Texas Commission on Environmental Quality

Edwards Aquifer Application Cover Page

Our Review of Your Application

The Edwards Aquifer Program staff conducts an administrative and technical review of all applications. The turnaround time for administrative review can be up to 30 days as outlined in 30 TAC 213.4(e). Generally administrative completeness is determined during the intake meeting or within a few days of receipt. The turnaround time for technical review of an administratively complete Edwards Aquifer application is 90 days as outlined in 30 TAC 213.4(e). Please know that the review and approval time is directly impacted by the quality and completeness of the initial application that is received. In order to conduct a timely review, it is imperative that the information provided in an Edwards Aquifer application include final plans, be accurate, complete, and in compliance with 30 TAC 213.

Administrative Review

1. Edwards Aquifer applications must be deemed administratively complete before a technical review can begin. To be considered administratively complete, the application must contain completed forms and attachments, provide the requested information, and meet all the site plan requirements. The submitted application and plan sheets should be final plans. Please submit one full-size set of plan sheets with the original application, and half-size sets with the additional copies.

   To ensure that all applicable documents are included in the application, the program has developed tools to guide you and web pages to provide all forms, checklists, and guidance. Please visit the below website for assistance: http://www.tceq.texas.gov/field/eapp.

2. This Edwards Aquifer Application Cover Page form (certified by the applicant or agent) must be included in the application and brought to the administrative review meeting.

3. Administrative reviews are scheduled with program staff who will conduct the review. Applicants or their authorized agent should call the appropriate regional office, according to the county in which the project is located, to schedule a review. The average meeting time is one hour.

4. In the meeting, the application is examined for administrative completeness. Deficiencies will be noted by staff and emailed or faxed to the applicant and authorized agent at the end of the meeting, or shortly after. Administrative deficiencies will cause the application to be deemed incomplete and returned.

   An appointment should be made to resubmit the application. The application is re-examined to ensure all deficiencies are resolved. The application will only be deemed administratively complete when all administrative deficiencies are addressed.

5. If an application is received by mail, courier service, or otherwise submitted without a review meeting, the administrative review will be conducted within 30 days. The applicant and agent will be contacted with the results of the administrative review. If the application is found to be administratively incomplete, it can be retrieved from the regional office or returned by regular mail. If returned by mail, the regional office may require arrangements for return shipping.

6. If the geologic assessment was completed before October 1, 2004 and the site contains “possibly sensitive” features, the assessment must be updated in accordance with the *Instructions to Geologists* (TCEQ-0585 Instructions).

Technical Review

1. When an application is deemed administratively complete, the technical review period begins. The regional office will distribute copies of the application to the identified affected city, county, and groundwater conservation district whose jurisdiction includes the subject site. These entities and the public have 30 days to provide comments on the application to the regional office. All comments received are reviewed by TCEQ.

2. A site assessment is usually conducted as part of the technical review, to evaluate the geologic assessment and observe existing site conditions. The site must be accessible to our staff. The site boundaries should be

clearly marked, features identified in the geologic assessment should be flagged, roadways marked and the alignment of the Sewage Collection System and manholes should be staked at the time the application is submitted. If the site is not marked the application may be returned.

3. We evaluate the application for technical completeness and contact the applicant and agent via Notice of Deficiency (NOD) to request additional information and identify technical deficiencies. There are two deficiency response periods available to the applicant. There are 14 days to resolve deficiencies noted in the first NOD. If a second NOD is issued, there is an additional 14 days to resolve deficiencies. If the response to the second notice is not received, is incomplete or inadequate, or provides new information that is incomplete or inadequate, the application must be withdrawn or will be denied. Please note that because the technical review is underway, whether the application is withdrawn or denied **the application fee will be forfeited**.

4. The program has 90 calendar days to complete the technical review of the application. If the application is technically adequate, such that it complies with the Edwards Aquifer rules, and is protective of the Edwards Aquifer during and after construction, an approval letter will be issued. Construction or other regulated activity may not begin until an approval is issued.

Mid-Review Modifications

It is important to have final site plans prior to beginning the permitting process with TCEQ to avoid delays.

Occasionally, circumstances arise where you may have significant design and/or site plan changes after your Edwards Aquifer application has been deemed administratively complete by TCEQ. This is considered a "Mid-Review Modification". Mid-Review Modifications may require redistribution of an application that includes the proposed modifications for public comment.

If you are proposing a Mid-Review Modification, two options are available:

- If the technical review has begun your application can be denied/withdrawn, your fees will be forfeited, and the plan will have to be resubmitted.
- TCEQ can continue the technical review of the application as it was submitted, and a modification application can be submitted at a later time.

If the application is denied/withdrawn, the resubmitted application will be subject to the administrative and technical review processes and will be treated as a new application. The application will be redistributed to the affected jurisdictions.

Please contact the regional office if you have questions. If your project is located in Williamson, Travis, or Hays County, contact TCEQ's Austin Regional Office at 512-339-2929. If your project is in Comal, Bexar, Medina, Uvalde, or Kinney County, contact TCEQ's San Antonio Regional Office at 210-490-3096

Please fill out all required fields below and submit with your application.

<table>
<tr><td colspan="5">1. Regulated Entity Name: Berry Creek Wastewater Interceptor</td><td colspan="4">2. Regulated Entity No.:110600343</td></tr>
<tr><td colspan="5">3. Customer Name: City of Georgetown</td><td colspan="4">4. Customer No.:600412043</td></tr>
<tr><td>5. Project Type:
(Please circle/check one)</td><td colspan="2">New</td><td colspan="2">Modification</td><td>Extension</td><td colspan="2">Exception</td><td></td></tr>
<tr><td>6. Plan Type:
(Please circle/check one)</td><td>WPAP</td><td>CZP</td><td>SCS</td><td>UST</td><td>AST</td><td>EXP</td><td>EXT</td><td>Technical Clarification</td><td>Optional Enhanced Measures</td></tr>
<tr><td>7. Land Use:
(Please circle/check one)</td><td colspan="2">Residential</td><td colspan="3">Non-residential</td><td colspan="2">8. Site (acres):</td><td>24 acres</td></tr>
<tr><td>9. Application Fee:</td><td colspan="2">$650</td><td colspan="3">10. Permanent BMP(s):</td><td colspan="3">None</td></tr>
<tr><td>11. SCS (Linear Ft.):</td><td colspan="2">305 LF</td><td colspan="3">12. AST/UST (No. Tanks):</td><td colspan="3">None</td></tr>
<tr><td>13. County:</td><td colspan="2">Williamson</td><td colspan="3">14. Watershed:</td><td colspan="3">San Gabriel River Watershed</td></tr>
</table>

Application Distribution

Instructions: Use the table below to determine the number of applications required. One original and one copy of the application, plus additional copies (as needed) for each affected incorporated city, county, and groundwater conservation district are required. Linear projects or large projects, which cross into multiple jurisdictions, can require additional copies. Refer to the "Texas Groundwater Conservation Districts within the EAPP Boundaries" map found at:

http://www.tceq.texas.gov/assets/public/compliance/field_ops/eapp/EAPP%20GWCD%20map.pdf

For more detailed boundaries, please contact the conservation district directly.

Austin Region			
County:	**Hays**	**Travis**	**Williamson**
Original (1 req.)	__	__	_X_
Region (1 req.)	__	__	_X_
County(ies)	__	__	_X_
Groundwater Conservation District(s)	__Edwards Aquifer Authority __Barton Springs/ Edwards Aquifer __Hays Trinity __Plum Creek	__Barton Springs/ Edwards Aquifer	NA
City(ies) Jurisdiction	__Austin __Buda __Dripping Springs __Kyle __Mountain City __San Marcos __Wimberley __Woodcreek	__Austin __Bee Cave __Pflugerville __Rollingwood __Round Rock __Sunset Valley __West Lake Hills	__Austin __Cedar Park __Florence _X_Georgetown __Jerrell __Leander __Liberty Hill __Pflugerville __Round Rock

San Antonio Region					
County:	**Bexar**	**Comal**	**Kinney**	**Medina**	**Uvalde**
Original (1 req.)	__	__	__	__	__
Region (1 req.)	__	__	__	__	__
County(ies)	__	__	__	__	__
Groundwater Conservation District(s)	__ Edwards Aquifer Authority __Trinity-Glen Rose	__Edwards Aquifer Authority	__Kinney	__EAA __Medina	__EAA __Uvalde
City(ies) Jurisdiction	__Castle Hills __Fair Oaks Ranch __Helotes __Hill Country Village __Hollywood Park __San Antonio (SAWS) __Shavano Park	__Bulverde __Fair Oaks Ranch __Garden Ridge __New Braunfels __Schertz	NA	__San Antonio ETJ (SAWS)	NA

I certify that to the best of my knowledge, that the application is complete and accurate. This application is hereby submitted to TCEQ for administrative review and technical review. Eric Lee Nelson, P.E.
Print Name of Customer/Authorized Agent  8/16/2023
Signature of Customer/Authorized Agent Date

FOR TCEQ INTERNAL USE ONLY				
Date(s)Reviewed:		Date Administratively Complete:		
Received From:		Correct Number of Copies:		
Received By:		Distribution Date:		
EAPP File Number:		Complex:		
Admin. Review(s) (No.):		No. AR Rounds:		
Delinquent Fees (Y/N):		Review Time Spent:		
Lat./Long. Verified:		SOS Customer Verification:		
Agent Authorization Complete/Notarized (Y/N):		Fee Check:	Payable to TCEQ (Y/N):	
Core Data Form Complete (Y/N):			Signed (Y/N):	
Core Data Form Incomplete Nos.:			Less than 90 days old (Y/N):	

General Information Form

Texas Commission on Environmental Quality

For Regulated Activities on the Edwards Aquifer Recharge and Transition Zones and Relating to 30 TAC §213.4(b) & §213.5(b)(2)(A), (B) Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. This **General Information Form** is hereby submitted for TCEQ review. The application was prepared by:

Print Name of Customer/Agent: Eric Lee Nelson, P.E

Date: 8/16/2023

Signature of Customer/Agent:



Project Information

1. Regulated Entity Name: Berry Creek Wastewater Interceptor
2. County: Williamson
3. Stream Basin: San Grabriel River Watershed of the Brazos River Basin
4. Groundwater Conservation District (If applicable): N/A
5. Edwards Aquifer Zone:

   ☒ Recharge Zone
   ☐ Transition Zone

6. Plan Type:

   ☐ WPAP
   ☒ SCS
   ☒ Modification
   ☐ AST
   ☐ UST
   ☐ Exception Request

7. Customer (Applicant):

   Contact Person: Chris Pousson
   Entity: City of Georgetown
   Mailing Address: PO Box 409
   City, State: Georgetown, Tx Zip: 78627
   Telephone: 512-930-6576 FAX: 512-930-3559
   Email Address: chris.pousson@georgetown.org

8. Agent/Representative (If any):

   Contact Person: Eric Lee Nelson, P.E.
   Entity: Walker Partners, LLC
   Mailing Address: 6504 Bridge Point Parkway, Suite 200
   City, State: Austin, Tx Zip: 78730
   Telephone: 512-382-0021 FAX: N/A
   Email Address: enelson@walkerpartners.com

9. Project Location:

   ☒ The project site is located inside the city limits of Georgetown.
   ☒ The project site is located outside the city limits but inside the ETJ (extra-territorial jurisdiction) of Georgetown.
   ☐ The project site is not located within any city's limits or ETJ.

10. ☒ The location of the project site is described below. The description provides sufficient detail and clarity so that the TCEQ's Regional staff can easily locate the project and site boundaries for a field investigation.

    This project will connect the existing 27" wastewater line feeding the LS to the existing 30" Berry Creek Interceptor that was constructed in 2019. All the proposed open cut excavation will occur on City of Georgetown property at the LS site.

11. ☒ **Attachment A – Road Map**. A road map showing directions to and the location of the project site is attached. The project location and site boundaries are clearly shown on the map.

12. ☒ **Attachment B - USGS / Edwards Recharge Zone Map**. A copy of the official 7 ½ minute USGS Quadrangle Map (Scale: 1" = 2000') of the Edwards Recharge Zone is attached. The map(s) clearly show:

    ☒ Project site boundaries.
    ☒ USGS Quadrangle Name(s).
    ☒ Boundaries of the Recharge Zone (and Transition Zone, if applicable).
    ☒ Drainage path from the project site to the boundary of the Recharge Zone.

13. ☒ **The TCEQ must be able to inspect the project site or the application will be returned**. Sufficient survey staking is provided on the project to allow TCEQ regional staff to locate the boundaries and alignment of the regulated activities and the geologic or manmade features noted in the Geologic Assessment.

☒ Survey staking will be completed by this date: 8/21/2023

14. ☒ **Attachment C – Project Description**. Attached at the end of this form is a detailed narrative description of the proposed project. The project description is consistent throughout the application and contains, at a minimum, the following details:

- ☒ Area of the site
- ☐ Offsite areas
- ☐ Impervious cover
- ☐ Permanent BMP(s)
- ☒ Proposed site use
- ☐ Site history
- ☐ Previous development
- ☐ Area(s) to be demolished

15. Existing project site conditions are noted below:

- ☐ Existing commercial site
- ☐ Existing industrial site
- ☒ Existing residential site
- ☒ Existing paved and/or unpaved roads
- ☒ Undeveloped (Cleared)
- ☒ Undeveloped (Undisturbed/Uncleared)
- ☒ Other: Existing wastewater treatment plant and lift station

Prohibited Activities

16. ☒ I am aware that the following activities are prohibited on the Recharge Zone and are not proposed for this project:

(1) Waste disposal wells regulated under 30 TAC Chapter 331 of this title (relating to Underground Injection Control);

(2) New feedlot/concentrated animal feeding operations, as defined in 30 TAC §213.3;

(3) Land disposal of Class I wastes, as defined in 30 TAC §335.1;

(4) The use of sewage holding tanks as parts of organized collection systems; and

(5) New municipal solid waste landfill facilities required to meet and comply with Type I standards which are defined in §330.41(b), (c), and (d) of this title (relating to Types of Municipal Solid Waste Facilities).

(6) New municipal and industrial wastewater discharges into or adjacent to water in the state that would create additional pollutant loading.

17. ☒ I am aware that the following activities are prohibited on the Transition Zone and are not proposed for this project:

(1) Waste disposal wells regulated under 30 TAC Chapter 331 (relating to Underground Injection Control);

(2) Land disposal of Class I wastes, as defined in 30 TAC §335.1; and

(3) New municipal solid waste landfill facilities required to meet and comply with Type I standards which are defined in §330.41 (b), (c), and (d) of this title.

Administrative Information

18. The fee for the plan(s) is based on:

- ☐ For a Water Pollution Abatement Plan or Modification, the total acreage of the site where regulated activities will occur.
- ☒ For an Organized Sewage Collection System Plan or Modification, the total linear footage of all collection system lines.
- ☐ For a UST Facility Plan or Modification or an AST Facility Plan or Modification, the total number of tanks or piping systems.
- ☐ A request for an exception to any substantive portion of the regulations related to the protection of water quality.
- ☐ A request for an extension to a previously approved plan.

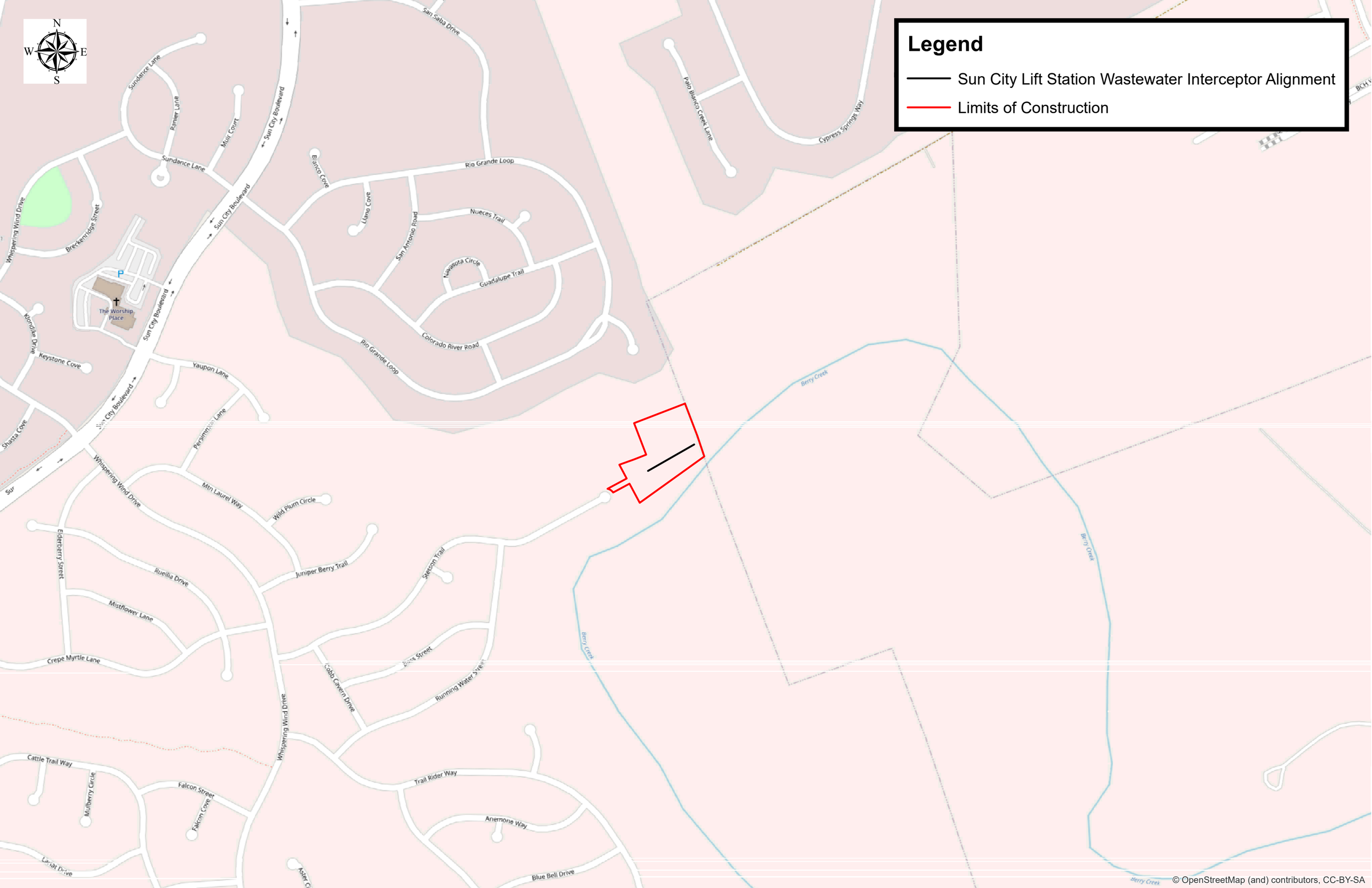
19. ☒ Application fees are due and payable at the time the application is filed. If the correct fee is not submitted, the TCEQ is not required to consider the application until the correct fee is submitted. Both the fee and the Edwards Aquifer Fee Form have been sent to the Commission's:

- ☐ TCEQ cashier
- ☒ Austin Regional Office (for projects in Hays, Travis, and Williamson Counties)
- ☐ San Antonio Regional Office (for projects in Bexar, Comal, Kinney, Medina, and Uvalde Counties)

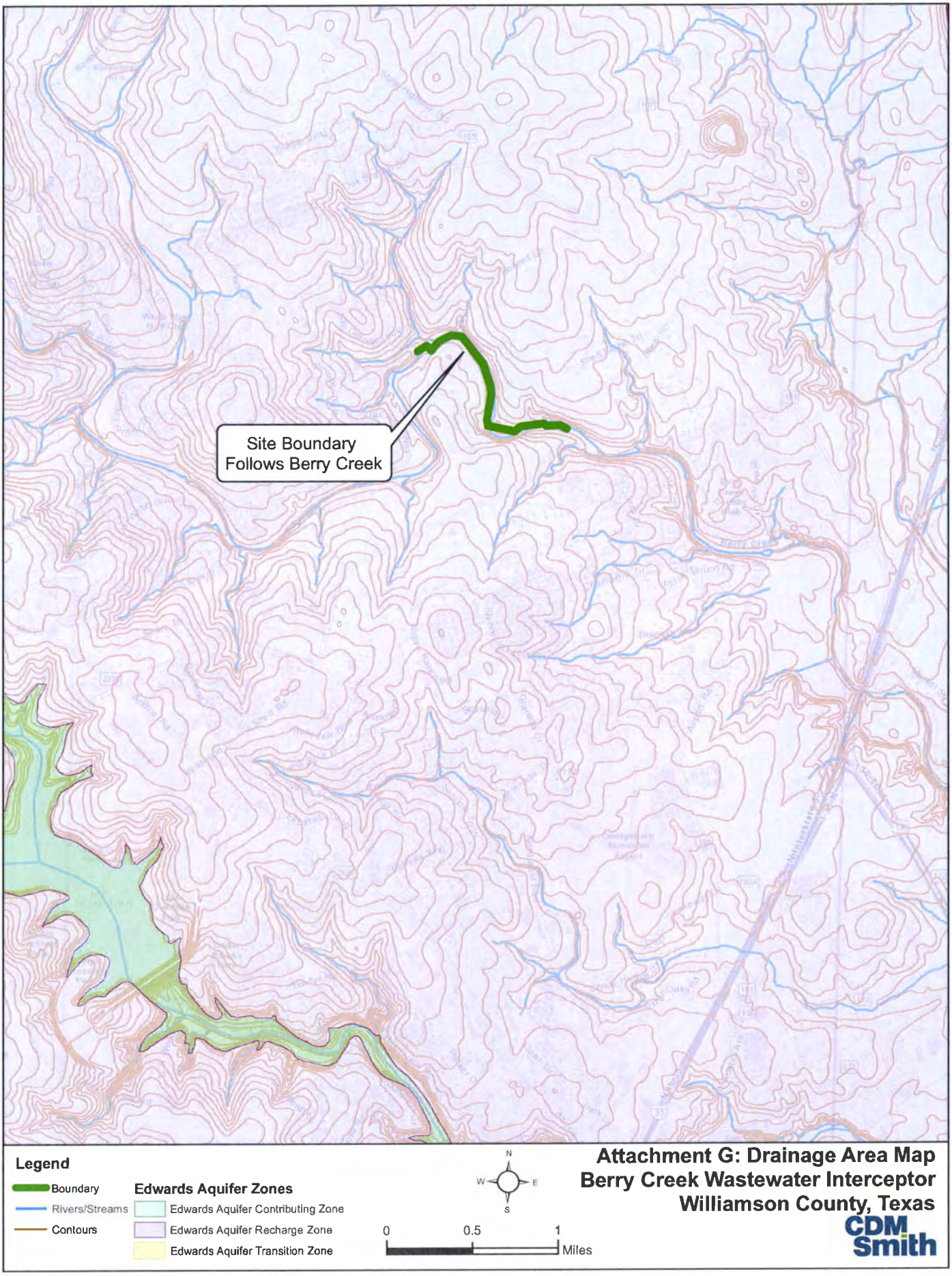
20. ☒ Submit one (1) original and one (1) copy of the application, plus additional copies as needed for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ will distribute the additional copies to these jurisdictions. The copies must be submitted to the appropriate regional office.

21. ☒ No person shall commence any regulated activity until the Edwards Aquifer Protection Plan(s) for the activity has been filed with and approved by the Executive Director.

ATTACHMENT A


N
W
E
S
Legend
Sun City Lift Station Wastewater Interceptor Alignment
Limits of Construction
San Saba Drive
Sundance Lane
Ranier Lane
Musk Court
Sun City Boulevard
Sundance Lane
Whispering Wind Drive
Breckenridge Street
Blanco Cove
Llano Cove
Rio Grande Loop
San Antonio Road
Nueces Trail
Nawasota Circle
Guadalupe Trail
Colorado River Road
Rio Grande Loop
Paso Blanco Creek Lane
Cypress Springs Way
P
The Worship Place
Klondike Drive
Keystone Cove
Yaupon Lane
Persimmon Lane
Shasta Cove
Whispering Wind Drive
Min Laurel Way
Wild Plum Circle
Elderberry Street
Ruellia Drive
Juniper Berry Trail
Stetson Trail
Mistflower Lane
Crepe Myrtle Lane
Cobb Cavern Drive
Running Water Street
Whispering Wind Drive
Cattle Trail Way
Mulberry Circle
Falcon Street
Falcon Cove
Trail Rider Way
Anemone Way
Blue Bell Drive
Berry Creek
Berry Creek
Berry Creek
© OpenStreetMap (and) contributors, CC-BY-SA

ATTACHMENT B



Attachment G: Drainage Area Map
Berry Creek Wastewater Interceptor
Williamson County, Texas

CDM Smith

ATTACHMENT C

PROJECT SUMMARY

The Berry Creek Wastewater Interceptor Project under the Texas Commission on Environmental Quality (TCEQ) Permit Number 11003570 from June 23rd, 2023 will address the future capacity deficiencies at the Sun City Lift Station (LS) and the extend an interceptor to the Dry Berry Creek sewer shed. The Project begins at the existing Pecan Branch Wastewater Treatment Plant (PB-WWTP) and terminates west of Airport Road, where it will connect to an existing interceptor that was constructed from the Sun City LS to Airport Road in 2019 under TCEQ Permit Numbers 11001386 from March 28, 2019 and 11001522 from June 3, 2019. In this application, the City of Georgetown will be requesting a revision or modification to permit number 1100152. Under TCEQ-0590 Attachment C, the connection from MH-44 and the 27" wastewater line, named "LINE B" was not installed. After the completion of the 2023 Berry Creek Wastewater Interceptor, Georgetown will be diverting flow from reaching the Sun City LS to the PB-WWTP by connecting the existing 27" wastewater line feeding the LS to the existing 30" wastewater line that was constructed in 2019. A ***Road Map*** showing the Project alignment is included as ***Attachment A***.

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GEOLOGIC ASSESSMENT
FOR
BERRY CREEK WASTEWATER INTERCEPTOR

Williamson County, Texas

July 15, 2016

Prepared for:

CDM Smith
12357-A Riata Trace Parkway, Suite 210
Austin, Texas 78727

Prepared by:

aci Group, LLC
1001 Mopac Circle
Austin, Texas 78746
TBPG Firm License No. 50260

aci project #: 30-15-028

Geologic Assessment

Texas Commission on Environmental Quality

For Regulated Activities on The Edwards Aquifer Recharge/transition Zones and Relating to 30 TAC §213.5(b)(3), Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. My signature certifies that I am qualified as a geologist as defined by 30 TAC Chapter 213.

Print Name of Geologist: Mark T. Adams Telephone: 512-347-9000

Date: 07-15-2016 Fax: 512-306-0974

Representing: aci Group LLC TBPG License No. 50260 (Name of Company and TBPG or TBPE registration number)

Signature of Geologist:



Regulated Entity Name: Berry Creek Wastewater Interceptor

Project Information

1. Date(s) Geologic Assessment was performed: February 29, March 1, March 14, 2016
2. Type of Project:
   - ☒ WPAP
   - ☒ SCS
   - ☐ AST
   - ☐ UST
3. Location of Project:
   - ☒ Recharge Zone
   - ☐ Transition Zone
   - ☐ Contributing Zone within the Transition Zone

4. ☒ **Attachment A - Geologic Assessment Table**. Completed Geologic Assessment Table (Form TCEQ-0585-Table) is attached.

5. ☒ Soil cover on the project site is summarized in the table below and uses the SCS Hydrologic Soil Groups* (Urban Hydrology for Small Watersheds, Technical Release No. 55, Appendix A, Soil Conservation Service, 1986). If there is more than one soil type on the project site, show each soil type on the site Geologic Map or a separate soils map.

Table 1 - Soil Units, Infiltration Characteristics and Thickness

Soil Name	Group*	Thickness(feet)
Eckrant cobbly clay, 1 to 8 percent slopes (Ead)	D	1.3
Eckrant-Rock outcrop complex, rolling (ErE)	D	1.3
Georgetown stony clay loam, 1 to 3 percent slopes (GsB)	D	5.0
Oakalla soils, 0 to 1 percent slopes, channeled, frequently flooded (Oc)	B	6.6

** Soil Group Definitions (Abbreviated)*

A. Soils having a high infiltration rate when thoroughly wetted.

B. Soils having a moderate infiltration rate when thoroughly wetted.

C. Soils having a slow infiltration rate when thoroughly wetted.

D. Soils having a very slow infiltration rate when thoroughly wetted.

6. ☒ **Attachment B – Stratigraphic Column**. A stratigraphic column showing formations, members, and thicknesses is attached. The outcropping unit, if present, should be at the top of the stratigraphic column. Otherwise, the uppermost unit should be at the top of the stratigraphic column.

7. ☒ **Attachment C – Site Geology**. A narrative description of the site specific geology including any features identified in the Geologic Assessment Table, a discussion of the potential for fluid movement to the Edwards Aquifer, stratigraphy, structure(s), and karst characteristics is attached.

8. ☒ **Attachment D – Site Geologic Map(s)**. The Site Geologic Map must be the same scale as the applicant's Site Plan. The minimum scale is 1": 400'

   Applicant's Site Plan Scale: 1" = 30'
   Site Geologic Map Scale: 1" = 30'

Site Soils Map Scale (if more than 1 soil type): 1" = 1,500'

9. Method of collecting positional data:

   ☒ Global Positioning System (GPS) technology.
   ☐ Other method(s). Please describe method of data collection: _____

10. ☒ The project site and boundaries are clearly shown and labeled on the Site Geologic Map.

11. ☒ Surface geologic units are shown and labeled on the Site Geologic Map.

12. ☒ Geologic or manmade features were discovered on the project site during the field investigation. They are shown and labeled on the Site Geologic Map and are described in the attached Geologic Assessment Table.

    ☐ Geologic or manmade features were not discovered on the project site during the field investigation.

13. ☒ The Recharge Zone boundary is shown and labeled, if appropriate.

14. All known wells (test holes, water, oil, unplugged, capped and/or abandoned, etc.): If applicable, the information must agree with Item No. 20 of the WPAP Application Section.

    ☐ There are _____ (#) wells present on the project site and the locations are shown and labeled. (Check all of the following that apply.)
       ☐ The wells are not in use and have been properly abandoned.
       ☐ The wells are not in use and will be properly abandoned.
       ☐ The wells are in use and comply with 16 TAC Chapter 76.
    ☒ There are no wells or test holes of any kind known to exist on the project site.

Administrative Information

15. ☒ Submit one (1) original and one (1) copy of the application, plus additional copies as needed for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ will distribute the additional copies to these jurisdictions. The copies must be submitted to the appropriate regional office.

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July 15, 2016

Geologic Assessment for the Berry Creek Wastewater Interceptor located in Williamson County, Texas

1.0 INTRODUCTION

The purpose of this assessment is to identify karst or non-karst features and their recharge potential. This report complies with the requirements of Title 30, Texas Administrative Code (TAC) Chapter 213 relating to the protection of the Edwards aquifer recharge zone.

The Berry Creek Wastewater Interceptor, hereafter referred to as the subject area or site, is located along Berry Creek between Stetson Trail and Airport Road in the City of Georgetown and the City of Georgetown ETJ, Williamson County, Texas (**Attachment D, Figure 1**).

2.0 PROJECT INFORMATION

Pedestrian investigations of the subject area were performed between February 29, 2016 and April 11, 2016, by Mark Adams, P.G..; Maggie Behnke, G.I.T.; Colin Strickland; and Emily Mixon with **aci consulting**.

This report is intended to satisfy the requirements for a Geologic Assessment, which shall be included as a component of a Water Pollution Abatement Plan (WPAP) and Sewage Collection System (SCS). The proposed site use is for a City of Georgetown Wastewater Line. The scope of the report consists of a site reconnaissance, field survey, and review of existing data and reports. Features identified during the field survey were ranked utilizing the Texas Commission on Environmental Quality (TCEQ) matrix for Edwards aquifer recharge zone features. The ranking of the features will determine their viability as "sensitive" features.

According to Edwards aquifer zone maps, the entire subject area is within the northern segment of the Edwards aquifer Recharge Zone (TCEQ 2005).

3.0 INVESTIGATION METHODS

The following investigation methods and activities were used to develop this report:

- Review of existing files and literature to determine the regional geology and any known caves associated with the project area;
- Review of past geological field reports, cave studies, and correspondence regarding the existing geologic features on the project area, if available;
- Site reconnaissance by a registered professional geologist to identify and examine caves, recharge features, and other significant geological structures;
- Evaluation of collected field data and a ranking of features using the TCEQ Ranking Table 0585 for the Edwards Aquifer Recharge Zone; and
- Review of historic aerial photographs to determine if there are any structural features present, and to determine any past disturbances on the subject property.

4.0 SUMMARY OF FINDINGS

This report documents the findings of a geologic assessment conducted by **aci consulting** personnel on February 29, 2016, previous and subsequent field work. It was determined that there are no sensitive karst features on the subject property. Eighteen features were identified across the site. Fourteen of these features are man-made features in bedrock and have been rated as sensitive to bring them to the attention of the project engineer.

5.0 RECOMMENDATIONS

No recommendations are made for the site because there were no sensitive karst features identified on site.

6.0 REFERENCES

Collins, E.W., 1998. *Geologic Map of the Georgetown Quadrangle, Texas.* Bureau of Economic Geology. Austin, Texas.

(SCS) Soil Conservation Survey. 1983. Soil Survey of Williamson County, Texas. United States Department of Agriculture. Texas Agriculture Experiment Station.

(TCEQ) Texas Commission on Environmental Quality. 2004. Instructions to Geologists for Geologic Assessments on the Edwards Aquifer Recharge/Transition Zones. October 1, 2004. Austin, Texas.

(TCEQ) Texas Commission on Environmental Quality. 2005. "Edwards Aquifer Protection Program, Chapter 213 Rules - Recharge Zone, Transition Zone, Contributing Zone, and Contributing Zone within the Transition Zone." Map. Digital data. September 1, 2005. Austin, Texas.

(USDA NRCS) U.S. Department of Agriculture Natural Resources Conservation Service. 2016. WebSoilSurvey.com. Soil Survey Area: Williamson County, Texas. Date accessed: April 4, 2016.

ATTACHMENT A
Geologic Assessment Table

GEOLOGIC ASSESSMENT TABLE

PROJECT NAME: BERRY CREEK WASTEWATER INTERCEPTOR

LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DIP (DEG)	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
BC5	30.720114	-97.699901	MB	30	Ked	-	-	-	-	0	-	-	X	30	60		x	x		hillside
BC6	**30.719679**	**-97.693464**	**CD**	**5**	**Qt**	**150**	**20**	**5**	**-**	**0**	**-**	**-**	**C,F,V**	**10**	**15**	**x**			**x**	**drainage**
BC7	30.720885	-97.694388	CD	5	Qt	100	20	5	-	0	-	-	C,F,V	10	15	x			x	drainage
BC9	**30.713828**	**-97.689973**	**MB**	**30**	**Ked**	**-**	**-**	**-**	**-**	**0**	**-**	**-**	**C,F**	**5**	**35**	**x**		**x**		**hilltop**
BC14	30.713647	-97.684882	MB	30	Qt	-	-	-	-	0	-	-	X	30	60		x	x		drainage
BC16	**30.706368**	**-97.672908**	**MB**	**30**	**Ked**	**-**	**-**	**-**	**-**	**0**	**-**	**-**	**X**	30	**60**		**x**	**x**		**drainage**
BC17	30.706871	-97.673164	SH	20	Ked	5	3	3	328	0	-	-	C, O	15	35		x	x		hillside
BC18	**30.710183**	**-97.673743**	**MB**	**30**	**Ked**	**-**	**-**	**-**	**-**	**0**	**-**	**-**	**X**	**30**	60		**x**	**x**		**drainage**
BC19	30.705332	-97.672336	MB	30	Ked	-	-	-	-	0	-	-	X	30	60		x	x		drainage
BC20	30.704848	-97.672024	**MB**	30	**Ked**	**-**	**-**	**-**	**-**	**0**	**-**	**-**	**X**	**30**	**60**		**x**	**x**		**drainage**
BC21	30.704433	-97.671524	MB	30	Ked	-	-	-	-	0	-	-	X	30	60		x	x		drainage
BC22	**30.704083**	**-97.670855**	**MB**	**30**	**Ked**	**-**	**-**	**-**	**-**	**0**	**-**	**-**	**X**	**30**	**60**		**x**	**x**		**drainage**
BC23	30.703765	-97.670312	MB	30	Ked	-	-	-	-	0	-	-	X	30	60		x	x		drainage
BC24	**30.703682**	**-97.669760**	**MB**	**30**	**Ked**	**-**	**-**	**-**	**-**	**0**	**-**	**-**	**X**	**30**	**60**		**x**	**x**		**drainage**
BC25	30.703486	-97.668482	MB	30	Ked	-	-	-	-	0	-	-	X	30	60		x	x		drainage
BC26	**30.703425**	**-97.668195**	**MB**	**30**	**Ked**	**-**	**-**	**-**	**-**	**0**	**-**	**-**	**X**	**30**	**60**		**x**	**x**		**drainage**
BC27	30.703457	-97.666478	MB	30	Ked	-	-	-	-	0	-	-	X	30	60		x	x		drainage
BC28	**30.712112**	**-97.680631**	**CD**	**5**	**Ked**	**30**	**20**	**2**	**110**	**0**	**-**	**-**	**N,F,V**	**10**	**15**		**x**	**x**		**hillside**

* DATUM: NAD 83

2A TYPE	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
Z	Zone, clustered or aligned features	30

8A INFILLING	
N	None, exposed bedrock
C	Coarse - cobbles, breakdown, sand, gravel
O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
V	Vegetation. Give details in narrative description
FS	Flowstone, cements, cave deposits
X	Other materials

12 TOPOGRAPHY
Cliff, Hilltop, Hillside, Drainage, Floodplain, Streambed

I have read, I understood, and I have followed the Texas Commission on Environmental Quality's Instructions to Geologists. The information presented here complies with that document and is a true representation of the conditions observed in the field.

My signature certifies that I am qualified as a geologist as defined by 30 TAC Chapter 213.

STATE OF TEXAS
MARK T. ADAMS
GEOLOGY
No. 1835
LICENSED PROFESSIONAL GEOSCIENTIST

Date 7-15-16

Sheet 1 of 1

TCEQ-0585-Table (Rev. 10-01-04)

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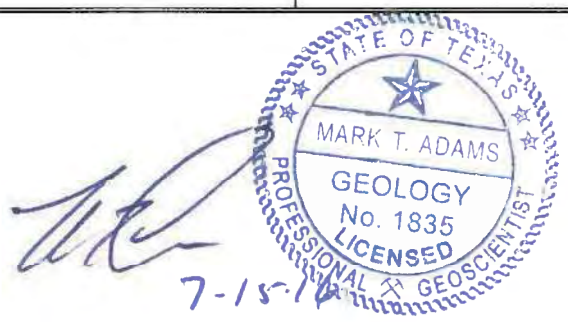
Berry Creek Wastewater Interceptor, Williamson County

Formation	Members	Thickness
Quaternary Terrace and Alluvial Deposits	Quaternary Terrace and Alluvial Deposits	0-20 feet
Edwards Limestone	Edwards Limestone	~200 feet



ATTACHMENT C
Site Geology

Locally, the dominant structural trend of the area is 20°, as evidenced by the mapped fault patterns (**Attachment D, Figure 2**). Thus, all features that have a trend ranging from 10° to 50° are considered on trend and were awarded the additional 10 points in the Geologic Assessment Table.

Based on the site assessment, the subject area is located in the Quaternary Terrace (Qt) and Edwards Limestone (Ked) (**Attachment D, Figure 3**). The stratigraphy, structure, and karstic characteristics of the Edwards Limestone are discussed below.

Karstic Characteristics

In limestone terrains, karst is expressed by erratically developed cavernous porosity and the manifestations of sinkholes, voids, and erratic surface drainage. Karst landscapes are typical of the Edwards Limestone, occurring across a vast region of Central Texas, west of the Balcones Escarpment, and these processes are critical to understanding the Edwards aquifer within its various segments. The features produced by karst processes (voids, holes, and solution layers) eventually provide conduits for surface water runoff and "point recharge" for the Edwards aquifer. The identification and protection of these features in established recharge areas is critical to maintaining groundwater quality and species habitat. The TCEQ require protective strategies within these areas to maintain quantity and quality of recharge prior to, during, and upon completion of construction activities.

Stratigraphy

Qt – Terrace deposits: Gravel, sand, silt and clay along streams and rivers. Mostly above flood level along entrenched streams and rivers. Larger deposits along San Gabriel River, Berry Creek and Brushy Creek are as thick as 36ft and locally may be thicker. Deposits of adjacent terraces at different elevations are mapped separately.

Ked – Edwards Limestone: Limestone, dolomitic limestone and marl. Massive to thin beds, chert, and fossiliferous; fossils include rudistids. Shallow subtidal to tidal-flat cycles. Honeycomb textures, voids in collapsed breccias, and cavern systems. Accounts for most of the Edwards aquifer strata. Thickness is between 100ft to 300ft; thins northward.

Structure

The subject area is underlain by the Quaternary Terrace (Qt) and Edwards Limestone (Ked) (Garner 1992). The geologic strata associated with the Edwards aquifer include the Georgetown Formations overlying the Edwards Limestone Group, interfingering with the Comanche Peak Formation. These rocks are underlain by the Walnut Formation, which has members including the Whitestone Member, Keys Valley Marl Member, the Cedar Park Member, the Bee Cave Member and the Bull Creek Member. The Glen Rose Formation, another marine limestone stratum, is located below the Walnut Formation.

Aerial photographs were reviewed for the site and it was determined that agricultural activities occurred along the alignment site (**Attachment E**). Development occurred along the alignment site starting in 1995.

Seventeen features were identified during site investigations and are detailed below, and shown on **Figure 3** in **Attachment D**.

Soils discussed on the Geologic Assessment Form are delineated in **Attachment D, Figure 4.**

BC5

GPS: N. 30.720114 W. -97.699901

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC5

BC6

GPS: N. 30.719679 W. -97.693464

This feature is a non-karst closed depression with a length, width, and depth of 150 feet, 20 feet and 5 feet, respectively. The feature is located in Quaternary Terrace and Alluvial Deposits, and is what appears to be an abandoned section of creek bed. Infill consists of cobbles, fines, vegetation, and clay sediments. The feature has no trend and appears to drain more than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 10 points due to its non-karst origin, which is not indicative of rapid infiltration.

Recommendation: No further action is recommended for this feature.



Photo of BC6

BC7

GPS: N. 30.720885 W. -97.694388

This feature is a non-karst closed depression with a length, width, and depth of 100 feet, 20 feet and 5 feet, respectively. The feature is located in Quaternary Terrace and Alluvial Deposits, and is what appears to be an abandoned section of creek bed. Infill consists of cobbles, fines, vegetation, and clay sediments. The feature has no trend and appears to drain more than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 10 points due to its non-karst origin which is not indicative of rapid infiltration.

Recommendation: No further action is recommended for this feature.



Photo of BC7

BC9

GPS: N. 30.713828 W. -97.689973

This feature is a manmade feature in bedrock (a dirt road). The feature is located in the Edwards Limestone and is positioned on a hilltop. Infill consists of cobbles and fines. The feature has no trend and appears to drain an area less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.

Photo of BC9 is unavailable at the time of this report.

BC14

GPS: N. 30.713647 W. -97.684882

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC14

BC16

GPS: N. 30.706368 W. -97.672908

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC16

BC17

GPS: N. 30.706871 W. -97.673164

This feature is a sinkhole with length, width, and depth of 5 feet, 3 feet and 3 feet respectively. The feature is located in the Edwards Limestone and is positioned on a hillside Infill consists of coarse cobbles, breakdown, and organics. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 15 points due to its origin in man-made alluvium (golf course fill) indicating a low background infiltration rate.

Recommendation: No further action is recommended for this feature.



Photo of BC17

BC18

GPS: N. 30.710183 W. -97.673743

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC18

BC19

GPS: N. 30.705332 W. -97.672336

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC19

BC20

GPS: N. 30.704848 W. -97.672024

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC20

BC21

GPS: N. 30.704433 W. -97.671524

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC21

BC22

GPS: N. 30.704083 W. -97.670855

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC22

BC23

GPS: N. 30.703765 W. -97.670312

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC23

BC24

GPS: N. 30.703682 W. -97.669760

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC24

BC25

GPS: N. 30.703486 W. -97.668482

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC25

BC26

GPS: N. 30.703425 W. -97.668195

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC26

BC27

GPS: N. 30.703457 W. -97.666478

This feature is a man-made feature in bedrock (a utility). The feature has unknown dimensions and is located in the Edwards Limestone and is positioned on a hillside Infill is unknown. The feature has no trend and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 30 points due to its status as a man-made feature in bedrock. This determination was made to bring the feature to the attention of the engineer.

Recommendation: This feature was ranked as sensitive to bring it to the attention of the engineer. No further action is recommended for this feature.



Photo of BC27

BC28

GPS: N. 30.712112 W. -97.680631

This feature is a non-karst closed depression with a length, width, and depth of 30 feet, 20 feet, and 2 feet, respectively. The feature is located in the Edwards Limestone and is positioned on a hillside. Infill consists of fines, bedrock, and vegetation. The feature has a trend of 110 degrees, and appears to drain less than 1.6 acres. In using Figure 1 in Instructions to Geologists, it was determined that this feature has an infiltration rate of 10 points due to its status as a non-karst feature with evidence of non-rapid, background infiltration.

Recommendation: No further action is recommended for this feature.



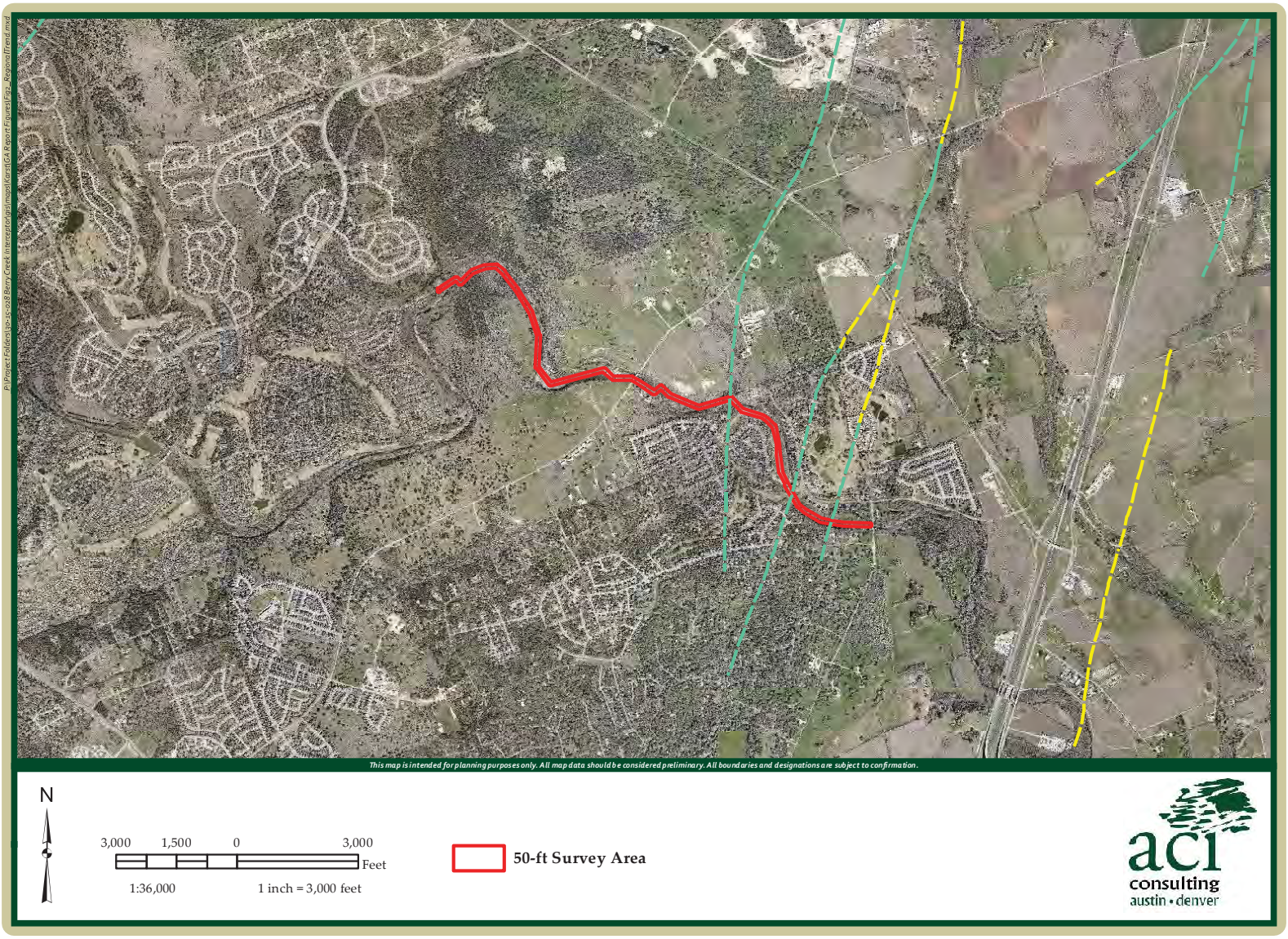
Photo of BC28

ATTACHMENT D
Site Maps



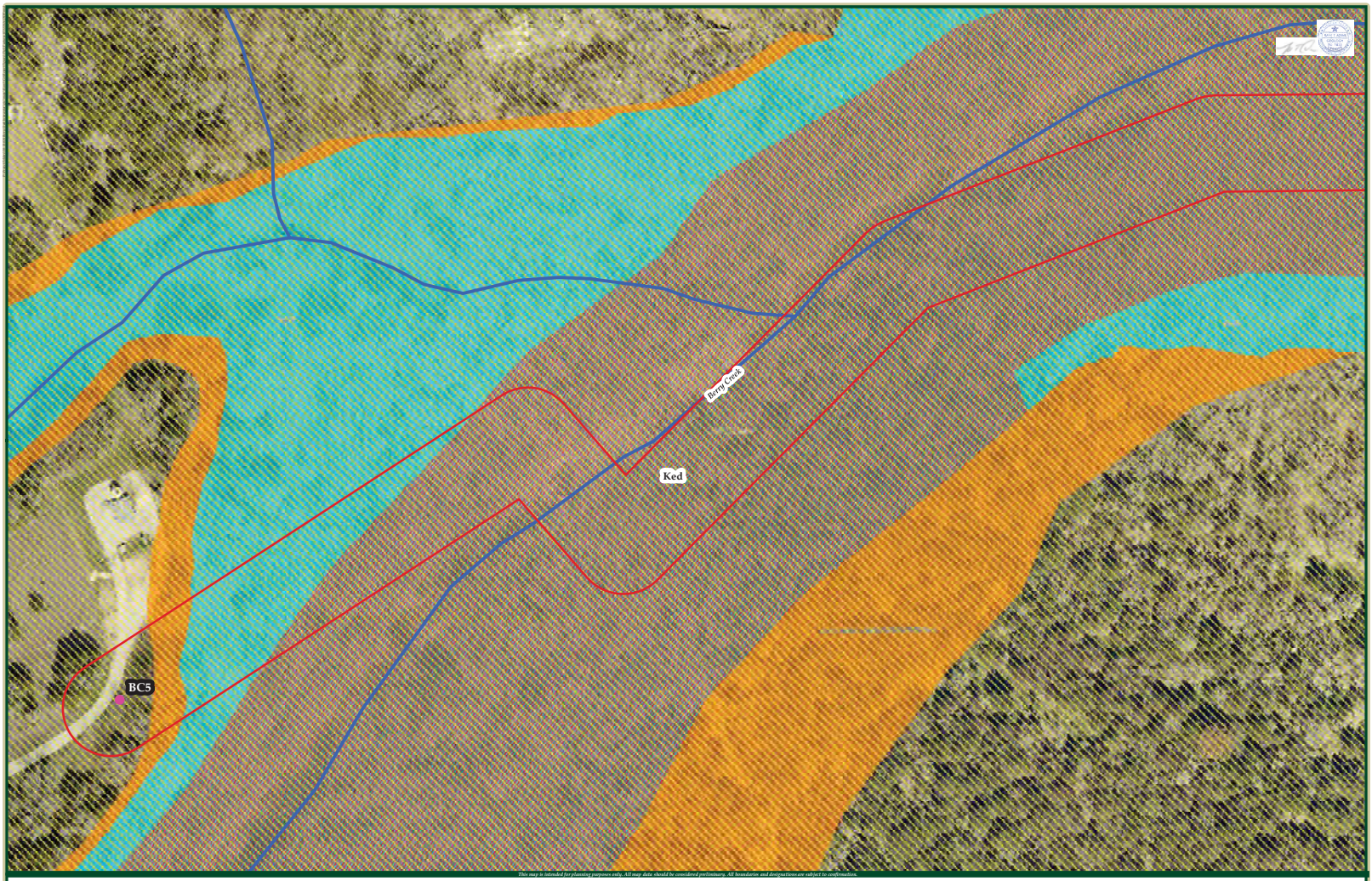
Berry Creek Wastewater Interceptor
Figure 1: Site Location

aci Project No.: 30-15-028
July 2016



Berry Creek Wastewater Interceptor
Figure 2: Regional Trend

aci Project No.: 30-15-028
July 2016



This map is intended for planning purposes only. All map data should be considered preliminary. All boundaries and designations are subject to confirmation.

N

30 0 30 Feet

1:360

1 inch = 30 Feet

National Flood Hazard Layer

GA Features

NHD Flowlines

Survey Area

Geology 24K

Ked

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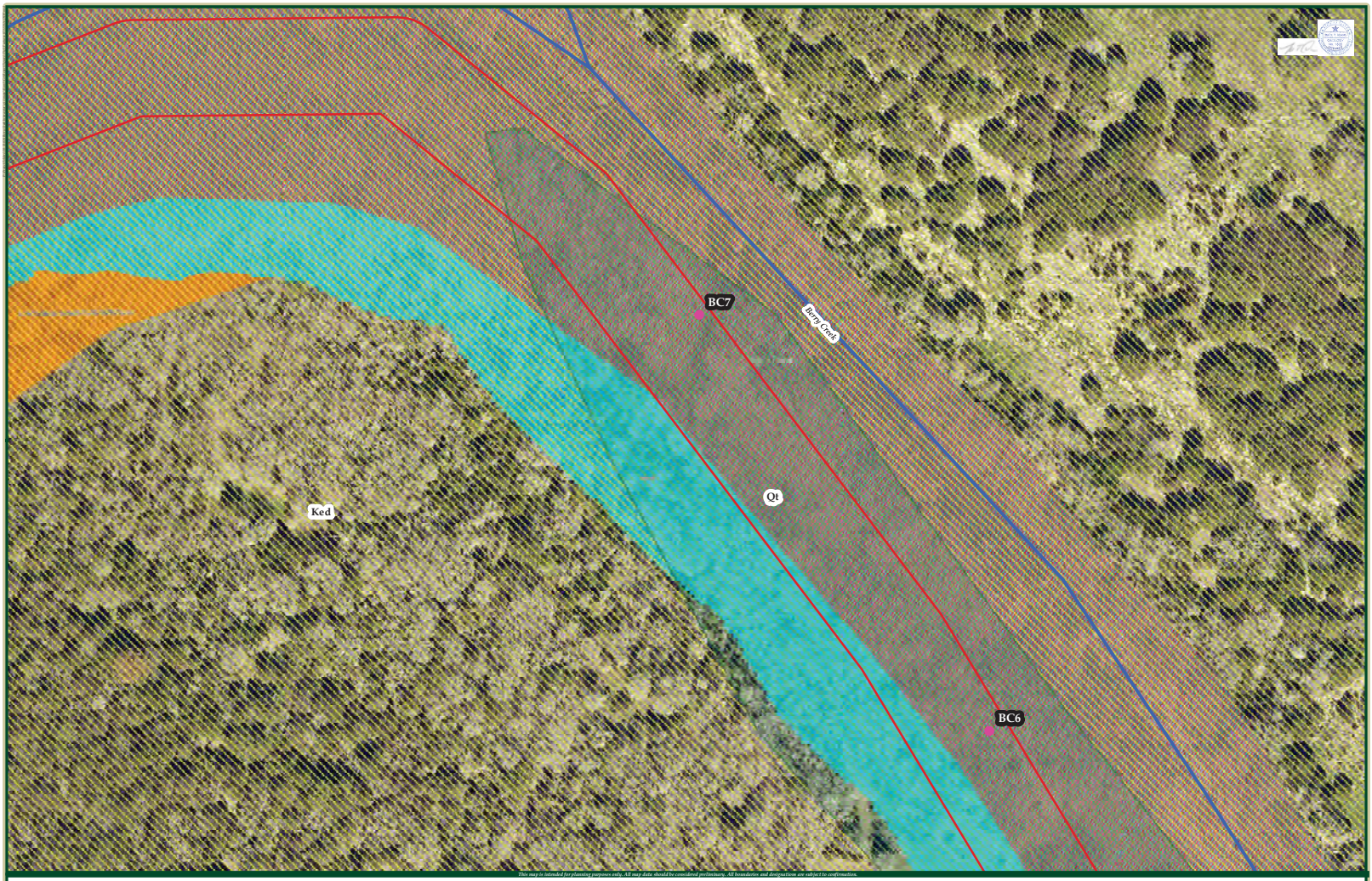
Berry Creek Interceptor

Figure 3: Features (1 of 11)

aci Project No.: 30-15-028

July 2016



This map is intended for planning purposes only. All map data should be considered preliminary. All boundaries and designations are subject to confirmation.

N

30 0 30 Feet

1:360

1 inch = 30 Feet

National Flood Hazard Layer

GA Features

NHD Flowlines

Survey Area

Geology 24K

Ked

Qt

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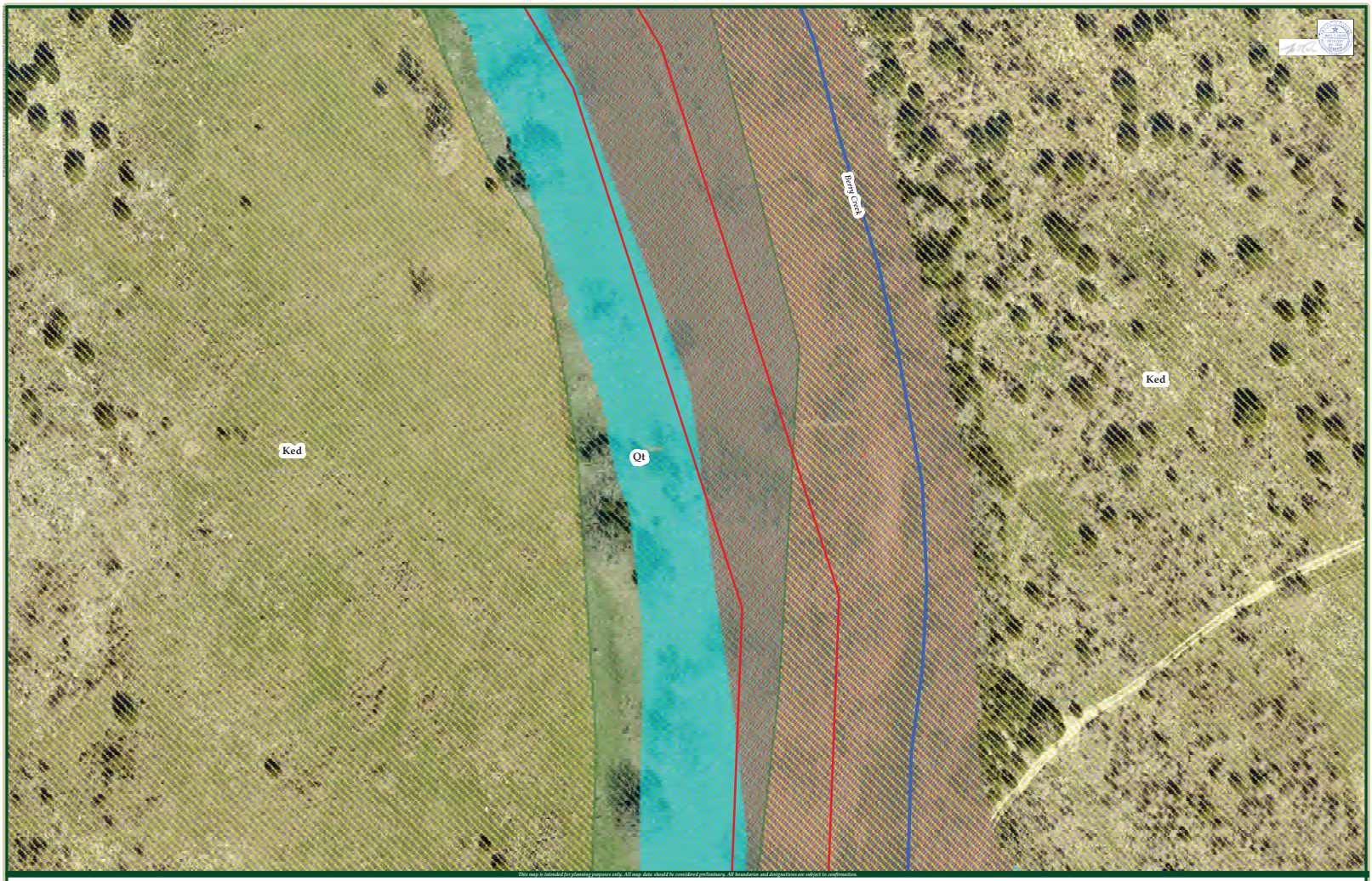
Berry Creek Interceptor

Figure 3: Features (2 of 11)

aci Project No.: 30-15-028

July 2016



This map is intended for planning purposes only. All map data should be considered preliminary. All boundaries and designations are subject to confirmation.

N

30 0 30 Feet

1:360

1 inch = 30 Feet

National Flood Hazard Layer

NHD Flowlines

Survey Area

Geology 24K

Ked

Qt



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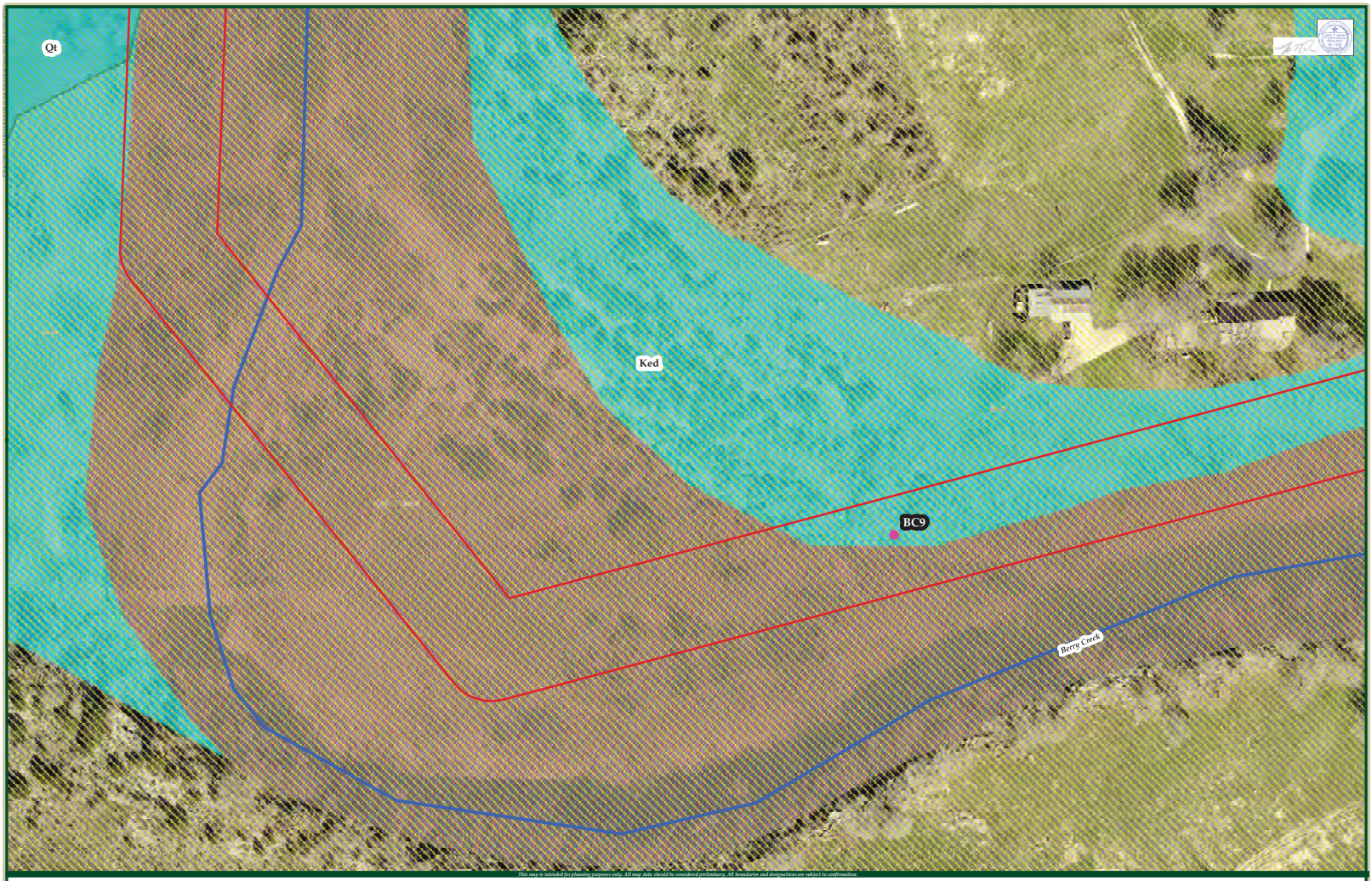
Berry Creek Interceptor

Figure 3: Features (3 of 11)

aci Project No.: 30-15-028

July 2016



This map is intended for planning purposes only. All map data should be considered preliminary. All boundaries and designations are subject to confirmation.

