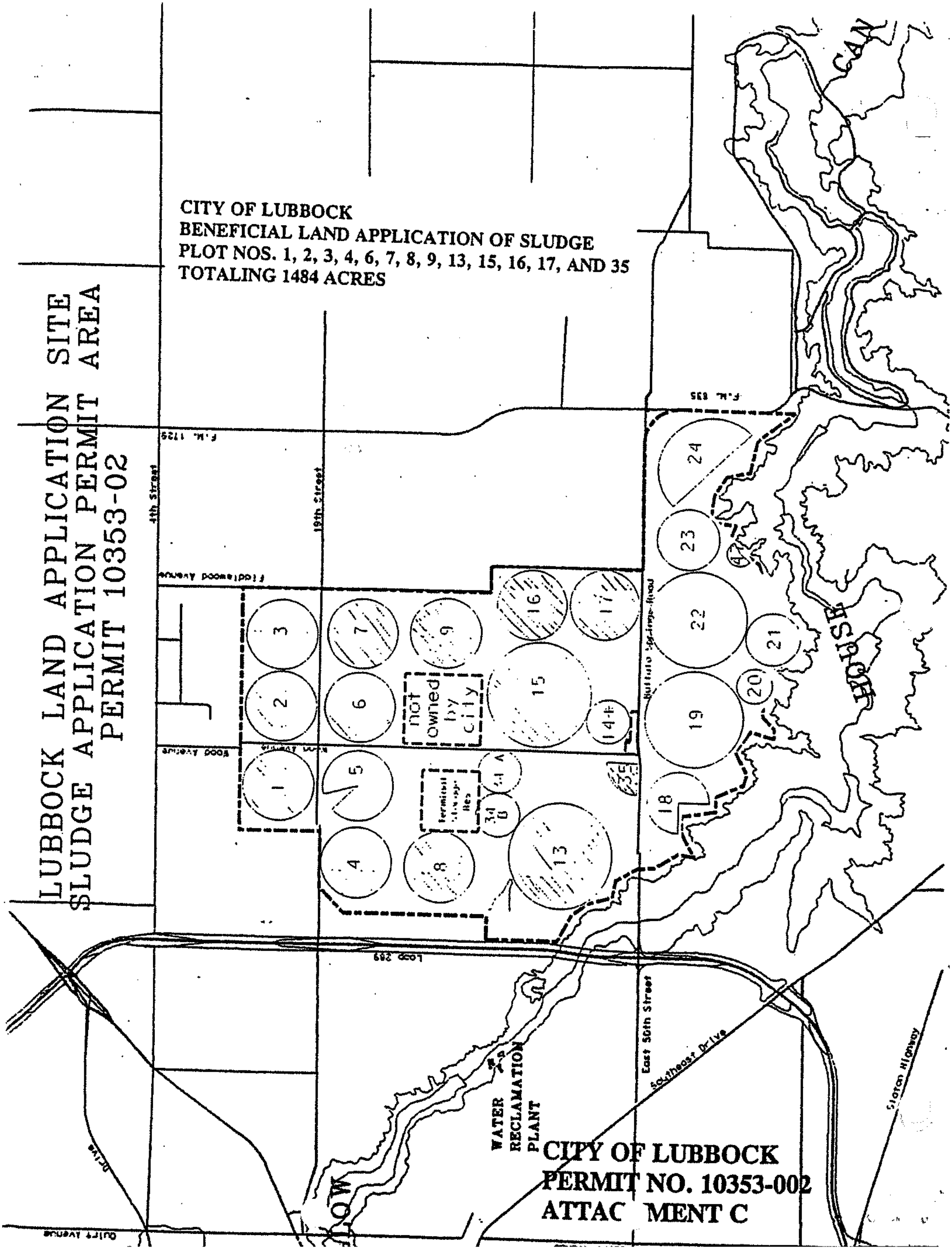
Method of LC50 calculation: ______________

* If 24-hour survivorship data from the chronic Ceriodaphnia dubia test is being used, the mean survival per dilution for all 10 replicates shall be reported on this row.

SOUTHEAST WATER RECLAMATION PLANT
BOUNDARIES OF THE TREATMENT FACILITY



CITY OF LUBBOCK
PERMIT NO. 10353-002
ATTACHMENT A

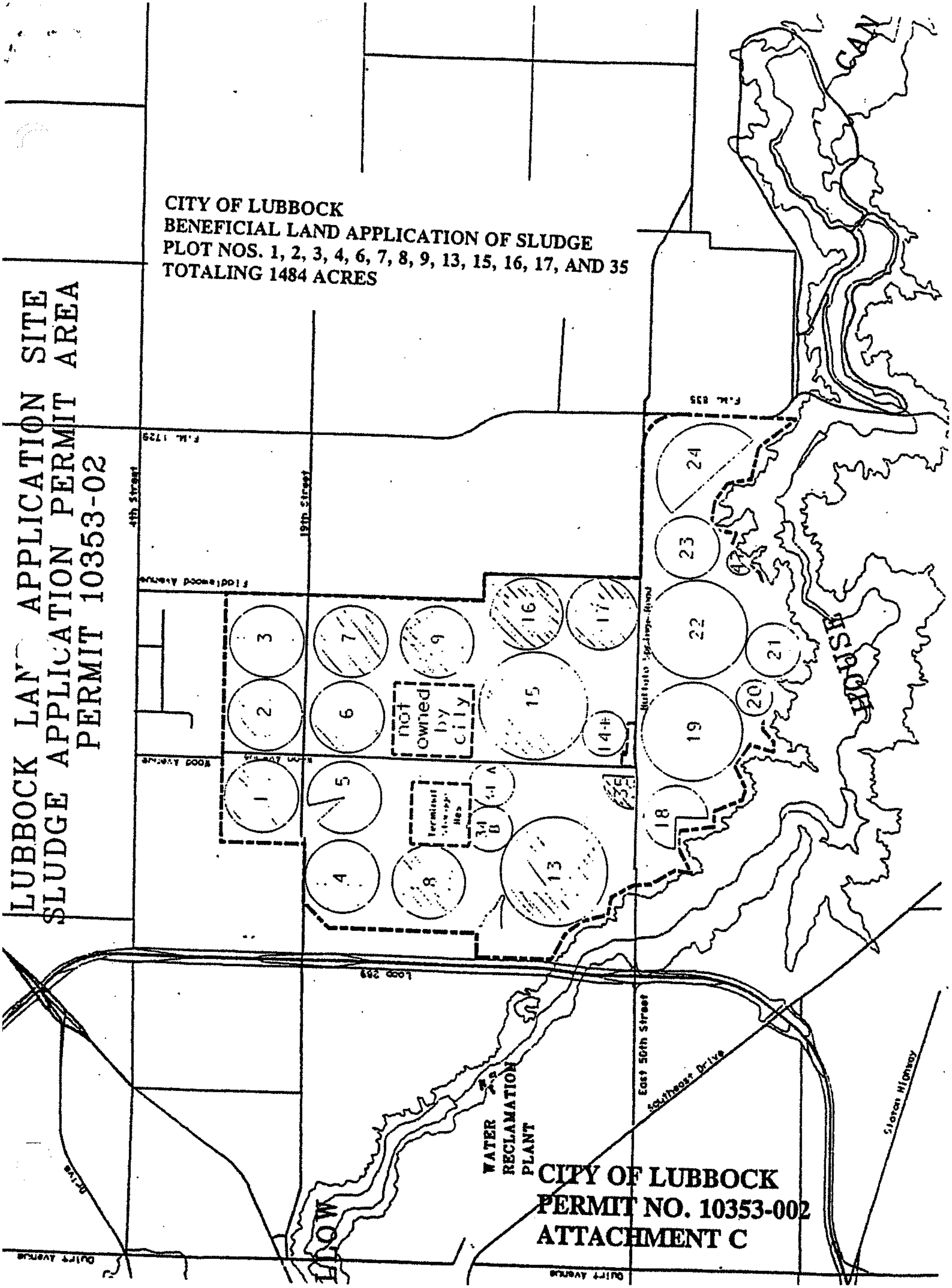


CITY OF LUBBOCK
BENEFICIAL LAND APPLICATION OF SLUDGE
PLOT NOS. 1, 2, 3, 4, 6, 7, 8, 9, 13, 15, 16, 17, AND 35
TOTALING 1484 ACRES

CITY OF LUBBOCK
PERMIT NO. 10353-002
ATTACHMENT C

LUBBOCK LAND APPLICATION SITE
SLUDGE APPLICATION PERMIT AREA
PERMIT 10353-02

CITY OF LUBBOCK
BENEFICIAL LAND APPLICATION OF SLUDGE
PLOT NOS. 1, 2, 3, 4, 6, 7, 8, 9, 13, 15, 16, 17, AND 35
TOTALING 1484 ACRES



CITY OF LUBBOCK
PERMIT NO. 10353-002
ATTACHMENT C

PARDUE & ASSOCIATES
ATTORNEYS & COUNSELORS AT LAW
16047 FONTAINE AVE.
AUSTIN, TX 78734
512-266-8135

KEITH A. PARDUE

MICHAEL A. GUEVARA

June 10, 2002

Via Hand Delivery

Texas Natural Resource Conservation Commission
Applications Processing Team
P.O. Box 13087
Austin, TX 78711-3087

Re: Permit No. 10353-002, City of Lubbock
Domestic Wastewater Permit Application

Dear Sir or Madam:

Please accept for processing one original and four copies of the above referenced amendment application submitted by the City of Lubbock.

Should you have any questions, please advise.

Sincerely,

Keith A. Pardue

Keith A. Pardue

Enclosure

cc: Ms. Mary Ann Airey

RECEIVED
JUN 10 2002
Water Quality Applications Team

Hand delivered
Rcvd SJD
3:45

FAX (512) 266-9266

PARDUE & ASSOCIATES
ATTORNEYS & COUNSELORS AT LAW
311 620 SOUTH, SUITE 103 • AUSTIN, TEXAS 78734
(512) 266-8135

KEITH A. PARDUE
BOARD CERTIFIED - ADMINISTRATIVE LAW
TEXAS BOARD OF LEGAL SPECIALIZATION

MICHAEL A. GUEVARA

December 10, 2002

VIA FACSIMILE: (512) 239-4430

Ms. Mary Ann Airey
Municipal Wastewater Permit Team (MC 148)
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Re: Consolidation of City of Lubbock Permit 10353-002 and Permit 13550-001

Dear Ms. Airey:

The City of Lubbock is requesting the consolidation and coordinated reviews of Texas Pollution Discharge Elimination System Permit No. 10353-002 and Wastewater Disposal Permit No. 13550-001 in accordance with 30 TAC §33.11. Permit No. 10353-002 authorizes the Southeast Water Reclamation Plant, the Lubbock Land Application Site, and the direct discharge in Lubbock County. Permit No. 13550-001 authorizes the Hancock Land Application Site in Wilson County. The application for Permit No. 13550-001 was submitted on December 5, 2000 and declared administratively complete on January 30, 2001. The application for Permit No. 10353-002 was submitted on June 10, 2002 and declared administratively complete on July 31, 2002. The Notice of Receipt of Application and Intent to Obtain Permit has been completed for both permit applications.

The City of Lubbock requests that published, posted and mailed notice be consolidated as allowed in 30 TAC §33.17 and 30 TAC §39.551. Lubbock also requests that, if necessary, one consolidated hearing be held for Permit No. 10353-002 and Permit No. 13550-001. *30 TAC §33.11.* If needed, we will be glad to meet with you regarding the consolidation of the permit review, notice and hearing.

In addition, Lubbock is requesting additional time to complete and submit the information requested by the TCEQ regarding the applications for Permit No. 10353-002 and Permit No. 13550-001. Because of the consolidation of the permits, Lubbock needs additional time to review the applications for consistency. Lubbock is requesting the current deadline of December 16, 2002 be extended beyond the upcoming holiday season to Wednesday, January 15, 2003.

Thank you for your consideration regarding this matter. If you have any question or need any further information, please do not hesitate to contact me at (512) 266-8135.

Sincerely,

Keith A. Pardue

Cc: Mr. Richard Casner
Mr. Terry Ellerbrook
Mr. Anthony Tatu

P.O. Box 2000
Lubbock, Texas 79457
(806) 775-2592 • Fax: (806) 775-3027

Water Utilities and
Solid Waste Management

January 14, 2003

RECEIVED
JAN 15 2003
MUNICIPAL PERMITS

FEDERAL EXPRESS 8369 6296 3553

Ms. Mary Ann Airey (MC 148)
Texas Commission on Environmental Quality
Water Quality Applications Team
Permits Administrative Review Section, Registration, Review & Reporting
Building F, Room 2101
12100 Park 35 Circle
Austin, TX 78753

Re: **Consolidation of City of Lubbock Permits 10353-002 and 13550-001**

Dear Ms. Airey,

In a letter dated December 10, 2002, the City of Lubbock requested the consolidation and coordinated reviews of Texas Pollution Discharge Elimination System Permit No. 10353-002 and Wastewater Disposal Permit No. 13550-001 in accordance with 30 TAC §33.11. Permit No. 10353-002 authorizes the Southeast Water Reclamation Plant, the Lubbock Land Application Site, and the direct discharge in Lubbock County. Permit No. 13550-001 authorizes the Hancock Land Application Site in Wilson County. The application for Permit No. 13550-001 was submitted on December 5, 2000 and declared administratively complete on January 30, 2001. The application for Permit No. 10353-002 was submitted on June 10, 2002 and declared administratively complete on July 31, 2002. The Notice of Receipt of Application and Intent to Obtain Permit has been completed for both permit applications.

The City has had an opportunity to review both permit applications for inconsistencies and offers the following changes. Enclosed you will find one original and four copies of the revised Cropping Plan, Growing Season and Harvesting Method report and Water Balance, Nitrogen Balance and Storage Volume Calculations. In addition to submitting these documents, the following changes need to be made to the permit application submittal.

1. All references to a maximum limit of 15 MGD sent to HLAS are now replaced with a range of 9.6 to 12 MGD sent to HLAS.

   LLAS Permit Application Reference: Domestic Administrative Report 1.0, Attachment 1, Page 2, Item 3.

   HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment 5, Item 1.

2. All references to effluent application rates and/or amounts are now replaced by the indications included in the *Water Balance, Nitrogen Balance and Storage Volume Calculations* document that is attached to this letter.

   LLAS Permit Application Reference: Domestic Worksheet 3.0 – Land Disposal of Effluent, Page 13, Number 2.

   HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Page C-2, Number 3.

3. All references to crops or plot acreage are now replaced by the indications included in the *Cropping Plan, Growing Season and Harvesting Method* document that is attached to this letter.

   LLAS Permit Application Reference: Domestic Worksheet 3.0 – Land Disposal of Effluent, Page 13, Number 2.

   HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment 5, Item 3.

4. All references to the LLAS reservoir surface area should be replaced with a surface area of 49 acres.

   LLAS Permit Application Reference: Domestic Worksheet 3.0 – Land Disposal of Effluent, Page 13, Number 3.5.

5. All references to the LLAS reservoir storage volume should be replaced with a storage volume of 400,530,837 gallons.

   LLAS Permit Application Reference: Domestic Worksheet 3.0 – Land Disposal of Effluent, Page 13, Number 3 and Domestic Administrative Report 1.0, Attachment 1, Page 5.

6. All references to the total HLAS reservoir capacity should be replaced with a total capacity of 778,738,906 gallons.

   HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment C, Page C-2, Number 4.

7. All references to the total HLAS surface area should be replaced with a total surface area of 173 acres.

   HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment C, Page C-2, Number 4.

8. All references to center pivot sprinkler irrigation efficiency should be replaced with an irrigation efficiency of 85%.

   HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment C, Page C-4, Number 8.

9. All references to furrow irrigation efficiency should be replaced with an irrigation efficiency of 70%.

   HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment C, Page C-4, Number 8.

10. All references to the capacity for HLAS reservoir 1 should be replaced with a capacity of 387,294,396 gallons.

    HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment 5, Item 3.

11. All references to the capacity for HLAS reservoir 2 should be replaced with a capacity of 196,259,829 gallons.

    HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment 5, Item 3.

12. All references to the capacity for HLAS reservoir 3 should be replaced with a capacity of 195,184,681 gallons.

    HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment 5, Item 3.

13. All references to the surface area for HLAS reservoir 1 should be replaced with a surface area of 85 acres.

    HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment 5, Item 4.

14. All references to the surface area for HLAS reservoir 2 should be replaced with a surface area of 47 acres.

    HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment 5, Item 4.

15. All references to the surface area for HLAS reservoir 3 should be replaced with a surface area of 41 acres.

    HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment 5, Item 4.

16. All references to HLAS Plot 21 as a subsurface irrigation plot should now indicate that this plot is planned to contain a center pivot.

    HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment 7 (Map) and January 20, 2001 letter, Attachment C & F.

17. All maps previously showing HLAS Plot 10 as a full-circle pivot should be replaced with the map in the *Cropping Plan, Growing Season, and Harvesting Method* section that shows HLAS Plot 10 as a half-circle pivot.

    HLAS Permit Application Reference: Domestic Wastewater Permit Application Technical Report, Attachment 7 (Map) and January 20, 2001 letter, Attachment F.

Finally, the City hereby incorporates by reference the following two reports by Agri-Waste Technologies, Inc. the first dated December 13, 2001 entitled "Recommendations for Utilizing Plots Containing Restricted Soils Types at the City of Lubbock's Land Application Site (LLAS)" and the second dated May 15, 2002 entitled "Sodium Adsorption Ratio Support Data for the City of Lubbock's Land Application Site (LLAS) and Hancock Land Application Site (HLAS)."

The City of Lubbock operates its land application sites with an absolute commitment to meet or exceed all conditions of its operating permits. We look forward to working with you and your staff on the consolidation of these permits. If you have any questions about the contents of this submittal or our operation in general, please do not hesitate to contact me at 806-775-2989.

Sincerely,
Sherry Stephens
Sherry Stephens, Water Programs Manager

Attachments

cc Mr. Terry Ellerbrook, Director of Public Works, cover only
Mr. Dan Dennison, Environmental Compliance, cover only
Ms. Jennifer Trombley, Environmental Compliance, cover only

Kathleen Hartnett White, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

October 6, 2005

Ms. Sherry Stephens
Water Programs Manager
P. O. Box 2000
Lubbock, Texas 79457-0001

Re: City of Lubbock - Proposed TPDES Permit WQ0010353002, (TX0106071)
Application to amend and combine TPDES Permit WQ0010353002 and TLAP Permit WQ0013550001 (CN600130736; RN103219325 for the LLAS; RN101609550 for WQ0013550001 and the HLAS)

Dear Ms. Stephens:

Enclosed for your review and comment is a copy of a draft proposed permit, fact sheet and statement of basis/technical summary for the above-referenced operation. This draft permit is subject to further staff review and modification; however, we believe it generally includes the terms and conditions that are appropriate to your discharge. **Please read the entire draft carefully as there may be changes from the existing permit and note the following:**

1. The draft permit will be issued to expire March 1, 2009 in accordance with 30 TAC Section 305.71, Basin Permitting.

2. The city's two permits are combined under the TPDES Permit No. WQ0010353002. In addition, the annual average flow of treated effluent for irrigation of the Lubbock Land Application Site or LLAS at Outfall 002 is reduced from 16.5 MGD to 14.5 MGD and the annual average flow of treated effluent for irrigation of the Hancock Land Application Site or HLAS at Outfall 003 is increased from 6.0 MGD to 12.0 MGD as requested by the city.

3. Monitoring requirements for conductivity and nitrogen were included in Outfall 003 for treated effluent for irrigation of the HLAS.

4. The surface areas and storage capacities of the LLAS and HLAS storage reservoirs as provided in the application were included in the draft permit in Other Requirement No. 7.

5. Other Requirement No. 12 was revised to include a description of the HLAS.

6. Other Requirement No. 13 was revised to authorize the city to irrigate plots with the Kimbrough soil series according to the report "Recommendations for Utilizing Plots Containing Restricted Soils Types at the City of Lubbock's Land Application Site (LLAS)."

P.O. Box 13087 • Austin, Texas 78711-3087 • 512/239-1000 • Internet address: www.tceq.state.tx.us

7. Other Requirement No. 14 which includes a maximum irrigation application rate of 4.8 acre-feet per year per acre irrigated was revised to indicate the city shall determine the appropriate irrigation application rates using the weekly water balance calculations which include the nutrient levels in the wastewater, the nutrient requirements of the crops, precipitation, evapotranspiration, irrigation efficiency and leaching requirements.

8. Other Requirement No. 15 was revised to include soil sampling requirements for both the LLAS and HLAS and authorize the city to manage sodic soils at the LLAS and HLAS according to the management plan described in the report "Soil Sodium Adsorption Ratio (SAR) Management Plan for the Lubbock Land Application Site and the Hancock Land Application Site" dated November 23, 2004. The SAR limit of 10 was removed from the draft permit.

9. Other Requirement No. 16 was included in the draft permit concerning grazing activities at the LLAS and HLAS and Other Requirement No. 18 was revised to include groundwater sampling requirements for both the LLAS and HLAS.

10. The application indicates that the permittee is requesting to continue authorization to land apply sludge for beneficial use on a portion of the LLAS irrigation area; however, the permittee did not submit the sewage sludge technical report and calculations to support the continuance of this request as required in the application forms. In addition, the city indicates that they do not intend to land apply sewage sludge during the next five-year term of the permit. It appears that this authorization is not needed by the city.

    Therefore, authorization to land apply sludge has not been included in the draft permit and the sludge provisions on page 12 and Section II of the existing permit have been revised to remove authorization to land apply sludge for beneficial use. In addition, the Maximum Sludge Application Rate and Site Life Calculations Table on pages 26 through 30 of the existing permit has been deleted from the draft permit. Also, Other Requirement No. 26 for soil sampling of the sludge land application area in the existing permit has been deleted from the proposed draft permit. Finally, Other Requirement No. 15 that includes a soil sampling frequency of twice per year for those plots where the city was authorized to land apply sludge has been revised to require annual soil sampling.

11. Effluent route descriptions provided by the city have been included in Other Requirement Nos. 3, 12 and 24. These descriptions detail the effluent route from the SEWRP to the LLAS, the HLAS, the Jones Power Plant, and Outfall OO1.

12. Please see the Fact Sheet, Sections G and H concerning minor changes from the existing permit that were requested by the city.

13. The Standard Permit Conditions, Sludge Provisions, Other Requirements, Contributing Industries and Pretreatment Requirements and Biomonitoring Requirements of the draft permit have been updated.

14. The draft permit includes a substantial modification to the approved pretreatment program.

Also enclosed for your review and comment is a copy of the draft second notice, the Notice of Application and Preliminary Decision, that was prepared for your application. Please review this notice and provide comments if there are any inaccuracies or any information that is not consistent with your application. Please do not publish the notice at this time; after the draft permit is filed with the Office of the Chief Clerk, you will receive instructions for publishing this notice in a newspaper from the Office of the Chief Clerk.

Please read the enclosed "Draft Permit Form" and submit your comments prior to the deadline that is indicated on the form. If your comments are not received by the deadline, the draft permit will be transferred to the Office of the Chief Clerk and comments received after this date will not be considered. Please see the enclosed form for further details.

If you have any comments or questions concerning the pretreatment program substantial modification, please contact Ms. Jill C. Russell of the Storm Water & Pretreatment Team at (512) 239-4564. If you have any other comments or questions, please contact me at (512) 239-4521, or if by correspondence, include MC 148 in the letterhead address following my name.

Sincerely,

Mary Ann Dimakos Airey

Mary Ann Dimakos Airey, P.E., Permit Coordinator
Municipal Permits Team
Wastewater Permitting Section (MC 148)
Water Quality Division
Texas Commission on Environmental Quality

Enclosures

cc: Ms. Mary Hinkley Gonzales, Wastewater Programs Coordinator, City of Lubbock
TCEQ Region 2
Mr. Gary Fogarty, Pretreatment Investigator, TCEQ Region 12 Office

CITY OF LUBBOCK

P.O. Box 2000
Lubbock, Texas 79457
(806) 775-2592 • Fax (806) 775-3027

Water Utilities Division

FEDERAL EXPRESS 8549 3524 4110

November 22, 2005

Ms. Mary Ann Airey, P.E., Permit Coordinator
Municipal Permits Team
Wastewater Permitting Section (MC 148)
Water Quality Division
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087

Re: City of Lubbock – Proposed TPDES Permit WQ0010353002, (TX0106071)
Application to amend and combine TPDES Permit WQ0010353002 and TLAP Permit WQ0013550001
(CN600130736; RN103219325 for the LLAS; RN101609550 for WQ0013550001 and the HLAS)
Comments on Draft Permit dated October 6, 2005

Dear Mary Ann,

The City of Lubbock has reviewed the draft permit dated October 6, 2005 and offers the following changes and comments to the Notice of Application and Preliminary Decision, the Fact Sheet and Executive Director's Preliminary Decision, and the Draft Permit. I want to thank you for your hard work and dedication to preparing this draft permit.

I. Notice of Application and Preliminary Decision

Other than the "*million gallons*" corrections we discussed in our phone conversation last week, we recommend no changes to the notice.

II. Fact Sheet and Executive Director's Preliminary Decision

Pages 7 and 9

Items C & G, first paragraph, respectively: The City of Lubbock does not intend to land apply sludge during the term of this permit.

Page 8

Item E.1.: As per our recent phone conversation, we understand that the effluent concentrations will remain unchanged.

Item E.2.(a): The draft permit also authorizes the use of *Ceriodaphnia dubia* as an option for acute 24-hour static toxicity testing.

Page 9

Item F, sixth paragraph: To make the language consistent with our approved sampling quality assurance plans, please reword this language to state

"The permittee shall obtain groundwater samples and water levels from the LLAS and the HLAS annually, during late winter months, according to the approved "Groundwater Sample Collection Quality Assurance Plan" and the "Groundwater Level Measurement Quality Assurance plan". In addition, semi-annual samples for nitrates will be

collected from the LLAS and the HLAS monitor wells in the middle of the summer according to the "Groundwater Sample Collection Quality Assurance Plan".

This language is consistent with the language proposed in our comments related to Other Requirement 18.

III. Draft Permit

Final Effluent Limitations and Monitoring Requirements

Page 2

Requirements 2 and 5: In our amendment application we requested a change in sampling methods for chlorine residual and dissolved oxygen from grab samples to chlorine residual meter (requirement 2) and dissolved oxygen meter (requirement 5), respectively. Since that request was made, we have determined that the grab sample is the preferred sampling method and are rescinding our previous request.

Pages 2a and 2b

Requirements 1, Conductivity: We request that the frequency and location of conductivity monitoring be change from daily to weekly and from the reservoirs to the wastewater treatment plant. Attachment 1 contains data demonstrating that there is not a significant change in conductivity from week to week nor between the plant and the reservoirs. If you need more data than has been provided, please let me know.

Page 2c

Requirement 5: We request a change in the language that represents the sampling methods used to serve SPS through the two pump stations. When discharging to SPS through EPS2, we use the length of the line for its 20-minute detention time and use a chlorine residual meter to monitor chlorine. When we discharge to SPS through EPS1 we have a chlorine contact chamber and we monitor chlorine using a grab sample.

Definitions and Standard Permit Conditions

Page 5

Requirement 3, last paragraph: Please change "*maybe*" to "*may be*".

Other Requirements

Page 23

Requirement 3, fourth paragraph: This requirement was included in our current permit because stream discharge was a contingent or emergency method of effluent disposal. Since May 2003, stream discharge has become one of three primary methods of disposing of effluent. As such, it is our opinion that this paragraph is no longer applicable and request that it be removed.

Page 24

Requirement 4: The City submitted a re-rating report dated July 26, 1999 to Mr. Louis Herrin for consideration during our last permit amendment process. This report recommended that the plant be re-rated from 26.0 million gallons daily to 31.5 million gallons daily. Our current permit recognizes our plant rating to be 31.5 million gallons daily. Since we are not requesting a change in this rating we request that this requirement be deleted.

Requirement 6, second paragraph: The City submitted a Nuisance Odor Prevention Request dated September 19, 2001 for consideration during our last permit amendment process. Since our current permit includes this variance we request that this requirement be deleted.

Requirement 7, first paragraph: Please delete reference to Plant B. This treatment process has not been referred to as Plant B for more than 10 years.

Second paragraph, first sentence: We request that the word "rerated" be changed to "rated" (see discussion under Page 24, Requirement 4).

Requirement 12, first paragraph, first sentence: Please change "*Land Application Site*" to the "*Lubbock Land Application Site*" and "*or*" to "*for*".

One of the HLAS effluent route descriptions was not included in the permit. Using the line to SPS, at the valve station we can either direct effluent to the stream (route description detailed in Other Requirement 3) or to the HLAS. Attachment 2 includes the effluent route descriptions provided to you by email on September 29, 2005. I've highlighted the missing route description.

Requirement 13, first paragraph, third sentence: Please change "*of*" to "*on*".

Requirement 16: Cattle grazing is just one of the harvesting methods available to us. Like any harvesting method, our success is in the appropriate implementation of the method, not in the method itself. It is our opinion that reference to one specific harvesting method, especially when referencing a particular report, limits our flexibility to plan and in some cases respond to issues that could occur on our site. In fact, the report referenced in the draft permit is in the process of being revised. To maintain our flexibility, we request that the draft language be replaced with more general language requiring that which ever harvesting method is utilized that it be done so in a manner that ensures that nitrogen loading does not exceed the ability of the crops to utilize the nitrogen.

Page 27

Requirement 15.d., last sentence: The name of the department to receive the soil sampling results is missing from the sentence.

Requirement 17: Please reword this language to state "*Any non-producing well not incorporated within the water level and sampling monitoring programs shall be plugged in accordance with 16 TAC Section 76.1004*".

Page 28

Requirement 18: To make the permit consistent with our approved sampling quality assurance plans, please reword this language to state:

"*The permittee shall obtain groundwater samples and water levels ~~samples~~ from the LLAS and the HLAS for the purpose of analyzing water quality and groundwater elevations.*

a. The permittee shall obtain groundwater samples and water levels from the LLAS and the HLAS annually, during late winter months, according to the approved "Groundwater Sample Collection Quality Assurance Plan" and the "Groundwater Level Measurement Quality Assurance Plan". The groundwater quality and water level measurements will be incorporated into an annual report.

b. Semi-annual samples for nitrate will be collected from the LLAS and the HLAS ~~monitor wells~~ in the middle of the summer according to the "Groundwater Sample Collection Quality Assurance Plan".

<u>Chronic Biomonitoring Requirements: Freshwater</u>

Page 29

Requirement 1.c.: As per our recent phone conversation, we understand that the effluent concentrations will remain unchanged.

Pages 36 and 45

Requirements 5.f., third paragraph, second sentence: To be consistent with recent boilerplate revisions that were recently negotiated with your agency and conform to your agency's Stream Standards Implementation Procedures (IPs), please insert the word "*persistent*" before the phrase "*significant lethality*".

24-Hour Acute Biomonitoring Requirements: Freshwater

Page 42

Requirement 3.c.: The draft permit does not include a DMR reporting code for *Ceriodaphnia dubia.*

Attachments

Attachment B, Site Drawing – SEWRP: Since we submitted this application in 2002, the City has annexed land southwest of the City. I have enclosed a revised map indicating the new city limits.

IV. Other Issues

While not an issue mentioned in the documents discussed above, you questioned whether the City was still considering subsurface irrigation as an irrigation method. This is to confirm that the City does not intend to utilize subsurface irrigation and that the use of subsurface irrigation was not a consideration in preparing the water balance calculations submitted with the permit amendment.

As always, I look forward to working with you and your staff to finalize this permit. In the meantime, please do not hesitate to contact me at 806-775-2989 with any questions or comments you have regarding our permit application or our operation in general.

Sincerely,

Sherry Stephens

Sherry Stephens
Chief Operating Officer

Attachment A – Conductivity Results Comparison
Attachment B – Effluent Route Descriptions
Revised Site Map to include new City Limits

cc Tom Adams, Deputy City Manager
Richard Casner, First Assistant City Attorney
Mary Gonzales, Water Reclamation Superintendent
John Hindman, Land Application Supervisor
JD Booker, Sampling and Monitoring Supervisor
File: Permit Amendment 10353-002 – June 2002

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Many Solutions℠

Memo

To:	Ches Carthel, P.E., City of Lubbock		
From:	Richard A. Shoemaker, P.E.	Project:	City of Lubbock Developed Water Permit
CC:	David D. Dunn, P.E.		
Date:	January 24, 2006	Job No:	34671

RE: Conceptual Design and Layout of Dams for Proposed Lakes 7 and 8

Geology

The proposed dam sites for Lakes 7 and 8 are located on the North Fork of the Double Mountain Fork of the Brazos River in a major geologic feature known as Yellow House Canyon southeast of Lubbock, Texas. The site for Lake 7 is located just above the upper end of existing Buffalo Springs Lake approximately 8 miles southeast of downtown Lubbock. The site for Lake 8 is approximately 8 miles further downstream, about 1 mile east of Slaton Road. The locations of the proposed dam sites and lakes are shown on Figure 1.

Yellow House Canyon has been carved deeply into sediments of Ogallala (Tertiary) age. A U-shaped valley was formed in the late Tertiary or early Pleistocene time by an ancestral river originating in the mountains of southeastern New Mexico prior to the development of the Pecos River. Many such canyons were cut into Ogallala sediments, but most of them were later filled with Pleistocene material. Palo Duro and Yellow House Canyons are major exceptions, where subsequent deposition did not take place.[1]

In general, the Ogallala is made up of lenses of permeable sands and fine gravels interbedded with light-colored to reddish, sandy silts and clays. It is capped with varying thicknesses of sandy, nodular limestone deposits, commonly referred to as Caliche. The formation is exposed in the canyon walls and road cuts, and the eroded surface of the formation occurs at very shallow depths in the bottom of the canyon. Site-specific geologic information was obtained using exploratory borings as part of the 1969 Freese, Nichols and Endress Report referenced herein.

A comprehensive description of the soil profile typical of Yellow House Canyon can be found in the Soil Survey of Lubbock County, Texas.[2] The soil profile at the proposed dam sites is identified as the Potter-Berda-Bippus unit. The definition of this unit, as given in the Soil Survey, is "Very shallow, shallow, and deep, nearly level to steep, moderately permeable loamy soils on uplands and bottom lands." Figure 2 has been reproduced from the Soil Survey to illustrate the surficial and geologic characteristics that are typical of the proposed dam sites. This three dimensional graphic provides a clear understanding of the composition of this soil profile. The Potter soil is the rock-like Caliche deposits of the parent Ogallala Formation. The Berda soil is Colluvium, which consists of Potter soil and rock that has been eroded by wind and water and moved down slope by gravity. This type of deposit is often referred to as "slope wash". Finally, the Bippus soil is Alluvium, which

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[1] Freese, Nichols and Endress Consulting Engineers, City of Lubbock, Texas, Feasibility Report on the Canyon Lakes Project, November 26, 1969.

[2] U.S. Dept. of Agriculture, Soil Conservation Service in cooperation with Texas Agricultural Experiment Station, Soil Survey of Lubbock County, Texas, Issued April 1979.

consists of Colluvium and Caliche deposits that have been transported down the canyon by the watercourse during flood events over time.

As the rocks and soils are transported down to and along the watercourse, they are eroded, ground down, and pulverized into smaller fragments. The rock-like Caliche deposits are fractured, weakly cemented, and not particularly sound. The forces of nature break them down relatively easily. The continual weathering, erosion and transport of the parent material acts as a natural sorting process for the soils. The coarser sands, fine gravel and rocks are found higher in the profile in the Potter material. The Berda material is a random and jumbled mixture of silts, sand of all sizes, gravel to a lesser extent, and rocks of varying size from occasional rock falls. The finer-grained soils, such as silts and clays, are found in the Bippus alluvial material along the watercourse. Clayey material is likely to be located in areas where the canyon floor is wide or where water pooled and sediment settled out after large floods.

Conceptual Dam Design

The availability of a wide-range of soils within Yellow House Canyon lends itself to the design of a zoned earthen embankment dam. A conceptual dam cross section, applicable to both dam sites, is shown in Figures 3 and 4. The dam would consist of five different material zones, including the upstream and downstream slope protection.

The primary barrier to seepage beneath and through the dam would be the Zone 1 impervious core. A cutoff trench would be excavated through the alluvial, colluvial and caliche soils to a sound, impervious foundation material. This trench would be backfilled with Zone 1 material. It is envisioned that the impervious core material would consist of lean clay and sandy clay obtained from selective excavations within the alluvial material along the creek.