N

30 0 30 Feet

1:360

1 inch = 30 Feet

National Flood Hazard Layer

- GA Features
- NHD Flowlines
- Survey Area

Geology 24K
- Ked
- Qt



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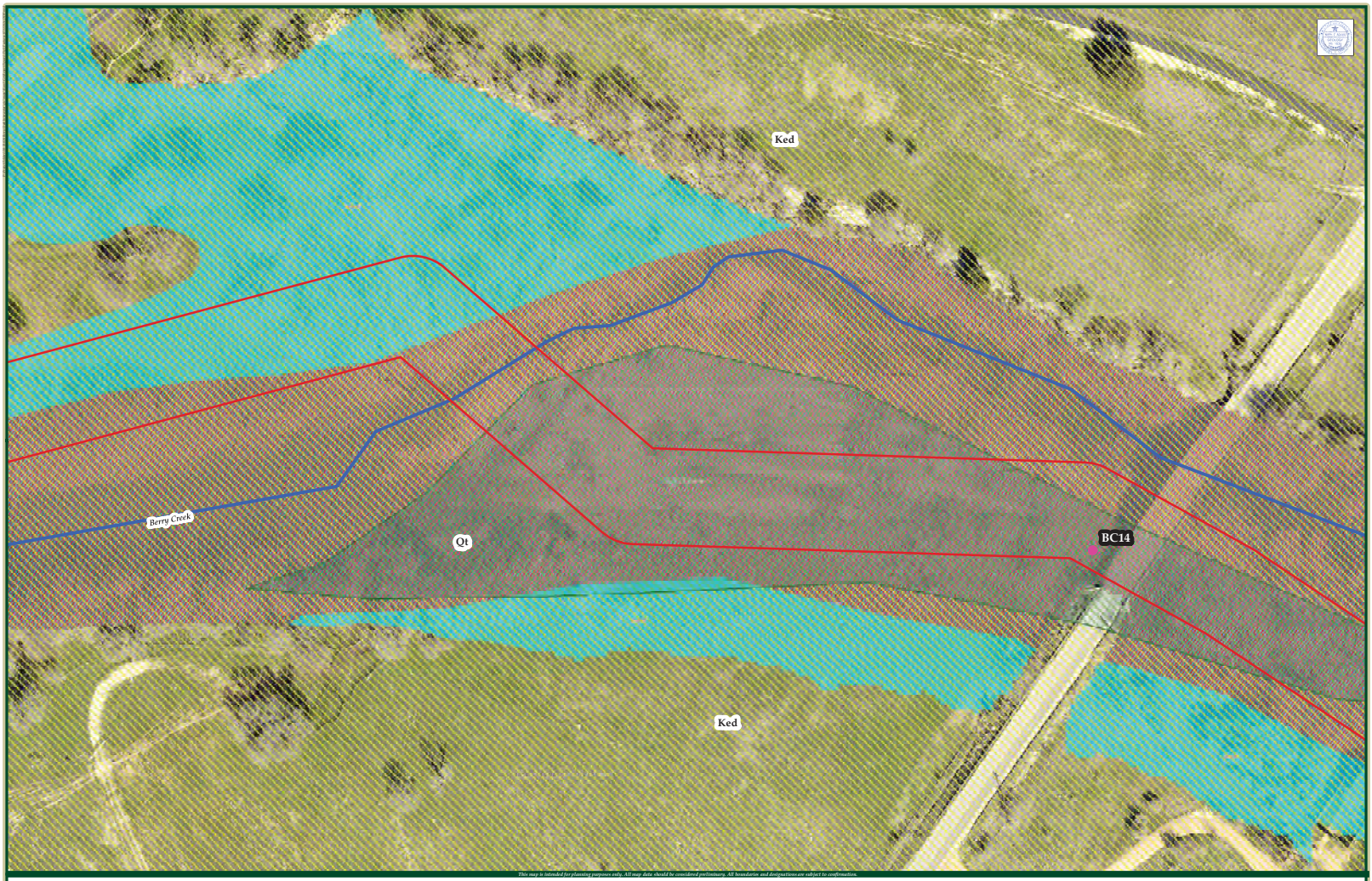
Berry Creek Interceptor
Figure 3: Features (4 of 11)

aci Project No.: 30-15-028
July 2016



N

30 0 30 Feet

1:360

1 inch = 30 Feet

National Flood Hazard Layer

- GA Features
- NHD Flowlines
- Survey Area

Geology 24K
- Ked
- Qt



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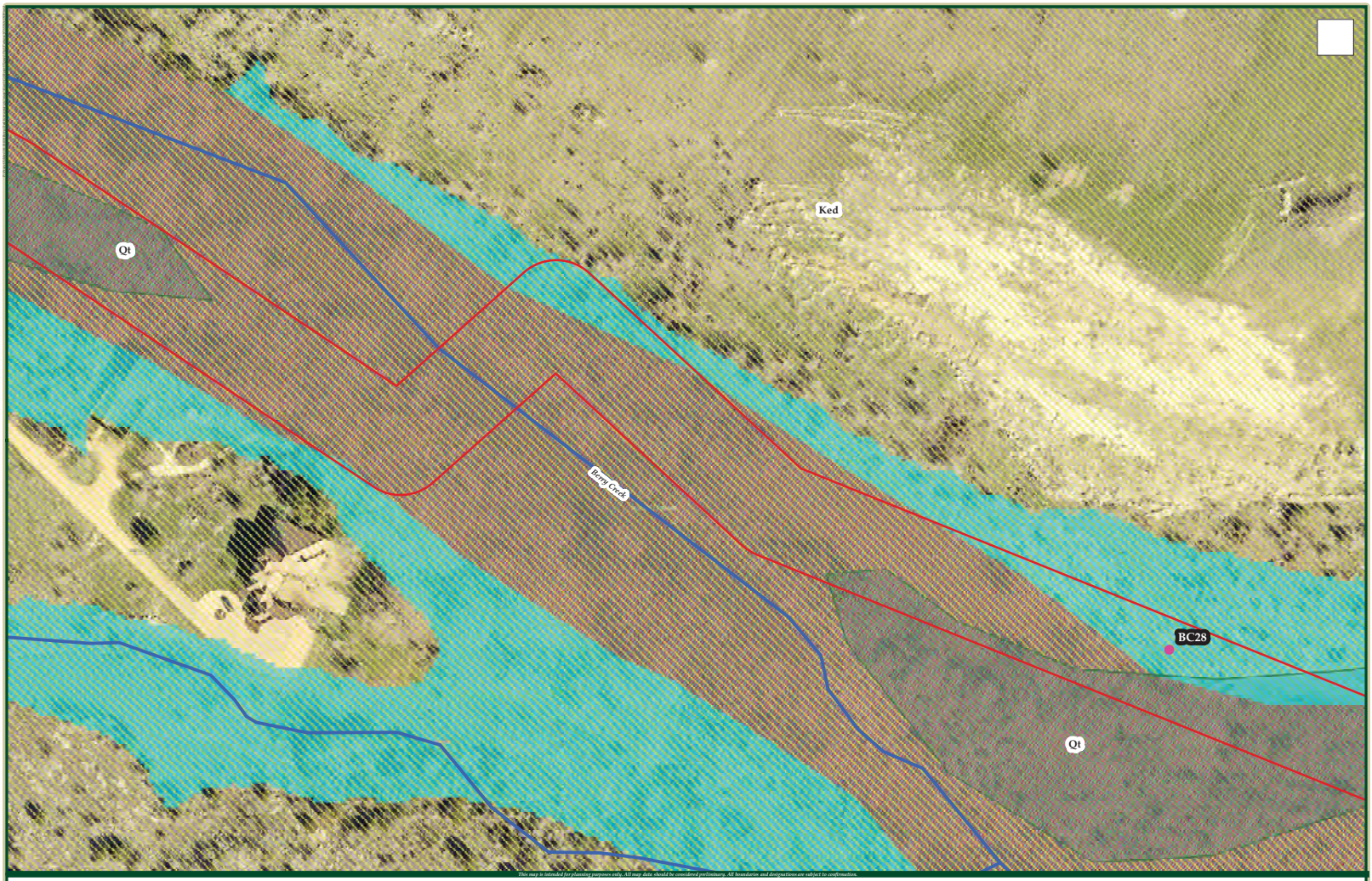
Berry Creek Interceptor
Figure 3: Features (5 of 11)

aci Project No.: 30-15-028
July 2016



This map is intended for planning purposes only. All map data should be considered preliminary. All boundaries and designations are subject to confirmation.

N

30 0 30

Feet

1:360

1 inch = 30 Feet

National Flood Hazard Layer

GA Features

NHD Flowlines

Survey Area

Geology 24K

Ked

Qt



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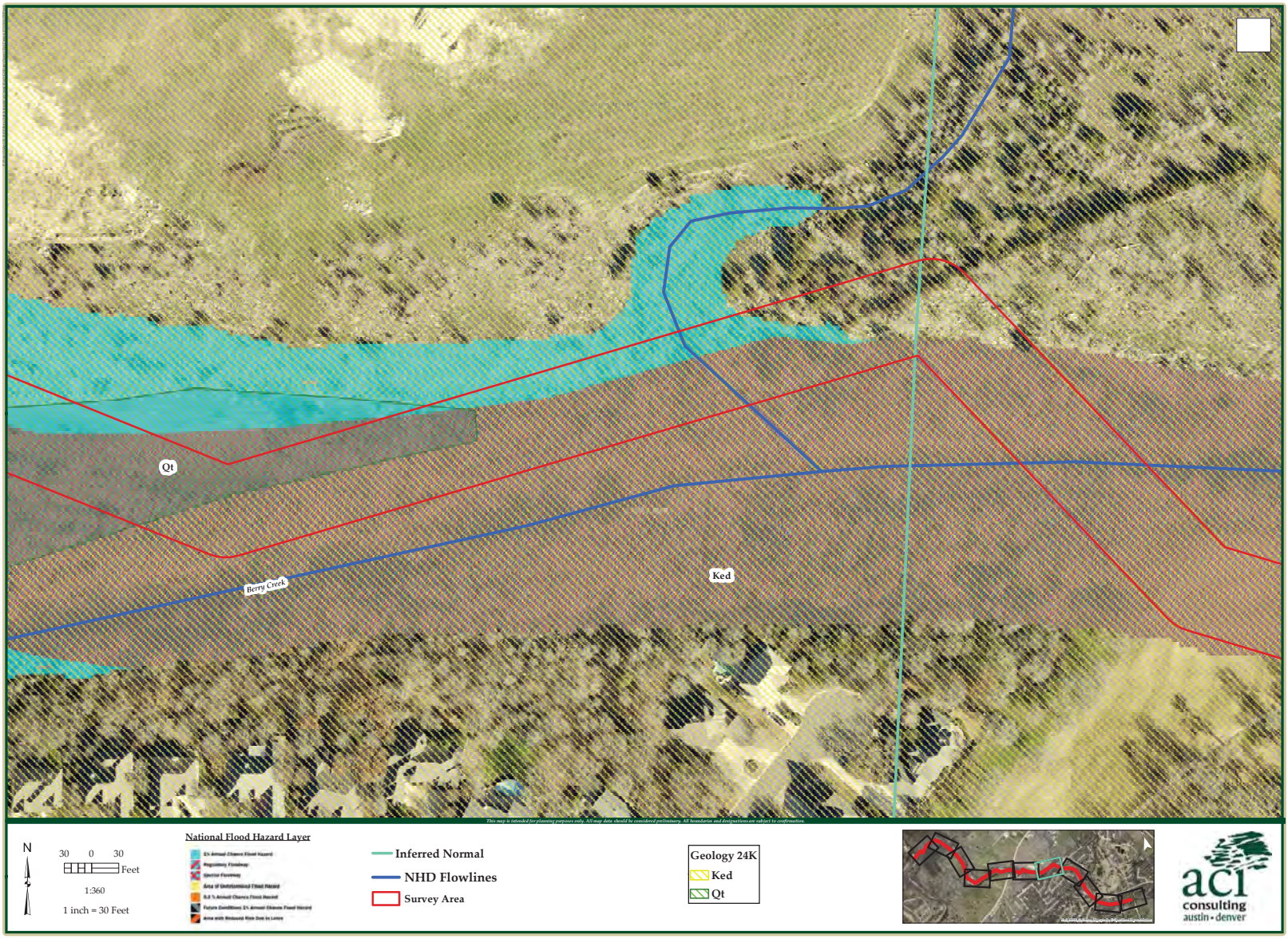
Berry Creek Interceptor

Figure 3: Features (6 of 11)

aci Project No.: 30-15-028

July 2016



This map is intended for planning purposes only. All map data should be considered preliminary. All boundaries and designations are subject to confirmation.

N

30 0 30 Feet

1:360

1 inch = 30 Feet

National Flood Hazard Layer

Inferred Normal

NHD Flowlines

Survey Area

Geology 24K

Ked

Qt

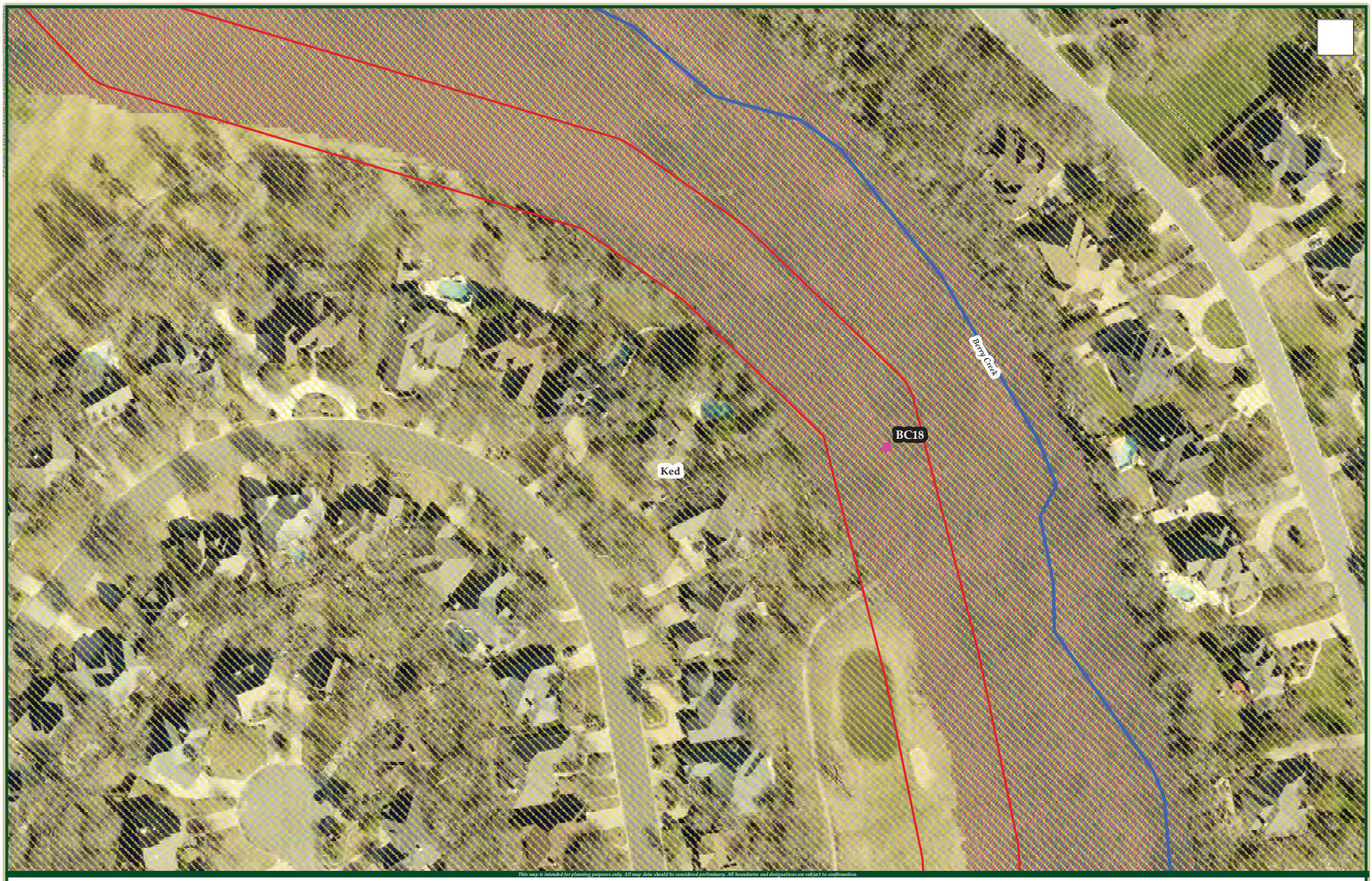
aci consulting austin • denver

Berry Creek Interceptor

Figure 3: Features (7 of 11)

aci Project No.: 30-15-028

July 2016



This map is intended for planning purposes only. All map data should be considered preliminary. All boundaries and designations are subject to confirmation.

N

30 0 30

Feet

1:360

1 inch = 30 Feet

National Flood Hazard Layer

GA Features

NHD Flowlines

Survey Area

Geology 24K

Ked



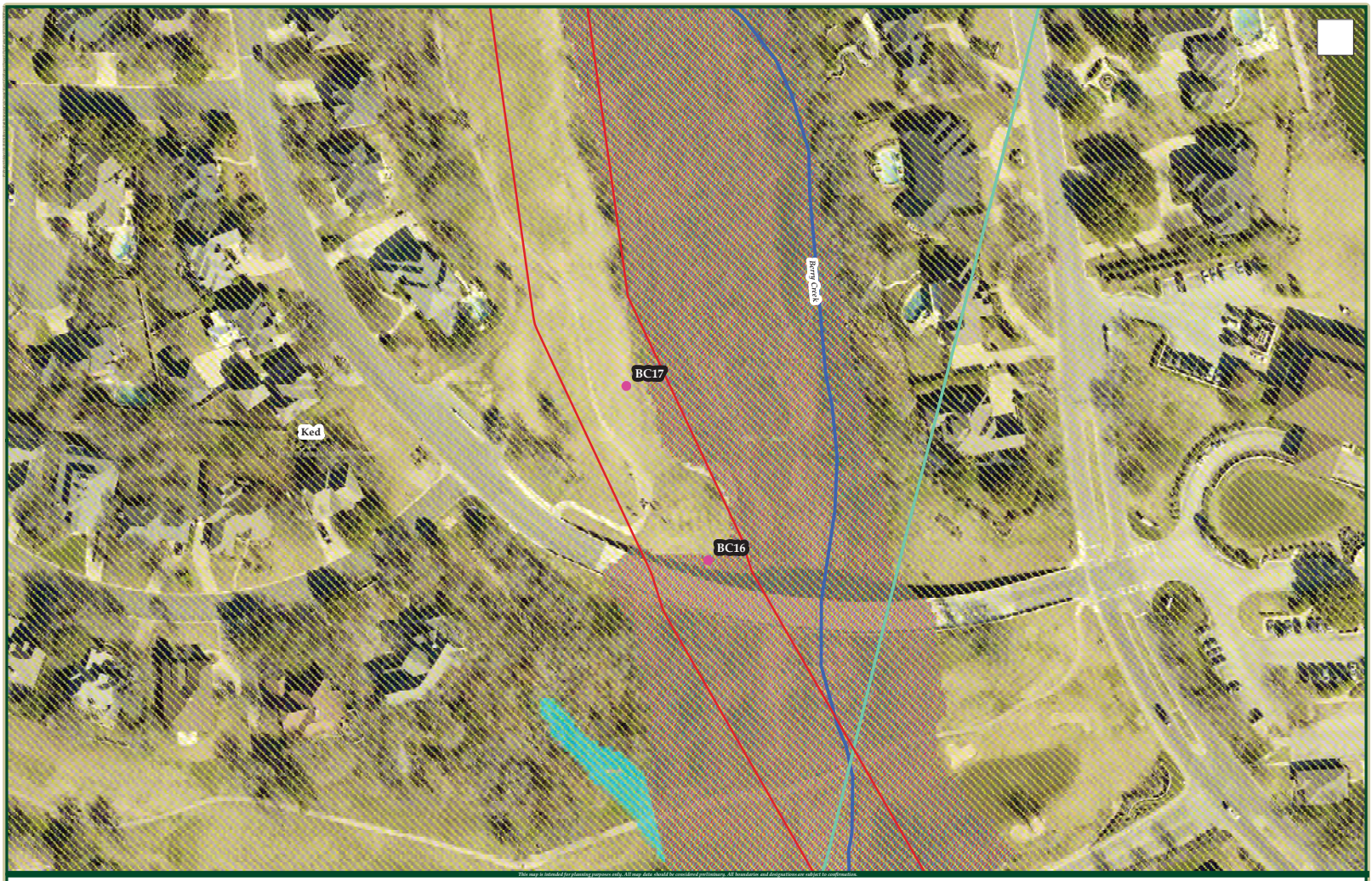
aci consulting austin • denver

Berry Creek Interceptor

Figure 3: Features (8 of 11)

aci Project No.: 30-15-028

July 2016



N

30 0 30 Feet

1:360

1 inch = 30 Feet

National Flood Hazard Layer

GA Features

Inferred Normal

NHD Flowlines

Survey Area

Geology 24K

Ked



aci consulting austin • denver

Berry Creek Interceptor

Figure 3: Features (9 of 11)

aci Project No.: 30-15-028

July 2016



N

30 0 30 Feet

1:360

1 inch = 30 Feet

National Flood Hazard Layer

GA Features

Inferred Normal

NHD Flowlines

Survey Area

Geology 24K

Ked



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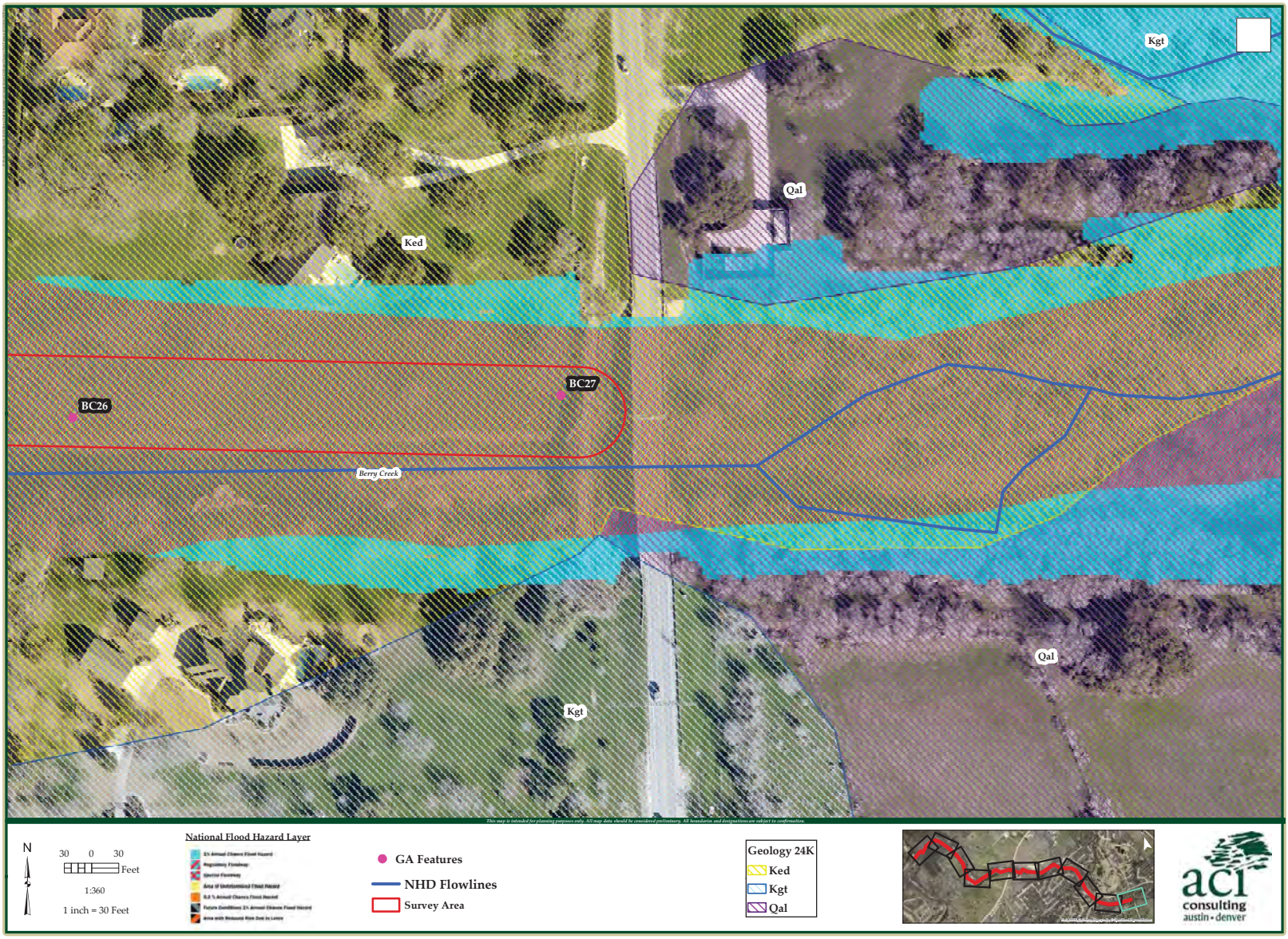
Berry Creek Interceptor

Figure 3: Features (10 of 11)

aci Project No.: 30-15-028

July 2016



N

30 0 30 Feet

1:360

1 inch = 30 Feet

National Flood Hazard Layer

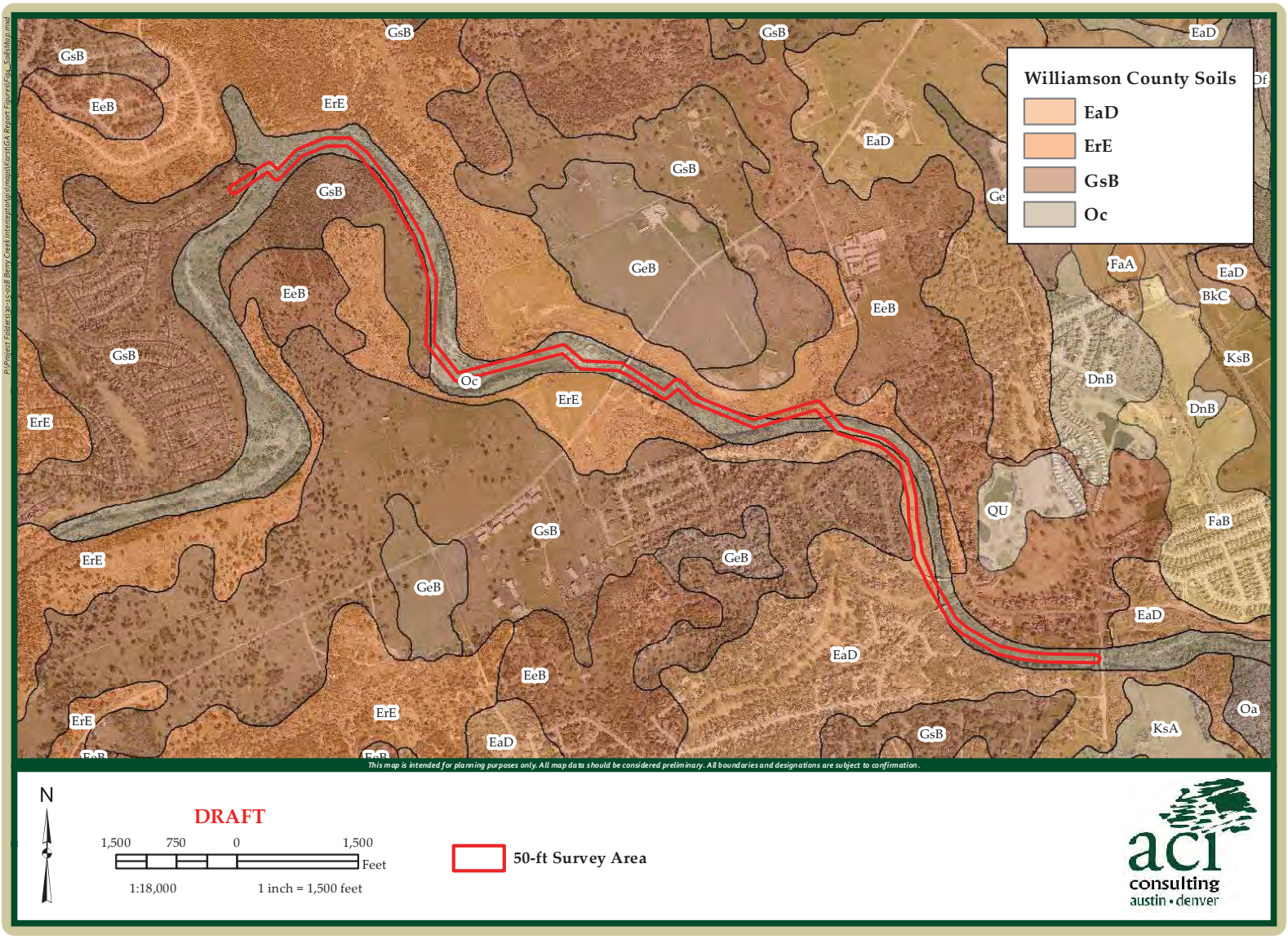
- GA Features
- NHD Flowlines
- Survey Area

Geology 24K
- Ked
- Kgt
- Qal

aci consulting austin • denver

Berry Creek Interceptor
Figure 3: Features (11 of 11)

aci Project No.: 30-15-028
July 2016



Berry Creek Wastewater Interceptor
Figure 4: Soils Map

aci Project No.: 30-15-028
July 2016

Prepared for:

ACI CONSULTING
1001 North Mopac Circle, #1000
Austin, TX 78746

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Historical Aerial Photographs

30-15-028

Williamson County, TX

ES-119368

Thursday, March 3, 2016



Date: 2014
Source: USDA

0 625 1,250 2,500 Feet

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Date: 2012
Source: USDA

0 625 1,250 2,500 Feet

BANKS
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Date: 2008
Source: USDA

0 625 1,250 2,500 Feet

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Date: 2004
Source: USDA

0 625 1,250 2,500 Feet

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Date: 1995
Source: USGS

0 625 1,250 2,500 Feet

BANKS
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Date: 1982
Source: USGS

0 625 1,250 2,500 Feet

BANKS
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Date: 1974
Source: USGS

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BANKS ENVIRONMENTAL DATA
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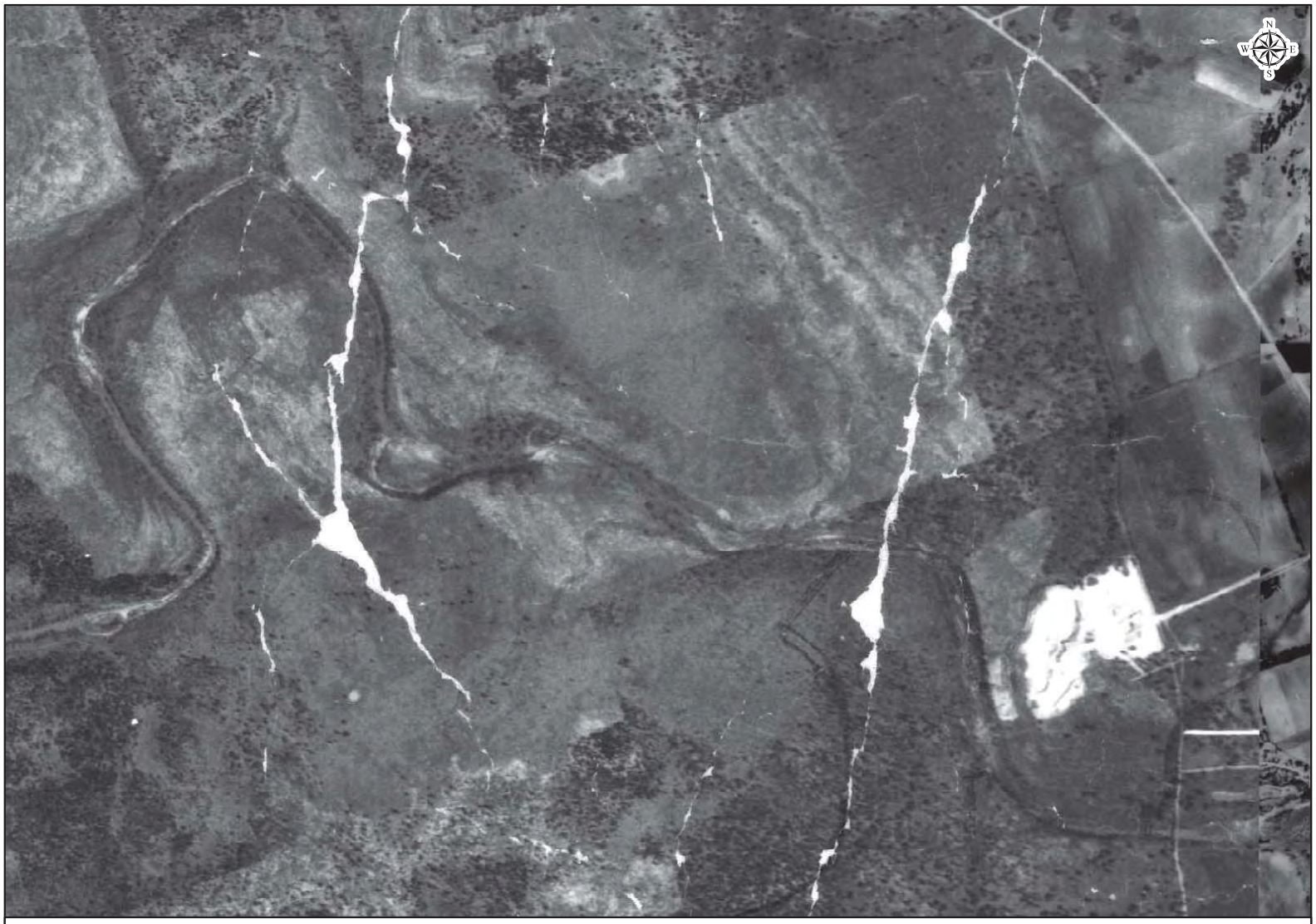

Date: 1964
Source: Fairchild

0 625 1,250 2,500 Feet

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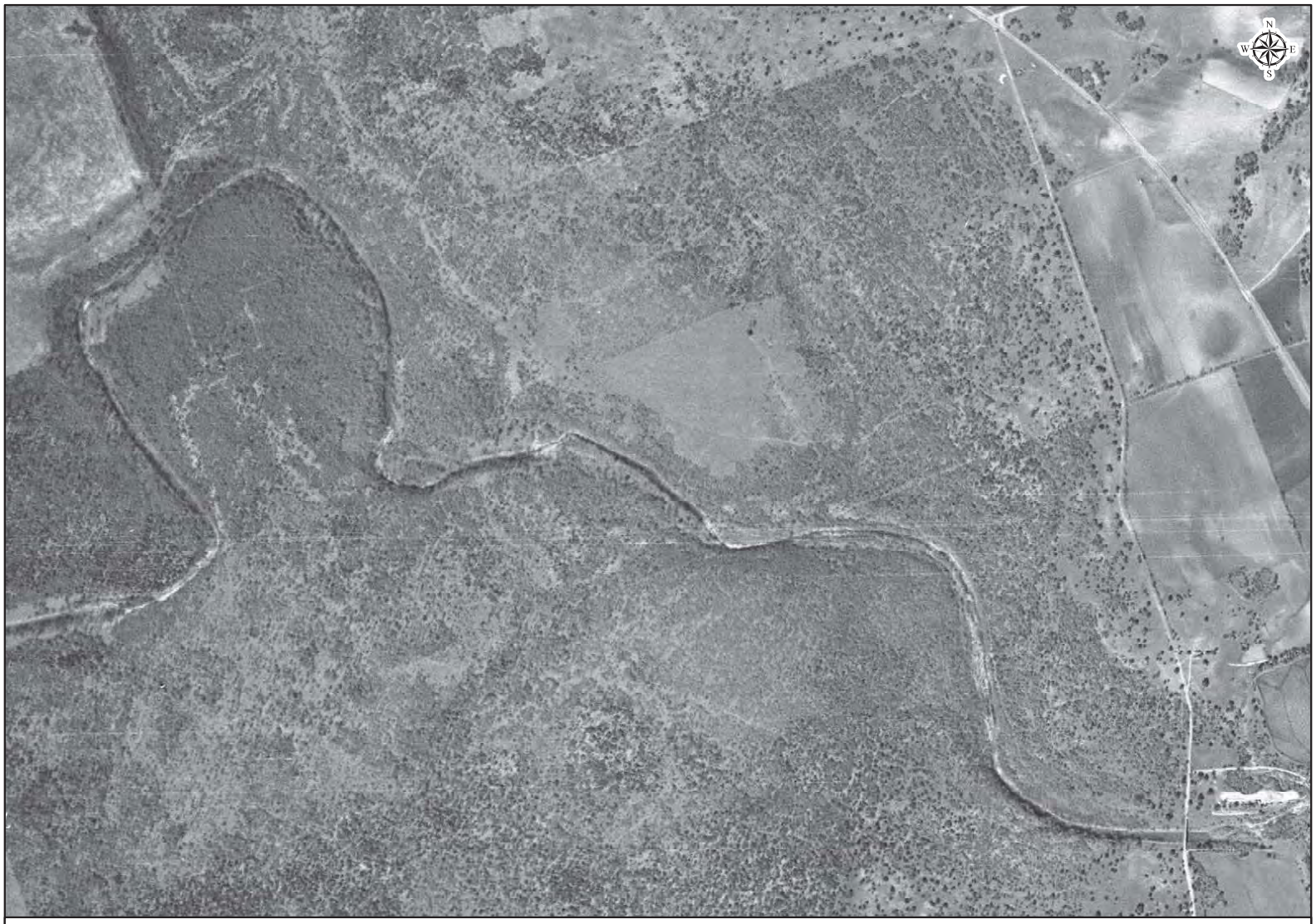

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Source: AMS

0 625 1,250 2,500 Feet

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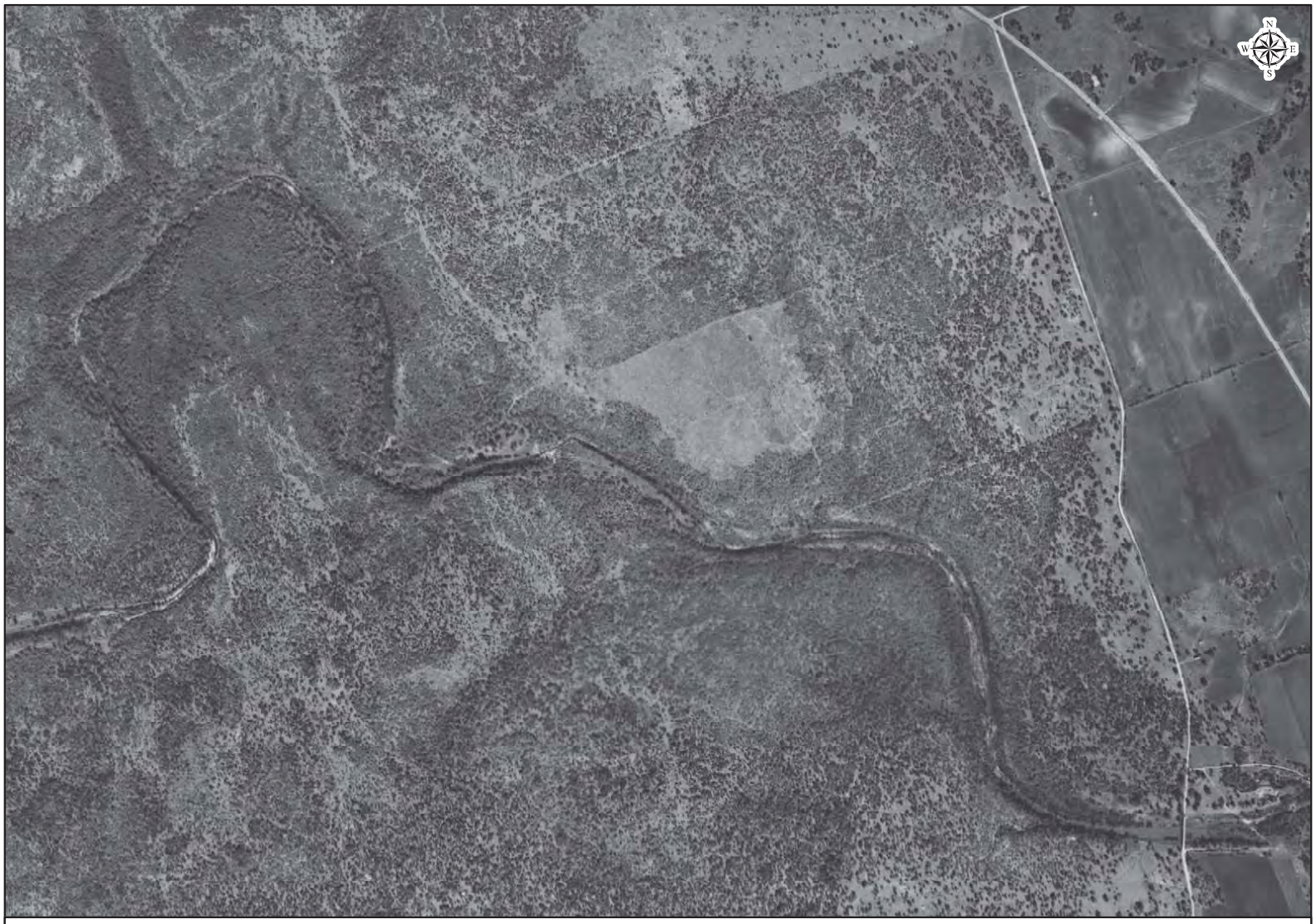

Date: 1941
Source: ASCS

0 625 1,250 2,500 Feet

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AERIAL SOURCE DEFINITIONS

Acronym	Agency
AerialOK	Aerial Oklahoma
AMS	Army Mapping Service
ASCS	Agricultural Stabilization & Conservation Service
EDAC	Earth Data Analysis Center
Fairchild	Fairchild Aerial Surveys
LDOT	Louisiana Department of Transportation
TXDOT	Texas Department of Transportation
USNavy	United States Navy
USAF	United States Air Force
USCOE	United States Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WALLACE	Wallace-Zingery Aerial Surveys
WSDOT	Washington State Department of Transportation

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

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Modification of a Previously Approved Plan

Texas Commission on Environmental Quality

for Regulated Activities on the Edwards Aquifer Recharge Zone and Transition Zone and Relating to 30 TAC 213.4(j), Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. This request for a **Modification of a Previously Approved Plan** is hereby submitted for TCEQ review and executive director approval. The request was prepared by:

Print Name of Customer/Agent: Eric Lee Nelson, P.E.

Date: 8/16/2023

Signature of Customer/Agent:



Project Information

1. Current Regulated Entity Name: Berry Creek Wastewater Interceptor
   Original Regulated Entity Name: Berry Creek Wastewater Interceptor
   Regulated Entity Number(s) (RN): RN110600343
   Edwards Aquifer Protection Program ID Number(s): 11001386 & 11001522
   ☒ The applicant has not changed and the Customer Number (CN) is: CN600412043
   ☐ The applicant or Regulated Entity has changed. A new Core Data Form has been provided.

2. ☒ **Attachment A: Original Approval Letter and Approved Modification Letters**. A copy of the original approval letter and copies of any modification approval letters are attached.

3. A modification of a previously approved plan is requested for (check all that apply):
   - ☐ Physical or operational modification of any water pollution abatement structure(s) including but not limited to ponds, dams, berms, sewage treatment plants, and diversionary structures;
   - ☐ Change in the nature or character of the regulated activity from that which was originally approved or a change which would significantly impact the ability of the plan to prevent pollution of the Edwards Aquifer;
   - ☐ Development of land previously identified as undeveloped in the original water pollution abatement plan;
   - ☒ Physical modification of the approved organized sewage collection system;
   - ☐ Physical modification of the approved underground storage tank system;
   - ☐ Physical modification of the approved aboveground storage tank system.

4. ☒ Summary of Proposed Modifications (select plan type being modified). If the approved plan has been modified more than once, copy the appropriate table below, as necessary, and complete the information for each additional modification.

WPAP Modification Summary	***Approved Project***	***Proposed Modification***
Acres	_____	_____
Type of Development	_____	_____
Number of Residential Lots	_____	_____
Impervious Cover (acres)	_____	_____
Impervious Cover (%	_____	_____
Permanent BMPs	_____	_____
Other	_____	_____

SCS Modification Summary	***Approved Project***	***Proposed Modification***
Linear Feet	8009	305
Pipe Diameter	30"-36"	30"
Other	_____	_____

AST Modification Summary	***Approved Project***	***Proposed Modification***
Number of ASTs	_____	_____
Volume of ASTs	_____	_____
Other	_____	_____

UST Modification Summary	***Approved Project***	***Proposed Modification***
Number of USTs	_____	_____
Volume of USTs	_____	_____
Other	_____	_____

5. ☒ **Attachment B: Narrative of Proposed Modification**. A detailed narrative description of the nature of the proposed modification is attached. It discusses what was approved, including any previous modifications, and how this proposed modification will change the approved plan.

6. ☒ **Attachment C: Current Site Plan of the Approved Project**. A current site plan showing the existing site development (i.e., current site layout) at the time this application for modification is attached. A site plan detailing the changes proposed in the submitted modification is required elsewhere.
   - ☐ The approved construction has not commenced. The original approval letter and any subsequent modification approval letters are included as Attachment A to document that the approval has not expired.
   - ☒ The approved construction has commenced and has been completed. Attachment C illustrates that the site was constructed as approved.
   - ☐ The approved construction has commenced and has been completed. Attachment C illustrates that the site was **not** constructed as approved.
   - ☐ The approved construction has commenced and has **not** been completed. Attachment C illustrates that, thus far, the site was constructed as approved.
   - ☐ The approved construction has commenced and has **not** been completed. Attachment C illustrates that, thus far, the site was **not** constructed as approved.

7. ☐ The acreage of the approved plan has increased. A Geologic Assessment has been provided for the new acreage.
   ☒ Acreage has not been added to or removed from the approved plan.

8. ☒ Submit one (1) original and one (1) copy of the application, plus additional copies as needed for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ will distribute the additional copies to these jurisdictions. The copies must be submitted to the appropriate regional office.

ATTACHMENT A

COPY

R-11

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

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 3, 2019

Mr. Michael Hallmark
CIP Manager
City of Georgetown,
300-1 Industrial Avenue,
Georgetown, Texas 78626

Re: Edwards Aquifer: Williamson County
NAME OF PROJECT: Berry Creek Wastewater Interceptor; Located along Berry Creek from Stetson Trail to Shell Road; Georgetown, Texas
TYPE OF PLAN: Request for Approval of a Sewage Collection System (SCS); 30 Texas Administrative Code (TAC) Chapter 213 Edwards Aquifer and 30 TAC Chapter 217 Edwards Aquifer Protection Program ID No. 11001522; RN: RN110600343

Dear Mr. Hallmark:

The Texas Commission on Environmental Quality (TCEQ) has completed its review of the SCS plans and specifications for the referenced project submitted to the Austin Regional Office by CDM Smith Inc., on behalf of City of Georgetown on April 17, 2019. Final review of the SCS was completed after additional material was received on May 30, 31, and June 3, 2019. As presented to the TCEQ, the construction documents were prepared by a Texas Licensed Professional Engineer to be in general compliance with the requirements of 30 TAC Chapter 213 and Chapter 217. These planning materials were sealed, signed and dated by a Texas Licensed Professional Engineer. Therefore, based on the Texas Licensed Professional Engineer's concurrence of compliance, the planning materials for construction of the proposed sewage collection system and pollution abatement measures are hereby approved subject to applicable state rules and the conditions in this letter. The applicant or a person affected may file with the chief clerk a motion for reconsideration of the executive director's final action on this Edwards Aquifer protection plan. A motion for reconsideration must be filed no later than 23 days after the date of this approval letter. *This approval expires (2) two years from the date of this letter unless, prior to the expiration date, more than 10 percent of construction has commenced, or an extension of time has been requested.*

PROJECT DESCRIPTION

The proposed project consists of 8,009 linear feet of wastewater line as part of Phase 2 of the Berry Creek Wastewater Interceptor which includes installation of approximately 16,240 linear feet of waste water line in two phases. This interceptor will allow City of Georgetown to divert flows in excess of the Sun City force main once both phases of the project is completed. The line will not be put into service until both phases are completed. The flow from the interceptor will

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be treated at the Berry Creek Wastewater Treatment Plant (WWTP) on an interim basis and will ultimately be processed at the existing Pecan Branch WWTP.

In addition to the described activities, temporary erosion and sedimentation controls will be installed prior to commencing site disturbance and maintained during construction.

SEWAGE COLLECTION SYSTEM

The SCS consists of a total of 8,009 linear feet of wastewater line. Please refer to the table below for the pipe specifications.

Pipe Diameter	Linear Feet	Pipe Material/Specifications
30"	7,216	PS-72 PVC / ASTM F679
27"	47	PS-72 PVC / ASTM F679
15"	79	PVC DR-26/ASTM D3034
8"	617	PVC DR-26/ASTM D3034
8"	20	PVC DR-26/ASTM D2241
12"	20	PVC DR-26/ASTM D3034
6"	10	PVC DR-26/ASTM D3034

After construction is complete, all sections located within the 100-year floodplain will have watertight manholes, water tight rings and covers and all sections located within the 5-year floodplain will be encased in concrete or capped with concrete.

The project is located within the City of Georgetown and will conform to all specifications, applicable codes, ordinances, and requirements of the City of Georgetown.

GEOLOGY

According to the Geologic Assessment (GA) included in the application, the project site is located within the Edwards limestone, dolomitic limestone and marl. A Geologic Assessment conducted on February 29, 2016 by ACI Consulting determined that there were no sensitive karst features on the subject property.

On May 16, 2019, the TCEQ conducted a site assessment, and determined that the site generally appeared as described in the GA.

SPECIAL CONDITIONS

I. It is emphasized that where wastewater lines must bridge faults, caverns, sinkholes, or solution features the lines shall be constructed in a manner that will maintain the structural integrity of the pipe. When such sensitive features are encountered, 30 TAC §213.5(f)(2) requires that all regulated activities near the feature must be immediately suspended and the owner/developer shall immediately notify the Austin Regional Office. Additionally, when such geologic features are encountered which are bridged by construction, the location and extent of those features must be assessed by a geologist and must be reported to the Austin Regional Office in writing within two working days of discovery as required by 30 TAC §213.5(c)(3)(K). Construction may not resume in the area of the feature until the executive director has reviewed and approved the methods proposed to protect the aquifer from any potential adverse impacts.

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II. Intentional discharges of sediment laden water are not allowed. Plans and specification which covers water treatment design criteria, water quality criteria and other discharge restrictions and limitations submitted with the application appears to be acceptable. As proposed in the plan, any discharge will be filtered or treated through appropriately selected water treatment or temporary best management practices.

STANDARD CONDITIONS

1. Pursuant to Chapter 7 Subchapter C of the Texas Water Code, any violations of the requirements in 30 TAC Chapter 213 may result in administrative penalties.
2. The holder of the approved Edwards Aquifer protection plan must comply with all provisions of 30 TAC Chapter 213 and all best management practices and measures contained in the approved plan. Additional and separate approvals, permits, registrations and/or authorizations from other TCEQ Programs (i.e., Stormwater, Water Rights, and UIC) can be required depending on the specifics of the plan.
3. In addition to the rules of the Commission, the applicant may also be required to comply with state and local ordinances and regulations providing for the protection of water quality.

Prior to Commencement of Construction:

4. All contractors conducting regulated activities at the referenced project location shall be provided a copy of this notice of approval. At least one complete copy of the approved SCS and this notice of approval shall be maintained at the project location until all regulated activities are completed.
5. Modification to the activities described in the referenced SCS application following the date of approval may require the submittal of a plan to modify this approval, including the payment of appropriate fees and all information necessary for its review and approval prior to initiating construction of the modifications.
6. The applicant must provide written notification of intent to commence construction, replacement, or rehabilitation of the referenced project. Notification must be submitted to the Austin Regional Office no later than 48 hours prior to commencement of the regulated activity. Written notification must include the date on which the regulated activity will commence, the name of the approved plan and program ID number for the regulated activity, and the name of the prime contractor with the name and telephone number of the contact person. The executive director will use the notification to determine if the approved plan is eligible for an extension.
7. Temporary erosion and sedimentation (E&S) controls, i.e., silt fences, rock berms, stabilized construction entrances, or other controls described in the approved WPAP, must be installed prior to construction and maintained during construction. Temporary E&S controls may be removed when vegetation is established, and the construction area is stabilized. If a water quality pond is proposed, it shall be used as a sedimentation basin during construction. The TCEQ may monitor stormwater discharges from the site to evaluate the adequacy of temporary E&S control measures. Additional controls may be necessary if excessive solids are being discharged from the site.
8. All borings with depths greater than or equal to 20 feet must be plugged with non-shrink grout from the bottom of the hole to within three (3) feet of the surface. The remainder of the hole must be backfilled with cuttings from the boring. All borings less than 20 feet must be backfilled with cuttings from the boring. All borings must be backfilled or plugged within four (4) days of completion of the drilling operation. Voids may be filled with gravel.

During Construction:

9. During the course of regulated activities related to this project, the applicant or agent shall comply with all applicable provisions of 30 TAC Chapter 213 and Chapter 217, Edwards Aquifer. The applicant shall remain responsible for the provisions and conditions of this approval until such responsibility is legally transferred to another person or entity.
10. This approval does not authorize the installation of temporary aboveground storage tanks on this project. If the contractor desires to install a temporary aboveground storage tank for use during construction, an application to modify this approval must be submitted and approved prior to installation. The application must include information related to tank location and spill containment. Refer to Standard Condition No. 6, above.
11. If any sensitive feature (caves, solution cavities, sink holes, etc.) is discovered during construction, all regulated activities near the feature must be suspended immediately. The applicant or his agent must immediately notify the Austin Regional Office of the discovery of the feature. Regulated activities near the feature may not proceed until the executive director has reviewed and approved the methods proposed to protect the feature and the aquifer from potentially adverse impacts to water quality. The plan must be sealed, signed, and dated by a Texas Licensed Professional Engineer.
12. No water well is located on this site. All water well including injection, dewatering, and monitoring wells must be in compliance with the requirements of the Texas Department of Licensing and Regulation under Title 16 TAC Chapter 76 (relating to Water Well Drillers and Pump Installers) and all other locally applicable rules, as appropriate.
13. If sediment escapes the construction site, the sediment must be removed at a frequency sufficient to minimize offsite impacts to water quality (e.g., fugitive sediment in street being washed into surface streams or sensitive features by the next rain). Sediment must be removed from sediment traps or sedimentation ponds not later than when design capacity has been reduced by 50 percent. Litter, construction debris, and construction chemicals shall be prevented from becoming stormwater discharge pollutants.
14. Intentional discharges of sediment laden water are not allowed. If dewatering becomes necessary, the discharge will be filtered or treated through appropriately selected best management practices. These may include vegetated filter strips, sediment traps, rock berms, silt fence rings, etc.
15. The following records shall be maintained and made available to the executive director upon request: the dates when major grading activities occur, the dates when construction activities temporarily or permanently cease on a portion of the site, and the dates when stabilization measures are initiated.
16. Stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, and construction activities will not resume within 21 days. When the initiation of stabilization measures by the 14th day is precluded by weather conditions, stabilization measures shall be initiated as soon as practicable.
17. No part of the system shall be used as a holding tank for a pump-and-haul operation.

After Completion of Construction:

18. Certification by a Texas Licensed Professional Engineer of the testing of sewage collection systems required by 30 TAC Chapter 213 and Chapter 217 shall be submitted to the Austin

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Regional Office within 30 days of test completion and prior to the new sewage collection system being put into service. The certification should include the project name as it appeared on the approved application, the program ID number, and two copies of a site plan sheet(s) indicating the wastewater lines that were tested and are being certified as complying with the appropriate regulations.

Every five years after the initial certification, the sewage collection system shall be retested. Any lines that fail the test must be repaired and retested. Certification that the system continues to meet the requirements of 30 TAC Chapter 213 and Chapter 217 shall be submitted to the Austin Regional Office. The certification should include the project name as it appeared on the approved application, the program ID number and two copies of a site plan sheet(s) indicating the wastewater lines that were tested and are being certified as complying with the appropriate regulations.

19. If ownership of this organized sewage collection system is legally transferred (e.g., developer to city or Municipal Utility District), the new owner(s) is required to comply with all terms of the approved Edwards Aquifer protection plan. If the new owner intends to commence any new regulated activity on the site, a new Edwards Aquifer protection plan that specifically addresses the new activity must be submitted to the executive director. Approval of the plan for the new regulated activity by the executive director is required prior to commencement of the new regulated activity.
20. At project locations where construction is initiated and abandoned, or not completed, the site shall be returned to a condition such that the aquifer is protected from potential contamination.
21. An Edwards Aquifer protection plan approval or extension will expire and no extension will be granted if more than 50 percent of the total construction has not been completed within ten years from the initial approval of a plan. A new Edwards Aquifer protection plan must be submitted to the Austin Regional Office with the appropriate fees for review and approval by the executive director prior to commencing any additional regulated activities.

This action is taken under authority delegated by the Executive Director of the Texas Commission on Environmental Quality. If you have any questions or require additional information, please contact Ms. Anusuya K. Iyer, P.E. of the Edwards Aquifer Protection Program of the Austin Regional Office at 512-339-2929.

Sincerely,

Robert Sadlier, Section Manager
Edwards Aquifer Protection Program
Texas Commission on Environmental Quality

RCS/aki

ATTACHMENT B

Walker Partners
engineers | surveyors

MODIFICATION NARRATIVE FOR SUN CITY LIFT STATION CONNECTION PROJECT

This narrative describes the project summary requesting a revision or modification to the TCEQ approved Berry Creek Wastewater Interceptor (Project) from Stetson Trail to Airport Road in 2019. On Sheet C-18 on Attachment C, the connection from MH-44 and the 27” wastewater line, named “LINE B” was not installed. Georgetown will be diverting from reaching the Sun City Lift Station (LS) in the Sun City neighborhood by connecting the existing 27” wastewater line feeding the LS to the existing 30” Berry Creek Interceptor that was constructed in 2019.

ATTACHMENT C

GEORGETOWN UTILITY SYSTEMS

CITY OF GEORGETOWN, TEXAS

BERRY CREEK WASTEWATER INTERCEPTOR

PROJECT No. 3CJ

OCTOBER 2018

RECEIVED
APR 17 2019
TCEQ
REGION 11

CITY COUNCIL

MAYOR
DALE ROSS

CITY COUNCIL MEMBERS

ANNA EBY	DISTRICT 1
VALERIE NICHOLSON	DISTRICT 2
JOHN HESSER	MAYOR PRO TEM/ DISTRICT 3
STEVE FOUGHT	DISTRICT 4
KEVIN PITTS	DISTRICT 5
RACHAEL JONROWE	DISTRICT 6
TOMMY GONZALEZ	DISTRICT 7

CITY MANAGER
DAVID MORGAN

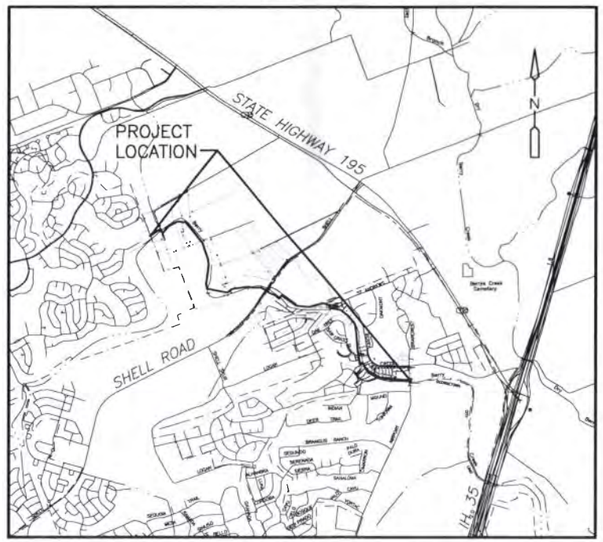
ASSISTANT CITY MANAGER/ GENERAL MANAGER OF UTILITIES
JIM BRIGGS

ASSISTANT CITY MANAGER
LAURIE BREWER
WAYNE REED

WATER SERVICES UTILITY DIRECTOR
GLENN DISHONG

UTILITY ENGINEER
DAVID MUNK, P.E.

SYSTEMS ENGINEERING DIRECTOR
WESLEY WRIGHT, P.E.



LOCATION PLAN
NTS

CITY OF GEORGETOWN, GEORGETOWN UTILITY SYSTEMS — DATE

PREPARED BY:

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED PROFESSIONAL ENGINEER
12-13-2018

CDM Smith — DATE
TEXAS REGISTRATION NUMBER F-3043

CDM Smith

AUSTIN, TEXAS

Water **Environment** **Transportation** **Energy** **Facilities**

XREFs: [Williamson-new, XC-BOUNDARY, ADR-SEAL] Images: [X-COG-LO]
Last saved by: DOAKEC Time: 10/29/2018 11:30:14 AM
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XREFs: [Wilkinson-new, BC-BOUNDARY, OWNERS, CWF0034ERIAL, FLOOD PLAIN TX83-CF, CDMS_2234, ADR-SEAL] Images: []
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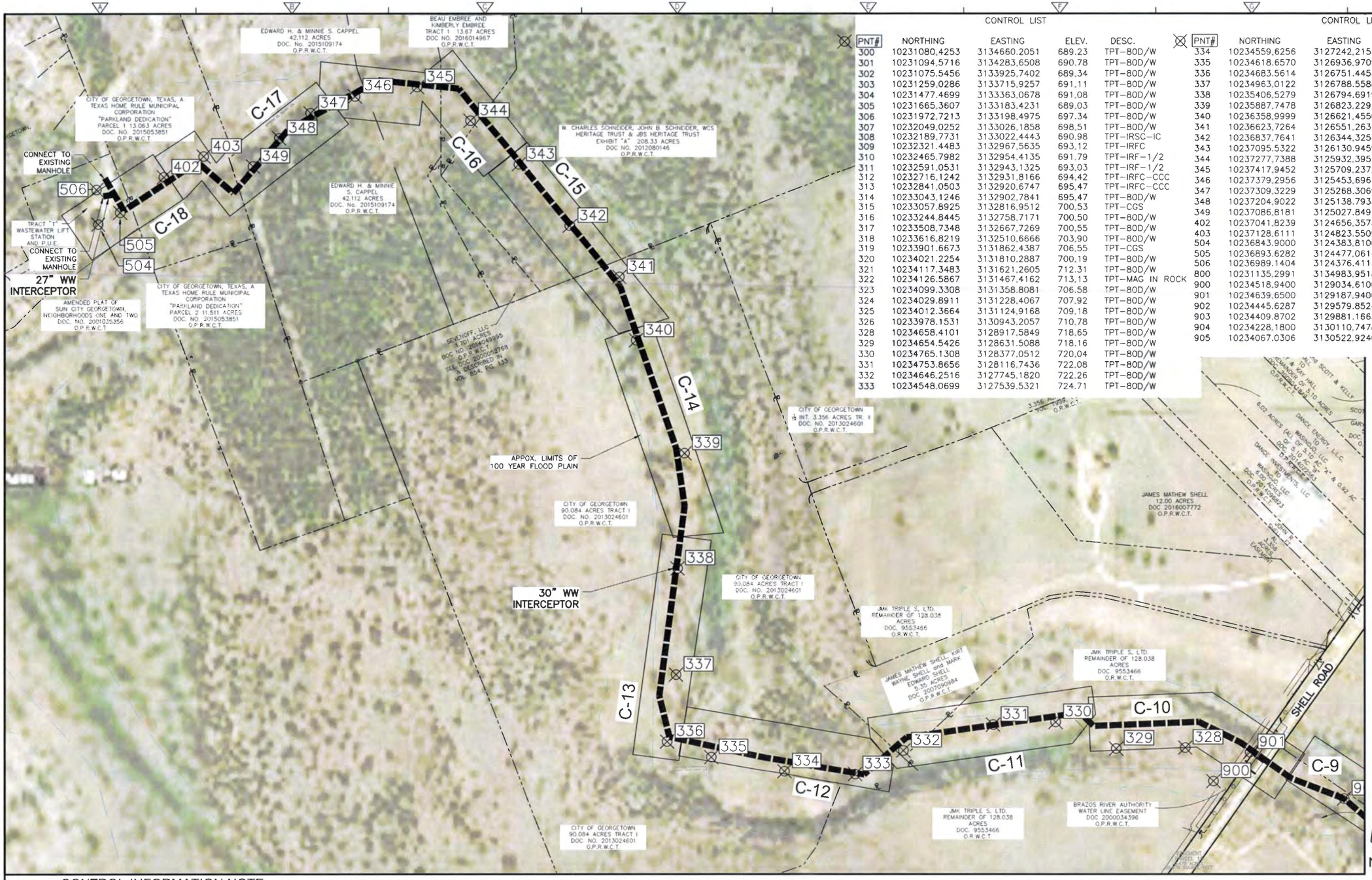

CONTROL LIST

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301	10231094.5716	3134283.6508	690.78	TPT-80D/W
302	10231075.5456	3133925.7402	689.34	TPT-80D/W
303	10231259.0286	3133715.9257	691.11	TPT-80D/W
304	10231477.4699	3133363.0678	691.08	TPT-80D/W
305	10231665.3607	3133183.4231	689.03	TPT-80D/W
306	10231972.7213	3133198.4975	697.34	TPT-80D/W
307	10232049.0252	3133026.1858	698.51	TPT-80D/W
308	10232189.7731	3133022.4443	690.98	TPT-IRSC-IC
309	10232321.4483	3132967.5635	693.12	TPT-IRFC
310	10232465.7982	3132954.4135	691.79	TPT-IRF-1/2
311	10232591.0531	3132943.1325	693.03	TPT-IRF-1/2
312	10232716.1242	3132931.8166	694.42	TPT-IRFC-CCC
313	10232841.0503	3132920.6747	695.47	TPT-IRFC-CCC
314	10233043.1246	3132902.7841	695.47	TPT-80D/W
315	10233057.8925	3132816.9512	700.53	TPT-CGS
316	10233244.8445	3132758.7171	700.50	TPT-80D/W
317	10233508.7348	3132667.7269	700.55	TPT-80D/W
318	10233616.8219	3132510.6666	703.90	TPT-80D/W
319	10233901.6673	3131862.4387	706.55	TPT-CGS
320	10234021.2254	3131810.2887	700.19	TPT-80D/W
321	10234117.3483	3131621.2605	712.31	TPT-80D/W
322	10234126.5867	3131467.4162	713.13	TPT-MAG IN ROCK
323	10234099.3308	3131358.8081	706.58	TPT-80D/W
324	10234029.8911	3131228.4067	707.92	TPT-80D/W
325	10234012.3664	3131124.9168	709.18	TPT-80D/W
326	10233978.1531	3130943.2057	710.78	TPT-80D/W
328	10234658.4101	3128917.5849	718.65	TPT-80D/W
329	10234654.5426	3128631.5088	718.16	TPT-80D/W
330	10234765.1308	3128377.0512	720.04	TPT-80D/W
331	10234753.8656	3128116.7436	722.08	TPT-80D/W
332	10234646.2516	3127745.1820	722.26	TPT-80D/W
333	10234548.0699	3127539.5321	724.71	TPT-80D/W

CONTROL LIST

PNT#	NORTHING	EASTING	ELEV.	DESC.
334	10234559.6256	3127242.2155	731.33	TPT-80D/W
335	10234618.6570	3126936.9709	728.15	TPT-80D/W
336	10234683.5614	3126751.4453	733.22	TPT-80D/W
337	10234963.0122	3126788.5588	733.61	TPT-80D/W
338	10235406.5279	3126794.6919	730.98	TPT-80D/W
339	10235887.7478	3126823.2292	731.02	TPT-80D/W
340	10236358.9999	3126621.4550	730.99	TPT-80D/W
341	10236623.7264	3126551.2632	732.85	TPT-80D/W
342	10236837.7641	3126344.3254	733.51	TPT-80D/W
343	10237095.5322	3126130.9459	732.95	TPT-80D/W
344	10237277.7388	3125932.3956	732.41	TPT-80D/W
345	10237417.9452	3125709.2372	734.10	TPT-80D/W
346	10237379.2956	3125453.6961	736.39	TPT-80D/W
347	10237309.3229	3125268.3069	736.60	TPT-80D/W
348	10237204.9022	3125138.7935	738.23	TPT-80D/W
349	10237086.8181	3125027.8496	737.32	TPT-80D/W
402	10237041.8239	3124656.3575	741.82	TPT-80D/W
403	10237128.6111	3124823.5509	737.90	TPT-80D/W
504	10236843.9000	3124383.8100	757.32	TPT-CGS
505	10236893.6282	3124477.0614	748.64	TPT-80D/W
506	10236989.1404	3124376.4114	754.99	MON-COG-96-014
800	10231135.2991	3134983.9518	690.80	TPT-80D/W
900	10234518.9400	3129034.6100	724.32	TPT-80D/W
901	10234639.6500	3129187.9400	716.25	TPT-80D/W
902	10234445.6287	3129579.8524	715.87	TPT-80D/W
903	10234409.8702	3129881.1663	716.87	TPT-80D/W
904	10234228.1800	3130110.7478	716.45	TPT-80D/W
905	10234067.0306	3130522.9240	715.57	TPT-80D/W

XXX CONTROL POINT LOCATION

CONTROL INFORMATION NOTE

NOTES:
COORDINATES ARE SURFACE VALUES BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, NAD 83, CENTRAL ZONE 4203.
TO CONVERT COORDINATES AND DISTANCES TO GRID VALUES MULTIPLY BY A COMBINED SURFACE ADJUSTMENT FACTOR OF 0.99986157.
ELEVATIONS REPORTED ARE ORTHOMETRIC HEIGHTS BASED ON NAVD 88.

LOCATION PLAN

NTS

REV. NO.	DATE	DRWN	CHK'D	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

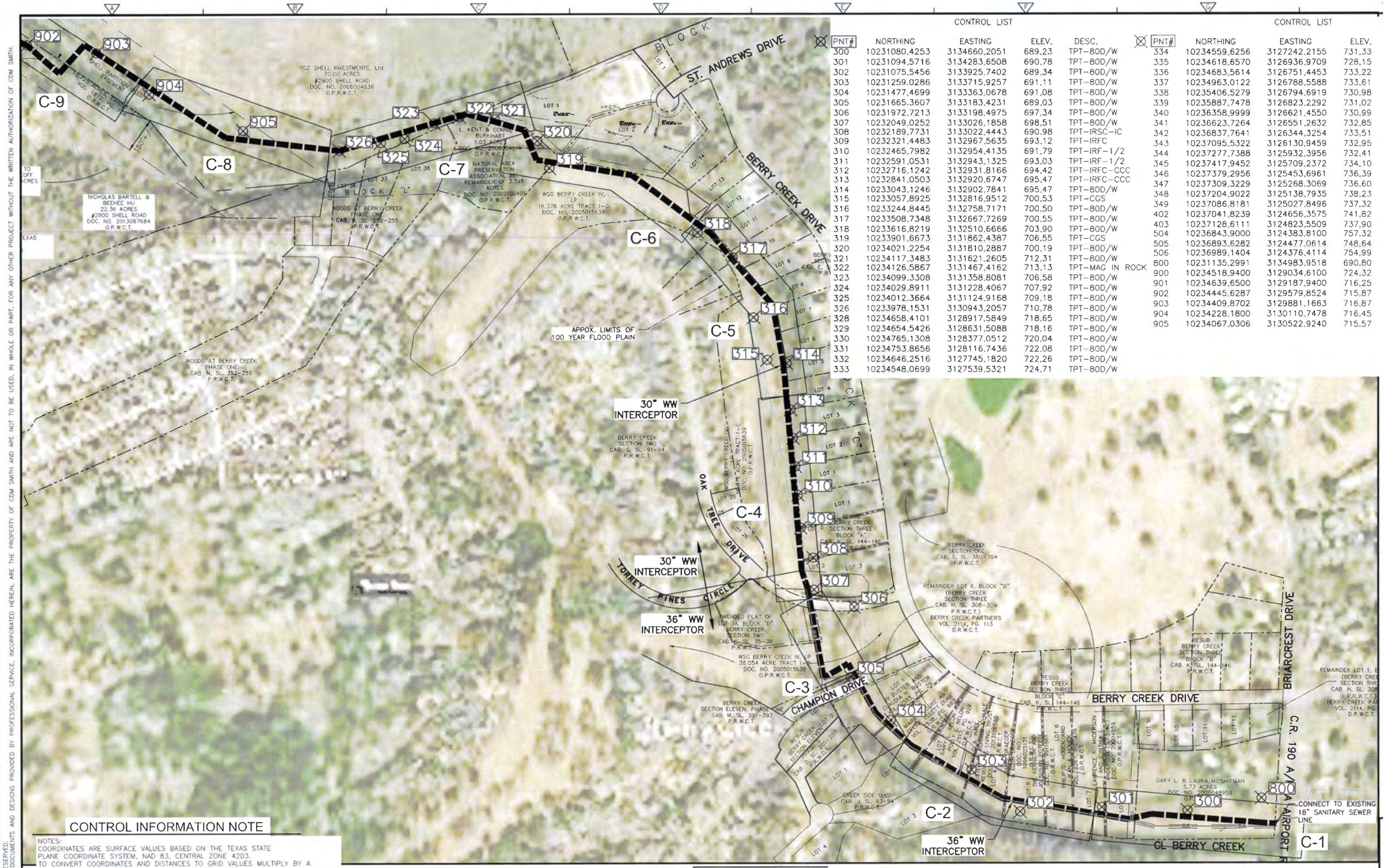
BERRY CREEK
WASTEWATER INTERCEPTOR

OVERALL ALIGNMENT AND SURVEY CONTROL

STATE OF TEXAS
ALAN D. RHAMES
92089
REGISTERED
PROFESSIONAL ENGINEER
12-13-2018

PROJECT NO: 2048-109788
FILE NAME: G001ALSC.DWG

SHEET NO.
G-1



CONTROL LIST

PNT#	NORTHING	EASTING	ELEV.	DESC.
300	10231080.4253	3134660.2051	689.23	TPT-80D/W
301	10231094.5716	3134283.6508	690.78	TPT-80D/W
302	10231075.5456	3133925.7402	689.34	TPT-80D/W
303	10231259.0286	3133715.9257	691.11	TPT-80D/W
304	10231477.4699	3133363.0678	691.08	TPT-80D/W
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309	10232321.4483	3132967.5635	693.12	TPT-IRFC
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905	10234067.0306	3130522.9240	715.57	TPT-80D/W

CONTROL INFORMATION NOTE

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ELEVATIONS REPORTED ARE ORTHOMETRIC HEIGHTS BASED ON NAVD 88.

NTS

LOCATION PLAN

N

1" = 200'
105 0 200

ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
STATE OF TEXAS
12-13-2018

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	EGD	ADR	CONFORMED DRAWING

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Rialta Corporate Park, 12357-A Rialta Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

OVERALL ALIGNMENT AND
SURVEY CONTROL

PROJECT NO. 2048-109788
FILE NAME: G002ALSC.DWG

SHEET NO.
G-2

XREFs: [W:\jmson-nre ▲DMS-2234, OWNERS, CWP03MATERIAL, XC-BOUNDARY, FLOOD PLAIN TXB3-CF, ADR-SEAL] Images: []
Last saved by: DOMEC, Time: 12/13/2018 3:28:19 PM
pw:\\jne-adrsmith.com:PW_CVT_20481\109788\04 Design Services NM_3085\01 General\10 CADD\G002ALSC.dwg
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GENERAL NOTES

1. ALL MANHOLES SHALL BE CONSTRUCTED WITH ECCENTRIC CONES. ALL MANHOLE LIDS SHALL BE STANDARD CITY OF GEORGETOWN MANHOLE LIDS AS SPECIFIED IN DRAWINGS & SECTION 02605 IN SPECIFICATIONS.
2. ANY EXISTING PAVEMENT (INCLUDING DRIVEWAY APPROACHES & PARKING LOTS) DAMAGED OR REMOVED DURING CONSTRUCTION SHALL BE REPLACED OR REPAIRED AT THE CONTRACTOR'S EXPENSE.
3. WHEN WORKING IN PUBLIC RIGHT-OF-WAY, CONTRACTOR WILL BE RESPONSIBLE FOR ERECTING AND MAINTAINING BARRICADES, FLAGGERS, SIGNS & OTHER DEVICES NECESSARY TO PROTECT THE PUBLIC & MAINTAIN TRAFFIC FLOW.
4. NO BLASTING WILL BE ALLOWED.
5. ANY EXISTING FENCES OR WALLS DAMAGED OR REMOVED DURING CONSTRUCTION SHALL BE REPLACED OR REPAIRED AT THE CONTRACTOR'S EXPENSE.
6. MANHOLE COVERS SHALL BE BOLTED & GASKETED ONLY WHERE INDICATED IN DRAWINGS.
7. THE CONTRACTOR SHALL GIVE THE CITY A MINIMUM OF 72 HOURS NOTICE BEFORE BEGINNING CONSTRUCTION.
8. THE LOCATION OF ANY UTILITY LINES SHOWN ON THE PLANS MUST BE FIELD VERIFIED BY THE CONTRACTOR. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO INSURE THAT NO CONFLICTS EXIST, AND THAT ANY DAMAGE TO SAID LINES WILL BE REPAIRED AS NECESSARY BY THE CONTRACTOR, OR AT THE CONTRACTOR'S EXPENSE. THE LOCATIONS OF EXIST UTILITIES SHOWN ON THESE PLANS ARE APPROXIMATE. AT LEAST 48 HOURS PRIOR TO BEGINNING CONSTRUCTION IN THE VICINITY OF UNDERGROUND UTILITIES, NOTIFY THE FOLLOWING AS APPLICABLE.

CITY OF GEORGETOWN	(512) 930-3555
GENERAL TELEPHONE CO	(512) 869-2237 (RON McCORMICK AT GEORGETOWN)
GEORGETOWN ELECTRIC CO	(512) 930-3555 (GARY WARNOCK)
LONE STAR GAS CO	(512) 244-0521 (TRANSMISSION LINES)
	(512) 244-1217 (DISTRIBUTION LINES)
TUELECTRIC	1-800-242-9113

9. NO BURNING OF TREES, BRUSH, RUBBISH, VEGETATION, OR OTHER OBJECTIONABLE MATTER WILL BE ALLOWED ON THE PROJECT SITE. ALL CLEARED & GRUBBED MATERIAL SHALL BE DISPOSED OF IN A MANNER ACCEPTABLE TO THE CITY OF GEORGETOWN.
10. PRIOR TO BEGINNING ANY CONSTRUCTION, THE CONTRACTOR SHALL VERIFY HORIZONTAL & VERTICAL LOCATIONS OF ALL KNOWN EXISTING UTILITIES WHICH WILL EITHER BE CONNECTED TO OR CROSSED. IF THERE ARE ANY CONFLICTS BETWEEN PROPOSED & EXISTING UTILITIES, OR IF THE EXISTING UTILITIES ARE IN ANY WAY DIFFERENT FROM WHAT IS SHOWN ON THE DRAWINGS, IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO NOTIFY THE CITY BEFORE PROCEEDING WITH ANY CONSTRUCTION. THE CONTRACTOR SHALL PROVIDE TO THE CITY, FOR THE CITY'S APPROVAL, A SOLUTION FOR RESOLVING SUCH CONFLICTS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR RESOLVING ALL CONFLICTS AT HIS EXPENSE.
11. ELECTRICAL LINES ARE LOCATED CLOSE TO THE PROJECT. THE ATTENTION OF THE CONTRACTOR IS DIRECTED TO THE STATE LAW (VERNON'S ANNOTATED TEXAS STATUTES, ARTICLE 1436(c)) CONCERNING OPERATIONS IN THE VICINITY OF ELECTRICAL LINES & THE NEED FOR EFFECTIVE PRECAUTIONARY MEASURES.
12. ALL DISTURBED AREAS SHALL BE RESTORED & HYDROMULCHED. THE SEEDING SHALL BE APPLIED AT THE SPECIFIED RATE OVER ALL AREAS DISTURBED BY THE CONTRACTOR.
13. SURVEYING WAS PERFORMED BY INLAND GEODETICS, 1504 CHISHOLM TRAIL, SUITE 101, ROUND ROCK, TEXAS 78681, (512) 238-1200.
14. UPON COMPLETION OF CONSTRUCTION, CONTRACTOR SHALL GRADE ROW TO EXISTING CONDITIONS. CONTRACTOR SHALL INSTALL TOPSOIL, EROSION CONTROL BLANKETS, FERTILIZER, SEED, & FIBER MULCH IN ACCORDANCE WITH SECTION 02490. MISCELLANEOUS SITE CLEANUP SHALL BE IN ACCORDANCE WITH SECTION 02901.
15. ANY DAMAGE TO EXISTING STRUCTURES (IE, FENCES, MAILBOXES, ROW MONUMENTS, SIGNS, CULVERTS, & CONCRETE APRONS, ETC.) DURING CONSTRUCTION SHALL BE REPAIRED AT CONTRACTOR'S EXPENSE. REPLACEMENT MATERIALS SHALL MATCH EXISTING. ALL REPAIR WORK MUST BE APPROVED BY OWNER OR OWNER REPRESENTATIVE.
16. CONTRACTOR SHALL CONTACT GARY WARNOCK, ELECTRICAL SYSTEMS PLANNER AT CITY OF GEORGETOWN COMMUNITY OWNED UTILITIES, 48 HOURS PRIOR TO CONSTRUCTION NEAR EXISTING AERIAL POWER UTILITIES.
17. NO WORK SHALL BE PERFORMED ON SATURDAYS, SUNDAYS, OR CITY HOLIDAYS WITHOUT WRITTEN PERMISSION BY OWNER. THE SPECIFIED CONTRACT TIMES WERE ESTABLISHED ASSUMING NO WEEKEND OR HOLIDAY WORK. SATURDAYS, SUNDAYS & HOLIDAYS WERE COUNTED IN DETERMINING THE NUMBER OF CONSECUTIVE CALENDAR DAYS USED TO COMPLETE PROJECT. WORKING HOURS ARE LIMITED TO 7:00 AM TO 6:00 PM MONDAY THROUGH FRIDAY.
18. ALL MANHOLE FRAMES & COVERS SHALL BE DESIGNED FOR HS-20 LOADING.
19. CONTRACTOR SHALL PROVIDE "AS--BUILT" PLANS TO THE ENGINEER SO THAT THE REPRODUCIBLES OF THE ENGINEERING PLANS MAY BE CORRECTED TO REFLECT "RECORD DRAWINGS" CONDITIONS.
20. ALL ASPHALT & CONCRETE PAVEMENT TO BE REMOVED SHALL BE SAW CUT TO MINIMUM DEPTH OF 2".
21. NO TREES SHALL BE REMOVED WITHOUT ENGINEER'S APPROVAL. THE ENGINEER MAY ELECT TO ALTER PIPE LINE ROUTES SLIGHTLY TO AVOID DAMAGING EXISTING TREES.
22. BID FORM QUANTITIES ARE NOT NECESSARILY ACTUAL QUANTITIES. CONTRACTOR WILL BE PAID FOR MEASURED QUANTITIES ACTUALLY INSTALLED & APPROVED.
23. MAILBOXES, STREET SIGNS & TRAFFIC CONTROL SIGNS IN CONFLICT WITH THE CONSTRUCTION SHALL BE REMOVED & REPLACED. DURING CONSTRUCTION, CONTRACTOR SHALL PROVIDE TEMPORARY SUPPORT SO THAT USE OF THE MAILBOX OR VISIBILITY OF THE TRAFFIC CONTROL SIGN IS NOT IMPAIRED. PAYMENT FOR REMOVING, REPLACING & PROVIDING TEMPORARY SUPPORT FOR MAILBOXES & SIGNS IS INCLUDED AS PART OF SITE CLEARING IN THE BID FORM.
24. IN CASE OF CONFLICT BETWEEN PLANS AND/OR SPECIFICATIONS AND THE TNRCC REGULATIONS, THE TNRCC REGULATIONS SHALL PREVAIL.

GENERAL CIVIL/SITE NOTES

1. ALL MATERIALS & CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTENANCE OF EACH SEDIMENTATION/EROSION CONTROL MEASURE ON THIS PROJECT.
3. UNSUITABLE EXCAVATED MATERIALS SHALL BE KNOWN AS "WASTE" & SHALL BECOME THE PROPERTY OF THE CONTRACTOR & IT SHALL BECOME HIS SOLE RESPONSIBILITY TO DISPOSE OF THIS MATERIAL OFF THE LIMITS OF THE PROJECT IN AN ENVIRONMENTALLY SOUND MANNER. THE CONTRACTOR SHALL NOTIFY THE CITY OF GEORGETOWN PRIOR TO OFFSITE DISPOSAL. THIS NOTIFICATION SHALL INCLUDE THE DISPOSAL LOCATION & COPY OF THE PERMIT ISSUED TO RECEIVE THE MATERIAL.
4. EROSION CONTROL CONSTRUCTION SEQUENCE:
   1. INSTALL EROSION CONTROL MEASURES AS INDICATED ON PLAN & PROFILE SHEETS.
   2. SITE VISIT BY CITY OF GEORGETOWN INSPECTOR.
   3. AFTER INSPECTOR APPROVAL, BEGIN CONSTRUCTION.
   4. UPON CONSTRUCTION COMPLETION, RESTORE ALL DISTURBED AREAS.
   5. ARRANGE FOR FINAL INSPECTION.
   6. REMOVE TEMPORARY EROSION CONTROL MEASURES.
5. UTILITIES & PIPES TO BE DISTURBED BY NEW WORK SHALL BE PROTECTED AS NOTED.
6. CARE SHALL BE TAKEN TO PROTECT EXISTING FACILITIES.
7. CONTRACTOR SHALL REPAIR ALL PAVEMENT DAMAGED DURING CONSTRUCTION. DAMAGED PAVEMENT SHALL BE SAW CUT & PATCHED IN A RECTANGULAR SHAPE PERPENDICULAR TO CURBS & STRUCTURES TO MATCH EXISTING CONDITIONS PRIOR TO CONSTRUCTION.
8. FINISH GRADES SHALL SLOPE UNIFORMLY.
9. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING FACILITIES (SIGNS, UTILITIES, STRUCTURES, ETC).
10. TRACK EQUIPMENT WILL NOT BE ALLOWED ON PAVED ROADWAYS WITHOUT SUITABLE PLYWOOD MATS OR OTHER APPROVED PROTECTION UNDER ALL TRACKS.
11. SEWER PIPES SHALL BE TYPE PSM, PVC SDR 26 OR TYPE PS-46 PVC PER SPECIFICATION SECTION WW2. SEWER PIPE WITHIN 9 FEET OF A WATER LINE CROSSING AS INDICATED ON DRAWINGS SHALL BE AWWA C900 DR 18 PVC PIPE & INSTALLED PER THE DETAILS.
12. DUE TO RESTRICTED WORKING AREAS AND THE CLOSE PROXIMITY OF EXISTING FACILITIES, THE CONTRACTOR WILL NOT BE ALLOWED TO USE THE "ANGLE OF REPOSE" METHOD ON THIS PROJECT. THE TRENCH BOX METHOD OR THE SHORING, SHEETING AND BRACING METHOD SHALL BE USED.
13. OWNER WILL PROVIDE BASELINE CONTROL POINTS AND BENCHMARKS AS SHOWN ON THE PLAN & PROFILE DRAWINGS FOR CONTRACTOR'S USE IN SETTING DETAILED CONSTRUCTION STAKES FOR THE PROJECT.
14. PIPE PLUGS FOR EXISTING LINES TO BE ABANDONED SHALL CONSIST OF CUTTING EXISTING WASTEWATER PIPE(S), REMOVING CUT PIPE(S) AND PLUGGING/FILLING MIN 18" LENGTH OF EXISTING PIPE(S) WITH TYPE A TxDOT CONCRETE.
15. ALL STUB-OUTS, ETC, FOR FUTURE CONNECTIONS SHALL BE SEALED WITH A MANUFACTURED PLUG OR CAP MADE SPECIFICALLY FOR THE PURPOSE OF PREVENTING LEAKAGE INTO THE PIPE.
16. CONTRACTOR SHALL CONSTRUCT TWO STABILIZED CONSTRUCTION ENTRANCES (SCE) PRIOR TO CONSTRUCTION. LOCATIONS OF SCE SHALL BE PER ENGINEER.
17. ALL BORE PITS SHOWN ON THE DRAWINGS ARE SCHEMATIC. CONTRACTOR SHALL DETERMINE THE REQUIRED SIZE AND CONFIGURATION OF ALL BORE PITS.
18. THE STEEL CASINGS MAY BE DEPICTED ON THE DRAWINGS WIDER THAN ACUTAL SPECIFIED DIAMETER FOR VISUAL CLARITY PURPOSES ONLY.
19. ALL MANHOLES SHALL BE COATED WITH A CORROSION RESISTANT LINING. SEE NOTE 4, CITY OF GEORGETOWN STANDARD DETAIL WW03.
20. IMMEDIATELY FOLLOWING THE JACKING OPERATION FOR CASING INSTALLATION, PRESSURE GROUT THE JACKED SECTION TO FILL ALL VOIDS IN THE ANNULAR SPACE OUTSIDE OF THE CASING. GROUTING SHALL BE CONDUCTED FROM THE INTERIOR OF THE CASING THROUGH GROUTING HOLES. ALL HOLES SHALL BE PLUGGED UPON COMPLETION OF WORK.
21. MANHOLES CAN BE CONSTRUCTED OF SIX-FOOT DIAMETER C478 PRECAST MANHOLE SECTIONS OR WITH SIX-FOOT BY SIX-FOOT CAST-IN-PLACE MANHOLE BASES WITH C478 PIPE RISERS ABOVE. THE CONTRACTOR SHALL DETERMINE WHICH MANHOLE CONSTRUCTION METHOD SHALL BE USED AT EACH LOCATION. PRECAST MANHOLES MAY NOT BE SUITABLE AT ALL LOCATIONS DUE TO INTERSECTING PIPE ANGLES. PAY FOR MANHOLES WILL BE MADE AT THE UNIT COST BID REGARDLESS OF WHAT CONSTRUCTION METHOD IS USED.
22. CONTRACTOR SHALL LOCATE SITE ACCESS POINTS AND INSTALL STABILIZED CONSTRUCTION ENTRANCES AT ALL EXIT POINTS ONTO PAVEMENT.
23. CONTRACTOR SHALL PROVIDE PEDESTRIAN AND VEHICULAR TRAFFIC CONTROL IN ACCORDANCE WITH CITY OF GEORGETOWN AND TXDOT REQUIREMENTS.
24. TRENCH AND EXCAVATION SAFETY SHALL BE PROVIDED IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL LOWA, REFER TO SPECIFICATIONS.
25. ALL WASTEWATER MANHOLE EXTERIORS SHALL BE SEALED WITH WRAPIDSEAL MANHOLE ENCAPSULATION SYSTEM BY CCI PIPELINE SYSTEMS OR ENGINEER APPROVED EQUAL PRODUCT. THE ENCAPSULATION SYSTEM SHALL BE INSTALLED IN STRICT ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS AND REQUIREMENTS.
26. ALL TEMPORARY AND PERMANENT PLUGS ON PIPE AND ON MANHOLES SHALL EQUAL OR EXCEED THE STRENGTH RATING OF THE ADJACENT PIPE. ALL PLUGS WHICH WILL BE LEFT ON MANHOLES AND/OR PIPE AFTER BURIAL SHALL BE RESTRAINED.
27. ALL BORES ARE DEPICTED WITH STEEL CASING PIPE. AT TREE, CREEK AND TEE BOX BORES, THE STEEL CASING PIPE MAY BE DELETED AND CARRIER PIPE DIRECTLY PUSHED THROUGH THE BORE HOLE IF FIELD CONDITIONS WARRANT PROVIDED THAT THE PIPE MANUFACTURER PROVIDES A WRITTEN CERTIFICATION THAT THE PIPE, JOINTS AND GASKETS ARE RATED FOR DIRECT JACKING. THE ANNULAR SPACE AROUND ALL DIRECTLY JACKED PIPE SHALL BE COMPLETELY GROUTED.

PLAN LEGEND

WATER METER	WM □
WATER VALVE	WV ⋈
POWER POLE	PP Ø
EXISTING MANHOLE	MH ○
PROPOSED MANHOLE	MH ●
CHAIN LINK FENCE	
WOOD FENCE	
WATER LINE	W
WASTEWATER LINE	WW
GAS LINE	G
PROPERTY LINE	
EXISTING CONTOUR	000
UNDERGROUND TELEPHONE LINE	UTEL
ITEMS TO BE DEMOLISHED	
PROPOSED UTILITIES	
SILT FENCE	SF
ROCK BERM	RB
TREE PROTECTION FENCING	
EXISTING TREE	
TREE TO BE REMOVED	

GENERAL CIVIL/SITE NOTES CONT'D

28. FOR DISTURBED AREAS WITHIN THE MAINTAINED TURF AREA OF THE GOLF COURSE, THE CONTRACTOR SHALL RETURN ALL DISTURBED AREAS TO ORIGINAL GRADE WITH TOPSOIL BUT SHALL NOT BE REQUIRED TO REVEGETATE. REVEGETATION OF MAINTAINED GOLF COURSE TURF AREAS AND REPAIR OF THE GOLF COURSE IRRIGATION SYSTEM WILL BE PERFORMED BY OTHERS. AREAS OUTSIDE OF THE MAINTAINED GOLF COURSE TURF AREA SHALL BE REVEGETATED BY THE CONTRACTOR.
29. THE CONTRACTOR SHALL INSTALL A CONCRETE TRENCH CAP AS SHOWN IN DETAIL E ON CZ-6 IN ALL LOCATIONS ALONG THE PROJECT ALIGNMENT IDENTIFIED AT THE COMMENCEMENT OF CONSTRUCTION BY THE OWNER.
30. THE CONTRACTOR SHALL COMPLETE THE CONSTRUCTION OF THE IMPROVEMENTS ACROSS THE GOLF COURSE PROPERTY NO LATER THAN MARCH 31, 2019. THE GOLF COURSE PROPERTY IS DEFINED AS LAND BETWEEN STA 21+80 AND 52+00.

SHEET INDEX

		COVER SHEET
1	G-1	OVERALL ALIGNMENT AND SURVEY CONTROL (1 OF 2)
2	G-2	OVERALL ALIGNMENT AND SURVEY CONTROL (2 OF 2)
3	G-3	GENERAL NOTES, LEGEND & SHEET INDEX
4	G-4	TCEQ GENERAL CONSTRUCTION NOTES
5	C-1	PLAN AND PROFILE FROM STA 1+00 TO STA 9+00
6	C-2	PLAN AND PROFILE FROM STA 9+00 TO STA 18+00
7	C-3	PLAN AND PROFILE FROM STA 18+00 TO STA 27+00
8	C-4	PLAN AND PROFILE FROM STA 27+00 TO STA 36+00
9	C-5	PLAN AND PROFILE FROM STA 36+00 TO STA 45+00
10	C-6	PLAN AND PROFILE FROM STA 45+00 TO STA 54+00
11	C-7	PLAN AND PROFILE FROM STA 54+00 TO STA 63+00
12	C-8	PLAN AND PROFILE FROM STA 63+00 TO STA 72+00
13	C-9	PLAN AND PROFILE FROM STA 72+00 TO STA 81+00
14	C-10	PLAN AND PROFILE FROM STA 81+00 TO STA 90+00
15	C-11	PLAN AND PROFILE FROM STA 90+00 TO STA 99+00
16	C-12	PLAN AND PROFILE FROM STA 99+00 TO STA 108+00
17	C-13	PLAN AND PROFILE FROM STA 108+00 TO STA 117+00
18	C-14	PLAN AND PROFILE FROM STA 117+00 TO STA 126+00
19	C-15	PLAN AND PROFILE FROM STA 126+00 TO STA 135+00
20	C-16	PLAN AND PROFILE FROM STA 135+00 TO STA 144+00
21	C-17	PLAN AND PROFILE FROM STA 144+00 TO STA 153+00
22	C-18	PLAN AND PROFILE FROM STA 153+00 TO STA 156+87
23	C-19	PLAN AND PROFILE LINE C FROM STA 0+00 TO END
24	CT-1	TREE POINT TABLES I
25	CT-2	TREE POINT TABLES II
26	CZ-1	MISCELLANEOUS DETAILS I
27	CZ-2	MISCELLANEOUS DETAILS II
28	CZ-3	MISCELLANEOUS DETAILS III
29	CZ-4	MISCELLANEOUS DETAILS IV
30	CZ-5	MISCELLANEOUS DETAILS V
31	CZ-6	MISCELLANEOUS DETAILS VI

REV. NO.	DATE	DRWN	CHKD	REMARKS
3	12/13/18	ECD	ADR	CONFORMED DRAWING
2	11/16/18	ECD	ADR	REVISED FOR ADDENDUM NO. 2
1	11/14/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

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TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

GENERAL NOTES, LEGEND & SHEET INDEX

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED PROFESSIONAL ENGINEER
12-13-2018

PROJECT NO. 2048-109788
FILE NAME: G003ALSV.DWG

SHEET NO.
G-3

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY ORGANIZED SEWAGE COLLECTION SYSTEM
GENERAL CONSTRUCTION NOTES

1. This Organized Sewage Collection System must be designed and constructed in accordance with the Texas Commission on Environmental Quality's (TCEQ) Edwards Aquifer Rules 30 Texas Administrative Code (TAC) §§213.5(c) and 217.51 – 217.70 and 30 TAC Chapter 217, Subchapter D, and the City of Georgetown Standard Specifications.

2. All contractors conducting regulated activities associated with this proposed regulated project must be provided with copies of the Sewage Collection System plan and the TCEQ letter indicating the specific conditions of its approval. During the course of these regulated activities, the contractors must be required to keep on-site copies of the plan and the approval letter.

3. No later than 48 hours prior to commencing any regulated activity, the applicant or his agent must notify the Austin Regional Office, in writing, of the date on which the regulated activity will begin.

4. Any modification to the activities described in the referenced SCS application following the date of approval may require the submittal of an SCS application to modify this approval, including the payment of appropriate fees and all information necessary for its review and approval.

5. All temporary erosion and sedimentation controls must be installed prior to construction, must be maintained during construction, and must be removed when sufficient vegetation is established to control the erosion and sedimentation and the construction area is stabilized.

6. The sewer line trench details showing the cross section with the dimensions, pipe placement, and backfill instructions are included on Plan Sheet 11 of 11 of these plans. All sewer pipes joints must meet the requirements in 30 TAC §§217.53(c) and 217.65.

Gravity lines must have a SDR 35 or less. Pressurized sewer systems must have pipe with a minimum working pressure rating of 150 psi.

The ASTM, ANSI, or AWWA specification numbers for the pipe(s) and joints are

The pipe material, the pressure classes, and the SDR and/or DR designations are PVC SDR35 and HDPE DR 17.

7. If any sensitive features are discovered during the wastewater line trenching activities, all regulated activities near the sensitive feature must be suspended immediately. The applicant must immediately notify the appropriate regional office of the Texas Commission on Environmental Quality of the feature discovered. A geologist's assessment of the location and extent of the feature discovered must be reported to that regional office in writing within two working days. The applicant must submit a plan for ensuring the structural integrity of the sewer line or for modifying the proposed collection system alignment around the feature. The regulated activities near the sensitive feature may not proceed until the executive director has reviewed and approved the methods proposed to protect the sensitive feature and the Edwards Aquifer from any potentially adverse impacts to water quality while maintaining the structural integrity of the line.

8. Sewer lines located within or crossing the 5-year floodplain of a drainage way will be protected from inundation and stream velocities which could cause erosion and scouring of backfill. The trench must be capped with concrete to prevent scouring of backfill, or the sewer lines must be encased in concrete. All concrete shall have a minimum thickness of six (6) inches.

9. Blasting procedures for protection of existing sewer lines and other utilities will be in accordance with the National Fire Protection Association criteria. Sand is not allowed as bedding or backfill in trenches that have been blasted. If any existing sewer lines are damaged, the lines must be repaired and retested.

10. All manholes constructed or rehabilitated on this project must have watertight size on size resilient connectors allowing for differential settlement. If manholes are constructed within the 100-year floodplain, the cover must have a gasket and be bolted to the ring. Where gasketed manhole covers are required for more than three manholes in sequence or for more than 1500 feet, alternate means of venting will be provided. Bricks are not an acceptable construction material for any portion of the manhole.

The diameter of the manholes must be a minimum of four feet and the manhole for entry must have a minimum clear opening diameter of 30 inches. These dimensions and other details showing compliance with the commission's rules concerning manholes and sewer line/manhole inverts described in 30 TAC §217.55 are included on Plan Sheet 10 of 11.

It is suggested that entrance into manholes in excess of four feet deep be accomplished by means of a portable ladder. The inclusion of steps in a manhole is prohibited.

11. Where water lines and new sewer line are installed with a separation distance closer than nine feet (i.e., water lines crossing wastewater lines, water lines paralleling wastewater lines, or water lines next to manholes) the installation must meet the requirements of 30 TAC §217.53(d) (Pipe Design) and 30 TAC §290.44(e) (Water Distribution).

12. Where sewers lines deviate from straight alignment and uniform grade all curvature of sewer pipe must be achieved by the following procedure which is recommended by the pipe manufacturer:

If pipe flexure is proposed, the following method of preventing deflection of the joint must be used:

Specific care must be taken to ensure that the joint is placed in the center of the trench and properly bedded in accordance with 30 TAC §217.54.

13. New sewage collection system lines must be constructed with stub outs for the connection of anticipated extensions. The location of such stub outs must be marked on the ground such that their location can be easily determined at the time of connection of the extensions. Such stub outs must be manufactured wyes or tees that are compatible in size and material with both the sewer line and the extension. At the time of original construction, new stub-outs must be constructed sufficiently to extend beyond the end of the street pavement. All stub-outs must be sealed with a manufactured cap to prevent leakage. Extensions that were not anticipated at the time of original construction or that are to be connected to an existing sewer line not furnished with stub outs must be connected using a manufactured saddle and in accordance with accepted plumbing techniques.

If no stub-out is present an alternate method of joining laterals is shown in the detail on Plan Sheet NA of NA. (For potential future laterals).

The private service lateral stub-outs must be installed as shown on the plan and profile sheets on Plan Sheet NA of NA and marked after backfilling as shown in the detail on Plan Sheet NA of NA.

14. Trenching, bedding and backfill must conform with 30 TAC §217.54. The bedding and backfill for flexible pipe must comply with the standards of ASTM D-2321, Classes IA, IB, II or III. Rigid pipe bedding must comply with the requirements of ASTM C 12 (ANSI A 106.2) classes A, B or C.

15. Sewer lines must be tested from manhole to manhole. When a new sewer line is connected to an existing stub or clean-out, it must be tested from existing manhole to new manhole. If a stub or clean-out is used at the end of the proposed sewer line, no private service attachments may be connected between the last manhole and the cleanout unless it can be certified as conforming with the provisions of 30 TAC §213.5(c)(3)(E).

16. All sewer lines must be tested in accordance with 30 TAC §217.57. The engineer must retain copies of all test results which must be made available to the executive director upon request. The engineer must certify in writing that all wastewater lines have passed all required testing to the appropriate regional office within 30 days of test completion and prior to use of the new collection system. Testing method will be:

(a) For a collection system pipe that will transport wastewater by gravity flow, the design must specify an infiltration and exfiltration test or a low-pressure air test. A test must conform to the following requirements:

(1) Low Pressure Air Test.

(A) A low pressure air test must follow the procedures described in American Society For Testing And Materials (ASTM) C-828, ASTM C-924, or ASTM F-1417 or other procedure approved by the executive director, except as to testing times as required in Table C.3 in subparagraph (C) of this paragraph or Equation C.3 in subparagraph (B)(ii) of this paragraph.

(B) For sections of collection system pipe less than 36 inch average inside diameter, the following procedure must apply, unless a pipe is to be tested as required by paragraph (2) of this subsection.

(i) A pipe must be pressurized to 3.5 pounds per square inch (psi) greater than the pressure exerted by groundwater above the pipe.

(ii) Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 psi gauge to 2.5 psi gauge is computed from the following equation:

Equation C.3

$$T = \frac{0.085 \times D \times K}{Q}$$

Where:

T = time for pressure to drop 1.0 pound per square inch gauge in seconds
K = 0.000419 X D X L, but not less than 1.0
D = average inside pipe diameter in inches
L = length of line of same size being tested, in feet
Q = rate of loss, 0.0015 cubic feet per minute per square foot internal surface

(C) Since a K value of less than 1.0 may not be used, the minimum testing time for each pipe diameter is shown in the following Table C.3:

PIPE DIAMETER (INCHES)	MINIMUM TIME (SECONDS)	MAXIMUM LENGTH FOR MINIMUM TIME (FEET)	TIME FOR LONGER LENGTH (SECONDS/FOOT)
6	340	398	0.855
8	454	298	1.520
10	567	239	2.374
12	680	199	3.419
15	850	159	5.342
18	1020	133	7.693
21	1190	114	10.471
24	1360	100	13.676
27	1530	88	17.309
30	1700	80	21.369
33	1870	72	25.856

(D) An owner may stop a test if no pressure loss has occurred during the first 25% of the calculated testing time.

(E) If any pressure loss or leakage has occurred during the first 25% of a testing period, then the test must continue for the entire test duration as outlined above or until failure.

(F) Wastewater collection system pipes with a 27 inch or larger average inside diameter may be air tested at each joint instead of following the procedure outlined in this section.

(G) A testing procedure for pipe with an inside diameter greater than 33 inches must be approved by the executive director.

(2) Infiltration/Exfiltration Test.

(A) The total exfiltration, as determined by a hydrostatic head test, must not exceed 50 gallons per inch of diameter per mile of pipe per 24 hours at a minimum test head of 2.0 feet above the crown of a pipe at an upstream manhole.

(B) An owner shall use an infiltration test in lieu of an exfiltration test when pipes are installed below the groundwater level.

(C) The total exfiltration, as determined by a hydrostatic head test, must not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at a minimum test head of two feet above the crown of a pipe at an upstream manhole, or at least two feet above existing groundwater level, whichever is greater.

(D) For construction within a 25-year flood plain, the infiltration or exfiltration must not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head as in subparagraph (C) of this paragraph.

(E) If the quantity of infiltration or exfiltration exceeds the maximum quantity specified, an owner shall undertake remedial action in order to reduce the infiltration or exfiltration to an amount within the limits specified. An owner shall retest a pipe following a remediation action.

(b) If a gravity collection pipe is composed of flexible pipe, deflection testing is also required. The following procedures must be followed:

(1) For a collection pipe with inside diameter less than 27 inches, deflection measurement requires a rigid mandrel.

(A) Mandrel Sizing.

(i) A rigid mandrel must have an outside diameter (OD) not less than 95% of the base inside diameter (ID) or average ID of a pipe, as specified in the appropriate standard by the ASTMs, American Water Works Association, UNI-BELL, or American National Standards Institute, or any related appendix.

(ii) If a mandrel sizing diameter is not specified in the appropriate standard, the mandrel must have an OD equal to 95% of the ID of a pipe. In this case, the ID of the pipe, for the purpose of determining the OD of the mandrel, must equal be the average outside diameter minus two minimum wall thicknesses for OD controlled pipe and the average inside diameter for ID controlled pipe.

(iii) All dimensions must meet the appropriate standard.

(B) Mandrel Design.

(i) A rigid mandrel must be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed.

(ii) A mandrel must have nine or more odd number of runners or legs.

(iii) A barrel section length must equal at least 75% of the inside diameter of a pipe.

(iv) Each size mandrel must use a separate proving ring.

(C) Method Options.

(i) An adjustable or flexible mandrel is prohibited.

(ii) A test may not use television inspection as a substitute for a deflection test.

(iii) If requested, the executive director may approve the use of a deflectometer or a mandrel with removable legs or runners on a case-by-case basis.

(2) For a gravity collection system pipe with an inside diameter 27 inches and **greater, other test methods may** be used to determine vertical deflection.

(3) **A deflection test method must be** accurate to within plus or minus 0.2% deflection.

(4) An owner shall not conduct a deflection test until at least 30 days after the final backfill.

(5) Gravity collection system pipe deflection must not exceed five percent (5%).

(6) If a pipe section fails a deflection test, an owner shall correct the problem and conduct a second test after the final backfill has been in place at least 30 days.

17. All manholes must be tested to meet or exceed the requirements of 30 TAC §217.58.

(a) All manholes must pass a leakage test.

(b) An owner shall test each manhole (after assembly and backfilling) for leakage, separate and independent of the collection system pipes, by hydrostatic exfiltration testing, vacuum testing, or other method approved by the executive director.

(1) Hydrostatic Testing.

(A) The maximum leakage for hydrostatic testing or any alternative test methods is 0.025 gallons per foot diameter per foot of manhole depth per hour.

(B) To perform a hydrostatic exfiltration test, an owner shall seal all wastewater pipes coming into a manhole with an internal pipe plug, fill the manhole with water, and maintain the test for at least one hour.

(C) A test for concrete manholes may use a 24-hour wetting period before testing to allow saturation of the concrete.

(2) Vacuum Testing.

(A) To perform a vacuum test, an owner shall plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering a manhole.

(B) No grout must be placed in horizontal joints before testing.

(C) Stub-outs, manhole boots, and pipe plugs must be secured to prevent movement while a vacuum is drawn.

(D) An owner shall use a minimum 60 inch/lb torque wrench to tighten the external clamps that secure a test cover to the top of a manhole.

(E) A test head must be placed at the inside of the top of a cone section, and the seal inflated in accordance with the manufacturer's recommendations.

(F) There must be a vacuum of 10 inches of mercury inside a manhole to perform a valid test.

(G) A test does not begin until after the vacuum pump is off.

(H) A manhole passes the test if after 2.0 minutes and with all valves closed, the vacuum is at least 9.0 inches of mercury.

18. All private service laterals must be inspected and certified in accordance with 30 TAC §213.5(c)(3)(I). After installation of and, prior to covering and connecting a private service lateral to an existing organized sewage collection system, a Texas Licensed Professional Engineer, Texas Registered Sanitarian, or appropriate city inspector must visually inspect the private service lateral and the connection to the sewage collection system, and certify that it is in conformity with the applicable provisions of this section. The owner of the collection system must maintain such certifications for five years and forward copies to the appropriate regional office upon request. Connections may only be made to an approved sewage collection system.

THESE GENERAL CONSTRUCTION NOTES MUST BE INCLUDED ON THE CONSTRUCTION PLANS PROVIDED TO THE CONTRACTOR AND ALL SUBCONTRACTORS.

TCEQ-0596 (Rev. 10/01/10)

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
12-13-2018

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

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TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

TCEQ GENERAL CONSTRUCTION NOTES

PROJECT NO. 2048-109788
FILE NAME: G004TCEQ.DWG
SHEET NO.
G-4

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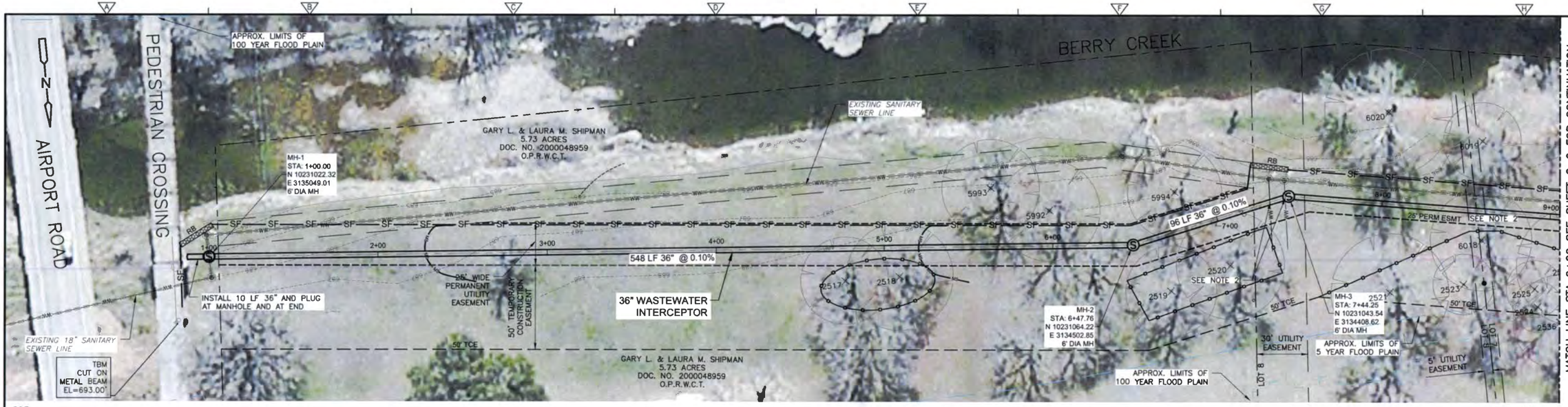

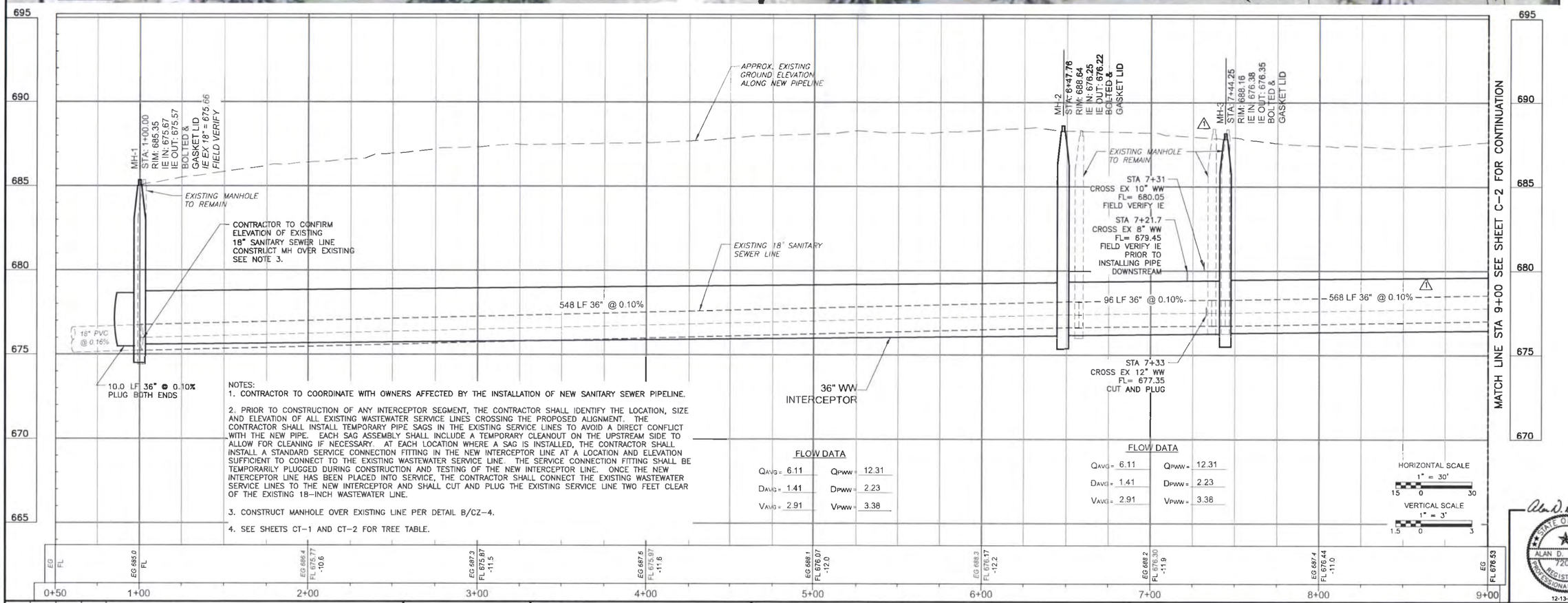

NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.

2. PRIOR TO CONSTRUCTION OF ANY INTERCEPTOR SEGMENT, THE CONTRACTOR SHALL IDENTIFY THE LOCATION, SIZE AND ELEVATION OF ALL EXISTING WASTEWATER SERVICE LINES CROSSING THE PROPOSED ALIGNMENT. THE CONTRACTOR SHALL INSTALL TEMPORARY PIPE SAGS IN THE EXISTING SERVICE LINES TO AVOID A DIRECT CONFLICT WITH THE NEW PIPE. EACH SAG ASSEMBLY SHALL INCLUDE A TEMPORARY CLEANOUT ON THE UPSTREAM SIDE TO ALLOW FOR CLEANING IF NECESSARY. AT EACH LOCATION WHERE A SAG IS INSTALLED, THE CONTRACTOR SHALL INSTALL A STANDARD SERVICE CONNECTION FITTING IN THE NEW INTERCEPTOR LINE AT A LOCATION AND ELEVATION SUFFICIENT TO CONNECT TO THE EXISTING WASTEWATER SERVICE LINE. THE SERVICE CONNECTION FITTING SHALL BE TEMPORARILY PLUGGED DURING CONSTRUCTION AND TESTING OF THE NEW INTERCEPTOR LINE. ONCE THE NEW INTERCEPTOR LINE HAS BEEN PLACED INTO SERVICE, THE CONTRACTOR SHALL CONNECT THE EXISTING WASTEWATER SERVICE LINES TO THE NEW INTERCEPTOR AND SHALL CUT AND PLUG THE EXISTING SERVICE LINE TWO FEET CLEAR OF THE EXISTING 18-INCH WASTEWATER LINE.

3. CONSTRUCT MANHOLE OVER EXISTING LINE PER DETAIL B/CZ-4.

4. SEE SHEETS CT-1 AND CT-2 FOR TREE TABLE.

FLOW DATA

Q_{AVG} =	6.11	Q_{PWW} =	12.31
D_{AVG} =	1.41	D_{PWW} =	2.23
V_{AVG} =	2.91	V_{PWW} =	3.38

FLOW DATA

Q_{AVG} =	6.11	Q_{PWW} =	12.31
D_{AVG} =	1.41	D_{PWW} =	2.23
V_{AVG} =	2.91	V_{PWW} =	3.38

HORIZONTAL SCALE
1" = 30'
15 0 30

VERTICAL SCALE
1" = 3'
1.5 0 3

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/5/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
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TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 1+00 TO STA 9+00

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED PROFESSIONAL ENGINEER
12-13-2018

PROJECT NO. 2048-109788
FILE NAME: C001PLPR.DWG
SHEET NO. C-1

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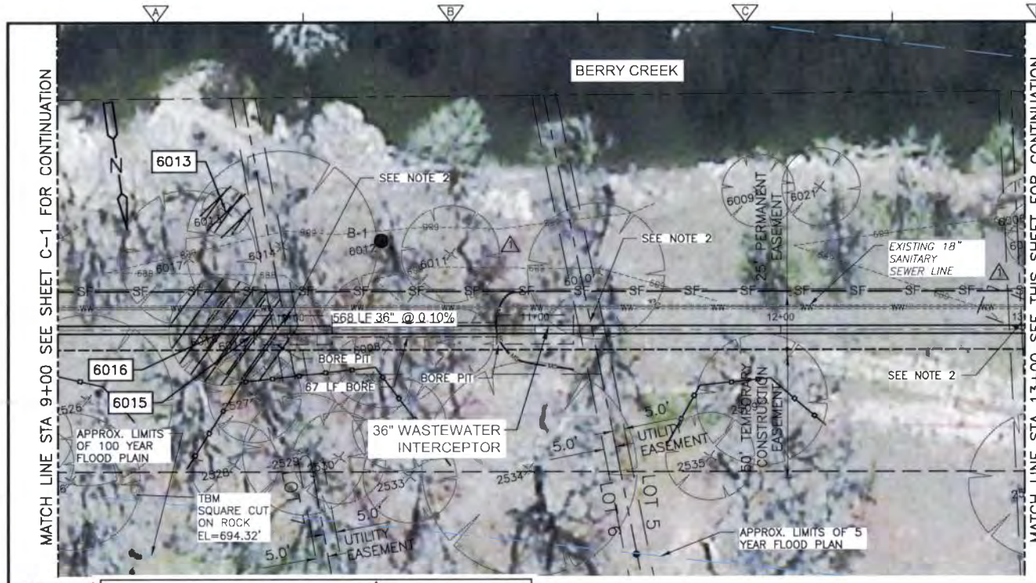
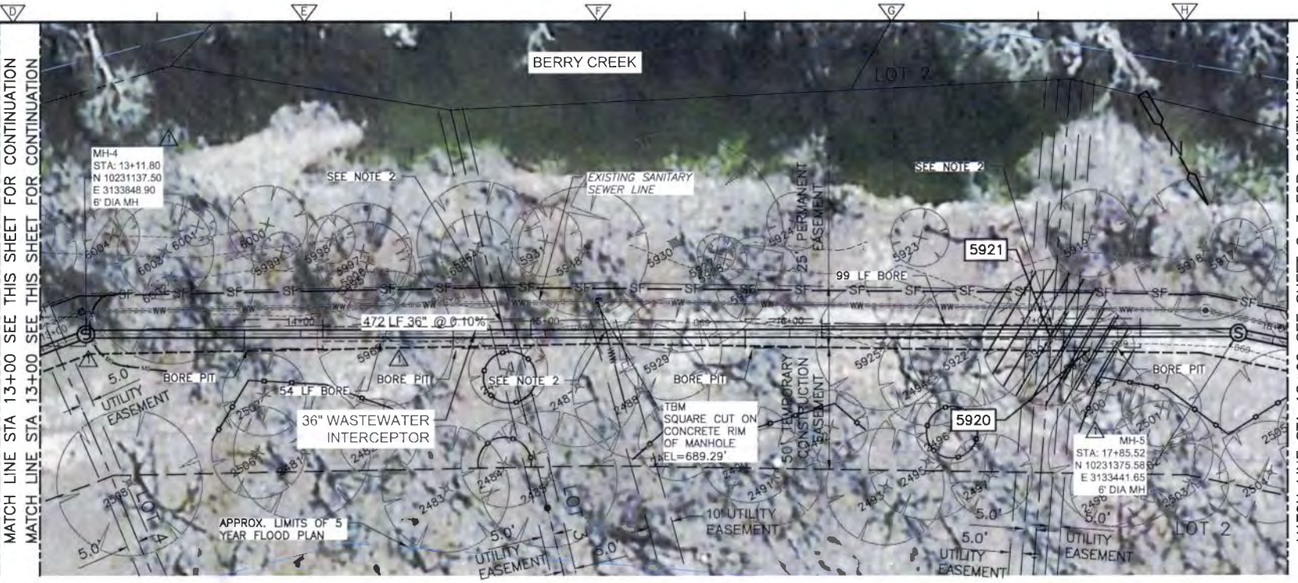
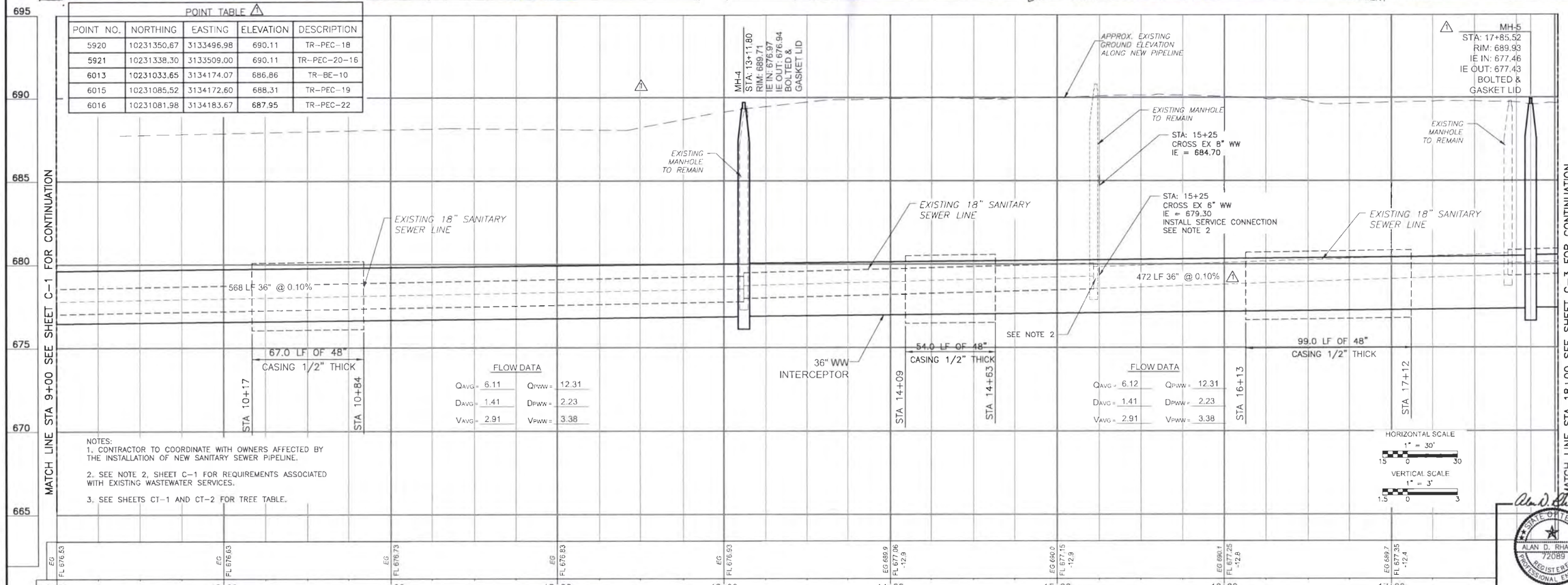




POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5920	10231350.67	3133496.98	690.11	TR-PEC-18
5921	10231338.30	3133509.00	690.11	TR-PEC-20-16
6013	10231033.65	3134174.07	686.86	TR-BE-10
6015	10231085.52	3134172.60	688.31	TR-PEC-19
6016	10231081.98	3134183.67	687.95	TR-PEC-22



NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. SEE SHEETS CT-1 AND CT-2 FOR TREE TABLE.

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/5/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Rialto Corporate Park, 12357-A Rialto Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

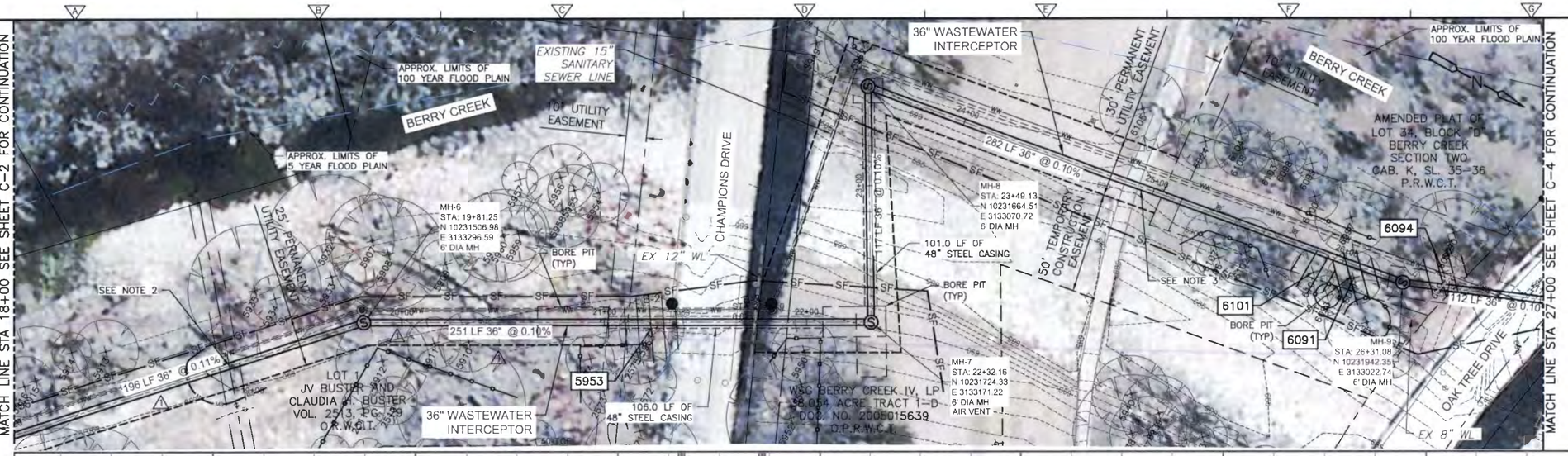
BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 9+00 TO STA 18+00

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED PROFESSIONAL ENGINEER
12-13-2018

PROJECT NO. 2048-109788
FILE NAME: C002PLPR.DWG
SHEET NO.
C-2

Plotted: 12/6/2018 1:05:24 PM



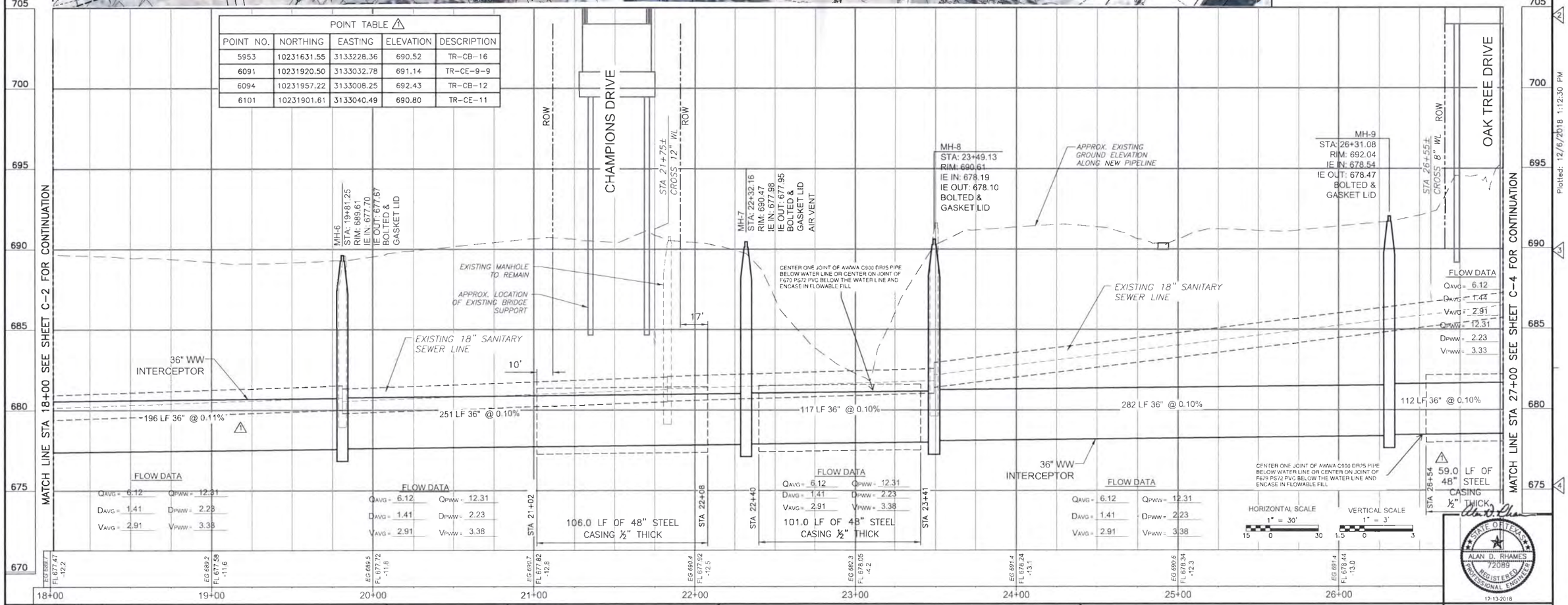
NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.

2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.

3. EXISTING CONCRETE WALK CROSSING TO BE REPLACED TO ITS ORIGINAL CONDITION IF DAMAGED DURING INSTALLATION OF NEW 30" SEWER LINE. REPLACE BACK TO THE NEAREST JOINT EITHER SIDE.

4. THE AIR VENT FOR MANHOLE 17 SHALL BE ROUTED BELOW GRADE SOUTHWARD TO APPROXIMATE STATION 22+00 AND THEM EXTENDED ABOVE GRADE. THE BURIED SECTION OF LINE SHALL HAVE A SLIGHT GRADE TOWARD THE MANHOLE.

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5953	10231631.55	3133228.36	690.52	TR-CB-16
6091	10231920.50	3133032.78	691.14	TR-CE-9-9
6094	10231957.22	3133008.25	692.43	TR-CB-12
6101	10231901.61	3133040.49	690.80	TR-CE-11



REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/5/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin TX 78727
Tel (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 18+00 TO STA 27+00

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
12-13-2018

PROJECT NO. 2048-109788
FILE NAME: C003PLPR.DWG

SHEET NO.
C-3

XREFs: [ccWS_2234_XC-BERRYCR_XC-BOUNDARY_XC-PR-BERRYCR_XC-AERIAL_1-50_W-SHADING_FLOOD PLAIN TXB3-CF_CWP004TREE_ADR-SEAL_CWP001BH] Images: []
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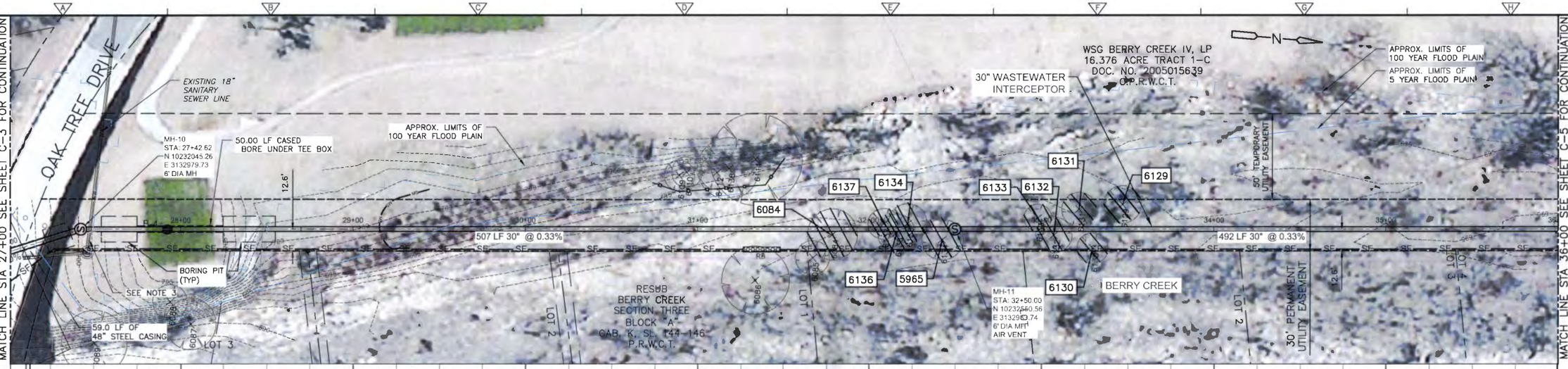
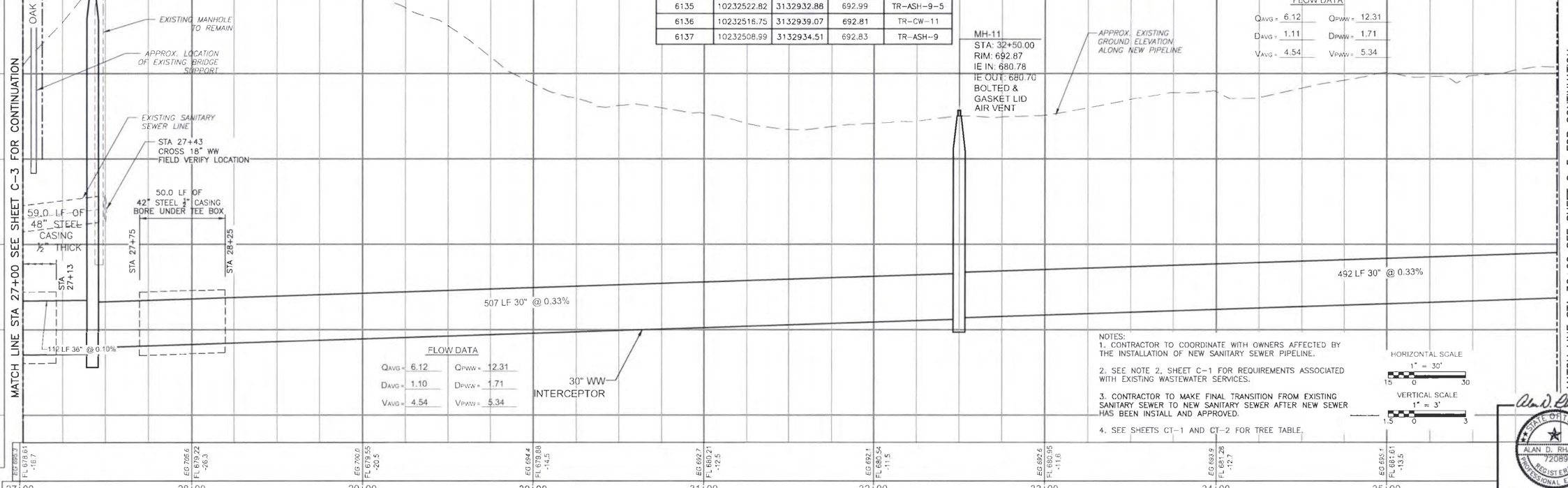




POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
6129	10232645.70	3132910.57	693.76	TR-CW-11
6130	10232630.76	3132937.55	693.54	TR-ASH-8-5
6130	10232630.76	3132937.55	693.54	TR-ASH-8-5
6131	10232621.00	3132915.72	693.59	TR-ASH-8
6132	10232607.89	3132931.93	693.56	TR-ASH-8-5
6133	10232597.66	3132922.92	692.80	TR-ASH-8
6134	10232543.85	3132940.48	692.58	TR-ASH-9-6
6135	10232522.82	3132932.88	692.99	TR-ASH-9-5
6136	10232516.75	3132939.07	692.81	TR-CW-11
6137	10232508.99	3132934.51	692.83	TR-ASH-9

FLOW DATA
Q_{AVG} = 6.12 Q_{PWW} = 12.31
D_{AVG} = 1.11 D_{PWW} = 1.71
V_{AVG} = 4.54 V_{PWW} = 5.34

FLOW DATA
Q_{AVG} = 6.12 Q_{PWW} = 12.31
D_{AVG} = 1.10 D_{PWW} = 1.71
V_{AVG} = 4.54 V_{PWW} = 5.34

NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO MAKE FINAL TRANSITION FROM EXISTING SANITARY SEWER TO NEW SANITARY SEWER AFTER NEW SEWER HAS BEEN INSTALL AND APPROVED.
4. SEE SHEETS CT-1 AND CT-2 FOR TREE TABLE.