The main upstream and downstream shells of the dam, Zone 2, would consist of a fairly random mixture of low plasticity to non-plastic silt, sand and gravel less than two inches in size. This material would be obtained from the extensive colluvial deposits in the canyon. The strength of these materials when suitably compacted is expected to make the proposed 3:1 upstream and 2.5:1 downstream slopes stable for all anticipated loading conditions.

A vertical "chimney" filter/drain, Zone 4, would be provided between the Zone 1 impervious core and the downstream Zone 2 shell to intercept and filter water that may seep through the dam over time. This filter/drain would consist of a clean sand material, which would most likely need to be imported from a commercial quarry that utilizes a washing process for its aggregate.

Typically the downstream slope of an earthen dam is protected from erosion using topsoil and a healthy stand of native grasses. However, the dry climate of this area makes such a solution impractical. Zone 3 in the dam would consist of clean, 3- to 6-inch rock that would be placed in a 15-foot wide zone along the downstream edge of the dam. It is envisioned that this material would be obtained from a simple screening process, wherein the oversize material would be used for Zone 3.

The final zone in the dam, Zone 5, would consist of soil cement to provide erosion protection from wave action on the upstream slope and a wearing surface for the top of the dam. The soil cement would be manufactured on-site by blending Portland cement with a fairly clean, pit-run source of sand and gravel material. The manufactured soil cement is then hauled, dumped, spread and compacted using conventional earth-moving equipment. A 2-foot thick layer of soil cement would be constructed using three separate and staggered 8-inch thick lifts placed like plating up and down the slope and along the dam crest. This material has been used in various locations on the City of Lubbock's John T. Montford Dam (Lake Alan Henry) and it has performed well.[3]

Conceptual Layout of Dam, Spillways, and Outlet Works System

Plan views of the dams and appurtenant structures at the proposed dam sites are provided in Figures 5 and 6. Facilities would be constructed to release water from the lakes and to safely pass floods through the dam site without overtopping the dam. It is anticipated that both dams will need to be designed to safely pass the probable maximum flood (PMF).

Two separate spillways would be utilized to pass flood events through the dam. An uncontrolled, morning-glory inlet would serve as the principal spillway to maintain the lake at the maximum normal pool elevation (permitted storage capacity). This inlet would connect to either a conduit or box tunnel constructed beneath the dam in the foundation material in the right (south) abutment at each dam site. The conduit or box tunnel would connect to a St. Anthony Falls type outlet structure to dissipate the flow energy and return the water to the creek.

A wide channel would be excavated around the end of each dam to serve as a secondary spillway for passing large flood events up to the PMF. Material excavated to create the spillway channel would be used in construction of the dam. At dam site 7, a natural saddle exists in the topography beyond the south end of the dam. As shown in Figure 5, this feature would be utilized to form the secondary spillway. Soil cement would also be used to provide erosion protection in areas of the channel and downstream of the spillway where flow may become concentrated and accelerate erosion. At dam site 8, the spillway channel would be excavated into the north abutment of the dam as shown in Figure 6.

An outlet works system would be constructed to provide low flow releases from the lake or to drain the lake should that become necessary. This system would have three major components: (1) a freestanding concrete intake tower; (2) a 48-inch diameter conduit beneath the dam; and (3) an impact-type outlet structure. The intake tower would contain hand-operated sluice gates at three different levels to make releases from the lake. The proposed location for this system is shown in the conceptual layout for each dam.

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[3] HDR Engineering, Inc., City of Lubbock, Texas, John T. Montford Dam (Lake Alan Henry) Inspection Report, August 2005.

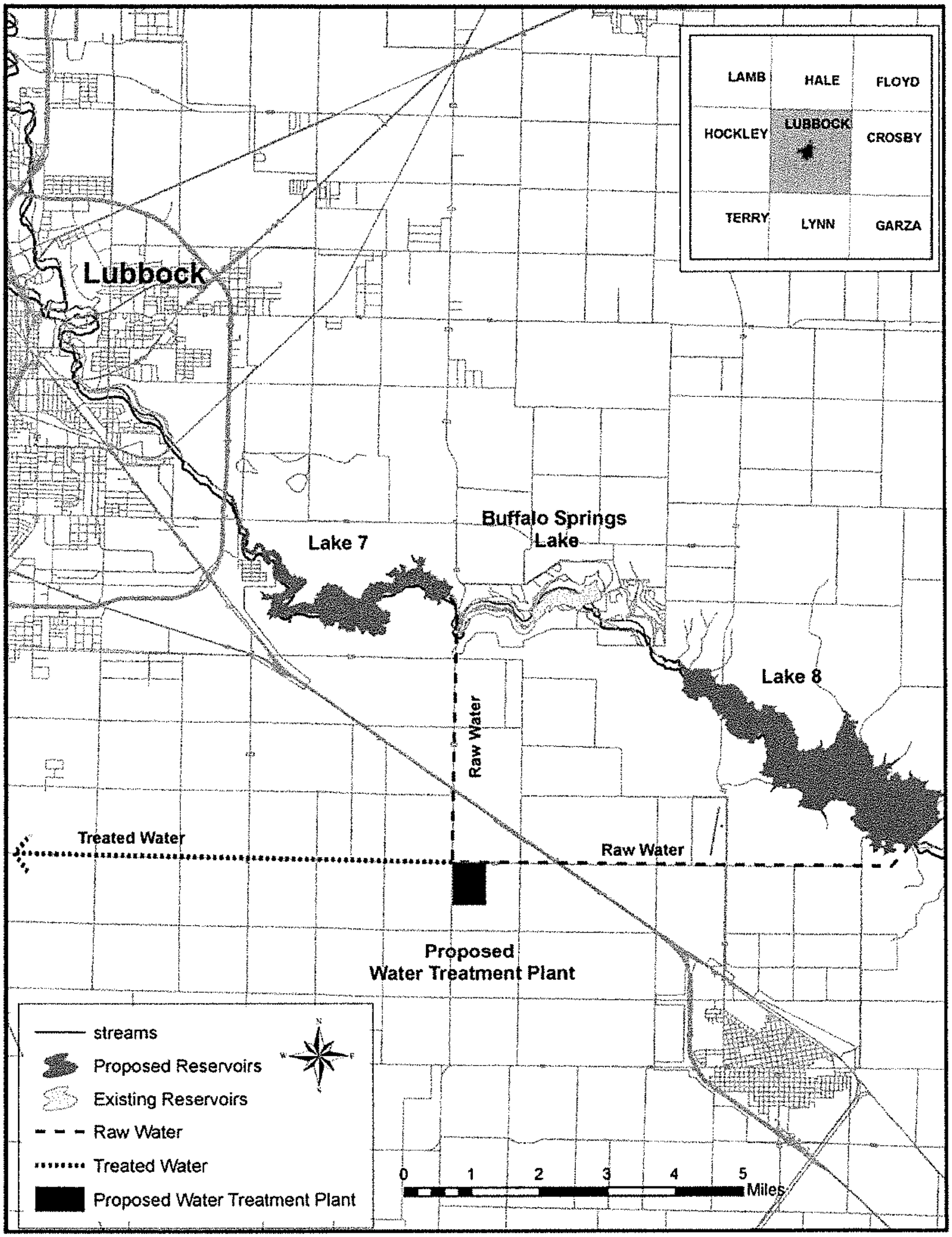


Figure 1. Project Location

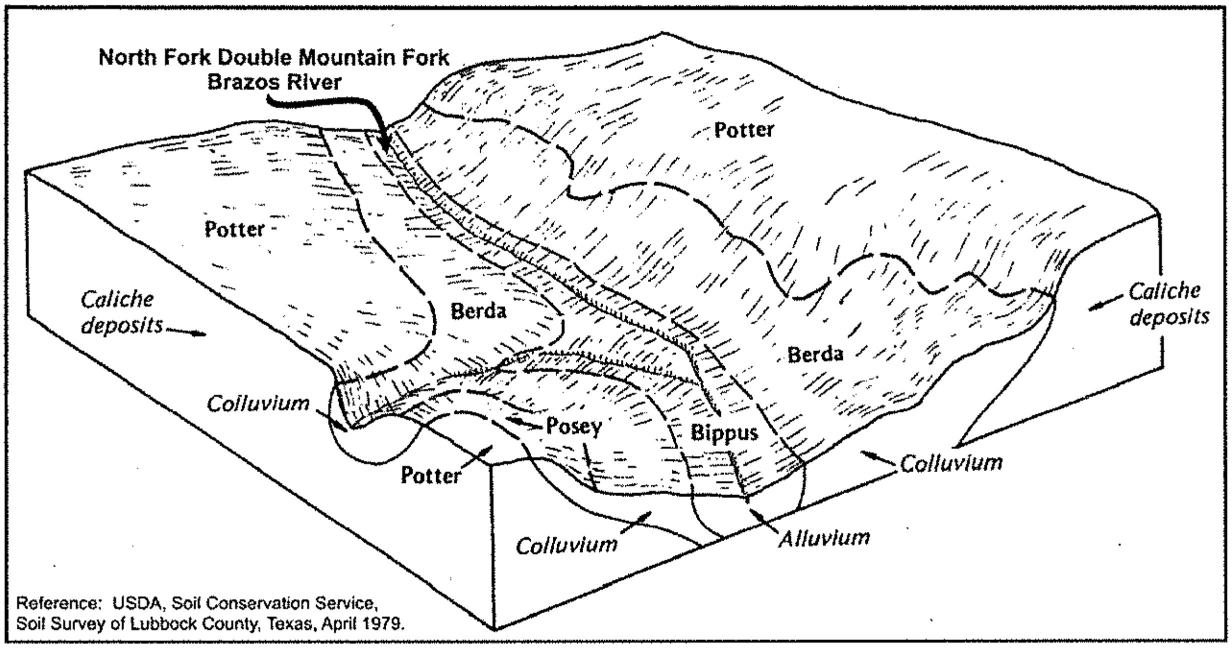
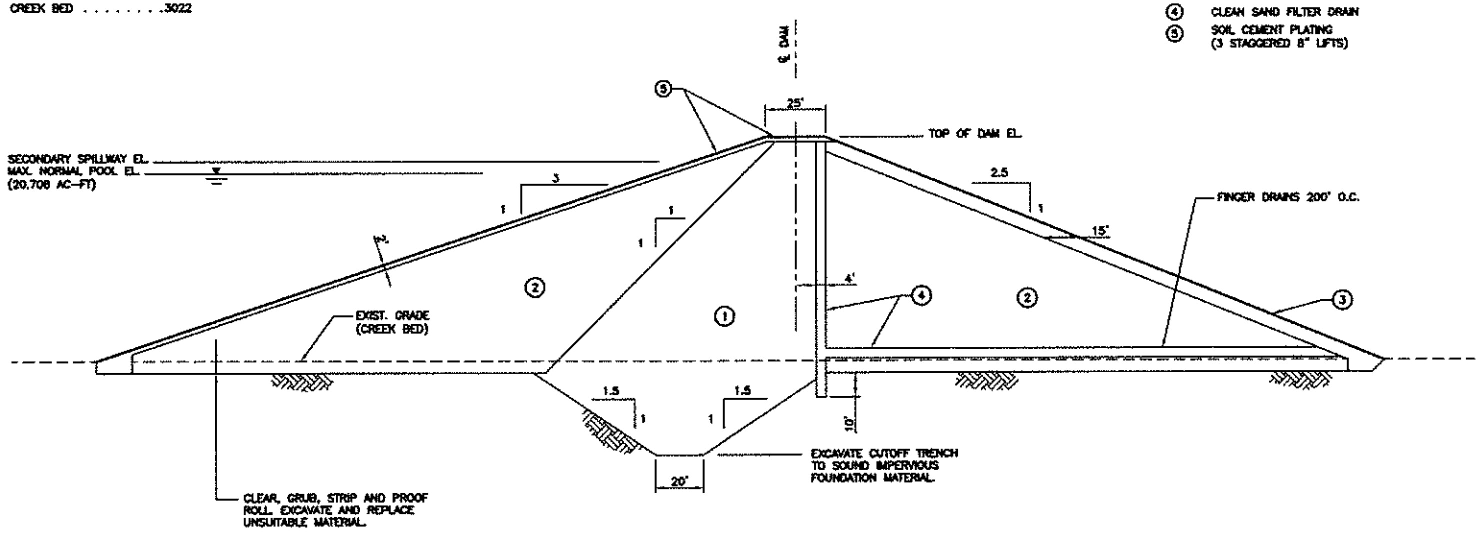


Figure 2. Soil Profile — Yellow House Canyon Southeastern Lubbock County, Texas

ELEVATIONS (FT-MSL)

TOP OF DAM	3115
SECONDARY SPILLWAY	3105
MAX. NORMAL POOL	3100
CREEK BED	3022

ZONE	MATERIAL DESCRIPTION
①	IMPERVIOUS CORE (CL, SC)
②	2" MINUS LOW/NO PI FILL
③	3" – 6" CLEAN ROCK SLOPE ARMOR
④	CLEAN SAND FILTER DRAIN
⑤	SOIL CEMENT PLATING (3 STAGGERED 8" LIFTS)



CONCEPTUAL DAM CROSS SECTION – DAM 7

SCALE: 1" = 50'

HDR
HDR Engineering, Inc.

CITY OF LUBBOCK
JIM BERTRAM LAKE SYSTEM

FIGURE 3. DAM 7 CONCEPTUAL DESIGN

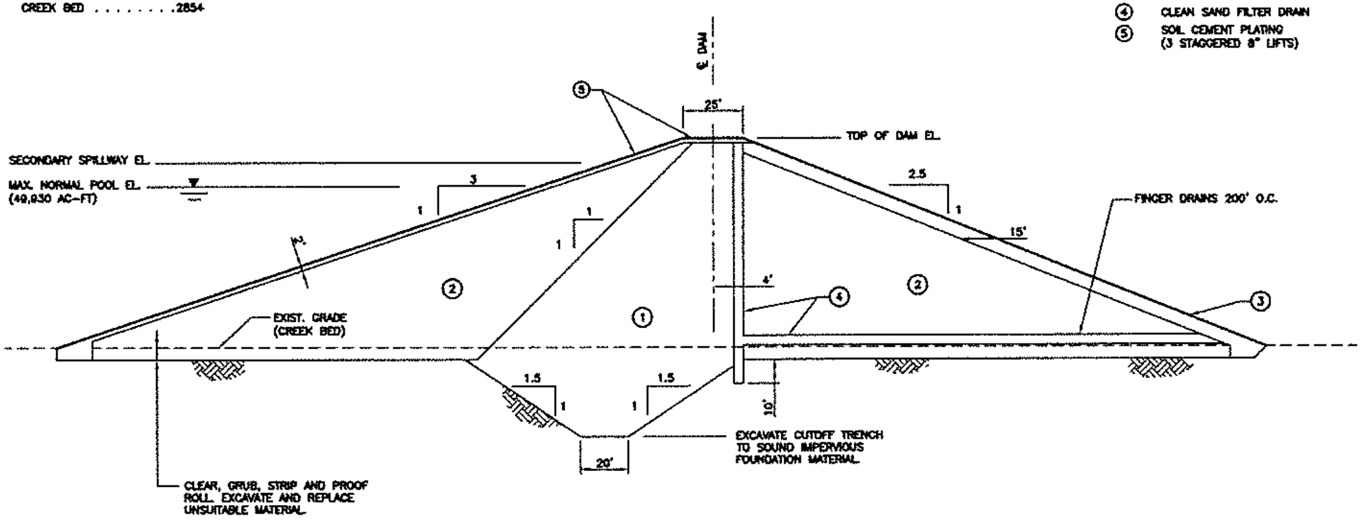
Date
01-24-2006

P:\00034671-Canyon-Lakes-Reservoir\PROP-DAM-SECTION.DWG, 1/24/2006 2:22:02 PM, JAbed

ELEVATIONS (FT-MSL)

TOP OF DAM	.2941
SECONDARY SPILLWAY. . .	.2931
MAX. NORMAL POOL . . .	.2921
CREEK BED	.2854

ZONE	MATERIAL DESCRIPTION
①	IMPERVIOUS CORE (CL, SC)
②	2" MINUS LOW/NO PI FILL
③	3" – 6" CLEAN ROCK SLOPE ARMOR
④	CLEAN SAND FILTER DRAIN
⑤	SOIL CEMENT PLATING (3 STAGGERED 8" LIFTS)



CONCEPTUAL DAM CROSS SECTION – DAM 8
SCALE: 1" = 50'

HDR
HDR Engineering, Inc.

CITY OF LUBBOCK
JIM BERTRAM LAKE SYSTEM

FIGURE 4. DAM 8 CONCEPTUAL DESIGN

Date
01-24-2006

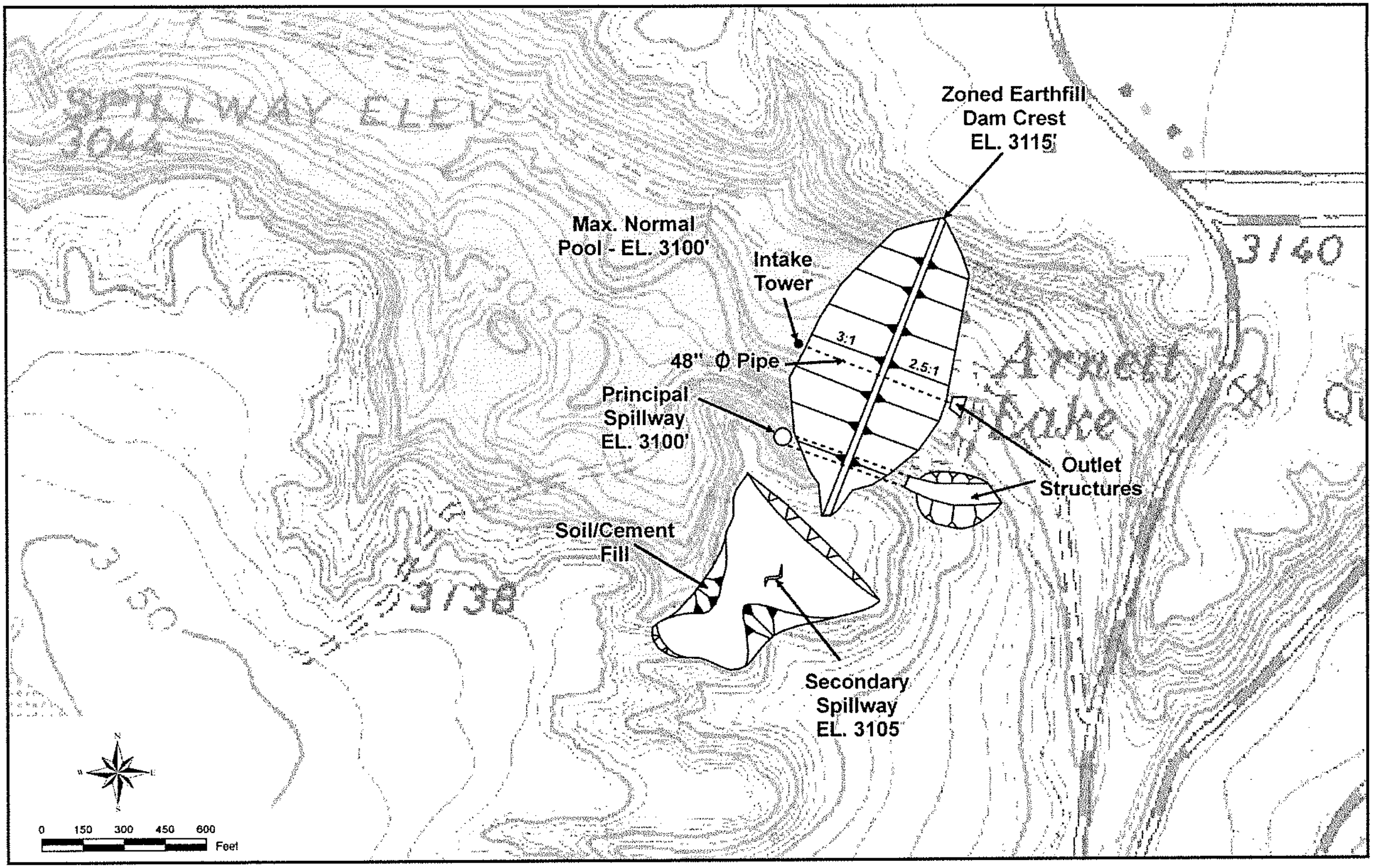


Figure 5. Conceptual Design Layout — Dam 7

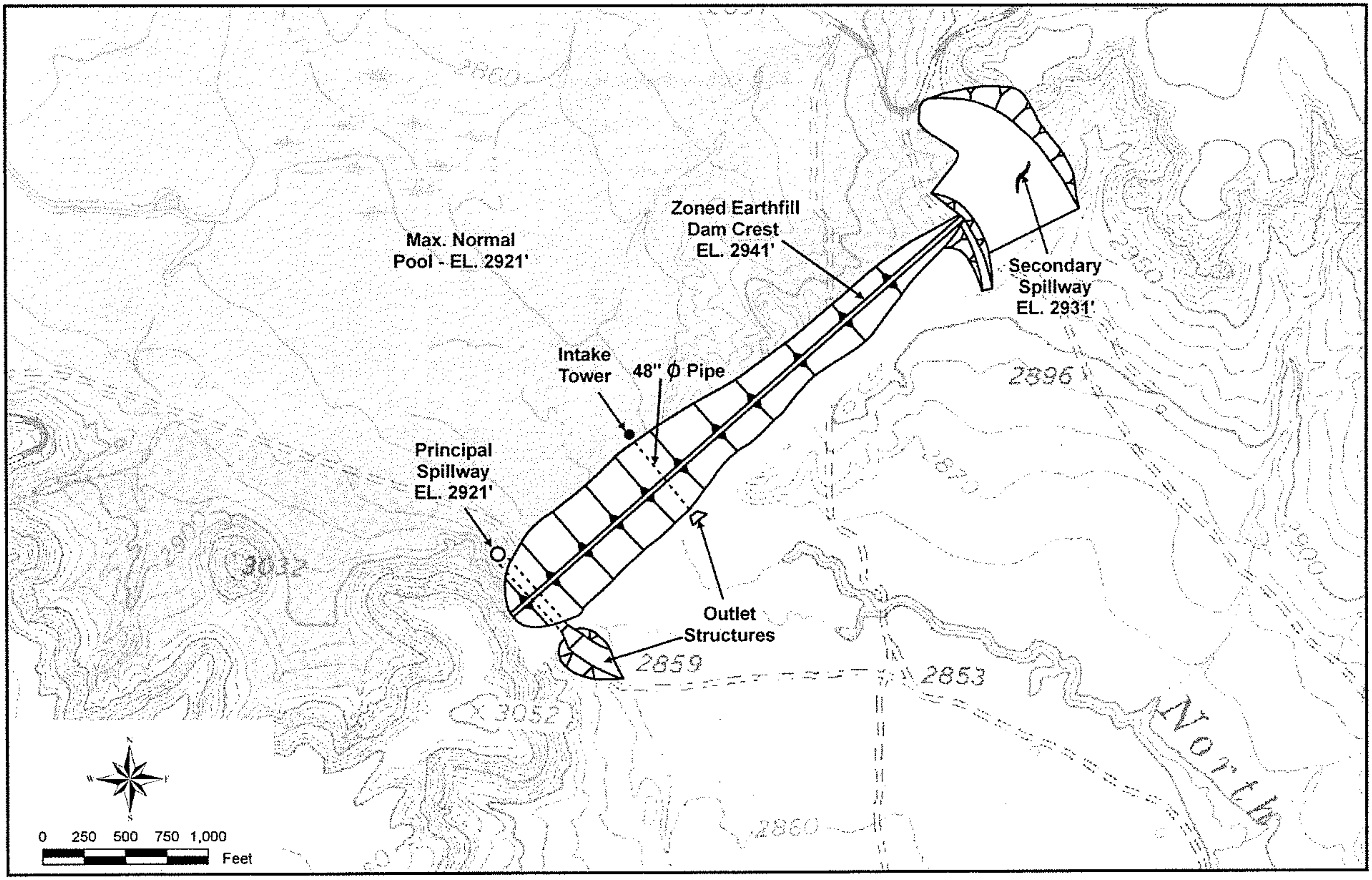


Figure 6. Conceptual Design Layout — Dam 8

4.4.3.7 Lubbock Jim Bertram Lake System (JBLS) Expansion

4.4.3.7.1 Description of Option[11]

This planning strategy would allow use of Lubbock's "developed water resources," including storm water collected within the City of Lubbock and transferred and discharged into the Yellowhouse Canyon, groundwater from the Lubbock Land Application Site, and treated wastewater (source of treated wastewater is groundwater and water from CRMWA) discharged into Yellowhouse Canyon. To achieve this, Lakes 7 and/or 8 from the Canyon Lakes System (now called the Jim Bertram Lake System) would be built to capture, store, and divert water (Figure 4.4-6). This water would be treated at a new water treatment facility located southeast of Lubbock. At some point in the future, water from Lake Alan Henry would also be treated at the same facility. This water would be transported to the south and southwest areas of Lubbock's service area. Key components of this system are:

• Lake 7:	Storage Capacity:	20,700 AF
	Pump station & pipeline capacity:	4.65 MGD
	Pipeline length:	21,200 feet
	Pipeline diameter:	36 inches
• Lake 8:	Storage Capacity:	49,900 AF
	Pump station & pipeline capacity:	26.7 MGD
	Pipeline length:	37,000 feet
	Pipeline diameter:	90 inches
• Water Treatment Plant:	Capacity:	21 MGD (initially)
• Transmission main:	Length:	79,200 feet
	Diameter:	66 inches

4.4.3.7.2 Quantity of Water Available

Water potentially available for impoundment in the proposed Lake 7 and Lake 8 was estimated using Run 3 of the Brazos River Basin Water Availability Model (Brazos WAM) developed by the Texas Commission on Environmental Quality (TCEQ)[12]. The model utilizes a timeframe from January 1940 through December 1997 hydrologic period

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[11] "Lubbock, Texas; Feasibility Report on the Canyon Lakes Project," Freese, Nichols and Endress, Fort Worth, Texas, 1969.

[12] HDR Engineering, Inc., "Water Availability in the Brazos River Basin and San Jacinto-Brazos Coastal Basin," Texas Natural Resource Conservation Commission (now TCEQ), December 1991.

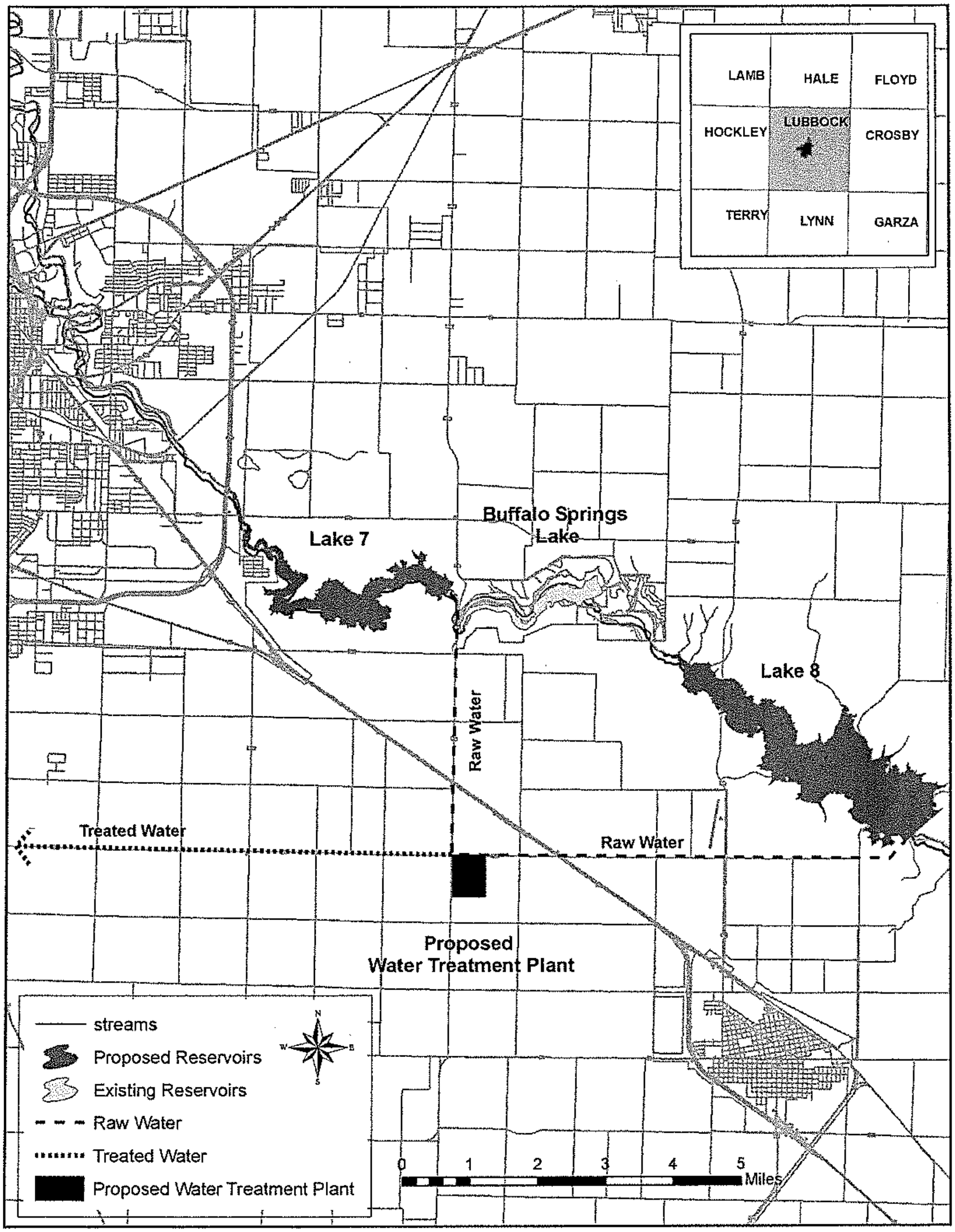


Figure 4.4-6. Lubbock Jim Bertram Lake System (JBLS) Expansion

of record to estimate water available to existing and potential water rights. The model assumes that existing perpetual water rights are fully utilized, reservoir storage capacity is as originally permitted, and wastewater treatment plant effluent is fully reused (zero return flows). The City of Lubbock has estimated that 22.9 million gallons per day (MGD) of effluent will be available in the future that can be dedicated to developing water supply from the reservoirs. These return flows are in excess of the 9 MGD for which the City has recently applied to the TCEQ for reuse authorization. The 22.9 MGD (25,648 acft/yr) of return flows were input into the Brazos WAM and used in conjunction with available unappropriated flows to develop firm yield estimates for Lakes 7 and 8. Other sources of developed water were not considered in the analysis, but could be used to augment firm supplies and also provide interruptible supplies in excess of the firm yield estimates presented herein.

Available unappropriated streamflows was determined by the Brazos WAM without causing increased shortages to existing downstream rights. Firm yield was computed subject to the reservoirs having to pass natural inflows to meet Consensus Criteria for Environmental Flow Needs (CCEFN) instream flow requirements. The streamflow statistics used to determine the Consensus Criteria pass-through requirements for the reservoirs are shown in Table 4.4-55. Only natural unappropriated flows were subjected to the CCEFN requirements; the return flows were not.

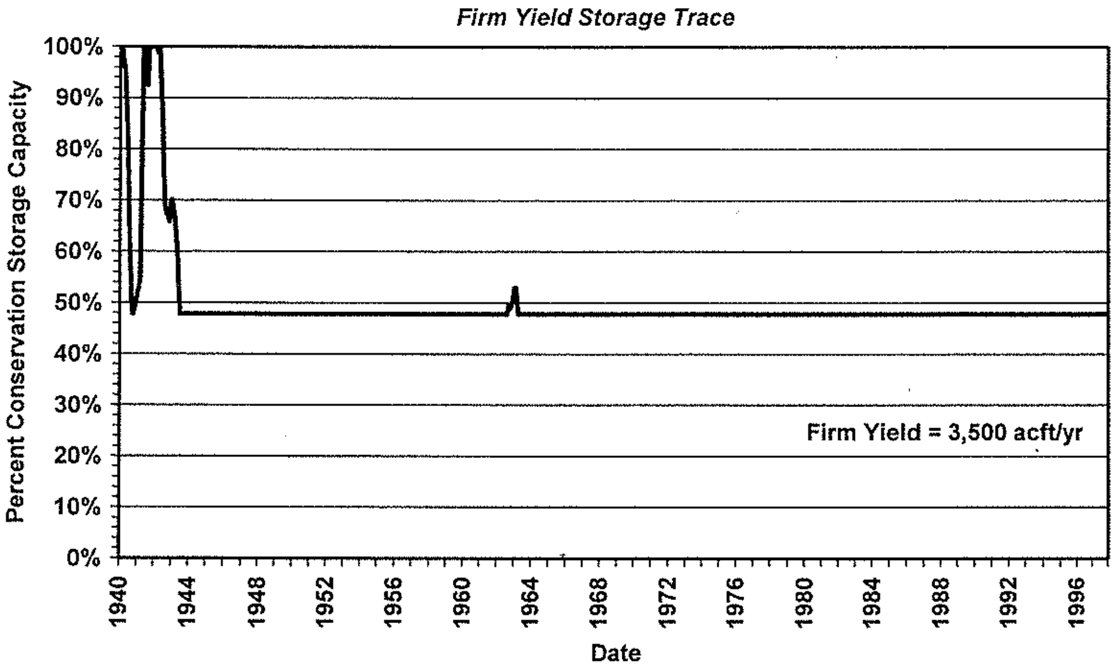
The firm yield of the system was calculated by establishing a firm yield for Lake 7 of 3,500 acft/yr, then operating Lake 8 such that at least 10,000 acft of storage would be maintained in Lake 7. Note that releases from Lake 7 would be passed through Buffalo Springs Lake in order to reach Lake 8. The resulting firm yield of Lake 8 was estimated to be 17,720 acft/yr, for a total combined system yield of 21,200 acft/yr.

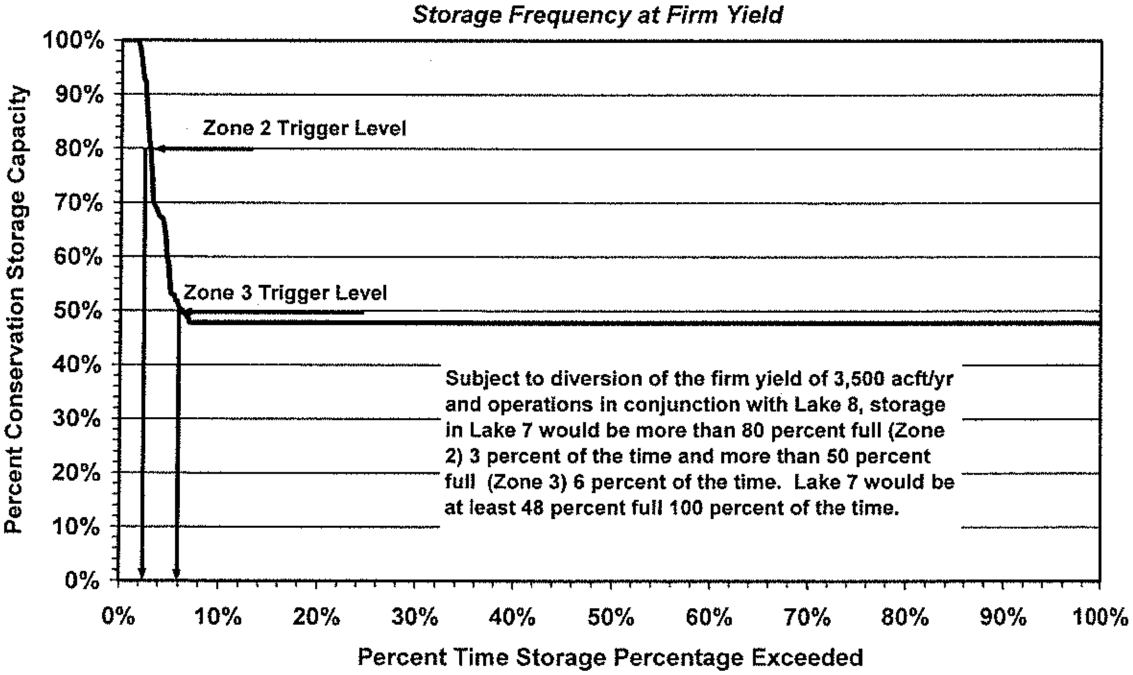
Figure 4.4-7 illustrates the simulated Lake 7 and Lake 8 storage levels for the 1940 to 1997 historical period, subject to the firm yield of 17,720 acft/yr for Lake 8 with annual diversions from Lake 7 of 3,500 acft/yr.