HORIZONTAL SCALE
1" = 30'
15 0 30

VERTICAL SCALE
1" = 3'
1.5 0 3

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/15/18	ADR	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

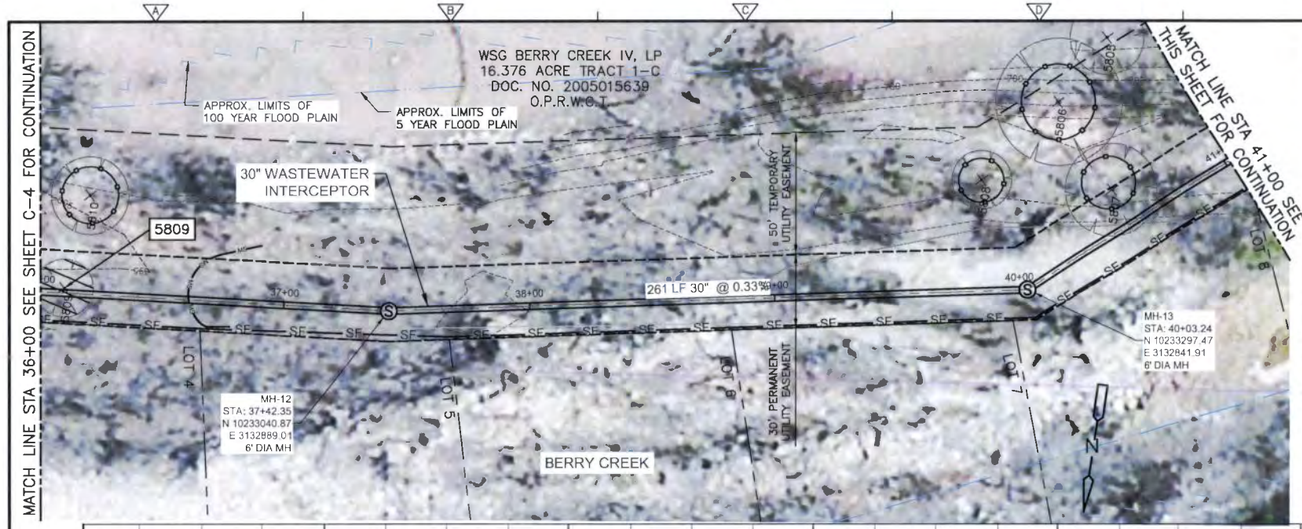
PLAN AND PROFILE FROM STA 27+00 TO STA 36+00

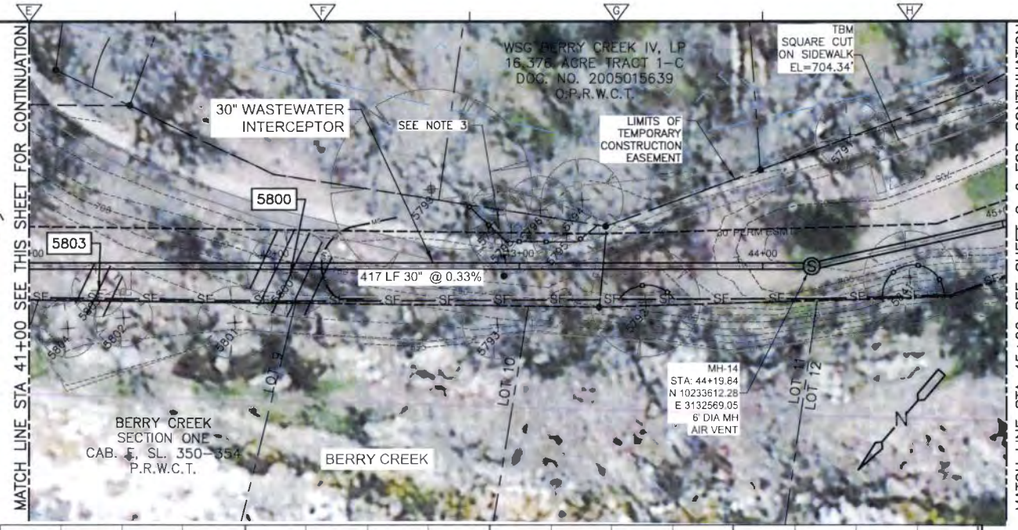
STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
12-13-2018

PROJECT NO. 2048-109788
FILE NAME: C004PLPR.DWG

SHEET NO.
C-4

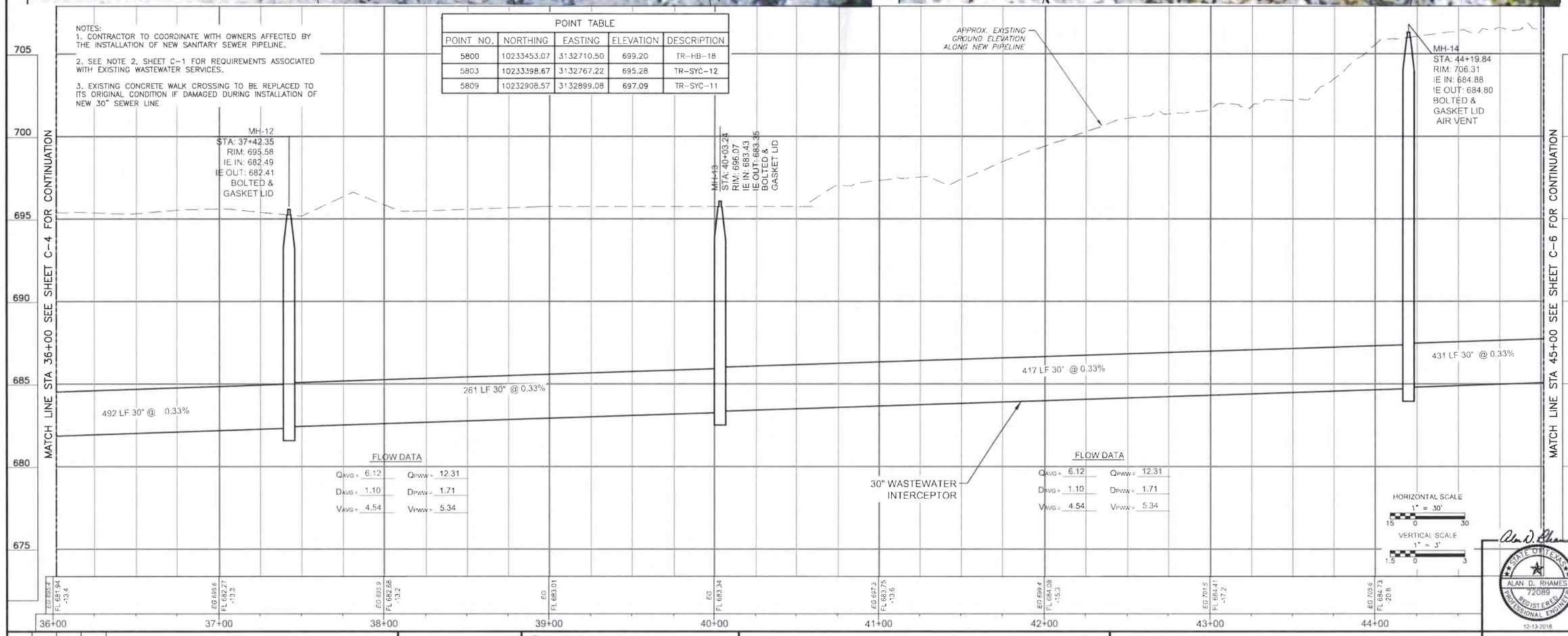
Plotted: 12/6/2018 1:41:26 PM





NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. EXISTING CONCRETE WALK CROSSING TO BE REPLACED TO ITS ORIGINAL CONDITION IF DAMAGED DURING INSTALLATION OF NEW 30" SEWER LINE

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5800	10233453.07	3132710.50	699.20	TR-HB-18
5803	10233398.67	3132767.22	695.28	TR-SYC-12
5809	10232908.57	3132899.08	697.09	TR-SYC-11



REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 36+00 TO STA 45+00

ALAN D. RHAMES 72089 REGISTERED PROFESSIONAL ENGINEER
STATE OF TEXAS
12-13-2018

PROJECT NO. 2046-109788
FILE NAME: C005PLPR.DWG
SHEET NO.
C-5

XREFs: [C:\CWS_2234_XC-BERRYCR_XC-BOUNDARY_XC-PR-BERRYCR_XC-AERIAL_1-50_W-SHADING_FLOOD PLAIN TX83-CF_CWP0047REE_ADR-SEAL_CWP001Bit] Images: []
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Plotted: 12/6/2018 3:30:11 PM

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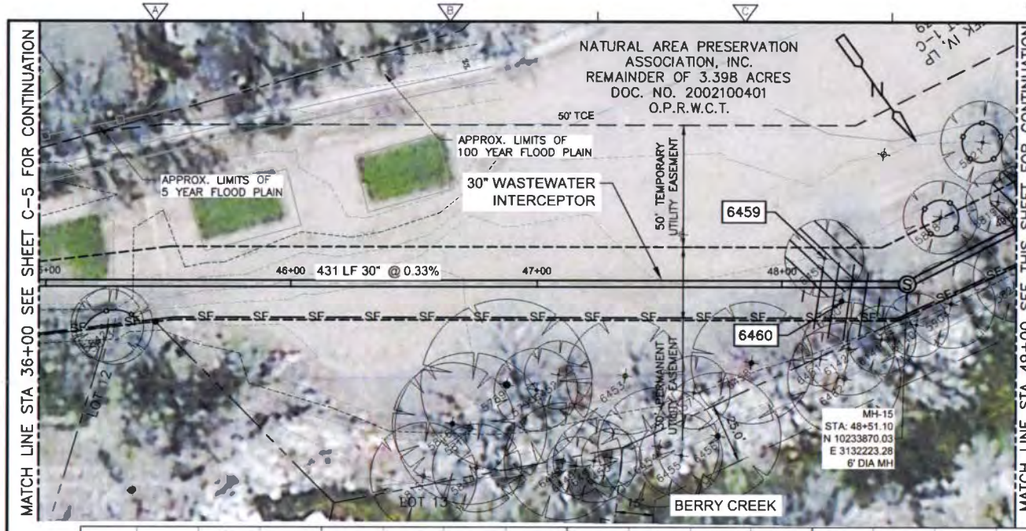
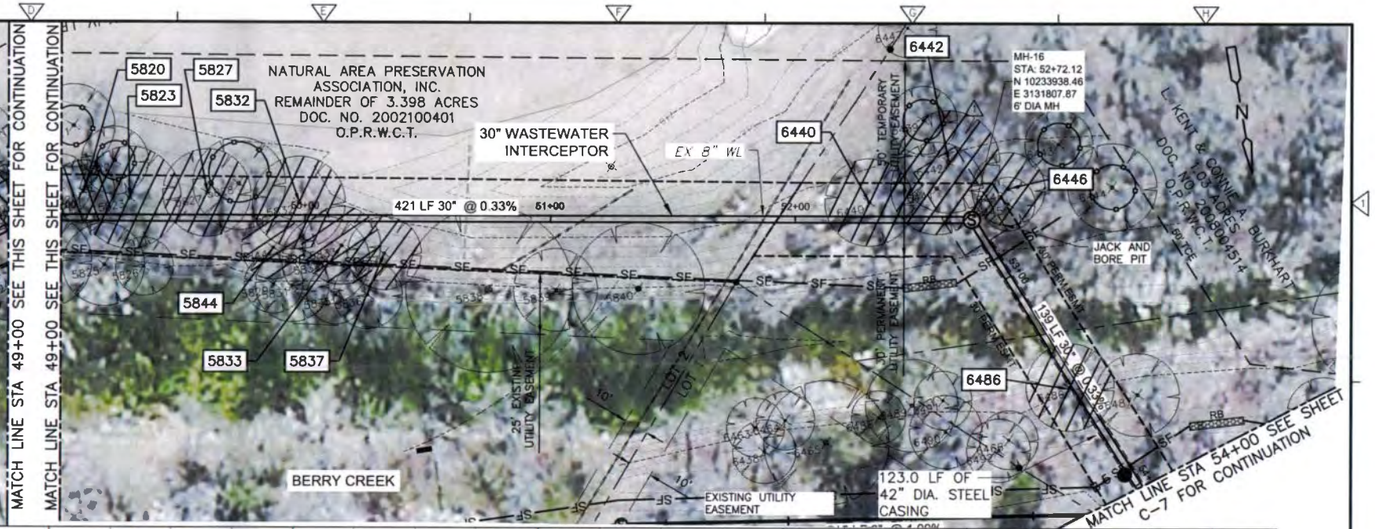
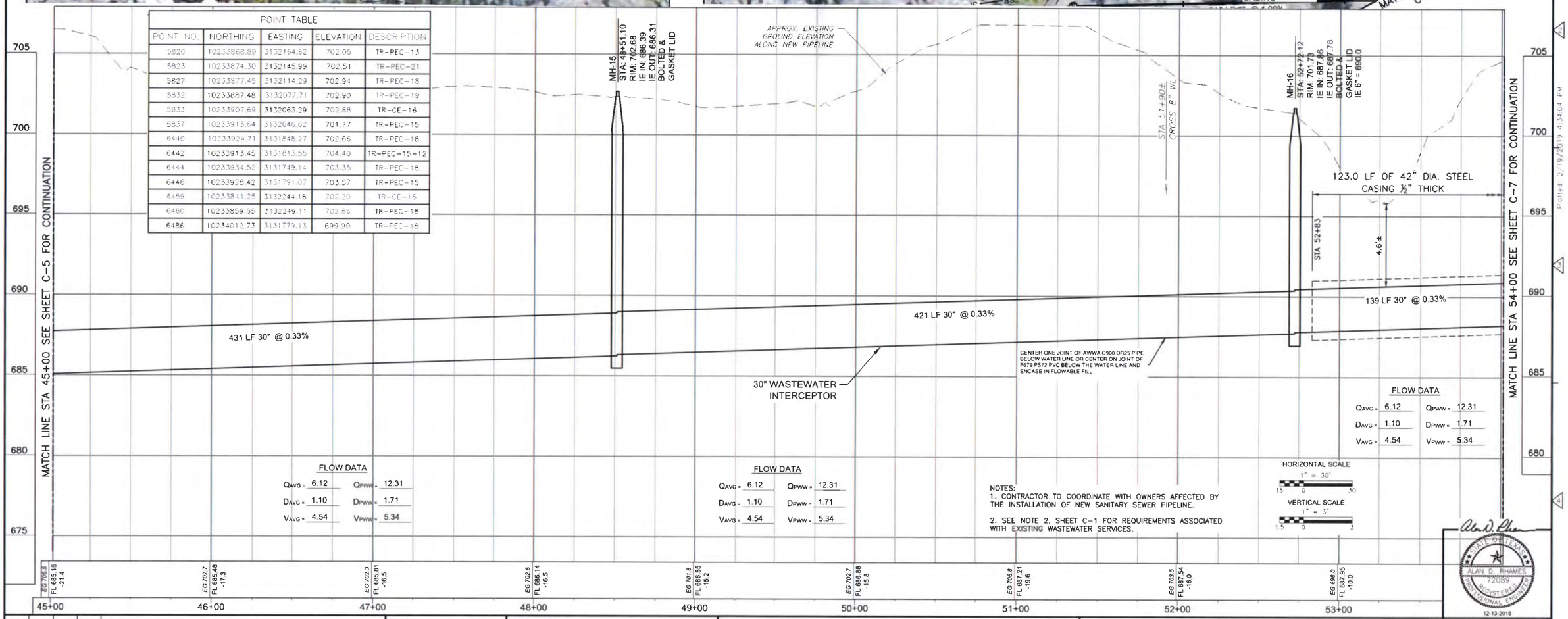




POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5820	10233868.89	3132164.62	702.05	TR-PEC-13
5823	10233874.30	3132145.99	702.51	TR-PEC-21
5827	10233877.45	3132114.29	702.94	TR-PEC-18
5832	10233867.48	3132077.71	702.90	TR-PEC-19
5833	10233907.69	3132063.29	702.88	TR-CE-16
5837	10233913.64	3132046.62	701.77	TR-PEC-15
6440	10233924.71	3131848.27	702.66	TR-PEC-18
6442	10233913.45	3131813.55	704.40	TR-PEC-15-12
6444	10233934.52	3131749.14	703.35	TR-PEC-18
6446	10233928.42	3131791.07	703.57	TR-PEC-15
6459	10233841.25	3132244.16	702.20	TR-CE-16
6460	10233859.56	3132249.11	702.66	TR-PEC-18
6486	10234012.73	3131779.13	699.90	TR-PEC-16



FLOW DATA

Q_{AVG} =	6.12	Q_{PWW} =	12.31
D_{AVG} =	1.10	D_{PWW} =	1.71
V_{AVG} =	4.54	V_{PWW} =	5.34

FLOW DATA

Q_{AVG} =	6.12	Q_{PWW} =	12.31
D_{AVG} =	1.10	D_{PWW} =	1.71
V_{AVG} =	4.54	V_{PWW} =	5.34

FLOW DATA

Q_{AVG} =	6.12	Q_{PWW} =	12.31
D_{AVG} =	1.10	D_{PWW} =	1.71
V_{AVG} =	4.54	V_{PWW} =	5.34

NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.

HORIZONTAL SCALE
1" = 30'
15 0 30

VERTICAL SCALE
1" = 3'
1.5 0 3

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
12-13-2018

REV. NO.	DATE	DRAWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/15/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel. (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE FROM STA 45+00 TO STA 54+00

PROJECT NO.: 2048-109788
FILE NAME: COGEPLPR.DWG
SHEET NO.: C-6

Plotted: 2/19/2019 4:34:04 PM

XREFs: [CDWS_2234_XC-BERRYCR_XC-BOUNDARY_XC-FP-BERRYCR_XC-AERIAL_1-50_W-SHADING_FLOOD PLAIN TY83-CF_ADR-SEAL_CWP0018TREE_CWP0018H] Images: []
Last saved by DOAEC Time: 12/7/2018 6:54:25 AM
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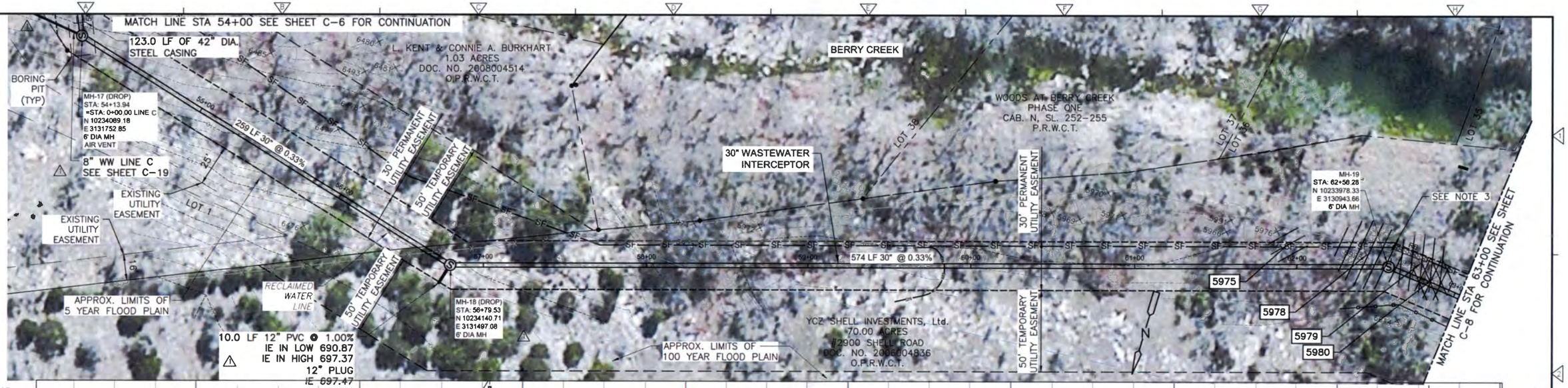
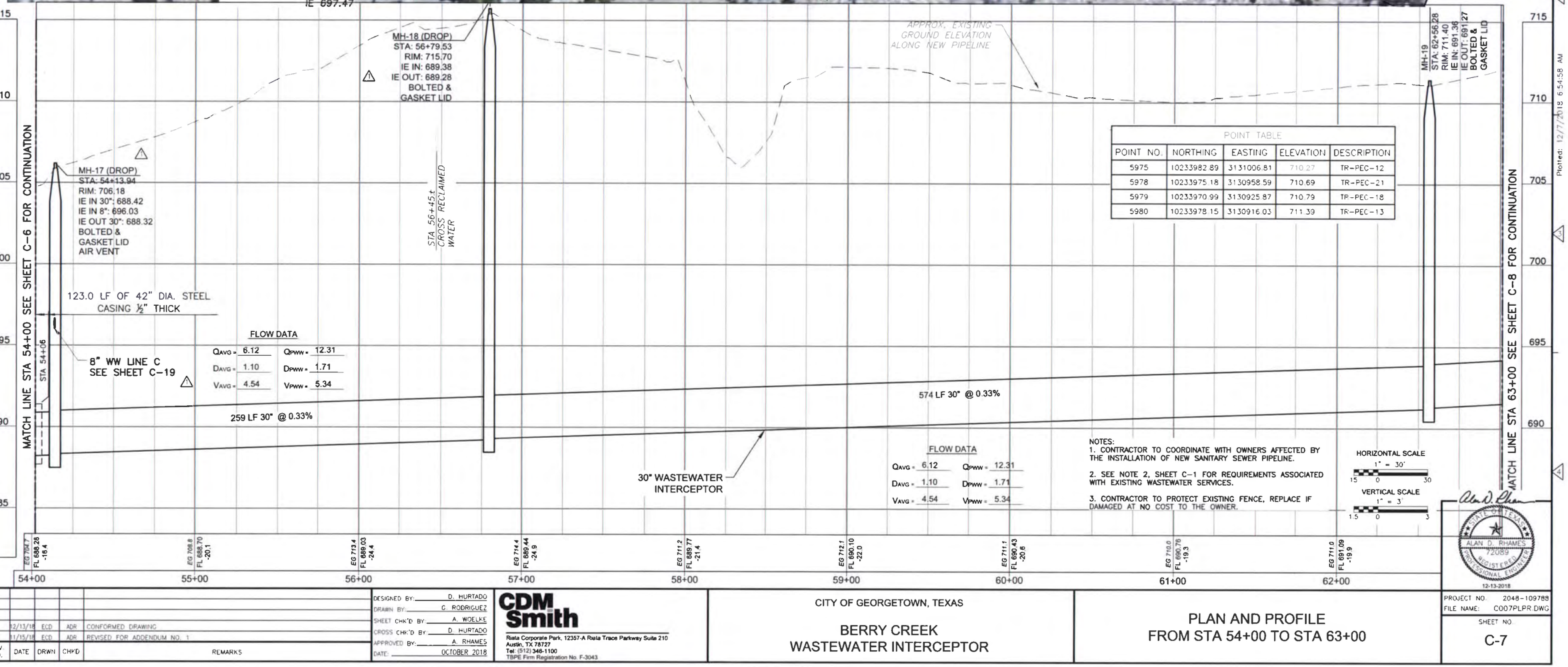




POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5975	10233982.89	3131006.81	710.27	TR-PEC-12
5978	10233975.18	3130958.59	710.69	TR-PEC-21
5979	10233970.99	3130925.87	710.79	TR-PEC-18
5980	10233978.15	3130916.03	711.39	TR-PEC-13

FLOW DATA
QAVG = 6.12 QPWW = 12.31
DAVG = 1.10 DPWW = 1.71
VAVG = 4.54 VPWW = 5.34

NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO PROTECT EXISTING FENCE, REPLACE IF DAMAGED AT NO COST TO THE OWNER.

HORIZONTAL SCALE
1" = 30'
15 0 30

VERTICAL SCALE
1" = 3'
1.5 0 3

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED PROFESSIONAL ENGINEER
12-13-2018

REV. NO.	DATE	DRWN	CHK'D	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/15/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

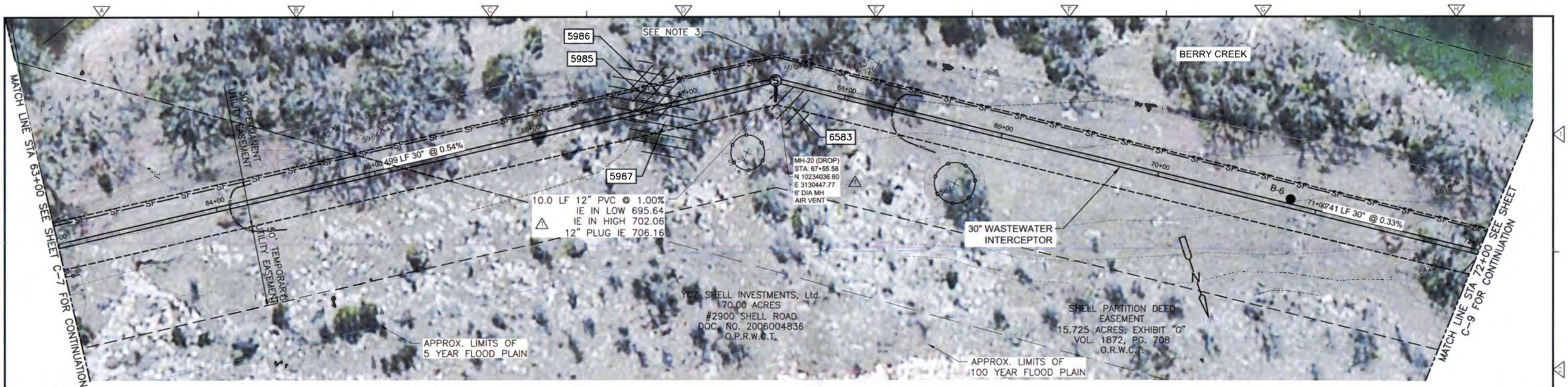
CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 54+00 TO STA 63+00

PROJECT NO. 2048-109788
FILE NAME: C007PLPR.DWG
SHEET NO. C-7

Plotted: 12/7/2018 6:54:58 AM

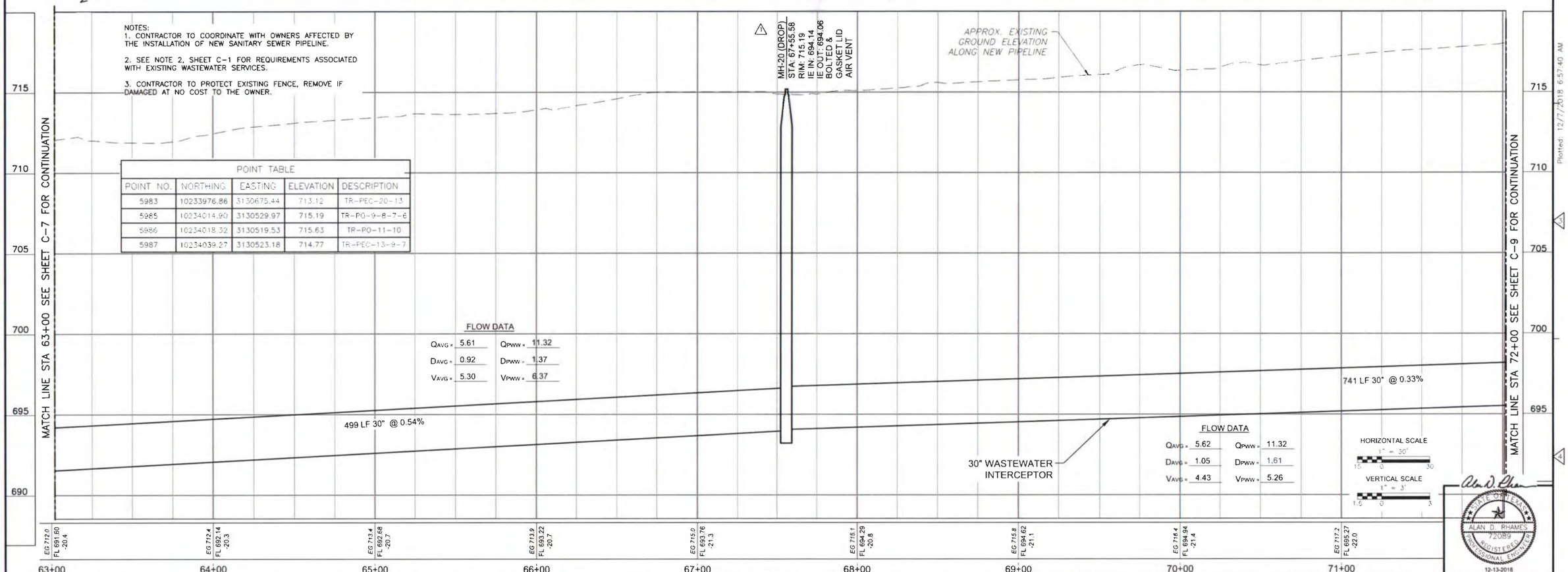


NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.

2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.

3. CONTRACTOR TO PROTECT EXISTING FENCE, REMOVE IF DAMAGED AT NO COST TO THE OWNER.

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5983	10233976.86	3130675.44	713.12	TR-PEC-20-13
5985	10234014.90	3130529.97	715.19	TR-PO-9-8-7-6
5986	10234018.32	3130519.53	715.63	TR-PO-11-10
5987	10234039.27	3130523.18	714.77	TR-PEC-13-9-7



REV. NO.	DATE	DRWN	CHK'D	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/15/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 63+00 TO STA 72+00

STATE OF TEXAS
ALAN D. RHAMES
92089
REGISTERED
PROFESSIONAL ENGINEER
12-13-2018

PROJECT NO. 2048-109788
FILE NAME: C008PLPR.DWG

SHEET NO.
C-8

Plotted: 12/7/2018 6:57:40 AM

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XREFs: [CDMS_2234_XC-BERRYCR_XC-BOUNDARY_XC-RP-BERRYCR_XC-AERIAL_1-50_W-SHADING_FLOOD PLAIN TX83-CF_CWP0041REE_ADR-SEAL_CWP0018H] images ()
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MATCH LINE STA 72+00 SEE SHEET C-8 FOR CONTINUATION

MATCH LINE STA 81+00 SEE SHEET C-10 FOR CONTINUATION

STEVE SHELL, ET AL TO HARVEY & SANDRA PIKOFF
TRACT 2-4-E 32.401 ACRES
VOL. 2059, PG. 33
O.R.W.C.T.

MH-22
STA: 76+61.74
N 10234321.75
E 3129721.41
6' DIA MH

BORING PIT (TYP)

188 LF 30" @ 0.36%

236 LF 30" @ 0.36%

MH-24
STA: 80+85.49
N 10234530.72
E 3129360.11
6' DIA MH

BERRY CREEK

145.0 LF OF 42" DIA. STEEL CASING

165 LF 30" @ 0.33%

30" WASTEWATER INTERCEPTOR

MH-23
STA: 78+49.85
N 10234445.63
E 3129579.85
6' DIA MH
AIR VENT

SHELL PARTITION DEED EASEMENT
15.725 ACRES, EXHIBIT "G"
VOL. 1872, PG. 708
O.R.W.C.T.

SHELL PARTITION DEED EASEMENT
15.725 ACRES, EXHIBIT "G"
VOL. 1872, PG. 708
O.R.W.C.T.

BERRY CREEK

APPROX. LIMITS OF 5 YEAR FLOOD PLAIN

APPROX. LIMITS OF 100 YEAR FLOOD PLAIN

MH-21
STA: 74+90.57
N 10234446.05
E 3129830.18
6' DIA MH

JACK AND BORE PIT

6479 6437 6467 6402 6430 6429 6427 6426 6382 6434

NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO PROTECT EXISTING FENCE. REPLACE IF DAMAGED AT NO COST TO THE OWNER.

MH-21
STA: 74+96.57
RIM: 717.42
IE IN: 696.66
IE OUT: 696.58
BOLTED & GASKET LID

MH-22
STA: 76+61.74
RIM: 717.16
IE IN: 697.29
IE OUT: 697.21
BOLTED & GASKET LID

APPROX. EXISTING GROUND ELEVATION ALONG NEW PIPELINE

MH-23
STA: 78+49.85
RIM: 716.35
IE IN: 698.05
IE OUT: 697.97
BOLTED & GASKET LID
AIR VENT

MH-24
STA: 80+85.49
RIM: 717.55
IE IN: 698.98
IE OUT: 698.90
BOLTED & GASKET LID

BERRY CREEK

145.0 LF OF 42" DIA. STEEL CASING ½" THICK

STA 75+07

5.4'±

STA 76+52

741 LF 30" @ 0.33%

165 LF 30" @ 0.33%

188 LF 30" @ 0.36%

236 LF 30" @ 0.36%

30" WASTEWATER INTERCEPTOR

POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
6382	10234426.06	3129827.25	715.44	TR-PEC-21-16
6402	10234464.53	3129511.72	717.03	TR-PEC-19
6426	10234346.84	3129965.19	717.18	TR-PEC-13
6427	10234344.52	3129962.09	717.37	TR-PEC-13-13
6429	10234378.87	3129942.55	717.61	TR-ELM-25
6430	10234385.0	3129910.51	715.80	TR-PEC-17
6434	10234300.11	3130070.32	718.45	TR-PEC-17
6437	10234506.17	3129405.04	716.54	TR-PEC-22
6467	10234520.65	3129388.65	716.97	TR-PEC-14
6479	10234505.15	3129415.84	716.47	TR-PEC-13

FLOW DATA
Q_{AVG} = 5.62 Q_{PWW} = 11.32
D_{AVG} = 1.05 D_{PWW} = 1.61
V_{AVG} = 4.43 V_{PWW} = 5.26

FLOW DATA
Q_{AVG} = 5.52 Q_{PWW} = 11.12
D_{AVG} = 1.04 D_{PWW} = 1.59
V_{AVG} = 4.41 V_{PWW} = 5.24

FLOW DATA
Q_{AVG} = 5.38 Q_{PWW} = 10.82
D_{AVG} = 1.00 D_{PWW} = 1.51
V_{AVG} = 4.53 V_{PWW} = 5.39

FLOW DATA
Q_{AVG} = 5.38 Q_{PWW} = 10.82
D_{AVG} = 0.97 D_{PWW} = 1.44
V_{AVG} = 4.80 V_{PWW} = 5.73

HORIZONTAL SCALE
1" = 30'
15 0 30

VERTICAL SCALE
1" = 3'
1.5 0 3

715 710 705 700 695 690

EG 718.0 FL 695.90 -22.4
EG 717.9 FL 695.93 -22.0
EG 716.2 FL 696.26 -19.9
EG 716.9 FL 696.67 -20.2
EG 706.5 FL 697.00 -9.5
EG 716.7 FL 697.43 -19.3
EG 716.4 FL 697.79 -18.6
EG 716.5 FL 698.23 -18.3
EG 716.8 FL 698.59 -18.2

72+00 73+00 74+00 75+00 76+00 77+00 78+00 79+00 80+00

ALAN D. RHAMES 72089 REGISTERED PROFESSIONAL ENGINEER
12-13-2018

REV. NO.	DATE	DRWN	CHK'D	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING

DESIGNED BY D. HURTADO
DRAWN BY G. RODRIGUEZ
SHEET CHK'D BY A. WOELKE
CROSS CHK'D BY D. HURTADO
APPROVED BY A. RHAMES
DATE OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

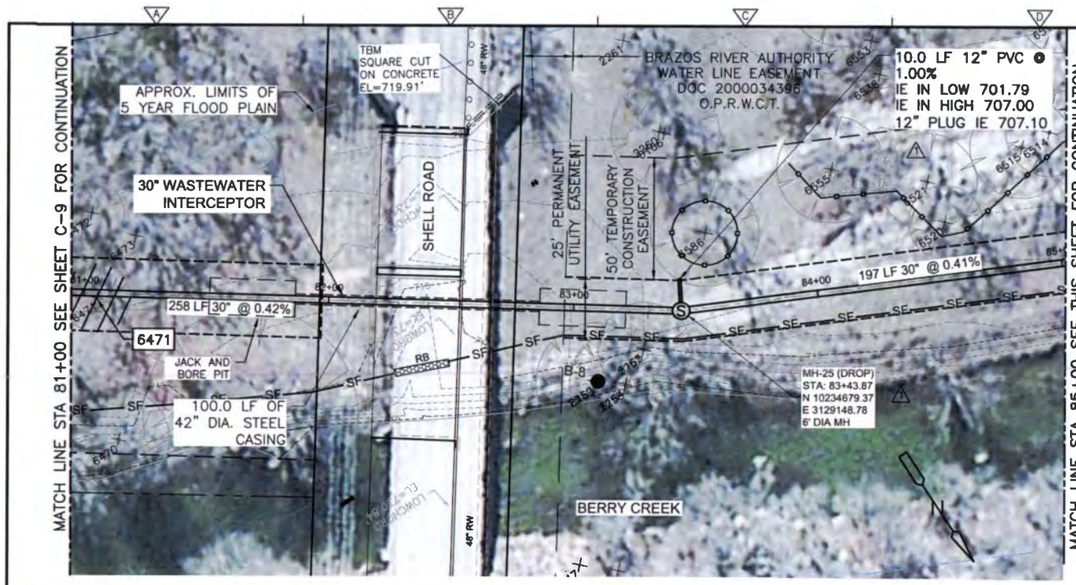
CITY OF GEORGETOWN, TEXAS

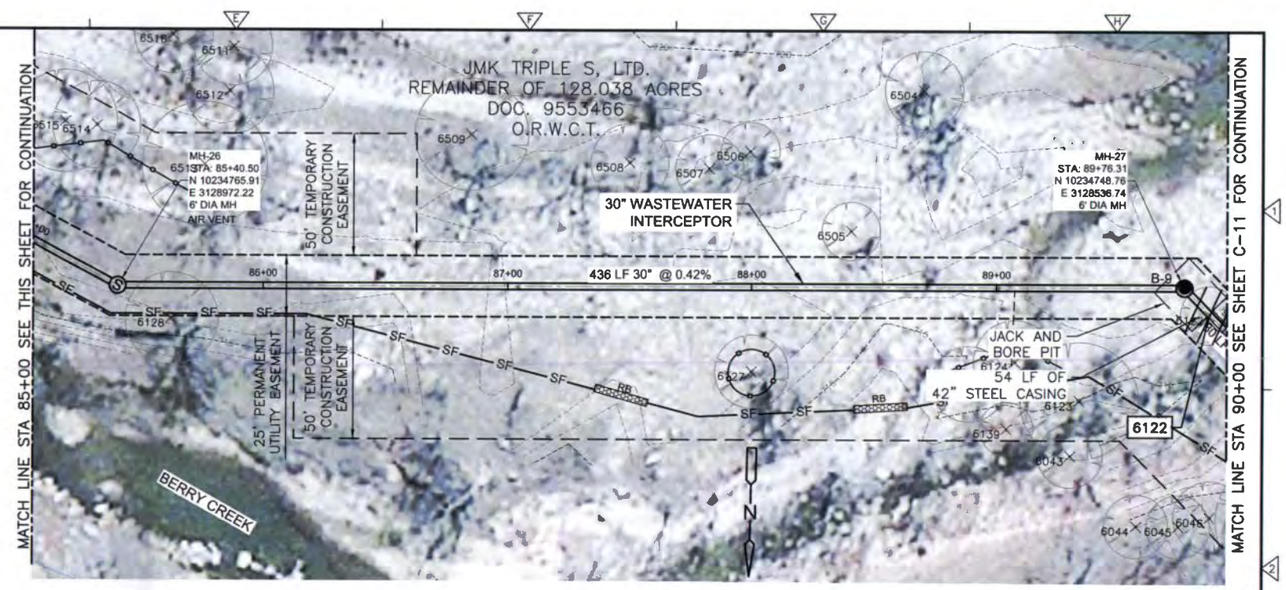
BERRY CREEK
WASTEWATER INTERCEPTOR

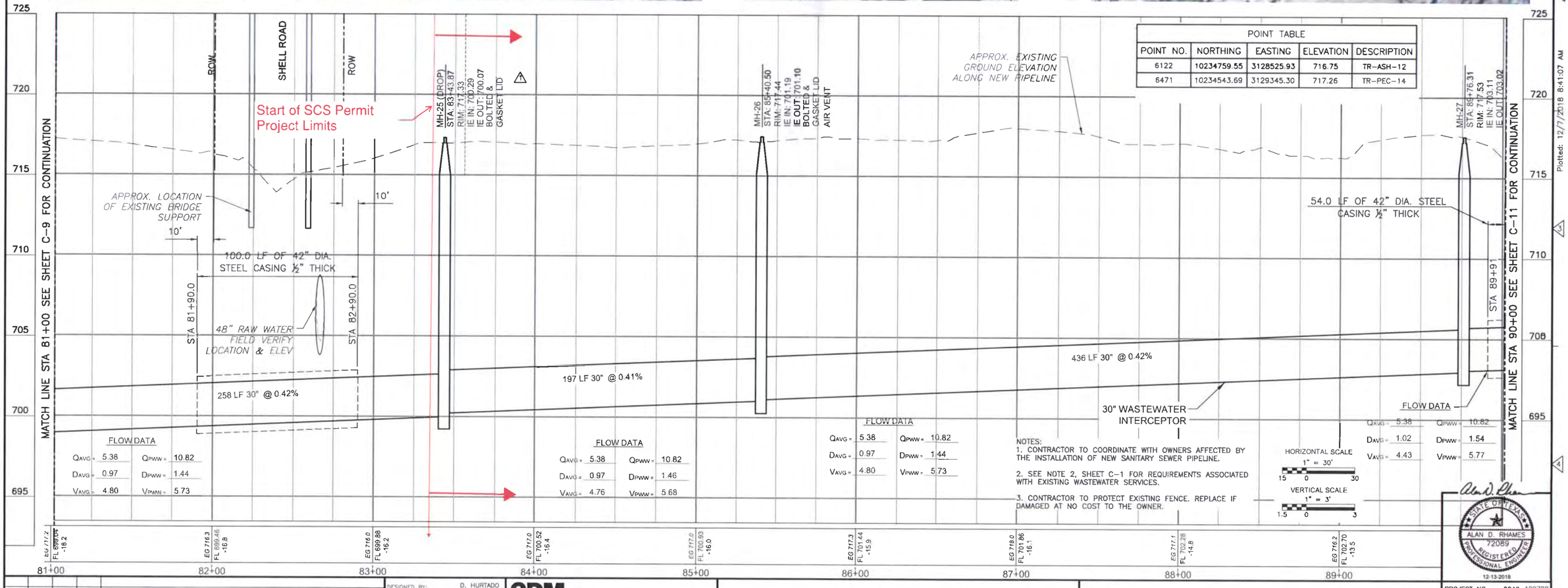
PLAN AND PROFILE
FROM STA 72+00 TO STA 81+00

PROJECT NO: 2048-109788
FILE NAME: C009PLPR.DWG
SHEET NO.
C-9

Plotted: 12/7/2018 8:17:09 AM







POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
6122	10234759.55	3128525.93	716.75	TR-ASH-12
6471	10234543.69	3129345.30	717.26	TR-PEC-14

NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO PROTECT EXISTING FENCE. REPLACE IF DAMAGED AT NO COST TO THE OWNER.

HORIZONTAL SCALE 1" = 30'
VERTICAL SCALE 1" = 3'

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED PROFESSIONAL ENGINEER
12-13-2018

REV. NO.	DATE	DRWN	CHKD	REMARKS
2	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/15/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 81+00 TO STA 90+00

PROJECT NO. 2048-109788
FILE NAME: C010PLPR.DWG
SHEET NO. C-10

Plotted: 12/7/2018 8:41:07 AM

XREFs: [CDMS_2234, XC-BERRYCR, XC-BOUNDARY, XC-PR-BERRYCR, XC-AERIAL_1-50, W-SHADING, FLOOD PLAIN TX83-CF, ADR-SEAL, CWPD04TREE, CWPD01BH] Images: []
Last saved by: DOAKEC Time: 12/7/2018 8:40:11 AM
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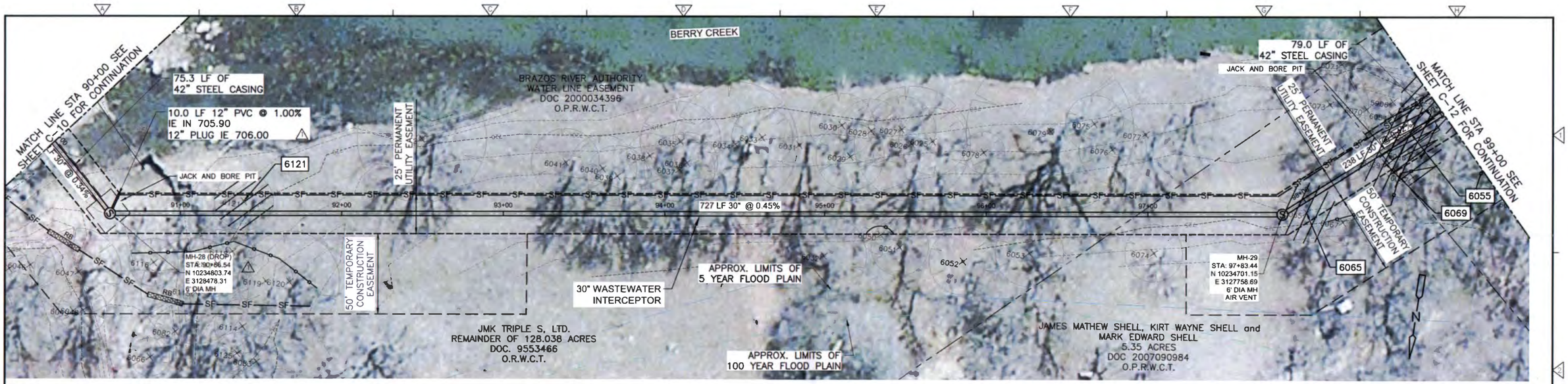
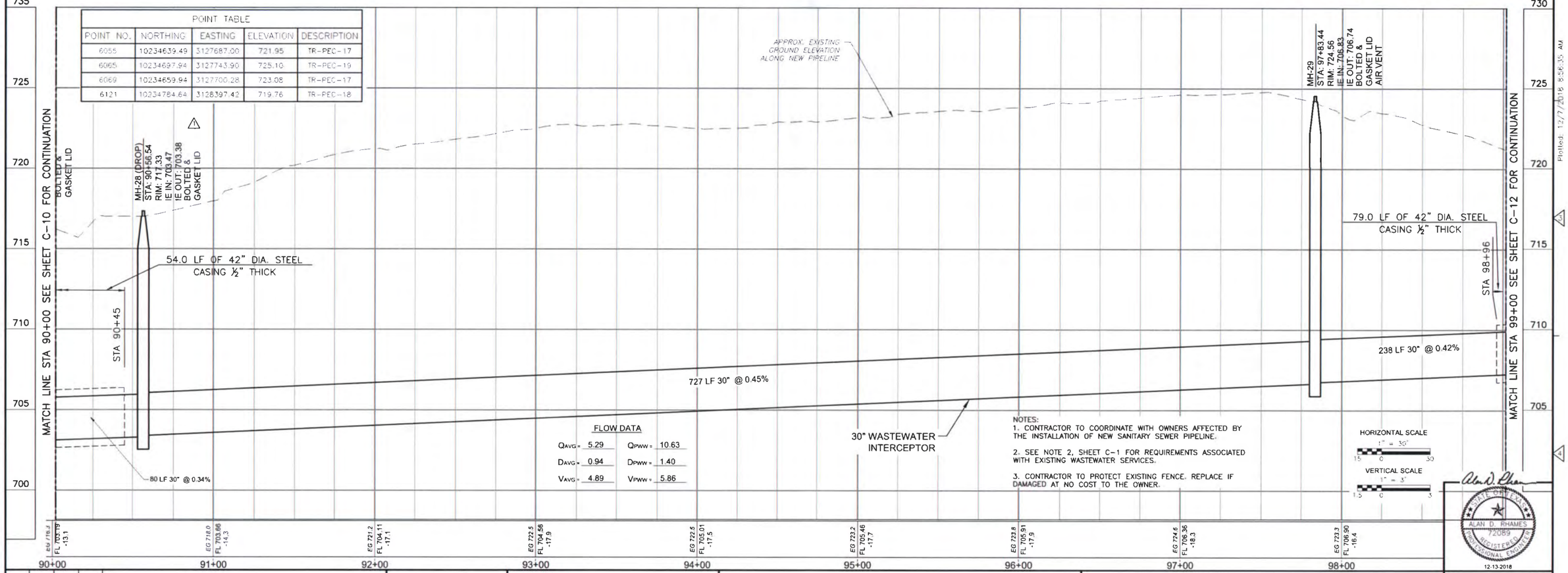


POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
6055	10234639.49	3127687.00	721.95	TP-PEC-17
6065	10234697.94	3127743.90	725.10	TP-PEC-19
6069	10234659.94	3127700.28	723.08	TP-PEC-17
6121	10234784.64	3128397.42	719.76	TP-PEC-18



FLOW DATA

Q_{AVG} =	5.29	Q_{PWW} =	10.63
D_{AVG} =	0.94	D_{PWW} =	1.40
V_{AVG} =	4.89	V_{PWW} =	5.86

NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO PROTECT EXISTING FENCE. REPLACE IF DAMAGED AT NO COST TO THE OWNER.

HORIZONTAL SCALE
1" = 30'
15 0 30

VERTICAL SCALE
1" = 3'
1.5 0 3

ALAN D. RHAMES 92089 REGISTERED PROFESSIONAL ENGINEER
12-13-2018

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/15/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: G. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 90+00 TO STA 99+00

PROJECT NO: 3048-109788
FILE NAME: C011PLPR.DWG
SHEET NO.
C-11

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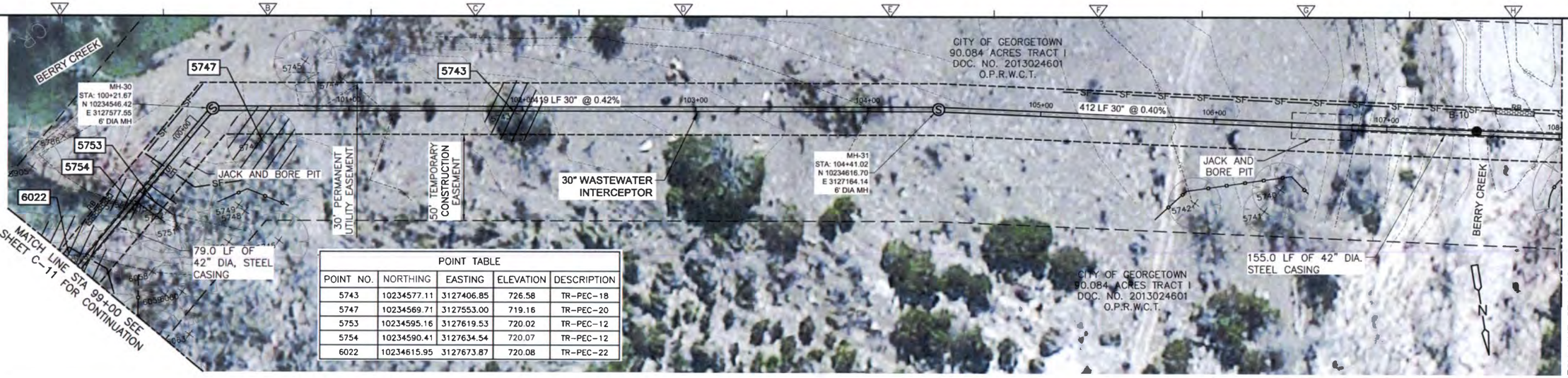
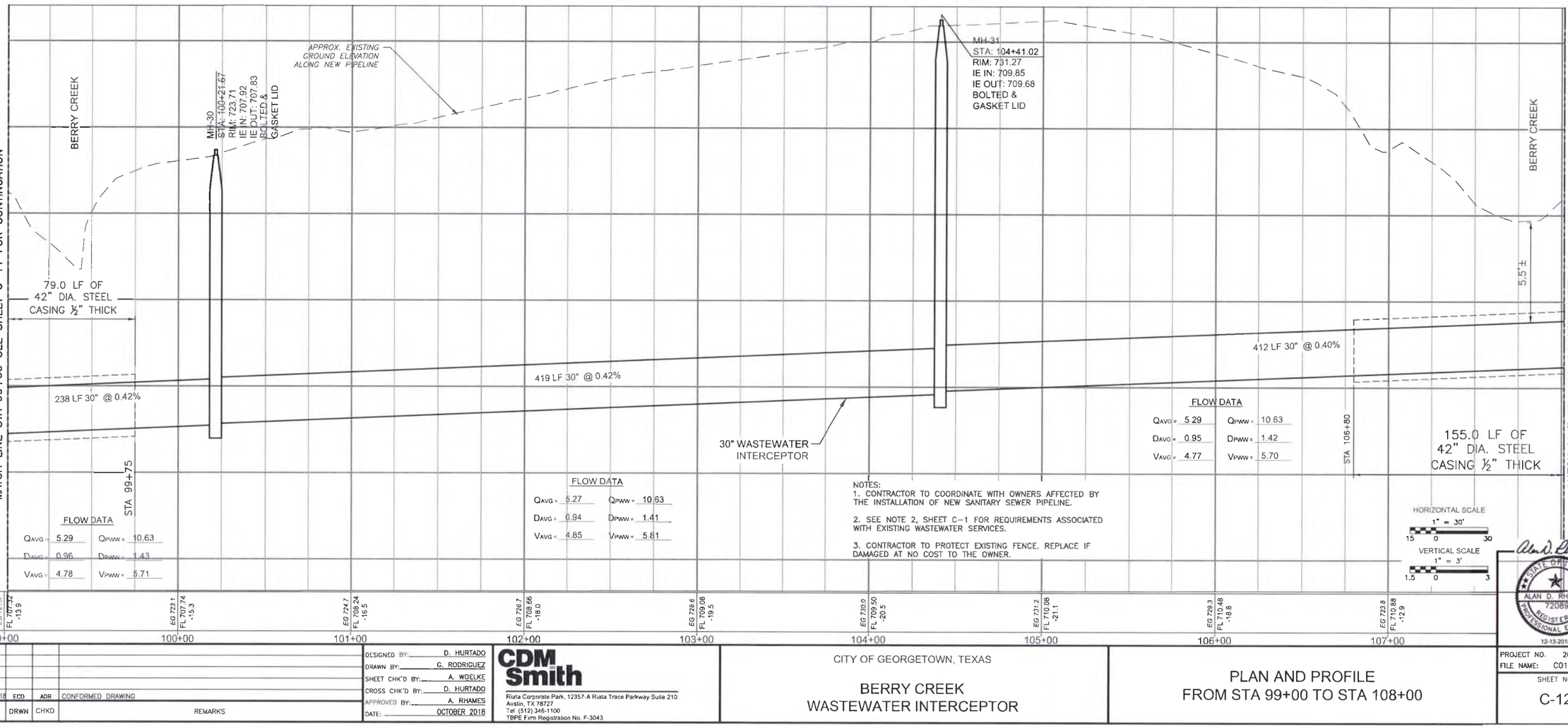


POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5743	10234577.11	3127406.85	726.58	TR-PEC-18
5747	10234569.71	3127553.00	719.16	TR-PEC-20
5753	10234595.16	3127619.53	720.02	TR-PEC-12
5754	10234590.41	3127634.54	720.07	TR-PEC-12
6022	10234615.95	3127673.87	720.08	TR-PEC-22



FLOW DATA
Q_{AVG} = 5.29 Q_{PWW} = 10.63
D_{AVG} = 0.96 D_{PWW} = 1.43
V_{AVG} = 4.78 V_{PWW} = 5.71

FLOW DATA
Q_{AVG} = 5.27 Q_{PWW} = 10.63
D_{AVG} = 0.94 D_{PWW} = 1.41
V_{AVG} = 4.85 V_{PWW} = 5.81

FLOW DATA
Q_{AVG} = 5.29 Q_{PWW} = 10.63
D_{AVG} = 0.95 D_{PWW} = 1.42
V_{AVG} = 4.77 V_{PWW} = 5.70

NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO PROTECT EXISTING FENCE. REPLACE IF DAMAGED AT NO COST TO THE OWNER.

HORIZONTAL SCALE
1" = 30'
15 0 30

VERTICAL SCALE
1" = 3'
1.5 0 3

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED PROFESSIONAL ENGINEER
12-13-2018

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel. (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 99+00 TO STA 108+00

PROJECT NO. 2048-109788
FILE NAME: C012PLPR.DWG
SHEET NO.
C-12

Plotted: 12/7/2018 9:00:27 AM

XREFs: [CDMS_2234, XC-BERRYCR, XC-BOUNDARY, XC-PR-BERRYCR, XC-AERIAL_1-50, W-SHADING, FLOOD PLAIN TXB3-CF, CWF0041REE, ADR-SEAL, CWP0018H] Images: []
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XREFs: [CDMS_2234_XC-BERYCR_XC-BOUNDARY_XC-PR-BERYCR_XC-AERIAL_1-50_W-SHADING_FLOOD PLAIN TX83-CF_CWP001REE_ADR-SEAL_CWP001BH] Images: []
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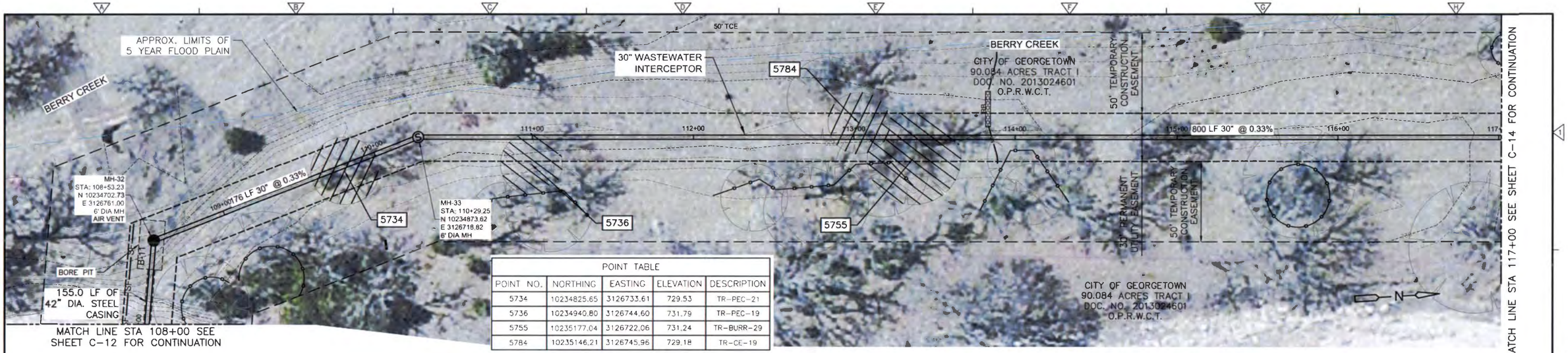
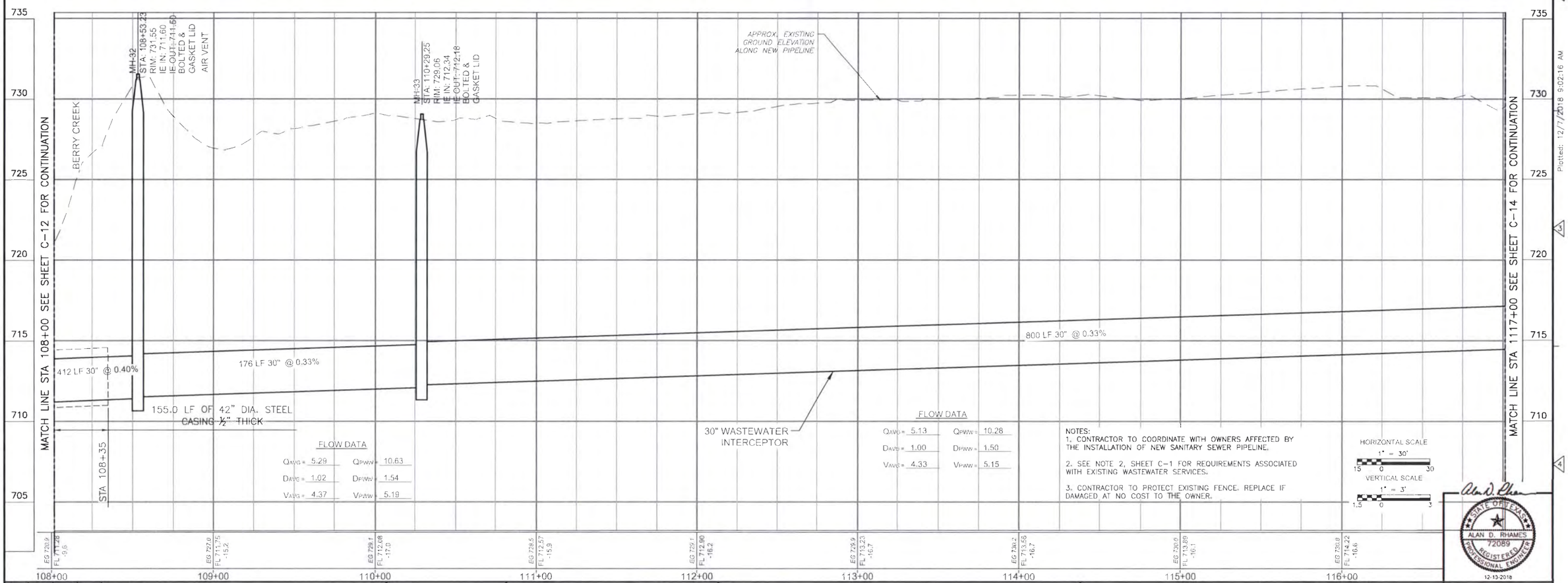


POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5734	10234825.65	3126733.61	729.53	TR-PEC-21
5736	10234940.80	3126744.60	731.79	TR-PEC-19
5755	10235177.04	3126722.06	731.24	TR-BURR-29
5784	10235146.21	3126745.96	729.18	TR-CE-19



FLOW DATA

Q_{AVG} = 5.29	Q_{PWW} = 10.63	Q_{AVG} = 5.13	Q_{PWW} = 10.28
D_{AVG} = 1.02	D_{PWW} = 1.54	D_{AVG} = 1.00	D_{PWW} = 1.50
V_{AVG} = 4.37	V_{PWW} = 5.19	V_{AVG} = 4.33	V_{PWW} = 5.15

NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO PROTECT EXISTING FENCE. REPLACE IF DAMAGED AT NO COST TO THE OWNER.

HORIZONTAL SCALE
1" = 30'
15 0 30
VERTICAL SCALE
1" = 3'
1.5 0 3

ALAN D. RHAMES 72089 REGISTERED PROFESSIONAL ENGINEER
STATE OF TEXAS
12-13-2018

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Rialta Corporate Park, 12357-A Rialta Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

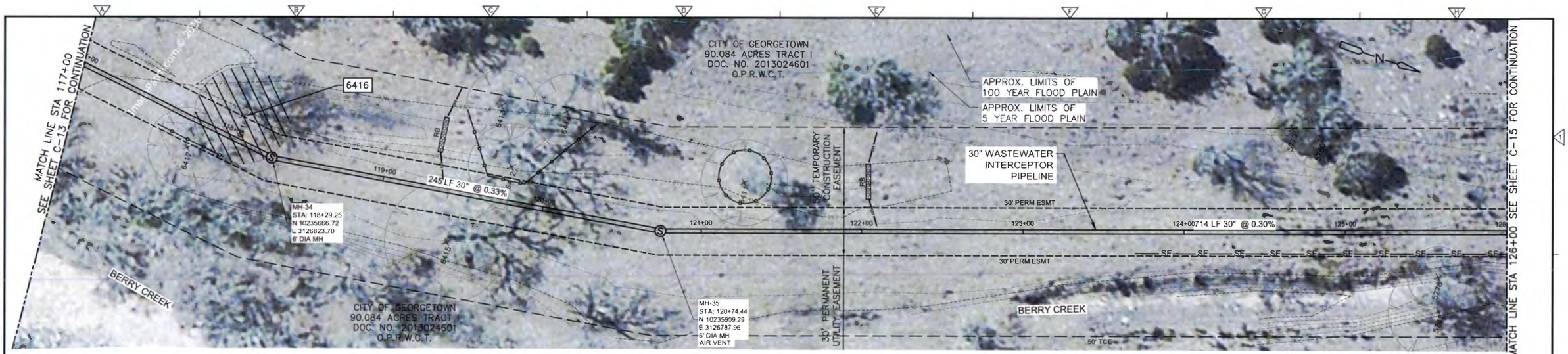
CITY OF GEORGETOWN, TEXAS

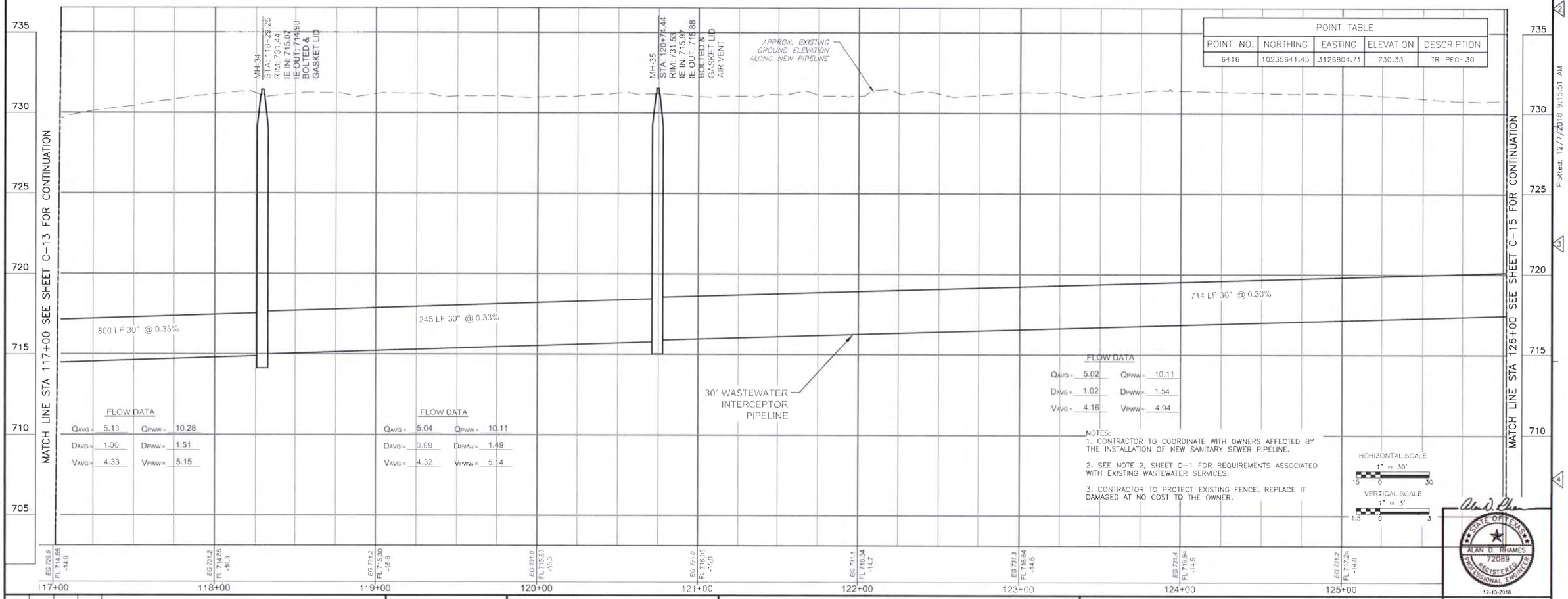
BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 108+00 TO STA 117+00

PROJECT NO. 2048-109788
FILE NAME: C013PLPR.DWG
SHEET NO.
C-13

Plotted: 12/7/2018 9:02:16 AM





POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
6416	10235641.45	3126804.71	730.33	TR-PEC-30

FLOW DATA

Q_{AVG} = 5.13	Q_{PWW} = 10.28		
D_{AVG} = 1.00	D_{PWW} = 1.51		
V_{AVG} = 4.33	V_{PWW} = 5.15		

FLOW DATA

Q_{AVG} = 5.04	Q_{PWW} = 10.11		
D_{AVG} = 0.99	D_{PWW} = 1.49		
V_{AVG} = 4.32	V_{PWW} = 5.14		

FLOW DATA

Q_{AVG} = 5.02	Q_{PWW} = 10.11		
D_{AVG} = 1.02	D_{PWW} = 1.54		
V_{AVG} = 4.16	V_{PWW} = 4.94		

NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO PROTECT EXISTING FENCE. REPLACE IF DAMAGED AT NO COST TO THE OWNER.

HORIZONTAL SCALE
1" = 30'
15 0 30

VERTICAL SCALE
1" = 3'
1.5 0 3

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
12-13-2018

REV. NO.	DATE	DRWN	CHKD	REMARKS
	2/13/18	ECO	ADR	COMFORMED DRAWING

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 117+00 TO STA 126+00

PROJECT NO. 2048-109788
FILE NAME: C014PLPR.DWG
SHEET NO.
C-14

Plotted: 12/7/2018 9:15:51 AM

XREFs: [CDMS_2234, XC-BERRYCR, XC-BOUNDARY, XC-PR-BERRYCR, XC-AERIAL_1-50, W-SHADING, FLOOD PLAIN TXB3-CF, ADR-SEAL, CWP0041REE, CWP0041BH] Images: []
Last saved by: DOAKES Time: 12/7/2018 9:15:16 AM
pw:\\pw.cdrsmith.com:PW_EXT\2048\109788\04 Design Services NM_30%\02 Civil\10 CADD\C014PLPR.dwg
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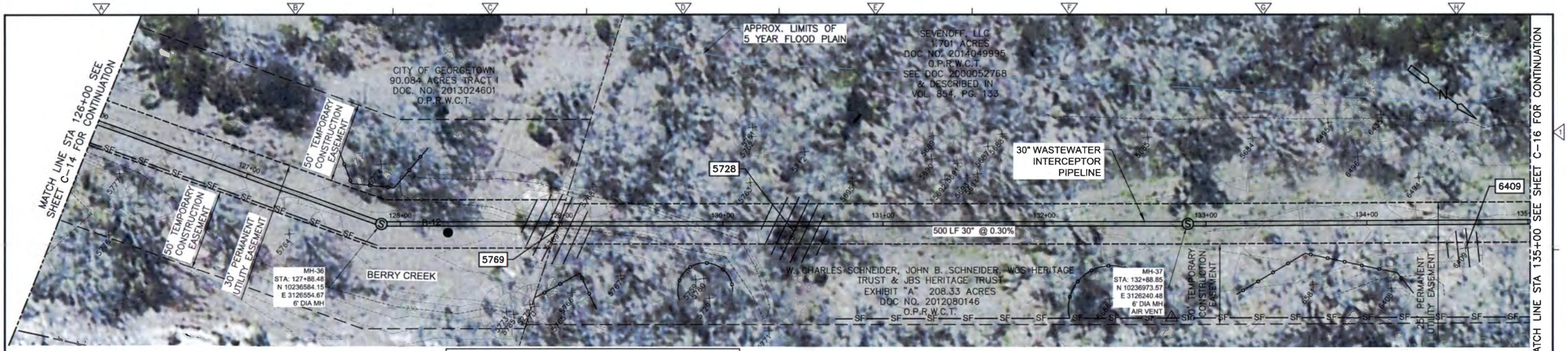
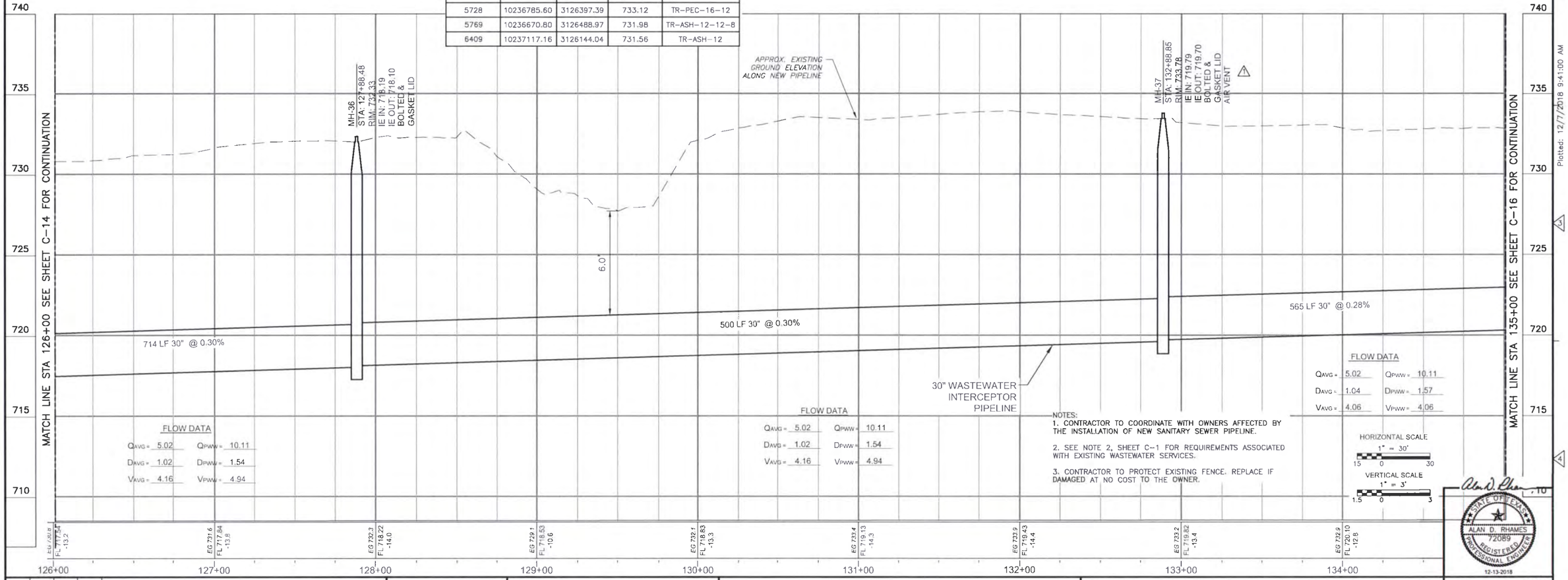


POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5728	10236785.60	3126397.39	733.12	TR-PEC-16-12
5769	10236670.80	3126488.97	731.98	TR-ASH-12-12-8
6409	10237117.16	3126144.04	731.56	TR-ASH-12



NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO PROTECT EXISTING FENCE. REPLACE IF DAMAGED AT NO COST TO THE OWNER.

HORIZONTAL SCALE
1" = 30'
15 0 30

VERTICAL SCALE
1" = 3'
1.5 0 3

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/15/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 126+00 TO STA 135+00

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED PROFESSIONAL ENGINEER
12-13-2018

PROJECT NO. 2048-109788
FILE NAME: C015PLPR.DWG

SHEET NO.
C-15

Plotted: 12/7/2018 9:41:00 AM

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XREFs: [COMS_2234_XC-BERRYCR_XC-BOUNDARY_XC-PR-BERRYCR_XC-AERIAL_1-50_W-SHADING_FLOOD PLAIN TX83-CF_CWP0041REE_ADR-SEAL_CWP001BH] Images: []
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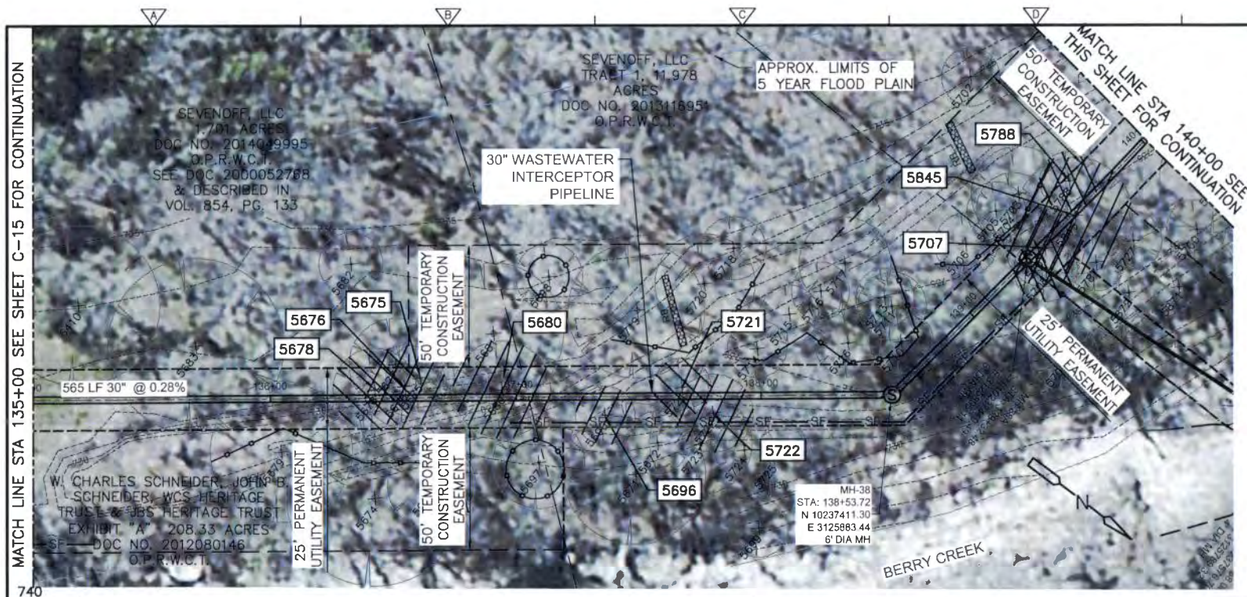

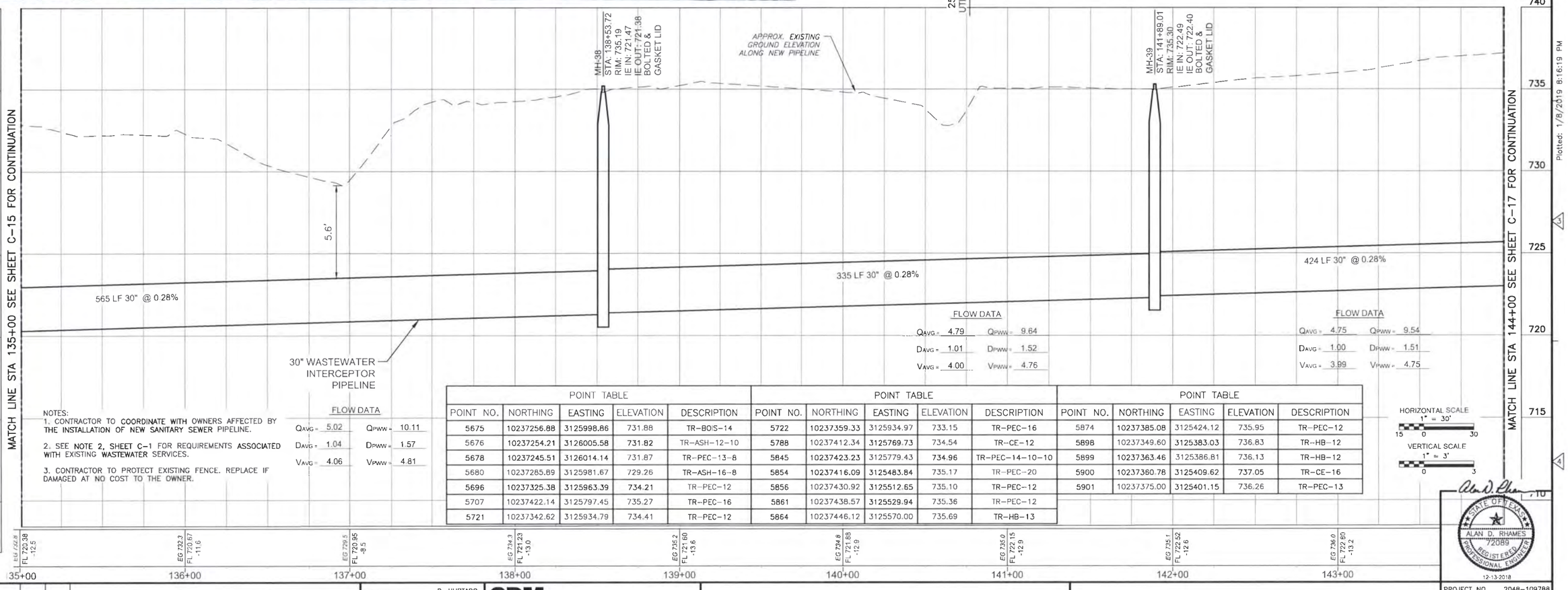

FLOW DATA

Q_{AVG} = 5.02	Q_{PWW} = 10.11
D_{AVG} = 1.04	D_{PWW} = 1.57
V_{AVG} = 4.06	V_{PWW} = 4.81

FLOW DATA

Q_{AVG} = 4.79	Q_{PWW} = 9.64
D_{AVG} = 1.01	D_{PWW} = 1.52
V_{AVG} = 4.00	V_{PWW} = 4.76

FLOW DATA

Q_{AVG} = 4.75	Q_{PWW} = 9.54
D_{AVG} = 1.00	D_{PWW} = 1.51
V_{AVG} = 3.99	V_{PWW} = 4.75

NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO PROTECT EXISTING FENCE. REPLACE IF DAMAGED AT NO COST TO THE OWNER.

POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5675	10237256.88	3125998.86	731.88	TR-BOIS-14
5676	10237254.21	3126005.58	731.82	TR-ASH-12-10
5678	10237245.51	3126014.14	731.87	TR-PEC-13-8
5680	10237285.89	3125981.67	729.26	TR-ASH-16-8
5696	10237325.38	3125963.39	734.21	TR-PEC-12
5707	10237422.14	3125797.45	735.27	TR-PEC-16
5721	10237342.62	3125934.79	734.41	TR-PEC-12

POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5722	10237359.33	3125934.97	733.15	TR-PEC-16
5788	10237412.34	3125769.73	734.54	TR-CE-12
5845	10237423.23	3125779.43	734.96	TR-PEC-14-10-10
5854	10237416.09	3125483.84	735.17	TR-PEC-20
5856	10237430.92	3125512.65	735.10	TR-PEC-12
5861	10237438.57	3125529.94	735.36	TR-PEC-12
5864	10237446.12	3125570.00	735.69	TR-HB-13

POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5874	10237385.08	3125424.12	735.95	TR-PEC-12
5898	10237349.60	3125383.03	736.83	TR-HB-12
5899	10237363.46	3125386.81	736.13	TR-HB-12
5900	10237360.78	3125409.62	737.05	TR-CE-16
5901	10237375.00	3125401.15	736.26	TR-PEC-13

HORIZONTAL SCALE
1" = 30'
15 0 30
VERTICAL SCALE
1" = 3'
0 3

ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
12-13-2018

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/15/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE FROM STA 135+00 TO STA 144+00

PROJECT NO. 2048-109788
FILE NAME: C016PLPR.DWG
SHEET NO.
C-16

Plotted: 1/8/2019 8:16:19 PM

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XREFs: [COM_2234_XC-BERRYCR_XC-BOUNDARY_XC-PR-BERRYCR_XC-AERIAL_1-50_W-SHADING_FLOOD PLAIN TX83-CF_CWP004TREE_ADR-SEAL_CWP001BH] Images: []
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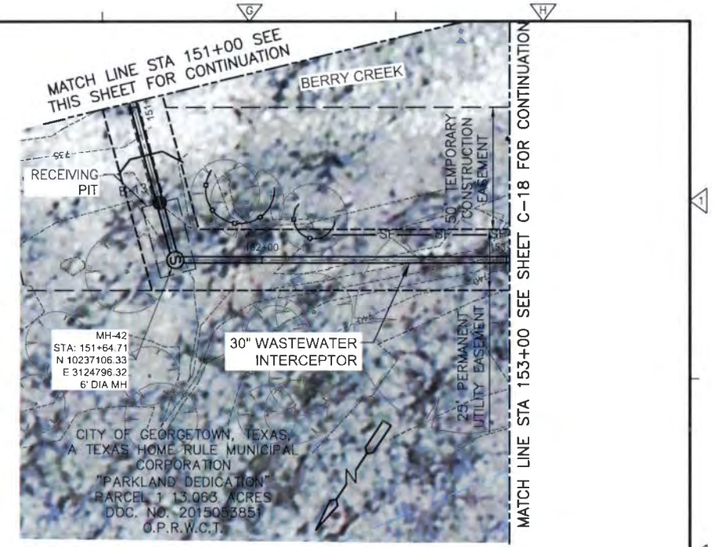
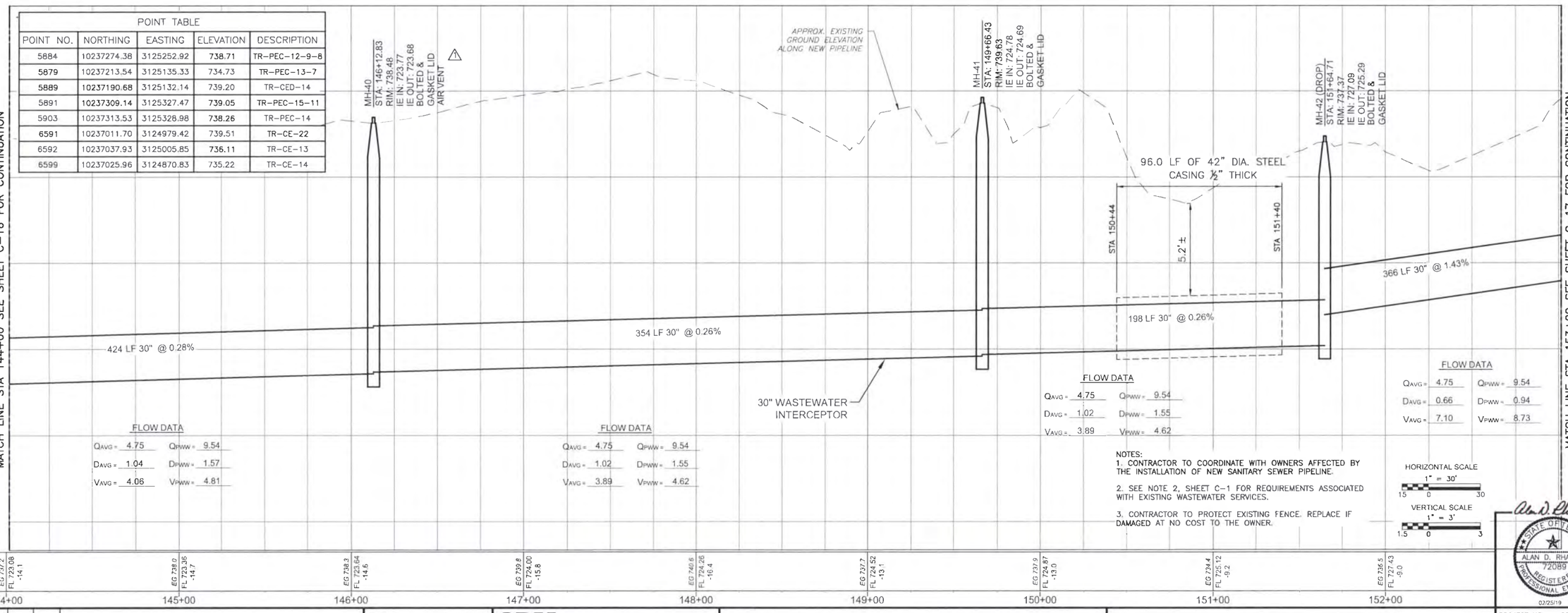


POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
5884	10237274.38	3125252.92	738.71	TR-PEC-12-9-8
5879	10237213.54	3125135.33	734.73	TR-PEC-13-7
5889	10237190.68	3125132.14	739.20	TR-CED-14
5891	10237309.14	3125327.47	739.05	TR-PEC-15-11
5903	10237313.53	3125328.98	738.26	TR-PEC-14
6591	10237011.70	3124979.42	739.51	TR-CE-22
6592	10237037.93	3125005.85	736.11	TR-CE-13
6599	10237025.96	3124870.83	735.22	TR-CE-14



FLOW DATA
Q_{AVG} = 4.75 Q_{PWW} = 9.54
D_{AVG} = 1.04 D_{PWW} = 1.57
V_{AVG} = 4.06 V_{PWW} = 4.81

FLOW DATA
Q_{AVG} = 4.75 Q_{PWW} = 9.54
D_{AVG} = 1.02 D_{PWW} = 1.55
V_{AVG} = 3.89 V_{PWW} = 4.62

FLOW DATA
Q_{AVG} = 4.75 Q_{PWW} = 9.54
D_{AVG} = 1.02 D_{PWW} = 1.55
V_{AVG} = 3.89 V_{PWW} = 4.62

FLOW DATA
Q_{AVG} = 4.75 Q_{PWW} = 9.54
D_{AVG} = 0.66 D_{PWW} = 0.94
V_{AVG} = 7.10 V_{PWW} = 8.73

NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO PROTECT EXISTING FENCE. REPLACE IF DAMAGED AT NO COST TO THE OWNER.

HORIZONTAL SCALE
1" = 30'
15 0 30

VERTICAL SCALE
1" = 3'
1.5 0 3

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
02/25/19

REV. NO.	DATE	DRWN	CHKD	REMARKS
2	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/15/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: C. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel. (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE
FROM STA 144+00 TO STA 153+00

PROJECT NO. 2048-109788
FILE NAME: C017PLPR.DWG
SHEET NO.
C-17

CONFORMED DRAWING

Plotted: 2/25/2019 11:41:50 AM

XREFs: [CDMS_2234, XC-BERRYCR, XC-BOUNDARY, XC-PR-BERRYCR, XC-AERIAL_1-50, W-SHADING, FLOOD PLAIN TX83-CF, CWP004TREE, ADR-SEA], Images: []
Last saved by: DOAREC Time: 12/7/2018 10:22:14 AM
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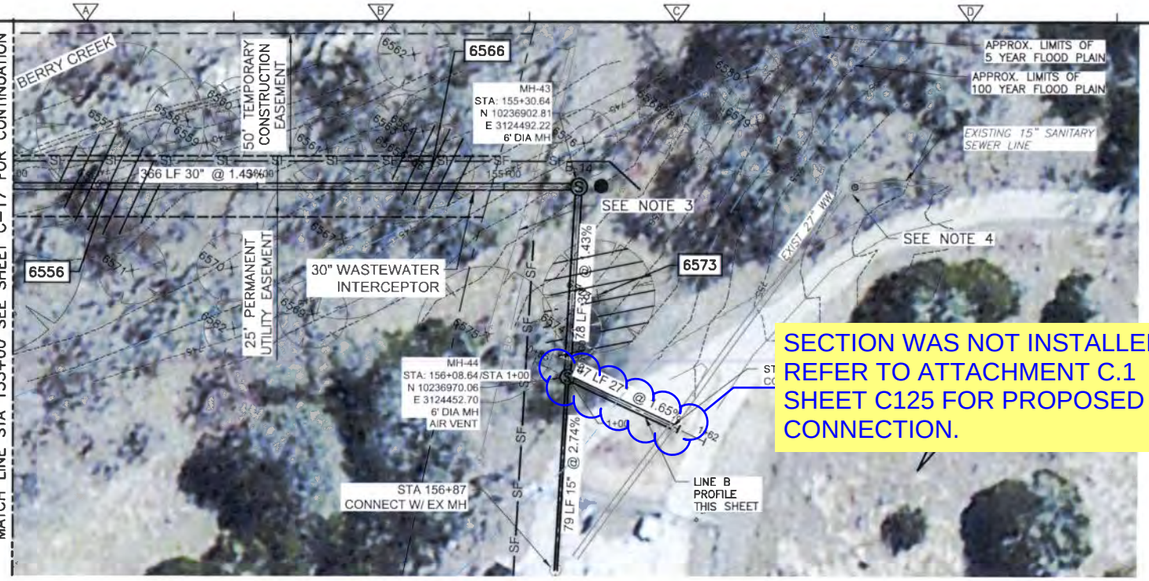
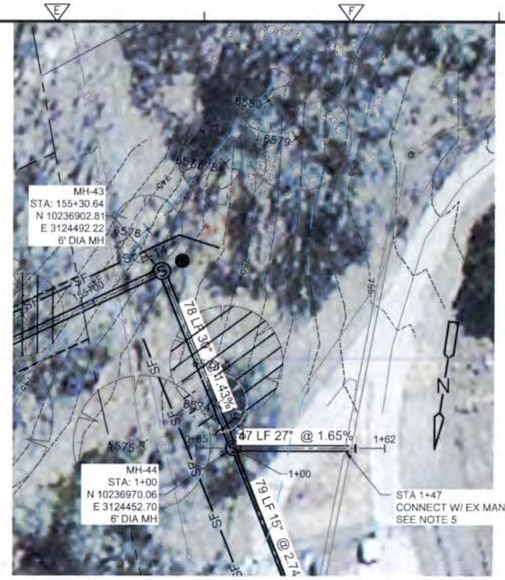


SECTION WAS NOT INSTALLED
REFER TO ATTACHMENT C.1
SHEET C125 FOR PROPOSED
CONNECTION.

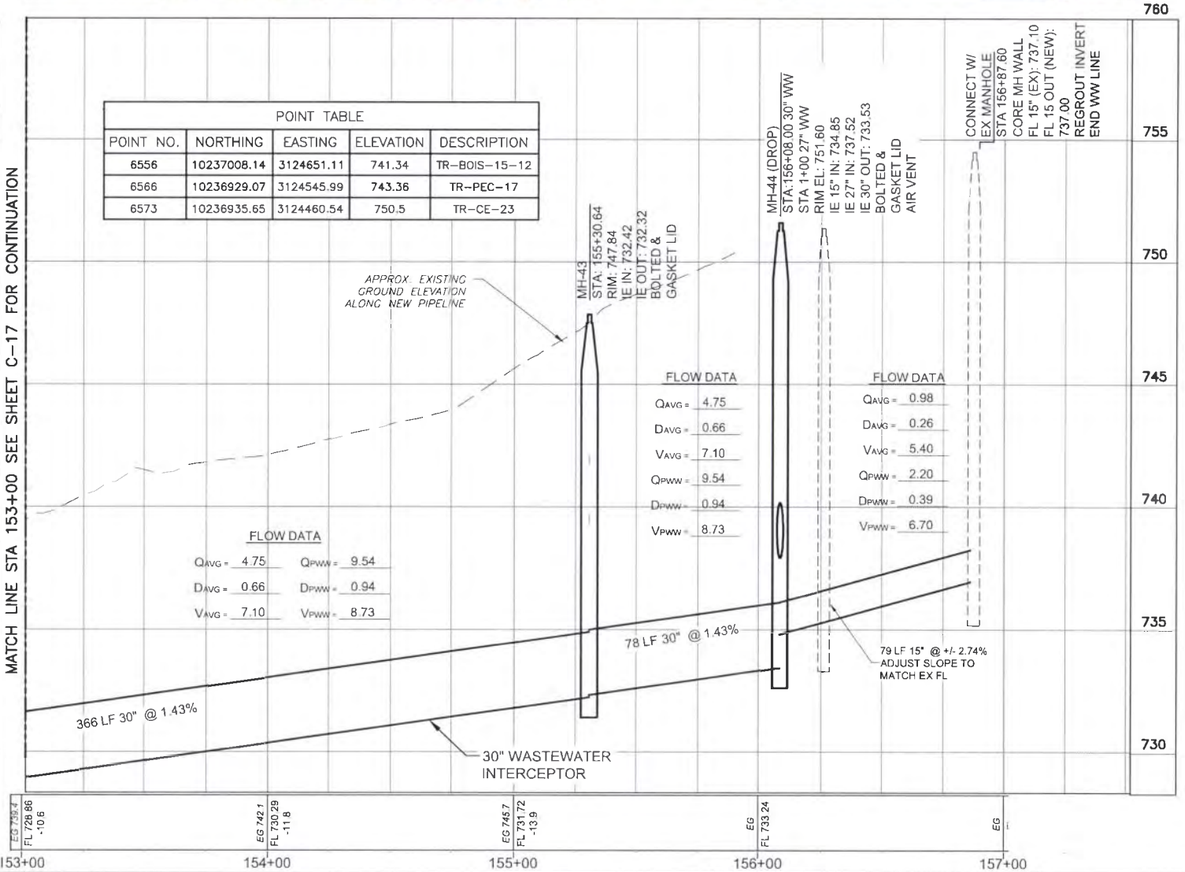


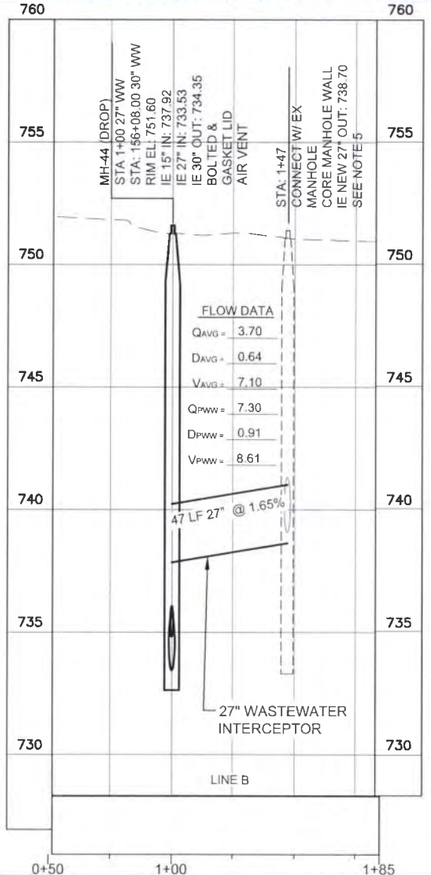
NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C–1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO REMOVE AND REPLACE EXISTING FENCE.
4. CONTRACTOR TO REMOVE AND REPLACE EXISTING MANHOLE WITH A 5' DIA MANHOLE.
5. FIELD VERIFY EXISTING MANHOLE LOCATION AND FLOW LINE. ADJUST PIPE SLOPE TO MATCH. PLUG OUTGOING PIPE WHEN NEW PIPE IS PLACED IN SERVICE.

SECTION WAS NOT INSTALLED
REFER TO ATTACHMENT C.1
SHEET C125 FOR PROPOSED
CONNECTION.

MATCH LINE STA 153+00 SEE SHEET C–17 FOR CONTINUATION

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
6556	10237008.14	3124651.11	741.34	TR–BOIS–15–12
6566	10236929.07	3124545.99	743.36	TR–PEC–17
6573	10236935.65	3124460.54	750.5	TR–CE–23





HORIZONTAL SCALE
1" = 30'
15 0 30
VERTICAL SCALE
1" = 3'
1.5 0 3

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED PROFESSIONAL ENGINEER
02/25/19

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

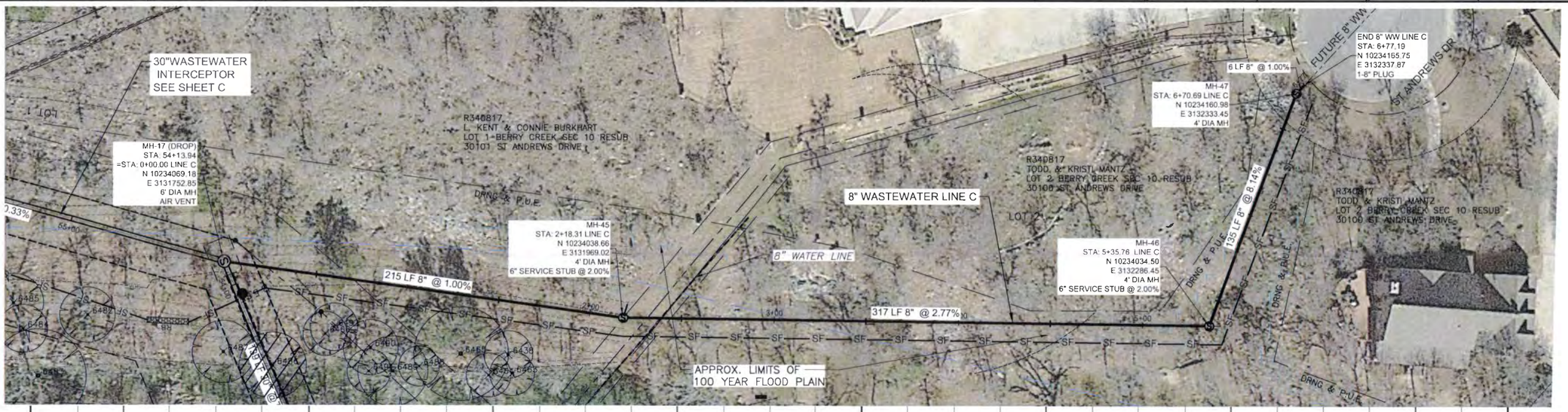
BERRY CREEK
WASTEWATER INTERCEPTOR

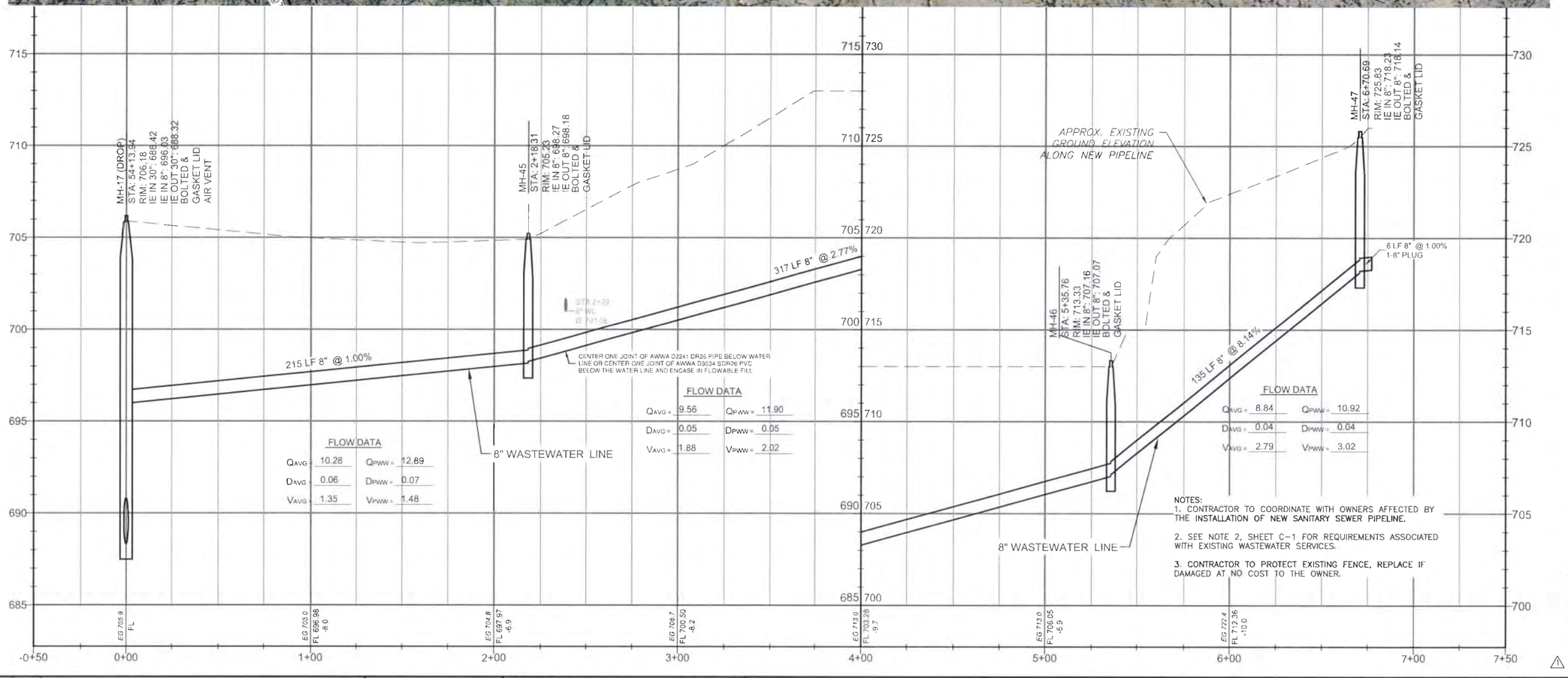
PLAN AND PROFILE
FROM STA 153+00 TO STA 156+87.60

PROJECT NO. 2048–109788
FILE NAME: C018PLPR.DWG
SHEET NO.
C-18

CONFORMED DRAWING

Plotted: 2/25/2019 11:14:02 AM





NOTES:
1. CONTRACTOR TO COORDINATE WITH OWNERS AFFECTED BY THE INSTALLATION OF NEW SANITARY SEWER PIPELINE.
2. SEE NOTE 2, SHEET C-1 FOR REQUIREMENTS ASSOCIATED WITH EXISTING WASTEWATER SERVICES.
3. CONTRACTOR TO PROTECT EXISTING FENCE, REPLACE IF DAMAGED AT NO COST TO THE OWNER.

HORIZONTAL SCALE
1" = 30'
15 0 30

VERTICAL SCALE
1" = 3'
1.5 0 3

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
11-14-2018

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/14/18	DWS	ADR	SHEET ADDED FOR ADDENDUM No. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

PLAN AND PROFILE LINE C
FROM STA 0+00 TO STA END

PROJECT NO. 2048-109788
FILE NAME: C0019PLPR.DWG

SHEET NO.
C-19

XREFs: [CDMS_2234, XC-BERRYCR, XC-BOUNDARY, XC-PR-BERRYCR, XC-AERIAL_1-50, W-SHADING, FLOOD PLAIN TXB3-CF, ADR-SEAL, CWP0047REE, CWP0019BH] Images: [X-LINE C-Aerial]
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POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	SPECIES & DIA
2246	10234754.13	3129228.54	715.49	TR-CE-18
2247	10234743.34	3129240.25	713.47	TR-CE-10
2248	10234774.33	3129257.06	728.08	TR-ELM-22-22
2249	10234777.16	3129243.60	727.45	TR-ELM-8
2250	10234772.31	3129253.72	725.69	TR-ELM-15
2251	10234781.99	3129240.85	727.28	TR-CE-8
2252	10234785.89	3129240.68	728.39	TR-HB-15
2253	10234795.81	3129233.90	734.16	TR-CE-10
2254	10234789.91	3129248.79	732.78	TR-HB-12
2255	10234801.26	3129251.19	742.64	TR-ELM-13
2256	10234804.29	3129241.66	742.64	TR-ELM-30
2257	10234684.41	3129170.23	715.79	TR-PEC-19
2258	10234692.50	3129184.75	712.34	TR-ELM-30
2259	10234684.06	3129194.33	713.60	TR-ELM-27
2260	10234613.04	3129115.73	717.58	TR-PEC-23
2261	10234573.83	3129107.73	719.28	TR-PEC-21
2262	10234483.71	3129105.54	724.49	TR-HB-14
2263	10234473.60	3129086.71	725.61	TR-PEC-25
2481	10231224.41	3133796.29	690.69	TR-PEC-28
2482	10231235.05	3133766.60	690.37	TR-PEC-16
2483	10231267.10	3133753.40	692.83	TR-PEC-26
2484	10231270.40	3133727.28	692.60	TR-PEC-18
2485	10231284.69	3133715.45	693.06	TR-ELM-28
2486	10231237.79	3133706.83	690.07	TR-PEC-16
2487	10231257.59	3133685.96	690.59	TR-PEC-25
2488	10231272.22	3133664.61	691.24	TR-PEC-28
2489	10231297.97	3133662.24	692.34	TR-PEC-16
2490	10231317.36	3133639.34	692.71	TR-PEC-20
2491	10231330.19	3133635.59	693.52	TR-PEC-20
2492	10231324.71	3133604.61	691.80	TR-PEC-15
2493	10231356.92	3133598.07	693.74	TR-PEC-24
2494	10231328.48	3133559.39	690.81	TR-PEC-21
2495	10231356.64	3133578.15	692.90	TR-PEC-24
2496	10231349.41	3133562.65	692.06	TR-PEC-15
2497	10231374.75	3133558.56	693.41	TR-PEC-17
2498	10231403.63	3133519.34	693.47	TR-PEC-16
2499	10231394.25	3133508.06	692.97	TR-BURR-30
2500	10231370.16	3133500.36	690.54	TR-PEC-15
2501	10231386.21	3133484.27	691.27	TR-PEC-16
2502	10231401.80	3133493.48	691.91	TR-PEC-13
2503	10231418.43	3133490.02	692.79	TR-PEC-16
2504	10231431.51	3133459.34	692.16	TR-PEC-21
2505	10231416.69	3133441.55	691.16	TR-PEC-22-13
2506	10231215.29	3133812.03	690.51	TR-PEC-19
2507	10231196.16	3133797.99	690.21	TR-PEC-17
2508	10231199.36	3133863.94	690.68	TR-PEC-30
2509	10231146.09	3133971.32	689.53	TR-PEC-27
2510	10231538.80	3133322.81	692.43	TR-CE-8-8
2511	10231527.76	3133333.41	692.43	TR-CE-11
2512	10231541.22	3133351.96	693.37	TR-CE-8
2513	10231525.45	3133361.42	693.37	TR-PEC-10
2514	10231580.07	3133330.74	694.60	TR-CE-8
2515	10231547.74	3133368.90	694.60	TR-PEC-9
2516	10231534.60	3133385.28	694.62	TR-CE-12
2517	10231070.19	3134675.13	688.77	TR-PEC-26
2518	10231070.61	3134642.54	689.16	TR-PEC-32
2519	10231093.56	3134482.75	692.39	TR-PEC-27
2520	10231081.43	3134446.43	690.18	TR-PEC-32
2521	10231105.95	3134353.58	692.01	TR-PEC-35
2522	10231431.23	3133427.75	691.46	TR-PEC-24
2523	10231105.00	3134309.71	691.25	TR-PEC-18
2524	10231122.28	3134267.10	692.58	TR-PEC-15
2525	10231111.55	3134268.02	690.66	TR-PEC-17
2526	10231100.44	3134242.89	688.58	TR-PEC-26-18
2527	10231110.24	3134175.21	689.27	TR-PEC-22-14
2528	10231136.78	3134188.20	691.44	TR-PEC-18
2529	10231137.00	3134159.36	690.64	TR-PEC-25
2530	10231140.89	3134145.38	690.56	TR-PEC-14
2531	10231110.58	3134127.73	688.53	TR-PEC-17
2532	10231131.48	3134119.19	690.34	TR-PEC-19
2533	10231153.28	3134118.54	691.85	TR-PEC-19
2534	10231158.42	3134069.74	691.75	TR-PEC-44
2535	10231165.50	3133996.21	690.95	TR-PEC-18

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	SPECIES & DIA
2536	10231132.27	3134254.66	693.80	TR-PEC-28
2538	10231488.61	3133418.01	694.38	TR-CB-22
2539	10231609.28	3133304.58	694.46	TR-PEC-10
2569	10231626.28	3133325.62	695.72	TR-CE-14-7
2570	10231660.97	3133289.30	696.46	TR-WIL-16-15-12
2571	10231652.12	3133274.99	695.27	TR-PEC-16
2572	10231644.17	3133251.51	693.41	TR-PEC-13
2573	10231626.49	3133267.04	693.37	TR-LO-11
2574	10231612.67	3133256.45	691.91	TR-PEC-12
2575	10231631.39	3133241.98	692.10	TR-PEC-16
2580	10237588.92	3125777.62	734.89	TR-CE-14
2581	10231568.80	3133308.27	693.58	TR-BURR-32
2582	10237582.46	3125802.76	733.29	TR-BURR-42
5671	10237350.04	3125974.47	730.28	TR-PEC-29
5672	10237348.93	3125958.91	731.83	TR-PEC-13
5673	10237288.03	3126030.06	729.86	TR-CE-18
5674	10237273.60	3126048.76	729.80	TR-BURR-36
5675	10237256.88	3125998.86	731.88	TR-BOIS-14
5676	10237254.21	3126005.58	731.82	TR-ASH-12-10
5677	10237245.54	3126000.78	732.22	TR-ASH-19
5678	10237245.51	3126014.14	731.87	TR-PEC-13-8
5679	10237231.91	3126057.80	728.54	TR-ASH-18-12-10
5680	10237285.89	3125981.67	729.26	TR-ASH-16-8
5681	10237268.58	3125965.99	732.13	TR-PEC-29
5682	10237205.59	3125980.06	733.17	TR-PEC-13
5683	10237177.52	3126045.93	732.54	TR-PEC-36
5684	10236971.18	3126173.91	734.05	TR-PEC-19-11-11-6
5685	10236920.64	3126214.09	734.34	TR-CE-25
5686	10236964.95	3126307.14	732.35	TR-PO-40
5687	10236847.04	3126280.65	734.15	TR-PEC-13
5688	10236848.89	3126269.32	734.57	TR-PEC-13-12-7
5689	10236816.47	3126297.00	733.73	TR-PEC-12-12
5690	10236824.83	3126308.73	734.23	TR-PEC-16
5691	10236839.22	3126300.71	734.21	TR-PEC-17
5692	10236839.44	3126313.17	733.68	TR-PEC-15
5693	10236849.56	3126303.82	734.00	TR-PEC-12
5694	10236852.93	3126297.98	734.07	TR-PEC-14
5695	10236795.21	3126350.44	732.99	TR-PEC-14
5696	10237325.38	3125963.39	734.21	TR-PEC-12
5697	10237316.42	3125995.52	731.97	TR-ELM-19
5698	10237271.79	3125933.55	732.38	TR-PEC-14
5699	10237403.05	3125960.19	727.83	TR-PEC-12
5700	10237465.73	3125752.25	734.68	TR-PEC-12
5701	10237458.68	3125730.32	734.76	TR-CE-23
5702	10237354.51	3125761.96	734.75	TR-PEC-12
5703	10237399.84	3125786.70	734.36	TR-PEC-16-7
5704	10237401.97	3125793.13	734.43	TR-CE-15
5705	10237397.02	3125798.04	734.60	TR-CE-12
5706	10237395.96	3125816.33	734.66	TR-CE-13
5707	10237422.14	3125797.45	735.27	TR-PEC-16
5708	10237427.89	3125804.25	735.62	TR-PEC-13
5709	10237456.14	3125826.95	733.89	TR-HB-14
5710	10237400.46	3125864.00	735.84	TR-CE-13
5711	10237388.45	3125855.11	735.13	TR-CE-14
5712	10236760.25	3126354.99	733.10	TR-CE-25
5713	10237383.96	3125854.18	734.83	TR-CE-12
5714	10237356.39	3125903.29	734.60	TR-BOIS-12
5715	10237357.59	3125884.17	734.36	TR-PEC-12
5716	10237361.68	3125868.69	734.08	TR-CE-12
5717	10237362.27	3125853.51	733.19	TR-PEC-19
5718	10237323.13	3125877.19	732.09	TR-PEC-13
5719	10237308.31	3125921.79	731.92	TR-PEC-15-14-12
5720	10237323.05	3125895.87	731.24	TR-PEC-14-13
5721	10237342.62	3125934.79	734.41	TR-PEC-12
5722	10237359.33	3125934.97	733.15	TR-PEC-16
5723	10237362.98	3125948.01	730.87	TR-CE-21
5724	10237378.43	3125938.82	730.08	TR-PEC-12
5725	10237389.77	3125934.17	729.84	TR-PEC-16
5726	10237383.90	3125878.12	735.55	TR-CE-14
5727	10237448.63	3125772.04	735.48	TR-PEC-12
5728	10236785.60	3126397.39	733.12	TR-PEC-16-12
5729	10236771.57	3126462.87	733.05	TR-PEC-13
5730	10235156.51	3126777.07	731.48	TR-CE-29

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	SPECIES & DIA
5731	10235118.58	3126793.22	733.31	TR-PO-27
5732	10235107.26	3126795.73	733.50	TR-PO-27
5733	10234620.95	3126753.72	732.17	TR-BURR-43
5734	10234825.65	3126733.61	729.53	TR-PEC-21
5735	10234919.61	3126774.43	734.02	TR-PEC-21
5736	10234940.80	3126744.60	731.79	TR-PEC-19
5737	10234948.42	3126773.31	734.12	TR-PO-27
5738	10234767.97	3126788.91	731.22	TR-PO-37
5739	10234726.88	3126804.29	729.63	TR-PO-30
5740	10234695.48	3126977.24	728.44	TR-PEC-16
5741	10234706.18	3126988.24	728.48	TR-PEC-12
5742	10234694.88	3127027.36	730.80	TR-PEC-15
5743	10234577.11	3127406.85	726.58	TR-PEC-18
5744	10234541.93	3127501.07	725.52	TR-PEC-19
5745	10234528.46	3127520.75	725.59	TR-PEC-18
5746	10234628.35	3127552.86	718.94	TR-PEC-17
5747	10234569.71	3127553.00	719.16	TR-PEC-20
5748	10234608.29	3127569.59	721.53	TR-PEC-20
5749	10234604.15	3127572.25	721.56	TR-PEC-13
5750	10234624.55	3127581.47	718.56	TR-PEC-14
5751	10234611.11	3127608.41	718.57	TR-PEC-14
5752	10234600.64	3127613.24	719.56	TR-PEC-17-15
5753	10234595.16	3127619.53	720.02	TR-PEC-12
5754	10234590.41	3127634.54	720.07	TR-PEC-12
5755	10235177.04	3126772.06	731.24	TR-BURR-29
5756	10235246.55	3126803.81	731.78	TR-CE-19
5757	10235242.99	3126780.83	730.71	TR-PEC-21
5758	10235411.73	3126817.95	731.58	TR-PEC-35
5759	10236757.88	3126459.18	732.70	TR-PEC-18
5760	10236761.24	3126455.55	732.53	TR-PEC-12
5761	10236725.74	3126363.25	733.41	TR-PEC-13
5762	10236729.19	3126368.10	733.10	TR-HB-12
5763	10236746.17	3126390.95	733.25	TR-PEC-13
5764	10236543.84	3126595.17	731.96	TR-PEC-23
5765	10236706.06	3126525.87	732.90	TR-PEC-17
5766	10236702.80	3126514.08	733.90	TR-CE-14
5767	10236719.81	3126486.65	733.77	TR-PEC-35
5768	10236671.61	3126454.48	732.03	TR-CE-19
5769	10236670.80	3126488.97	731.98	TR-ASH-12-12-8
5770	10236690.39	3126534.96	731.99	TR-ELM-14
5771	10236813.21	3126454.98	730.34	TR-BOIS-14
5772	10236687.48	3126535.67	731.99	TR-PEC-12
5773	10236678.92	3126548.41	730.31	TR-CE-12-10
5774	10236560.64	3126525.93	731.77	TR-PEC-30
5775	10236486.93	3126618.86	730.91	TR-PO-35
5776	10236457.24	3126665.77	725.83	TR-PO-42
5777	10236438.36	3126631.91	728.75	TR-PEC-15
5778	10236375.10	3126656.38	726.81	TR-PEC-19
5779	10236259.72	3126598.69	733.86	TR-PEC-14
5780	10236277.92	3126598.62	733.80	TR-PEC-19
5781	10236382.48	3126676.42	726.33	TR-CE-31
5782	10235075.39	3126783.32	733.07	TR-PEC-21
5783	10235129.48	3126728.65	729.38	TR-BURR-26
5784	10235146.21	3126745.96	729.18	TR-CE-19
5785	10236683.46	3126546.75	729.68	TR-PEC-14
5786	10234547.92	3127665.56	720.67	TR-SYC-20
5787	10237441.84	3125788.83	735.79	TR-PEC-12
5788	10237412.34	3125769.73	734.54	TR-CE-12
5789	10233805.70	3132379.03	702.40	TR-PEC-35
5790	10233814.55	3132370.56	702.54	TR-PEC-17
5791	10233588.76	3132518.09	704.99	TR-SHIN-14
5792	10233570.60	3132524.61	700.60	TR-CB-15-15
5793	10233530.94	3132671.42	697.50	TR-ASH-14
5794	10233523.48	3132610.09	702.87	TR-CE-17
5795	10233527.76	3132625.24	702.22	TR-CE-14
5796	10233513.12	3132624.61	702.51	TR-CE-14
5797	10233501.54	3132637.14	702.15	TR-CE-12
5798	10233510.03	3132639.02	702.02	TR-PEC-17
5799	10233474.00	3132647.13	702.48	TR-BURR-41
5800	10233453.07	3132710.50	699.20	TR-HB-18
5801	10233449.22	3132741.08	696.66	TR-SYC-15
5802	10233413.80	3132769.27	696.60	TR-SYC-12
5803	10233398.67	3132767.22	697.28	TR-SYC-11

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	SPECIES & DIA
5804	10233399.38	3132787.42	696.42	TR-SYC-12
5805	10233314.81	3132735.05	701.99	TR-CE-15
5806	10233298.89	3132763.92	699.32	TR-ASH-26
5807	10233325.87	3132796.30	697.50	TR-SYC-19
5808	10233272.50	3132800.11	697.02	TR-SYC-12
5809	10232908.57	3132899.08	695.09	TR-SYC-12
5810	10232913.58	3132859.85	695.09	TR-SYC-16
5811	10237167.21	3125038.75	733.09	TR-PEC-17
5812	10237163.55	3125051.64	734.06	TR-BOIS-18
5813	10237210.09	3125093.11	734.47	TR-BOIS-16
5814	10233825.86	3132408.99	698.10	TR-SYC-18
5815	10233815.55	3132428.46	698.59	TR-SYC-22
5816	10233805.50	3132406.10	700.89	TR-PEC-25
5817	10233811.28	3132401.54	701.34	TR-PEC-16-15-15
5818	10233855.96	3132196.17	702.46	TR-CE-15
5819	10233884.75	3132173.71	702.48	TR-PEC-13
5820	10233868.89	3132164.62	702.05	TR-PEC-13
5821	10233841.45	3132164.16	704.17	TR-CE-17
5822	10233858.35	3132149.56	703.09	TR-CE-14
5823	10233874.30	3132145.99	702.51	TR-PEC-21
5824	10233894.59	3132184.53	699.73	TR-PEC-19
5825	10233899.70	3132160.85	700.52	TR-ELM-17
5826	10233903.15	3132144.54	699.61	TR-PEC-12
5827	10233877.45	3132114.29	702.94	TR-PEC-18
5828	10233875.83	3132100.80	703.39	TR-PEC-19
5829	10233918.74	3132093.28	699.91	TR-ASH-12
5830	10237208.38	3125084.32	733.22	TR-ASH-13
5831	10233920.57	3132085.87	700.15	TR-PEC-15
5832	10233887.48	3132077.71	702.90	TR-PEC-19
5833	10233907.69	3132063.29	702.88	TR-CE-16
5834	10233912.72	3132070.64	701.19	TR-PEC-18
5835	10233927.35	3132068.81	698.98	TR-PEC-12
5836	10233929.34	3132055.99	698.94	TR-ASH-14
5837	10233913.64	3132046.62	701.77	TR-PEC-15
5838	10233935.10	3132006.90	700.30	TR-SYC-23-22
5839	10233939.61	3131980.18	700.63	TR-ELM-17
5840	10233944.55	3131946.89	699.23	TR-ASH-27
5841	10233645.60	3132546.19	703.14	TR-CE-19
5842	10233689.20	3132494.99	700.95	TR-CE-15
5843	10233690.90	3132492.72	700.72	TR-CE-16
5844	10233903.94	3132090.97	701.69	TR-PEC-13
5845	10237423.23	3125779.43	734.96	TR-PEC-14-10-10
5846	10237206.86	3125080.16	732.63	TR-CE-12
5847	10237192.52	3125190.34	743.35	TR-CED-12-8
5848	10237362.71	3125440.45	737.56	TR-PEC-12-11
5849	10237357.21	3125453.05	737.70	TR-PEC-12
5850	10237373.88	3125464.12	737.01	TR-PEC-14-9-8
5851	10237434.12	3125485.20	735.21	TR-PEC-12-8
5852	10237431.14	3125489.85	735.35	TR-PEC-12-6
5853	10237426.96	3125492.76	734.81	TR-PEC-12
5854	10237416.09	3125483.84	735.17	TR-PEC-20
5855	10237400.78	3125521.29	735.76	TR-CE-13
5856	10237430.92	3125512.65	735.10	TR-PEC-12
5857	10237430.01	3125507.12	735.05	TR-PEC-15
5858	10237476.03	3125488.10	728.48	TR-SYC-21
5859	10237488.17	3125521.71	728.68	TR-SYC-31
5860	10237453.48	3125522.09	734.21	TR-PEC-12
5861	10237438.57	3125529.94	735.36	TR-PEC-12
5862	10237405.36	3125549.67	735.57	TR-PEC-13
5863	10237420.54	3125597.24	735.26	TR-PEC-37
5864	10237446.12	3125570.00	735.69	TR-HB-13
5865	10237466.59	3125602.81	734.43	TR-PEC-41
5866	10237466.26	3125554.28	732.65	TR-PEC-38
5867	10237454.89	3125647.65	733.86	TR-PEC-36
5868	10237411.75	3125646.18	734.73	TR-PEC-45
5869	10237495.25	3125665.72	730.93	TR-ASH-22
5870	10237507.99	3125714.43	728.63	TR-SYC-13
5871	10237475.11	3125775.00	733.99	TR-CE-25
5872	10237460.46	3125789.83	734.66	TR-PEC-19
5873	10237373.02	3125445.95	737.04	TR-PEC-12
5874	10237385.08	3125424.12	735.95	TR-PEC-12
5875	10237440.21	3125411.70	729.70	TR-SYC-14
5876	10237459.82	3125454.45	728.97	TR-SYC-18

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	SPECIES & DIA
5877	10237197.21	3125180.63	742.12	TR-CED-15
5878	10237181.63	3125177.26	744.05	TR-CED-16
5879	10237213.54	3125135.33	737.84	TR-BOIS-16
5880	10237233.39	3125210.26	740.25	TR-CED-12
5881	10237229.20	3125201.92	740.14	TR-CED-14
5882	10237220.33	3125214.27	743.26	TR-CED-13
5883	10237306.55	3125236.50	734.55	TR-BOIS-12-5
5884	10237274.38	3125252.92	738.71	TR-PEC-12-9-8
5885	10237348.18	3125240.01	731.30	TR-SYC-18
5886	10237273.50	3125295.78	740.79	TR-CED-19
5887	10237341.77	3125298.93	734.73	TR-PEC-13-7
5888	10237338.80	3125296.53	734.97	TR-CE-12
5889	10237190.68	3125132.14	739.20	TR-CED-14
5890	10237327.95	3125292.77	735.72	TR-CE-13
5891	10237309.14	3125327.47	739.05	TR-PEC-15-11
5892	10237310.08	3125356.47	739.79	TR-PEC-14
5893	10237403.16	3125331.11	730.42	TR-SYC-13
5894	10237361.24	3125339.71	734.91	TR-CE-12
5895	10237351.03	3125345.75	736.06	TR-CE-13
5896	10237364.95	3125369.40	736.22	TR-HB-12
5897	10237338.76	3125392.50	738.69	TR-HB-16-9-7
5898	10237349.60	3125383.03	736.83	TR-HB-12
5899	10237363.46	3125386.81	736.13	TR-HB-12
5900	10237360.78	3125409.62	737.05	TR-CE-16
5901	10237375.00	3125401.15	736.26	TR-PEC-13
5902	10237401.20	3125406.12	735.05	TR-PEC-37
5903	10237313.53	3125328.98	738.26	TR-PEC-14
5904	10233887.13	3132214.00	700.17	TR-PEC-18
5905	10234562.52	3127686.15	719.88	TR-PEC-17
5906	10234621.84	3127700.65	721.71	TR-PEC-14-12-11-9-9
5907	10231490.29	3133259.20	687.39	TR-PEC-18-10
5908	10231500.53	3133261.04	688.65	TR-SYC-28
5909	10231527.56	3133251.29	688.69	TR-PEC-13
5910	10231556.37	3133279.09	690.45	TR-PEC-15
5911	10231542.09	3133288.16	690.33	TR-PEC-13
5912	10231524.40	3133308.29	690.49	TR-PEC-23
5913	10231403.91	3133372.32	687.77	TR-PEC-16
5914	10231389.51	3133381.16	687.37	TR-PEC-10
5915	10231380.85	3133402.17	688.22	TR-PEC-27
5916	10231377.53	3133407.52	688.47	TR-BE-15
5917	10231344.16	3133424.02	686.80	TR-CE-11
5918	10231338.72	3133436.22	687.70	TR-PEC-21-17
5919	10231309.70	3133473.16	687.28	TR-ELM-18
5920	10231350.67	3133496.98	690.11	TR-PEC-18
5921	10231338.30	3133509.00	690.11	TR-PEC-20-16
5922	10231324.64	3133539.21	690.19	TR-PEC-25
5923	10231275.75	3133534.26	688.03	TR-PEC-12
5924	10231244.56	3133574.70	686.68	TR-PEC-12
5925	10231306.03	3133569.80	690.30	TR-PEC-27
5926	10231257.36	3133600.39	689.55	TR-PEC-18
5927	10231239.26	3133609.49	688.81	TR-PEC-8
5928	10231242.92	3133607.45	688.99	TR-PEC-9
5929	10231263.86	3133645.56	690.23	TR-PEC-21
5930	10231226.95	3133622.16	688.77	TR-PEC-34-22
5931	10231199.98	3133667.02	689.80	TR-CB-10-9
5932	10231471.74	3133268.40	686.49	TR-SYC-21-21
5933	10231481.86	3133284.91	688.06	TR-SYC-17
5934	10231463.04	3133308.23	688.00	TR-PEC-12
5935	10231452.24	3133309.56	688.28	TR-SYC-33
5936	10231889.03	3133143.64	691.42	TR-SYC-12
5937	10231871.69	3133150.74	691.27	TR-PEC-19
5938	10231863.98	3133154.27	692.07	TR-ELM-29
5939	10231870.61	3133139.17	687.78	TR-SYC-19
5940	10231854.03	3133137.54	687.47	TR-SYC-19
5941	10231920.88	3133193.34	695.02	TR-CE-18
5942	10231902.31	3133190.32	694.95	TR-CE-13
5943	10231867.85	3133180.86	694.25	TR-PEC-15
5944	10231881.76	3133196.33	695.44	TR-CE-14
5945	10231880.76	3133216.95	697.58	TR-PEC-18
5946	10231850.54	3133202.59	695.71	TR-PEC-17
5947	10231845.69	3133209.06	696.43	TR-PEC-20-20
5948	10231211.12	3133655.95	689.60	TR-PEC-19-15
5949	10231631.52	3133064.89	691.95	TR-PO-16

REV. NO.	DATE	DRWN	CHKD	REMARKS
2	2/13/18	ECD	ADR	CONFORMED DRAWING

DESIGNED BY: D. HURTADO
DRAWN BY: E. DOAK
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

TREE POINT TABLES I

PROJECT NO. 2048-109788
FILE NAME: CT01TBTR.DWG

SHEET NO.
CT-1

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
12-13-2018

XREFs: [CDMS_2234, XC-BERRYCR, XC-BOUNDARY, XC-PR-BERRYCR, XC-AERIAL_1-50, W-SHADING, FLOOD PLAIN TXBJ-CF, CWP004TREE, ADR-SEA, CWPG01BH] Images: []
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POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	SPECIES & DIA
5950	10231702.49	3133200.25	691.56	TR-PEC-16
5951	10231709.47	3133215.47	693.09	TR-PEC-19
5952	10231713.64	3133232.36	695.55	TR-ELM-32
5953	10231631.55	3133228.36	690.52	TR-CB-16
5954	10231575.20	3133182.85	686.02	TR-SYC-15
5955	10231564.12	3133187.97	686.51	TR-SYC-13
5956	10231555.09	3133185.75	685.78	TR-SYC-17
5957	10231538.12	3133196.65	686.45	TR-SYC-9
5958	10231563.90	3133199.28	686.97	TR-SYC-19
5959	10231550.70	3133220.22	688.23	TR-PEC-14
5960	10231544.88	3133224.86	688.26	TR-SYC-23
5961	10231541.41	3133227.89	688.47	TR-SYC-22
5962	10231651.50	3133053.13	692.42	TR-PO-19
5963	10231895.50	3133138.50	690.74	TR-SYC-12
5964	10231187.55	3133690.59	689.50	TR-PEC-18-9-7
5965	10231201.11	3133743.74	690.35	TR-PEC-28
5966	10233985.98	3131045.63	709.43	TR-PEC-18
5967	10234007.06	3131158.23	707.96	TR-PEC-21
5968	10234005.06	3131151.77	708.03	TR-PEC-16
5969	10234004.14	3131134.05	707.88	TR-PEC-16
5970	10233983.26	3131121.93	707.92	TR-PEC-18
5971	10233994.31	3131109.50	708.81	TR-PEC-16
5972	10234064.69	3131320.53	709.40	TR-PEC-17
5973	10234085.08	3131354.05	706.30	TR-CE-14
5974	10234073.63	3131360.80	707.88	TR-ELM-23
5975	10233982.89	3131006.81	710.27	TR-PEC-12
5976	10233976.81	3131015.60	714.54	TR-PEC-21
5978	10233975.18	3130958.59	710.69	TR-PEC-21
5979	10233970.99	3130925.87	710.79	TR-PEC-18
5980	10233978.15	3130916.03	711.39	TR-PEC-13
5981	10233984.61	3130736.10	713.09	TR-PEC-14-13
5982	10233971.83	3130716.25	712.89	TR-PEC-25
5983	10233976.86	3130675.44	713.12	TR-PEC-20-13
5984	10233982.57	3130688.17	712.99	TR-PEC-12
5985	10234014.90	3130529.97	715.19	TR-PO-9-8-7-6
5986	10234018.32	3130519.53	715.63	TR-PO-11-10
5987	10234039.27	3130523.18	714.77	TR-PEC-13-9-7
5988	10234072.84	3130479.85	716.01	TR-CE-11-11
5989	10234029.75	3130427.26	714.70	TR-PEC-12
5990	10234030.47	3130420.57	715.04	TR-PEC-14
5991	10233978.31	3131044.95	709.08	TR-PEC-26
5992	10231039.52	3134550.66	687.46	TR-PEC-30
5993	10231023.03	3134584.10	686.75	TR-PEC-29
5994	10231035.04	3134475.74	687.93	TR-PEC-28
5995	10231173.30	3133736.32	690.49	TR-PEC-20
5996	10231170.75	3133734.10	690.41	TR-CB-12-10
5997	10231165.70	3133733.54	689.89	TR-PEC-20
5998	10231154.86	3133742.18	688.80	TR-PEC-10
5999	10231148.99	3133761.94	689.52	TR-CB-8
6000	10231136.51	3133761.46	687.58	TR-CE-16
6001	10231122.70	3133786.89	687.60	TR-PEC-8
6002	10231135.52	3133807.28	690.14	TR-PEC-24-22
6003	10231124.68	3133803.19	689.36	TR-CE-20
6004	10231107.59	3133819.14	687.85	TR-PEC-12
6005	10231098.71	3133847.79	689.15	TR-CE-15
6006	10231088.13	3133850.68	687.26	TR-CE-14
6007	10231189.17	3133693.46	690.19	TR-CE-15
6008	10231096.32	3134118.80	688.05	TR-PEC-22-12
6009	10231061.35	3133958.72	687.36	TR-ASH-15
6010	10231082.89	3134029.22	689.19	TR-PEC-28
6011	10231066.02	3134086.89	688.94	TR-PEC-20
6012	10231055.91	3134113.77	688.45	TR-PEC-24
6013	10231033.65	3134174.07	686.86	TR-BE-10
6014	10231051.15	3134154.18	688.37	TR-PEC-20-20-18
6015	10231085.52	3134172.60	688.31	TR-PEC-19
6016	10231081.98	3134183.67	687.95	TR-PEC-22
6017	10231049.87	3134192.56	688.09	TR-PEC-28
6018	10231079.85	3134297.10	687.93	TR-PEC-30
6019	10231021.09	3134291.20	685.91	TR-ASH-16-14
6020	10230998.93	3134345.03	684.06	TR-SYC-26-24
6021	10231064.04	3133933.25	687.92	TR-ASH-16
6022	10234615.95	3127673.87	720.08	TR-PEC-22
6023	10231907.73	3133141.71	687.94	TR-SYC-14