Figure 4.4-8 illustrates the changes in streamflows of the North Fork Double Mountain Fork of the Brazos River caused by impounding the unappropriated waters of the Brazos River. There are no significant changes in streamflows at Lake 8. At Lake 7, however, releases of impounded return flows to Lake 8 would increase streamflows between Lake 7 and Lake 8 over natural conditions.

Table 4.4-55.
Daily Natural Streamflow Statistics
Lubbock Jim Bertram Lake System (JBLS) Expansion
Llano Estacado Water Planning Region

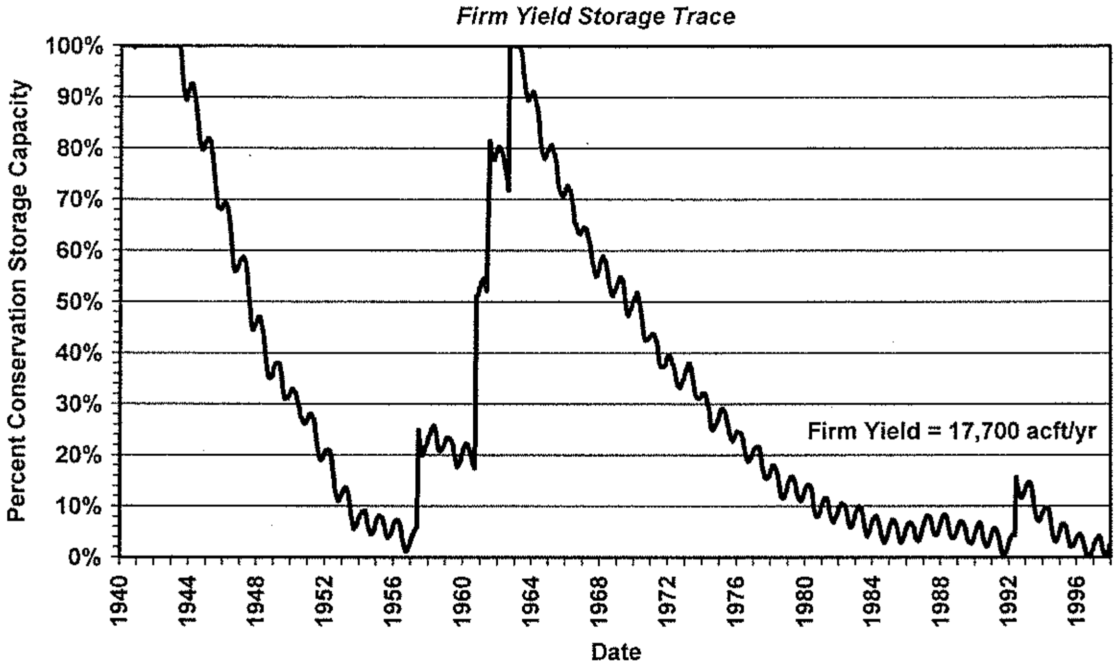
Month	*Median Flows – Zone 1 Pass-Through Requirements (cfs)*	*25th Percentile Flows – Zone 2 Pass-Through Requirements (cfs)*
	Lake 7	
January	0.2	0.0
February	0.2	0.0
March	0.1	0.0
April	0.2	0.0
May	3.4	0.1
June	5.1	0.5
July	1.5	0.0
August	0.6	0.0
September	1.3	0.0
October	0.9	0.0
November	0.6	0.0
December	0.4	0.0
Zone 3 (7Q2) Pass-Through Requirement (cfs):		0
	Lake 8	
January	0.3	0.0
February	0.3	0.0
March	0.1	0.0
April	0.3	0.0
May	3.8	0.1
June	5.7	0.5
July	1.7	0.0
August	0.7	0.0
September	1.5	0.0
October	1.0	0.0
November	0.7	0.0
December	0.4	0.0
Zone 3 (7Q2) Pass-Through Requirement (cfs):		0

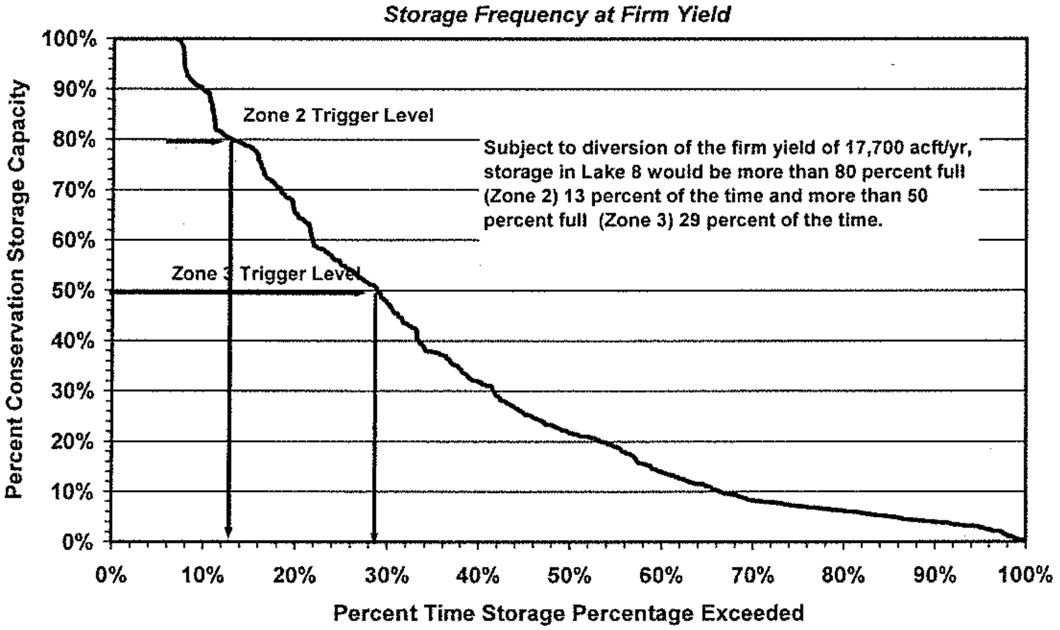




Subject to diversion of the firm yield of 3,500 acft/yr and operations in conjunction with Lake 8, storage in Lake 7 would be more than 80 percent full (Zone 2) 3 percent of the time and more than 50 percent full (Zone 3) 6 percent of the time. Lake 7 would be at least 48 percent full 100 percent of the time.

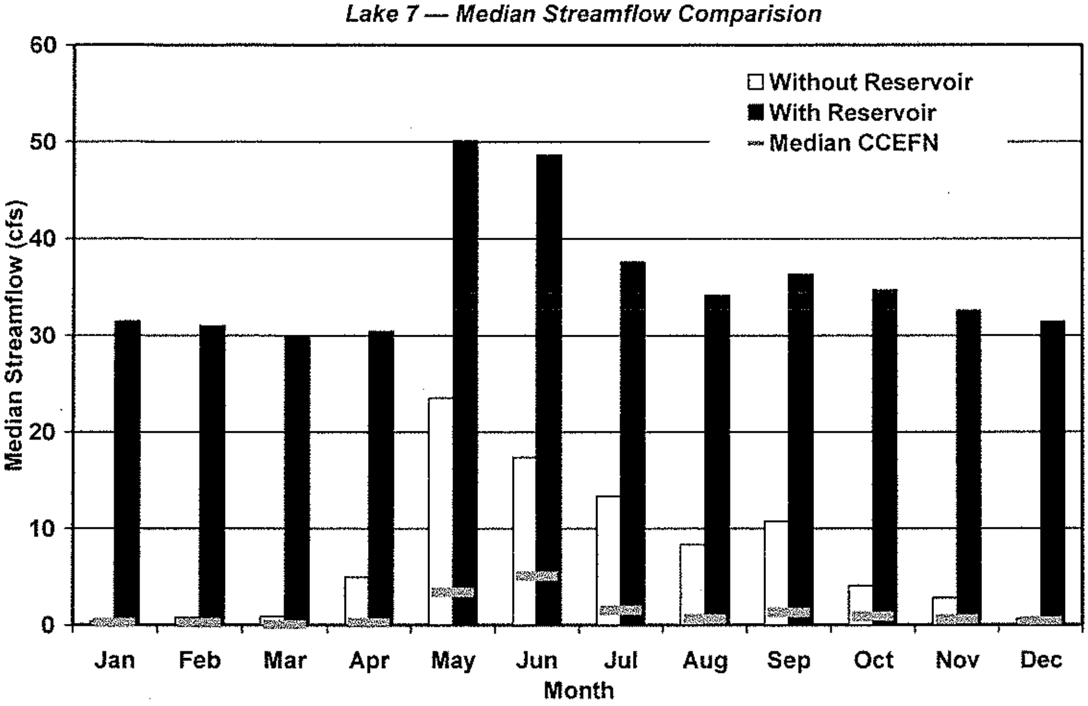
Figure 4.4-7A. Jim Bertram Lake System (JBLS) Expansion Reservoir Storage Considerations – Lake 7





Subject to diversion of the firm yield of 17,700 acft/yr, storage in Lake 8 would be more than 80 percent full (Zone 2) 13 percent of the time and more than 50 percent full (Zone 3) 29 percent of the time.

Figure 4.4-7B. Jim Bertram Lake System (JBLS) Expansion Reservoir Storage Considerations – Lake 8



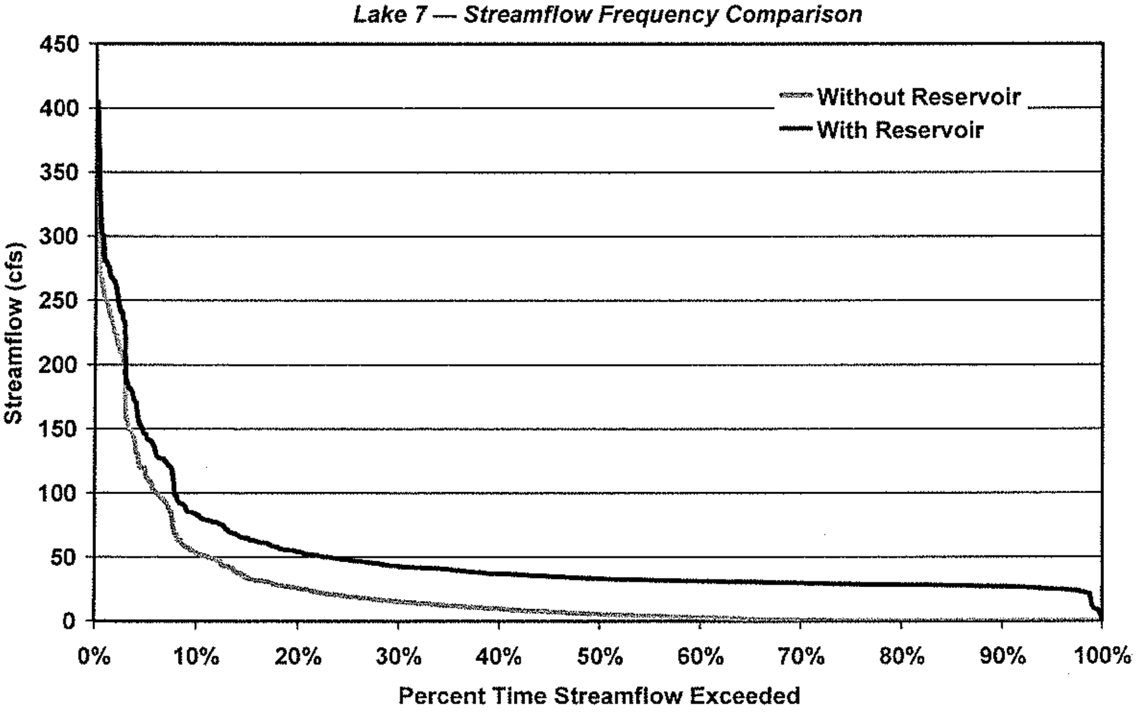
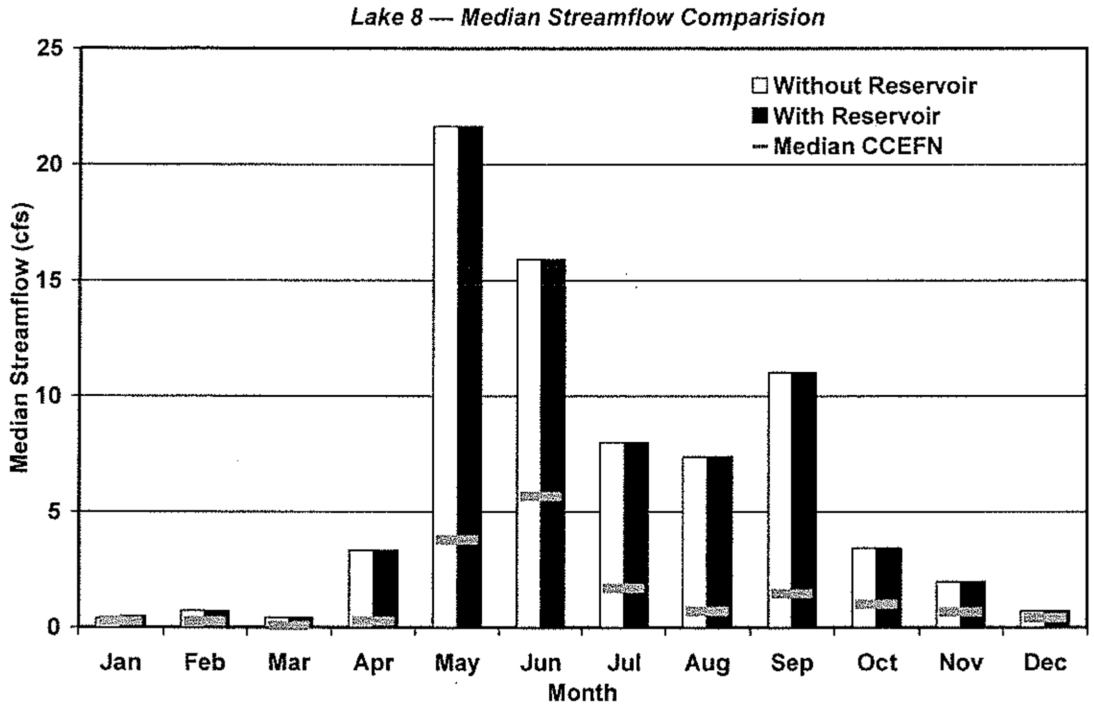


Figure 4.4-8A. Jim Bertram Lake System (JBLS) Expansion Streamflow Comparisons – Below Lake 7



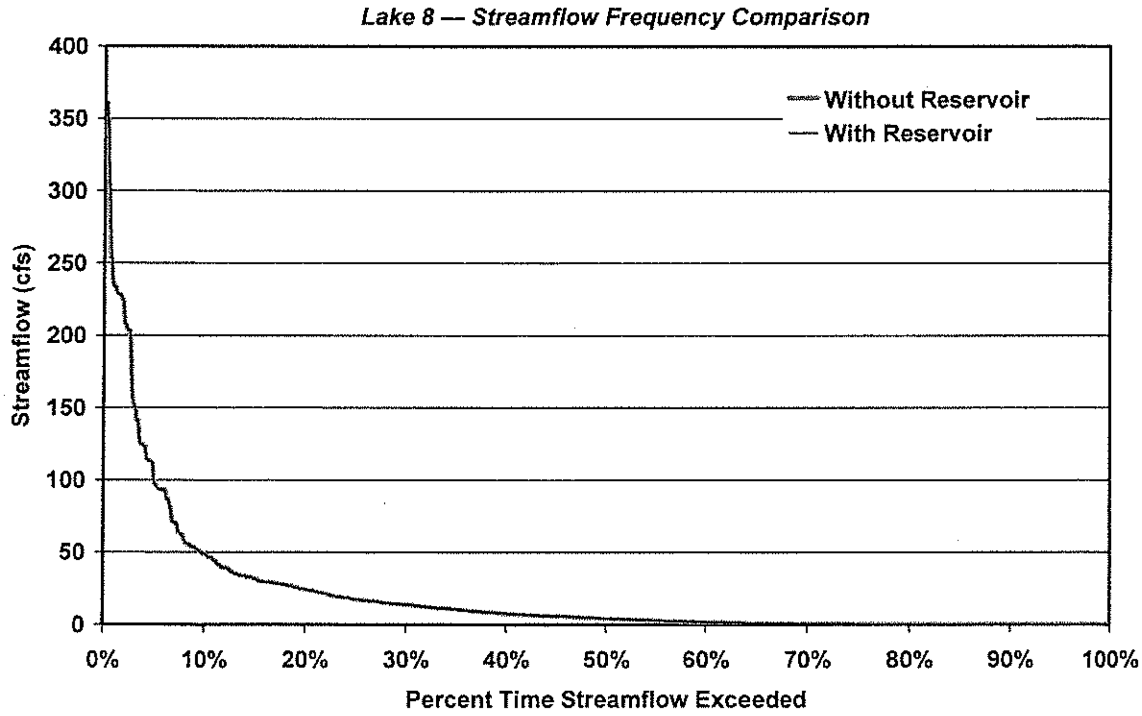


Figure 4.4-8B. Jim Bertram Lake System (JBLS) Expansion Streamflow Comparisons – Below Lake 8

4.4.3.7.3 Environmental and Cultural Resource Issues

The City of Lubbock Storm Water and Reclaimed Water System Project involves the construction of two reservoirs along an approximately 14.5-mile reach of the North Double Mountain Fork of the Brazos River, raw water intake structures and their associated water transmission lines. The proposed lake sites, designated as Lake 7 and Lake 8 are located in Lubbock County southeast of the City of Lubbock within the Western High Plains ecoregion,[13] in the High Plains vegetational area of Texas,[14] and in the Kansan biotic province.[15] The High Plains Region is a nearly level treeless plain with a relatively even surface. It is dominated by native grasses, the major species including buffalo grass *(Buchloe dactyloides)*, blue grama (*Bouteloua gracilis*), and sideoats grama (*Bouteloua curtipendula*). Annual and perennial forbs, legumes and woody species such as beargrass and cholla cactus occasionally invade this grassland region. In zones with loamy soils, honey mesquite *(Prosopis glandulosa)* and yucca have invaded large areas. The prevalent landuse within the proposed Lake 7 project area is mixed rangeland (52%)[16], with additional areas of nonforested wetlands (19%), gravel pits (15%), confined feeding operations (10%), and minor amounts of cropland or pasture. It is unlikely that the area designated as nonforested wetlands has a large amount of wetland areas; however the presence and location of actual wetland areas potentially affected by reservoir construction would have to be determined by a site survey. In addition, a small portion of this proposed lake area is currently an existing reservoir (5%). The Lake 8 project area is divided between nonforested wetland areas (65%), and mixed rangeland (35%). Based upon a review of information available, the dominant vegetation type within the area of both Lake 7 and Lake 8 is considered to be Mesquite-Lotebush-Brush, with the exception of approximately 24% of the southeastern portion of Lake 8 which is identified as juniper.[17]

Within the proposed lake sites, the General Soil Map for Lubbock County shows Potter-Berda-Bippus soils. These soils, found on bottomlands and uplands, and can be very shallow, shallow, or deep, and are located on nearly level to steep slopes. Two of these soil types are

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[13] Omernik, James M., "Ecoregions of the Conterminous United States," Annals of the Association of American Geographers, 77(1), pp. 118-125, 1986.

[14] Gould, F.W., "The Grasses of Texas," Texas A&M University Press, Texas Agricultural Experiment Station, College Station, Texas, 1962.

[15] Blair, W.F., "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117, 1950.

[16] U. S. Geological Survey, 1990. Reston, Virginia

[17] The Vegetation Types of Texas. Texas Parks and Wildlife

found on gently sloping to steep slopes, and include Potter soils which are found on uplands and Berda soils which are generally found on foot slopes. Slopes of areas containing these soils are generally found to be 1 to 45 percent. Bippus soils are found on nearly level areas on frequently flooded bottom lands. These soils areas have very little slope, generally less than one percent. The surface layer for all of these soils is composed of a friable, alkaline loam which differs in depth within each soil type from 5 to 30 inches. Rangeland is the most common landuse occurring within areas of Bippus soils. Cultivated crops are not generally grown in this area due to the steep slopes, and the potential for water erosion and flooding.

There are six existing, smaller impoundments along the North Double Mountain Fork of the Brazos River in the upper reaches of the canyon above the proposed Lake 7 location, and two larger lakes, Buffalo Springs Lake and Lake Ransom Canyon above Lake 8 but downstream of Lake 7. The North Double Mountain Fork of the Brazos River (Segment 1241A) is considered perennial from its confluence with the Double Mountain Fork to the dam impounding Lake Ransom Canyon. The water is typically high in dissolved solids, with segment standards for chloride and sulfate of 2500 mg/L and 2400 mg/L, respectively. This segment is on the Draft 2004 303(d) list for excessive bacterial concentrations, and is listed in the Statewide Water Quality Inventory (305b list) for concerns over algal growth and nitrogen concentrations. Although the current data listing on the Brazos River Authority web site indicates that the segment meets the average screening criterion for Fecal Coliforms of 200 MPN/100 ml, 23% of the samples collected exceeded the single grab criterion of 400 MPN/100 ml. Additional study will be required to confirm this result before a TMDL is scheduled. There are no Ecologically Significant River and Stream Segments within the project area.[18]

The major sources for these water bodies include streamflow from natural rainfall, which is generally infrequent and irregular in this area, future return flows, releases of cooling water from a municipal power plant, springs associated with the irrigation of adjoining farm lands by effluent from the main Lubbock Sewer Treatment Plant, and runoff from the city's storm sewer system. The principal function of the proposed Lakes 7 and 8 will be to store and reuse reclaimed water and storm water, and to provide additional recreation opportunities. The upper six small impoundments presently form the core of a municipal park which stretches for approximately 8 miles through the southeast quadrant of the city.

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[18] Texas Parks and Wildlife, Water Resources Branch, 2005.

Health concerns for the two proposed lakes include bacteria from discharged water and pollution from storm runoff. Storm runoff, particularly from urban areas, will likely be a source of coliform bacteria, oxygen demanding materials, nutrients and other materials (e.g., oil and grease, metals, household chemicals) potentially affecting water quality. However, this condition is common in streams and their impoundments receiving urban runoff, and has proved a serious problem in limited cases. Water quality and aquatic life conditions in the existing reservoir system are the best predictors of conditions most likely to develop in the proposed Lakes 7 and 8.

Plant and animal species listed by USFWS, and TPWD, as endangered or threatened with potential habitat in Lubbock County are listed in Table 4.4-56. There are two species listed as endangered by the State of Texas found within Lubbock County, the Whooping Crane (*Gus Americana*), and Black-footed Ferret (*Mustela nigripes*). In addition there are three threatened species which are state-listed within the county, the Arctic Peregrine Falcon (*Falco peregrinus tundrius*), Bald Eagle (*Haliaeetus leucocephalus*), and Texas horned lizard (*Phrynosoma cornutum*).

The Whooping Crane, Arctic Peregrine Falcon and Bald Eagle are potential migrants to Lubbock County which may use habitats in the area during migration. A survey of the lake sites may be required to determine whether populations of or potential habitats used by listed species occur in the area to be affected. The Black-footed Ferret is generally found in areas occupied by prairie dogs, usually dry, flat short grasslands including land overgrazed by cattle and the Texas Horned Lizard generally prefers open, arid areas with sparse vegetation. Either of these two species might be found within the mixed rangeland areas of the project.

There are two fish species found in the Brazos River Basin which are candidates for Federal Listing, the sharpnose shiner (*Notropis oxyrhynchus*), and the smalleye shiner (*Notropis buccula*). Both of these species require fairly shallow water in broad, open sandy channels with moderate current. Neither of these shiner species is listed as occurring within Lubbock County.

The primary impacts that would result from construction and operation of the proposed lakes would include conversion of existing habitats and land uses within the conservation pool to open water, and potential downstream effects due to modification of the existing flow regime. Figure 4.4-7A (Lake 7 Storage) shows that operation of the proposed Lake 7 near its 50% capacity elevation more than 90% of the time will result in the permanent inundation of

Table 4.4-56.
Potentially Occurring Species that are Rare or Federal-and State-Listed at the Lubbock Jim Bertram Lake System (JBLS) Expansion Llano Estacado Water Planning Region

Birds	*Federal Status*	*State Status*
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	T
Baird's Sparrow (Ammodramus bairdii) – shortgrass prairie with scattered low bushes and matted vegetation.		
Bald Eagle (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds.	LT-PDL	T
Ferruginous Hawk (Buteo regalis) – open country, primarily prairies, plains, and badlands; nests in tall trees along streams or on steep slopes, cliff ledges, river-cut banks, hillsides, power line towers.		
Lesser Prairie Chicken (Tympanuchus pallidicinctus) – arid grasslands, generally interspersed with shrubs and dwarf trees; nests in a scrape lined with grasses.	C1	
Mountain Plover (*Charadrius montanus*) – breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Snowy Plover (Charadrius alexandrinus) – formerly an uncommon breeder in the Panhandle; potential migrant		
Western Burrowing Owl (*Athene cunicularia hypugaea*) - open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows and man-made structures, such as culvert.		
Whooping Crane *(Grus americana*) - potential migrant; winters in and around Aransas National Wildlife Refuge and migrates to Canada for breeding; only remaining natural breeding population of this species.	LE	E
Mammals		
Black-footed Ferret (Mustela nigripes) – considered extirpated in Texas; potential inhabitant of any prairie dog towns in the general area.	LE	E
Black-tailed Prairie Dog (Cynomys ludovicianus) – dry, flat, short grasslands with low, relatively sparse vegetation, including areas overgrazed by cattle; live in large family groups.		
Cave Myotis Bat (Myotis velifer) – roosts colonially in caves, rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Petrochelidon pyrrhonots)* nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum caves of Panhandle during winter; opportunistic insectivore.		
Plains Spotted Skunk (Spilogale putorius interrupta) – catholic in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie.		
Swift Fox (Vulpes velox) – restricted to current and historic shortgrass prairie; western and northern portions of Panhandle.		
Reptiles		
Texas Horned Lizard (Phrynosoma cornutum) – open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September.		T
Status Key: DL-De-Listed, PDL-Proposed De-Listed, LE, LT-Federally Listed Endangered/Threatened, PE, PT-Federally Proposed Endangered/Threatened, E/SA, T/SA-Federally Listed Endangered/Threatened by Similarity of Appearance, C1-Federal Candidate for Listing, E,T-State Listed Endangered/Threatened, "blank"-Rare, but with no regulatory listing status.		
June 2005, Annotated County Lists of Rare Species maintained by TPWD, Austin, Texas.		

514 acres of brush – invaded grassland habitat and its conversion to a lacustrine environment in which an aquatic community will develop. Excursions above 50% capacity will be rare and relatively brief, and would be expected to result in little change in the terrestrial habitat now present in the zone between the 50 and 100% capacity elevations. On-site surveys will be required to document existing habitat values and determine the necessity and scope of mitigation for significant losses.

The storage trace for Lake 8 (Figure 4.4-7B) indicates that this larger impoundment will experience water surface elevations exceeding the 50% capacity level more frequently (22%), but diversion of the system yield from this impoundment will result in a more gradual dewatering regime than in Lake 7, and Lake 8 will experience periodic drawdowns to elevations below 10% capacity. The mosaic of grassland and thorny shrublands within the footrprint of Lake 8 will experience decreasing frequencies and durations of inundation at successively higher capacity elevations. At the 8% capacity elevation, about 351 acres will be inundated permanently, while the median water surface elevation for the simulation period, which corresponds to the 30% capacity level, indicates that the lower 889 acres will be under water half or more the time and the upper 829 acres will be inundated half or less of the time. While annual grasses and forbs will rapidly recolonize formerly inundated areas, perennial grass and shrub populations will recover more slowly. With respect to aquatic communities, frequent changes in reservoir surface elevation may be detrimental to shallow-water nesting species, which include the recreationally and economically important sunfish and bass, particularly when these changes occur during the spring and summer seasons when these fish are reproducing.

Operation of the reservoir system will result in an increase in the volume and constancy of streamflow in the North Fork reach between the Lake 7 dam and the Buffalo Springs Lake backwater, and between Buffalo Springs Lake and the Lake 8 backwater, presumably enhancing lotic habitats in those areas (Figure 4.4-8A). These reaches will vary in length depending on the contents of Buffalo Springs Lake and Lake 8. Below Lake 8, the North Fork will experience no change in streamflow at and below existing median monthly flow levels, but reductions in flood flows will occur as the reservoir system captures these infrequent events. Potential changes in channel morphology, and consequent habitat changes below the Lake 8 dam, will reflect the extent that reductions in the frequency of "bankfull" events result from system operation. Although large floods can result in severe scour and extensive redoposition of stream sediments, the events that maintain a stream's typical channel width, characteristic distribution of sediment particles, riffle-pool ratios and nature of streamside vegetation typically recurr at 1 to 2 year intervals.[19] Reduction in the frequency of these events can result in channel narrowing, siltation of large particle substrate areas and encroachment of vegetation into the channel. Reductions in flood flows and stabilization of flow levels in arid areas with water containing high levels of dissolved solids can result in channel encroachment by salt cedar (*Tamarix* spp), which has been a problem significantly affecting both lotic and riparian habitats where it has occurred (e.g., in the Pecos River above Red Bluff Reservoir).

Federal and state laws such as Section 106 of the National Historic Preservation Act and the Antiquities Code of Texas require that impacts to cultural resources be considered. To address impacts these laws outline a consultation process that may involve the State Historic Preservation Officer (SHPO), Native American Tribes, the Advisory Council on Historic Preservation, and other interested parties. The consultation process is usually initiated by gathering information regarding cultural resources located within project area and presenting it to the SHPO for an effect determination. Based on the information available the SHPO makes a determination as to whether the properties affected are eligible for listing on the National Register of Historic Places (NRHP) or for formal designation as a State Archeological Landmark (SAL). If the SHPO feels that more information is needed in order to evaluate eligibility, they may request additional information such as archival research, or archeological field investigations. If the SHPO determines that there is "no effect" to properties eligible for listing on the NRHP or for formal designation as an SAL, the consultation process ends and project activities may proceed. On the other hand, if it is determined that eligible properties will be affected, then mitigation of the effects will likely be required. Mitigation may include additional archeological investigations, archival research, or avoidance and protection.

Available information regarding know cultural resources was gathered from the Texas Archeological Research Laboratory in Austin. Examination of their map files identified 14 recorded archeological sites within the footprint and park boundary of Lake 7 and three within the footprint and park boundary of Lake 8 (see Table 4.4-57).

Sites 41LU9 through 41LU23 have no eligibility recommendations. However sites 41LU132 and 41LU48 were recommended for listing on the NRHP. Site 41LU49 was not recommended for the NRHP.

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[19] Allan, J. D. 1995. Stream Ecology. Chapman & Hall, New York.

As there is no evidence of any systematic archeological investigations being conducted for the lake areas, it is likely that the Texas Historical Commission and the U.S. Army Corps of Engineers will require an intensive archeological survey of the dam sites, the maximum flood pool area, and the proposed park areas of both lakes. This information will be required in order to begin the Section 106 and Antiquities Code consultation with these agencies.

Table 4.4-57.
Archeological sites on record for Lake 7 and Lake 8

Lake 7	Site Description	Lake 8	Site Description
41LU9	Prehistoric camp	41LU21	Prehistoric camp
41LU10	Prehistoric camp	41LU22	Prehistoric camp
41LU11	Prehistoric camp	41LU23	Prehistoric camp
41LU12	Prehistoric camp		
41LU13	Prehistoric camp		
41LU14	Prehistoric camp		
41LU15	Prehistoric camp		
41LU16	Prehistoric camp		
41LU17	Prehistoric camp		
41LU18	Prehistoric camp		
41LU19	Prehistoric camp		
41LU132	Prehistoric camp		
41LU48	Stone wall		
41LU49	Prehistoric lithic scatter		

4.4.3.7.4 Engineering and Costing

Costs for this option include the following:

- Land and right-of-way for Lakes 7 and 8, and pipelines and water treatment plant site;
- Construction of dams for Lakes 7 and 8;
- Pump stations and pipelines;
- Environmental impact assessments and archeological studies and recovery, and mitigation, if needed;
- State and federal permit acquisition;
- Engineering, legal, and contingency costs, at 30 percent of the construction costs for pipelines and 35 percent for other facilities; and
- Interest during construction calculated at 6 percent interest rate, and a 4 percent annual rate of return.

The total project cost for this option was estimated at $150,759,000 (Table 4.4-58). Annual operation and maintenance costs, including energy, are estimated at $3,808,000, with the total annual cost, including debt service, operation and maintenance, and power cost, totaling $14,575,000 (Table 4.4-58). For an annual quantity of 21,200 acft/yr of treated water ready for delivery to customers, the cost is $696 per acft, or $2.13 per 1,000 gallons (Table 4.4-58). To the extent that interruptible water and other firm developed water are available, the unit costs of water would be lowered.

4.4.3.7.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 4.4-59, and the option meets each criterion.

The implementation of this option to supply additional water to the City of Lubbock depends upon acquisition of the necessary permits, including water rights and those required for construction, as well as other issues as summarized below:

Potential Regulatory Requirements:

- Texas Commission on Environmental Quality Water Right and Storage permits;
- U.S. Army Corps of Engineers Permits will be required for discharges of dredge or fill into wetlands and waters of the U.S. for dam construction, and other activities (Section 404 of the Clean Water Act);
- Texas Commission on Environmental Quality administered Texas Pollutant Discharge Elimination System Storm Water Pollution Prevention Plan;
- General Land Office Easement if State-owned land or water is involved; and
- Texas Parks and Wildlife Department Sand, Shell, Gravel and Marl permit if state-owned streambed is involved.

State and Federal Permits may require the following studies and plans:

- Environmental impact or assessment studies;
- Wildlife habitat mitigation plan that may require acquisition and management of additional land;
- Flow releases downstream to maintain aquatic ecosystems;
- Assessment of impacts on Federal- and State-listed endangered and threatened species; and
- Cultural resources studies to determine resources impacts and appropriate mitigation plan that may include cultural resource recovery and cataloging; requires coordination with the Texas Historical Commission.

Land Acquisition Issues:

- Land acquired for reservoir and/or mitigation plans could include market transactions and/or eminent domain;
- Additional acquisition of rights-of-way and/or easements may be required; and
- Possible relocations or removal of residences, utilities, roads, or other structures.

Environmental Information Document
in Support of Water Use Permit Application No. 5921
Prepared in Response to
TCEQ RFI Dated 12/01/05

Prepared for:

CITY OF LUBBOCK

Prepared by:

HDR | ONE COMPANY
Many Solutions℠

January 2006

Section 1
Introduction

This Environmental Information Document was developed to support Water Use Permit Application No. 5921 by the City of Lubbock to construct a Storm Water and Reclaimed Water System Project. **Specifically, this document is intended to address questions 7, 8 and 10 of the Request for Information (RFI) received from the Texas Commission on Environmental Quality (TCEQ), dated December 1, 2005.**

The proposed project involves construction of two impoundments (Lakes 7 and 8) on the North Fork of the Double Mountain Fork of the Brazos River (North Fork) to capture and store treated wastewater, stormwater discharges, and other developed-water sources, and unappropriated run of river water for subsequent use.

1.1 Project Location

Construction of Dams for Lakes 7 and 8 will impound an approximately 14.5-mile reach of the North Fork located immediately up- and downstream of an existing, large impoundment, Buffalo Springs Lake (Figure 1-1). The proposed locations for the dams (at the centerline of the North Fork channel) are 33° 29' 33.27" N, 101° 37' 23.75" W for Lake 7 and 33° 32' 4.42" N, 101° 43' 47.67" W for Lake 8. Lake 7 is located on the Buffalo Springs and Lubbock East 7.5 Minute Quadrangle Maps. Lake 8 is located on the Slaton NE and Buffalo Springs 7.5 Minute Quadrangle Maps.

1.2 Purpose and Need for the Project

The principal function of the proposed Lakes 7 and 8 will be to store developed water in the form of reclaimed wastewater and storm water, and available unappropriated flows for subsequent use. Although the six small impoundments already constructed upstream of the proposed reservoir locations form the core of a municipal park which stretches for approximately eight miles through the southeast quadrant of the City of Lubbock, no recreational use if planned for these two reservoirs. The major water sources for the proposed impoundments include unappropriated streamflows, which are generally infrequent and irregular in this area, wastewater return flows, releases of cooling water from a municipal power plant, seepage associated with the irrigation of adjoining farm lands by effluent from the main Lubbock Sewer Treatment Plant, and runoff from the city's storm sewer system.