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	SPECIES & DIA
6024	10231823.29	3133010.63	692.85	TR-CE-9-9
6025	10234686.85	3127979.72	721.19	TR-PO-21
6026	10234690.19	3127992.20	721.29	TR-PO-36
6027	10234682.30	3127999.78	720.64	TR-PO-21
6028	10234685.88	3128018.66	720.84	TR-PO-20
6029	10234703.52	3128028.98	721.43	TR-PO-21
6030	10234684.88	3128036.97	720.29	TR-PO-20
6031	10234700.84	3128061.29	721.27	TR-PO-27
6032	10234766.95	3128036.18	725.23	TR-PO-26
6033	10234699.45	3128084.96	720.81	TR-PEC-19
6034	10234706.04	3128100.96	721.20	TR-PEC-26-26
6035	10234709.19	3128134.98	720.93	TR-PEC-25
6036	10234721.73	3128129.11	720.94	TR-PEC-19
6037	10234726.73	3128133.15	720.86	TR-PEC-15-14
6038	10234720.71	3128152.73	720.95	TR-PEC-14
6039	10234736.10	3128170.53	722.11	TR-PEC-19
6040	10234732.78	3128180.22	721.97	TR-PEC-21
6041	10234732.14	3128203.61	721.14	TR-PEC-21
6042	10234730.25	3128293.99	718.27	TR-PEC-40
6043	10234819.39	3128580.07	714.70	TR-SYC-13
6044	10234847.07	3128552.38	721.17	TR-PEC-13
6045	10234846.48	3128535.11	721.95	TR-PEC-13
6046	10234842.22	3128522.39	721.66	TR-PEC-15
6047	10234842.41	3128492.75	720.25	TR-PEC-27
6048	10234865.64	3128486.56	720.11	TR-PEC-15
6049	10234866.90	3128492.60	720.31	TR-PEC-12
6050	10234749.12	3128003.56	723.90	TR-PEC-12
6051	10234754.96	3127990.53	725.34	TR-PEC-18
6052	10234758.15	3127950.43	726.73	TR-PEC-21
6053	10234747.23	3127910.52	725.58	TR-PEC-21
6054	10234630.28	3127700.01	721.88	TR-PEC-17
6055	10234639.49	3127687.00	721.95	TR-PEC-17
6056	10234653.01	3127685.02	722.95	TR-PEC-19
6057	10234666.56	3127681.64	723.24	TR-PEC-13
6058	10234633.75	3127628.13	720.16	TR-PEC-18
6059	10234648.49	3127622.57	721.49	TR-PEC-17
6060	10234648.36	3127612.51	721.14	TR-PEC-20
6061	10234668.91	3127634.96	723.20	TR-PEC-23
6062	10234670.82	3127630.13	722.81	TR-PEC-14
6063	10234673.32	3127612.49	722.89	TR-PEC-22
6064	10234654.43	3127728.05	722.57	TR-PEC-21
6065	10234697.94	3127743.90	725.10	TR-PEC-19
6066	10234888.60	3128441.05	715.72	TR-ASH-12
6067	10234700.61	3127720.75	725.60	TR-PEC-13
6068	10234690.85	3127690.25	724.89	TR-PEC-15
6069	10234659.94	3127700.28	723.08	TR-PEC-17
6070	10234628.85	3127716.08	721.76	TR-PEC-14
6071	10234603.18	3127735.38	719.39	TR-PEC-24
6072	10234610.57	3127764.72	719.34	TR-ASH-15
6073	10234629.01	3127739.19	722.12	TR-PEC-24
6074	10234736.34	3127834.12	726.21	TR-PEC-18
6075	10234661.85	3127882.26	720.98	TR-PEC-18
6076	10234676.19	3127868.68	722.11	TR-PEC-21
6077	10234663.92	3127849.93	721.77	TR-PEC-25
6078	10234689.21	3127947.32	721.98	TR-PEC-13
6079	10234670.31	3127908.73	720.74	TR-PEC-52
6080	10234693.76	3127699.43	725.01	TR-PEC-19
6081	10231930.05	3133137.14	688.74	TR-SYC-12
6082	10234870.58	3128427.98	716.12	TR-PEC-13
6083	10234882.09	3128375.74	719.56	TR-PEC-12-9
6084	10232479.90	3132943.34	692.19	TR-CW-15
6085	10232469.35	3132957.81	692.19	TR-ASH-10
6086	10232437.51	3132973.86	692.24	TR-CW-20
6087	10232113.35	3133028.90	690.86	TR-ASH-10-10
6088	10232100.14	3133017.10	703.52	TR-HB-10
6089	10232059.19	3133044.88	689.85	TR-WIL-9-8-7-5
6090	10231952.10	3132988.76	694.11	TR-CE-12-10
6091	10231920.50	3133032.78	691.14	TR-CE-9-9
6092	10231952.43	3132993.61	693.71	TR-PO-18-15
6093	10231913.30	3133047.11	690.05	TR-CE-10
6094	10231957.22	3133008.25	692.43	TR-CB-12
6095	10231937.02	3133048.72	689.95	TR-PEC-21
6096	10231955.97	3133057.16	688.88	TR-SYC-11

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	SPECIES & DIA
6097	10231904.29	3133007.54	692.49	TR-CE-18
6098	10231862.05	3132995.98	693.04	TR-CE-9
6099	10231873.99	3132993.93	693.25	TR-PEC-8
6100	10231883.45	3133007.41	692.66	TR-CE-12
6101	10231901.61	3133040.49	690.80	TR-CE-11
6102	10231867.73	3133048.44	689.86	TR-PEC-17
6103	10231856.47	3133001.41	692.83	TR-CE-9
6104	10231836.35	3132998.92	693.30	TR-ORN
6105	10231788.18	3133012.11	693.12	TR-PEC-21
6106	10231857.61	3133057.45	689.16	TR-CE-11
6107	10231852.79	3133052.60	689.31	TR-CE-12-9
6108	10231840.93	3133004.85	693.34	TR-PO-14
6109	10232387.67	3132917.13	697.64	TR-BOIS-9
6110	10232391.92	3132914.89	696.92	TR-HB-9
6111	10232431.23	3132903.72	699.47	TR-CB-19-16
6112	10232409.15	3132913.51	697.75	TR-HB-10
6113	10234901.05	3128379.08	719.78	TR-PEC-16
6114	10234861.62	3128387.20	721.58	TR-PEC-17
6115	10234844.12	3128419.51	719.47	TR-PEC-33
6116	10234830.03	3128447.19	716.79	TR-PEC-15
6117	10234825.06	3128407.97	720.11	TR-PEC-16-10
6118	10234816.35	3128399.87	720.23	TR-PEC-14
6119	10234831.90	3128377.17	721.22	TR-PEC-17
6120	10234830.14	3128362.57	719.91	TR-PEC-22-19
6121	10234784.64	3128397.42	719.76	TR-PEC-18
6122	10234759.55	3128525.93	716.75	TR-ASH-12
6123	10234796.72	3128577.40	715.03	TR-SYC-24
6124	10234781.82	3128604.20	716.30	TR-SYC-17
6125	10234878.74	3128388.02	720.81	TR-PEC-13
6126	10234791.69	3128622.74	715.57	TR-SYC-12-7
6127	10234790.28	3128711.55	717.24	TR-PO-15
6128	10234778.48	3128949.49	717.06	TR-PEC-19
6129	10232645.70	3132910.57	693.76	TR-ASH-11
6130	10232630.76	3132937.55	693.54	TR-ASH-9
6131	10232621.00	3132915.72	693.59	TR-ASH-10
6132	10232607.89	3132931.93	693.56	TR-ASH-8-5
6133	10232597.66	3132922.92	692.80	TR-ASH-8
6134	10232543.85	3132940.48	692.58	TR-ASH-9-6
6135	10232522.82	3132932.88	692.99	TR-ASH-9-5
6136	10232516.75	3132939.07	692.81	TR-CW-11
6137	10232508.99	3132934.51	692.83	TR-ASH-9
6138	10232415.74	3132910.58	697.56	TR-BE-18
6139	10234809.41	3128606.50	714.13	TR-SYC-11
6140	10233885.68	3132230.25	699.69	TR-PEC-13
6141	10233882.09	3132245.32	699.25	TR-PEC-14
6142	10233876.98	3132258.28	699.33	TR-PEC-19
6163	10234684.29	3129193.82	713.15	TR-AE-24
6164	10234692.11	3129184.10	712.69	TR-AE-23
6165	10234684.03	3129169.87	715.97	TR-CE-19
6166	10234614.82	3129114.45	717.62	TR-PEC-22
6379	10234375.27	3129852.68	714.60	TR-PEC-31
6380	10234418.20	3129836.30	716.12	TR-PEC-16
6381	10234410.53	3129829.69	710.50	TR-PEC-14
6382	10234426.06	3129827.25	715.44	TR-PEC-21-16
6383	10234436.93	3129796.49	714.99	TR-PEC-17
6384	10234451.65	3129802.42	716.57	TR-PEC-13
6385	10234451.48	3129786.93	715.63	TR-PEC-19
6386	10234469.26	3129757.85	714.51	TR-PEC-23
6387	10234487.06	3129738.68	714.37	TR-CE-19
6388	10234230.26	3129771.85	719.46	TR-PEC-16
6389	10234233.12	3129749.20	720.46	TR-PEC-15
6390	10234228.72	3129758.47	719.75	TR-PEC-17
6391	10234275.34	3129706.19	719.49	TR-PEC-17
6392	10234285.87	3129719.75	717.99	TR-PEC-13
6393	10234330.24	3129653.87	718.32	TR-PEC-17-12
6394	10234361.36	3129645.32	717.54	TR-PEC-14
6395	10234385.62	3129614.56	717.37	TR-PEC-15
6396	10234390.24	3129614.99	717.49	TR-PEC-20
6397	10234399.78	3129593.35	717.41	TR-PEC-15
6398	10234464.09	3129603.33	710.00	TR-ASH-11-6
6399	10234427.31	3129556.92	717.60	TR-PEC-20-17-16
6400	10234484.50	3129556.71	712.68	TR-PEC-31
6401	10234535.03	3129482.11	712.69	TR-PEC-23-19

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	SPECIES & DIA
6402	10234464.53	3129511.72	717.03	TR-PEC-19
6403	10234451.09	3129509.62	717.64	TR-PEC-22
6404	10234365.83	3129889.50	716.14	TR-PEC-20
6405	10234360.54	3129916.32	715.41	TR-PEC-22
6406	10234478.35	3129847.07	720.39	TR-PEC-21
6407	10234450.09	3129871.45	718.45	TR-PEC-22
6408	10237096.95	3126192.42	729.13	TR-CE-12
6409	10237117.16	3126144.04	731.56	TR-ASH-12
6410	10237130.00	3126062.81	733.85	TR-CE-33
6411	10235948.86	3126742.19	729.47	TR-PO-27
6412	10235809.01	3126780.40	729.55	TR-PEC-27
6413	10235790.59	3126746.22	729.99	TR-PO-22
6414	10235830.22	3126736.40	730.07	TR-PO-23
6415	10235786.22	3126837.92	730.60	TR-PO-38
6416	10235641.45	3126804.71	730.33	TR-PEC-30
6417	10235615.66	3126834.87	731.10	TR-PEC-25
6418	10235551.60	3126753.45	729.80	TR-PEC-19
6419	10235514.84	3126872.55	726.64	TR-PO-41
6420	10234465.16	3129472.58	717.24	TR-PEC-24
6421	10235477.13	3126693.35	742.45	TR-BURR-43
6422	10234281.54	3130098.69	718.38	TR-PEC-27
6423	10234276.96	3130052.63	718.18	TR-PEC-34
6424	10234299.15	3130005.18	717.16	TR-PEC-26
6425	10234367.14	3129996.77	720.26	TR-PEC-29
6426	10234346.84	3129965.19	717.18	TR-PEC-13
6427	10234344.52	3129962.09	717.37	TR-PEC-13-13
6428	10234357.86	3129934.24	716.73	TR-PEC-27
6429	10234378.87	3129942.55	717.61	TR-ELM-25
6430	10234385.00	3129910.51	715.80	TR-PEC-17
6431	10234401.65	3129939.15	718.89	TR-PEC-18
6432	10234400.17	3129924.71	717.43	TR-PEC-16
6433	10234432.15	3129875.00	717.51	TR-PEC-22-13
6434	10234300.11	3130070.32	718.45	TR-PEC-17
6435	10237024.07	3126112.45	735.38	TR-CE-17
6436	10234485.85	3129425.96	717.27	TR-PEC-13-8
6437	10234506.17	3129405.04	716.54	TR-PEC-22
6438	10234018.63	3131906.64	701.44	TR-PEC-13
6439	10233895.03	3131821.05	706.40	TR-HB-14
6440	10233924.71	3131848.27	702.66	TR-PEC-18
6441	10233923.42	3131820.02	703.54	TR-CE-19
6442	10233913.45	3131813.55	704.40	TR-PEC-15-12
6443	10233913.67	3131767.76	705.65	TR-CE-14
6444	10233934.52	3131749.14	703.35	TR-PEC-18
6445	10233934.43	3131792.22	702.51	TR-PEC-11
6446	10233928.42	3131791.07	703.57	TR-PEC-15
6447	10233856.88	3131821.52	709.17	TR-CE-12
6448	10233844.59	3132379.14	698.97	TR-SYC-16-16
6449	10233849.30	3132376.06	699.26	TR-SYC-12
6450	10233855.22	3132362.48	698.62	TR-SYC-12
6451	10233852.16	3132368.73	698.62	TR-SYC-17
6452	10233815.08	3132359.68	702.13	TR-PEC-14
6453	10233831.56	3132338.05	702.28	TR-PEC-24
6454	10233863.11	3132344.49	698.82	TR-SYC-17-15
6455	10233871.27	3132339.30	697.71	TR-SYC-17
6456	10233873.85	3132322.50	697.65	TR-SYC-26
6457	10233853.59	3132319.83	700.50	TR-PEC-15
6458	10233858.04	3132293.50	701.69	TR-PEC-25
6459	10233841.25	3132244.16	702.20	TR-CE-16
6460	10233859.55	3132249.11	702.35	TR-PEC-27
6461	10233873.47	3132270.05	699.73	TR-PEC-11
6462	10233885.80	3132266.93	698.37	TR-SYC-23
6463	10234008.28	3131908.61	699.37	TR-ASH-12
6464	10234007.47	3131896.06	699.34	TR-CE-12
6465	10234019.12	3131881.10	701.71	TR-LO-18-15
6466	10234029.97	3131807.28	700.85	TR-PEC-12
6467	10234520.65	3129388.65	716.97	TR-PEC-14
6468	10234548.03	3129399.00	715.69	TR-PEC-25
6469	10234585.72	3129398.91	712.85	TR-PEC-21
6470	10234597.19	3129389.59	713.81	TR-CE-21
6471	10234543.69	3129345.30	717.26	TR-PEC-14
6472	10234513.43	3129327.57	718.02	TR-PEC-13
6473	10234531.11	3129317.77	717.91	TR-PEC-16-15-14
6474	10234531.73	3129278.96	718.72	TR-PEC-19-18

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	SPECIES & DIA
6475	10234618.33	3129319.03	715.21	TR-BURR-44
6476	10234142.94	3131589.43	717.30	TR-LO-16
6477	10234080.19	3131586.26	708.02	TR-CE-14
6478	10234061.76	3131575.68	705.30	TR-CE-13
6479	10234505.15	3129415.84	716.47	TR-PEC-13
6480	10234021.28	3131577.49	701.43	TR-ASH-20
6481	10234033.50	3131563.28	704.25	TR-CE-21
6482	10234040.13	3131678.72	702.31	TR-ELM-15
6483	10234006.98	3131652.35	698.74	TR-SYC-18-15
6484	10234032.62	3131844.34	701.71	TR-PEC-13
6485	10234046.59	3131639.23	702.79	TR-PO-16
6486	10234012.73	3131779.13	699.90	TR-PEC-18
6487	10234020.15	3131752.56	700.95	TR-CE-17
6488	10234012.35	3131858.52	700.22	TR-LO-11
6489	10234009.68	3131844.27	699.35	TR-ASH-19
6490	10234022.57	3131832.21	700.55	TR-PEC-14
6491	10234009.69	3131831.31	699.21	TR-CE-12
6492	10234033.61	3131812.06	702.12	TR-CE-13
6493	10234041.27	3131580.70	702.56	TR-CE-17
6494	10237066.89	3126128.11	732.43	TR-CE-27
6495	10237001.80	3126136.87	734.76	TR-CE-12-10
6496	10237029.45	3126141.65	733.60	TR-PEC-12
6503	10231955.24	3133200.14	697.07	TRANSFORMER PAD
6504	10234672.24	3128646.08	718.89	TR-CE-16
6505	10234731.15	3128673.50	717.18	TR-SYC-12
6506	10234700.19	3128715.85	718.29	TR-PEC-12
6507	10234707.96	3128732.34	718.79	TR-PEC-14
6508	10234706.86	3128765.16	719.74	TR-PEC-16
6509	10234697.99	3128830.03	724.90	TR-PEC-23
6510	10234623.20	3128894.70	719.42	TR-PEC-24
6511	10234666.01	3128929.04	717.98	TR-PEC-16
6512	10234684.21	3128929.80	716.20	TR-PEC-18
6513	10234714.69	3128938.64	718.12	TR-PEC-20-11
6514	10234700.53	3128983.56	718.23	TR-PEC-18
6515	10234699.47	3128996.33	718.69	TR-PEC-21
6516	10234662.10	3128953.64	706.56	TR-PEC-16
6517	10234649.79	3128954.86	718.24	TR-PEC-17
6518	10234622.84	3128964.34	719.26	TR-PEC-14
6519	10234599.73	3128986.94	718.65	TR-PEC-15-13
6520	10234708.09	3129039.01	718.17	TR-PEC-15
6521	10234690.40	3129035.90	718.48	TR-PEC-20
6538	10234642.74	3129028.20	717.62	TR-PEC-10
6553	10234629.44	3129023.49	717.97	TR-PEC-20
6554	10234606.33	3129022.68	717.96	TR-PEC-22
6555	10234664.43	3129065.98	717.31	TR-PEC-15-14
6556	10237008.14	3124651.11	741.34	TR-BOIS-15-12
6557	10236985.80	3124660.72	737.35	TR-AE-34
6558	10236968.67	3124639.45	737.93	TR-CE-17
6559	10236971.98	3124628.07	740.56	TR-BOIS-16
6560	10236952.30	3124625.16	738.11	TR-BOIS-12
6561	10236946.63	3124585.49	741.92	TR-HB-14
6562	10236895.02	3124577.77	739.45	TR-CE-15
6563	10236923.07	3124563.52	742.63	TR-HB-15
6564	10236919.06	3124557.28	742.85	TR-AE-13
6565	10236929.69	3124557.75	743.02	TR-AE-14
6566	10236929.07	3124545.99	743.36	TR-PEC-17
6567	10236973.72	3124559.79	743.85	TR-PO-33
6568	10237060.48	3124758.91	736.11	TR-PEC-14
6569	10237006.15	3124552.69	745.85	TR-HB-14
6570	10237008.95	3124590.98	743.17	TR-ASH-14
6571	10237032.07	3124623.56	742.83	TR-PEC-14
6572	10237060.77	3124683.12	741.10	TR-AE-46
6573	10236935.65	3124460.54	750.50	TR-CE-23
6574	10236952.85	3124461.54	749.42	TR-ASH-12
6575	10236973.97	3124489.56	748.62	TR-PO-28
6576	10236886.81	3124500.44	746.33	TR-CB-14
6577	10236854.77	3124479.91	747.46	TR-CB-13
6578	10236855.43	3124473.82	748.13	TR-SO-17
6579	10236840.58	3124445.97	752.04	TR-AE-22
6580	10236827.16	3124459.92	749.75	TR-HB-13
6581	10237057.77	3126221.13	731.10	TR-PEC-49
6582	10237029.12	3124576.44	744.59	TR-CE-12
6583	10234054.96	3130444.30	715.59	TR-CE-12

POINT TABLE				
POINT NO.	NORTHING	EASTING	ELEVATION	SPECIES & DIA
6584	10237072.33	3124794.38	737.42	TR-CE-14
6585	10237092.50	3124737.22	739.13	TR-CE-16
6586	10234657.88	3129123.25	717.61	TR-PEC-22
6587	10234134.65	3130364.80	716.92	TR-CE-16-6
6588	10237108.81	3124974.32	737.00	TR-CE-12
6589	10237097.38	3124971.36	738.16	TR-BURR-34
6590	10237035.18	3124949.60	740.56	TR-AE-35
6591	10237011.70	3124979.42	739.51	TR-CE-22
6592	10237037.93	3125005.85	736.11	TR-CE-13
6593	10237153.66	3125034.01	735.50	TR-PEC-32
6594	10237061.44	3124906.16	732.93	TR-PEC-12
6595	10237026.80	3124916.61	740.30	TR-BOIS-13
6596	10236942.15	3124907.93	740.11	TR-AE-26
6597	10237002.53	3124884.92	738.98	TR-CE-12
6598	10237070.40	3124784.98	738.84	TR-AE-15
6599	10237025.96	3124870.83	735.22	TR-CE-14
6600	10237129.30	3124871.75	736.05	TR-CE-12
6601	10237144.78	3124900.63	736.58	TR-AE-13-13-13
6602	10237187.00	3124810.69	737.61	TR-CE-12
6603	10237161.58	3124817.43	737.83	TR-AE-13
6604	10237151.73	3124778.60	738.99	TR-CE-12
6605	10237121.28	3124810.06	736.91	TR-AE-12-10
6606	10237163.97	3124764.64	738.20	TR-CE-15
6607	10237138.28	3124729.74	740.32	TR-CE-12
6608	10237130.62	3124720.59	740.18	TR-CE-13
6609	10237117.36	3124725.03	740.50	TR-HB-15
6610	10237109.11	3124745.35	739.17	TR-CE-12
6611	10237107.66	3124745.59	738.84	TR-CE-14
6612	10236975.85	3124873.61	740.27	TR-AE-30
6613	10234043.18	3130388.27	714.46	TR-CE-15
6614	10234008.31	3130929.41	713.59	TR-PEC-24-23
6615	10234238.56	3130072.53	717.38	TR-PEC-23
6776	10234048.36	3130384.27	714.87	TR-CE-13

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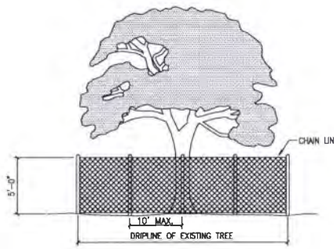


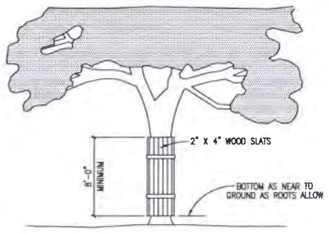
NOTES:

1. TREE PROTECTION FENCES SHALL BE INSTALLED PRIOR TO THE COMMENCEMENT OF ANY SITE PREPARATION WORK (CLEARING, GRUBBING OR GRADING).
2. FENCES SHALL COMPLETELY SURROUND THE TREE, OR CLUSTERS OF TREES; WILL BE LOCATED AT THE OUTERMOST LIMIT OF THE TREE BRANCHES (DRIPLINE), AND WILL BE MAINTAINED THROUGHOUT THE CONSTRUCTION PROJECT IN ORDER TO PREVENT THE FOLLOWING:
   A. SOIL COMPACTION IN THE ROOT ZONE AREA RESULTING FROM VEHICULAR TRAFFIC, OR STORAGE OF EQUIPMENT OR MATERIALS.
   B. ROOT ZONE DISTURBANCES DUE TO GRADE CHANGES (GREATER THAN SIX INCHES (6") CUT OR FILL, OR TRENCHING NOT REVIEWED AND AUTHORIZED BY THE CITY.
   C. WOUNDS TO EXPOSED ROOTS, TRUNKS OR LIMBS BY MECHANICAL EQUIPMENT.
   D. OTHER ACTIVITIES DETRIMENTAL TO TREES, SUCH AS CHEMICAL STORAGE, CEMENT TRUCK CLEANING AND FIRE.
3. EXCEPTIONS TO INSTALLING FENCES AT TREE DRIPLINES MAY BE PERMITTED IN THE FOLLOWING CASES:
   A. WHERE PERMEABLE PAVING IS TO BE INSTALLED, ERECT THE FENCE AT THE OUTER LIMITS OF THE PERMEABLE PAVING AREA.
   B. WHERE TREES ARE CLOSE TO PROPOSED BUILDINGS, ERECT THE FENCE NO CLOSER THAN SIX FEET (6'-0") TO BUILDING.

ADOPTED 6/21/2006

CITY OF GEORGETOWN
CONSTRUCTION STANDARDS AND DETAILS
TREE PROTECTION – CHAIN LINK FENCE
EC09
NTS 1/2003

DETAIL A
NTS



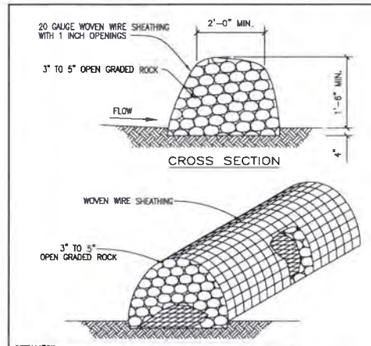
NOTES:

1. WHERE ANY EXCEPTIONS RESULT IN A FENCE BEING CLOSER THAN FOUR FEET (4'-0") TO A TREE TRUNK; PROTECT THE TRUNK WITH STRAPPED-ON-PLANKING TO A HEIGHT OF EIGHT FEET (8'-0"), OR TO THE LIMITS OF LOWER BRANCHING IN ADDITION TO THE REDUCED FENCING PROVIDED.
2. ANY ROOTS EXPOSED BY CONSTRUCTION ACTIVITY SHALL BE PRUNED FLUSH WITH THE SOIL. BACKFILL ROOT AREAS WITH GOOD QUALITY TOP SOIL AS SOON AS POSSIBLE. IF EXPOSED ROOT AREAS ARE NOT BACKFILLED WITHIN TWO (2) DAYS, COVER THEM WITH ORGANIC MATERIAL IN A MANNER WHICH REDUCES SOIL TEMPERATURE, AND MINIMIZES WATER LOSS DUE TO EVAPORATION.
3. PRIOR EXCAVATION OR GRADE CUTTING WITHIN TREE DRIPLINE, MAKE A CLEAN CUT BETWEEN THE DISTURBED AND UNDISTURBED ROOT ZONES WITH A ROCK SAW OR SIMILAR EQUIPMENT, TO MINIMIZE DAMAGE TO REMAINING ROOTS.
4. TREES MOST HEAVILY IMPACTED BY CONSTRUCTION ACTIVITIES SHOULD BE WATERED DEEPLY ONCE A WEEK DURING PERIODS OF HOT, DRY WEATHER. TREE CROWNS SHOULD BE SPRAYED WITH WATER PERIODICALLY TO REDUCE DUST ACCUMULATION ON THE LEAVES.
5. ANY TRENCHING REQUIRED FOR THE INSTALLATION OF LANDSCAPE IRRIGATION SHALL BE PLACED AS FAR FROM EXISTING TREE TRUNKS AS POSSIBLE.
6. NO LANDSCAPE TOPSOIL DRESSING GREATER THE FOUR INCHES (4") SHALL BE PERMITTED WITHIN THE DRIPLINE OF A TREE. NO SOIL IS PERMITTED ON THE ROOT FLARE OF ANY TREE.
7. PRUNING TO PROVIDE CLEARANCE FOR STRUCTURES, VEHICULAR TRAFFIC AND EQUIPMENT SHALL TAKE PLACE BEFORE CONSTRUCTION BEGINS.

ADOPTED 6/21/2006

CITY OF GEORGETOWN
CONSTRUCTION STANDARDS AND DETAILS
TREE PROTECTION – WOOD SLATS
EC10
NTS 1/2003

DETAIL B
NTS



INSTALLATION:

- LAYOUT THE ROCK BERM FOLLOWING AS CLOSELY AS POSSIBLE TO THE CONTOUR.
- CLEAR THE GROUND OF DEBRIS, ROCKS OR PLANTS THAT WILL INTERFERE WITH INSTALLATION.
- PLACE WOVEN WIRE FABRIC ON THE GROUND ALONG THE PROPOSED INSTALLATION WITH ENOUGH OVERLAP TO COMPLETELY ENCIRCLE THE FINISHED SIZE OF THE BERM.
- PLACE THE ROCK ALONG THE CENTER OF THE WIRE TO THE DESIGNATED HEIGHT.
- WRAP THE STRUCTURE WITH THE PREVIOUSLY PLACED WIRE MESH SECURE ENOUGH SO THAT WHEN WALKED ACROSS THE STRUCTURE RETAINS IT'S SHAPE.
- SECURE WITH TIE WIRE.
- THE ENDS OF THE BERM SHOULD BE TIED INTO EXISTING UPSLOPE GRADE AND THE BERM SHOULD BE BURIED IN A TRENCH APPROX. 4 INCHES DEEP TO PREVENT FAILURE OF THE CONTROL.
- THE ROCK BERM SHOULD BE LEFT IN PLACE UNTIL ALL UPSTREAM AREAS ARE STABILIZED AND ACCUMULATED SILT REMOVED.

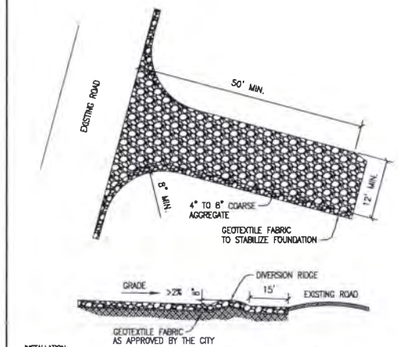
INSPECTION AND MAINTENANCE GUIDELINES:

- INSPECTION SHOULD BE MADE WEEKLY AND AFTER EACH RAINFALL EVENT BY THE RESPONSIBLE PARTY. FOR INSTALLATIONS IN STREAMBEDS, ADDITIONAL DAILY INSPECTIONS SHOULD BE MADE.
- REMOVE SEDIMENT AND OTHER DEBRIS WHEN BUILDUP REACHES 6 INCHES AND DISPOSE OF THE ACCUMULATED SILT IN AN APPROVED MANNER.
- REPAIR ANY LOOSE WIRE SHEATHING.
- THE BERM SHOULD BE RESHAPED AS NEEDED DURING INSPECTION.
- THE BERM SHOULD BE REPLACED WHEN THE STRUCTURE CEASES TO FUNCTION AS INTENDED DUE TO SILT ACCUMULATION AMONG THE ROCKS, WASHOUT, CONSTRUCTION TRAFFIC DAMAGE, ETC.

ADOPTED 6/21/2006

CITY OF GEORGETOWN
CONSTRUCTION STANDARDS AND DETAILS
ROCK BERM DETAIL
EC03
NTS 1/2003

DETAIL C
NTS



INSTALLATION:

- CLEAR THE AREA OF DEBRIS, ROCKS OR PLANTS THAT WILL INTERFERE WITH INSTALLATION.
- GRADE THE AREA FOR THE ENTRANCE TO FLOW BACK ON TO THE CONSTRUCTION SITE, RUNOFF FROM THE STABILIZED CONSTRUCTION
- PLACE GEOTEXTILE FABRIC AS APPROVED BY THE CITY.
- PLACE ROCK AS APPROVED BY THE CITY.

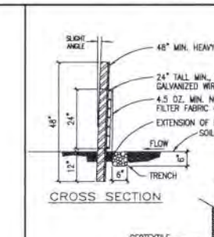
INSPECTIONS AND MAINTENANCE GUIDELINES:

- THE ENTRANCE SHOULD BE MAINTAINED IN A CONDITION, WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.
- ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ON TO PUBLIC RIGHTS-OF-WAY SHOULD BE REMOVED IMMEDIATELY BY CONTRACTOR.
- WHEN NECESSARY, WHEELS SHOULD BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTRANCE ONTO PUBLIC RIGHTS-OF-WAY.
- WHEN WASHING IS REQUIRED, IT SHOULD BE DONE ON AN AREA STABILIZED WITH CRUSHED STONE THAT DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN.
- ALL SEDIMENT SHOULD BE PREVENTED FROM ENTERING ANY STORM DRAIN, DITCH OR WATER COURSE BY USING APPROVED METHODS.

ADOPTED 6/21/2006

CITY OF GEORGETOWN
CONSTRUCTION STANDARDS AND DETAILS
STABILIZED CONSTRUCTION ENTRANCE
EC06
NTS 1/2003

DETAIL D
NTS



INSPECTION AND MAINTENANCE GUIDELINES:

- INSPECT ALL FENCING WEEKLY, AND AFTER ANY RAINFALL EVENT.
- REMOVE SEDIMENT WHEN BUILDUP REACHES 6 INCHES.
- REPLACE ANY TORN FABRIC.
- REPLACE OR REPAIR ANY SECTIONS CRUSHED OR COLLAPSED IN THE COURSE OF CONSTRUCTION ACTIVITY.

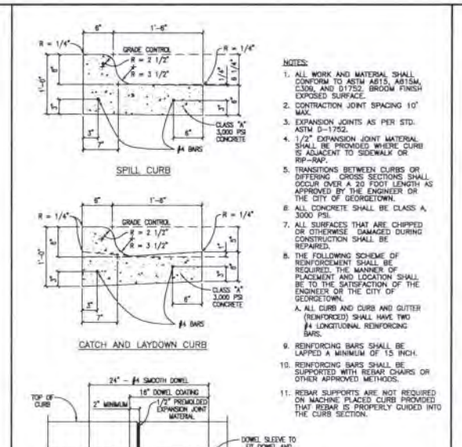
INSTALLATION:

- LAYOUT THE SILT FENCE FOLLOWING AS CLOSELY AS POSSIBLE TO THE CONTOUR.
- CLEAR THE GROUND OF DEBRIS, ROCKS, PLANTS (INCLUDING GRASSES TALLER THAN 2") TO PROVIDE A SMOOTH FLOW APPROACH SURFACE. EXCAVATE 8" DEEP X 8" WIDE TRENCH ON UPSTREAM SIDE OF FACE FOR PLANS.
- DRIVE THE HEAVY DUTY T-POST AT LEAST 12 INCHES INTO THE GROUND AND AT A SLIGHT ANGLE TOWARDS THE FLOW.
- ATTACH THE 5' X 4" 12 GAUGE WELDED WIRE MESH TO THE T-POST WITH 11 1/2 GAUGE GALVANIZED T-POST CLIPS. THE TOP OF THE WIRE TO BE 24" ABOVE GROUND LEVEL. THE WELDED WIRE MESH TO BE OVERLAPPED 8" AND TIED AT LEAST 6 TIMES WITH HOG RINGS.
- THE SILT FENCE TO BE INSTALLED WITH A SKIRT A MINIMUM OF 8" WIDE PLACED ON THE UPHILL SIDE OF THE FENCE. INSIDE EXCAVATED TRENCH. THE FABRIC TO OVERLAP THE TOP OF THE WIRE BY 1".
- ANCHOR THE SILT FENCE BY BACKFILLING WITH EXCAVATED DIRT AND ROCKS (NOT LARGER THAN 2").
- GEOTEXTILE SPLICES SHOULD BE A MINIMUM OF 18" WIDE ATTACHED IN AT LEAST 6 PLACES. SPLICES IN CONCENTRATED FLOW AREAS WILL NOT BE ACCEPTED.
- SILT FENCE SHALL BE REMOVED WHEN THE SITE IS COMPLETELY STABILIZED SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.

ADOPTED 6/21/2006

CITY OF GEORGETOWN
CONSTRUCTION STANDARDS AND DETAILS
SILT FENCE DETAIL
EC02
NTS 1/2003

DETAIL E
NTS



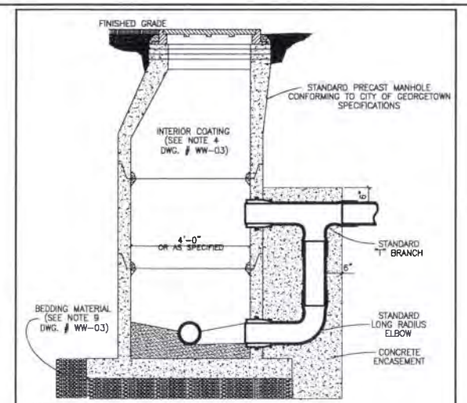
NOTES:

1. ALL WORK AND MATERIAL SHALL CONFORM TO ASTM A615, A615M, C309, AND D1752. BROOM FINISH EXPOSED SURFACE.
2. CONTRACTION JOINT SPACING 10' MAX.
3. EXPANSION JOINTS AS PER STD. ASTM D-1752.
4. 1/2" EXPANSION JOINT MATERIAL SHALL BE PROVIDED WHERE CURB IS ADJACENT TO SIDEWALK OR RIP-RAP.
5. TRANSITIONS BETWEEN CURBS OR DIFFERING CURBS SECTIONS SHALL OCCUR OVER A 20 FOOT LENGTH AS APPROVED BY THE ENGINEER OR THE CITY OF GEORGETOWN.
6. ALL CONCRETE SHALL BE CLASS A, 3000 PSI.
7. ALL SURFACES THAT ARE CHIPPED OR OTHERWISE DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED.
8. THE FOLLOWING SCHEME OF REINFORCEMENT SHALL BE REQUIRED. THE MANNER OF PLACEMENT AND LOCATION SHALL BE TO THE SATISFACTION OF THE ENGINEER OR THE CITY OF GEORGETOWN.
   A. ALL CURB AND CURB AND GUTTER (NONFORCED) SHALL HAVE TWO #4 LONGITUDINAL REINFORCING BARS.
9. REINFORCING BARS SHALL BE LAPPED A MINIMUM OF 15 INCH.
10. REINFORCING BARS SHALL BE SUPPORTED WITH REBAR CHAIRS OR OTHER APPROVED METHODS.
11. REBAR SUPPORTS ARE NOT REQUIRED ON MACHINE PLACED CURBS PROVIDED THAT REBAR IS PROPERLY GUIDED INTO THE CURB SECTION.

ADOPTED 6/21/2006

CITY OF GEORGETOWN
CONSTRUCTION STANDARDS AND DETAILS
CURB AND GUTTER DETAILS
SD06
NTS

DETAIL F
NTS



NOTES:

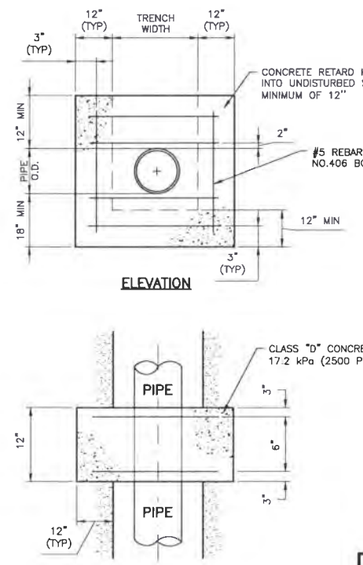
1. CONCRETE ENCASEMENT FOR DROP CONNECTION TO BE POURED INTEGRALLY WITH BOTH MANHOLE SLAB AND WALL.
2. DROP CONNECTIONS SHALL BE REQUIRED WHENEVER AN INFLUENT SEWER IS LOCATED TWO FEET (2') OR MORE ABOVE THE MAIN INVERT CHANNEL.
3. A FLOW CHANNEL SHALL BE CONSTRUCTED INSIDE MANHOLE TO DIRECT INFLUENT INTO FLOW STREAM.
4. WHEN P.V.C. IS USED IN SANITARY SEWER LINES, SOLVENT TYPE JOINT P.V.C. FITTINGS MAY BE UTILIZED IN THE DROP ASSEMBLY ONLY.
5. MINIMUM PIPE SIZE FOR DROP IS EIGHT INCHES (8").
6. SEE STANDARD MANHOLE DETAIL (DWG. # WW-03) FOR ADDITIONAL REQUIREMENTS.

The Architect/Engineer assumes responsibility for appropriate use of this standard.

ADOPTED 6/21/2006

CITY OF GEORGETOWN
CONSTRUCTION STANDARDS AND DETAILS
DROP CONNECTION – PRECAST MANHOLE TYPE "A"
WWD4
NTS 1/2003

DETAIL G
NTS



CONCRETE TRENCH COLLAR

DETAIL H
N.T.S.

Alan D. Rhames
STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
02-20-2019

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel. (512) 346-1100
TBPE Firm Registration No. F-30430202

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

MISCELLANEOUS DETAIL I

PROJECT NO. 2048-109788
FILE NAME: CZ01STDT

SHEET NO.
CZ-1

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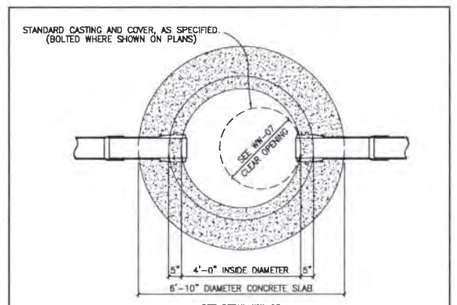


SEE DETAIL WW-03

MANHOLE PLAN

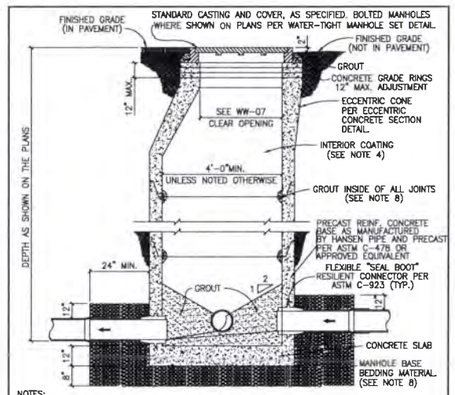
CITY OF GEORGETOWN NOTES:

MANHOLE DETAILS SHALL REFLECT THE CITY'S MINIMUM SPECIFICATIONS, AS STATED BELOW:

A. ALL MANHOLES SHALL BE 48" I.D., R.C.P., CLASS III, WITH RUBBER PROFILE GASKET – SINGLE OFF-SET JOINT CONFORMING TO ASTM C478, C433 AND C76.
B. ALL MANHOLES SHALL HAVE FRAME AND COVER, AS MANUFACTURED BY EAST JORDAN IRON WORKS (AS PER DETAIL # WW-07) OR APPROVED EQUIVALENT.
C. ALL MANHOLES SHALL BE CONCRETE WITH CAST IRON FRAME AND COVER.
D. ALL MANHOLES SHALL HAVE AN ECCENTRIC CONE.
E. MANHOLES MAY HAVE A FLAT I.D. IF APPROVED BY CITY OF GEORGETOWN, BEING 12" THICK WITH A MINIMUM 30" OPENING, AS MANUFACTURED BY HANSEN PIPE AND PRECAST OR APPROVED EQUAL. M.F.G. CONFORMING TO ASTM C478, 5000 P.S.I. CONCRETE, TRAFFIC BEARING AND WITH PROFILE GASKET – SINGLE OFF-SET JOINT CONFORMING TO ASTM C443.
F. INVERTS AND FLEXIBLE SEAL BOOTS, PER ASTM C-923, SHALL BE CAST INTO BASE SECTION.
G. MINIMUM DROP BETWEEN INVERTS SHALL BE ONE-TENTH OF A FOOT (0.1')
H. GRADE RINGS WITH AN I.D. TO MATCH FRAMES CLEAR OPENING WITH A MAXIMUM ADJUSTMENT OF 12" ARE ALLOWED
⚠1 MANHOLE INSIDE DIAMETERS SHALL BE AS SPECIFIED ON THE DRAWINGS.

CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS	ADOPTED 6/21/2006
STANDARD MANHOLE – PLAN	WW02
NTS	1/2003

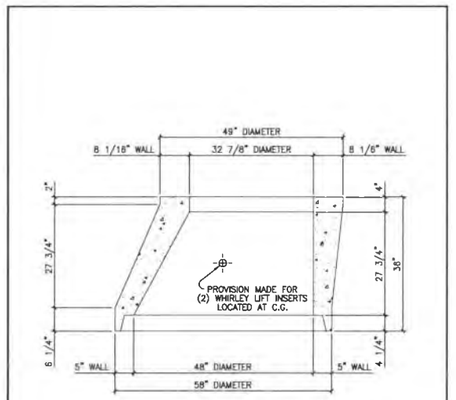
DETAIL A NTS



NOTES:
1. MANHOLES SHALL BE PRECAST ASTM C-478 BELL AND SPIGOT WITH PROFILE GASKET – SINGLE OFF-SET JOINTS.
2. SEE PLANS AND MANHOLE SCHEDULE, FOR MANHOLE SIZE, LOCATION, CONFIGURATION, TYPE OF TOP SECTION, VENTING REQUIREMENTS, PIPE SIZE AND TYPES.
3. SEE SPECIFICATIONS ON MATERIALS AND CONSTRUCTION.
4. AN 80 MIL. COAT OF RAVEN LINING SYSTEMS, RAVEN 405 ULTRA HIGH BUILD EPOXY COATING, OR SPRAY WALL EPOXY COATING, OR APPROVED EQUAL, TO BE APPLIED TO ENTIRE INTERIOR OF EACH WASTEWATER MANHOLE AND UNDERSIDE OF FLAT TOPS.
5. ALL MANHOLE COVERS SHALL BE BOLTED AND GASKETTED WHEN MANHOLES ARE LOCATED OUT FROM PAVEMENT.
6. MANHOLES TO BE VENTED ARE IDENTIFIED ON MANHOLE SCHEDULE. REFERENCE MANHOLE VENT DETAIL.
7. MANHOLES ARE TO BE DESIGNED TO RESIST LATERAL AND VERTICAL SOIL FORCES RESULTING FROM MANHOLE DEPTH. ADDITIONALLY, MANHOLES LOCATED IN PAVEMENT TO BE DESIGNED FOR HS-20 TRAFFIC LOADS.
8. GROUT SHALL MEET THE REQUIREMENTS AS STATED BY THE COATING MANUFACTURER.
9. MANHOLE BASE BEDDING MATERIAL SPECS. FOR 3/4" WASHED GRAVEL:
   SIEVE SIZE 2", PERCENT (%) RETAINED 0 — SIEVE SIZE 3/4", % RETAINED 85–100
   SIEVE SIZE 1 1/2", % RETAINED 0–10 — SIEVE SIZE 3/8", % RETAINED 85–100
   SIEVE SIZE 1", % RETAINED 45–80
10. MANHOLE RISER DIAMETER CAN BE REDUCED TO A 4–FOOT DIAMETER AT A DISTANCE OF SEVEN FEET CLEAR OR MORE ABOVE MANHOLE BOTTOM. DIAMETER REDUCTION SHALL BE THROUGH A PRECAST ECCENTRIC CONE ALIGNED WITH THE TOP ECCENTRIC CONE.
⚠1

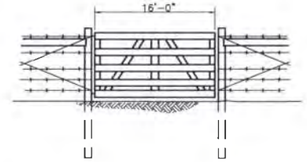
CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS	ADOPTED 6/21/2006
STANDARD MANHOLE – SECTION	WW03
NTS	1/2003

DETAIL B NTS



CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS	ADOPTED 6/21/2006
48"X5" TO 33"X8"X36" TALL ECCENTRIC CONCRETE SECTION	WW08
NTS	1/2003

DETAIL C NTS

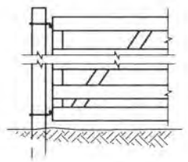


NOTES

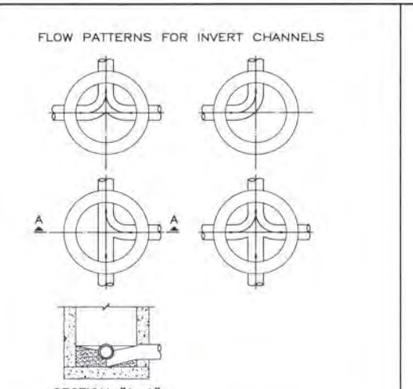
1 METAL GATE SHALL CONSIST OF 5 PANELS NOT LESS THAN 4'-4" HIGH AND SHALL BE GALVANIZED METAL AND OF GOOD QUALITY. GATE AND HARDWARE SHALL MEET THE APPROVAL OF THE ENGINEER.

2 PULL POST ASSEMBLY SHALL BE INSTALLED ON BOTH SIDES OF GATE.

TYPE 1 GATE



INSTALLATION OF HINGES OF TYPE 1 GATE

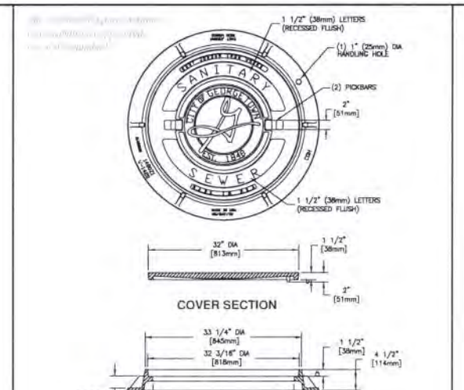


SECTION "A–A"

NOTES:
1. INVERT CHANNELS TO BE CONSTRUCTED FOR SMOOTH FLOW WITH NO OBSTRUCTIONS.
2. SPILLWAYS SHALL BE CONSTRUCTED BETWEEN PIPES WITH DIFFERENT INVERT ELEVATIONS PROVIDING FOR SMOOTH FLOW.
3. CHANNELS FOR FUTURE CONSTRUCTIONS (STUBS) SHALL BE CONSTRUCTED, FILLED WITH SAND, AND COVERED WITH 1" OF MORTAR.
4. SLOPE MANHOLE ITSELF WITH A 1:2 SLOPE FROM MANHOLE WALL TO CHANNEL.
5. INVERT SHALL BE A MINIMUM OF 1/2 THE DIAMETER OF THE LARGEST PIPE OR 4" DEEP.

CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS	ADOPTED 6/21/2006
FLOW PATTERNS FOR INVERT CHANNELS	WW06
NTS	1/2003

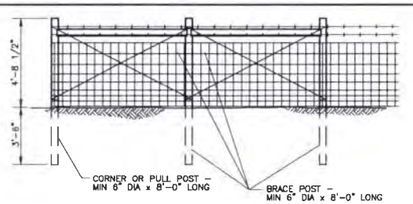
DETAIL D NTS



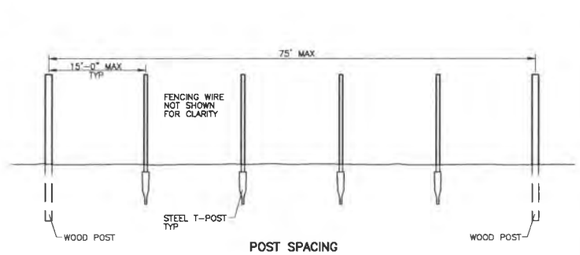
NOTES:
1. STANDARD WASTEWATER MANHOLE SET TO BE EAST JORDAN IRON WORKS, INC. CATALOG NO. 1480A V-1420/1480Z1, COVER TO BE STAMPED WITH "SANITARY SEWER".
2. STANDARD WASTEWATER MANHOLE SET TO BE HEAVY DUTY LOAD RATED.
3. FOR MORE DETAILED SPECIFICATIONS REFER TO EAST JORDAN IRON WORKS, INC. REFERENCE PRODUCT DRAWING 41420012 001148390.
4. FOR BOLTED WASTEWATER MANHOLE SET REFER TO DETAIL WW07A.

CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS	ADOPTED 6/21/2006
STANDARD WASTEWATER MANHOLE SET	WW07
NTS	1/2003

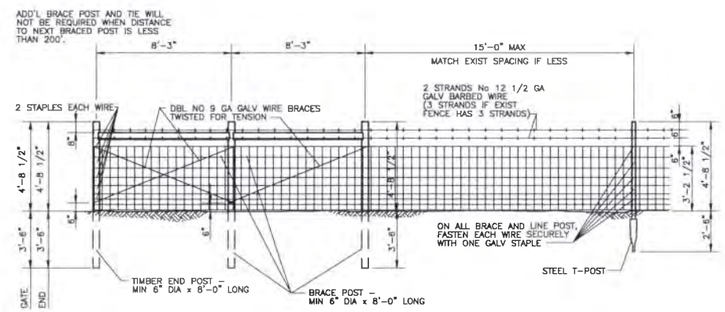
DETAIL E NTS



CORNER OR PULL POST ASSEMBLY



POST SPACING



NOTES:
IF ROCK IS ENCOUNTERED AT A DEPTH OF 1'–6" OR MORE BELOW THE GROUND SURFACE, THE HOLE SHALL BE DRILLED THE REQUIRED DEPTH. IF ROCK IS ENCOUNTERED AT A DEPTH LESS THAN 1'–6" BELOW THE GROUND SURFACE, THE HOLES SHALL BE DRILLED A MINIMUM OF 2'–0" INTO THE ROCK OR THE REQUIRED DEPTH WHICHEVER IS THE LESSER DEPTH.

SQUARE POSTS MAY BE USED IN LIEU OF ROUND POSTS PROVIDED MINIMUM EQUIVALENT SIZE REQUIREMENTS AS TABULATED HEREON ARE MET.

ALL POSTS SHALL BE WOLMANIZED OR CREOSOTED TO MATCH EXISTING.

SECTION GALV BARBED WIRE FENCE WITH WOOD POSTS BRACING DETAIL USED AT ENDS AND GATES

TYPICAL BARBED WIRE FENCE

DETAIL F NTS

Alan D. Rhames
STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
12-13-2018

REV. NO.	DATE	DRWN	CHKD	REMARKS
2	12/13/18	ECD	ADR	CONFORMED DRAWING
1	12/6/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

MISCELLANEOUS DETAIL II

PROJECT NO. 2048–109788
FILE NAME: CZ02STDT

SHEET NO.
CZ-2

XREFs: [CDMS_2234, ADR-SEAL] Images: []
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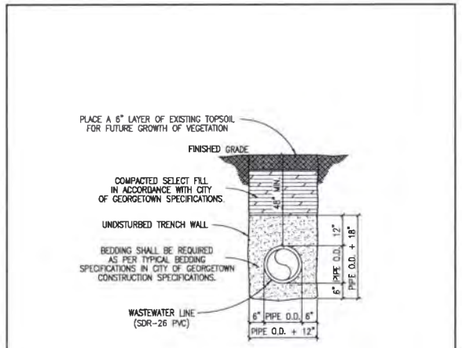
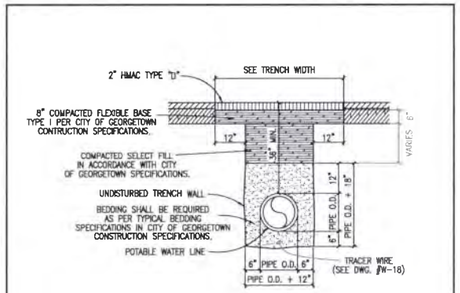


TRENCH WIDTHS
*PIPE LESS THAN 20" DIAMETER
1'-0" + PIPE O.D.
*20" DIAMETER PIPE AND LARGER
2'-0" + PIPE O.D.

CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS
TRENCH AND EMBEDMENT DETAIL UNDER NON-PAVED AREAS
ADOPTED 6/21/2006 — WW16 — NTS — 1/2003

DETAIL A
NTS

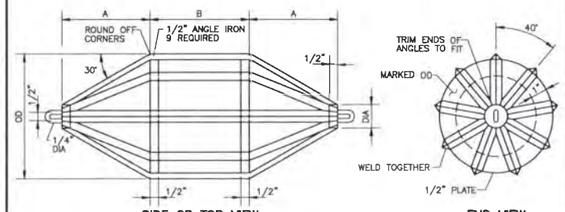


TRENCH WIDTHS
*PIPE LESS THAN 20" DIAMETER
1'-0" + PIPE O.D.
*20" DIAMETER PIPE AND LARGER
2'-0" + PIPE O.D.

NOTES:
1. REPLACED BASE MATERIAL OVER DITCH SHALL BE TWICE THE THICKNESS OF THE ORIGINAL BASE.
2. BASE MATERIAL SHALL BE IN LIFTS NOT TO EXCEED 6" AND EACH LIFT THOROUGHLY ROLLED OR TAMPED TO SPECIFIED MAXIMUM DENSITY.
3. ASPHALT CONCRETE PAVEMENT JOINTS SHALL BE MECHANICALLY SAWED.
4. SURFACE MATERIAL WILL BE CONSISTENT WITH THE EXISTING SURFACE.
5. DENSITY TESTS SHALL BE TAKEN IN ACCORDANCE WITH THE CITY OF GEORGETOWN CONSTRUCTION SPECIFICATIONS AND STANDARDS.
6. CONTRACTOR OR ENGINEER MAY USE FLOWABLE BACKFILL AS AN ALTERNATE BACKFILL MATERIAL (SEE C9 FLOWABLE BACKFILL FOR THE SPECIFICATION)

CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS
TRENCH AND EMBEDMENT AND PAVEMENT REPLACEMENT DETAIL UNDER EXISTING ROADWAY
ADOPTED 6/21/2006 — W17 — NTS — 1/2003

DETAIL B
NTS

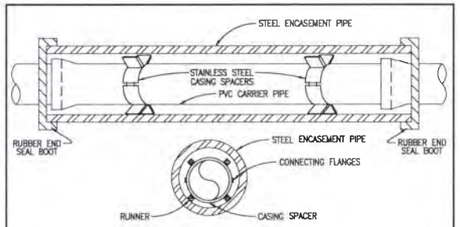


SIDE OR TOP VIEW — END VIEW

PIPE SIZE (IN)	A (IN)	B (IN)	MANDREL OD PVC (SDR 26) ASTM F789 (IN)	DIA (IN)
8	5.81	6	7.36	1.40
12	8.65	8	10.96	1.95
15	10.59	9	13.41	2.15

DEFLECTION TESTING MANDREL

DETAIL C
NTS

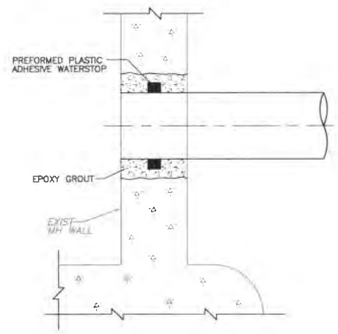


NOTES:
1. CASING SPACERS SHALL BE BOLT ON STYLE WITH A SHELL MADE IN TWO SECTIONS OF HEAVY T-304 STAINLESS STEEL. CONNECTING FLANGES SHALL BE RIBBED FOR EXTRA STRENGTH. CASING SPACERS SHALL BE MADE BY CASCADE WATERWORKS MFG. CO. OR APPROVED EQUAL.
2. CASING SPACERS SHALL HAVE RUNNERS MADE OF ULTRA HIGH MOLECULAR WEIGHT POLYMER, WITH A MINIMUM HEIGHT OF 2 INCHES.
3. DO NOT USE WEDGES BETWEEN TOP OF PVC CARRIER PIPE AND INSIDE OF CASING TO KEEP PVC FROM MOVING.
4. PRIOR TO INSERTING PVC CARRIER PIPE, ANY WATER SHOULD BE PUMPED OUT OF THE CASING PIPE SO THAT NO MORE THAN A FEW INCHES OF WATER REMAINS.
5. SPACERS WILL BE REQUIRED WITHIN AT LEAST 3 FEET FROM BOTH OPENINGS OF THE ENCASEMENT PIPE AND SPACED NO GREATER THAN 6 FEET THROUGHOUT THE ENCASEMENT PIPE.
6. ENCASEMENT PIPE SHALL BE SMOOTH STEEL 35,000 PSI YIELD STRENGTH WITH THICKNESS ACCORDING TO THE FOLLOWING TABLE:
7. WHEN CASING IS REQUIRED UNDER PAVEMENT WITHIN THE R.O.W., THE CASING SHALL EXTEND OUT TO WITHIN 4' INSIDE OF THE R.O.W. LINE, ON BOTH SIDES.
8. ALL JOINTS SHALL BE RESTRAINED ON PVC CARRIER PIPE.

PIPE SIZE-CARRIER (DIAMETER)	PIPE SIZE-CASING (DIAMETER)(MIN.)	MINIMUM PIPE THICKNESS (INCHES)	
6"	16"		
8"	18"	1/4	0.2500
10"	20"	5/16	0.3125
12" - 14"	24"	3/8	0.3750
16" - 18"	30"	7/16	0.4375
20"	36"	1/2	0.5000
24"	42"	1/2	0.5000
30"	48"	1/2	0.5000

CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS
INSTALLATION OF P.V.C. PIPE THROUGH CASING
ADOPTED 6/21/2006 — W14 — NTS — 1/2003

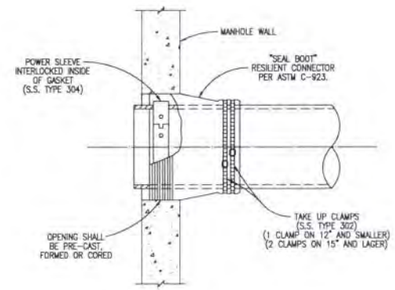
DETAIL D
NTS



NOTES
1. REMOVE EXISTING CONCRETE AROUND EXISTING PIPE TO ALLOW INSERTION OF PIPE BURSTING TOOL & HDPE PIPE.
2. AFTER PIPE BURSTING IS COMPLETE, REPAIR MANHOLE WALL AS SHOWN IN DETAIL.
3. REMOVE & REPAIR CONCRETE BASE INVERT TO MATCH DIAMETER OF NEW PIPE.

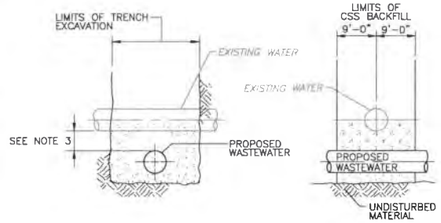
NEW HDPE PIPE BURST CONNECTION TO EXISTING MANHOLE

DETAIL E
NTS



CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS
FLEXIBLE "SEAL BOOT" CONNECTOR
ADOPTED 6/21/2006 — WW10 — NTS — 1/2003

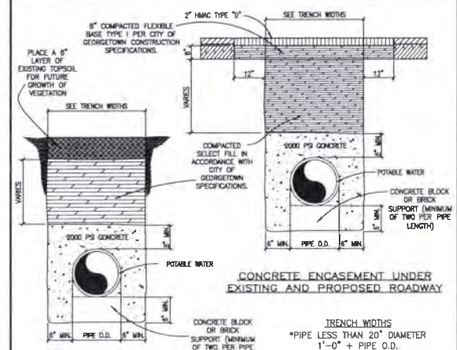
DETAIL F
NTS



NOTES
1 CENTER ONE LENGTH OF AWWA C-900 PIPE WITH 150 PSI RATING AT CROSSING.
2 UTILITY CROSSINGS TO CONFORM TO 30 TAC CHAPTER 317 13 (APPENDIX E).
3 WHEN PROPOSED WASTEWATER LINE CROSSES UNDER EXISTING POTABLE WATER LINE, A MINIMUM VERTICAL SEPARATION OF 6" SHALL BE ACHIEVED.
4 CEMENT STABILIZED BEDDING SHALL BE A MINIMUM OF 6" ABOVE AND 4" BELOW THE NEW WASTEWATER LINE.

WATER & WASTEWATER UTILITY CROSSING:
FOR CROSSINGS SEPARATED BY LESS THAN 9 FEET

DETAIL G
NTS



TRENCH WIDTHS
*PIPE LESS THAN 20" DIAMETER
1'-0" + PIPE O.D.
*20" DIAMETER PIPE AND LARGER
2'-0" + PIPE O.D.

NOTES:
1. ENCASEMENT TO BE CONSTRUCTED WHERE SEWER LINES PASS OVER OR UNDER A WATER MAIN WITH LESS THAN TWELVE INCHES (12") CLEAR DISTANCE.
2. AT CROSSINGS, ENCASEMENT SHALL EXTEND TEN FEET (10'-0") ON EITHER SIDE OF CROSSING.
3. BEGINNING AND ENDING OF ENCASEMENTS SHALL NOT BE MORE THAN SIX INCHES (6") FROM A PIPE JOINT.
4. WHERE WATER AND SEWER LINES PARALLEL WITH LESS THAN TEN FEET (10'-0") HORIZONTAL CLEAR DISTANCE, NO ENCASEMENT IS REQUIRED IF BOTH LINES ARE 150 PSI PRESSURE PIPE.
5. RAW WATER MAINS SHALL BE 150 PSI PRESSURE RATED WHEN PARALLELING POTABLE WATER MAINS WITH LESS THAN NINE FEET (9'-0") HORIZONTAL CLEARANCE.
6. WHERE MINIMUM COVER, THIRTY SIX INCHES (36") IS NOT AVAILABLE, ENCASEMENT WILL BE REQUIRED.
7. ALL CONCRETE ENCASEMENTS MUST BE FORMED AND INSPECTED BY THE CITY OF GEORGETOWN INSPECTOR PRIOR TO PLACING CONCRETE AND BACKFILLING.
8. CONTRACTOR OR ENGINEER MAY USE FLOWABLE BACKFILL AS AN ALTERNATE BACKFILL MATERIAL (SEE C9 FLOWABLE BACKFILL FOR THE SPECIFICATION).

CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS
CONCRETE ENCASEMENT DETAIL
ADOPTED 6/21/2006 — W15 — NTS — 1/2003

DETAIL H
NTS

Alan D. Rhames
STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED PROFESSIONAL ENGINEER
12-13-2018

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

MISCELLANEOUS DETAIL III

PROJECT NO. 2048-109788
FILE NAME: CZ03STDT

SHEET NO.
CZ-3

XREFs: [CDM_22x34_ADR_SEAL] Images: □
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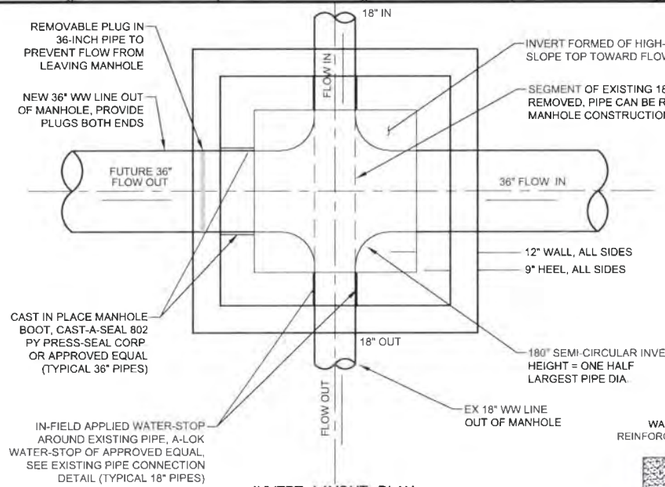
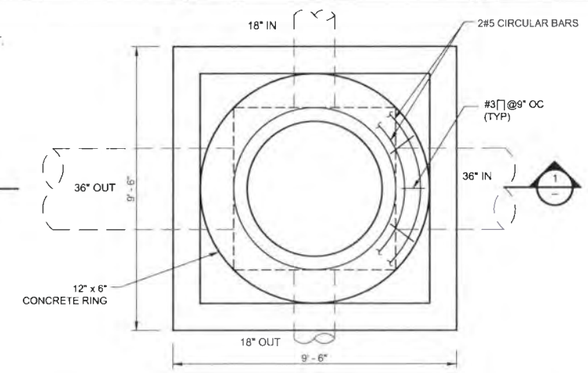
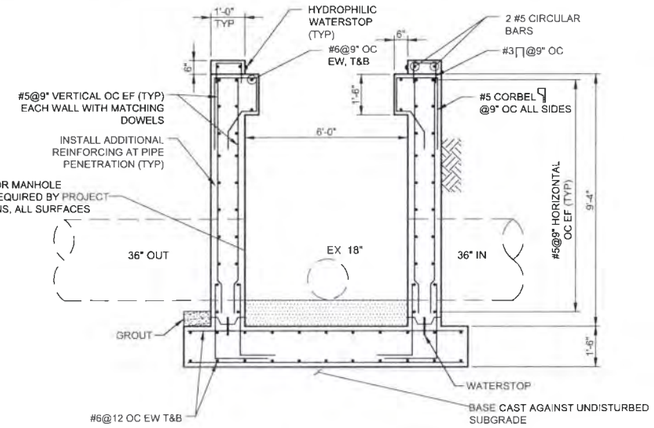


INVERT LAYOUT PLAN
PLAN
NOT TO SCALE



TOP PLAN STRUCTURAL
PLAN
NOT TO SCALE



SECTION 1
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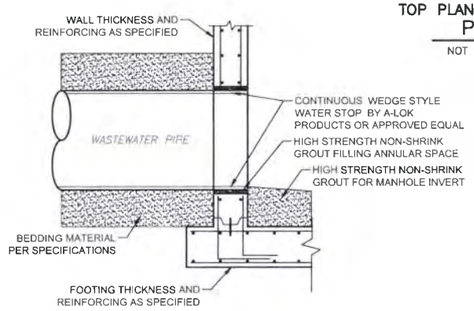
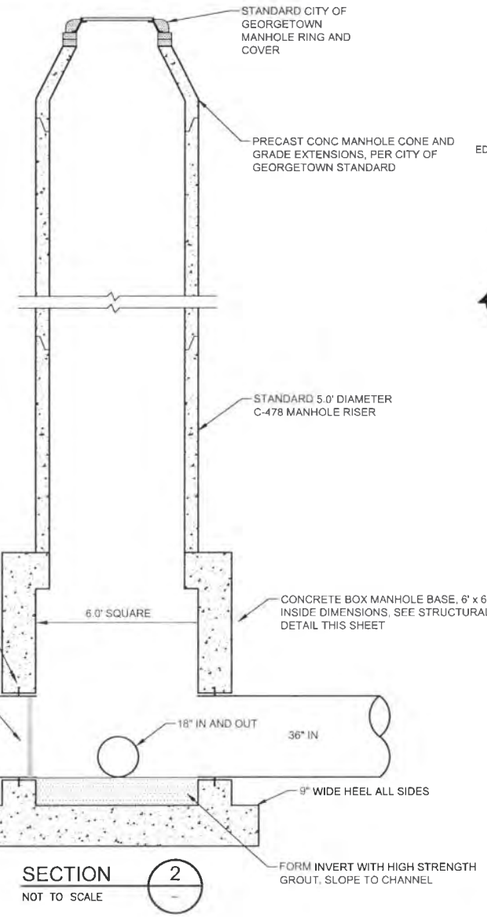


EXISTING PIPE CONNECTION
DETAIL
NOT TO SCALE



EXISTING PIPE MANHOLE CONNECTION
DETAIL B
NTS

SECTION 2
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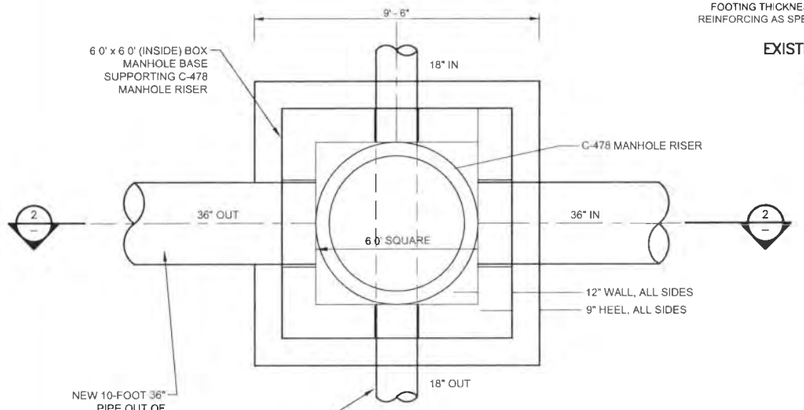
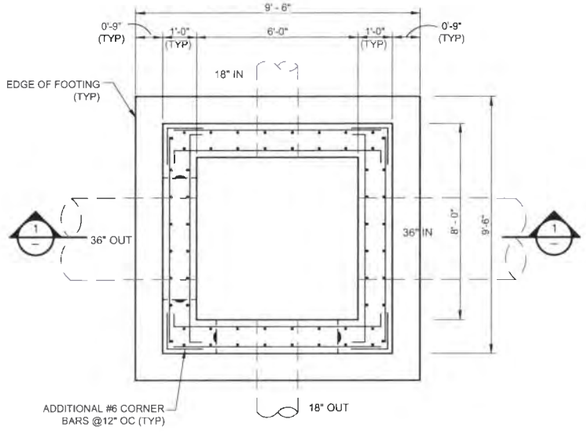


MANHOLE LAYOUT PLAN
PLAN
NOT TO SCALE

6-FOOT CAST-IN-PLACE MANHOLE NO. 1
DETAIL B



INTERMEDIATE PLAN STRUCTURAL
PLAN
NOT TO SCALE

NOTES:

1. FOR LOCATION AND ELEVATIONS SEE CIVIL SHEETS
2. ALL CONCRETE SHALL BE 4000 PSI PER SPECIFICATION.
3. ALL STEEL SHALL CONFORM WITH ASTM A615 GRADE 60 REQUIREMENTS.
4. CONTRACTOR TO VERIFY THE EXACT CONFIGURATION OF EXISTING AND PROPOSED PIPING INTO AND OUT OF PROPOSED MANHOLE.
5. EXISTING WASTEWATER PIPING AND MANHOLES SHALL BE SUPPORTED AT ALL TIMES DURING CONSTRUCTION
6. FIELD VERIFY ALL INVERT ELEVATIONS PRIOR TO COMMENCING MANHOLE CONSTRUCTION.
7. CONTRACTOR SHALL PROVIDE A WASTEWATER PUMP AROUND AS REQUIRED TO GROUT THE INVERT, CUT THE EXISTING 18-INCH WASTEWATER PIPE AND PLACE THE NEW MANHOLE INTO SERVICE.
8. ⚠1 MANHOLE RISER DIAMETER CAN BE REDUCED TO A 4-FOOT DIAMETER AT A DISTANCE OF SEVEN FEET CLEAR OR MORE ABOVE THE MANHOLE BOTTOM DIAMETER REDUCTION SHALL BE THROUGH A PRECAST ECCENTRIC CONE ALIGNED WITH THE TOP ECCENTRIC CONE.
9. ⚠1 MANHOLE CONE AT THE TOP OF THE MANHOLE SHALL BE ECCENTRIC.

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
12-13-2018

REV. NO.	DATE	DRWN	CHKD	REMARKS
2	12/13/18	ECD	ADR	CONFORMED DRAWING
1	12/6/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

MISCELLANEOUS DETAIL IV

PROJECT NO. 2048-109788
FILE NAME: CZ04STDT

SHEET NO.
CZ-4

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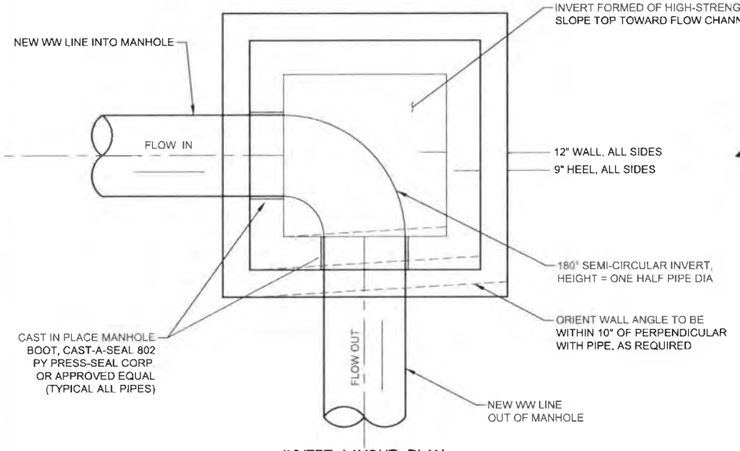
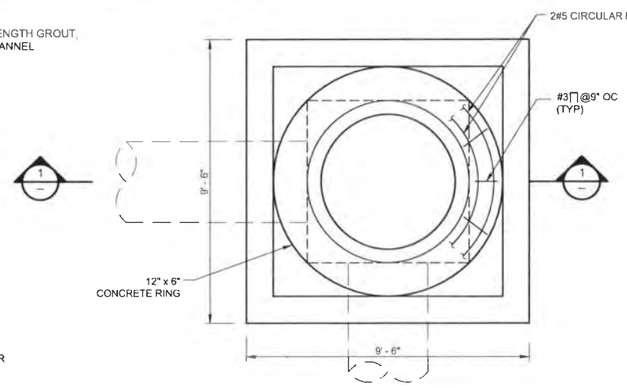
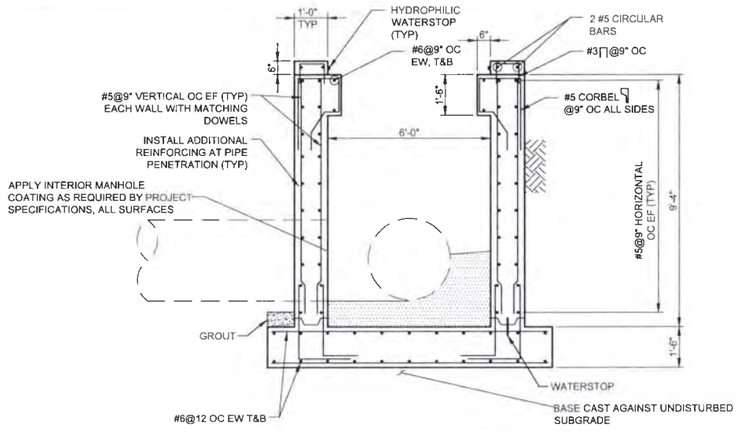


INVERT LAYOUT PLAN
PLAN
NOT TO SCALE



TOP PLAN STRUCTURAL
PLAN
NOT TO SCALE



SECTION 1
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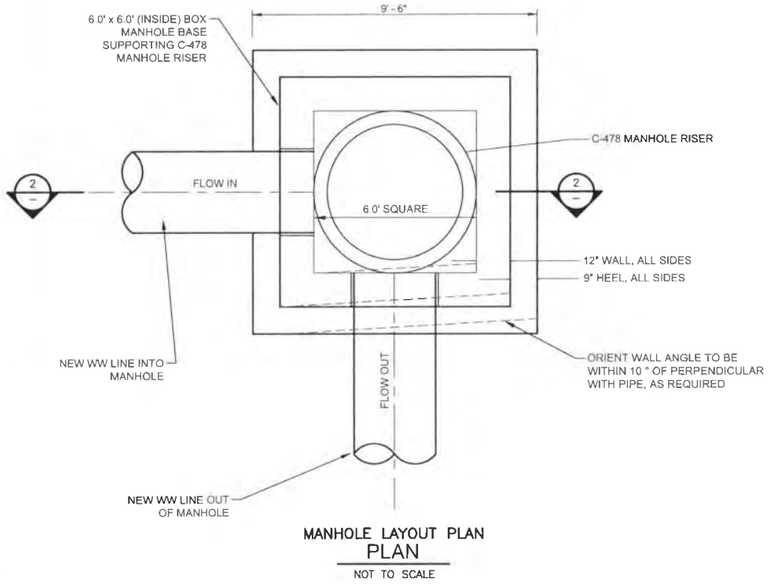
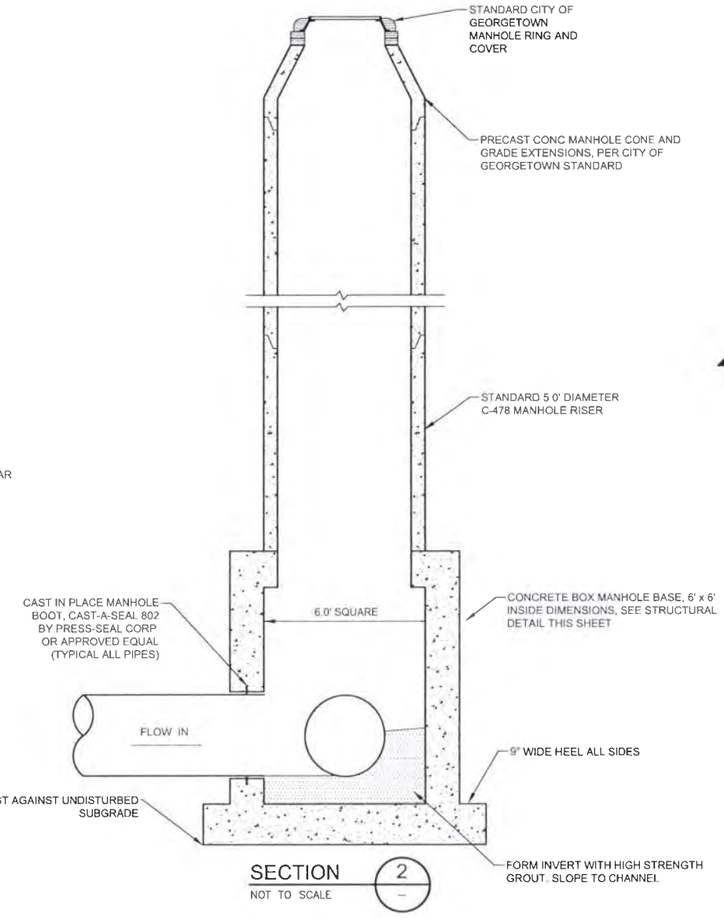


MANHOLE LAYOUT PLAN
PLAN
NOT TO SCALE



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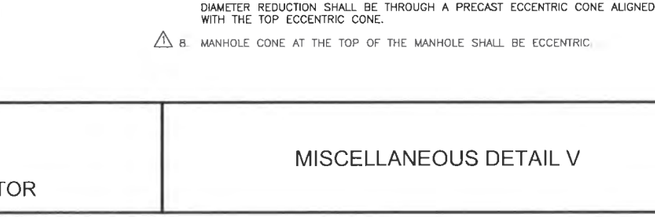

INTERMEDIATE PLAN STRUCTURAL
PLAN
NOT TO SCALE

NOTES:

1. FOR LOCATION AND ELEVATIONS SEE CIVIL SHEETS.
2. ALL CONCRETE SHALL BE 4000 PSI PER SPECIFICATION.
3. ALL STEEL SHALL CONFORM WITH ASTM A615 GRADE 60 REQUIREMENTS.
4. CONFIGURATION OF PIPING INTO AND OUT OF MANHOLES MAY VARY WITH LOCATION.
5. PROVIDE 6-FOOT SQUARE CAST-IN-PLACE BASE IN LOCATIONS WHERE PIPE CONFIGURATIONS PROHIBIT THE USE OF PRE-CAST CIRCULAR C-478 MANHOLES.
6. MANHOLES CONSTRUCTED WITH POURED-IN-PLACE BOTTOM WITH INTERIOR DIMENSIONS OF 6-FOOT BY 6-FOOT CLEAR MAY USE A 5-FOOT DIAMETER RISER.
7. ⚠1 MANHOLE RISER DIAMETER CAN BE REDUCED TO A 4-FOOT DIAMETER AT A DISTANCE OF SEVEN FEET CLEAR OR MORE ABOVE THE MANHOLE BOTTOM. DIAMETER REDUCTION SHALL BE THROUGH A PRECAST ECCENTRIC CONE ALIGNED WITH THE TOP ECCENTRIC CONE.
8. ⚠1 MANHOLE CONE AT THE TOP OF THE MANHOLE SHALL BE ECCENTRIC.

6-FOOT CAST-IN-PLACE MANHOLE - NEW PIPE
DETAIL A

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	12/6/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
DRAWN BY: G. RODRIGUEZ
SHEET CHK'D BY: A. WOELKE
CROSS CHK'D BY: D. HURTADO
APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

CDM Smith
Riata Corporate Park, 12357-A Riata Trace Parkway Suite 210
Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

MISCELLANEOUS DETAIL V

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED PROFESSIONAL ENGINEER
12-13-2018

PROJECT NO. 2048-109788
FILE NAME: CZ05STDT
SHEET NO. CZ-5

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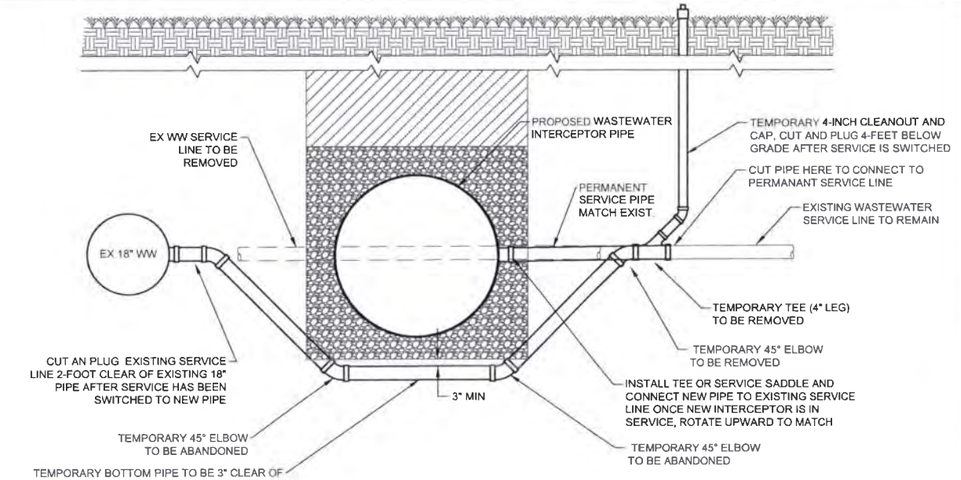
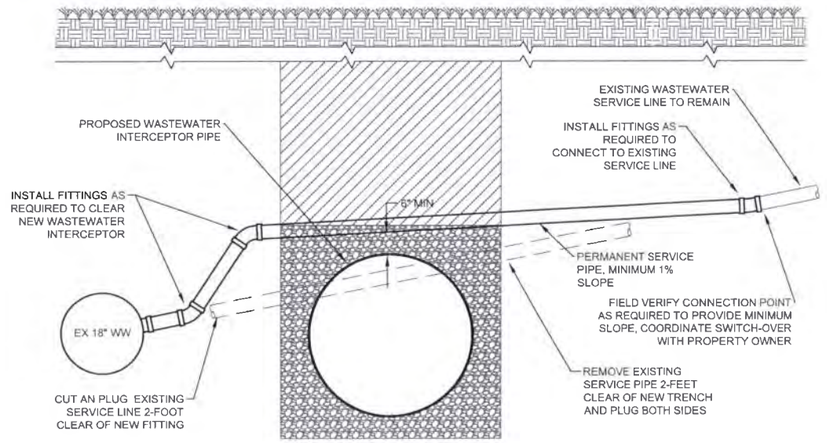


TEMPORARY PIPE SAG & PERMANENT CONNECTION
PLAN
NOT TO SCALE

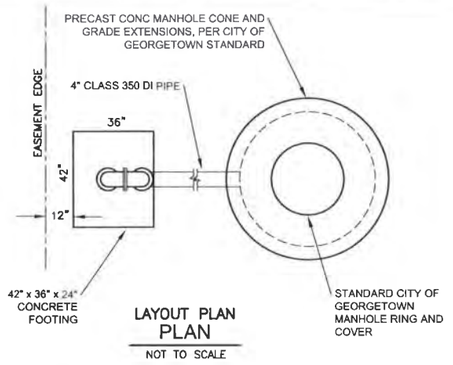


SERVICE PIPE UPWARD ADJUSTMENT & PERMANENT CONNECTION
PLAN
NOT TO SCALE

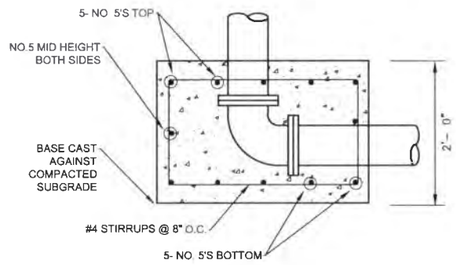
NOTES:

1. WASTEWATER SERVICE TO ADJACENT PROPERTIES SHALL BE MAINTAINED. CONTRACTOR SHALL COORDINATE WITH PROPERTY OWNER/TENANT FOR TEMPORARY SHORT-TERM INTERRUPTIONS FOR SERVICE SWITCH-OVER.
2. NEW SERVICE LINES SHALL MATCH THE PIPE DIAMETER OF THE EXISTING WASTEWATER SERVICE LINES.
3. D3034 SDR 26 PVC PIPE SHALL BE USED FOR SERVICE LINES EXCEPT THAT SCHEDULE 40 PVC MAY BE USED IF CONNECTING TO EXISTING SCHEDULE 40 SERVICE LINES
4. PROVIDE ADAPTER FITTINGS AS REQUIRED TO CONNECT VARYING PIPE TYPES.
5. ALL PIPE TO BE ABANDONED BELOW THE NEW TRENCH AND WITHIN TWO FEET OF THE TRENCH WALLS SHALL BE FILLED WITH GROUT ALL OTHER PIPE ABANDONED SHALL BE PLUGGED ON BOTH ENDS OF THE ABANDONED SEGMENT.
6. CONTRACTOR SHALL NOT WORK OUTSIDE OF AUTHORIZED EASEMENTS TO MAKE SERVICE PIPE ADJUSTMENTS UNLESS GRANTED WRITTEN PERMISSION BY THE AFFECTED PROPERTY OWNER/TENANT. AUTHORIZED WORK OUTSIDE OF EASEMENTS SHALL BE LIMITED TO ADJUSTMENTS OF EXISTING WASTEWATER SERVICE LINES.

WASTEWATER SERVICE PIPE ADJUSTMENT DETAIL
DETAIL C



LAYOUT PLAN
PLAN
NOT TO SCALE



FOOTING STRUCTURAL
SECTION
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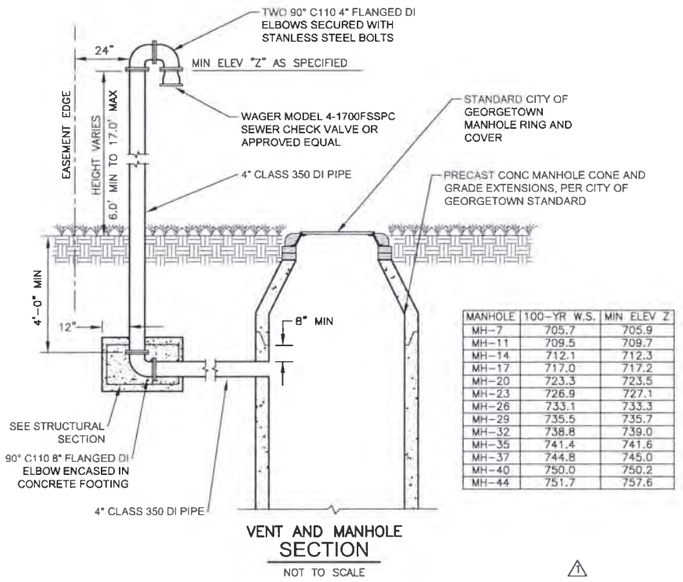


MANHOLE	100-YR W.S.	MIN ELEV Z
MH-7	705.7	705.9
MH-11	709.5	709.7
MH-14	712.1	712.3
MH-17	717.0	717.2
MH-20	723.3	723.5
MH-23	726.9	727.1
MH-26	733.1	733.3
MH-29	735.5	735.7
MH-32	738.8	739.0
MH-35	741.4	741.6
MH-37	744.8	745.0
MH-40	750.0	750.2
MH-44	751.7	757.6

VENT AND MANHOLE
SECTION
NOT TO SCALE

MANHOLE VENT NOTES

1 CONTRACTOR SHALL INSTALL THE VENT TO THE EASEMENT SIDE FARTHEST FROM THE CREEK, UNLESS NOTED OTHERWISE ON THE DRAWINGS

2 CONCRETE FOOTING SHALL BE CAST AGAINST COMPACTED SUBGRADE; DO NOT CONSTRUCT ON BACKFILL PLACED AFTER MANHOLE CONSTRUCTION

3 PIPE INSTALLATION AT MANHOLE SHALL BE MADE AS SHOWN ON DETAIL F, SHEET CZ-3

4 THE INTERIOR SURFACES OF ALL DUCTILE IRON PIPE AND FITTINGS SHALL BE COATED WTH PROTECTO 401 OR OTHER APPROVED COATING INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS

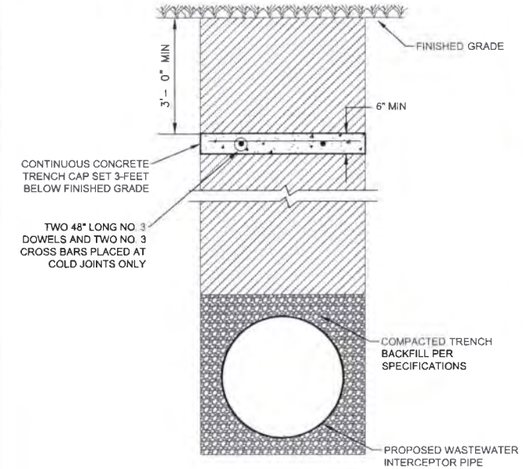
5 BURIED VENT PIPE TO BE WRAPPED IN POLYETHYLENE EXCEPT FOR IN CONCRETE ABOVE GRADE PIPE TO RECEIVE TWO COATS FOREST GREEN PAINT

6 ALL BOLTS NOT ENCASED IN CONCRETE SHALL BE STAINLESS STEEL

7 GRADE 304 STAINLESS STEEL PIPE WITH WELDED FITTINGS MAY BE SUBSTITUTED FOR DI PIPE FOR THE VENT

MANHOLE VENT
DETAIL D

CONCRETE TRENCH CAP SHALL BE POURED THE FULL WIDTH OF THE TRENCH, REGARDLESS OF WIDTH PAYMENT SHALL BE PER LINEAR FOOT OF TRENCH. REGARDLESS OF TRENCH WIDTH NO SEPARATE AND/OR ADDITIONAL PAY WILL BE PROVIDED FOR WIDENED TRENCH SECTIONS.



CONCRETE TRENCH CAP
DETAIL E

REV. NO.	DATE	DRWN	CHKD	REMARKS
	12/13/18	ECD	ADR	CONFORMED DRAWING
1	11/14/18	ECD	ADR	REVISED FOR ADDENDUM NO. 1

DESIGNED BY: D. HURTADO
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APPROVED BY: A. RHAMES
DATE: OCTOBER 2018

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Austin, TX 78727
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

BERRY CREEK
WASTEWATER INTERCEPTOR

MISCELLANEOUS DETAIL VI

STATE OF TEXAS
ALAN D. RHAMES
72089
REGISTERED
PROFESSIONAL ENGINEER
12-13-2018

PROJECT NO. 2048-109788
FILE NAME: CZ06STDT

SHEET NO.
CZ-6

XREFs: [CDMS_2234, ADR-SEAL] Images: [XG-Harvey 03-13-17]
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ATTACHMENT C.1

DRAWINGS
for
CITY OF GEORGETOWN
BERRY CREEK WASTEWATER INTERCEPTOR

GEORGETOWN, TEXAS

CITY COUNCIL

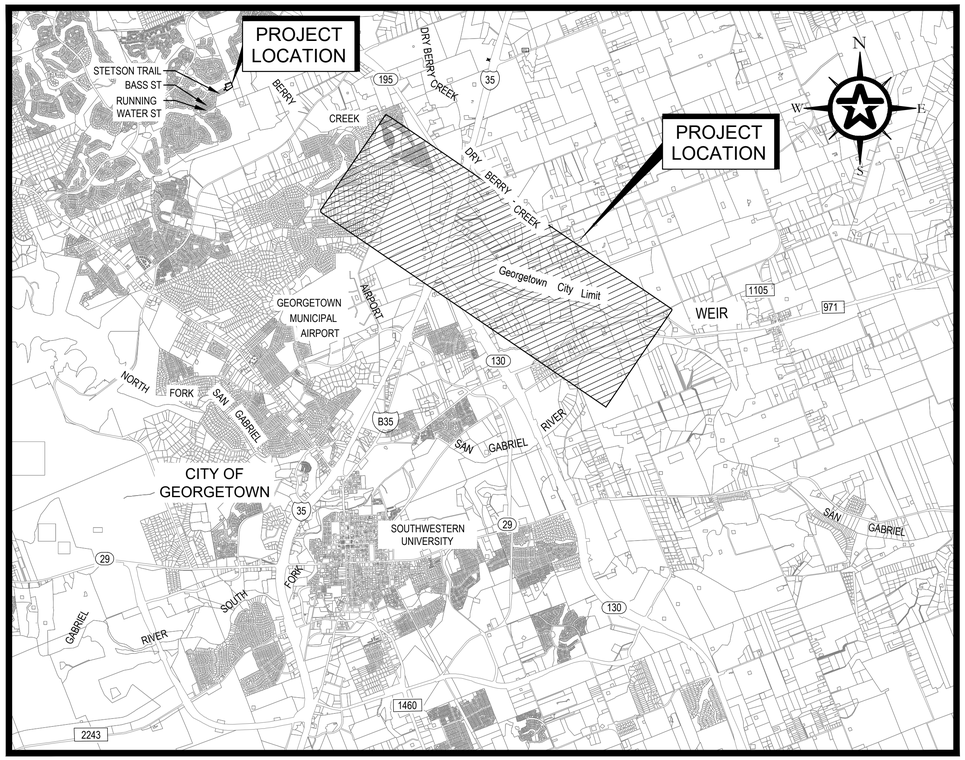
MAYOR	JOSH SCHROEDER
DISTRICT 1	AMANDA PARR
DISTRICT 2	SHAWN F. HOOD
DISTRICT 3	MIKE TRIGGS
DISTRICT 4	RON GARLAND
DISTRICT 5	KEVIN PITTS
DISTRICT 6	JAKE FRENCH
DISTRICT 7	BEN STEWART
CITY MANAGER	DAVID MORGAN

OWNER: CITY OF GEORGETOWN
300-1 INDUSTRIAL AVENUE
GEORGETOWN, TEXAS 78626

APPROVED BY THE CITY OF GEORGETOWN, TEXAS
THIS _____ DAY OF _____, 2023

_____
SYSTEMS ENGINEER DIRECTOR DATE

_____
CIP PROJECT DIRECTOR DATE



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GRAPHIC SCALE IN FEET

Walker Partners
engineers | surveyors

T.B.P.E. REGISTRATION NO. 8053

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

08/14/2023
DATE

ERIC LEE NELSON

3-00582 - CITY OF GEORGETOWN- BERRY CREEK WW INTERCEPTOR

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REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

INDEX

08/14/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C001

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GENERAL NOTES:

1. ALL CONSTRUCTION SHALL COMPLY WITH THE "CITY OF GEORGETOWN" STANDARD TECHNICAL SPECIFICATIONS AND STANDARD DETAILS FOR PUBLIC INFRASTRUCTURE CONSTRUCTION," LATEST EDITION.
2. FOR SLOPES OR TRENCHES GREATER THAN FIVE (5) FEET IN DEPTH, ALL CONSTRUCTION OPERATIONS SHALL BE ACCOMPLISHED IN ACCORDANCE WITH SPECIFICATION SECTION CIP11 – TRENCH SAFETY .
3. THE LOCATIONS OF UNDERGROUND UTILITIES AS SHOWN HEREON ARE BASED ON ABOVE GROUND STRUCTURES AND RECORD DRAWINGS PROVIDED TO THE ENGINEER. LOCATIONS OF UNDERGROUND UTILITIES/STRUCTURES MAY VARY FROM LOCATIONS SHOWN HEREON. ADDITIONAL BURIED UTILITIES/STRUCTURES MAY BE ENCOUNTERED. NO EXCAVATIONS WERE MADE DURING THE PROCESS OF THIS SURVEY TO LOCATE BURIED UTILITIES/STRUCTURES. BEFORE EXCAVATIONS ARE BEGUN, THE FOLLOWING ENTITIES SHALL BE CONTACTED FOR VERIFICATION OF UTILITY TYPE AND FIELD LOCATIONS.

   LCRA TRANSMISSION SERVICES CORPORATION:

   A) PRIOR TO BEGINNING CONSTRUCTION, THE CONTRACTOR SHALL CONTACT JUAN GUERRA, TRANSMISSION SERVICES LINE OPERATIONS AT (830) 596–7261.

   B) THE CONTRACTOR SHALL ALSO CONTACT LCRA SYSTEMS OPERATION CONTROL CENTER AT (800) 776–5272, EXT. 6220 AT LEAST 72 HOURS PRIOR TO WORKING IN LCRA EASEMENTS OR NEAR LCRA FACILITIES.

   ONCOR ELECTRIC DELIVERY COMPANY, LLC:

   A) BEFORE ANY WORK IS DONE UNDER ONCOR LINES OR BY ONCOR STRUCTURES NOTIFY THE REGION TRANSMISSION DEPARTMENT, 903–439–6910

   CITY OF GEORGETOWN
   JONAH WATER SUPPLY COMPANY
   AT&T
   VERISON
   PEDERNALES ELECTRIC COOP
   FRONTIER COMMUNICATION
   WINDSTREAM
   CAPROCK

   CALL TEXAS 811 AT 800–344–8377

4. CONTRACTOR SHALL TAKE ALL DUE PRECAUTIONS TO PROTECT EXISTING FACILITIES FROM DAMAGE DURING CONSTRUCTION. ANY DAMAGE TO EXISTING FACILITIES INCURRED AS A RESULT OF CONSTRUCTION OPERATIONS SHALL BE REPAIRED IMMEDIATELY BY THE CONTRACTOR, AT NO ADDITIONAL COST TO OWNER.
5. PRIOR TO BEGINNING ANY CONSTRUCTION, THE CONTRACTOR SHALL VERIFY HORIZONTAL AND VERTICAL LOCATIONS OF ALL KNOWN EXISTING UTILITIES WHICH WILL EITHER BE CONNECTED TO, ADJACENT, OR CROSSED, IF THERE ARE ANY CONFLICTS BETWEEN PROPOSED AND EXISTING UTILITIES, OR IF THE EXISTING UTILITIES ARE IN ANY WAY DIFFERENT FROM WHAT IS SHOWN ON THE DRAWINGS. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO NOTIFY THE ENGINEER BEFORE PROCEEDING WITH ANY CONSTRUCTION. THE CONTRACTOR SHALL WORK WITH THE ENGINEER IN RESOLVING SUCH CONFLICTS BEFORE PROCEEDING WITH WORK.
6. CONTRACTOR SHALL GIVE NOTICE TO ALL AUTHORIZED INSPECTORS, SUPERINTENDENTS, OR PERSONS IN CHARGE OF PRIVATE AND PUBLIC UTILITIES AFFECTED BY HIS OPERATIONS PRIOR TO COMMENCEMENT OF WORK.
7. WHEN UNLOCATED OR INCORRECTLY LOCATED UNDERGROUND PIPING, OR A BREAK LOCATED IN THE LINE, OR OTHER UTILITIES AND SERVICES ARE ENCOUNTERED DURING WORK OPERATIONS, NOTIFY THE APPLICABLE UTILITY COMPANY IMMEDIATELY TO OBTAIN PROCEDURE DIRECTIONS. COOPERATE WITH THE APPLICABLE UTILITY COMPANY IN MAINTAINING ACTIVE SERVICES IN OPERATION.
8. THROUGHOUT THE CONSTRUCTION, AND AT THE COMPLETION OF CONSTRUCTION, THE CONTRACTOR SHALL ENSURE THAT DRAINAGE OF STORM WATER RUNOFF IS NOT BLOCKED OR OBSTRUCTED.
9. CONTRACTOR SHALL INSTALL 2–INCH DIAMETER BY 36–INCH LONG CAPPED PVC PIPE VERTICALLY, WITH TWO (2) FEET OF SURVEYOR'S RIBBON ATTACHED, AT END OF ALL PIPE AND CONDUIT STUBS. TOP OF PIPE MARKER TO BE NOT LESS THAN 12 INCHES ABOVE THE FINISHED GRADE.
   A. WHITE RIBBON – PROPOSED EXCAVATION
   B. PINK RIBBON – TEMPORARY SURVEY MARKINGS
   C. RED RIBBON – ELECTRIC POWER LINES, CABLES, CONDUIT AND LIGHTING CABLES
   D. YELLOW RIBBON – GAS, OIL, STEAM, PETROLEUM OR GASEOUS MATERIALS
   E. ORANGE RIBBON – COMMUNICATION, ALARM OR SIGNAL LINES, CABLES OR CONDUIT
   F. BLUE RIBBON – POTABLE WATER
   G. PURPLE RIBBON – RECLAIMED WATER, IRRIGATION AND SLURRY LINES
   H. GREEN RIBBON – SEWERS AND DRAIN LINES
10. EXISTING PAVEMENT, INCLUDING SIDEWALKS AND DRIVEWAYS, SHALL BE SAWED TO A SMOOTH STRAIGHT LINE AT ALL CONSTRUCTION LIMITS.
11. CONTRACTOR SHALL PROVIDE "AS–BUILT" DRAWINGS TO THE ENGINEER IN ACCORDANCE WITH SPECIFICATION SECTION CIP14 – PROJECT CLOSEOUT.
12. ANY EXISTING PAVEMENT DAMAGED OR REMOVED DURING CONSTRUCTION SHALL BE REPLACED OR REPAIRED IN ACCORDANCE WITH THE DRAWINGS AND/OR SPECIFICATIONS TO MATCH, OR EXCEED, EXISTING CONDITIONS PRIOR TO CONSTRUCTION.
13. CONTRACTOR SHALL MAINTAIN ACCESS TO EXISTING DRIVEWAYS AT ALL TIMES.
14. THE CONTRACTOR SHALL OBTAIN ALL REQUIRED CONSTRUCTION PERMITS PRIOR TO COMMENCING WORK AND IN ACCORDANCE WITH SPECIFICATION SECTION CIP8 – LEGAL RELATIONS AND RESPONSIBILITIES TO THE PUBLIC.
15. ANY DAMAGE TO EXISTING STRUCTURES (I.E., FENCES, WALLS, R.O.W. MONUMENTS, SIGNS, CULVERTS, AND CONCRETE APRONS, ETC.) DURING CONSTRUCTION SHALL BE REPAIRED OR REPLACED AT CONTRACTOR'S EXPENSE. REPLACEMENT MATERIALS SHALL MATCH EXISTING. ALL REPAIRS MUST BE APPROVED BY ENGINEER.
16. CONTRACTOR SHALL MAINTAIN A CLEAN CONSTRUCTION SITE AT ALL TIMES FREE FROM TRASH, LITTER, BLOWING DEBRIS, AND SILT RUNOFF IN ACCORDANCE WITH SPECIFICATION SECTION CIP6 – CONTROL OF WORK.
17. CONTRACTOR IS RESPONSIBLE FOR PROVIDING ADEQUATE SANITATION FACILITIES FOR ITS EMPLOYEES AND SUB–CONTRACTORS IN ACCORDANCE WITH SPECIFICATION SECTION CIP6 – CONTROL OF WORK.

ENVIRONMENTAL NOTES:

1. A STORMWATER POLLUTION PREVENTION PLAN (SWP3) SHALL BE PREPARED IN ACCORDANCE WITH SPECIFICATION SECTION CIP 9 – ENVIRONMENTAL PROTECTION PROCEDURES.
2. ALL DISTURBED AREAS SHALL BE RESTORED AND CONTRACTOR SHALL REVEGETATE ALL EXPOSED CUT & FILL AREAS UPON COMPLETION OF CONSTRUCTION. THE SEEDING SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION G7 – LOAMING, HYDROSEEDING AND PERMANENT EROSION CONTROL.
3. IT IS THE INTENT OF THE DRAWINGS AND SPECIFICATIONS THAT THE SCOPE OF WORK INCLUDES CLEARING, EROSION CONTROLS, AND TREE PROTECTION REQUIRED FOR CONSTRUCTION. THE CONTRACTOR SHALL REMOVE ONLY TREES SO INDICATED, PLUS TREES SMALLER THAN 8" AS REQUIRED TO ENABLE CONSTRUCTION. REVEGETATION AND ENVIRONMENTAL RESTORATION IS INCLUDED IN THE SCOPE OF WORK.
4. EROSION CONTROL CONSTRUCTION SEQUENCE:
   A. CONTRACTOR SHALL INSTALL STABILIZED CONSTRUCTION ENTRANCE AND INSTALL EROSION/SEDIMENTATION CONTROLS, AND TREE PROTECTION FENCING PRIOR TO BEGINNING OF ANY CLEARING OR EXCAVATION ACTIVITIES.
   B. BEGIN CLEARING FOLLOWED BY CONSTRUCTION ACTIVITIES. PERFORM ALL CLEARING AT START OF PROJECT. INSPECT AND RESTORE EROSION CONTROL DEVICES AND TREE PROTECTION CONTROLS THROUGHOUT CONSTRUCTION PROJECT ACTIVITY.
   C. ALL TOPSOIL EXCAVATED SHALL BE STOCKPILED SEPARATELY IN A DESIGNATED AREA. UPON COMPLETION OF BACKFILL, TOPSOIL SHALL BE REPLACED OVER DISTURBED AREAS.
   D. AFTER ACCEPTANCE OF REVEGETATION BY ENGINEER, CONTRACTOR SHALL REMOVE TEMPORARY EROSION/SEDIMENTATION CONTROLS.
5. INSTALL SILT FENCE, WHERE APPLICABLE, OUTSIDE OF CANOPY OF TREES TO BE RETAINED.
6. WHERE SILT FENCING CROSSES UTILITY TRENCH EXCAVATIONS, EROSION CONTROLS SHALL BE TEMPORARILY REMOVED DURING TRENCHING AND PIPE INSTALLATION AND REPLACED IMMEDIATELY UPON COMPLETION OF TRENCH BACKFILLING.
7. IF ANY ENVIRONMENTALLY SENSITIVE FEATURE IS DISCOVERED DURING CONSTRUCTION, ALL CONSTRUCTION ACTIVITIES NEAR THE SENSITIVE FEATURE MUST BE SUSPENDED IMMEDIATELY AND THE ENGINEER MUST BE NOTIFIED IMMEDIATELY.
8. LITTER, CONSTRUCTION DEBRIS, AND CONSTRUCTION CHEMICALS EXPOSED TO STORMWATER SHALL BE PREVENTED FROM BECOMING A POLLUTANT SOURCE FOR STORMWATER DISCHARGES.
9. ALL SPOILS (EXCAVATED MATERIAL) GENERATED FROM THE PROJECT SITE MUST BE STORED ON–SITE WITH PROPER EROSION AND SEDIMENTATION CONTROLS IN ACCORDANCE WITH SPECIFICATION SECTION G4 – PIPE EXCAVATION, TRENCHING, EMBEDMENT, ENCASEMENT AND BACKFILLING.

SAFETY NOTES:

1. ALL CONSTRUCTION OPERATIONS SHALL BE ACCOMPLISHED IN ACCORDANCE WITH APPLICABLE REGULATIONS OF THE U.S. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA).
2. ELECTRICAL LINES MAY BE LOCATED CLOSE TO THE PROJECT AREA. THE ATTENTION OF THE CONTRACTOR IS DIRECTED TO THE STATE LAW (VERNON'S ANNOTATED TEXAS STATUTES, ARTICLE 1436(c)) CONCERNING OPERATION IN THE VICINITY OF ELECTRICAL LINES & THE NEED FOR EFFECTIVE PRECAUTIONARY MEASURES. IT IS A VIOLATION OF OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) REGULATIONS TO OPERATE EQUIPMENT IN SUCH A MANNER THAT PERSONS OR EQUIPMENT COME WITHIN TEN FEET OF AN ENERGIZED ELECTRIC LINE. SUCH REGULATIONS ARE ENFORCED BY OSHA, FEDERAL LAWS. TEXAS CODE ANNOTATED 1990, HEALTH AND SAFETY CODES, SUBSECTION 752.001 ET.SEQ. V.A.T.S. WAS ENACTED FOR THE PURPOSE OF ENSURING THE SAFETY OF PERSONS ENGAGED IN ACTIVITIES WITHIN PROXIMITY OF OVERHEAD LINES. THE LAW PROHIBITS ANY FUNCTION OR ACTIVITY WHERE IT IS POSSIBLE FOR THE PERSON PERFORMING SUCH ACTIVITY TO COME WITHIN SIX FEET OF AN OVERHEAD POWER LINE. THE LAW ALSO FORBIDS ANY PART OF ANY TOOL, EQUIPMENT, MACHINERY OR MATERIAL USED BY SUCH PERSON TO BE BROUGHT WITHIN SIX FEET OF ANY OVERHEAD LINE DURING THE PERFORMANCE OF SUCH ACTIVITY. IN ADDITION, THE LAW PROHIBITS OPERATION OF EQUIPMENT OR MACHINES WITHIN TEN FEET OF ANY OVERHEAD POWER LINE UNLESS CONTACT WITH SUCH LINE HAS BEEN EFFECTIVELY GUARDED AGAINST PURSUANT TO THE PROVISIONS OF THE LAW. VIOLATORS OF THE LAW ARE SUBJECT TO A FINE OR INCARCERATION OR BOTH, IN ADDITION TO CIVIL LIABILITY.
3. WHEN WORKING IN OR ADJACENT TO PUBLIC RIGHT–OF–WAY, CONTRACTOR WILL BE RESPONSIBLE FOR ERECTING AND MAINTAINING ALL BARRICADES, FLAGGERS, SIGNS AND OTHER DEVICES NECESSARY TO PROTECT THE PUBLIC AND MAINTAIN TRAFFIC FLOW. IT IS THE CONTRACTORS' RESPONSIBILITY TO FURNISH AND MAINTAIN ALL NECESSARY WARNING AND SAFETY DEVICES (FLASHING LIGHTS, FLAG MEN, BARRICADES, SIGNS, ETC.), AS REQUIRED TO ENSURE TRAFFIC SAFETY AND TO PROTECT THE PUBLIC SAFETY AND HEALTH. NO LANE CLOSURES WILL BE PERMITTED AND CONTRACTOR SHALL MAINTAIN TRAFFIC FLOW AT ALL TIMES IN EXISTING ROADWAYS.
4. IN ACCORDANCE WITH THE LAWS OF THE STATE OF TEXAS AND THE U.S. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATION, ALL TRENCHES OVER 5 FEET IN DEPTH IN EITHER HARD AND COMPACT OR SOFT AND UNSTABLE SOIL SHALL BE SLOPED, SHORED, SHEETED, BRACED OR OTHERWISE SUPPORTED. FURTHERMORE, ALL TRENCHES LESS THAN 5 FEET IN DEPTH SHALL ALSO BE EFFECTIVELY PROTECTED WHEN HAZARDOUS GROUND MOVEMENT MAY BE EXPECTED.
5. IN ACCORDANCE WITH THE U.S. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATIONS, WHEN EMPLOYEES ARE REQUIRED TO BE IN TRENCHES 4 FEET DEEP OR MORE, ADEQUATE MEANS OF EXIT, SUCH AS A LADDER OR STEPS, MUST BE PROVIDED AND LOCATED SO AS TO REQUIRE NO MORE THAN 25 FEET OF LATERAL TRAVEL.
6. TRENCH SAFETY SYSTEMS ARE INCLUDED AS A SEPARATE PAY ITEM. IT IS THE CONTRACTOR'S RESPONSIBILITY TO FURNISH ENGINEERING DESIGN, INSTALLATION, & MAINTENANCE OF THE SAFETY SYSTEMS IN ACCORDANCE WITH THE TRENCH SAFETY ENGINEER'S DRAWINGS AND SPECIFICATIONS. CONTRACTOR SHALL SUBMIT FOR REVIEW A PROJECT SPECIFIC TRENCH SAFETY SYSTEM DESIGNED BY A STATE OF TEXAS REGISTERED PROFESSIONAL ENGINEER. THE DESIGN SHALL BE SUBMITTED TO THE OWNER PRIOR TO CONSTRUCTION FOR SUBSTANTIATION OF DESIGN BY REGISTERED ENGINEER, AND FOR RECORDS OF OWNER'S FIELD REPRESENTATIVE.
7. THE WALLS AND FACES OF ALL EXCAVATIONS IN WHICH EMPLOYEES ARE EXPOSED TO DANGER FROM MOVING GROUND SHALL BE GUARDED BY A SHORING SYSTEM, OR SOME EQUIVALENT MEANS.
8. IN EXCAVATIONS WHICH CONTRACTOR'S EMPLOYEES MAY BE REQUIRED TO ENTER, EXCAVATED MATERIAL SHALL BE EFFECTIVELY STORED AND RETAINED AT LEAST 3 FEET OR MORE FROM THE EDGE OF THE OPEN TRENCH.
9. DIVERSION DIKES, DITCHES, OR OTHER SUITABLE MEANS SHALL BE USED TO PREVENT SURFACE WATER FROM ENTERING AN EXCAVATION. WATER SHALL NOT BE ALLOWED TO ACCUMULATE IN AN EXCAVATION. CONTRACTOR SHALL FOLLOW OSHA REQUIREMENTS FOR TRENCH SAFETY, INCLUDING DEWATERING AS NEEDED. THE CONTRACTOR SHALL FURNISH, INSTALL, OPERATE, AND MAINTAIN EFFECTIVE DEWATERING MEASURES. DEWATERING SHALL BE ACCOMPLISHED AT NO ADDED PAY.
10. BANKS MORE THAN 5 FEET HIGH SHALL BE SHORED, LAID BACK TO A STABLE SLOPE, OR SOME OTHER EQUIVALENT MEANS OF PROTECTION SHALL BE PROVIDED WHERE EMPLOYEES MAY BE EXPOSED TO MOVING GROUNDS OR CAVE–INS.
11. SIDES OF TRENCHES 5 FEET OR MORE IN DEPTH SHALL BE SHORED OR OTHERWISE SUPPORTED.

PUBLIC SANITARY UTILITY SEWERAGE SYSTEM NOTES:

1. ALL PUBLIC SANITARY UTILITY SYSTEM CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE CITY OF GEORGETOWN TECHNICAL SPECIFICATIONS AND STANDARD DETAILS FOR PUBLIC INFRASTRUCTURE.

SPECIAL PUBLIC SANITARY UTILITY SEWERAGE SYSTEM NOTES:

1. SANITARY SEWER PIPE, UNLESS OTHERWISE SPECIFIED ON THE PLANS, SHALL BE PER TABLE BELOW USING BEDDING, EMBEDMENT, AND BACKFILL PER THE TECHNICAL SPECIFICATIONS AND DETAILS SHOWN HEREIN.

DIAMETER	MATERIAL	SPECIFICATIONS
8"	PVC SDR26	ASTM D3034 – PS 115
12"	PVC SDR26	ASTM D3034 – PS 115
18"	PVC SDR32	ASTM F679 – PS 75
36"	CCFRPM	ASTM D3262 – SN 72
48"	PVC SDR32	ASTM F679 – PS 75
54"	CCFRPM	ASTM D3262 – SN 72
60"	CCFRPM	ASTM D3262 – SN 72

2. AN "S" SHALL BE STAMPED ON THE FACE OF CURB AT THE LOCATION OF EACH SANITARY SEWER SERVICE.
3. ALL SANITARY SEWER ADAPTERS REQUIRED TO CONNECT TO EXISTING SANITARY SEWERS ARE INCIDENTAL TO THE BID ITEM FOR SANITARY SEWER PIPE.
4. ALL STREET AND ROADWAY BORES TO BE AS SPECIFIED IN THE TRENCHLESS CONSTRUCTION NOTES.

PAVING CONSTRUCTION NOTES:

1. WHEN THE TOP OF CURB ELEVATION OR BOTTOM OF PAVEMENT SLAB IS ABOVE NATURAL GROUND, THE PAVING CONTRACTOR SHALL BACKFILL FROM THE NATURAL GROUND TO TOP OF CURB IN LAYERS NOT EXCEEDING 8 INCHES IN DEPTH AND EACH LAYER COMPACTED TO NOT LESS THAN 95% STANDARD PROCTOR DENSITY AND SHALL FILL FROM CURB TO RIGHT–OF–WAY.
2. PAVING CONTRACTOR SHALL PROTECT WATER, SEWER, AND DRAINAGE FACILITIES; AND WILL REPLACE AT HIS EXPENSE ANY FACILITIES DAMAGED DURING PAVING OPERATIONS. ALL MANHOLES AND VALVES FALLING WITHIN PAVEMENT AREA SHALL BE ADJUSTED TO FINISHED GRADE BY PAVING CONTRACTOR WITHOUT THE USE OF BLOCKOUTS WHEN DIRECTED BY OWNER (WITH NO SEPARATE PAY).
3. PAVING SHALL BE IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS.
4. EXISTING PAVEMENT, CURBS, SIDEWALKS, AND DRIVEWAYS DAMAGED OR REMOVED DURING CONSTRUCTION SHALL BE REPLACED AT NO COST TO THE OWNER.
5. ALL DRIVEWAYS WILL BE LOCATED TO AVOID EXISTING CURB INLET STRUCTURES.
6. ALL ROAD WIDTHS, CURB RADII, AND CURB ALIGNMENT SHOWN INDICATE BACK OF CURB. ALL CURB ELEVATIONS ARE TO "TOP OF CURB" UNLESS NOTED OTHERWISE.
7. AREAS TO RECEIVE FILL SHALL BE STRIPPED 6 INCHES, SCARIFIED, AND COMPACTED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS PRIOR TO FILL PLACEMENT.

STORM SEWER CONSTRUCTION NOTES:

1. CONTRACTOR SHALL PROVIDE 6" MINIMUM CLEARANCE AT STORM SEWER AND WATER LINE CROSSINGS.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING, MAINTAINING, AND RESTORING ANY BACKSLOPE DRAINAGE SYSTEMS DISTURBED AS A RESULT OF HIS WORK.
3. ALL DITCHES SHALL BE REGRADED TO PROPOSED ELEVATIONS TO INSURE PROPER DRAINAGE. ALL OUTFALLS SHALL BE PROPERLY BACKFILLED AND COMPACTED AND ALL DISTURBED AREAS SHALL BE REGRADED, SEEDED, AND FERTILIZED WITHIN 10 WORKING DAYS OF EACH OCCURRENCE.

SPECIAL STORM SEWER NOTES:

1. STORM SEWER GRAVITY PIPE, UNLESS OTHERWISE SPECIFIED ON THE PLANS, SHALL BE RCP (ASTM C76, CLASS III) BACKFILLED USING AGGREGATE EMBEDMENT PER THE TECHNICAL SPECIFICATIONS AND DETAILS SHOWN HEREIN.

REINFORCED CONCRETE NOTES:

1. ALL CONCRETE WORK SHALL CONFORM TO "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE" (ACI 318–83) AND "SPECIFICATIONS FOR STRUCTURAL CONCRETE FOR BUILDINGS" (ACI 301–84), BY THE AMERICAN CONCRETE INSTITUTE.
2. CEMENT SHALL CONFORM TO ASTM C150, TYPE I, OR TYPE II, UNLESS SPECIFIED OTHERWISE.
3. AGGREGATES SHALL CONFORM TO ASTM C33 FOR NORMAL WEIGHT AGGREGATE. THE MAXIMUM SIZE OF AGGREGATE SHALL BE 1.5," UNLESS SPECIFIED OTHERWISE.
4. MIXING WATER SHALL BE CLEAN AND FREE FROM INJURIOUS AMOUNTS OF OILS, ACIDS, ALKALIS, SALTS, ORGANIC MATERIALS, AND OTHER DELETERIOUS SUBSTANCES.
5. AIR–ENTRAINING ADMIXTURES SHALL CONFORM TO ASTM C260. OTHER ADMIXTURES TO MODIFY WORKABILITY, HARDNESS, OR OTHER CHARACTERISTICS SHALL NOT BE USED. CALCIUM CHLORIDE SHALL NOT BE USED UNDER ANY CIRCUMSTANCES.
6. ALL REINFORCEMENT SHALL BE OF DOMESTIC MANUFACTURE AND SHALL CONFORM TO ACI 318–83, AND SHALL BE FREE FROM LOOSE FLAKY RUST, LOOSE SCALE, MUD, OIL, OR OTHER COATINGS THAT WILL PREVENT OR REDUCE THE BOND. ALL REINFORCING STEEL SHALL HAVE A MINIMUM 60,000 PSI YIELD STRESS AND CONFORM TO ASTM A615 GRADE 60 DEFORMED REINFORCING BARS. REINFORCEMENT SHALL BE PLACED IN CONFORMANCE WITH ACI 318–83, CHAPTER 7, AND AS SHOWN ON THE PLANS. DETAILING OF CONCRETE REINFORCEMENT SHALL BE IN ACCORDANCE WITH ACI PUBLICATION 315.
7. ALL CONCRETE SHALL MEET THE QUALITY REQUIREMENTS SPECIFIED IN THE TECHNICAL SPECIFICATIONS.
8. DIMENSIONS SHOWN ARE TO OUTSIDE OF REBAR.
9. CAST IN PLACE CONCRETE SHALL STRICTLY ADHERE TO THE PROPORTIONS ESTABLISHED IN DESIGN MIXES, CONSISTING OF THE ACTUAL MATERIALS TO BE USED DURING CONSTRUCTION, FOR STRENGTHS AND USES INTENDED. THESE DESIGN MIXES ARE TO BE PREPARED BY A QUALIFIED LABORATORY, AND THE MATERIALS AND TEST RESULTS ARE TO BE APPROVED BY THE ENGINEER PRIOR TO USE.
10. CONTRACTOR SHALL VERIFY THE PRESENCE, LOCATION AND SIZE OF ALL OPENINGS AND SLAB DEPRESSIONS AND EMBEDMENTS PRIOR TO PLACING CONCRETE. NO OPENINGS SHALL BE PERMITTED THROUGH BEAMS, JOISTS, OR COLUMNS UNLESS NOTED OTHERWISE ON PLANS AND/OR APPROVED BY THE ENGINEER.
11. PROPER ACCESSORIES AND SUPPORTS ARE TO BE USED AS NOTED AND APPROVED ON THE SHOP DRAWINGS. PROVIDE GALVANIZED OR PLASTIC COATED CHAIRS AND BAR SUPPORTS AT SOFFITS OF ALL EXPOSED MEMBERS. ALL REINFORCING TO BE SECURELY AND ACCURATELY HELD IN POSITION.
12. PROVIDE ¾" CHAMFER ON ALL EXPOSED CORNERS OF CONCRETE.
13. CAPSULE ANCHORS SHALL BE PARABOUND CAPSULE SYSTEM BY HILTI OR APPROVED EQUAL.
14. ALL ANCHOR BOLTS SHALL BE 316 STAINLESS STEEL UNLESS NOTED OTHERWISE.

DEMOLITION NOTES:

1. FOLLOWING APPROPRIATE SAFETY PROCEDURES, DEMOLISH EXISTING FACILITIES AS SHOWN ON THE PLANS. PROTECTION OF PUBLIC AND PRIVATE PROPERTY AND SAFE DISPOSITION OF SPOIL MATERIAL IS INCLUDED IN THIS ITEM.
2. CONTRACTOR SHALL SUBMIT FOR APPROVAL TO ENGINEER AND THE OWNER A DEMOLITION PLAN INCLUDING BUT NOT LIMITED TO THE FOLLOWING:
   A. METHODS, EQUIPMENT AND SEQUENCE OF OPERATION.
   B. CREDENTIALS OF INDIVIDUALS PERFORMING DEMOLITION OPERATIONS, INCLUDING SUBCONTRACTORS.
   C. SAFETY MEASURES TO PROTECT WORKERS, PERSONNEL, AND THE PUBLIC.
   D. SAFETY MEASURES TO PROTECT ADJACENT PROPERTIES, LANDSCAPING, IMPROVEMENTS TO REMAIN OR PUBLIC RIGHTS–OF–WAY.
   E. ASBESTOS OR OTHER HAZARDOUS MATERIAL ABATEMENT PLAN, UNLESS SUCH PLAN IS PROVIDED BY THE OWNER.
   F. STORAGE, REMOVAL AND DISPOSAL OF SPOIL MATERIAL.
   G. EROSION CONTROL MEASURES, INCLUDING NPDES PROCEDURES AND REGULATIONS.
   H. POLLUTION AND AIR QUALITY CONTROL MEASURES (DUST CONTROL, ETC.).
   I. HEALTH DEPARTMENT NOTICE.
   J. UTILITY COORDINATION WITH ALL AFFECTED UTILITIES, INCLUDING LOCATION OF FACILITIES, PROTECTION DURING DEMOLITION, DAMAGE REPAIRS AND DISRUPTION OF SERVICE).
3. THE USE OF EXPLOSIVES WILL NOT BE PERMITTED.
4. THE PROJECT SITE SHALL BE CLEANED DAILY. DEBRIS, RUBBISH AND CONTRACTORS SALVAGED MATERIAL SHALL BE REMOVED PROMPTLY.
5. ALL SPOIL MATERIAL REMAINING AFTER OWNER SALVAGE IS COMPLETE AND RESULTING FROM DEMOLITION OPERATIONS BECOMES THE PROPERTY OF THE CONTRACTOR. APPROPRIATE DISPOSAL OF SPOIL MATERIAL SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AT HIS EXPENSE. OWNER WILL PROVIDE LIST OF ITEMS TO BE SALVAGED.

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) NOTE:

BY GRAPHIC PLOTTING ONLY THIS PROPERTY IS IN FEMA "SPECIAL FLOOD HAZARD AREAS" ZONES A AND AE AND REGULATORY FLOODWAY AND "OTHER AREAS" ZONE X AS SHOWN ON THE FLOOD INSURANCE RATE MAP, COMMUNITY PANELS 48491C0283F, 48491C0285F, 48491C0292F AND 48491C0315F, ALL HAVING AN EFFECTIVE DATE OF DECEMBER 20, 2019. THIS FLOOD STATEMENT DOES NOT IMPLY THAT THIS TRACT WILL, OR WILL NOT FLOOD, NOR DOES IT CREATE ANY LIABILITY IN SUCH EVENT ON THE PART OF THIS SURVEYOR OR COMPANY.

EXPLANATION OF FEMA ZONES:
FEMA "SPECIAL FLOOD HAZARD AREAS" ZONE AE = THE FLOOD INSURANCE RATE ZONE THAT CORRESPONDS TO THE 1% ANNUAL CHANCE FLOODPLAINS. BASE FLOOD ELEVATIONS DERIVED FROM THE HYDRAULIC ANALYSES ARE SHOWN WITHIN THIS ZONE.
THE FLOOD INSURANCE RATE ZONE THAT CORRESPONDS TO THE 1% ANNUAL CHANCE FLOODPLAINS. NO BASE (1% ANNUAL CHANCE) FLOOD ELEVATIONS (BFES) OR DEPTHS ARE SHOWN WITHIN THIS ZONE.

FEMA "SPECIAL FLOOD HAZARD AREAS" ZONE A = THE FLOOD INSURANCE RATE ZONE THAT CORRESPONDS TO THE 1% ANNUAL CHANCE FLOODPLAINS. NO BASE (1% ANNUAL CHANCE) FLOOD ELEVATIONS (BFES) OR DEPTHS ARE SHOWN WITHIN THIS ZONE.

FEMA "OTHER AREAS OF FLOOD HAZARD" ZONE X =0.2% ANNUAL CHANCE FLOOD HAZARD, AREAS OF 1% ANNUAL CHANCE FLOOD WITH AVERAGE DEPTH LESS THAN ONE FOOT OR WITH DRAINAGE AREAS OF LESS THAN ONE SQUARE MILE.

FEMA "OTHER AREAS" ZONE X = AREA OF MINIMAL FLOOD HAZARD

REV.	DESCRIPTION	DATE

Walker Partners
engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WALKER PARTNERS PROJECT NOTES

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C002

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CONSTRUCTION WITHIN TxDOT RIGHT-OF-WAY:

1. TXDOT'S SPECIFICATIONS:
   - A. THE INSTALLATION OF THE PIPELINE SHALL BE INSPECTED BY A REPRESENTATIVE OF THE TEXAS DEPARTMENT OF TRANSPORTATION BEFORE BACKFILL IS MADE.
   - B. RIGHT-OF-WAY SHALL BE RESTORED TO ITS ORIGINAL CONDITION, INCLUDING, BUT NOT LIMITED TO, THE RE-ESTABLISHMENT OF GRASSES AND/OR WILDFLOWERS. WORK IN OR AROUND LARGE WOODY VEGETATION OR A CONCENTRATION OF WOODY VEGETATION SHALL BE DONE IN SUCH A MANNER AS TO NOT DAMAGE THE VEGETATION. BEFORE CONSTRUCTION IS STARTED, A SATISFACTORY MUTUAL ARRANGEMENT SHALL BE REACHED BETWEEN THE TEXAS DEPARTMENT OF TRANSPORTATION, THE UTILITY AGENT AND THE CONTRACTOR CONCERNING VEGETATION MANAGEMENT REQUIREMENTS.
   - C. UPON COMPLETION OF THE INSTALLATION, A FINAL INSPECTION SHALL BE MADE BY THE TEXAS DEPARTMENT OF TRANSPORTATION.
2. TRENCH EXCAVATIONS AND PIT LOCATIONS
   - A. GENERAL – NO DIRT FROM A TRENCH OR PIT EXCAVATION SHALL BE PLACED ON THE ROADWAY OR SHOULDERS. ALL EQUIPMENT AND STOCKPILED DIRT SHALL MEET THE SAFETY CLEAR ZONE DISTANCES LISTED BELOW OR HAVE ADEQUATE BARRICADES AND WARNING DEVICES TO PROTECT THE TRAVELING PUBLIC.

     TOPSOIL SHALL BE KEPT SEPARATE FROM THE OTHER EXCAVATION MATERIAL, AND REPLACED IN ACCORDANCE WITH "SPECIFICATIONS FOR BACKFILL."
   - B. ALL PITS AND TRENCHES SHALL BE KEPT DRY AND FREE FROM STANDING WATER. IF ANY TRENCHES AND/OR PITS ARE LEFT OPEN FOR EXTENDED PERIODS OF TIME WITHOUT A CONTINUOUS PROGRESSION OF WORK, THE UTILITY WILL BE REQUIRED TO BACKFILL THE TRENCHES AND/OR PITS.
   - C. IN ALL EXCAVATIONS WHERE SLOUGHING IS LIKELY TO OCCUR, SHORING SHALL BE UTILIZED TO PREVENT DAMAGE TO THE HIGHWAY STRUCTURE(S). THE UTILITY AGENCY OF CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING TRENCH EXCAVATION PROTECTION AS REQUIRED BY PROVISIONS OF PART 1926, SUBPART P– EXCAVATIONS, TRENCHING, AND SHORING OF OSHA STANDARDS.
   - D. TRENCHING – LONGITUDINAL INSTALLATIONS MUST BE PLACED AS NEAR A UNIFORM ALIGNMENT TO THE RIGHT-OF-WAY LINE AS POSSIBLE. THIS OPERATION MAY BE DONE BY A TRENCHING MACHINE OR BACKHOE. IF A UNIFORM ALIGNMENT CANNOT BE MAINTAINED BY USING A TRENCHING MACHINE, THE TXDOT INSPECTOR CAN REQUIRE THE USE OF A BACKHOE MACHINE TO OBTAIN A MORE UNIFORM ALIGNMENT.
   - E. SAFETY CLEAR ZONE DISTANCES – CLEAR ZONE DISTANCES REQUIRED FOR TRENCH EXCAVATIONS, STOCKPILES, AND BORE PIT LOCATIONS AS FOLLOWS:

     FOR UNCURBED HIGHWAYS:

     1) THIRTY (30) FEET FROM EDGE OF PAVEMENT OF HIGH SPEED (OVER 40 MPH), HIGH VOLUME (OVER 750 VEHICLES PER DAY) HIGHWAYS.
     2) SIXTEEN (16) FEET FROM THE EDGE OF PAVEMENT OF HIGH-SPEED, LOW VOLUME (LESS THAN 750 VEHICLES PER DAY) HIGHWAYS.
     3) SIXTEEN (16) FEET FROM RAMPS.
     4) TEN (10) FEET FOR LOW-SPEED (40 MPH OR LESS) HIGHWAYS.
     5) TEN (10) FEET FOR ANY INTERSECTING SIDE STREETS.