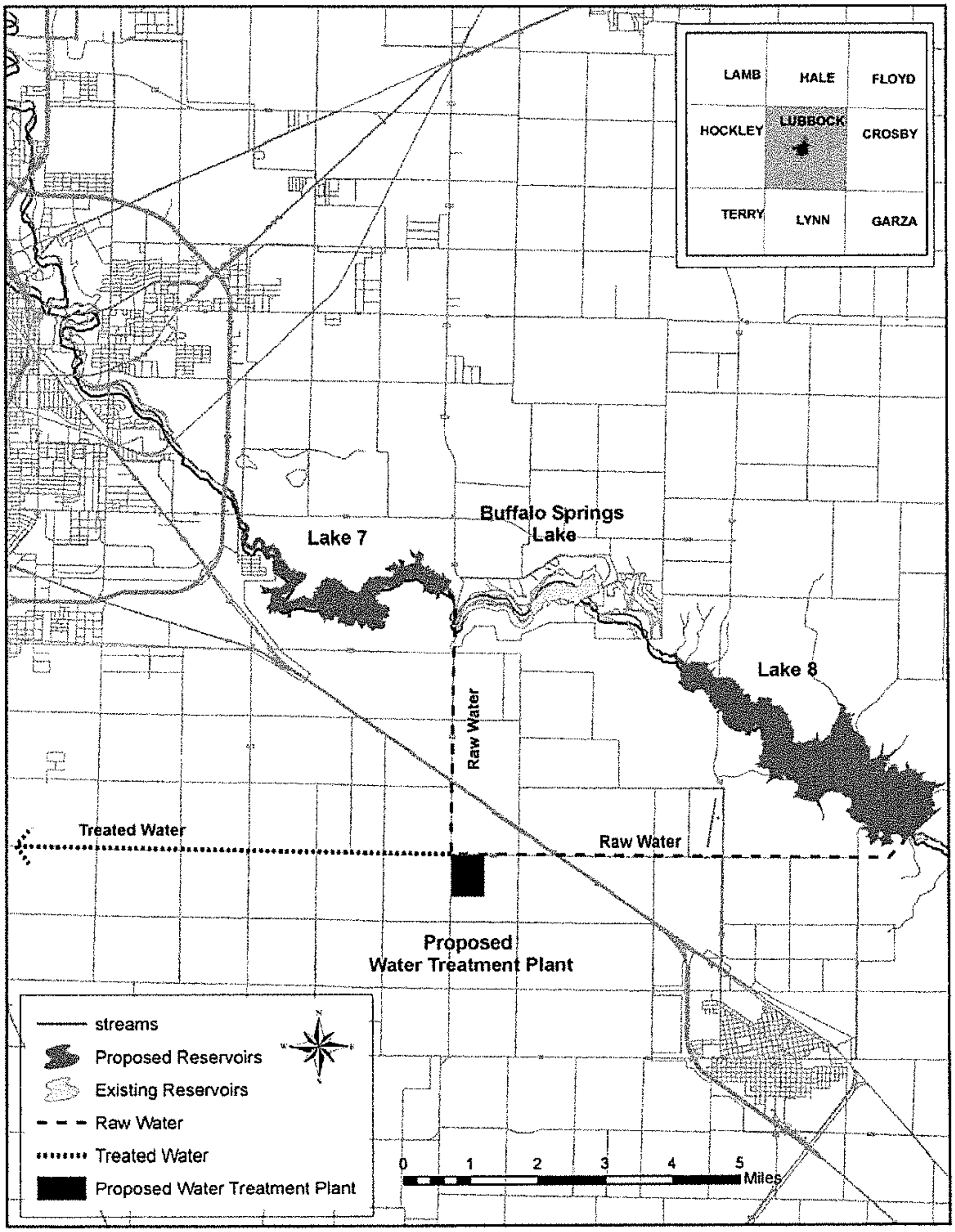

Figure 1-1. Project Location

Section 2
Affected Environment

The environmental resources of the proposed project area include the physical habitat and the plant and animal populations resident within, adjacent to and downstream of the reach of the North Fork proposed for impoundment and inundation. Cultural resources encompass the archaeological and historic remains present in areas that would be disturbed as a result of the proposed reservoir project.

2.1 Regional Setting

The proposed lake sites, designated as Lake 7 and Lake 8 are located in Lubbock County southeast of the City of Lubbock on the the North Fork. The North Fork originates at the confluence of Yellow House and Blackwater Creeks on the northern edge of Lubbock and flows southeastward, cutting a deep canyon in the eastern margin of the Caprock. This erosional feature, steeply incised into the surrounding, flat farmland of the Panhandle Plains is locally known as Yellow House Canyon. The uplands flanking the river and to the north and south of the proposed reservoir sites are flat, dominated by row-crop agriculture and thickly dotted with shallow, enclosed intermittently flooded basins (Playas).

Lubbock County is located in the Western High Plains ecoregion,[1] the High Plains vegetational area of Texas,[2] and the Kansan biotic province.[3] The High Plains Region is a nearly level treeless plain with a relatively even surface. It is dominated by native grasses, the major species including buffalo grass (*Buchloe dactyloides)*, blue grama (*Bouteloua gracilis*), and sideoats grama (*Bouteloua curtipendula*). Annual and perennial forbs, legumes and woody species such as beargrass and cholla cactus occasionally invade this grassland region. In zones with loamy soils, honey mesquite (*Prosopis glandulosa)* and yucca have invaded large areas.

Downstream of the proposed impoundments, the North Fork flows through the Rolling Plains Ecological Region. This region is bordered on the south by the Edwards Plateau Ecological Region and on the west by the High Plains Ecological Region and is characterized by

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[1] Omernik, James M., "Ecoregions of the Conterminous United States," Annals of the Association of American Geographers, 77(1), pp. 118-125, 1986.

[2] Gould, F.W., "The Grasses of Texas," Texas A&M University Press, Texas Agricultural Experiment Station, College Station, Texas, 1962.

[3] Blair, W.F., "The Biotic Provinces of Texas, "Tex. J. Sci. 2:93-117, 1950.

gently rolling hills that are dissected by streams and rivers that flow from west to east. Because land use in the Rolling Plains is primarily for range land, much more wildlife habitat is present than on the adjacent High Plains. Vegetation in this area is generally classified as mesquite-buffalo grass, and the predominant vegetation form is medium-tall grassland with a sparse shrub cover.

Little bluestem (*Schizachyrium scoparium* var. *frequens*), blue grama (*Bouteloua gracilis*), sideoats grama (*Bouteloua curtipendula*), Indiangrass (*Sorghastrum nutans*), and sand bluestem (*Andropogon gerardii* var. *paucipilus*) are included in the list of native grasses in this area. Invasion of the rangeland areas in this region by annual and perennial forbs, legumes, and woody species has been facilitated by historic livestock grazing practices and a lack of naturally occurring fire in the area. Dominant woody species include redberry juniper (*Juniperus pinchotii*), yucca, mesquite (*Prosopis glandulosa*), lotebush (*Zizyphus obtusifolia* var. *obtusifolia*), hackberry (*Celtis* sp.), bumelia, pricklypear (*Opuntia* sp.), skunkbush sumac (*Rhus aromatica* var. *flabelliformis*), ephedra, plum (*Prunus* sp.), western soapberry (*Sapindus saponaria*), little leaf sumac (*Rhus microphylla*), shin oak (*Quercus sinuata* var. *breviloba*), tasajillo (*Opuntia leptocaulis*), agarito (*Berberis trifoliolata*), catclaw acacia (*Acacia* greggii var. *greggii*), lime pricklyash (*Zanthoxylum fagara*), sand sage, and others. Bottomland areas found along larger streams contain American elm (*Ulmus Americana)*, button willow (*Cephalanthus occidentalis)*, pecan (*Carya illinoensis)* and cottonwood (*Populus* sp.). The limestone ridges and steep terrains of this area produce a greater diversity of woody plants and wildlife habitat than would normally be expected from a plains region.

Faunal species in both regions include those suited to a semi-arid environment. Riparian zones along the Brazos River and streams and their tributaries contain important wildlife habitat for the region and support populations of white-tailed deer (*Odocoileus virginianus)* and Rio Grande turkeys (*Meleagris gallopavo intermedia)*. Bobwhites (*Colinus virginianus)*, scaled quail (*Callipepla squamata*), mourning dove (*Zenaida macroura*), and a variety of song birds, small mammals, waterfowl, shorebirds, reptiles, and amphibians are found in this region. Large to medium-size mammals include the coyote (*Canis latrans)*, ringtail (*Bassariscus astusus)*, and collared peccary (*Tayassu tajacu)*. Typical smaller herbivores include desert cottontail (*Sylvilagus auduboni*), hispid pocket mouse (*Perognathus hispidis)*, Texas kangaroo rat (*Dipodomys elator)*, Texas mouse (*Peromyscus attwateri*), desert shrew (*Notiosorex crawfordi)*, and rock squirrel (*Spermophilus variegates)*, Bison (*Bos bison)*, and black-footed ferret (*Mustela nigripes)* are historically associated with this area.

2.2 Water Resources

The North Fork (Segment 1241A) is considered perennial from its confluence with the Double Mountain Fork of the Brazos River in Kent County to the dam impounding Lake Ransom Canyon, approximately 100 river miles upstream. Although the North Fork is considered perennial, it periodically ceases flowing and perennial surface water is confined to isolated pools. Alan Henry Reservoir was constructed on the Double Mountain Fork about six miles above its confluence with the North Fork as a water supply source for the City of Lubbock.

The North Fork itself is ungaged; the nearest station providing streamflow monitoring is U.S. Geological Survey (USGS) Gage 08080500, located below the confluence with the Double Mountain Fork of the Brazos River near Aspermont in Stonewall County over 100 river miles downstream of the proposed projects. At that location, median daily flow is 6.2 cubic feet per second (cfs), and zero flow has been recorded during 17.4% of the 1924-2004 period of record for the gage. Streamflow in the Double Mountain Fork at Justiceburg (Gage No. 08079600) above the confluence exhibits a median daily discharge of only 0.01 cfs. Much of the base flow of the North Fork presently originates as stormwater and wastewater return flow from the City of Lubbock discharged into the chain of small lakes located upstream of the proposed Lakes 7 and 8.

Segment 1241 waters are typically high in dissolved solids, with segment standards for chloride and sulfate of 2500 mg/L and 2400 mg/L, respectively. Segment 1241A is on the Draft 2004 303(d) list for excessive bacterial concentrations, and is listed in the Statewide Water Quality Inventory (305b list) for concerns over algal growth and nitrogen concentrations. Although the current data listing on the Brazos River Authority web site indicates that the segment meets the average screening criterion for Fecal Coliform of 200 MPN/100 ml, 23% of the samples collected exceeded the single grab criterion of 400 MPN/100 ml. Additional study will be required to confirm this result before a TMDL is scheduled. There are no Ecologically Significant River and Stream Segments, either nominated by Texas Parks and Wildlife, Water Resources Branch or designated by the Llano Estacado Regional Water Planning Group (Region O), within the project area.

2.3 Biological Resources

2.3.1 Terrestrial Habitats and Communities

In contrast to the intensive agricultural development of the surrounding High Plains, the prevalent land uses within Yellow House Canyon are rangeland, suburban residential, and recreational facilities, including substantial development around Lakes Buffalo Springs and Ransom Canyon. The proposed Lake 7 project area has been mapped as mixed rangeland (52%), with additional areas of nonforested wetlands (19%), gravel pits (15%), confined feeding operations (10%), and minor amounts of cropland or pasture.[4] In addition, a small portion of this proposed lake area is currently an existing reservoir (5%). The Lake 8 project area is divided between nonforested wetland areas (65%), and mixed rangeland (35%). However, Texas Parks and Wildlife Department has mapped the dominant vegetation type within the area of both Lake 7 and Lake 8 as Mesquite-Lotebush-Brush (76%) and Juniper (24%), the latter being confined to the southeastern portion of Lake 8[5]. This information appears to be in conflict as the mesquite-lotebush and juniper brush cover in the Texas Parks and Wildlife Department vegetation mapping does not include any wetland areas and the proportion of the reservoir footprints designated as wetlands in the TNRIS mapping seems high for typical regional conditions.

Within the proposed lake sites, the Soil Survey Report for Lubbock County shows that the North Fork is flanked by a continuous bank of Bippus Fine Sandy Loam and Bippus Clay Loam soils, both frequently flooded.[6] Bippus soils belong to the Potter-Berda-Bippus Series found on bottomlands and uplands that includes very shallow, shallow, or deep soils located on nearly level to steep slopes. Two of these soil types are found on gently sloping to steep slopes, and include Potter soils which are found on uplands and Berda soils which are generally found on foot slopes. Slopes of areas containing these soils are generally found to be 1 to 45 percent. Bippus soils are found on nearly level areas (less than 1 percent slopes) on frequently flooded bottom lands, and should include any wetland areas in the reservoir sites. However, with respect to wildlife habitat potential, the Soil Survey Report rates both these soils very poor in their capabilities to support wetland plants and shallow water habitats because of periodic drying.

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[4] U. S. Geological Survey, 1990. Reston, Virginia

[5] The Vegetation Types of Texas. Texas Parks and Wildlife

[6] SCS, 1975. Soil Survey of Lubbock County, Texas, USDA Soil Conservation Service.

National Wetland Inventory (NWI) mapping is not available for the Buffalo Springs 7.5 minute quad map, which includes the lower portion of the proposed Lake 7 site and the upper portion of the Lake 8 site. The portions of the two proposed reservoir sites encompassed by Lubbock East, Slaton and Slaton, NE 7.5 minute quad maps show primarily intermittent wetland features that include intermittent riverine streambed in the Lake 8 site, while the level bottom of Yellow House Canyon at the Lake 7 site is occupied by Palustrine (floodplain and terrace) shrubland and intermittent emergent wetland.[7] Examination of recent aerial photography seems to indicate that aquatic and wetland habitats are confined to the channel of the North Fork as the band of "frequently flooded" Bippus soils shows little evidence of wetland characteristics and much of it appears to be pasture or hayland. Overbank channels and areas of ephemeral ponding can be seen in a few locations, such as the wide central area of proposed Lake 7, but a field survey would be required to finally determine the other two essential wetland criteria, the presence of hydric soils and wetland vegetation.

The surface layer for all of these soils is composed of a friable, alkaline loam which differs in depth within each soil type from 5 to 30 inches. Rangeland is the most common land use occurring within areas of Bippus soils. Cultivated crops are not generally grown in this area due to the steep, arid slopes, and the potential for water erosion and flooding in the bottoms.

2.3.2 Aquatic Habitats and Communities

There are six existing, smaller impoundments in the upper reaches of the North Fork canyon above the proposed Lake 7 location, and two larger lakes, Buffalo Springs Lake and Lake Ransom Canyon between Lakes 7 and 8. The existing chain of 6 small lakes are the core of an extensive urban park system in which boating and fishing are not only permitted, but in which Texas Parks and Wildlife Department (TPWD) manages fisheries for largemouth bass, channel catfish and rainbow trout. Lakes Buffalo Springs and Ransom Canyon are regional recreational centers which appear to be maintaining healthy fisheries. TPWD currently reports good to excellent fishing for channel catfish, sunfish, crappie, largemouth and stripped bass in Lake Buffalo Springs.

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[7] FWS. 1994. National Wetland Inventory Map of the Lubbock, Slaton and Slaton, NE 7.5 minute Quad Map. US Fish and Wildlife Service, Reston, VA.

The fish assemblages in the North Fork have been most recently sampled at two locations in Garza County by Texas Parks and Wildlife Department during a 1988-91 study.8 Wilde and Ostrand collected fish from the Double Mountain Fork above Alan Henry reservoir, which was constructed about six miles above its confluence with the North Fork, in the late 1990s.9 The list of fish species present in the upper Brazos River Drainage (i.e., the Salt and Double Mountain Forks) shown in Table 2-1 consists of relatively few species that tend to be typical of the relatively harsh environments of prairie streams. Prairie streams tend to exhibit wide ranges in temperature, dissolved oxygen and dissolved solids (salinity), and their typical fish assemblages tend to be dominated by species with tolerance for wide ranges of physical and chemical conditions that fluctuate widely.10 This is particularly the case in headwater areas like the North Fork, where flow may cease seasonally and aquatic habitats are restricted to isolated pools. These same species tend to be poor competitors in less stressed environments, especially with regard to dissolved solids concentrations, and are thought to limited in their downstream distributions by the presence of species populations less tolerant of high salinities.11 Wilde and Ostrand reported that the fish assemblage in the river reach above Alan Henry Reservoir had changed substantially, presumably in response to the reservoir construction. A subsequent physiology study of the dominant species in that assemblage indicated that those changes are most likely the result of an inability of the cyprinids to repopulate the river above Alan Henry Reservoir following episodes when aquatic habitats are reduced to isolated pools. The plains minnow (Hybognathus placitus), smalleye shiner (Notropis buccula) and the sharpnose shiner (N. oxyrhynchus), whose populations were much reduced in the late 1990s in the Double Mountain Fork of the Brazos River, were found to be eliminated from pool habitats by increasing salinities as evaporation proceeded, but that the dominant cyprinodontids (Red River pupfish and plains killifish, Fundulus zebrinus) were sufficiently tolerant of high salinities to survive in isolated pools until streamflow resumed. The cyprinids, on the other hand, could not repopulate

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[8] Moss, R.E. and K. B. Mayes. 1993. Current Status of *Notropis buccula* and *Notropis oxyrhyncus* in Texas. River Studies Report No. 8. Resource Protection Division, Texas Parks and Wildlife Department, Austin, Texas.

[9] Wilde, G.R. and K.G. Ostrand. 1999. Changes in the fish assemblage of an intermittent prairie stream upstream of a Texas impoundment. Texas Journal of Science 51: 203-210.

[10] Matthews, W.J. 1987. Physiochemical tolerance and selectivity of stream fish related to their geographic ranges and local distributions. *In* Community and Evolutionary Ecology of North American Stream Fishes, Matthews and Heins, *eds*. University of Oklahoma Press, Norman.

[11] Echelle, A.A., A.F. Echelle and L.G. Hill. 1972. Interspecific interactions and limiting factors of abundance and distribution in the Red River Pupfish, *Cyprinodon rubrofluviatalis*. American Midland Naturalist 88(1): 109-130.

the river when flow resumed because of the migratory barrier imposed by Alan Henry Reservoir.[12]

Table 2-1.
Fish Species Reported from the Upper Brazos River Drainage

Common Name	**Scientific Name**
Longnose gar	*Lepisosteus osseus*
Gizzard shad	*Dorosoma cepedianum*
Central Stoneroller	*Campostoma anomolum*
Common carp	*Cyprinus carpio*
Red shiner*	*Cyprinella lutrensis*
Blacktail shiner	*Cyprinella venusta*
Plains minnow*	*Hybognathus placitus*
Smalleye shiner*	*Notropis buccula*
Sharpnose shiner*	*Notropis oxyrhynchus*
Speckled chub	*Macrhybopsis aestivalis*
Suckermouth minnow	*Phenocobius mirabilis*
Bullhead minnow	*Pimephales vigilax*
River carpsucker	*Carpiodes carpio*
Channel catfish	*Ictalurus punctatus*
Plains killifish*	*Fundulus zebrinus*
Red River pupfish	*Cyprinodon rubrofluviatilis*
Western mosquitofish*	*Gambusia affinis*
Inland silverside	*Menidia beryllina*
White bass	*Morone chrysops*
Largemouth bass	*Micropterus salmoides*
Spotted bass	*Micropterus punctulatus*
Warmouth	*Lepomis gulosus*
Bluegill	*Lepomis macrochirus*
Longear sunfish	*Lepomis megalotis*
Redear sunfish	*Lepomis microlophus*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Dusky darter	*Percina sciera*
Freshwater drum	*Applodinotus grunniens*
*Species collected (by seine only) from the North Fork	

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[12] Ostrand, K.G. and G.R. Wilde. 2001. Temperature, dissolved oxygen, and salinity tolerances of five prairie stream fishes and their role in explaining fish assemblage patterns. Transactions of the American Fisheries Society 130(5): 742-749.

2.3.3 Important Species

Plant and animal species listed by USFWS, and TPWD, as endangered or threatened with potential habitat in Lubbock County are listed in Table 2-2. There are two species listed as endangered by the State of Texas found within Lubbock County, the Whooping Crane (*Gus Americana*), and Black-footed Ferret (*Mustela nigripes*). In addition there are three threatened species which are state-listed within the county, the Arctic Peregrine Falcon (*Falco peregrinus tundrius*), Bald Eagle (*Haliaeetus leucocephalus*), and Texas horned lizard (*Phrynosoma cornutum*). Information available from the Texas Parks and Wildlife Department Natural Diversity Database indicates that swift fox (*Vulpes velox*) and cylinder spikesedge (*Eleocharis cylindrica*), both species of interest but without official protection, have been reported in the vicinity of the proposed reservoirs.

The Whooping Crane, Arctic Peregrine Falcon and Bald Eagle are potential migrants to Lubbock County which may use habitats in the area during migration. A survey of the lake sites may be required to determine whether populations of or potential habitats used by listed species occur in the area to be affected. The Black-footed Ferret is generally found in areas occupied by prairie dogs, usually dry, flat short grasslands including land overgrazed by cattle and the Texas Horned Lizard generally prefers open, arid areas with sparse vegetation. Either of these two species might be found within the mixed rangeland areas of the project.

There are two fish species, both endemic and once present throughout the Brazos River Basin and now apparently restricted to waters above Possum Kingdom Reservoir that are candidates for Federal Listing: the sharpnose shiner, and the smalleye shiner. Both of these species require fairly shallow water in broad, open sandy channels with moderate current. Neither of these shiner species has been reported to occur within Lubbock County, although they have been collected from two locations in the North Fork in Garza County above Alan Henry Reservoir.

Table 2-2.
Endangered and Threatened Species, and Species of Special Concern Potentially Occurring in the Vicinity of the Jim Bertram Lake System (JBLS) Expansion

BIRDS	*Federal Status*	*State Status*
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	T
Baird's Sparrow (Ammodramus bairdii) – shortgrass prairie with scattered low bushes and matted vegetation.		
Bald Eagle (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds.	LT-PDL	T
Ferruginous Hawk (Buteo regalis) – open country, primarily prairies, plains, and badlands; nests in tall trees along streams or on steep slopes, cliff ledges, river-cut banks, hillsides, power line towers.		
Lesser Prairie Chicken (Tympanuchus pallidicinctus) – arid grasslands, generally interspersed with shrubs and dwarf trees; nests in a scrape lined with grasses.	C1	
Mountain Plover (*Charadrius montanus*) – breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Snowy Plover (Charadrius alexandrinus) – formerly an uncommon breeder in the Panhandle; potential migrant		
Western Burrowing Owl (*Athene cunicularia hypugaea*) - open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows and man-made structures, such as culvert.		
Whooping Crane *(Grus americana)* - potential migrant; winters in and around Aransas National Wildlife Refuge and migrates to Canada for breeding; only remaining natural breeding population of this species.	LE	E
MAMMALS		
Black-footed Ferret (Mustela nigripes) – considered extirpated in Texas; potential inhabitant of any prairie dog towns in the general area.	LE	E
Black-tailed Prairie Dog (Cynomys ludovicianus) – dry, flat, short grasslands with low, relatively sparse vegetation, including areas overgrazed by cattle; live in large family groups.		
Cave Myotis Bat (Myotis velifer) – roosts colonially in caves, rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Petrochelidon pyrrhonots)* nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum caves of Panhandle during winter; opportunistic insectivore.		
Plains Spotted Skunk (Spilogale putorius interrupta) – catholic in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie.		
Swift Fox (Vulpes velox) – restricted to current and historic shortgrass prairie; western and northern portions of Panhandle.		
REPTILES		
Texas Horned Lizard (Phrynosoma cornutum) – open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September.		T
Status Key: DL-De-Listed, PDL-Proposed De-Listed, LE, LT-Federally Listed Endangered/Threatened, PE, PT-Federally Proposed Endangered/Threatened, E/SA, T/SA-Federally Listed Endangered/Threatened by Similarity of Appearance, C1-Federal Candidate for Listing, E,T-State Listed Endangered/Threatened, "blank"-Rare, but with no regulatory listing status		
June 2005, Annotated County Lists of Rare Species maintained by TPWD, Austin, Texas.		

Section 3
Cultural Resources

The cultural/archeological investigation of the proposed reservoir sites has to date been limited to a review of existing records regarding recorded archeological and historical sites that may be affected.

3.1 Historical and Archaeological Records

Available information regarding known cultural resources was gathered from the Texas Archeological Research Laboratory in Austin. Examination of their map files identified 14 recorded archeological sites within the footprint and vicinity of Lake 7 and three within the footprint and vicinity of Lake 8 (see Table 3-1). Sites 41LU9 through 41LU23 have no eligibility recommendations. However sites 41LU132 and 41LU48 were recommended for listing on the NRHP. Site 41LU49 was not recommended for the NRHP.

As there is no evidence of any systematic archeological investigations being conducted for the lake areas, it is likely that the Texas Historical Commission and the U.S. Army Corps of Engineers will require an intensive archeological survey of the dam sites, the maximum flood pool area, and the proposed park areas of both lakes. This information will be required in order to begin the Section 106 and Antiquities Code consultation with those agencies.

Table 3-1.
Archeological Sites on Record for Lake 7 and Lake 8

Lake 7	***Site Description***
41LU9	Prehistoric camp
41LU10	Prehistoric camp
41LU11	Prehistoric camp
41LU12	Prehistoric camp
41LU13	Prehistoric camp
41LU14	Prehistoric camp
41LU15	Prehistoric camp
41LU16	Prehistoric camp
41LU17	Prehistoric camp
41LU18	Prehistoric camp
41LU19	Prehistoric camp
41LU132	Prehistoric camp
41LU48	Stone wall
41LU49	Prehistoric lithic scatter

Lake 8	***Site Description***
41LU21	Prehistoric camp
41LU22	Prehistoric camp
41LU23	Prehistoric camp

Section 4
Potential Impacts

As part of the permitting process, potential direct and indirect impacts to aquatic and upland habitats of the reservoir site, and of downstream areas potentially affected by changes in flow regime must be considered. The effects on endangered species, water quality, cultural resources, and other issues that may be raised by interested parties must also be considered. Texas Parks and Wildlife Department (TPWD) is a party to all water rights permits processes and that agency's comments and opinions must be considered. The following assessments are offered as our interpretation of the available information regarding the project area and the expected results of construction and operation of a dam and water supply reservoir.

The effects of the reservoirs shown are the results of hydrologic and operational analyses performed in support of the Llano Estacado Regional Water Planning Group, and should be considered preliminary. They are presented here for the purposes of defining potential environmental effects of the proposed reservoirs. The City of Lubbock is continuing to complete more detailed hydrologic analyses, which will include alternative operating scenarios, during the technical review portion of the permitting process.

4.1 Effects of Project Construction and Reservoir Impoundment

Primary, immediate impacts that will result from construction of the proposed lakes would include conversion of existing habitats and land uses within their conservation pools to open water. Figure 4-1 (Lake 7 Storage) shows that operation of the proposed Lake 7 near its 50% capacity elevation more than 90% of the time will result in the permanent inundation of 514 acres of aquatic, wetland and terrestrial habitats and their conversion to a lacustrine environment in which an aquatic community will develop. Excursions above 50% capacity are projected to be rare and relatively brief, and would be expected to result in little change in the terrestrial habitat now present in the zone between the 50 and 100% capacity elevations.

The storage trace for Lake 8 (Figure 4-2) indicates that this larger impoundment will experience water surface elevations exceeding the 50% capacity level more frequently (22%), but diversion of the system yield from this impoundment will result in a more gradual

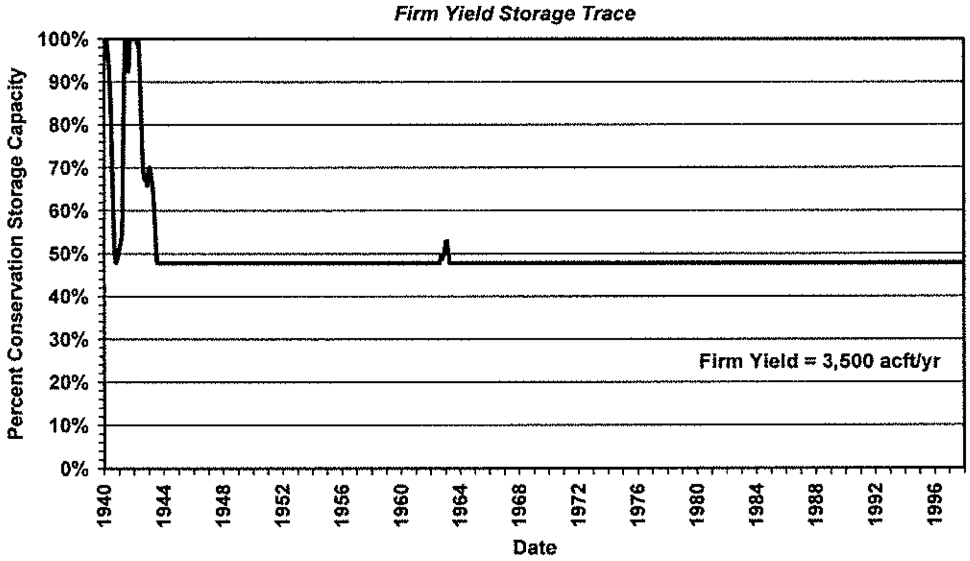


Figure 4-1. Water Surface Elevation of Proposed Lake 7 Assuming 1940-1998 Hydrologic Conditions

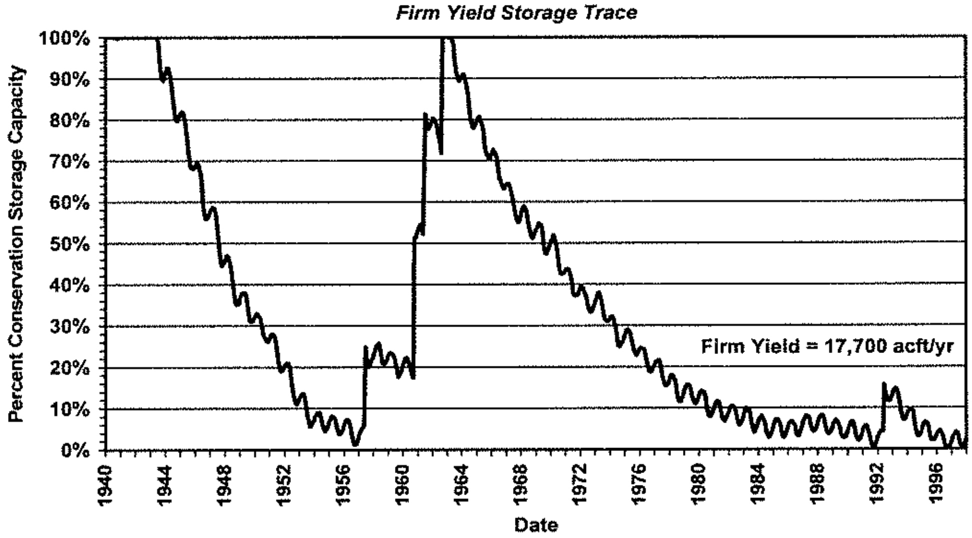


Figure 4-2. Water Surface Elevation of Proposed Lake 8 Assuming 1940-1998 Hydrologic Conditions

dewatering regime than in Lake 7, and Lake 8 will experience periodic drawdowns to elevations below 10% capacity. The mosaic of grassland and thorny shrublands within the footprint of Lake 8 will experience decreasing frequencies and durations of inundation at successively higher capacity elevations. At the 8% capacity elevation, about 351 acres will be inundated permanently, while the median water surface elevation for the simulation period, which corresponds to the 30% capacity level, indicates that the lower 889 acres will be under water half or more of the time and the upper 829 acres will be inundated half or less of the time. While annual grasses and forbs will rapidly recolonize areas exposed following a drawdown, perennial grass and shrub populations will recover more slowly.

With respect to aquatic communities, frequent changes in reservoir surface elevation in Lake 8 may limit populations of shallow-water nesting species, which include the recreationally and economically important sunfish and bass. As these species construct nests in shallow water, rapid changes in water surface elevation during the spring and summer reproductive season may reduce nesting success to some extent. However, the fish assemblages and other components of the biota of Lakes 7 and 8 are expected to be comparable to those now present in the existing Yellow House Canyon impoundments, absent substantial changes in water quality. Frequent changes in water surface elevation would be expected to at least periodically inhibit recreational use and may discourage lakeside development around Lake 8, both of which are not planned for the reservoir sites.

4.1.1 Waters of the US and Adjacent Wetlands

Jurisdictional wetlands potentially affected by dam construction include the channel of the North Fork, which may include permanent pool areas, inundated tributary mouths and periodically flooded palustrine wetlands. Where adverse impacts to wetlands cannot be avoided, the U.S. Army Corps of Engineers (USACE) will require some form of compensation for lost wetland functions or values. Existing data are not sufficient to identify and quantify wetlands in the project area and a wetland delineation will have to be performed to identify, characterize and quantify potentially affected wetland areas.

4.1.2 Riparian and Upland Habitats

Upland habitats potentially affected by dam construction and inundation consist of a mosaic of grassland and lotebush-mesquite-juniper habitats on the slopes of Yellow House

Canyon. Riparian areas are highly disturbed, with little native woodland persisting uninvaded by exotic species such as (*Tamarix* spp.) and Siberian elm (*Ulmus pumelia*). Field surveys will be required to identify, locate and quantify potentially affected vegetational associations and habitats, and to assess the appropriate level and nature of compensation for lost habitat value.

4.1.3 Important Species

State or federally listed endangered or threatened species potentially affected by reservoir construction appear to be limited to the horned lizard, which is a likely inhabitant of Yellow House Canyon. Individuals of this species could be killed or displaced into less suitable habitats by dam construction and reservoir filling. Although a small amount of terrestrial habitat will be permanently rendered unsuitable for horned lizard use, no significant impact to horned lizard populations is expected.

4.1.4 Cultural Resources

Considering the proximity of the project area to the rich archaeological deposits at Lubbock Lake, and the well known use of Yellow House Canyon as an east-west thoroughfare of great antiquity, there is a substantial probability that significant cultural resources are present within the area to be affected by reservoir and pipeline construction. However, the number, quality and potential for damage cannot be determined without a detailed field study. A U.S. Army Corps of Engineers permit to construct reservoirs on the North Fork will have to be consistent with the requirements of Section 106 of the National Historic Preservation Act. Furthermore, if the project sponsor is a political subdivision of the State of Texas (i.e. county, municipality, etc.) and owns or controls the project lands, compliance with the Antiquities Code of Texas will also apply. These laws and their implementing regulations generally require a pedestrian survey to identify cultural deposits, testing to determine the significance of identified sites, and where impacts to significant resources cannot be avoided, some form of compensation, such as data recovery prior to site destruction, is usually required.

4.2 Impacts of Project Operation

4.2.1 Reservoir Water Quality

Health concerns for the two proposed lakes include bacteria and other pollutants from storm runoff and treated wastewater. Storm runoff, particularly from urban areas, will likely be a source of coli form bacteria, oxygen demanding materials, nutrients and other materials (e.g., oil and grease, metals, household chemicals) potentially affecting water quality. This condition is common in streams and impoundments receiving urban runoff, and has proved to be a serious problem in some cases. Water quality in the existing Yellow House Canyon reservoirs shows the effects of the adjacent urban area of Lubbock, but that quality remains sufficient to maintain acceptable aquatic life uses in those water bodies. Water quality conditions in the existing impoundments, which are not expected to change significantly as a result of the proposed reservoir projects, are the best predictors of conditions most likely to develop in the proposed Lakes 7 and 8.

4.2.2 Downstream Water Quantity and Quality

Hydrologic effects of operating the proposed reservoir system on a firm yield basis have been preliminarily evaluated using the TCEQ Brazos Basin Water Availability Model (Brazos WAM). The model utilizes a January 1940 through December 1997 hydrologic period of record to compute the streamflow available from the North Fork without causing increased shortages to existing downstream rights. Firm yield was computed subject to the reservoirs having to pass natural inflows to meet Consensus Criteria for Environmental Flow Needs instream flow requirements. Naturalized streamflow statistics used to determine the Consensus Criteria pass-through requirements and potential effects on streamflows below Lakes 7 and 8 are shown in Tables 4-1 and 4-2. Instream flow requirements were not applied to the developed water sources, which would not be required to meet the Consensus Criteria flow requirements.

While the "developed water resources" contemplated in this permit include both storm water and treated wastewater from the City of Lubbock that is discharged into Yellowhouse Canyon (in addition to groundwater seepage from the Lubbock Land Application Site), only future treated effluent was utilized as a developed water source for these hydrologic studies; it was assumed for these preliminary analyses that the developed storm water flows, while likely adding to the firm yield, will primarily be utilized as an interruptible supply. Not withstanding the foregoing, the City will be presenting additional hydrologic analyses that utilize the developed storm water as a source to augment firm yield as well as interruptible supplies.

Table 4-1.
Daily Natural Streamflow Statistics for Lake 7

Month	*Median Flows – Zone 1 Pass-Through Requirements (cfs)*	*25th Percentile Flows – Zone 2 Pass-Through Requirements (cfs)*
January	0.2	0.0
February	0.2	0.0
March	0.1	0.0
April	0.2	0.0
May	3.4	0.1
June	5.1	0.5
July	1.5	0.0
August	0.6	0.0
September	1.3	0.0
October	0.9	0.0
November	0.6	0.0
December	0.4	0.0
Zone 3 (7Q2) Pass-Through Requirement (cfs):		0

Table 4-2.
Daily Natural Streamflow Statistics for Lake 8

Month	*Median Flows – Zone 1 Pass-Through Requirements (cfs)*	*25th Percentile Flows – Zone 2 Pass-Through Requirements (cfs)*
January	0.3	0.0
February	0.3	0.0
March	0.1	0.0
April	0.3	0.0
May	3.8	0.1
June	5.7	0.5
July	1.7	0.0
August	0.7	0.0
September	1.5	0.0
October	1.0	0.0
November	0.7	0.0
December	0.4	0.0
Zone 3 (7Q2) Pass-Through Requirement (cfs):		0

The treated wastewater originates from groundwater and from Canadian River water purchased from CRMWA. These return flows are in excess of the 9 MGD for which the City has recently applied to the TCEQ for reuse authorization. The 22.9 MGD (25,648 acft/yr) of return flows considered here were input into the Brazos WAM and used in conjunction with available unappropriated flows to develop the firm yield estimates for Lakes 7 and 8.

Operation of the reservoir system would result in an increase in the volume and constancy of streamflow in the North Fork reach between Buffalo Springs Lake and the Lake 8 backwater, which includes Lake Ransom Canyon (Figures 4-3 and 4-4). The increased flow would presumably benefit lotic habitats but these reaches would vary in length depending on the contents of Lake 8 (Figure 1-1).

Figures 4-5 and 4-6 indicate that operation of Lakes 7 and 8 would not change the frequencies of low to normal streamflows (i.e., at and below naturalized median monthly flows). However, streamflows in North Fork are presently dominated by "developed water" discharges whose reuse is the target of the proposed reservoir system. Reductions in flood flows will occur as the reservoir system captures these infrequent events, and the extent to which channel maintenance may be affected will be assessed during the technical review process.

Existing impoundments are already exerting the same kinds of downstream water quality changes that will occur below Lake 8. These changes include temperatures in the tailwater that are warmer in winter than the unimpounded stream would exhibit, and cooler summer water temperatures. Bottom water releases from the dams may exhibit reduced dissolved oxygen concentrations, particularly during summer conditions when stratification occurs. Given the abundance of sulfate in stream waters here, very low dissolved oxygen concentrations (<1 mg/L) may be accompanied by substantial levels of hydrogen sulfide, which can be toxic to fish if persistent at sufficient levels. However, it is contemplated that a principal spillway tower with gated inlets at various elevations would be used, or a "morning glory" type of principal spillway would be constructed. In these cases, bottom water releases would be unlikely. Other effects of impoundment include fragmentation of stream habitat, and the trapping of sediment, organic material and nutrients in the reservoir, which results in reduced oxygen demand, nutrient and sediment loads downstream of the dam.

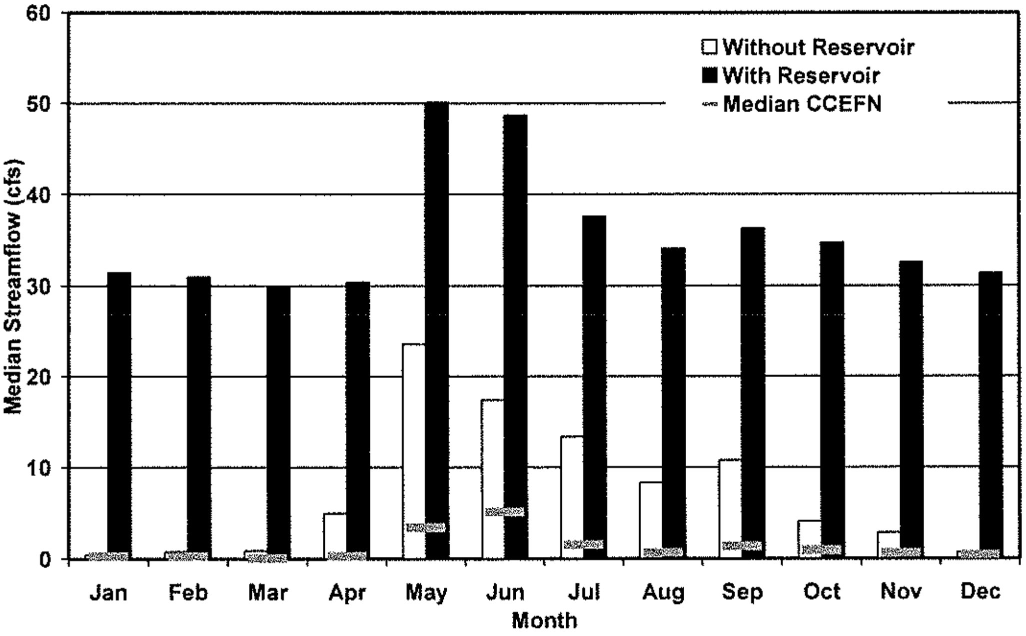


Figure 4-3. Lake 7 — Median Streamflow Comparison

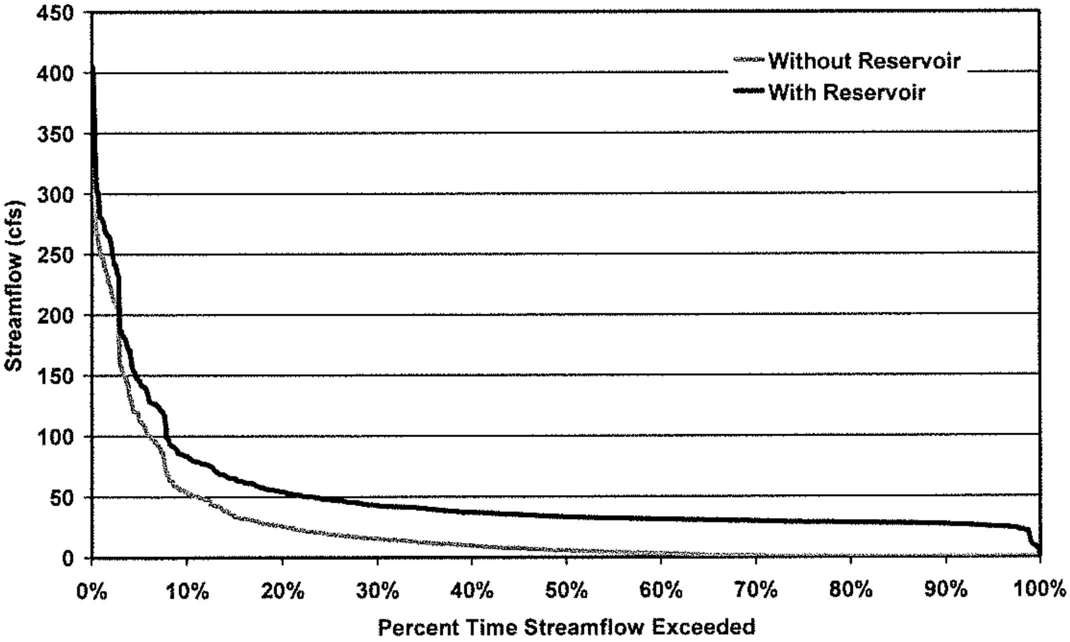


Figure 4-4. Lake 7 — Streamflow Frequency Comparison

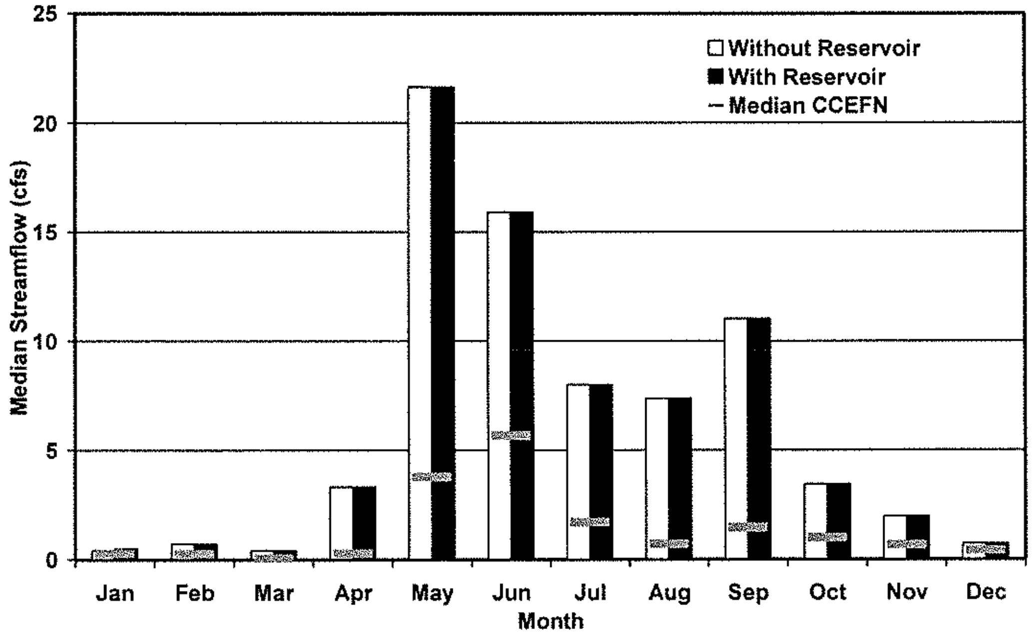


Figure 4-5. Lake 8 — Median Streamflow Comparison

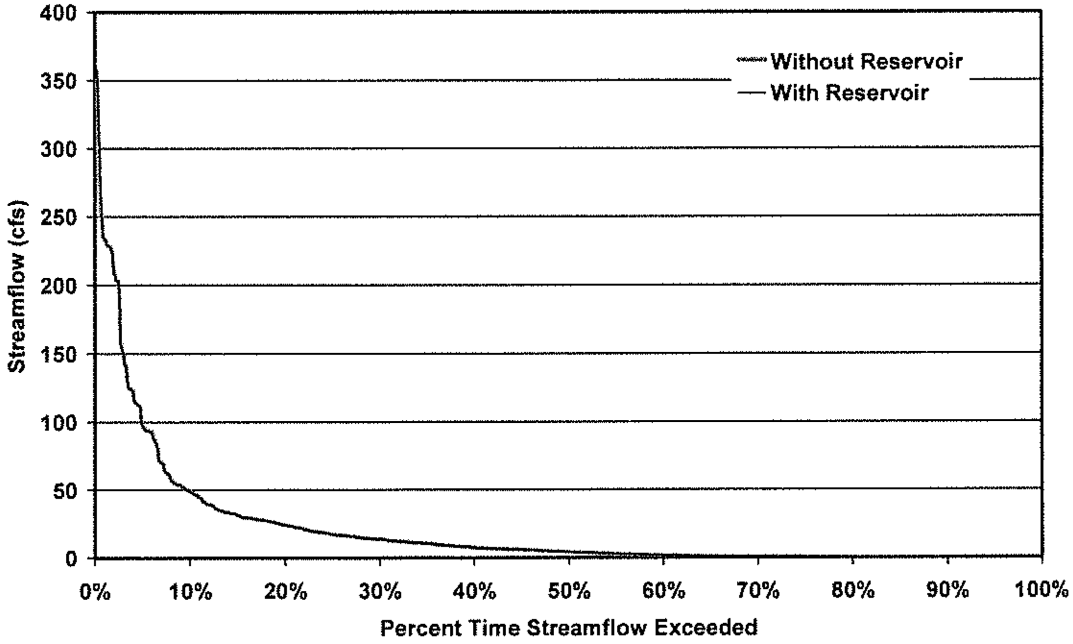


Figure 4-6. Lake 8 — Streamflow Frequency Comparison

While reduced oxygen demand and nutrient loads would be beneficial in the North Fork, reduction of sediment loads could result in increased erosion below the dam. However, all of these conditions are presently occurring in the North Fork as a result of the existing reservoir system and would not be exacerbated by the proposed projects, other than serving to further polish the water flowing through them (i.e., detention in standing waters allows time for algal and microbial growth to remove dissolved nutrients and organic material from the water column while sedimentation removes those organisms as well as detrital and mineral particles). Water quality effects from operation of the existing impoundments are expected to be extended downstream for a distance roughly equivalent to the length of Lake 8 as a result of project implementation.

4.2.3 Lotic Community Impacts

The lotic community of the upper North Fork consists of a small number of species tolerant of wide ranges in abiotic habitat parameters (e.g., temperature, dissolved oxygen concentration, salinity) that occur during periodic episodes of zero streamflow and isolation in channel pools. Expected changes in water quality as a result of project operation are not expected to have significant adverse impacts on downstream biotic communities.

Maintenance of a naturalized low flow regime below the proposed Lake 8 should be sufficient to protect the rather hardy species populating downstream aquatic communities, assuming that periodic maintenance flows are sufficient to prevent channel narrowing, riparian encroachment, bank armoring and other changes in habitat.

Section 5
Measures to Avoid or Minimize Adverse Impacts, and Compensation for Unavoidable Impacts

Mitigation planning will require completion of site-specific studies in order to adequately quantify potential impacts to environmental and cultural resources, and to investigate alternatives for avoidance or minimization of impacts. Planning that addresses compensation for unavoidable environmental impacts may require additional field work to characterize areas outside of the reservoir footprints suitable for appropriate management that would generate the necessary additional habitat value to compensate for that lost through project implementation. Compensation for impacts to significant cultural resources most often involves recovery of data and artifacts from affected sites and, where appropriate, may include some type of public informational display.

5.1 Field Study and Mitigation Planning Requirements

The work described below is consistent with the provisions of the Texas Administrative Code governing Water Rights applications before the TCEQ and is intended to address those areas in which our site-specific information of the proposed project must be supplemented by field work and additional analyses. An assessment of environmental effects, specifically with respect to habitat impacts and mitigation, water quality effects, estuarine considerations and instream uses (TAC 297.53-56), are to be conducted as part of the application process. The City of Lubbock proposes to consult with TCEQ staff concerning the requirements, scopes of work, and analysis methodologies prior to commencing the work described below.

5.1.1 Vegetation, Habitats and Protected Species

A field survey and recent aerial photography would be used to delineate vegetational cover, land use and habitats within the footprints of Lakes 7 and 8 and to develop a map of those resources. Field survey personnel will assess the potential for the presence of protected species on the proposed reservoir sites and pipeline corridors based on their known distributions and habitat requirements. Where occurrence probability is judged to be high, targeted endangered species surveys would be conducted. Based on the results of the vegetation/habitat mapping, a suitable quantitative method of terrestrial habitat assessment (e.g., the Wildlife Habitat

Assessment Procedure used by TPWD or FWS' Habitat Evaluation Procedure) will be applied to evaluate probable impacts over the life of the project and used to guide mitigation planning. With either method, it would be most useful to request assistance in planning and conducting the field work from the respective resource agencies in order to secure sufficient manpower to quickly complete the field work and obtain agreement on the basic approach, assumptions and habitat scoring. For USACE, FWS or other federal personnel to participate, an application for a Department of the Army permit pursuant to Section 404 of the Clean Water Act will have to be filed with the Fort Worth District US Army Corps of Engineers.

5.1.2 Wetland Delineation

The presence, nature and actual locations of jurisdictional wetlands potentially affected by reservoir construction will be determined by a site survey preparatory to application for the US Army Corps of Engineers construction permit required by Section 404 of the Clean Water Act. This will involve a wetland delineation conducted according to the guidelines established in the 1987 US Army Corps of Engineers Wetland Delineation Manual.

5.1.3 Aquatic Habitats and Instream Flows

Aquatic habitats and fish communities in the North Fork will be characterized, in part, using the Rapid Biological Assessment procedures outlined in *SWQM Procedures Manual* (TCEQ GI-252). This information will be used with additional hydrologic modeling to evaluate the low flow regime necessary to ensure the continued health of the aquatic community, and the level and frequency of maintenance flows necessary to maintain existing channel morphology below the proposed reservoirs. Because of the low diversity of the resident fish assemblage and the tolerant, generalist nature of the component species, we would contend that the need for an elaborate instream flow study is unnecessary in this case.

5.1.4 Cultural Resources

An archeological survey would be necessary to identify and assess impacts to cultural properties within the reservoir footprint, borrow areas and pipeline routes. This survey will include a level of effort that meets the current standards for archeological survey in accordance with the National Historic Preservation Act, and the Antiquities Code of Texas. Because the City of Lubbock is a political subdivision of the State of Texas, a State Antiquities permit would be required for this investigation. Because a federal (USACE) permit would be required for dam construction, the cultural resources investigation, significance testing and mitigation planning must also be coordinated with the USACE archaeologist to insure compliance with Section 106 of the National Historic Preservation Act.

The field survey would include a visual inspection of the entire project area and would likely include subsurface archeological exploration consisting of a number of backhoe trenches and auger tests to ascertain the presence of buried archeological deposits and facilitate their examination. Cultural properties that are at least 50 years of age and older would be recorded on State of Texas Archeological Site Recording Forms. A significance evaluation of each site would be conducted in accordance with significance criteria contained in Chapter 26, Rules of Practice Procedure for the Antiquities Code of Texas. A report of the investigations would be assembled in accordance with the Council of Texas Archeologist's Guidelines. In order to complete the requirements of the state antiquities permit we would curate all artifacts recovered and records produced during this investigation in accordance with state and federal laws and regulations.

5.1.5 Downstream Geomorphic Impacts of Reservoir Operations

Reservoir construction and operation has been shown to modify downstream hydrology by reducing the magnitude of peak flows, attenuating flood hydrographs, and increasing base flows through low-flow releases. In addition, reservoirs trap inflowing sediment (both bed and suspended loads), and release clear-water discharges that are essentially free of appreciable quantities of sediment. The sediment-carrying capacity is often compensated for through erosion of the channel and banks immediately downstream of the reservoir as the downstream channel adjusts to the revised hydrologic regime. These channel adjustments can modify stream and riparian habitats.

Expected channel responses vary considerably amongst reservoir sites, and are a function of the natural hydrology, sediment loads in the stream prior to reservoir construction, and other changes to the natural hydrology that pre-date reservoir construction. The stream channel in any specific location can be considered to be in a constant state of disequilibrium, as channel forms continually adjust to changes in the hydrologic regime, both man-induced as well as meteorological. The expected effects at any specific project cannot be generalized, and should be determined through site-specific analyses of natural hydrology, pre-existing man-induced changes to natural hydrology, and site-specific channel hydraulic and sediment transport analyses.

In order to estimate the potential effects of the proposed Lakes 7 and 8 on habitat downstream of the project, the City will conduct a geomorphic assessment. This assessment will quantify existing flood hydrology (which has been altered by upstream development and the construction of Buffalo Springs Lake and Lake Ransom Canyon), and estimate any further effects the proposed Lakes 7 and 8 will have on downstream hydrology. The impacts of these changes on the downstream channel will be estimated, with consideration given to changes in sediment loads and changes in existing land use that have occurred in the contributing watershed. Potential reservoir operations will be considered to mitigate any channel adjustments, including release of periodic flood-simulation flows.

5.1.6 Mitigation Planning

A mitigation plan includes a summary of potential adverse environmental and cultural resources impacts, delineates those impacts that are avoided or minimized by project features and operation, and presents a plan to compensate for unavoidable (net) impacts. Demonstrations of avoidance or minimization may include (for example) management planning for project lands or flowage easements above the conservation elevation to restrict certain land uses thereby avoiding additional upland habitat loss due to lakeside development, project features such as multilevel outlets for water quality management in the stream below Lake 8, and operational plans to allow for periodic flushing flow releases. In addition, channel restoration projects in other locations may be considered for mitigation of impacts on downstream channel morphology, if determined to be caused by Lakes 7 and 8.

The results of the vegetation mapping, wetland delineation, habitat evaluation and instream flow assessment studies would be used to define the habitat functions or values affected by reservoir construction and operation. Additional, offsite surveys may be required during this process to identify and evaluate potential areas to acquire and manage to achieve compensation for loss of habitat values. At this time, we anticipate that perennial wetlands and wooded riparian areas will be a preservation priority, given the generally ephemeral nature of regional surface waters and the degree of agricultural development characterizing the surrounding uplands.

A mix of habitat enhancement and preservation measures that will compensate for unavoidable losses of habitat functions would be developed in consultation with Texas Commission on Environmental Quality, Texas Parks and Wildlife Department, US Army Corps of Engineers and US Fish and Wildlife Service personnel. This is typically an iterative process in which differences in interpretations of habitat values, impact severity, necessity for compensation and methods of achieving increases in habitat value are resolved through negotiation and consensus building.

Table 4.4-58.
Cost Estimate Summary for
Lubbock Jim Bertram Lake System (JBLS) Expansion
Llano Estacado Water Planning Region
Second Quarter 2002 Prices

Item	*Estimated Cost*
Capital Costs	
Construction of Dams and Reservoirs (Lakes 7 and 8)	$15,889,000
Intake and Pump Stations (4.62 MGD and 26.7 MGD)	7,115,000
Transmission Pipelines (21,200 ft , 36 in; 37,000 ft, 90 in, and 79,200 ft, 66 in)	48,407,000
Water Treatment Plant (21 MGD)	22,079,000
Total Capital Cost	**$ 93,490,000**
Engineering, Legal Costs and Contingencies (30% for pipelines & 35% for all other construction costs; zero for studies)	30,301,000
Environmental and Archeological Studies and Mitigation	2,768,000
Land Acquisition and Surveying (2,613 acres)	3,405,000
Interest During Construction (7 years, 4 percent)	20,795,000
Total Project Cost	**$ 150,759,000**
Annual Costs	
Debt Service (Pipelines, Pump Stations, & Treatment Plant) (6 percent for 30 years)	$ 8,779,000
Debt Service (Reservoirs) (6 percent for 40 years)	1,988,000
Operation and Maintenance	
Intake, Pipelines, and Pump Stations	662,000
Dams and Reservoirs	238,000
Water Treatment Plant	1,942,000
Pumping Energy Costs (16,096,384 kWh @ $0.06/kWh)	966,000
Total Annual Cost	**$ 14,575,000**
Quantity of Water (acft/yr) Firm Yield	**21,200**
Annual Cost of Water ($ per acft) Firm Yield[1]	**$ 688**
Annual Cost of Water ($ per 1,000 gallons)[1]	**$ 2.11**

[1] Annual Cost of Water is for treated water at the treated water storage tanks and does not include costs associated with distribution within municipal systems. To the extent that interruptible water is available, unit cost would be lower.

Table 4.4-59.
Comparison of Lubbock Jim Bertram Lake System (JBLS) Expansion to Plan Development Criteria
Llano Estacado Water Planning Region

Impact Category	*Comment(s)*
A. Water Supply 1. Quantity 2. Reliability 3. Cost	 1. Sufficient to meet needs 2. High reliability 3. Reasonable to High
B. Environmental factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries 5. Threatened and Endangered Species 6. Wetlands	 1. Low impact 2. Low impact 3. Moderate impact 4. Negligible impact 5. Possible Low impact 6. Low impact
C. Impact on Other State Water Resources	• No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	• Potential impact on bottomland farms and habitat in reservoir area
E. Equitable Comparison of Strategies Deemed Feasible	• Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

HDR ONE COMPANY | *Many Solutions* ℠

January 23, 2006

Mr. Presley Hatcher
Regulatory Branch (CESWF-PER-R)
Fort Worth District
U.S. Army Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102-0300

Re.: City of Lubbock TCEQ Water Rights Permit Application No. 5921

Dear Mr. Hatcher:

On October 17, 2005, the City of Lubbock, Texas (City) submitted an application for a water use permit (Application No. 5921) to the Texas Commission on Environmental Quality (TCEQ). Application No. 5921 contemplates the construction of two dams and reservoirs on the North Fork of the Double Mountain Fork of the Brazos River (North Fork) east of Lubbock to supply water to the City. Water impounded in the reservoirs will consist of unappropriated flows of the North Fork and its tributaries, developed water-based stormwater runoff from the City's storm drainage system and its associated playa lake system, and return flows discharged by the City and the Town of Ransom Canyon. Enclosed herein is a copy of Application No. 5921, as filed, and an excerpt from the 2006 Water Plan recently adopted by the Llano-Estacado Regional Water Planning Group, representing a planning-level analysis and assessment of the proposed project.

The City will be contacting you in the upcoming months to discuss possible Corps authorizations pursuant to Section 10 of the Rivers and Harbors Act of 1899 and Sections 401 and 404 of the Clean Water Act, and their associated regulations.

We look forward to visiting with you about this important project for the City of Lubbock. If you have questions concerning this project in the meantime, , please feel free to call me at 512-912-5136, Mr. Ches Carthel, P.E. with the City of Lubbock, at 806-775-2344; or, Mr. Martin Rochelle, the City's Special Counsel, at 512-322-5810.

HDR Engineering, Inc.

4401 West Gate Blvd.
Suite 400
Austin, TX 78745

Phone: 512•912•5100
Fax: 512•912•5158
www.hdrinc.com

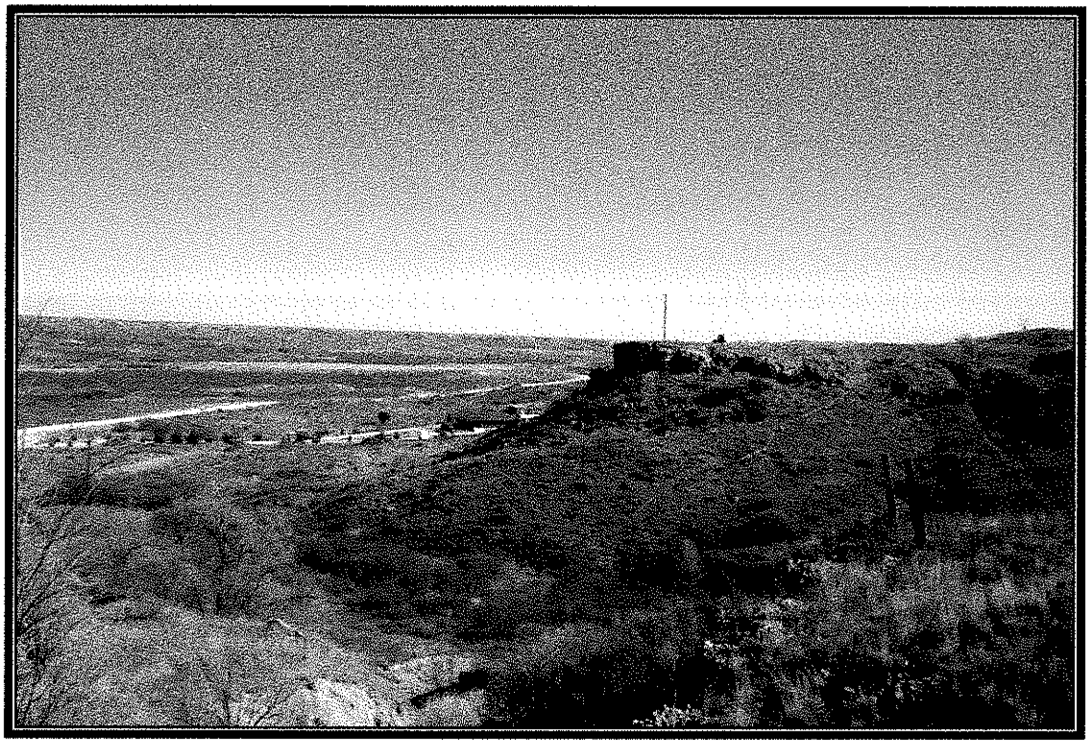
Sincerely,

HDR Engineering, Inc.

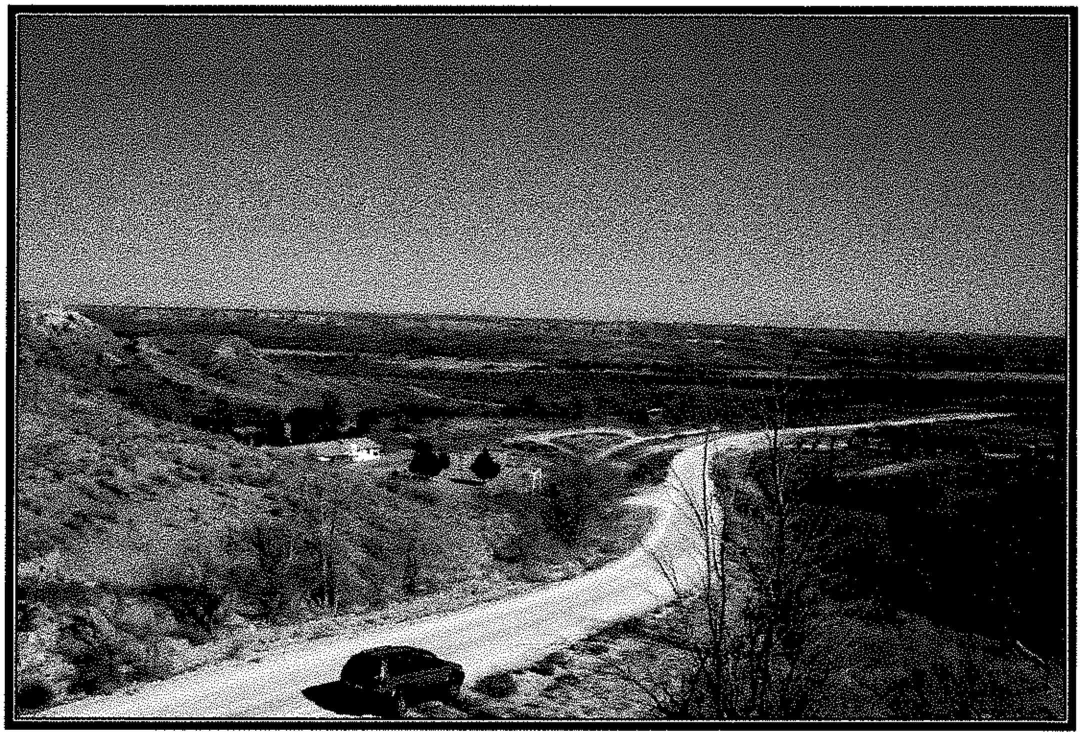
David D. Dunn, P.E.
Vice President

Cc: Ches Carthel, City of Lubbock
Anita Burgess, City of Lubbock
Richard Casner, City of Lubbock
Martin Rochelle, Lloyd-Gosselink
Brad Castleberry, Lloyd-Gosselink

Enclosures: 1. TCEQ Water Use Permit Application No. 5921
2. Excerpt from the 2006 Llano-Estacado Regional Water Plan



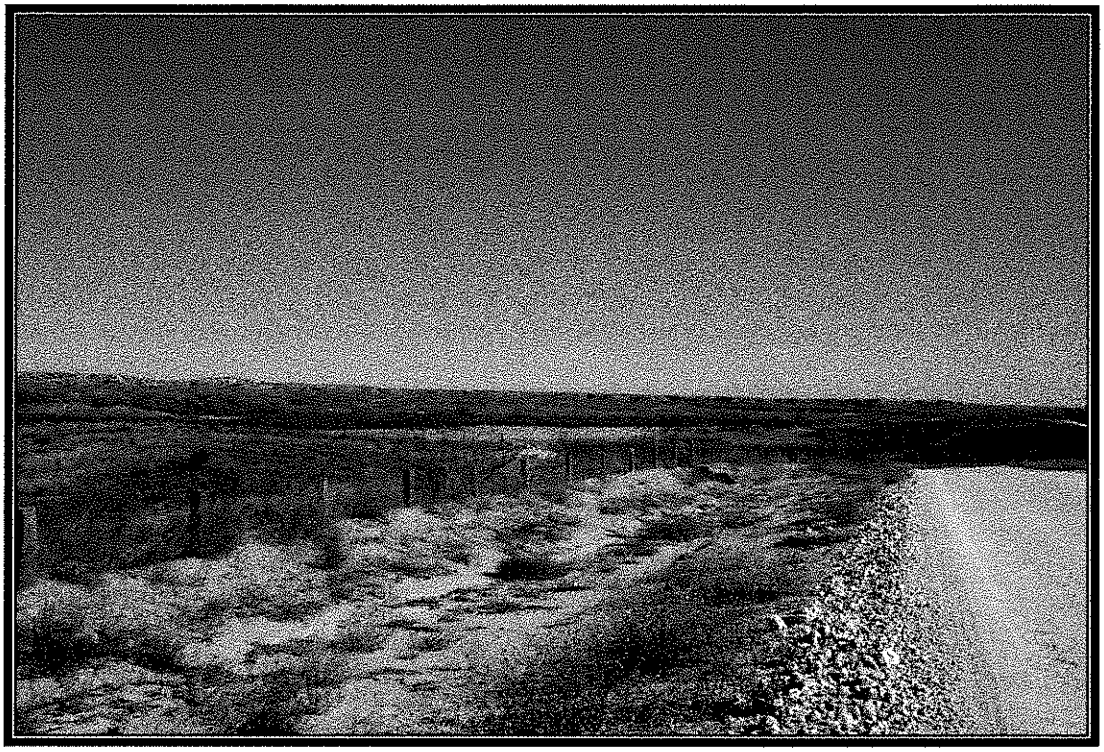
Picture 1 - Lake 8 - South Canyon Rim looking ENE.



Picture 2 - Lake 8 - South Canyon Rim Looking NE.

Picture 3 - Lake 8 - County Road 7300 Looking NW.

Picture 4 - Lake 8 - County Road 7300 Looking NE.



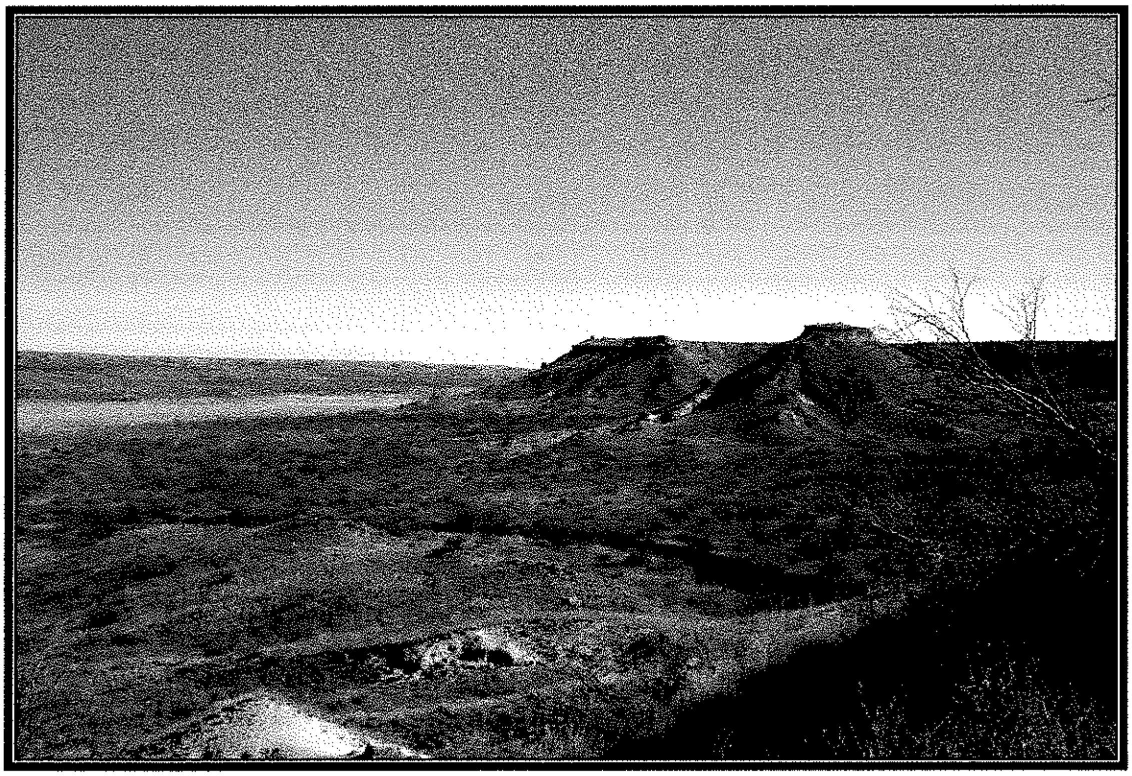
Picture 5 - Lake 8 - County Road 7300 Looking E.

Picture 6 - Lake 8 - N. Fork Crossing of Co. Road 7300 Looking Upstream.

Picture 7 - N. Fork Crossing Co. Road 7300 Looking Downstream.

Picture 8 - Lake 8 - Co. Road 7300 on Forrest Ranch Looking S.

Picture 9 - Lake 8 - Co. Road 7300 on Forrest Ranch Looking W.



Picture 10 - Lake 8 - Co. Road 3600 S. Canyon Rim Looking E.

Picture 11 - Lake 8 - Co. Road 3600 S. Canyon Rim Looking NE towards Forrest Ranch.

Picture 12 - Lake 8 - Co. Road 3600 S. Canyon Rim Looking N.

Picture 13 - Lake 8 - Co. Road 3600 S. Canyon Rim Looking NNW.

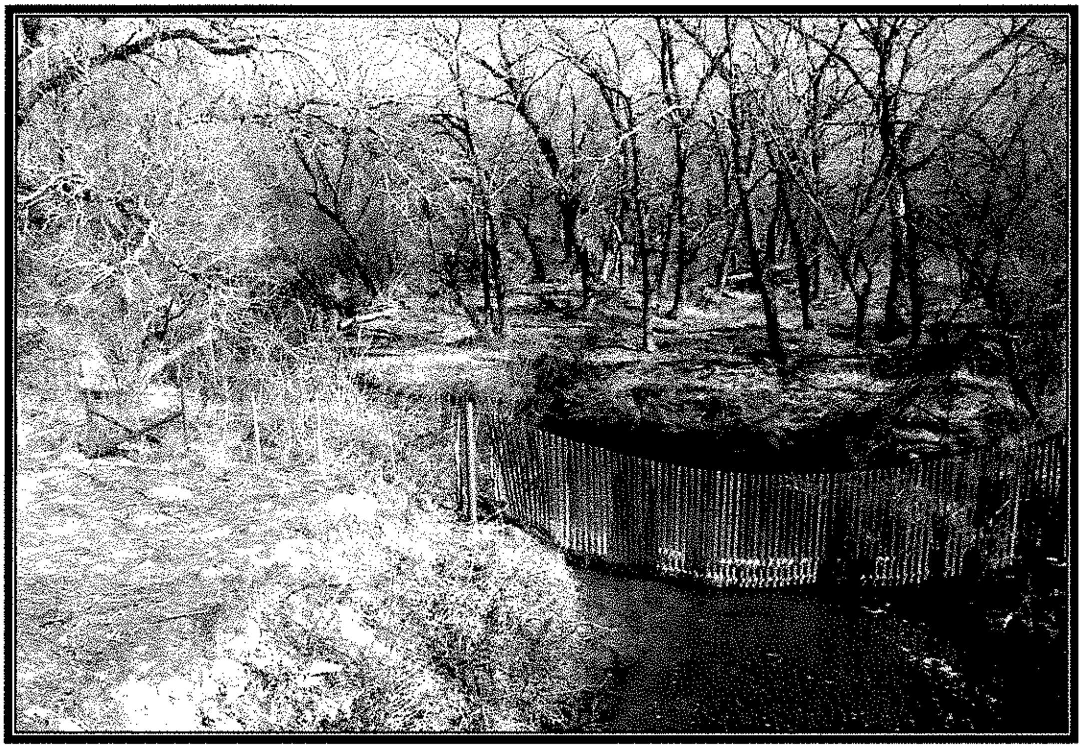
Picture 14 - Lake 8 - Co. Road 3600 S. Canyon Rim Looking NW.

Picture 15 - Lake 8 - Co. Road 3600 Valley Bottom Looking SW.

Picture 16 - Lake 8 - Co. Road 3600 Valley Bottom Looking W.

Picture 17 - Lake 8 - Co. Road 3600 Valley Bottom Looking NW.

Picture 18 - Lake 8 - N. Fork Crossing at FM 400 Looking Upstream (City of Lubbock Stream Discharge Pipe in foreground).

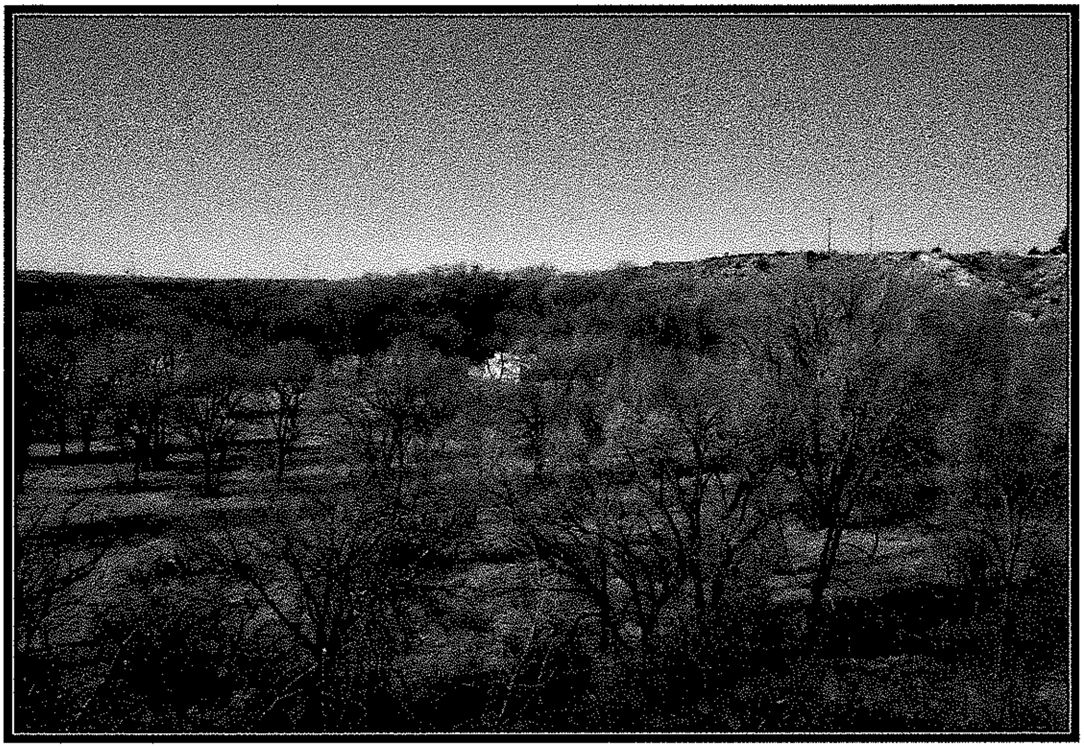


Picture 19 - Lake 8 - N. Fork Crossing at FM 400 Looking Downstream.

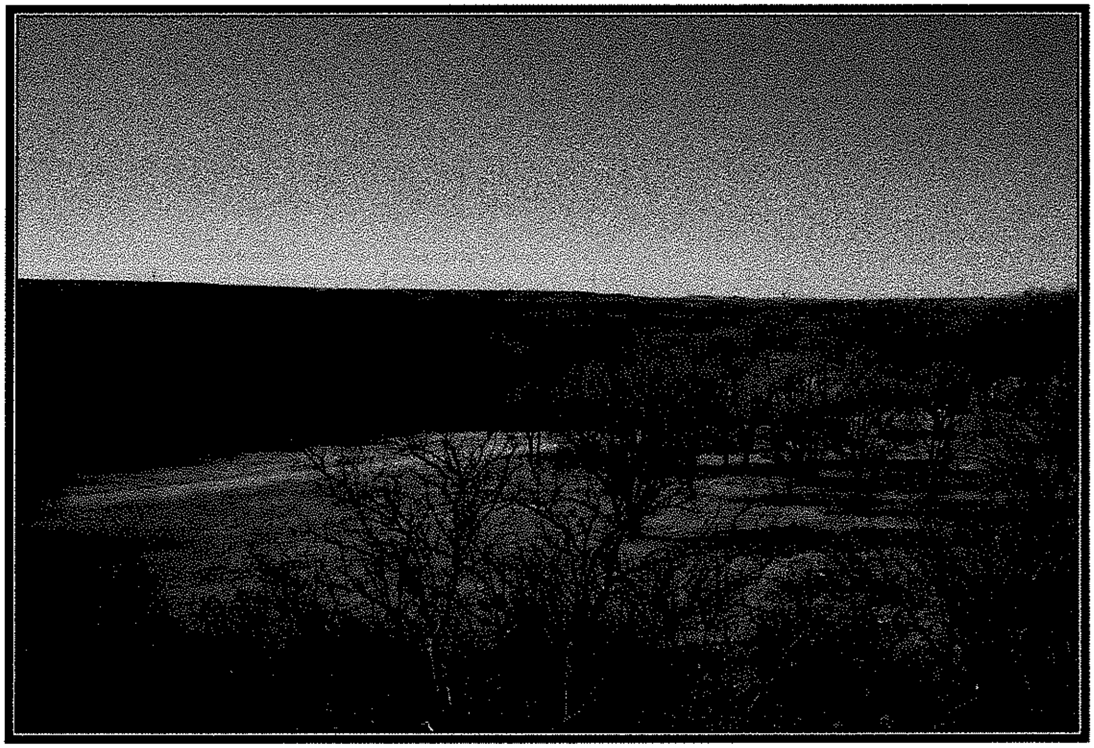
Picture 20 - Lake 8 - FM 400 Looking S. from the N. Canyon Rim.

Picture 21 - Lake 8 - N. Canyon Rim Looking SW upstream of FM 400.

Picture 22 - Lake 8 - View towards the tail of Lake 8 from the N. Canyon Rim.



Picture 23 - Lake 7 - View from N. Canyon Rim at FM 835 Looking to the WNW.

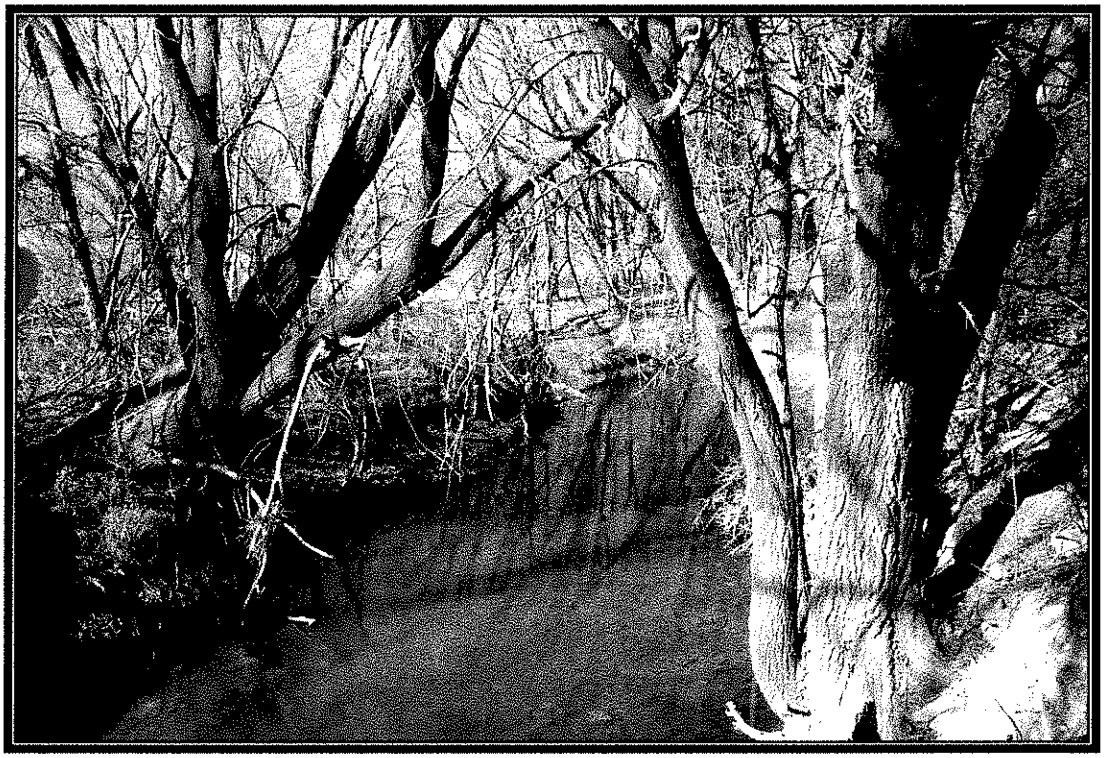


Picture 24 - Lake 7 - View from FM 835 at N. Canyon Rim Looking SW towards dam site.

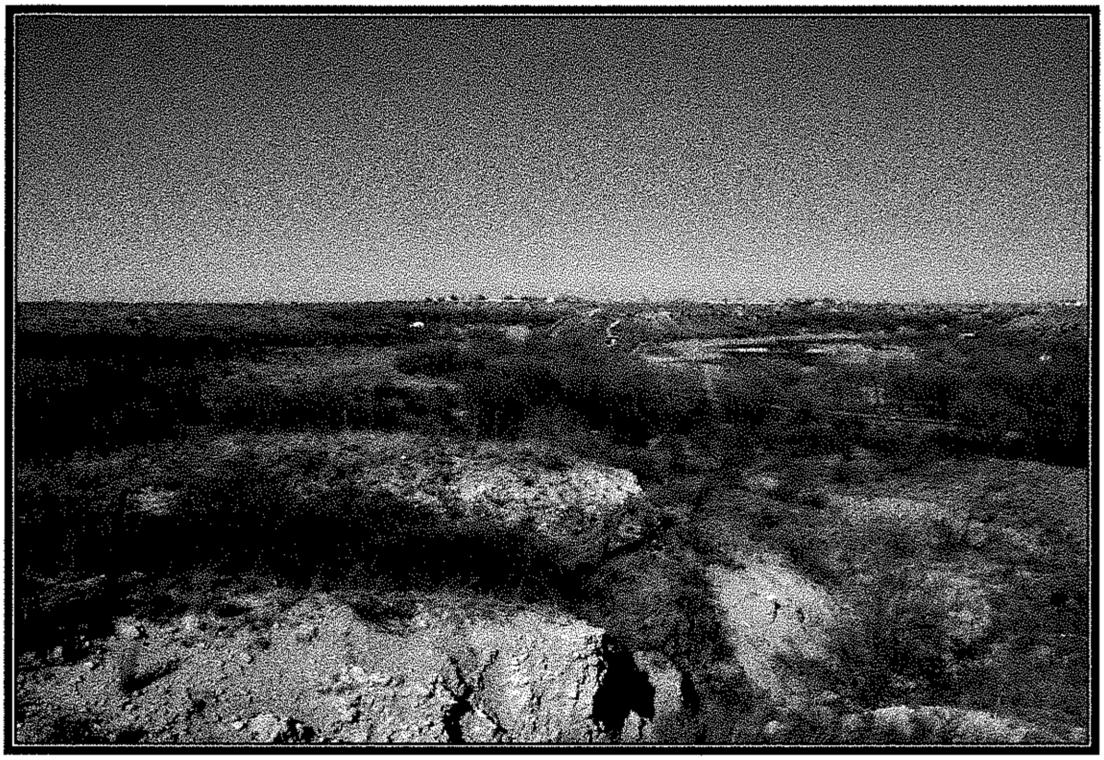
Picture 25 - Lake 7 - View from FM 835 at N. Canyon Rim Looking SW.

Picture 26 - Lake 7 - View from FM 835 at N. Canyon Rim Looking S.

Picture 27 - Upper End of Buffalo Springs Lake. N. Fork Crossing at FM 835 Looking Downstream (East).



Picture 28 - Lake 7 - N. Fork Crossing at FM 835 Looking Upstream.



Picture 29 - Lake 7 - View from S. Canyon Rim at FM 835 Looking N.

Picture 30 - Lake 7 - View from S. Canyon Rim at FM 835 Looking NW.

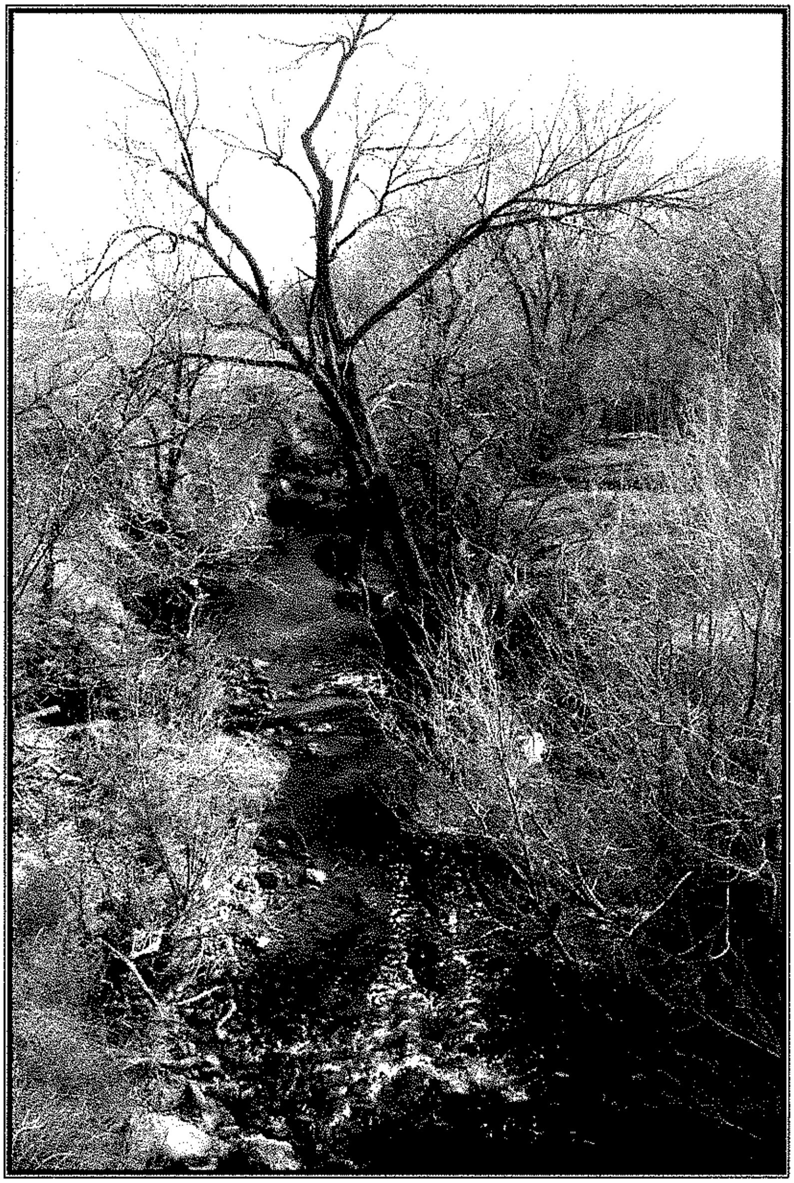
Picture 31 - Lake 7 - View from FM 835 Looking W.

South abutment for Dam 7 shown at left.

Picture 32 - Lake 7 - View from FM 835 Looking NW.

North abutment for Dam 7 shown behind white house.

Picture 33 - Lake 7 - N. Fork Crossing at FM 835 (E. 50th St.) Looking Upstream.



Picture 34 - Lake 7 - N. Fork Crossing at FM 835 (E. 50th St.) Looking Downstream.

Picture 35 - Lake 7 - View from SW Canyon Rim Looking SE

Picture 36 - Lake 7 - View from SW Canyon Rim SSE.

Attachment 1, Table 1. Developed-Water Discharge Point Information

Outfall	Water Source	General Location	Tributary Discharged to in the Brazos River Basin	Latitude	Longitude	Nearest Section Corner	Original Survey No.	Abstract No.	County	Bearing to nearest Section Corner	Distance to nearest Section Corner feet	Method Used for Lat-Long	Maximum Discharge Rate cfs	Discharge Volume acft/yr	Purpose of Use	Location from County Seat	Distance to Dam 7 Site miles	Delivery Factor to Dam 7[1]	Distance to Dam 8 Site miles	Delivery Factor to Dam 8[1]
0	Developed Stormwater	Canyon at Duke Street (University Avenue outfall)	Yellow House Draw	33.60523	-101.86032	NE Cor. Sec. 19, Blk A	N/A	N/A	Lubbock	77.46222	2280.76	GPS	See Table 2	See Table 2	Municipal & Industrial Supply	1.6 miles in a NW direction from the city of Lubbock, Lubbock County, Texas.	14.23	91.76%	24.56	86.24%
1	Developed Stormwater	North of Cornell & Ave Q	Yellow House Draw	33.60388	-101.85564	NE Cor. Sec. 19, Blk A	N/A	N/A	Lubbock	38.49000	1317.9	GPS			Municipal & Industrial Supply	1.4 miles in a N/NW direction from the city of Lubbock, Lubbock County, Texas.	13.91	91.96%	24.24	86.41%
2	Developed Stormwater	Ave P between Erskine & Cornell	Yellow House Draw	33.60439	-101.85315	NE Cor. Sec. 19, Blk A	N/A	N/A	Lubbock	3.68611	871.66	GPS			Municipal & Industrial Supply	1.4 miles in a N/NW direction from the city of Lubbock, Lubbock County, Texas.	13.79	92.02%	24.12	86.47%
3	Developed Stormwater	Aztlan Park (at Canyon) about 300 feet west of outfall #4)	Yellow House Draw	33.59928	-101.84506	SW Cor. Sec 79, Blk A	N/A	N/A	Lubbock	45.79056	3526.02	GPS			Municipal & Industrial Supply	1.0 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.17	92.37%	23.50	86.79%
4	Developed Stormwater	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	Yellow House Draw	33.59908	-101.84420	SE Cor. Sec. 79, Blk A	N/A	N/A	Lubbock	44.32167	3562.48	GPS			Municipal & Industrial Supply	1.0 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.12	92.40%	23.45	86.82%
5	Developed Stormwater	Aztlan Park (at Canyon under I-27 southbound frontage rd.)	Yellow House Draw	33.59908	-101.84416	SE Cor. Sec. 79, Blk A	N/A	N/A	Lubbock	44.32167	3562.48	GPS			Municipal & Industrial Supply	1.0 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.12	92.40%	23.45	86.82%
6	Developed Stormwater	Aztlan Park (at Canyon northeast of outfall #5 across canyon)	Unnamed tributary to Yellow House Draw	33.59970	-101.84401	NE Cor. Sec. 80, Blk A	N/A	N/A	Lubbock	46.22444	3608	GPS			Municipal & Industrial Supply	1.0 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.16	92.37%	23.49	86.80%
7	Developed Stormwater	McKenzie State Park (just west of Joyland)	Unnamed tributary to Yellow House Draw	33.59227	-101.83507	NW Cor. Sec. 3, Blk O	N/A	N/A	Lubbock	84.91861	211.81	GPS			Municipal & Industrial Supply	0.8 miles in a NE direction from the city of Lubbock, Lubbock County, Texas.	12.36	92.82%	22.69	87.22%
8	Developed Stormwater	McKenzie State Park (just east of Joyland, north of overpass)	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.59180	-101.82975	NW Cor. Sec. 3, Blk O	N/A	N/A	Lubbock	82.48250	1841.28	GPS			Municipal & Industrial Supply	1.0 miles in a E/NE direction from the city of Lubbock, Lubbock County, Texas.	12.05	92.99%	22.38	87.38%
9	Developed Stormwater	300 feet West of Compress Ave.on E. 19th	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.57822	-101.83005	SW Cor. Sec. 3, Blk O	N/A	N/A	Lubbock	86.90111	1760.48	GPS			Municipal & Industrial Supply	1.0 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	10.04	94.13%	20.37	88.45%
10	Developed Stormwater	300 feet West of Compress Ave.on E. 19th	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.57822	-101.83005	SW Cor. Sec. 3, Blk O	N/A	N/A	Lubbock	86.90111	1760.48	GPS			Municipal & Industrial Supply	1.0 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	10.04	94.13%	20.37	88.45%
11	Developed Stormwater	East 26th & Southeast Dr	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.57139	-101.82472	SW Cor. Sec. 3, Blk O	N/A	N/A	Lubbock	86.57444	1729.81	GPS			Municipal & Industrial Supply	1.0 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	10.04	94.13%	20.37	88.45%
12	Developed Stormwater	Canyon Lake, East of MLK (south of Vanda Ave.)	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.57243	-101.82461	NE Cor. Sec. 5, Blk B	N/A	N/A	Lubbock	47.46139	2702.28	GPS			Municipal & Industrial Supply	1.5 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	9.67	94.34%	20.00	88.64%
13	Developed Stormwater	Canyon Lake, East of MLK (south of Zenith Ave.)	North Fork of the Double Mountain Fork of the Brazos River	33.57558	-101.81202	NW Cor. Sec. 3, Blk B	N/A	N/A	Lubbock	66.78667	2043.69	GPS			Municipal & Industrial Supply	2.0 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	8.77	94.85%	19.10	89.13%
14	Developed Stormwater	Lift Station at I-27 & Lp 289	Blackwater Draw	33.61712	-101.84157	NE Cor. Sec. 15, Blk A	N/A	N/A	Lubbock	52.42056	2327.25	GPS			Municipal & Industrial Supply	2.2 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	14.77	91.48%	25.10	85.96%
15	Developed Stormwater	Southeast of Municipal Dr & Northbound I-27 Frontage Rd.(Canyon)	Unnamed tributary to Yellow House Draw	33.60099	-101.84333	NE Cor. Sec. 80, Blk A	N/A	N/A	Lubbock	49.53694	3135.66	GPS			Municipal & Industrial Supply	1.1 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.23	92.34%	23.56	86.76%
16	Developed Stormwater	Under Northbound I-27 at Canyon Lakes Dr (Canyon)	Yellow House Draw	33.59749	-101.84161	SE Cor. Sec. 79, Blk A	N/A	N/A	Lubbock	41.47000	2595.4	GPS			Municipal & Industrial Supply	0.9 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	12.93	92.50%	23.26	86.92%
17	Developed Stormwater	Southwest of Northbound I-27 frontage Rd. & Municipal Dr (Canyon)	Unnamed tributary to Yellow House Draw	33.59972	100.18000	NE Cor. Sec. 80, Blk A	N/A	N/A	Lubbock	49.53694	3135.68	GPS			Municipal & Industrial Supply	0.9 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.00	92.46%	23.33	86.88%
18	Developed Stormwater	At Canyon Lakes Dr Under I-27	Unnamed tributary to Yellow House Draw	33.59861	-101.84284	SE Cor. Sec. 79, Blk A	N/A	N/A	Lubbock	40.53222	3106.5	GPS			Municipal & Industrial Supply	0.9 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.06	92.43%	23.39	86.85%
19	Developed Stormwater	Entrance to I-27 Northbound, North of Municipal Dr.	Unnamed tributary to Yellow House Draw	33.60054	-101.84314	NE Cor. Sec. 80, Blk A	N/A	N/A	Lubbock	46.07444	3143.07	GPS			Municipal & Industrial Supply	1.1 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	13.20	92.35%	23.53	86.78%
20	Developed Stormwater	Southeast of Compress and E. 19th	North Fork of the Double Mountain Fork of the Brazos River	33.57781	-101.82868	NW Cor. Sec 5, Blk B	N/A	N/A	Lubbock	88.36028	2747.95	GPS			Municipal & Industrial Supply	1.2 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	9.78	94.28%	20.11	88.58%
24	Developed Stormwater	East Loop 289 & E. 50th (northeast corner)	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.54905	-101.78690	SE Cor. Sec 1, Blk B	N/A	N/A	Lubbock	82.34028	914.11	GPS			Municipal & Industrial Supply	4.2 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	6.08	96.40%	16.41	90.58%
27	Developed Stormwater	Southeast of the Water Rec Plant (South Outfall)	North Fork of the Double Mountain Fork of the Brazos River	33.55945	-101.79633	NW Cor. Sec. 1 Blk B	N/A	N/A	Lubbock	44.39500	2013.56	GPS			Municipal & Industrial Supply	3.3 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	7.09	95.82%	17.42	90.03%
28	Developed Stormwater	South of E. 14th and Date Ave. (West of Warehouse)	Unnamed tributary to the North Fork of the Double Mountain Fork of the Brazos River	33.58224	-101.83307	Sw Cor. Sec. 3, Blk O	N/A	N/A	Lubbock	27.23306	1612.26	GPS			Municipal & Industrial Supply	0.7 miles in a E/SE direction from the city of Lubbock, Lubbock County, Texas.	10.27	94.00%	20.60	88.32%
29	Developed Stormwater	I-27 Northbound Frontage Rd at the Canyon (South of N. Loop)	Blackwater Draw	33.61496	-101.84373	NE Cor. Sec. 15, Blk A	N/A	N/A	Lubbock	49.25833	3317.43	GPS			Municipal & Industrial Supply	2.1 miles in a N direction from the city of Lubbock, Lubbock County, Texas.	14.63	91.58%	24.96	86.03%
30	Developed Stormwater	Southeast of the Water Rec Plant (North Outfall)	North Fork of the Double Mountain Fork of the Brazos River	33.55967	-101.79653	NW Cor. Sec. 1 Blk B	N/A	N/A	Lubbock	44.91889	1913.61	GPS			Municipal & Industrial Supply	3.3 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	7.11	95.81%	17.44	90.02%
31	Developed Stormwater	South Lubbock Drainage Improvements Outfall	North Fork of the Double Mountain Fork of the Brazos River	33.53361	-101.77878	NW Cor. Sec. 11, Blk. S	N/A	N/A	Lubbock	52.19500	568.64	Construction Plans			Municipal & Industrial Supply	5.2 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	3.55	97.88%	13.88	91.97%
32	Treated Effluent	City of Lubbock - SEWRP (future)[2]	North Fork of the Double Mountain Fork of the Brazos River	33.55961	-101.79654	NW Cor. Sec. 11, Blk S	N/A	N/A	Lubbock	26.62139	10389.04	USGS 7.5 Minute Topo Map			Municipal & Industrial Supply	3.3 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	7.12	95.80%	17.45	90.02%
33	Treated Effluent	Town of Ransom Canyon[3]	North Fork of the Double Mountain Fork of the Brazos River	31.43567	-101.67819	NE Cor. Sec. 20, Blk 3	N/A	N/A	Lubbock	61.96722	7326.72	USGS 7.5 Minute Topo Map			Municipal & Industrial Supply	10.5 miles in a SE direction from the city of Lubbock, Lubbock County, Texas.	Downstream of Dam 7		5.84	96.66%

[1] Channel losses and corresponding delivery factors calculated based on channel loss factors used in the development of the Brazos Basin Water Availability Model (WAM) for the North Fork Double Mountain Fork Brazos River. Delivery factor is the percentage of discharge that will reach the respective dam sites.

[2] TPDES Permit No. 10353; Discharges originate from developed water sources, consisting of 60% groundwater and 40% developed (out of basin) surface water.

[3] TPDES Permit No. 10778; Discharges originate from developed water sources, consisting of 60% groundwater and 40% developed (out of basin) surface water.

CEQ Core Data Form

TCEQ Use Only

If you have questions on how to fill out this form or about our Central Registry, please contact us at 512-239-5175.

Individuals are entitled to request and review their personal information that the agency gathers on its forms.
They may also have any errors in their information corrected. To review such information, contact us at 512-239-3282.

SECTION I: General Information

1. Reason for Submission *Example: new wastewater permit; IHW registration; change in customer information; etc.*

Water rights permit application (WR PERM 5921)

2. Attachments				**Describe Any Attachments:** ***(ex: Title V Application, Waste Transporter Application, etc.)***
X	YES		NO	See attached

3. Customer Reference Number-*if issued*				**4. Regulated Entity Reference Number-*if issued***		
CN	CN600130736	***(9 digits)***		RN	**See attached**	***(9 digits)***

SECTION II: Customer Information

5. Customer Role *(Proposed or Actual)* -- As It Relates to the Regulated Entity Listed on This Form

Please check one of the following:		Owner		Operator	X	Owner and Operator
	Occupational Licensee		Volunteer Cleanup Applicant			Other
TCEQ Use Only		**Superfund**		**PST**		**Respondent**

6. General Customer Information

	New Customer	X	Change to Customer Information
	Change in Regulated Entity Ownership		No Change *

***If ANo Change@ and Section I is complete, skip to Section III - Regulated Entity Information.**

7. Type of Customer:			Individual		Sole Proprietorship - D.B.A.
	Partnership		Corporation		Federal Government
	State Government		County Government	X	City Government
	Other Government				Other:

8. Customer Name *(If an individual, please print last name first)*	*If new name, enter previous name:*
City of Lubbock	

9. Mailing Address:	**P.O. Box 2000**			
	City	State	ZIP	ZIP + 4
	Lubbock	**Texas**	**79457**	

10. Country Mailing Information *if outside USA*	**11. E-Mail Address *if applicable***

12. Telephone Number	**13. Extension or Code**	**14. Fax Number *if applicable***
(806) 775-3000		

15. Federal Tax ID ***(9 digits)***	**16. State Franchise Tax ID Number** ***if applicable***	**17. DUNS Number** ***if applicable (9 digits)***
1-75-6000590-6 (Municipality Tax Exempt Number)		

18. Number of Employees									**19. Independently Owned and Operated?**			
	0-20		**21-100**	X	**101-250**		**251-500**		**501 and higher**	X	**Yes**		**No**

SECTION III: Regulated Entity Information

20. General Regulated Entity Information

	New Regulated Entity	X	Change to Regulated Entity Information		No Change*

*If "No Change" and Section I is complete, skip to Section IV - Preparer Information.

21. Regulated Entity Name *(If an individual, please print last name first)*				
City of Lubbock				
22. Street Address (No PO Boxes)	**1625 13th Street**			
	City	State	ZIP	ZIP + 4
	Lubbock	**TX**	**79457**	
23. Mailing Address	**P.O. Box 2000**			
	City	State	ZIP	ZIP + 4
	Lubbock	**TX**	**79457**	
24. E-Mail Address:				

25. Telephone Number	**26. Extension or Code**	**27. Fax Number** ***if applicable***
(806) 775-3000		

28. Primary SIC Code (4 digits)	**29. Secondary SIC Code** (4 digits)	**30. Primary NAICS Code** (5 or 6 digits)	**31. Secondary NAICS Code** (5 or 6 digits)
N/A			

32. What is the Primary Business of this entity? (Please do not repeat the SIC or NAICS description)

Municipality

Questions 33 - 37 address geographic location. Please refer to the instructions for applicability.

33. County	**Lubbock**

34. Description of Physical Location

See attached

35. Nearest City	**State**	**Nearest Zip**
See attached	**Texas**	

36. Latitude (N) See attached			***37. Longitude (W) See attached***		
Degrees	***Minutes***	***Seconds***	***Degrees***	***Minutes***	***Seconds***

38. TCEQ Programs In Which This Regulated Entity Participates *Not all programs have been listed. Please add to this list as needed. If you don't know or are unsure, please mark "Unknown".* If you know a permit or registration # for this entity, please write it below the program."

	Animal Feeding Operation		Petroleum Storage Tank		Water Rights
	Title V - Air		Wastewater Permit		
	Industrial & Hazardous Waste		Water Districts		
	Municipal Solid Waste		Water Utilities	**X**	Unknown
	New Source Review - Air		Licensing - TYPE(s)		

Section IV: Preparer Information

39. Name **Brad B. Castleberry**		**40. Title** **Attorney**
41. Telephone Number 512/322-5856	**42. Extension or Code**	**43. Fax Number** ***if applicable*** **512/472-0532**
44. E-mail Address:	[redacted]	

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Chief Clerk

Date: April 17, 2006

Thru: Kellye Rila KR
Team Leader
Water Rights Permitting Team

CID # 52624

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

2006 APR 17 PM 1:57

CHIEF CLERKS OFFICE

From: Iliana Delgado
Water Rights Permitting Team

Subject: City of Lubbock
WRPERM 5921
CN 600130736, RN – see attached list 22
Application No. 5921 for a Water Use Permit
TWC §11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

The application and partial fees were received on October 17, 2005. Additional information and fees were received on January 31, March 24, and April 13, 2006. The application was declared administratively complete and accepted for filing on April 17, 2006. Mailed and published notice of the application is required pursuant to 30 TAC §295.151.

The City of Lubbock has applied for a Water Use Permit to construct two dams and reservoirs on the North Fork Double Mountain Fork Brazos River, Brazos River Basin, for in-place recreational purposes. The Applicant further seeks to divert and use water from those reservoirs and use the bed and banks of tributaries of the North Fork Double Mountain Fork Brazos River for subsequent diversion and use of water for municipal, industrial, and agricultural purposes in Lubbock and Lynn Counties.

All fees have been paid, and the application is sufficient for filing.

Iliana Delgado
Water Rights Permitting Team
Water Supply Division

CN600130736 City of Lubbock

RN104917984	11205921501	DL1	WRPERM 5921
RN104917992	11205921502	DL2	WRPERM 5921
RN104918008	11205921503	DL3	WRPERM 5921
RN104918016	11205921504	DL4	WRPERM 5921
RN104918024	11205921505	DL5	WRPERM 5921
RN104918032	11205921506	DL6	WRPERM 5921
RN104918040	11205921507	DL7	WRPERM 5921
RN104918057	11205921508	DL8	WRPERM 5921
RN104918065	11205921509	DL9	WRPERM 5921
RN104918073	11205921510	DL10	WRPERM 5921
RN104918081	11205921511	DL11	WRPERM 5921
RN104918099	11205921512	DL12	WRPERM 5921
RN104918107	11205921513	DL13	WRPERM 5921
RN104918115	11205921514	DL14	WRPERM 5921
RN104918131	11205921515	DL15	WRPERM 5921
RN104918149	11205921516	DL16	WRPERM 5921
RN104918156	11205921517	DL17	WRPERM 5921
RN104918164	11205921518	DL18	WRPERM 5921
RN104918172	11205921519	DL19	WRPERM 5921
RN104918180	11205921520	DL20	WRPERM 5921
RN104918198	11205921521	DL21	WRPERM 5921
RN104918206	11205921522	DL22	WRPERM 5921
RN104918214	11205921523	DL23	WRPERM 5921
RN104918222	11205921524	DL24	WRPERM 5921
RN104918230	11205921525	DL25	WRPERM 5921
RN104918248	11205921526	DL26	WRPERM 5921
RN104918255	11205921527	DL27	WRPERM 5921
RN104918263	11205921528	DL28	WRPERM 5921
RN104918271	11205921301	DR1	WRPERM 5921
RN104918289	11205921302	DR2	WRPERM 5921
RN104918297	11205921001	DP1	WRPERM 5921
RN104918313	11205921002	DP2	WRPERM 5921

WRPERM 5921

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
APPLICATION FOR PERMIT TO APPROPRIATE PUBLIC WATER

Texas Water Code Section Nos. 11.042, 11.046, and 11.121
TAC Chapters 30, 50, 281, 287, 288, 295, 297 AND 299
Water Supply Division, Water Rights Permitting MC-160
***P.O. Box 13087**
Austin, Texas 78711-3087
Telephone (512) 239-4691, FAX (512) 239-4770

If including a check, mail directly to P.O. Box 13088; ZIP 78711-3088

---

1. **Name:** City of Lubbock, Texas

MailingAddress: P.O. Box 2000
Lubbock, Texas 79457

Email Address: [redacted]

A. **Customer Reference Number (if issued):** CN600130736

Note: If you do not have a Customer Reference Number, complete Section II of the Core Data Form (TCEQ-10400) and submit it with this application.

B. Lienholder Information (provide this information on the holder of any liens on any land to which the water right would be appurtenant): Not Applicable

2. Dam (structure), Reservoir and Watercourse Data: The City proposes to construct two (2) reservoirs. The engineering assessment and relevant data for these reservoirs is provided as Attachment A.

2.1 Structure No. 1: Dam No. 7

A. Type of Storage Reservoir (indicate by checking () all applicable)

☒ On-Channel ☐ Off-Channel ☐ Existing Structure ☒ Proposed Structure ☐ Exempt Structure*

(TWC Section 11.143 for uses of water for other than domestic or livestock use from an existing reservoir, with a capacity of 200 acre-feet or less.) Please complete Paragraph 6 below if proceeding under TWC 11.143.

Date of Construction: Commencing within two (2) years of permit issuance.

B. Location of Structure:

1) Watercourse: **North Fork Double Mountain Fork Brazos River**

2) Location from County Seat: 7.6 miles in a southeasterly direction from Lubbock, County, Texas. **(See Figure 1)**

3) Location from nearby town (if other than County Seat): N/A miles in a _____ direction from _______, a nearby town shown on county highway map.

4) The dam will be located in Lubbock County, Texas. **(See Figure 2)**

5) Station ________ on the centerline of the dam is N _____ W, _____ feet from the _______ corner of ________ Survey, Abstract No._____, in Lubbock County, Texas, also being at Latitude _________ N, Longitude _________ W.

C. Reservoir:

1) Acre-feet of water impounded by structure at normal maximum operating level: 20,708 acre-feet

2) Surface area in acres of reservoir at normal maximum operating level: 801 acres

RECEIVED
OCT 17 2005

D. 1) If this is a U.S. Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service (SCS)) floodwater-retarding structure, provide the Site No. ______________ and watershed project name **Not Applicable.**

2) Do you request authorization to close the "ports" or "windows" in the service spillway? **Not Applicable.**

☐ Yes ☐ No

E. The drainage area above the dam and/or diversion point is _________ acres or **378** square miles.

2.2 Structure No. 2: Dam No. 8

A. Type of Storage Reservoir (indicate by checking () all applicable)

☒ On-Channel ☐ Off-Channel ☐ Existing Structure ☒ Proposed Structure ☐ Exempt Structure*

(TWC Section 11.143 for uses of water for other than domestic or livestock use from an existing reservoir, with a capacity of 200 acre-feet or less.) Please complete Paragraph 6 below if proceeding under TWC 11.143.

Date of Construction: Commencing within **two (2)** years of permit issuance.

B. Location of Structure:

1) Watercourse: **North Fork Double Mountain Fork Brazos River**

2) Location from County Seat: **15.4** miles east-southeast from Lubbock, County, Texas. **(See Figure 1)**

3) Location from nearby town (if other than County Seat): **N/A** miles in a _____ direction from ______, a nearby town shown on county highway map.

4) The dam will be located in Lubbock County, Texas. **(See Figure 3)**

5) Station _______ on the centerline of the dam is N ____ W, ____ feet from the ______ corner of ________ Survey, Abstract No.____, in Lubbock County, Texas, also being at Latitude _________ N, Longitude _________ W.

C. Reservoir:

3) Acre-feet of water impounded by structure at normal maximum operating level: **49,930** acre-feet

4) Surface area in acres of reservoir at normal maximum operating level: **1,680** acres

D. 1) If this is a U.S. Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service (SCS)) floodwater-retarding structure, provide the Site No. ______________ and watershed project name **Not Applicable.**

2) Do you request authorization to close the "ports" or "windows" in the service spillway? **Not Applicable.**

☐ Yes ☐ No

E. The drainage area above the dam and/or diversion point is _________ acres or **408** square miles.*

***The drainage area for Dam No. 8 encompasses the drainage area for Dam No. 7.**

3. Appropriation Request (total amount of water needed, including maximum projected uses and accounting for evaporative losses for off-channel storage, if applicable).

A. Appropriated water will be used as follows:

	Purpose*	Place of Use	Acre-feet per year
1)	**Municipal/Industrial/ Agricultural**	**All or a part of Lubbock and Lynn Counties**	**50,000**[1]
2)			
3)			

(1) **This application is filed pursuant to Water Code § § 11.121, 11.042 and 11.046 and proposes the recognition of rights to the City under any and all theories of water rights law, including rights related to i) the City's claim to developed water-based storm water discharges from the City's storm sewer system to the North Fork Double Mountain Fork Brazos River and its tributaries, ii) unappropriated state water, iii) future surface water-based return flows and developed water-based return flows resulting from the City's use of groundwater and its use of other developed waters, excluding return flows previously sought by the City pursuant to Application Nos. CA 12-3705B and Permit 3985A, which are currently pending at the Commission, and iv) any and all wastewater return flows that are discharged upstream of Lakes 7 or 8 by third parties.**

*If agricultural use, list crops(s) to be irrigated: No commercial crops to be irrigated.

B. Lands to be irrigated (if applicable):

The City proposes to make raw water available to golf courses, other commercial, and other domestic irrigation users to support the City's conservation initiatives.

C. Diversion Point **No. 01**.

1) Watercourse: **North Fork Double Mountain Fork Brazos River**

2) Location of point of diversion: **Anywhere along the perimeter of the reservoir created by Dam No. 7.**

3) Location from County Seat: 7.6 miles in a southeasterly direction from Lubbock County, Texas. Location from nearby town (if other than County Seat): ______ miles in a ______ direction from _______, a nearby town shown on county highway map.

4) The diversion will be (check all appropriate boxes and if applicable, indicate whether existing or proposed):

		Existing	Proposed
	Directly from stream		
X	From an on-channel reservoir		X
	From stream to an off-channel reservoir		
	From a stream to an on-channel reservoir		
	From an off-channel reservoir		
	Other method (explain fully, use additional sheets if necessary)		

5) Rate of Diversion (Check () applicable provision):
_X_ 1. Diversion Facility:
A. 3,230 Maximum gpm (gallons per minute)
1) Number of pumps: 4

2) Type of pump: **Unknown at this time**
3) Pump capacity of each pump: **2 @ 1,100 gpm; 2 @ 550 gpm**
4) Portable pump __ Yes or X__ No.

___2. If by gravity: **Not Applicable.**
A.____ Headgate _____ Diversion Dam _____ Maximum gpm
B.____ Other method (explain fully - use additional sheets if necessary)

D. Diversion Point **No. 02.**

2) Watercourse: **North Fork Double Mountain Fork Brazos River**

2) Location of point of diversion: **Anywhere along the perimeter of the reservoir created by Dam No. 8.**

3) Location from County Seat: 15.4 miles east-southeast from Lubbock County, Texas. Location from nearby town (if other than County Seat): ______ miles in a ______ direction from _______, a nearby town shown on county highway map.

4) The diversion will be (check all appropriate boxes and if applicable, indicate whether existing or proposed):

	Directly from stream	Existing	Proposed
X	From an on-channel reservoir		X
	From stream to an off-channel reservoir		
	From a stream to an on-channel reservoir		
	From an off-channel reservoir		
	Other method (explain fully, use additional sheets if necessary)		

5) Rate of Diversion (Check () applicable provision):
__X__1. Diversion Facility:
A. 20,000 Maximum gpm (gallons per minute)
1) Number of pumps: 9
2) Type of pump: **Unknown at this time**
3) Pump capacity of each pump: **7 @ 2,500 gpm; 2 @ 1,250 gpm**
4) Portable pump __ Yes or X__ No.

___2. If by gravity: **Not Applicable.**
A.____ Headgate _____ Diversion Dam _____ Maximum gpm
B.____ Other method (explain fully - use additional sheets if necessary)

E. Return Water or Return Flow (location and quantity information): **To the extent that they may exist, return flows will be returned to the tributaries of the North Fork Double Mountain Fork Brazos River and are sought to be appropriated by the City pursuant to this application.**

F. Surplus Water: **Not Applicable.**

4. General Information:
A. The proposed X___ or existing _____ works will be (are) located on: **land that will be purchased by the City. Such properties will be acquired in the event that permits authorizing the construction of the proposed works are issued.**

B. If an application for the appropriation is granted, either in whole or in part, construction works will begin within two years after such permit is issued. The proposed work will be completed within five years from the date the permit is issued.

C. A Water Conservation Plan is attached? X Yes __ No

D. X Interbasin transfer is not requested.

E. Is this project located within 200 river miles of the coast? ___Yes X No __ Unknown

5. **Bed and Banks Authorization. By this application and pursuant to Water Code Section 11.042, the City also seeks to convey the water requested by this application within the bed and banks of the North Fork Double Mountain Fork Brazos River, including all tributaries named or unnamed, from the points of discharge to the diversion points proposed herein.**

6. **Maps, plats, plans, and drawings accompany this application as required by applicable TAC Sections.** X Yes __ No. **See figures and attachments.**

7. **Consistency.** Provide information describing how this application addresses a water supply need in a manner that is consistent with the state water plan or the applicable approved regional water plan for any area in which the proposed appropriation is located or, in the alternative, describe conditions that warrant a waiver of this requirement.

See attached letter and associated materials dated October 10, 2005 to H.P. Brown from Thomas Adams.

Witness by my hand in LUBBOCK, Texas, this the 13th day of October, 2005.

Thomas L. Adams

Name (Printed)

Name (Printed)

SWORN TO AND SUBSCRIBED before me this 13th day of October, 2005.

REBECCA L. VEACH
MY COMMISSION EXPIRES
February 7, 2006

Rebecca L. Veach

Notary Public for the State of Texas

CITY OF LUBBOCK
Office of the City Manager

P.O. Box 2000 • 1625 13th Street • Lubbock, TX 79457
(806) 775-3002 • Fax: (806) 775-2051

January 23, 2006

County Judge: Tom Head
Co. Commissioners:
Mr. William L. "Bill" McKay
Mr. James Kitten
Mr. Ysidro Gutierrez
Ms. Patti Jones
904 Broadway
Lubbock, Texas 79401

Re: Notice of Application for Water Use Permit
City of Lubbock, Texas

The Honorable Tom Heard & Commissioners:

This letter is submitted pursuant to the requirements of H.B. 2140, 79th Legislative Session, to notify you that the City of Lubbock (the "City") has filed an application for a water use permit (the "Application") with the Texas Commission on Environmental Quality (the "Commission"). Specifically, this letter is provided to give you notice that, by the Application, the City seeks authorization from the Commission to construct two (2) reservoirs on the North Fork Double Mountain Fork, and to impound therein both privately-owned developed water and state water, in the collective amount of approximately 71,000 acre-feet. Attached is a copy of the Application filed by the City.

Should you have any questions about the Application or the City's project in general, please feel free to call at your convenience. We will be glad to come by and provide information on the City's water supply plans.

Sincerely,

Thomas L. Adams
Deputy City Manager

AFFIDAVIT

STATE OF TEXAS §
§
COUNTY OF LUBBOCK §

BEFORE ME the undersigned notary, on this day personally appeared Thomas L. Adams, who, being by me duly sworn on oath deposed and stated:

1) My name is Thomas L. Adams, I am of sound mind and capable of making this affidavit and am personally acquainted with the facts herein stated;

2) I am the Deputy City Manager for the City of Lubbock;

3) On January 23, 2006, by first class mail, to the County Judge and County Commissioners of Lubbock County, on behalf of the City I mailed notice of Application for Water Use Permit No. 5921 filed with the Texas Commission on Environmental by the City of Lubbock, as required by H.B. 2140, 79th Legislative Session.

Thomas L. Adams

SUBSCRIBED AND SWORN to before me on this 23rd day of January 2006, to certify which witness my hand and official seal of office.

TINA IVINS
Notary Public, State of Texas
My Commission Expires
March 26, 2007

Notary Public in and for the State of Texas
My commission expires 3/26/07

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==============================================================================================================================
FEE
TYPE       ACCOUNT NAME                               REMITTER                    ID NUMBER
ACCT                                                                 RECEIPT                      CHECK
NUMBER                                                               NUMBER                       NUMBER
                                                                                                         TRANSACTION
                                                                                                              AMOUNT

FEE TYPE: WUP


BATCH #    DATE
 77888     FEB08,06      D6802555


WUP         AMENDMENT                                 KOTHMANN, DONALD L/RITA J      ADJ14-1301A     0
FEB03,06
WUP                                                                  R627824                      1905
0
                                                                                                               101.25-
                         TOTAL RECEIPT N: R627824
                                                                                                               101.25-
                                                                                                         =============


WUP         APPLICATION                               LUBBOCK, CITY OF               5921            0
FEB03,06
WUP                                                                  R627825A                     372437
0
                                                                                                             61326.50-
                         TOTAL RECEIPT N: R627825A
                                                                                                             61326.50-
                                                                                                         =============
            TOTAL BATCH NUM:   77888
                                                                                                             61427.75-
TOTAL FEE TYPE: WUP
                                                                                                             61427.75-
                                                                                                         =============
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FEE
TYPE        ACCOUNT NAME                                REMITTER                           ID NUMBER
ACCT                                                                          RECEIPT                        CHECK
NUMBER                                                                        NUMBER                         NUMBER
                                                                                                                     TRANSACTION
                                                                                                                          AMOUNT

FEE TYPE: PTGU

BATCH #    DATE
 77888      FEB08,06      D6802555


PTGU       POSTAGE-WUP-WATER USE PERMITS                LUBBOCK, CITY OF                    5921             0
FEB03,06
PTGU                                                                          R627825B                       372437
0
                                                                                                                        1021.78-
                              TOTAL RECEIPT N: R627825B
                                                                                                                        1021.78-
                                                                                                                    =============
            TOTAL BATCH NUM:  77888
                                                                                                                        1021.78-
TOTAL FEE TYPE: PTGU
                                                                                                                        1021.78-
                                                                                                                    =============
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Kathleen Hartnett White, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*

THE STATE OF TEXAS

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

December 1, 2005

Mr. Martin Rochelle
Lloyd Gosselink Blevins Rochelle & Townsend, P.C.
111 Congess Avenue, Suite 1800
Austin, TX 78701

CERTIFIED MAIL
and VIA FACSIMILE

RE: City of Lubbock
WRPERM 5921
CN 600130736
Application No. 5921 for a Water Use Permit
TWC §11.121, Requiring Mailed and Published Notice
North Fork Double Mountain Fork Brazos River, Brazos River Basin
Lubbock and Lynn Counties

Dear Mr. Rochelle:

This acknowledges receipt of the referenced application and fees in the amount of $100.00 (receipt R607624 enclosed) on October 17, 2005.

The applicant indicates the reservoirs will be within a park area in Figures 2 and 3. The applicant shall therefore request recreation use for both reservoirs.

TCEQ Hydrology staff performed a preliminary review of this application. Staff determined that there is little to no water available for either a term or perpetual appropriation at your location. If the applicant elects to amend the application by adding an alternative source, please provide all documentation for the alternative source. This could be a signed water supply contract; a contract for re-use of effluent; or well information including, but not limited to, a 24 hour pump test and water quality results, if applicable, to show the reliability of the source.

Before the application can be declared administratively complete, please provide the following:

1. A completed *Supplemental Discharge Point Information Sheet* for each point as well as a list of third parties' wastewater plants; discharges for past five years; and the estimated amount of water that will be lost to transportation, evaporation, seepage, channel or other associated carriage losses from the points of discharge to the point(s) of diversion, including the method of calculation of carriage losses.

binding legal contracts or conservation easements and shall include goals and schedules for completion of those goals. Mitigation areas shall be managed in perpetuity by a party approved by the Commission to maintain the habitat functions and values that will be effected by the proposed project.

11. Whether the U.S. Army Corps of Engineers has been notified of the proposed project in order to determine whether Federal authorization will be required under Section 404/401 of Clean Water Act.

12. On-ground color photographs of the stream at each dam site and downstream as well as several photographs of the stream and riparian areas within, upstream, and downstream of the reservoir inundation areas. Each photograph should include a description of what is depicted as well as be referenced to a map indicating the location and direction of the shot.

13. Identification of all the tributaries of the North Fork requested under the bed and banks portion of the application.

14. Deeds, leases, and/or consents for the property where the proposed reservoirs will be located.

15. A completed *Core Data Form*.

16. Fees in the amount of $122,567.28*, described below. Please make checks payable to the TCEQ or Texas Commission on Environmental Quality.

Filing (120,638 acre/feet)	$ 1,000.00
Recording ($1.25 * 6 pages)	$ 7.50
Use (maximum use fee)	$ 50,000.00
Recreation ($1.00 * 70,638 acre/feet)	$ 70,638.00
Postage (Brazos River Basin)	$ 1,021.78
TOTAL FEES	$122,667.28
FEES RECEIVED	$ 100.00
FEES DUE	**$122,567.28***

*Pursuant to TAC 295.133, if the total fee for a permit exceeds $1,000, the applicant shall pay at least one-half of the use fee when the application is filed, and one-half within 180 days after notice is mailed to the applicant that the permit is granted. If the applicant does not pay all of the amount owed before beginning to use state water under the permit, the permit is annulled and reverts to the status of a pending, filed application requiring notice, the payment of notice fees, and the balance of the use fees.

Amount due prior to the application being declared administratively complete	$62,348.28
Amount due within 180 days after notice is mailed that the permit is granted	$60,219.00

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
APPLICATION FOR PERMIT TO APPROPRIATE PUBLIC WATER

Texas Water Code Section Nos. 11.042, 11.046, and 11.121
TAC Chapters 30, 50, 281, 287, 288, 295, 297 AND 299
Water Supply Division, Water Rights Permitting MC-160
***P.O. Box 13087**
Austin, Texas 78711-3087
Telephone (512) 239-4691, FAX (512) 239-4770

If including a check, mail directly to P.O. Box 13088; ZIP 78711-3088

---

1. **Name:** City of Lubbock, Texas

MailingAddress: P.O. Box 2000
Lubbock, Texas 79457

Email Address: [redacted]

A. **Customer Reference Number (if issued):** CN600130736

Note: If you do not have a Customer Reference Number, complete Section II of the Core Data Form (TCEQ-10400) and submit it with this application.

B. Lienholder Information (provide this information on the holder of any liens on any land to which the water right would be appurtenant): Not Applicable

2. **Dam (structure), Reservoir and Watercourse Data:** The City proposes to construct two (2) reservoirs. The engineering assessment and relevant data for these reservoirs is provided as Attachment A.

2.1 **Structure No. 1: Dam No. 7**

A. Type of Storage Reservoir (indicate by checking () all applicable)

☒ On-Channel ☐ Off-Channel ☐ Existing Structure ☒ Proposed Structure ☐ Exempt Structure*

(TWC Section 11.143 for uses of water for other than domestic or livestock use from an existing reservoir, with a capacity of 200 acre-feet or less.) Please complete Paragraph 6 below if proceeding under TWC 11.143.

Date of Construction: Commencing within two (2) years of permit issuance.

LLOYD GOSSELINK BLEVINS ROCHELLE & TOWNSEND, P.C. 18011

Texas Commission on Environmental Quality 18011 10/17/2005 $100.00

Inv.Date	Inv.No.	Invoice Description	Invoice Amt.	Amt. Paid
10-17-2005	OCT437	Lubbock Water Rights Application	100.00	100.00

application fees
-Iliana Delgado
MC160

$100.00

OCT 17 2005

Lloyd
Gosselink
ATTORNEYS AT LAW

111 Congress Avenue, Suite 1800
Austin, Texas 78701
Telephone: (512) 322-5800
Facsimile: (512) 472-0532
www.lglawfirm.com

Mr. Rochelle's Direct Line: (512) 322-5810
Email: [redacted]

October 17, 2005

Ms. Kellye Rila (MC 160)
Texas Commission on Environmental Quality
Bldg. F, Room 3101
Austin, Texas 78711-3087

VIA HAND DELIVERY

Re: Application for Water Use Permit
Pursuant to Water Code Sections 11.042, 11.046, and 11.121
City of Lubbock, Texas (2020-2)

Dear Kellye:

Please find attached one (1) original and six (6) copies of an application for a water use permit filed on behalf of the City of Lubbock (the "City"). Also attached is my firm's check in the amount of $100.00 submitted as partial payment for the application fees. On behalf of the City please consider me your contact for processing this application.

We look forward to working with you and your staff in amending this water right. Should you have any questions or concerns about this application, do not hesitate to contact either Brad Castleberry (322-5856) or me at your convenience.

Sincerely,

Martin C. Rochelle

MCR/ldp
2020\02\ltr050831bbc
ENCLOSURES

cc: Mr. Anita Burgess
Mr. Richard Casner
Mr. Tom Adams
Mr. Ches Carthel
Ms. Sherry Stephens
Mr. Brad Castleberry

RECEIVED
OCT 17 2005
WATER RIGHTS PERMITTING

Lloyd Gosselink Blevins Rochelle & Townsend, P.C.

WRPERM 5921

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
APPLICATION FOR PERMIT TO APPROPRIATE PUBLIC WATER

Texas Water Code Section Nos. 11.042, 11.046, and 11.121
TAC Chapters 30, 50, 281, 287, 288, 295, 297 AND 299
Water Supply Division, Water Rights Permitting MC-160
***P.O. Box 13087**
Austin, Texas 78711-3087
Telephone (512) 239-4691, FAX (512) 239-4770

If including a check, mail directly to P.O. Box 13088; ZIP 78711-3088

---

1. **Name:** City of Lubbock, Texas

MailingAddress:
P.O. Box 2000
Lubbock, Texas 79457

Email Address: [redacted]

A. **Customer Reference Number (if issued):** CN600130736

Note: If you do not have a Customer Reference Number, complete Section II of the Core Data Form (TCEQ-10400) and submit it with this application.

B. Lienholder Information (provide this information on the holder of any liens on any land to which the water right would be appurtenant): Not Applicable

2. Dam (structure), Reservoir and Watercourse Data: The City proposes to construct two (2) reservoirs. The engineering assessment and relevant data for these reservoirs is provided as Attachment A.

2.1 Structure No. 1: Dam No. 7

A. Type of Storage Reservoir (indicate by checking () all applicable)

☒ On-Channel ☐ Off-Channel ☐ Existing Structure ☒ Proposed Structure ☐ Exempt Structure*

(TWC Section 11.143 for uses of water for other than domestic or livestock use from an existing reservoir, with a capacity of 200 acre-feet or less.) Please complete Paragraph 6 below if proceeding under TWC 11.143.

Date of Construction: Commencing within two (2) years of permit issuance.

B. Location of Structure:

1) Watercourse: **North Fork Double Mountain Fork Brazos River**

2) Location from County Seat: 7.6 miles in a southeasterly direction from Lubbock, County, Texas. **(See Figure 1)**

3) Location from nearby town (if other than County Seat): N/A miles in a _____ direction from ______, a nearby town shown on county highway map.

4) The dam will be located in Lubbock County, Texas. **(See Figure 2)**

5) Station _______ on the centerline of the dam is N _____ W, _____ feet from the ______ corner of ________ Survey, Abstract No._____, in Lubbock County, Texas, also being at Latitude ________ N, Longitude _________ W.

C. Reservoir:

1) Acre-feet of water impounded by structure at normal maximum operating level: 20,708 acre-feet

2) Surface area in acres of reservoir at normal maximum operating level: 801 acres

RECEIVED
OCT 17 2005
[illegible]

D. 1) If this is a U.S. Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service (SCS)) floodwater-retarding structure, provide the Site No. ______________ and watershed project name **Not Applicable.**

2) Do you request authorization to close the "ports" or "windows" in the service spillway? **Not Applicable.**

☐ Yes ☐ No

E. The drainage area above the dam and/or diversion point is _________ acres or 378 square miles.

2.2 Structure No. 2: Dam No. 8

A. Type of Storage Reservoir (indicate by checking () all applicable)

☒ On-Channel ☐ Off-Channel ☐ Existing Structure ☒ Proposed Structure ☐ Exempt Structure*

(TWC Section 11.143 for uses of water for other than domestic or livestock use from an existing reservoir, with a capacity of 200 acre-feet or less.) Please complete Paragraph 6 below if proceeding under TWC 11.143.

Date of Construction: Commencing within two (2) years of permit issuance.

B. Location of Structure:

1) Watercourse: **North Fork Double Mountain Fork Brazos River**

2) Location from County Seat: 15.4 miles east-southeast from Lubbock, County, Texas. **(See Figure 1)**

3) Location from nearby town (if other than County Seat): N/A miles in a _____ direction from ______, a nearby town shown on county highway map.

4) The dam will be located in Lubbock County, Texas. **(See Figure 3)**

5) Station _______ on the centerline of the dam is N ____ W, ____ feet from the ______ corner of ________ Survey, Abstract No.____, in Lubbock County, Texas, also being at Latitude ________ N, Longitude _________ W.

C. Reservoir:

3) Acre-feet of water impounded by structure at normal maximum operating level: 49,930 acre-feet

4) Surface area in acres of reservoir at normal maximum operating level: 1,680 acres

D. 1) If this is a U.S. Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service (SCS)) floodwater-retarding structure, provide the Site No. ______________ and watershed project name **Not Applicable.**

2) Do you request authorization to close the "ports" or "windows" in the service spillway? **Not Applicable.**

☐ Yes ☐ No

E. The drainage area above the dam and/or diversion point is _________ acres or 408 square miles.*

***The drainage area for Dam No. 8 encompasses the drainage area for Dam No. 7.**

3. Appropriation Request (total amount of water needed, including maximum projected uses and accounting for evaporative losses for off-channel storage, if applicable).

A. Appropriated water will be used as follows:

	Purpose*	Place of Use	Acre-feet per year
1)	**Municipal/Industrial/ Agricultural**	**All or a part of Lubbock and Lynn Counties**	**50,000**[1]
2)			
3)			

(1) This application is filed pursuant to Water Code § § 11.121, 11.042 and 11.046 and proposes the recognition of rights to the City under any and all theories of water rights law, including rights related to i) the City's claim to developed water-based storm water discharges from the City's storm sewer system to the North Fork Double Mountain Fork Brazos River and its tributaries, ii) unappropriated state water, iii) future surface water-based return flows and developed water-based return flows resulting from the City's use of groundwater and its use of other developed waters, excluding return flows previously sought by the City pursuant to Application Nos. CA 12-3705B and Permit 3985A, which are currently pending at the Commission, and iv) any and all wastewater return flows that are discharged upstream of Lakes 7 or 8 by third parties.

*If agricultural use, list crops(s) to be irrigated: No commercial crops to be irrigated.

B. Lands to be irrigated (if applicable):

The City proposes to make raw water available to golf courses, other commercial, and other domestic irrigation users to support the City's conservation initiatives.

C. Diversion Point **No. 01**.

1) Watercourse: **North Fork Double Mountain Fork Brazos River**

2) Location of point of diversion: **Anywhere along the perimeter of the reservoir created by Dam No. 7.**

3) Location from County Seat: 7.6 miles in a southeasterly direction from Lubbock County, Texas. Location from nearby town (if other than County Seat): ______ miles in a ______ direction from _______, a nearby town shown on county highway map.

4) The diversion will be (check all appropriate boxes and if applicable, indicate whether existing or proposed):

	Directly from stream	Existing	Proposed
X	From an on-channel reservoir		X
	From stream to an off-channel reservoir		
	From a stream to an on-channel reservoir		
	From an off-channel reservoir		
	Other method (explain fully, use additional sheets if necessary)		

5) Rate of Diversion (Check () applicable provision):

__X__ 1. Diversion Facility:

A. 3,230 Maximum gpm (gallons per minute)

1) Number of pumps: 4

2) Type of pump: **Unknown at this time**
3) Pump capacity of each pump: **2 @ 1,100 gpm; 2 @ 550 gpm**
4) Portable pump __ Yes or X__ No.

___2. If by gravity: **Not Applicable.**
A.____ Headgate _____ Diversion Dam _____ Maximum gpm
B.____ Other method (explain fully - use additional sheets if necessary)

D. Diversion Point **No. 02**.

2) Watercourse: **North Fork Double Mountain Fork Brazos River**

2) Location of point of diversion: **Anywhere along the perimeter of the reservoir created by Dam No. 8.**

3) Location from County Seat: **15.4** miles east-southeast from Lubbock County, Texas. Location from nearby town (if other than County Seat): ______ miles in a ______ direction from _______, a nearby town shown on county highway map.

4) The diversion will be (check all appropriate boxes and if applicable, indicate whether existing or proposed):

	Directly from stream	Existing	Proposed
X	From an on-channel reservoir		X
	From stream to an off-channel reservoir		
	From a stream to an on-channel reservoir		
	From an off-channel reservoir		
	Other method (explain fully, use additional sheets if necessary)		

5) Rate of Diversion (Check () applicable provision):
__X_1. Diversion Facility:
A. **20,000** Maximum gpm (gallons per minute)
1) Number of pumps: **9**
2) Type of pump: **Unknown at this time**
3) Pump capacity of each pump: **7 @ 2,500 gpm; 2 @ 1,250 gpm**
4) Portable pump __ Yes or X__ No.

___2. If by gravity: **Not Applicable.**
A.____ Headgate _____ Diversion Dam _____ Maximum gpm
B.____ Other method (explain fully - use additional sheets if necessary)

E. Return Water or Return Flow (location and quantity information): **To the extent that they may exist, return flows will be returned to the tributaries of the North Fork Double Mountain Fork Brazos River and are sought to be appropriated by the City pursuant to this application.**

F. Surplus Water: **Not Applicable.**

4. General Information:

A. The proposed X__ or existing _____ works will be (are) located on: **land that will be purchased by the City. Such properties will be acquired in the event that permits authorizing the construction of the proposed works are issued.**

B. If an application for the appropriation is granted, either in whole or in part, construction works will begin within two years after such permit is issued. The proposed work will be completed within five years from the date the permit is issued.

C. A Water Conservation Plan is attached? X Yes __ No

D. X Interbasin transfer is not requested.

E. Is this project located within 200 river miles of the coast? __Yes X No _ Unknown

5. Bed and Banks Authorization. **By this application and pursuant to Water Code Section 11.042, the City also seeks to convey the water requested by this application within the bed and banks of the North Fork Double Mountain Fork Brazos River, including all tributaries named or unnamed, from the points of discharge to the diversion points proposed herein.**

6. Maps, plats, plans, and drawings accompany this application as required by applicable TAC Sections.
X Yes _ No. **See figures and attachments.**

7. Consistency. Provide information describing how this application addresses a water supply need in a manner that is consistent with the state water plan or the applicable approved regional water plan for any area in which the proposed appropriation is located or, in the alternative, describe conditions that warrant a waiver of this requirement.

See attached letter and associated materials dated October 10, 2005 to H.P. Brown from Thomas Adams.

Witness by my hand in Lubbock, Texas, this the 13th day of October, 2005.

Thomas L. Adams
Name (Printed)

Name (Printed)

SWORN TO AND SUBSCRIBED before me this 13th day of October, 2005.

REBECCA L. VEACH
MY COMMISSION EXPIRES
February 7, 2006

Rebecca L. Veach
Notary Public for the State of Texas

Resolution No. 2003-R0362
September 4, 2003
Item No. 26

RESOLUTION

WHEREAS, the City of Lubbock is required to obtain certain permits from the State of Texas regarding appropriative water rights and the discharge and disposal of wastewater; and

WHEREAS, the City of Lubbock is required to execute applications for such permits; and

WHEREAS, the City Council of the City of Lubbock desires to appoint the Director of Public Works of the City of Lubbock, to act in the capacity set forth below, regarding said permit applications.

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF LUBBOCK;

THAT the Director of Public Works, is hereby appointed by the City Council of the City of Lubbock to execute and submit any and all applications for appropriative water rights permits and/or applications to amend or renew same, and Texas Pollutant Discharge Elimination System Permits, and/or applications to amend or renew same, and any and all other related documents to be submitted to the Texas Commission on Environmental Quality, related to or in connection with Chapter 11 of the Texas Water Code, Chapter 26 of the Texas Water Code, and/or other laws of the State of Texas relating to the same or similar subject matter, as each of same may be amended from time to time, and all rules and regulations promulgated pursuant to such laws.

BE IT FURTHER RESOLVED BY THE CITY COUNCIL OF THE CITY OF LUBBOCK:

THAT all actions of the Director of Water Utilities and the Director of Public Works taken prior to the date of the adoption of this Resolution regarding the subject matter hereof, are ratified in all respects and instances.

Passed by the City Council this 4th day of September, 2003.

MARC MCDOUGAL, MAYOR

ATTEST:

Rebecca Garza, City Secretary

APPROVED AS TO CONTENT:

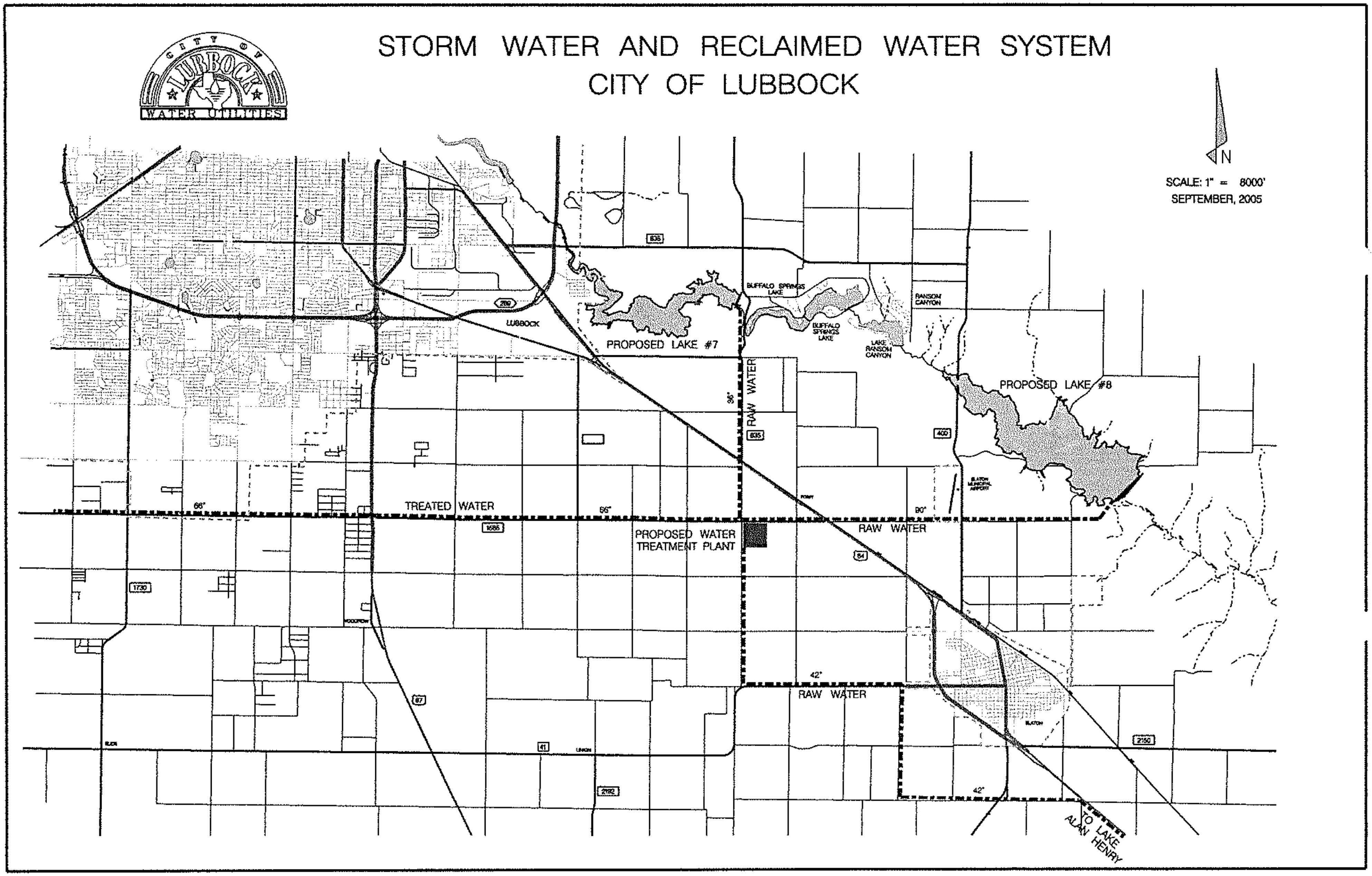
Dan Dennison

Dan Dennison
Environmental Compliance Manager

APPROVED AS TO FORM:

Richard K. Casner
First Assistant City Attorney

ke/ccdcos/Ellerbrook.designee.res
August 25, 2003


STORM WATER AND RECLAIMED WATER SYSTEM
CITY OF LUBBOCK

...\user\109682\CHES\lake7-8-b.dgn 10/07/2005 03:31:38 PM

FIGURE 1

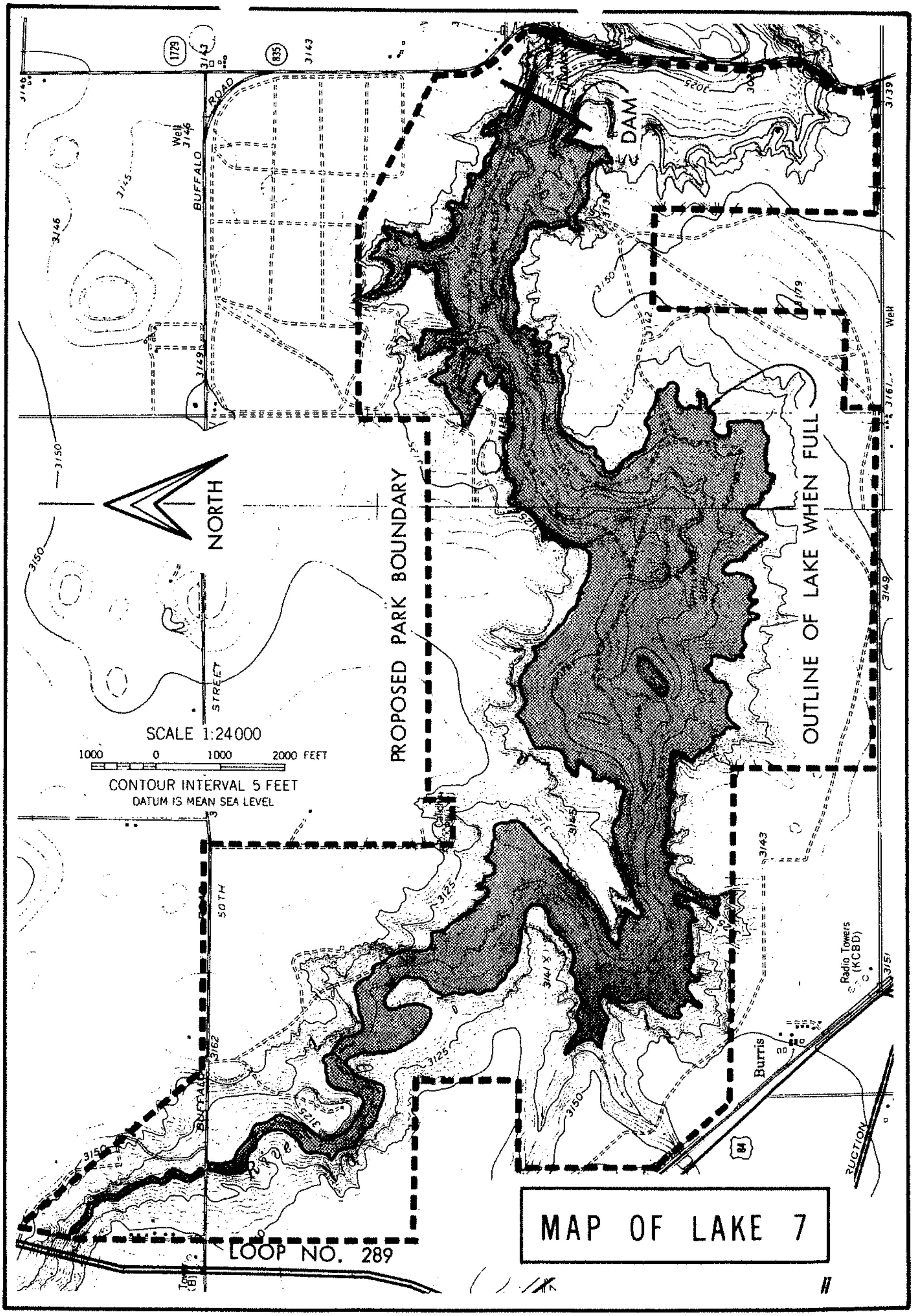

MAP OF LAKE 7
NORTH
SCALE 1:24000
1000 0 1000 2000 FEET
CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL
PROPOSED PARK BOUNDARY
OUTLINE OF LAKE WHEN FULL
DAM
LOOP NO. 289
BUFFALO ROAD
STREET
50TH
BUFFALO
Well
1729
835
84
Burris
Radio Towers (KCBD)
3150
3125
3145
3146
3149
3143
3139
3161
3151
3162
3141

FIGURE 2

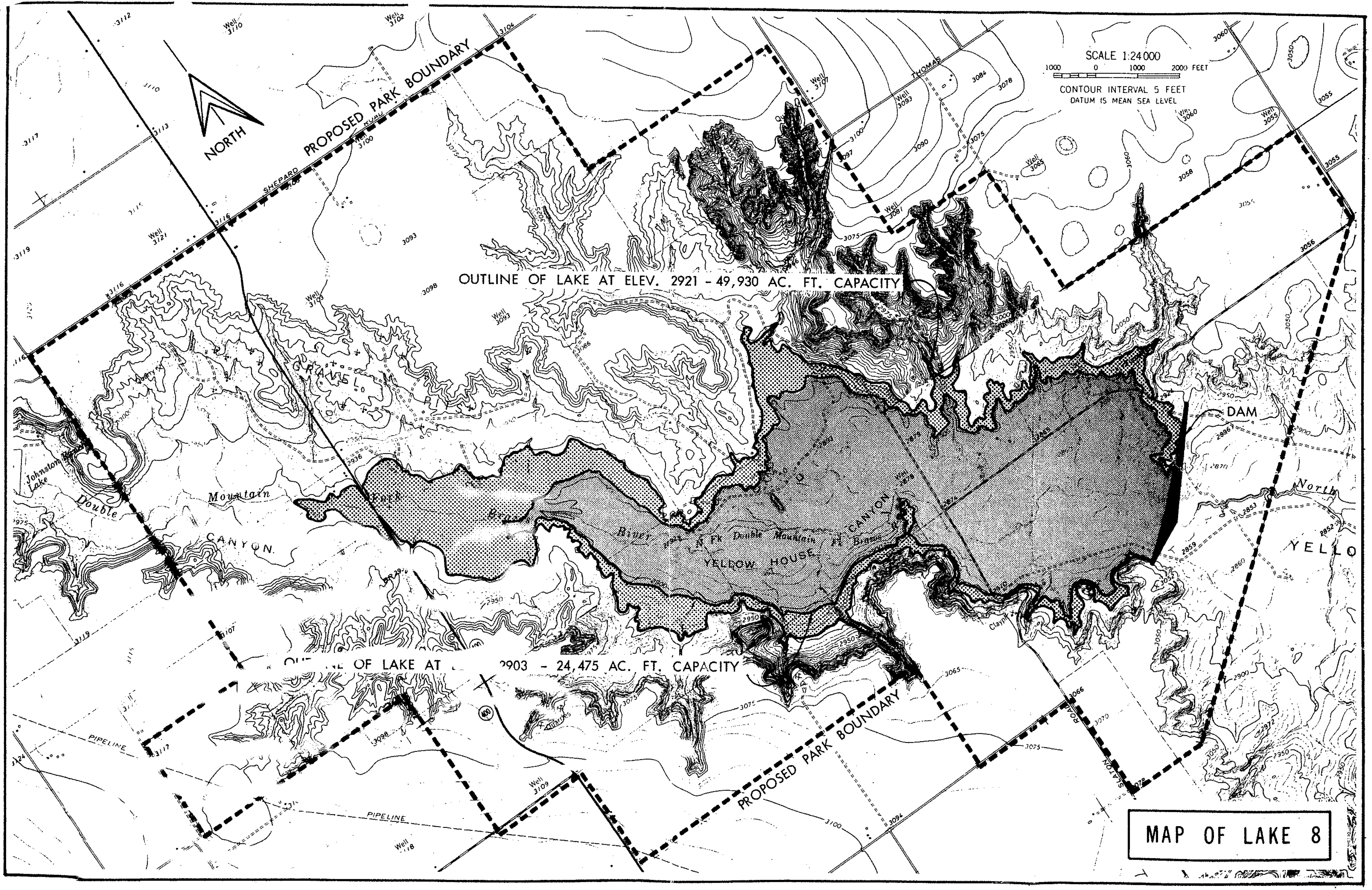

NORTH
SCALE 1:24000
1000 0 1000 2000 FEET
CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL
PROPOSED PARK BOUNDARY
SHEPARD ROAD
THOMAS
GRAVEL PIT
OUTLINE OF LAKE AT ELEV. 2921 - 49,930 AC. FT. CAPACITY
OUTLINE OF LAKE AT ELEV. 2903 - 24,475 AC. FT. CAPACITY
DAM
Johnston Lake
Double Mountain Fork Brazos River
CANYON
N Fk Double Mountain Ft Brazos
YELLOW HOUSE CANYON
North
YELLO
PIPELINE
STATION ROAD
PROPOSED PARK BOUNDARY
Well 3110
Well 3102
Well 3107
Well 3093
Well 3081
Well 3063
Well 3060
Well 3055
Well 3100
Well 3121
Well 3103
Well 3093
Well 2878
Well 3109
Well 3118
MAP OF LAKE 8

FIGURE 3

P.O. Box 2000
Lubbock, Texas 79457
(806) 775-2351 • Fax: (806) 775-3344

Office of
Public Works Engineering

April 16, 2004

Resource Protection Team
Texas Commission on Environmental Quality
MC160
P.O. Box 13087
Austin, Texas 78711-3087

Re: Revised Drought Contingency and Water Conservation Plans
City of Lubbock
Public Water System ID 1520002

To Whom It May Concern:

Please find attached to this letter revised Drought Contingency and Water Conservation Plans for the City of Lubbock. The Lubbock City Council approved these documents on April 6, 2004. On March 23, 2004, a public meeting was held at the City Council chambers for both plans. No comments were received.

Please contact us should you have questions.

Sincerely,

Chester "Ches" Carthel, P.E.
Water Planning Engineer

Xc: Lou Fox, City Manager
Anita Burgess, City Attorney
Terry Ellerbrook, Director of Public Works

Post-it® Fax Note	7671	Date	10/17/05 # of pages ▸
To	Brad Castleberry	From	Ches Carthel
Co./Dept.	Lloyd, Gosselink	Co.	Lubbock
Phone #	512-322-5800	Phone #	806-775-2280
Fax #	512-472-0532	Fax #	806-775-2051

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P.O. Box 2000 • 1625 13th Street • Lubbock, TX 79457
(806) 775-3002 • Fax: (806) 775-2051

Office of the City Manager

October 10, 2005

Mr. H. P. "Bo" Brown, Jr.
Chair
Region O Planning Group
2930 Ave. Q
Lubbock, Texas 79411

Re: Region O Water Plan
Public Comments

Dear Mr. Brown:

The City of Lubbock wishes to submit public comment on the Draft Regional Water Plan. Lubbock has been actively and dynamically planning for its water future. As a result, the City Council and Lubbock Water Advisory Commission have evaluated many options over the past year. At least four of these options need to be included in the Region O Plan so Lubbock may obtain the necessary permitting and funding. The attached document describes each of these in more detail. However, in general, the four water supply strategies that Lubbock requests be made part of the Region O Plan are as follows:

- Brackish Groundwater Desalination.
- CRMWA II: A second major water transmission system for groundwater from the northern panhandle to Lubbock.
- Jim Bertram Lake System (JBLS) Expansion.
- North Fork Scalping Operation to supplement the yield of Lake Alan Henry.

We appreciate the cooperation of the Planning Group. Please contact me should you have questions.

Sincerely,

Thomas Adams
Deputy City Manager

Xc: Ches Carthel
Herb Grubb, HDR

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CITY OF LUBBOCK WATER PLANNING STRATIGIES REGION O INITIALLY PREPARED PLAN

STRATEGY 1: BRACKISH GROUNDWATER DESALINATION

Description. Develop wells in the Trinity and Dockum Group of aquifers for subsequent treatment and use as drinking water. Wells will initially be developed in existing water rights in Bailey and Lubbock Counties.

The proposed system is added in groups of four wells to produce an estimated 4 million gallons per day (mgd) of groundwater. Each well group has an associated well collection, treatment and reject water disposal system. Each well group is estimated to produce about 3,360 acre-feet per year (AF/yr) of potable water.

It is intended that well groups with treatment and disposal systems will be brought on line, as the water is needed.

Costs. Estimated capital cost for each well group complete with collection system, treatment system, and disposal system is $9,700,000 (see Table 1). Annual operation and maintenance costs are estimated to be $1,000,000 (see Table 2).

STRATEGY 2: CRMWA II

Description. This strategy is a second transmission system from groundwater rights in the Northern panhandle to Lubbock. The pipeline would roughly parallel the existing Canadian River Municipal Water Authority (CRMWA) transmission system (see attached map). In general, this system is designed to deliver water to Amarillo, Plainview and Lubbock. Other cities may participate but current planning is based only on these three cities.

The system is designed to provide the 100,000 AF/yr of groundwater production. Lubbock would receive 40 percent or 40,000 AF/yr of this water.

Costs. Capital costs for Lubbock only are estimated to be $182,100,000 (see Table 3). Operation and maintenance cost are estimated at $190/AF. This is based on the 2003/04 delivery cost of water from CRMWA of $187/AF.

STRATEGY 3: JIM BERTRAM LAKE SYSTEM (JBLS) EXPANSION

Description. This planning strategy is intended to allow use of Lubbock's developed water resources. These developed water resources include run off from the storm water collection system, groundwater from the Lubbock Land Application Site, treated wastewater discharged into Yellowhouse Canyon, and other water sources. To achieve this, Lakes 7 and/or 8 from the original Canyon

Lakes System (now called the Jim Bertram Lake System) would be built to store and divert water (see attached map). This water would treated at a new water treatment facility southeast of Lubbock. At some point, water from Lake Alan Henry would also be included with the developed water and treated at the same facility. This water would be transported to the south and southwest areas of Lubbock's service area. Key components of this system are:

- Lake 7: Storage: 20,700 AF
  - Firm annual yield: 3,500 AF/yr (3.1 mgd)
  - Pump station & pipeline capacity: 4.65 mgd
  - Pipeline length: 21,200 feet
  - Pipeline diameter: 36 inches

- Lake 8: Storage: 49,900 AF
  - Firm annual yield: 20,000 AF/yr (17.8 mgd)
    - Storm water: 5,000 AF/yr
    - Reclaimed water: 15,000 AF/yr
  - Pump station & pipeline capacity: 26.7 mgd
  - Pipeline length: 37,000 feet
  - Pipeline diameter: 90 inches
- Water Treatment Plant: Capacity: 21 mgd (initially)
- Transmission main: Length: 79,200 feet
  - Diameter: 66 inches

Costs. Capital and operation and maintenance costs for this option have not been developed.

STRATEGY 4: NORTH FORK SCALPING OPERATION

Description. This water supply strategy would involve the diversion of interruptible water flows on the North Fork of the Double Mountain Fork of the Brazos River (the North Fork) to Lake Alan Henry to supplement its' firm annually yield. The attached map indicating a location of the diversion dam and lake in Garza County is only intended to serve as a general conceptual location. If this option were to be implemented, the actual location would depend on the topography, geology, land availability, permitting possibilities, and other factors. This option would be similar in the City of Abilene's Clear Fork scalping operation. Consequently, component sizing and water yields are similar to Abilene's permit. Key components of the proposed system are:

- Diversion dam: Capacity: 1000 AF
- Diversion rate: Annual: 30,000 AF/yr
  - Max. flow: 250 cfs
- Pump station & pipeline capacity: 250 cfs
- Pipeline diameter: 96 inches

- Pipeline length: 32,000 feet

Water would be pumped from the diversion lake during storm events and discharged into Gobbler Creek, which would then flow to Lake Alan Henry.

Costs. Capital and operation and maintenance costs for this option have not been developed.

TABLE 1- BRACKISH GROUNDWATER CAPITAL COST (1)

Capital Costs

Item	Cap / Size (Ea)	Units	# Req'd	Unit Cost	Extension	Comments
Supply Wells	1	mgd	4	$600,000	$2,400,000	Includes well, power, control panel and site work.
Well Collection Lines	12	in. dia.	10560	$30	$316,800	Four Collection Lines - 1/2 mile each
Reverse Osmosis	1	mgd	4	$400,000	$1,600,000	Budget Price from manufacturer of $0.40/gal of capacity.
Building & Support	6000	SF	6000	$150	$900,000	Include disinfection (chloramine), post treatment, and byproduct pumping, electrical, SCADA
Sitework	1	LS	1	$25,000	$25,000	Fencing, pavement, drainage, security
Byproduct Wells	0.5	mgd	2	$350,000	$700,000	
Byproduct Transmission	8	in. dia.	2640	$20	$52,800	
Total Construction					$5,995,000	
Feasibility					$300,000	
Pilot Studies					$600,000	
Design					$899,000	
Real Estate, Legal, Admin.					$300,000	
SUBTOTAL					$8,094,000	
Contingency @	20%				$1,619,000	
TOTAL Initial Cost					$9,713,000	
Amortized Cost @ 20 years and 6% interest					$846,824	
Annual Production					1,095,000,000	
Cost per Thousand Gallons					$0.77	

(1) SOURCE: Mark V. Lowry, P.E., Turner, Collie & Braden
Prepared for City of Lubbock

TABLE 2 - BRACKISH GROUNDWATER O&M COSTS (1)

Operating Costs

Item	Cap (mgd)	Head (psi)	Efficiency	Unit Consump.	Units	Operation	Annual Consumpt	Units	Unit Cost	Annual Cost	Comments
Power - Supply Wells	4	875	75%	1900	HP	Continuous	12,411,431	KW-Hrs	$0.06	$745,000	Includes well depth of 1500 feet plus RO feed pressure of 225 psi. Energy recovery system may reduce costs.
Power - Injection Wells	1	200	75%	100	HP	Continuous	653,233	KW-Hrs	$0.06	$39,000	Injection pressure assumed.
Membrane Replacement	N/A	N/A	N/A	630	Ea	Total	90	Ea	$675.00	$60,750	Assumes 7 year life of membranes
Disinfection Costs	N/A	N/A	N/A	1.5	mg/l	Continuous	6.8	Tons/Yea	$450.00	$3,082	Includes combined chlorine plus ammonia costs to achieve 1.5 mg/l total chlorine
Subtotal Annual O&M Costs										$848,000	
Contingency @ 20%										$169,600	
Total Annual O&M Costs										$1,017,600	
Annual Production										1,095,000,000	gallons
O&M Cost / Thousand gallons										$0.93	per thousand gallons
Initial Cost / 1000 gallons										$0.77	per thousand gallons
Total life Cycle Unit Costs						$619 per ac-ft				$1.70	per thousand gallons

(1) SOURCE: Mark V. Lowry, P.E., Turner, Collie & Braden
Prepared for City of Lubbock

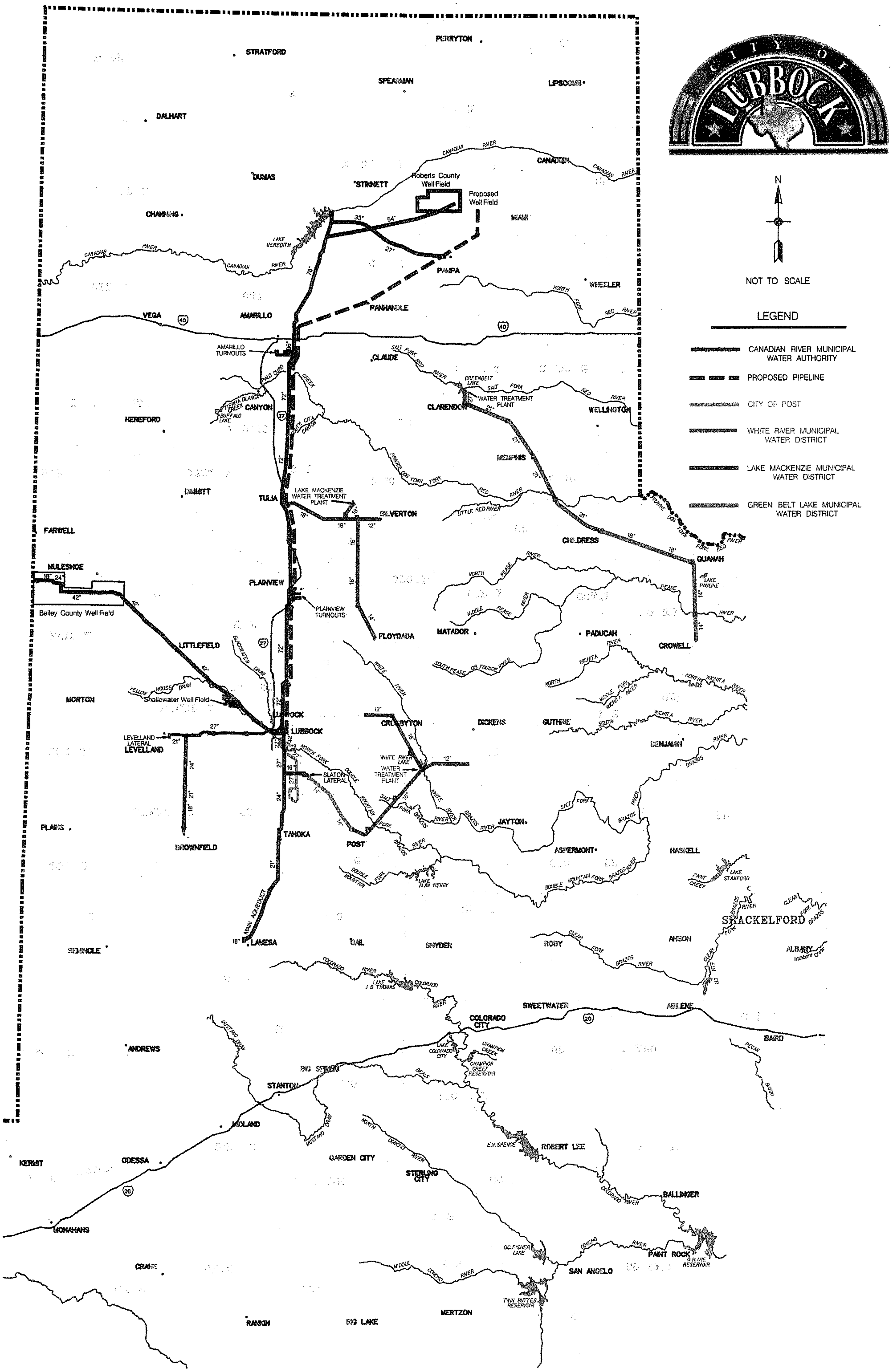
TABLE 3 - CRMWA II (Amarillo, Plainview & Lubbock)
WELL FIELD AND TRANSMISSION SYSTEM
City of Lubbock, Water Utilities

10/10/05

Estimate by: Chester "Ches" Carthel, P.E.

ITEM	QTY	UNITS	UNIT COST	TOTAL COST	PROPORTIONATE COSTS		
					AMARILLO 45%	PLAINVIEW 10%	LUBBOCK 45%
WELL FIELD							
Water Rights	100,000	Acres	$400	$40,000,000	$18,000,000	$4,000,000	$18,000,000
Well Field development	100,000	Acres	$1,000	$100,000,000	$45,000,000	$10,000,000	$45,000,000
Subtotal Well Field				$140,000,000	$63,000,000	$14,000,000	$63,000,000
TRANSMISSION SYSTEM							
72" w/ PS from well field to Amarillo	40	Miles	$1,200,000	$48,000,000	$21,600,000	$4,800,000	$21,600,000
72" from Amarillo to Plainview	75	Miles	$1,000,000	$75,000,000	$0	$13,500,000	$61,500,000
66" from Plainview to Lubbock	45	Miles	$800,000	$36,000,000	$0	$0	$36,000,000
Subtotal Transmission System				$159,000,000	$21,600,000	$18,300,000	$119,100,000
Subtotal				$299,000,000	$84,600,000	$32,300,000	$182,100,000

ITEM	QTY	UNITS	UNIT COST	TOTAL COST	ANNUAL COST
OPERATION & MAINT. COST - LUBBOCK ONLY					
Debt Service (5% for 40 yrs)				$10,616,430	
Annual Operations	0	AF	$190	$0	$10,616,430
	5000	AF	$190	$950,000	$11,566,430
	10000	AF	$190	$1,900,000	$12,516,430
	15000	AF	$190	$2,850,000	$13,466,430
	20000	AF	$190	$3,800,000	$14,416,430
	25000	AF	$190	$4,750,000	$15,366,430
	30000	AF	$190	$5,700,000	$16,316,430
	35000	AF	$190	$6,650,000	$17,266,430
	40000	AF	$190	$7,600,000	$18,216,430
	45000	AF	$190	$8,550,000	$19,166,430

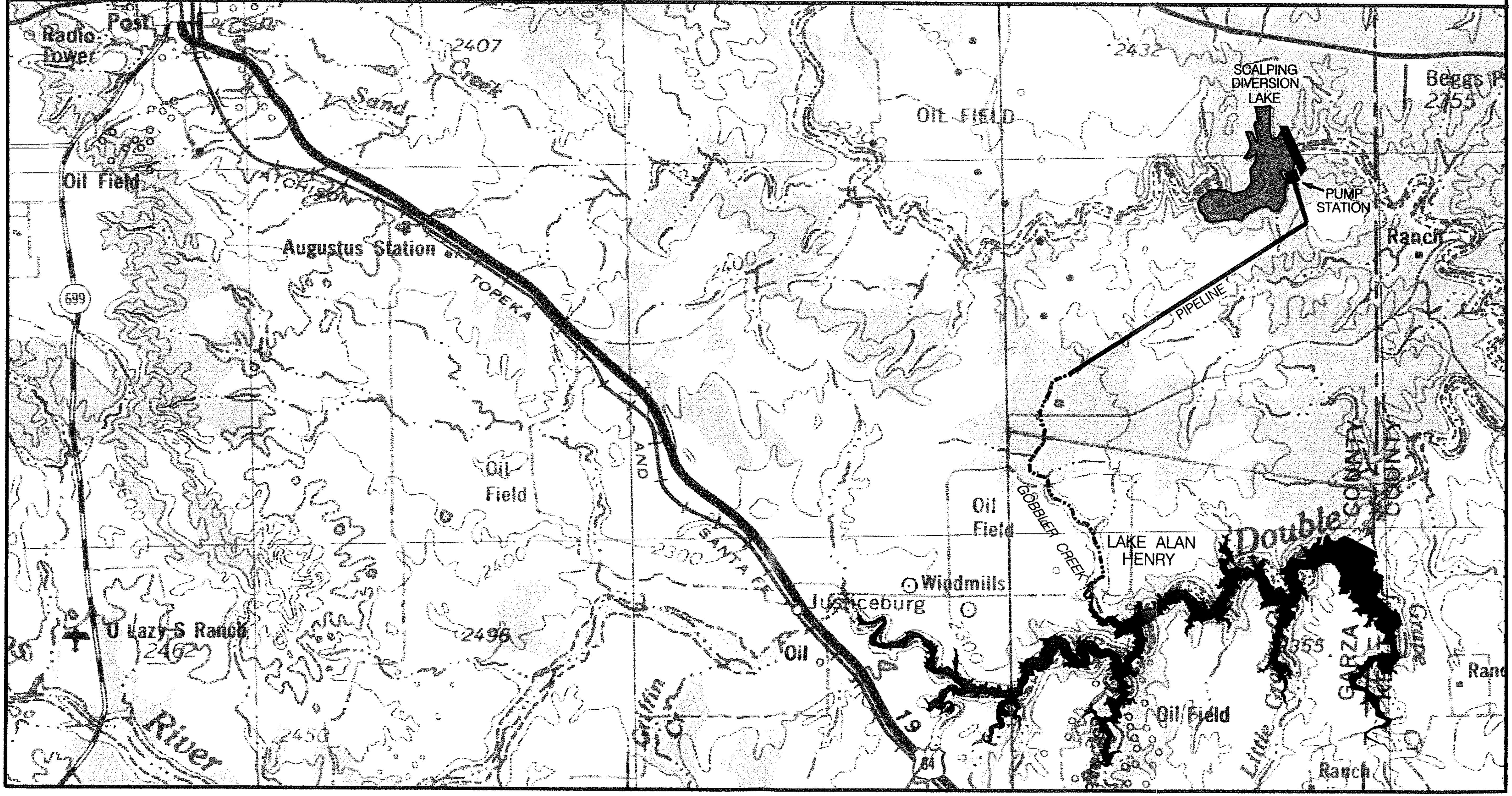


CANADIAN RIVER MUNICIPAL WATER AUTHORTY II

CITY OF LUBBOCK
WATER UTILITIES

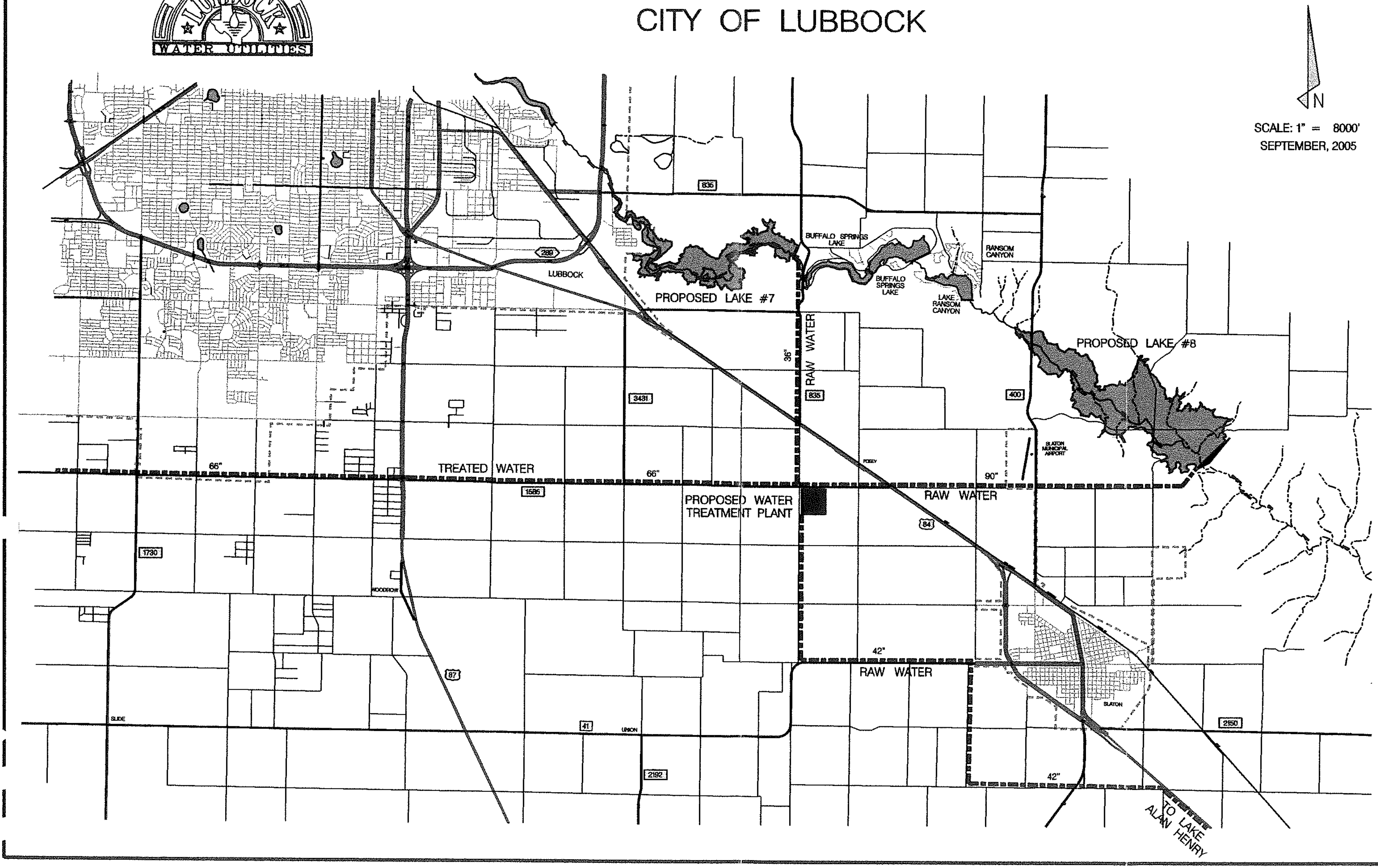
PROPOSED SCALPING DIVERSION LAKE AND PUMP STATION TO LAKE ALAN HENRY

N
SCALE: 1" = 8000'
SEPTEMBER, 2005



CITY OF LUBBOCK
WATER UTILITIES

STORM WATER AND RECLAIMED WATER SYSTEM
CITY OF LUBBOCK



SCALE: 1" = 8000'
SEPTEMBER, 2005