     FOR CURBED HIGHWAYS:

     1) THIRTY (30) FEET FROM EDGE OF PAVEMENT OF HIGH SPEED (OVER 40 MPH), HIGH VOLUME (OVER 750 VEHICLES PER DAY) HIGHWAYS.
     2) FIVE (5) FEET FROM THE BACK OF CURB, PLUS ANY ADDITIONAL DISTANCE TO CLEAR EXISTING SIDEWALKS, OF LOW SPEED (40 MPH OR LESS) HIGHWAYS.
     3) FIVE (5) FEET FROM BACK OF CURB FOR ANY INTERSECTING SIDE STREETS.
3. GENERAL CONDITIONS
   - A. ALL EXISTING UTILITIES MUST BE LOCATED AND MARKED, AND THE PROPOSED LINE ROUTE MUST BE STAKED AND APPROVED PRIOR TO ANY INSTALLATION. PROPOSED LINE MUST FOLLOW THE ALIGNMENT OF AND BE WITHIN FIVE FEET (5') OF THE STATE RIGHT-OF-WAY LINE. TXDOT IS NOT RESPONSIBLE FOR ANY STAKING OF RIGHT-OF-WAY. INSTALLATION OF PROPOSED CROSSINGS AT INTERSECTIONS WITH TRAFFIC LIGHT SYSTEMS OF ANY TYPE MUST FIRST BE CLEARED WITH THE DISTRICT TRAFFIC SIGNAL SERVICE DEPARTMENT (512-832-7000). THIS WOULD INCLUDE AREAS WITH SAFETY LIGHTING.
   - B. HIGHWAY LANE SURFACES AND PAVED SHOULDERS MUST BE KEPT FREE OF MUD AND OTHER DEBRIS AT ALL TIMES. OVERHANGING BRUSH AND/OR TREE LIMBS ENCOUNTERED IN YOUR PREVIOUSLY APPROVED ROUTE MUST BE NEATLY PRUNED AND IN ACCEPTABLE MANNER TO TXDOT, AND THE TRIMMINGS DISPOSED OF. IF LARGE DESIRABLE TREES OR A ROW OR THICKET OF SMALLER TREES OR BRUSH LIES IN THE PATH OF YOUR ROUTE, THEY MUST BE NEGOTIATED BY DIRECTIONAL BORING UNDERNEATH AT A DEPTH SO AS NOT TO DAMAGE THE ROOT SYSTEM. "SKIRTING AROUND" OR CHANGING THE ALIGNMENT OF THE PIPELINE INSTALLATION TO AVOID THIS TYPE OF VEGETATION WILL NOT BE ALLOWED.
   - C. ANY PROPOSED FIELD CHANGES OR MODIFICATIONS DUE TO UNFORESEEN CIRCUMSTANCES MUST BE APPROVED PRIOR TO ANY INSTALLATION.
   - D. AFTER THE INSTALLATION OF PIPELINE IS COMPLETE, A THOROUGH CLEANUP OF THE RIGHT-OF-WAY IS REQUIRED. THIS SHALL INCLUDE, BUT NOT BE LIMITED TO, COMPACTION AND LEVELING OF TRENCH LINE AND BORE SITES, REMOVAL OF ALL COARSE ROCK BROUGHT TO THE SURFACE, AND THE SMOOTHING OF ANY AND ALL RUTTING OF THE RIGHT-OF-WAY CREATED AS A RESULT OF INSTALLATION.
4. SPECIAL PROVISIONS ATTACHED TO AND PART OF THIS PERMIT
   - A. THE PERMIT APPLICANT SHALL INSURE THAT THE CONTRACTOR'S AGENTS (EMPLOYEES, CONTRACTORS AND SUBCONTRACTORS) ARE COVERED BY COMMERCIAL GENERAL LIABILITY INSURANCE, TEXAS BUSINESS AUTOMOBILE INSURANCE AND WORKER'S COMPENSATION INSURANCE IN THE AMOUNTS SHOWN ON TXDOT FORM NO. 1560. THE TXDOT ENGINEER AT HIS/HER DISCRETION MAY REQUIRE PROOF OF INSURANCE (COMPLETED TXDOT FORM NO. 1560) PRIOR TO THE APPROVAL OF THE PERMIT.
   - B. NOTIFICATION OF AT LEAST FORTY-EIGHT (48) HOURS PRIOR TO STARTING CONSTRUCTION OF UTILITY INSTALLATION IS REQUIRED. FAILURE TO COMPLY MAY RESULT IN A SHUTDOWN OF THE PROJECT. THE INSTALLATION CREW AND/OR CONTRACTOR MUST HAVE AN APPROVED COMPLETE COPY OF THIS PERMIT IN THEIR POSSESSION AT THE JOBSITE.
   - C. PRIOR TO STARTING CONSTRUCTION THE CONTRACTOR'S REPRESENTATIVE WILL BE REQUIRED TO MEET WITH TXDOT'S AREA ENGINEERS OFFICE IN ADVANCE OF ANY OPERATIONS TO DISCUSS THE TRAFFIC CONTROL PLAN (SIGNING, BARRICADES, ETC.), THE ESTIMATED TIME OF COMPLETION, CLEAN-UP, AND FINAL INSPECTION.

GRADING NOTES:

1. VERIFY THE SUITABILITY OF ALL EXISTING AND PROPOSED SITE CONDITIONS INCLUDING GRADES AND DIMENSIONS BEFORE COMMENCEMENT OF CONSTRUCTION. THE ENGINEER SHALL BE NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES. MINOR ADJUSTMENT TO FINISH GRADE TO ACCOMPLISH SPOT DRAINAGE IS ACCEPTABLE, IF NECESSARY, UPON PRIOR APPROVAL OF THE ENGINEER.
2. ALL FILL MATERIAL SHALL BE APPROVED BY THE ENGINEER PRIOR TO IMPORTING AND/OR PLACING AND COMPACTING.

TRAFFIC CONTROL NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR TRAFFIC CONTROL. A TRAFFIC CONTROL PLAN MUST BE SUBMITTED FOR APPROVAL PRIOR TO CONSTRUCTION.
2. TRAFFIC CONTROL SHALL CONFORM TO APPLICABLE REQUIREMENTS OF THE TEXAS MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS (THE LATEST EDITION). ADEQUATE SIGNS, BARRICADES, FLAG PERSONNEL, ETC. SHALL BE ERECTED AND MAINTAINED IN COMPLETE COMPLIANCE WITH THE TEXAS MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.
3. ANY METHODS, STREET MARKINGS AND SIGNAGE NECESSARY FOR WARNING MOTORISTS, WARNING PEDESTRIANS OR DIVERTING TRAFFIC DURING CONSTRUCTION SHALL CONFORM TO THE TEXAS MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS (THE LATEST EDITION).
4. ALL PAVEMENT MARKINGS, MAKERS, PAINT, TRAFFIC BUTTONS, TRAFFIC CONTROLS AND SIGNS SHALL BE INSTALLED IN ACCORDANCE WITH THE TEXAS DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREETS AND BRIDGES AND THE TEXAS MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS (THE LATEST EDITIONS).

EARTHWORK:

1. EXCESS MATERIAL RESULTING FROM EXCAVATION OPERATIONS IS THE PROPERTY OF THE CONTRACTOR. APPROPRIATE DISPOSAL SHALL BE AT THE CONTRACTOR'S EXPENSE.
2. ALL EXCAVATION SHALL BE PERFORMED AS DIRECTED IN THE DRAWINGS AND IN COMPLIANCE WITH OSHA STANDARDS.
3. DATA ON SUBSURFACE CONDITIONS IS AVAILABLE TO THE CONTRACTOR FROM THE OWNER UPON REQUEST. THE OWNER MAKES NO WARRANTY AS TO THE CORRECTNESS OF THESE REPORTS. THE CONTRACTOR MAY, AT HIS OWN EXPENSE, PERFORM ADDITIONAL TEST BORINGS.
4. CONTRACTOR IS RESPONSIBLE FOR COORDINATION WITH ALL AFFECTED UTILITY COMPANIES. THIS SHALL INCLUDE LOCATION OF FACILITIES, PROTECTION DURING CONSTRUCTION, DAMAGE REPAIRS AND DISRUPTION OF SERVICE.
5. THE EXCAVATION IS UNCLASSIFIED, AND CONTRACTOR SHALL PERFORM EXCAVATION TO THE ELEVATIONS INDICATED IN THE PLANS, REGARDLESS OF CHARACTER OF MATERIAL, WITH NO ADDITIONAL COMPENSATION FROM THE OWNER. USE OF EXPLOSIVES IS PROHIBITED.
6. CONTRACTOR IS RESPONSIBLE FOR PROVIDING BARRICADES REQUIRED TO WARN AND/OR PREVENT ACCESS TO CONSTRUCTION AREA.
7. CONTRACTOR IS RESPONSIBLE FOR PROTECTING ADJACENT FACILITIES FROM DAMAGE.
8. OVER-EXCAVATION IS NONCOMPENSABLE, AND SHALL BE BACKFILLED AND COMPACTED AS DIRECTED BY THE ENGINEER AT NO ADDITIONAL COST TO THE OWNER.
9. CONTRACTOR SHALL PROVIDE ALL LABOR AND EQUIPMENT NECESSARY TO PROPERLY DEWATER EXCAVATION AREAS – AS REQUIRED.
10. EXCAVATED MATERIAL SHALL BE STOCKPILED WHERE DIRECTED IN THE PLANS. STOCKPILE SHALL BE MAINTAINED IN COMPLIANCE WITH ALL RELEVANT POLLUTION PREVENTION PLANS.

TRENCHLESS CONSTRUCTION NOTES:

1. REACHES DESIGNATED AS "TRENCHLESS CONSTRUCTION" ON THE PLANS MUST BE INSTALLED VIA TRENCHLESS METHODS. REACHES DESIGNATED AS "TRENCHLESS CONSTRUCTION ALTERNATE" MAY BE INSTALLED BY TRENCHLESS OR OPEN CUT METHODOLOGIES. REACHES UTILIZING TRENCHLESS METHODOLOGIES MUST BE INSTALLED BY EITHER TUNNEL BORING MACHINE PER SPECIFICATION SECTION 33 30 02 OR MICROTUNNEL BORING MACHINE PER SPECIFICATION SECTION 33 30 03. SPECIFIC REACHES REQUIRE THE USE OF A TWO-PASS SYSTEM UTILIZING OVERSIZED STEEL CASING OR CONCRETE JACKING PIPE FUNCTIONING AS CASING WITHIN WHICH THE CCFRPM CARRIER PIPE IS INSTALLED. OTHER REACHES THE CONTRACTOR IS PERMITTED TO INSTALL THE CARRIER PIPE DIRECTLY UTILIZING CCFRPM JACKING PIPE. SEE ADDITIONAL NOTES AND TABLE BELOW SUMMARIZING THE METHODOLOGY REQUIREMENTS OF EACH REACH
2. IN A TWO-PASS SYSTEM, THE CCFRPM CARRIER PIPE SHALL BE OF THE NOMINAL DIAMETER INDICATED ON THE DRAWING, BE MINIMUM SN-72, AND BE INSTALLED PER SPECIFICATION 33 05 24 INSTALLATION OF CARRIER PIPE IN CASING.
3. IF INSTALLED DIRECTLY, THE CCFRPM JACKING PIPE SHALL BE PROVIDED WITH AN INSIDE DIAMETER EQUAL TO OR SLIGHTLY LARGER THAN THE INSIDE DIAMETER OF THE CCFRPM CARRIER PIPE THAT WOULD BE PROVIDED IN A TWO-PASS INSTALLATION AND BE MINIMUM SN-72. CONNECTING CCFRPM JACKING PIPE TO CARRIER PIPE INSTALLED IN TWO-PASS TUNNELING OR CCFRPM JACKING PIPE TO DIRECT BURY PIPE WILL NOT BE ALLOWED. CCFRPM JACKING PIPE SHALL BE CONNECTED TO CONCRETE MANHOLES IN ACCORDANCE WITH SPECIFICATION SECTION WW1.09 PIPE CONNECTION TO MANHOLE. CONTRACTOR SHALL COORDINATE THE INSTALLATION OF CCFRPM JACKING PIPE AND CONCRETE MANHOLES TO PROVIDE OPENING(S) FOR THE CONNECTION(S) OF THE CCFRPM JACKING PIPE AND THE MANHOLE(S) TO THE DIMENSIONS AND SIZE REQUIRED TO COMPLETE THE CCFRPM JACKING PIPE TO MANHOLES.
4. PER SPECIFICATION 33 30 02 OR 33 30 03, THE CONTRACTOR IS RESPONSIBLE FOR THE FINAL STRUCTURAL DESIGN OF THE STEEL CASING OR CONCRETE JACKING PIPE FUNCTIONING AS CASING, OR CCFRPM PIPE INSTALLED IN SINGLE PASS CONSTRUCTION TO ACCOMMODATE ALL CONSTRUCTION LOADING INCLUDING, BUT NOT LIMITED TO, GROUND LOADING, HYDROSTATIC PRESSURE, JACKING LOADS, HANDLING LOADS, AND SURCHARGE LOADS.
5. A TWO PASS SYSTEM UTILIZING STEEL CASING PIPE WITH A MINIMUM THICKNESS OF 0.5 INCHES IS REQUIRED FOR REACHES 1, 4, AND 17. REACH 1 WHICH CROSSES BENEATH FM 971 MAY UTILIZE HAND TUNNELING TO INSTALL THE STEEL CASING PER SPECIFICATION 33 30 04. SEE TABLE BELOW.
6. BORE PIT OR SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES.
7. CONTRACTOR IS RESPONSIBLE FOR DESIGNING THE BORE PIT OR SHAFT SUPPORT OF EXCAVATION PER SPECIFICATION SECTION 33 73 15 WHERE TRENCH EXCAVATIONS ARE UTILIZED TO FACILITATE TRENCHLESS CONSTRUCTION, THE DESIGN REQUIREMENTS IN SECTION 33 73 15 – SHAFTS WILL GOVERN THE DESIGN.
8. THE CONTRACTOR SHALL PROVIDE PUMP OR DEWATERING SYSTEM TO CONTROL GROUNDWATER ENTERING INTO THE BORE PIT OR SHAFT EXCAVATION IN ACCORDANCE WITH THE SPECIFICATIONS.

TUNNEL REACH DESIGNATION	REQUIRED TRENCHLESS OR ALTERNATE	APPROXIMATE BEGINNING STATION	APPROXIMATE END STATION	LENGTH* (FEET)	NOMINAL CARRIER PIPE DIAMETER	CASING	NOMINAL CASING PIPE DIAMETER** (INCHES)
REACH 1	REQUIRED	4+48	5+28	80	60	REQUIRED – STEEL	78
REACH 2	REQUIRED	56+71	59+50	279	54	REQUIRED – STEEL OR RCP	72
REACH 3	ALTERNATE	65+20	75+20	1000	54	STEEL, RCP, OR SINGLE-PASS	72
REACH 4	REQUIRED	75+20	79+16	396	54	REQUIRED – STEEL	72
REACH 5	REQUIRED	79+16	85+53	637	54	STEEL, RCP, OR SINGLE-PASS	72
REACH 6	REQUIRED	85+53	91+89	637	54	STEEL, RCP, OR SINGLE-PASS	72
REACH 7	REQUIRED	91+89	101+89	1000	54	STEEL, RCP, OR SINGLE-PASS	72
REACH 8	ALTERNATE	101+89	106+89	500	54	STEEL, RCP, OR SINGLE-PASS	72
REACH 9	ALTERNATE	106+89	114+07	718	54	STEEL, RCP, OR SINGLE-PASS	72
REACH 10	REQUIRED	114+07	122+73	866	54	STEEL, RCP, OR SINGLE-PASS	72
REACH 11	ALTERNATE	122+73	132+67	994	36	STEEL, RCP, OR SINGLE-PASS	54
REACH 12	ALTERNATE	132+67	142+67	1000	36	STEEL, RCP, OR SINGLE-PASS	54
REACH 13	ALTERNATE	142+67	149+00	633	36	STEEL, RCP, OR SINGLE-PASS	54
REACH 14	REQUIRED	149+00	151+97	297	36	STEEL, RCP, OR SINGLE-PASS	54
REACH 15	REQUIRED	151+97	158+58	662	36	STEEL, RCP, OR SINGLE-PASS	54
REACH 16	REQUIRED	158+58	165+29	671	36	STEEL, RCP, OR SINGLE-PASS	54
REACH 17	REQUIRED	165+29	171+81	652	36	REQUIRED – STEEL	54
REACH 18	ALTERNATE	171+81	175+86	405	36	STEEL, RCP, OR SINGLE-PASS	54
REACH 19	REQUIRED	175+86	179+50	364	36	STEEL, RCP, OR SINGLE-PASS	54
REACH 20	ALTERNATE	179+50	183+14	364	36	STEEL, RCP, OR SINGLE-PASS	54
REACH 21	REQUIRED	183+14	184+68	154	36	REQUIRED – STEEL OR RCP	54
REACH 22	ALTERNATE	184+68	187+71	303	36	STEEL, RCP, OR SINGLE-PASS	54
REACH 23	ALTERNATE	187+71	190+25	254	36	STEEL, RCP, OR SINGLE-PASS	54
REACH 24	REQUIRED	190+25	191+25	100	36	REQUIRED – STEEL OR RCP	54
REACH 25	ALTERNATE	191+25	194+19	294	36	STEEL, RCP, OR SINGLE-PASS	54
REACH 26	REQUIRED	232+61	234+90	229	36	REQUIRED – STEEL OR RCP	54

* THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING THE EXACT STATIONING AND LENGTHS FOR TREHNCLESS REACHES BASED ON THEIR MEANS AND METHODS INCLUDING SHAFT LOCATIONS AND SIZES.

** CASING PIPE DIAMETER MAY BE REFINED BY CONTRACTOR BASED ON MEANS AND METHODS AND SELECTED PIPE TYPES.

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Walker Partners engineers | surveyors
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CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

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03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C003

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ENVIRONMENTAL, CULTURAL RESOURCES, AND HAZARDOUS WASTE NOTES:

1. DO NOT ENGAGE IN ANY ACTIVITY THAT PURSUES, HUNTS, TAKES, CAPTURES, KILLS, POSSESSES, SELLS, PURCHASES, BARTERS, IMPORTS, EXPORTS OR TRANSPORTS ANY MIGRATORY BIRD OR ANY PART, NEST OR EGG OF SUCH BIRD. CONTRACTOR SHALL NOT USE EASEMENTS OR RIGHT-OF-WAY FOR RECREATION AT ANY TIME, INCLUDING BUT NOT LIMITED TO HUNTING, FISHING, SHOOTING, HIKING, BICYCLING, OR CAMPING.

2. IMMEDIATELY NOTIFY CITY INSPECTOR IF ANY RARE OR ENDANGERED SPECIES (KARST INVERTEBRATES, SPRING ADAPTED SALAMANDERS) OR SPECIAL FEATURE (CAVE) IS FOUND WITHIN THE SITE. ALSO NOTIFY CITY INSPECTOR IF ANY BATS ARE SEEN ROOSTING (SLEEPING/NESTING) WITHIN THE PROJECT AREA, SPECIFICALLY WITHIN TREES, BUILDINGS, BRIDGES OR CULVERTS.

3. DO NOT ENGAGE IN ANY ACTIVITY THAT TAKES, HARMS OR HARASSES A STATE OR FEDERAL LISTED THREATENED OR ENDANGERED SPECIES. IF A STATE OR FEDERALLY THREATENED OR ENDANGERED SPECIES IS ENCOUNTERED DURING WORK, IMMEDIATELY CEASE WORK IN THE AREA OF THE ENCOUNTER AND NOTIFY THE CITY INSPECTOR AND THE ENGINEER, WHO WILL DETERMINE AN APPROPRIATE COURSE OF ACTION. DO NOT RESUME WORK IN THE AREA OF THE ENCOUNTER UNTIL AUTHORIZED TO DO SO BY THE OWNER.

4. NO WILDLIFE SPECIES SHOULD BE PICKED UP, HANDLED, HARMED, OR KILLED UNLESS THE SAFETY OF WORKERS IS BEING COMPROMISED. AVOID WILDLIFE AND ALLOW TO ESCAPE FROM EQUIPMENT AND CONSTRUCTION AREA WHEN FEASIBLE. WHEN POSSIBLE, COORDINATE REMOVAL OF WILDLIFE WITH THE OWNERS ENVIRONMENTAL PROFESSIONAL.

5. IF CULTURAL RESOURCES ARE ENCOUNTERED DURING CONSTRUCTION (ARCHEOLOGICAL FINDINGS UNEARTHED) CONTRACTOR SHALL STOP WORK IN THAT AREA AND IMMEDIATELY CONTACT THE CITY INSPECTOR AND THE TEXAS HISTORICAL COMMISSION AT (512) 463-6100.

6. ALL HUMAN REMAINS IN THE STATE OF TEXAS ARE PROTECTED BY LAW. IN THE EVENT THAT HUMAN REMAINS OR BURIALS ARE ENCOUNTERED THE CONTRACTOR WILL STOP WORK IMMEDIATELY WITHIN 100 FEET OF THE DISCOVERY AND IMMEDIATELY CONTACT THE CITY INSPECTOR. THE CONTRACTOR IN COORDINATION WITH THE CITY INSPECTOR WILL PROTECT THE AREA FROM FURTHER DISTURBANCE BY COVERING THE BURIAL WITH IMPERMEABLE PLASTIC SHEETING, AND MARK IT WITH LATHING STAKES OR FENCING. THE CITY INSPECTOR WILL IMMEDIATELY CONTACT BOTH LOCAL LAW ENFORCEMENT AND THE STATE HISTORIC PRESERVATION (SHPO) OFFICER. IF HUMAN SKELETAL REMAINS APPEAR TO BE FROM AN UNREGISTERED GRAVE, THE CORONER SHALL NOTIFY THE SHPO WITHIN 24 HOURS. UNDER THE TEXAS HEALTH AND SAFETY CODE (8 THSC § 711.010) AND THE TEXAS ANTIQUITIES CODE (13 TAC §§ 22.1-22.6) THE COUNTY CLERK SHALL BE NOTIFIED WITHIN 10 DAYS OF THE DISCOVERY OF THE GRAVE OR GRAVES. IF THE HUMAN REMAINS ARE DETERMINED TO BE NATIVE AMERICAN, THEY WILL BE HANDLED IN ACCORDANCE WITH THE NATIVE AMERICAN GRAVES PROTECTION AND REPATRIATION ACT (NAGPRA). WORK IN THE AFFECTED AREA MAY RESUME PER SHPO AUTHORIZATION.

SHPO Contact Information:
Mark Wolfe
State Historic Preservation Officer
Texas Historical Commission
P.O. Box 12276
Austin, Texas 78711-2276
Phone: 512-463-6100
Fax: 512-463-8222
mark.wolfe@thc.state.tx.us

7. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE CITY INSPECTOR OF ANY SUSPECTED HAZARDOUS MATERIALS ENCOUNTERED BEFORE OR DURING PERFORMANCE OF THE WORK AND SHALL TAKE ALL NECESSARY PRECAUTIONS TO AVOID FURTHER DISTURBANCE OF THE MATERIALS.

8. IMMEDIATELY NOTIFY CITY INSPECTOR IF ANY CAVES OR OTHER KARST FEATURES ARE ENCOUNTERED DURING TRENCHING OR OTHER SUBSURFACE ACTIVITIES. CEASE WORK WITHIN 50 FEET OF ANY SUCH FEATURE, KEEP EQUIPMENT 50 FEET AWAY, ERECT STORMWATER BMPS AROUND THE FEATURE, AND CONTACT TCEQ WITHIN 24 HOURS.

9. KEEP EQUIPMENT AND MATERIALS OUT OF WATERWAYS AND WETLANDS. IMMEDIATELY NOTIFY CITY INSPECTOR IF EQUIPMENT OR MATERIALS ARE ACCIDENTALLY LOCATED WITIHN WETLANDS.

10. ACTIVE AND DIRECT DISCHARGES OF SEDIMENT LADEN WATER FROM DEWATERING OPERATIONS INTO ANY STORM DRAINS OR RECEIVING WATERS UNPROTECTED BY BEST MANAGEMENT PRACTICES (BMPS) ARE IN VIOLATION OF THE SITE'S CONSTRUCTION GENERAL PERMIT (CGP). DISCHARGING SEDIMENT LADEN WATER FROM DEWATERING OPERATIONS SHALL COMPLY WITH CITY SPECIFICATION SECTION CIP9 AND IN ACCORDANCE WITH THE STORMWATER PREVENTION POLLUTION PLAN (SWPPP).

11. IF SEDIMENT ESCAPES THE PROJECT AREA, OFF-SITE ACCUMULATIONS WILL BE REMOVED AT A FREQUENCY TO MINIMIZE FURTHER NEGATIVE EFFECTS AND, WHENEVER FEASIBLE, PRIOR TO THE NEXT RAIN EVENT. SEDIMENT TRACKED ONTO PUBLIC ROADWAYS MUST BE REMOVED AND PROPERLY DISPOSED OF IMMEDIATELY IN ACCORDANCE WITH THE SWPPP.

12. STABILIZATION MEASURES WILL BE INITIATED IMMEDIATELY IN PORTIONS OF THE PROJECT AREA WHERE CONSTRUCTION ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED AND WILL NOT RESUME FOR A PERIOD EXCEEDING 14 CALENDAR DAYS. IF THE PROJECT AREA IS EXPERIENCING A DROUGHT AND THE 14-DAY PERIOD IS PRECLUDED BY SEASONAL ARID CONDITIONS, ALTERNATIVE STABILIZATION MEASURES MUST BE INITIATED AS SOON AS PRACTICABLE. THE ESTABLISHMENT OF PERMANENT VEGETATION WILL INVOLVE NATIVE PLANT SPECIES, SO AREAS MAY BE TEMPORARILY STABILIZED WITH ANNUAL NON-NATIVES (E.G., RYEGRASS) UNTIL THE APPROPRIATE PLANTING SEASON FOR THE PERMANENT VEGETATION IS REACHED.

LIVESTOCK PROTECTION NOTES:

1. LIVESTOCK IS OR WILL BE PRESENT ON PRIVATE PROPERTIES THAT THE CONTRACTOR WILL USE TO CONSTRUCT THIS PROJECT. LIVESTOCK IS THE PERSONAL PROPERTY OF THE EASEMENT GRANTOR. CARE AND PROTECTION OF PROPERTY SHALL BE IN ACCORDANCE WITH CITY SPECIFICATION SECTION CIP 6 CONTROL OF WORK.

2. LIVESTOCK SAFEY FENCE IS NOTED ON THE PLANS, BUT IT IS THE CONTRACTOR'S RESPONSIBILITY TO TAKE REASONABLE MEASURES TO PROTECT ALL LIVESTOCK AND GUARD AGAINST DAMAGES FROM LIVESTOCK.

3. LIVESTOCK SAFETY FENCE MAY CONSIST OF TEMPORARY FENCING, PANELS, OR OTHER DEVICES THAT ARE APPROVED BY THE CITY INSPECTOR. NO SEPARATE PAYMENT WILL BE MADE FOR LIVESTOCK SAFETY FENCE, CATTLEGUARDS, GATES, OR OTHER ITEMS USED BY THE CONTRACTOR TO PROTECT LIVESTOCK IN ACCORDANCE WITH SECTION CIP 6 CONTROL OF WORK, AND THE COST THEREOF SHALL BE INCLUDED IN THE APPROPRIATE ITEMS OF THE PROPOSAL AND BID SCHEDULE EXCEPT FOR THE PIPE GATE AND CATTLEGUARD AT THE END OF MARKET STREET. PAYMENT FOR THE PIPE GATE AND CATTLEGUARD AT THE END OF MARKET STREET WILL BE PAID BY THE UNIT QUANTITIES FOR THE ITEMS INCLUDED IN THE PROPOSAL AND BID SCHEDULE.

4. TO THE EXTENT ALLOWED BY LAW, CONTRACTOR INDEMNIFIES ALL EASEMENT GRANTORS FROM ANY CLAIM OR CLAIMS RELATED TO CONTRACTOR'S OPERATION WITHIN THE CONSTRUCTION AREA OR CLAIMS RELATED TO GRANTOR'S AGRICULTURAL OPERATION WITHIN THE CONSTRUCTION AREA, INCLUDING DAMAGE TO EQUIPMENT OR INJURIES RESULTING FROM GRANTOR'S LIVESTOCK. CONTRACTOR FURTHER AGREES, TO THE EXTENT ALLOWED BY LAW, TO INDEMNIFY GRANTOR FROM ANY CLAIM OR CLAIMS RESULTING FROM CONTRACTOR'S FAILURE TO EXERCISE REASONABLE CARE TO ENSURE GRANTOR'S LIVESTOCK DOES NOT ESCAPE FROM GRANTOR'S PROPERTY, AS REQUIRED BY THIS AGREEMENT.

5. CONTRACTOR WILL TAKE REASONABLE MEASURES (INCLUDING, INSTALLING TEMPORARY FENCING) TO PREVENT LIVESTOCK FROM BEING INJURED BY FALLING INTO AN OPEN DITCH, EXCAVATIONS, OR SHAFTS DURING THE CONSTRUCTION PERFORMED BY THE CONTRACTOR. CONTRACTOR WILL PROMPTLY PAY EASEMENT GRANTOR FOR ANY LIVESTOCK THAT ARE INJURED OR KILLED BY FALLING INTO CONTRACTOR'S OPEN DITCH, EXCAVATIONS, OR SHAFTS DUE TO CONTRACTOR'S NEGLIGENCE, PROVIDED EASEMENT GRANTOR GIVES CONTRACTOR NOTICE OF THE SAME IN WRITING ACCOMPANIED BY REASONABLE DOCUMENTATION SUPPORTING THE SAME. CONTRACTOR WILL BRACE AND SECURE ANY BOUNDARY LINE FENCING THAT IT CUTS TO ENSURE THAT GRANTOR'S CATTLE DO NO LEAVE GRANTOR'S PROPERTY.

6. CONTRACTOR TO PROVIDE NON-VEHICULAR WARNING SIGNS FOR LIVESTOCK AT ALL ENTRANCES INTO A PASTURE AND AT ALL LIVESTOCK CROSSINGS.

ALTERNATE BID POLYMER CONCRETE MANHOLES:

1. ALTERNATE BID POLYMER CONCRETE MANHOLES SHALL BE MANUFACTURED BY ARMOROCK, LLC OR APPROVED EQUAL.

2. <u>SUBMITTALS:</u>

A. SUBMIT MANUFACTURER'S DATA AND DETAILS OF FOLLOWING ITEMS FOR APPROVAL:

i. SHOP DRAWINGS OF MANHOLE SECTIONS, BASE UNITS AND CONSTRUCTION DETAILS, JOINTING METHODS, MATERIALS, AND DIMENSIONS.

ii. SUMMARY OF CRITERIA USED IN MANHOLE DESIGN INCLUDING, AS MINIMUM, MATERIAL PROPERTIES, LOADING CRITERIA, AND DIMENSIONS ASSUMED. INCLUDE CERTIFICATION FROM MANUFACTURER THAT POLYMER CONCRETE MANHOLE DESIGN MEETS OR EXCEEDS THE LOAD AND STRENGTH REQUIREMENTS OF ASTM C 478 AND ASTM C 857, REINFORCED IN ACCORDANCE WITH ACI 440.1R-15. INCLUDE CURRENT ISO 9001:2018 CERTIFICATION

iii. FRAMES, GRATES, RINGS, AND COVERS.

iv. MATERIALS TO BE USED FOR PIPE CONNECTIONS.

v. SUBMITTED SEALED DESIGN DRAWINGS BY A LICENSED PROFESSIONAL ENGINEER IN THE STATE OF TEXAS.

3. <u>GENERAL:</u>

A. PROVIDE POLYMER CONCRETE MANHOLE SECTIONS, MONOLITHIC BASE SECTIONS AND RELATED COMPONENTS REFERENCING TO ASTM C 478.

B. PROVIDE BASE RISER SECTION WITH MONOLITHIC FLOORS.

C. PROVIDE RISER SECTIONS JOINED WITH BELL AND SPIGOT / SHIP-LAP DESIGN SEAMED WITH BUTYL MASTIC AND RUBBER GASKETS (ASTM C 990) SO THAT ON ASSEMBLY, MANHOLE BASE, RISER AND TOP SECTION MAKE A CONTINUOUS AND UNIFORM MANHOLE STRUCTURE WITH WATERTIGHT JOINTS.

D. CONSTRUCT RISER SECTIONS FOR POLYMER CONCRETE MANHOLES FROM STANDARD POLYMER CONCRETE MANHOLE SECTIONS OF THE DIAMETER INDICATED ON DRAWINGS. USE VARIOUS LENGTHS OF POLYMER CONCRETE MANHOLE SECTIONS IN COMBINATION TO PROVIDE CORRECT HEIGHT WITH THE FEWEST JOINTS.

E. DESIGN WALL SECTIONS FOR DEPTH AND LOADING CONDITIONS WITH WALL THICKNESS AS DESIGNED BY POLYMER CONCRETE MANUFACTURER AND LICENSED PROFESSIONAL ENGINEER IN THE STATE OF TEXAS.

F. PROVIDE TOPS TO SUPPORT AASHTO HS-20 VEHICLE LOADING AND RECEIVING CAST IRON FRAME COVERS AS INDICATED ON DRAWINGS.

4. <u>DESIGN:</u>

A. POLYMER CONCRETE MANHOLE RISERS, CONES, FLAT LIDS, GRADE RINGS AND MANHOLE BASE SECTIONS SHALL BE DESIGNED BY MANUFACTURER TO MEET THE INTENT AND LOADING REQUIREMENTS OF ASTM C 478, ASTM C857 AND ACI 350-06 WITH ALLOWABLE COMPOSITIONAL AND SIZING DIFFERENCES AS DESIGNED BY THE POLYMER CONCRETE MANUFACTURER.

B. AASHTO HS-20 DESIGN VEHICLE LOADING APPLIED TO MANHOLE COVER AND TRANSITION AND BASE SLABS.

C. POLYMER MANHOLES WILL BE DESIGNED BASED UPON LIVE AND DEAD LOAD CRITERIA IN ASTM C 857 AND ACI 350-06.

D. UNIT SOIL WEIGHT OF 130 PCF LOCATED ABOVE PORTIONS OF MANHOLE, INCLUDING BASE SLAB PROJECTIONS.

E. INTERNAL LIQUID PRESSURE BASED ON UNIT WEIGHT OF 63 PCF.

F. DEAD LOAD OF MANHOLE SECTIONS FULLY SUPPORTED BY POLYMER CONCRETE MANHOLE BASE.

G. POLYMER CONCRETE MIX DESIGN SHALL CONSIST OF THERMOSETTING RESIN, SAND, AND AGGREGATE. NO PORTLAND CEMENT SHALL BE ALLOWED AS PART OF THE MIX DESIGN MATRIX. ALL SAND AND AGGREGATE SHALL BE INERT IN AN ACIDIC ENVIRONMENT.

H. REINFORCEMENT - SHALL USE ACID RESISTANT REINFORCEMENT (FRP BAR) IN ACCORDANCE WITH ACI 440.1R-06 AS APPLICABLE FOR POLYMER CONCRETE DESIGN.

I. THE WALL THICKNESS OF POLYMER CONCRETE STRUCTURES SHALL NOT BE LESS THAN THAT PRESCRIBED BY THE MANUFACTURER'S DESIGN.

J. RESIN SELECTION SHALL BE SUITABLE FOR APPLICATIONS IN THE CORROSIVE CONDITIONS TO WHICH THE POLYMER CONCRETE MANHOLE STRUCTURES WILL BE EXPOSED.

K. EACH POLYMER CONCRETE MANHOLE COMPONENT SHALL BE FREE OF ALL DEFECTS, INCLUDING INDENTATIONS, CRACKS, AND FOREIGN INCLUSIONS THAT, DUE TO THEIR NATURE AND DEGREE OR EXTENT, DETRIMENTALLY AFFECT THE STRENGTH AND SERVICEABILITY OF THE COMPONENT PART. THE NOMINAL INTERNAL DIAMETER OF MANHOLE COMPONENTS SHALL NOT VARY MORE THAN 2%.

L. MARKING AND IDENTIFICATION - EACH MANHOLE SHALL BE MARKED WITH THE FOLLOWING INFORMATION - MANUFACTURER'S NAME OR TRADEMARK, MANUFACTURER'S LOCATION AND PRODUCTION DATE.

M. MANHOLE JOINTS SHALL BE ASSEMBLED WITH A BELL/SPIGOT / SHIPLAP DESIGN SEAMED WITH BUTYL MASTIC AND RUBBER GASKETED JOINTS SO THAT ON ASSEMBLY, MANHOLE BASE, RISER AND TOP SECTION MAKE A CONTINUOUS AND UNIFORM MANHOLE. JOINT SEALING SURFACES SHALL BE FREE OF DENTS, GOUGES AND OTHER SURFACE IRREGULARITIES THAT WOULD AFFECT JOINT INTEGRITY.

N. MINIMUM CLEARANCE BETWEEN WALL PENETRATIONS AND JOINTS SHALL BE PER MANUFACTURER'S DESIGN.

O. CONSTRUCT FULL PIPE DEPTH INVERT CHANNELS TO PROVIDE SMOOTH FLOW TRANSITION WITH MINIMAL DISRUPTION OF FLOW AT PIPE-MANHOLE CONNECTIONS. INVERT SLOPE THROUGH MANHOLE IS AS INDICATED ON DRAWINGS. ALL PRECAST BASE SECTIONS TO BE CAST MONOLITHICALLY. POLYMER BENCH AND CHANNEL ARE TO BE CONSTRUCTED WITH ALL POLYMER CONCRETE MATERIAL, MONOLITHICALLY. EXTENDED BALLAST SLAB REQUIREMENTS FOR BUOYANCY CONCERNS CAN BE ADDRESSED WITH CEMENTITIOUS CONCRETE MATERIAL.

P. PROVIDE RESILIENT CONNECTORS CONFORMING TO REQUIREMENTS OF ASTM C 923. ALL CONNECTORS ARE TO BE WATERTIGHT. INSTALL APPROVED RESILIENT CONNECTORS AT EACH PIPE ENTERING AND EXITING MANHOLES IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

Q. FACILITY QUALITY CONTROL SHOULD BE MAINTAINED BY ADHERING TO ISO 9001:2018 FOR MANUFACTURING. ALL FABRICATORS WILL BE ISO 9001:2018 CERTIFIED AND PROVIDE DOCUMENTATION OF CURRENT CERTIFICATION. ALL MANUFACTURING WILL TAKE PLACE IN AN ALL POLYMER CONCRETE FACILITY. AT NO TIME WILL THE POLYMER CONCRETE MANUFACTURING FACILITY SHARE THE FACILITY WITH A CEMENTITIOUS PRECAST PRODUCT PRODUCTION FACILITY. FABRICATOR IS ALSO TO PROVIDE REFERENCES OF 5 PREVIOUS PROJECTS IN THE LAST 5 YEARS PERFORMED WITH BOTH OWNER AND CONTRACTOR FOR REFERENCE AND REVIEW BY OWNER. POLYMER CONCRETE SHALL BE CAST IN A POLYMER ONLY FACILITY AND SHALL NOT BE MANUFACTURED IN A CEMENTITIOUS CONCRETE FACILITY.

R. ALL MATERIALS NEEDED FOR GROUTING AND PATCHING WILL BE A POLYESTER MORTAR COMPOUND PROVIDED BY THE MANUFACTURER.

S. MANHOLE LINER SYSTEM SHALL NOT BE INSTALLED TO THE INTERIOR OF ANY POLYMER CONCRETE MANHOLE.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

PROJECT NOTES (3 OF 3)

03/31/2023
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TCEQ SEWAGE COLLECTION SYSTEM GENERAL CONSTRUCTION NOTES (REV. JULY 15, 2015)

1. THIS ORGANIZED SEWAGE COLLECTION SYSTEM (SCS) MUST BE CONSTRUCTED IN ACCORDANCE WITH 30 TEXAS ADMINISTRATIVE CODE (TAC) §213.5(C), THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY'S (TCEQ) EDWARDS AQUIFER RULES AND ANY LOCAL GOVERNMENT STANDARD SPECIFICATIONS.

2. ALL CONTRACTORS CONDUCTING REGULATED ACTIVITIES ASSOCIATED WITH THIS PROPOSED REGULATED PROJECT MUST BE PROVIDED WITH COPIES OF THE SCS PLAN AND THE TCEQ LETTER INDICATING THE SPECIFIC CONDITIONS OF IT APPROVAL. DURING THE COURSE OF THESE REGULATED ACTIVITIES, THE CONTRACTORS MUST BE REQUIRED TO KEEP ON-SITE COPIES OF THE PLAN AND THE APPROVAL LETTER.

3. A WRITTEN NOTICE OF CONSTRUCTION MUST BE SUBMITTED TO THE PRESIDING TCEQ REGIONAL OFFICE AT LEAST 48 HOURS PRIOR TO THE START OF ANY REGULATED ACTIVITIES. THIS NOTICE MUST INCLUDE:
   - THE NAME OF THE APPROVED PROJECT;
   - THE ACTIVITY START DATE; AND
   - THE CONTRACT INFORMATION OF THE PRIME CONTRACTOR.

4. ANY MODIFICATION TO THE ACTIVITIES DESCRIBED IN THE REFERENCED SCS APPLICATION FOLLOWING THE DATE OF APPROVAL MAY REQUIRE THE SUBMITTAL OF AN SCS APPLICATION TO MODIFY THIS APPROVAL, INCLUDING THE PAYMENT OF APPROPRIATE FEES AND ALL INFORMATION NECESSARY FOR ITS REVIEW AND APPROVAL.

5. PRIOR TO BEGINNING ANY CONSTRUCTION ACTIVITY, ALL TEMPORARY EROSION AND SEDIMENTATION (E&S) CONTROL MEASURES MUST BE PROPERLY INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS. THESE CONTROLS MUST REMAIN IN PLACE UNTIL THE DISTURBED AREAS HAVE BEEN PERMANENTLY STABILIZED.

6. IF ANY SENSITIVE FEATURES ARE DISCOVERED DURING THE WASTEWATER LINE TRENCHING ACTIVITIES, ALL REGULATED ACTIVITIES NEAR THE SENSITIVE FEATURE MUST BE SUSPENDED IMMEDIATELY. THE APPLICANT MUST IMMEDIATELY NOTIFY THE APPROPRIATE REGIONAL OFFICE OF THE TCEQ OF THE FEATURE DISCOVERED. A GEOLOGIST'S ASSESSMENT OF THE LOCATION AND EXTENT OF THE FEATURE DISCOVERED MUST BE REPORTED TO THAT REGIONAL OFFICE IN WRITING AND THE APPLICANT MUST SUBMIT A PLAN FOR ENSURING THE STRUCTURAL INTEGRITY OF THE SEWER LINE FOR MODIFYING THE PROPOSED COLLECTION SYSTEM ALIGNMENT AROUND THE FEATURE. THE REGULATED ACTIVITIES NEAR THE SENSITIVE FEATURE MAY NOT PROCEED UNTIL THE EXECUTIVE DIRECTOR HAS REVIEWED AND APPROVED THE METHODS PROPOSED TO PROTECT THE SENSITIVE FEATURE AND THE EDWARDS AQUIFER FROM ANY POTENTIALLY ADVERSE IMPACTS TO WATER QUALITY WHILE MAINTAINING THE STRUCTURAL INTEGRITY OF THE LINE.

7. SEWER LINES LOCATED WITHIN OR CROSSING THE 5-YEAR FLOODPLAIN OF A DRAINAGE WAY WILL BE PROTECTED FROM INUNDATION AND STREAM VELOCITIES WHICH COULD CAUSE EROSION AND SCOURING OF BACKFILL. THE TRENCH MUST BE CAPPED WITH CONCRETE TO PREVENT SCOURING OF BACKFILL, OR THE SEWER LINES MUST BE ENCASED CONCRETE. ALL CONCRETE SHALL HAVE A MINIMUM THICKNESS OF 6 INCHES.

8. BLASTING PROCEDURES FOR PROTECTION OF EXISTING SEWER LINES AND OTHER UTILITIES WILL BE IN ACCORDANCE WITH THE NATIONAL FIRE PROTECTION ASSOCIATION CRITERIA. SAND IS NOT ALLOWED AS BEDDING OR BACKFILL IN TRENCHES THAT HAVE BEEN BLASTED. IF ANY EXISTING SEWER LINES ARE DAMAGED, THE LINES MUST BE REPAIRED AND RETESTED.

9. ALL MANHOLES CONSTRUCTED OR REHABILITATED ON THIS PROJECT MUST HAVE WATERTIGHT SIZE ON SIZE RESILIENT CONNECTORS ALLOWING FOR DIFFERENTIAL SETTLEMENT. IF MANHOLES ARE CONSTRUCTED WITHIN THE 100-YEAR FLOODPLAIN, THE COVER MUST HAVE A GASKET AND BE BOLTED TO THE RING. WHERE GASKETED MANHOLE COVERS ARE REQUIRED FOR MORE THAN THREE MANHOLES IN SEQUENCE OR MORE THAN 1500 FEET, ALTERNATE MEANS OF VENTING WILL BE PROVIDED. BRICKS ARE NOT ACCEPTABLE CONSTRUCTION MATERIAL FOR ANY PORTION OF THE MANHOLE. THE DIAMETER OF THE MANHOLES MUST BE A MINIMUM OF FOUR FEET AND THE MANHOLE FOR ENTRY MUST HAVE A MINIMUM CLEAR OPENING DIAMETER OF 30 INCHES. THESE DIMENSIONS AND OTHER DETAILS SHOWING COMPLIANCE WITH THE COMMISSION'S RULE CONCERNING MANHOLES AND SEWER LINE/MANHOLE INVERTS DESCRIBED IN 30 TAC §217.55 ARE INCLUDED ON PLAN SHEET D105. IT IS SUGGESTED THAT ENTRANCE INTO MANHOLES IN EXCESS OF FOUR FEET DEEP BE ACCOMPLISHED BY MEANS OF A PORTABLE LADDER. THE INCLUSION OF STEPS IN A MANHOLE IS PROHIBITED.

10. WHERE WATER LINES AND NEW SEWER LINE ARE INSTALL WITH A SEPARATION DISTANCE CLOSER THAN NINE FEET (I.E., WATER LINES CROSSING WASTEWATER LINES, WATER LINES PARALLELING WASTEWATER LINES, OR WATER LINES NEXT TO MANHOLES) THE INSTALLATION MUST MEET THE REQUIREMENTS OF 30 TAC §217.53(D)(PIPE DESIGN) AND 30 TAC §290.44(E)(WATER DISTRIBUTION).

11. ~~WHERE SEWER LINES DEVIATE FROM STRAIGHT ALIGNMENT AND UNIFORM GRADE ALL CURATIVE OF SEWER PIPE MUST BE ACHIEVED BY THE FOLLOWING PROCEDURE WHICH IS RECOMMENDED BY THE PIPE MANUFACTURER: _____. IF PIPE FLEXURE IS PROPOSED, THE FOLLOWING METHOD OF PREVENTING DEFLECTION OF THE JOINT MUST BE USED: _____. SPECIFIC CARE MUST BE TAKEN TO ENSURE THAT THE JOINT IS PLACED IN THE CENTER OF THE TRENCH AND PROPERLY BEDDED IN ACCORDANCE WITH 30 TAC §217.54.~~

12. NEW SEWAGE COLLECTION SYSTEM LINES MUST BE CONSTRUCTED WITH STUB OUTS FOR THE CONNECTION OF ANTICIPATED EXTENSIONS. THE LOCATION OF SUCH STUB OUTS MUST BE MARKED ON THE GROUND SUCH THAT THEIR LOCATION CAN BE EASILY DETERMINED AT THE TIME OF CONNECTION OF THE EXTENSIONS. SUCH STUB OUTS MUST BE MANUFACTURED WYES OR TEES THAT ARE COMPATIBLE IN SIZE AND MATERIAL WITH BOTH THE SEWER LINE AND THE EXTENSION. AT THE TIME OF ORIGINAL CONSTRUCTION, NEW STUB-OUTS MUST BE CONSTRUCTED SUFFICIENTLY TO EXTEND BEYOND THE END OF THE STREET PAVEMENT. ALL STUB-OUTS MUST BE SEALED WITH A MANUFACTURED CAP TO PREVENT LEAKAGE. EXTENSIONS THAT WERE NOT ANTICIPATED AT THE TIME OF ORIGINAL CONSTRUCTION OR THAT ARE TO BE CONNECTED TO AN EXISTING SEWER LINE NOT FURNISHED WITH STUB OUTS MUST BE CONNECTED USING A MANUFACTURED SADDLE AND IN ACCORDANCE WITH ACCEPTED PLUMBING TECHNIQUES. IF NO STUB-OUT IS PRESENT AN ALTERNATE METHOD OF JOINING LATERALS IS SHOWN IN THE DETAIL ON PLAN SHEET D105 & D107. (FOR POTENTIAL FUTURE LATERALS). THE PRIVATE SERVICE LATERAL STUB-OUTS MUST BE INSTALLED AS SHOWN ON THE PLAN AND PROFILE SHEETS AND MARKED AFTER BACKFILLING AS SHOWN IN THE DETAIL ON PLAN SHEET D108.

13. TRENCHING, BEDDING AND BACKFILL MUST CONFORM WITH 30 TAC §217.54. THE BEDDING AND BACKFILL FOR FLEXIBLE PIPE MUST COMPLY WITH THE STANDARDS OF ASTM D-2321, CLASSES IA, IB, II OR III. RIGID PIPE BEDDING MUST COMPLY WITH THE REQUIREMENTS OF ASTM C 12 (ANSI A 106.2) CLASSES A, B, C.

14. SEWER LINES MUST BE TESTED FROM MANHOLE TO MANHOLE. WHEN A NEW SEWER LINE IS CONNECTED TO AN EXISTING STUB OR CLEAN OUT, IT MUST BE TESTED FROM EXISTING MANHOLE TO NEW MANHOLE. IF A STUB OR CLEAN-OUT IS USED AT THE END OF THE PROPOSED SEWER LINE, NO PRIVATE SERVICE ATTACHMENTS MAY BE CONNECTED BETWEEN THE LAST MANHOLE AND THE CLEAN-OUT UNLESS IT CAN BE CERTIFIED AS CONFORMING WITH THE PROVISIONS OF 30 TAC §213.5(C)(3)(E).

15. ALL SEWER LINES MUST BE TESTED IN ACCORDANCE WITH 30 TAC §217.57. THE ENGINEER MUST RETAIN COPIES OF ALL TEST RESULTS WHICH MUST BE MADE AVAILABLE TO THE EXECUTIVE DIRECTOR UPON REQUEST. THE ENGINEER MUST CERTIFY IN WRITING THAT ALL WASTEWATER LINES HAVE PASSED ALL REQUIRED TESTING TO THE APPROPRIATE REGIONAL OFFICE WITHIN 30 DAYS OF TEST COMPLETION AND PRIOR TO USE OF THE NEW COLLECTION SYSTEM. TESTING METHOD WILL BE:

(a) FOR A COLLECTION SYSTEM PIPE THAT WILL TRANSPORT WASTEWATER BY GRAVITY FLOW, THE DESIGN MUST SPECIFY AN INFILTRATION AND EXFILTRATION TEST OR A LOW-PRESSURE AIR TEST. A TEST MUST CONFORM TO THE FOLLOWING REQUIREMENTS:

(1) LOW PRESSURE AIR TEST.

(A) A LOW PRESSURE AIR TEST MUST FOLLOW THE PROCEDURES DESCRIBED IN AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) C-828, ASTM C-924, OR ASTM F-1417 OR OTHER PROCEDURE APPROVED BY THE EXECUTIVE DIRECTOR, EXCEPT AS TO TESTING TIMES AS REQUIRED IN TABLE C.3 IN SUBPARAGRAPH (C) OF THIS PARAGRAPH OR EQUATION C.3 IN SUBPARAGRAPH (B)(ii) OF THIS PARAGRAPH.

(B) FOR SECTIONS OF COLLECTION SYSTEM PIPE LESS THAN 36 INCH AVERAGE INSIDE DIAMETER, THE FOLLOWING PROCEDURE MUST APPLY, UNLESS A PIPE IS TO BE TESTED AS REQUIRED BY PARAGRAPH (2) OF THIS SUBSECTION

(i) A PIPE MUST BE PRESSURIZED TO 3.5 POUNDS PER SQUARE INCH (PSI) GREATER THAN THE PRESSURE EXERTED BY GROUNDWATER ABOVE THE PIPE.

(ii) ONCE THE PRESSURE IS STABILIZED, THE MINIMUM TIME ALLOWABLE FOR THE PRESSURE TO DROP FROM 3.5 PSI GAUGE TO 2.5 PSI GAUGE IS COMPUTED FROM THE FOLLOWING EQUATION:

EQUATION C.3 $$T = \frac{0.085 \times D \times K}{Q}$$

WHERE:

T = TIME FOR PRESSURE TO DROP 1.0 POUND PER SQUARE INCH GAUGE IN SECONDS

K = 0.000419 X D X L, BUT NOT LESS THAN 1.0

D = AVERAGE INSIDE PIPE DIAMETER IN INCHES

L = LENGTH OF LINE OF SAME SIZE BEING TESTED, IN FEET

Q = RATE OF LOSS, 0.0015 CUBIC FEET PER MINUTE PER SQUARE FOOT INTERNAL SURFACE

(C) SINCE A K VALUE OF LESS THAN 1.0 MAY NOT BE USED, THE MINIMUM TESTING TIME FOR EACH PIPE IS SHOWN IN THE FOLLOWING TABLE C.3:

PIPE DIAMETER (INCHES)	MINIMUM TIME (SECONDS)	MAXIMUM LENGTH FOR MINIMUM TIME (FEET)	TIME FOR LONGER LENGTH (SECONDS/FOOT)
6	340	398	0.855
8	454	298	1.520
10	567	239	2.374
12	680	199	3.419
15	850	159	5.342
18	1020	133	7.693
21	1190	114	10.471
24	1360	100	13.676
27	1530	88	17.309
30	1700	80	21.369
33	1870	72	25.856

(D) AN OWNER MAY STOP A TEST IF NO PRESSURE LOSS HAS OCCURRED DURING THE FIRST 25% OF THE CALCULATED TESTING TIME.

(E) IF ANY PRESSURE LOSS OR LEAKAGE HAS OCCURRED DURING THE FIRST 25% OF A TESTING PERIOD, THEN THE TEST MUST CONTINUE FOR THE ENTIRE DURATION AS OUTLINED ABOVE OR UNTIL FAILURE.

(F) WASTEWATER COLLECTION SYSTEMS PIPES WITH A 27 INCH OR LARGER AVERAGE INSIDE DIAMETER MAY BE AIR TESTED AT EACH JOINT INSTEAD OF FOLLOWING THE PROCEDURE OUTLINE IN THIS SECTION.

(G) A TESTING PROCEDURE FOR PIPE WITH AN INSIDE DIAMETER GREATER THAN 33 INCHES MUST BE APPROVED BY THE EXECUTIVE DIRECTOR.

(2) INFILTRATION/EXFILTRATION TEST.

(A) THE TOTAL EXFILTRATION, AS DETERMINED BY A HYDROSTATIC HEAD TEST, MUST NOT EXCEED 50 GALLONS PER INCH OF DIAMETER PER MILE OF PIPE PER 24 HOURS AT A MINIMUM TEST HEAD OF 2.0 FEET ABOVE THE CROWN OF A PIPE AT AN UPSTREAM MANHOLE

(B) AN OWNER SHALL USE AN INFILTRATION TEST IN LIEU OF AN EXFILTRATION TEST WHEN PIPES ARE INSTALLED BELOW THE GROUNDWATER LEVEL.

(C) THE TOTAL EXFILTRATION, AS DETERMINED BY A HYDROSTATIC HEAD TEST, MUST NOT EXCEED 50 GALLONS PER INCH DIAMETER PER MILE OF PIPE PER 24 HOURS AT A MINIMUM TEST HEAD OF TWO FEET ABOVE THE CROWN OF A PIPE AT AN UPSTREAM MANHOLE, OR AT LEAST TWO FEET ABOVE EXISTING GROUNDWATER LEVEL, WHICHEVER IS GREATER.

(D) FOR CONSTRUCTION WITHIN A 25-YEAR FLOOD PLAIN, THE INFILTRATION OR EXFILTRATION MUST NOT EXCEED 10 GALLONS PER INCH DIAMETER PER MILE OF PIPE PER 24 HOURS AT THE SAME MINIMUM TEST HEAD AS IN SUBPARAGRAPH (C) OF THIS PARAGRAPH.

(E) IF THE QUANTITY OF INFILTRATION OR EXFILTRATION EXCEEDS THE MAXIMUM QUANTITY SPECIFIED, AN OWNER SHALL UNDERTAKE REMEDIAL ACTION IN ORDER TO REDUCE THE INFILTRATION OR EXFILTRATION TO AN AMOUNT WITHIN THE LIMITS SPECIFIED. AN OWNER SHALL RETEST A PIPE FOLLOWING A REMEDIATION ACTION.

(b) IF A GRAVITY COLLECTION PIPE IS COMPOSED OF FLEXIBLE PIPE, DEFLECTION TESTING IS ALSO REQUIRED. THE FOLLOWING PROCEDURES MUST BE FOLLOWED:

(1) FOR A COLLECTION PIPE WITH INSIDE DIAMETER LESS THAN 27 INCHES, DEFLECTION MEASUREMENT REQUIRES A RIGID MANDREL.

(A) MANDREL SIZING.

(i) A RIGID MANDREL MUST HAVE AN OUTSIDE DIAMETER (OD) NOT LESS THAN 95% OF THE BASE INSIDE DIAMETER (ID) OR AVERAGE ID OF A PIPE, AS SPECIFIED IN THE APPROPRIATE STANDARD BY THE ASTMs, AMERICAN WATER WORKS ASSOCIATION, UNI-BELL, OR AMERICAN NATIONAL STANDARDS INSTITUTE, OR ANY RELATED APPENDIX.

(ii) ALL DIMENSIONS MUST MEET THE APPROPRIATE STANDARD.

(B) MANDREL DESIGN.

(i) A RIGID MANDREL MUST BE CONSTRUCTED OF A METAL OR RIGID PLASTIC MATERIAL THAT CAN WITHSTAND 200 PSI WITHOUT BEING DEFORMED.

(ii) A MANDREL MUST HAVE NINE OR MORE ODD NUMBER OF RUNNERS OR LEGS.

(iii) A BARREL SECTION LENGTH MUST EQUAL AT LEAST 75% OF THE INSIDE DIAMETER OF A PIPE.

(iv) EACH SIZE MANDREL MUST USE A SEPARATE PROVING RING.

(C) METHOD OPTIONS.

(i) AN ADJUSTABLE OR FLEXIBLE MANDREL IS PROHIBITED.

(ii) A TEST MAY NOT USE TELEVISION INSPECTION AS A SUBSTITUTE FOR A DEFLECTION TEST.

(iii) IF REQUESTED, THE EXECUTIVE DIRECTOR MAY APPROVE THE USE OF A DEFLECTOMETER OR A MANDREL WITH REMOVABLE LEGS OR RUNNERS ON A CASE-BY-CASE BASIS.

(2) FOR GRAVITY COLLECTION SYSTEM PIPE WITH AN INSIDE DIAMETER 27 INCHES AND GREATER, OTHER TEST METHODS MAY BE USED TO DETERMINE VERTICAL DEFLECTION.

(3) A DEFLECTION TEST METHOD MUST BE ACCURATE TO WITHIN PLUS OR MINUS 0.2% DEFLECTION.

(4) AN OWNER SHALL NOT CONDUCT A DEFLECTION TEST UNTIL AT LEAST 30 DAYS AFTER THE FINAL BACKFILL.

(5) GRAVITY COLLECTION SYSTEM PIPE DEFLECTION MUST NOT EXCEED FIVE PERCENT (5%).

(6) IF A PIPE SECTION FAILS A DEFLECTION TEST, AN OWNER SHALL CORRECT THE PROBLEM AND CONDUCT A SECOND TEST AFTER THE FINAL BACKFILL HAS BEEN IN PLACE AT LEAST 30 DAYS.

16. ALL MANHOLES MUST BE TESTED TO MEET OR EXCEED THE REQUIREMENTS OF 30 TAC §217.58.

(a) ALL MANHOLES MUST PASS A LEAKAGE TEST.

(b) AN OWNER SHALL TEST EACH MANHOLE (AFTER ASSEMBLY AND BACKFILLING) FOR LEAKAGE, SEPARATE AND INDEPENDENT OF THE COLLECTION SYSTEM PIPES, BY HYDROSTATIC EXFILTRATION TESTING, VACUUM TESTING, OR OTHER METHOD APPROVED BY THE EXECUTIVE DIRECTOR.

(1) HYDROSTATIC TESTING.

(A) THE MAXIMUM LEAKAGE FOR HYDROSTATIC TESTING OR ANY ALTERNATIVE TEST METHODS IS 0.025 GALLONS PER FOOT DIAMETER PER FOOT OF MANHOLE DEPTH PER HOUR.

(B) TO PERFORM A HYDROSTATIC EXFILTRATION TEST, AN OWNER SHALL SEAL ALL WASTEWATER PIPES COMING INTO A MANHOLE WITH AN INTERNAL PIPE PLUG, FILL THE MANHOLE WITH WATER, AND MAINTAIN THE TEST FOR AT LEAST ONE HOUR.

(C) A TEST FOR CONCRETE MANHOLES MAY USE A 24-HOUR WETTING PERIOD BEFORE TESTING TO ALLOW SATURATION OF THE CONCRETE.

(2) VACUUM TESTING.

(A) TO PERFORM A VACUUM TEST, AN OWNER SHALL PLUG ALL LIFT HOLES AND EXTERIOR JOINTS WITH A NON-SHRINK GROUT AND PLUG ALL PIPES ENTERING A MANHOLE.

(B) NO GROUT MUST BE PLACED IN HORIZONTAL JOINTS BEFORE TESTING.

(C) STUB-OUTS, MANHOLE BOOTS, AND PIPE PLUGS MUST BE SECURED TO PREVENT MOVEMENT WHILE A VACUUM IS DRAWN.

(D) AN OWNER SHALL USE A MINIMUM 60 INCH/LB TORQUE WRENCH TO TIGHTEN THE EXTERNAL CLAMPS THAT SECURE A TEST COVER TO THE TOP OF A MANHOLE.

(E) A TEST HEAD MUST BE PLACED AT THE INSIDE OF THE TOP OF A CONE SECTION, AND THE SEAL INFLATED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

(F) THERE MUST BE A VACUUM OF 10 INCHES OF MERCURY INSIDE A MANHOLE TO PERFORM A VAIL TEST.

(G) A TEST DOES NOT BEGIN UNTIL AFTER THE VACUUM PUMP IS OFF.

(H) A MANHOLE PASSES THE TEST IF AFTER 2.0 MINUTES AND WITH ALL VALVES CLOSED, THE VACUUM IS AT LEAST 9.0 INCHES OF MERCURY.

ALL PRIVATE SERVICE LATERALS MUST BE INSPECTED AND CERTIFIED IN ACCORDANCE WITH 30 TAC §213.5(C)(3)(I). AFTER INSTALLATION OF AND, PRIOR TO COVERING AND CONNECTING A PRIVATE SERVICE LATERAL TO AN EXISTING ORGANIZED SEWAGE COLLECTION SYSTEM, A TEXAS LICENSED PROFESSIONAL ENGINEER, TEXAS REGISTERED SANITARIAN, OR APPROPRIATE CITY INSPECTOR MUST VISUALLY INSPECT THE PRIVATE SERVICE LATERAL AND THE CONNECTION TO THE SEWAGE COLLECTION SYSTEM, AND CERTIFY THAT IT IS CONSTRUCTED IN CONFORMITY WITH THE APPLICABLE PROVISIONS OF THIS SECTION. THE OWNER OF THE COLLECTION SYSTEM MUST MAINTAIN SUCH CERTIFICATIONS FOR FIVER YEARS AND FORWARD COPIES TO THE APPROPRIATE REGIONAL OFFICE UPON REQUEST. CONNECTIONS MAY ONLY BE MADE TO AN APPROVED SEWAGE COLLECTION SYSTEM.

AUSTIN REGIONAL OFFICE 12100 PARK 35 CIRCLE, BUILDING A AUSTIN, TEXAS 78753-1808 PHONE (512)-339-2929 FAX (512)-339-3795	~~SAN ANTONIO REGIONAL OFFICE~~ ~~14250 JUDSON ROAD~~ ~~SAN ANTONIO, TEXAS 78233-4480~~ ~~PHONE (210)-490-3096~~ ~~FAX (210)-545-4329~~

TCEQ -0602 TEMPORARY STORM WATER SECTION NOTES

1. TEMPORARY ABOVE GROUND STORAGE TANKS OVER EDWARDS AQUIFER RECHARGE ZONE.
   a. IF ABOVE GROUND STORAGE TANKS WITH A CUMULATIVE STORAGE CAPACITY OF 500 GALLONS OR MORE WILL BE STORED ON THE SITE, AN ABOVEGROUND STORAGE TANK FACILITY PLAN APPLICATION MUST BE SUBMITTED TO THE APPROPRIATE REGIONAL OFFICE OF THE TCEQ PRIOR TO MOVING THE TANKS ONTO THE PROJECT AT NO EXPENSE TO THE OWNER.
   b. TEMPORARY ABOVE GROUND STORAGE TANK SYSTEMS OF 250 GALLONS OR MORE MUST BE LOCATED A MINIMUM HORIZONTAL DISTANCE OF 150 FEET FROM ANY DOMESTIC, INDUSTRIAL, IRRIGATION, OR PUBLIC WATER SUPPLY WELL, OR OTHER SENSITIVE FEATURE.
2. VEHICLE AND EQUIPMENT MAINTENANCE.
   a. IF MAINTENANCE MUST OCCUR ONSITE, USE A DESIGNATED AREA AND A SECONDARY CONTAINMENT, LOCATED AWAY FROM DRAINAGE COURSES, TO PREVENT THE RUN-ON OF STORMWATER AND THE RUNOFF OF SPILLS.
   b. REGULARLY INSPECT ONSITE VEHICLES AND EQUIPMENT FOR LEAKS AND REPAIR IMMEDIATELY.
   c. CHECK INCOMING VEHICLES AND EQUIPMENT (INCLUDING DELIVERY TRUCKS, AND EMPLOYEE AND SUBCONTRACTOR VEHICLES) FOR LEAKING OIL AND FLUIDS. DO NOT ALLOW LEAKING VEHICLES OR EQUIPMENT ONSITE.
   d. ALWAYS USE SECONDARY CONTAINMENT, SUCH AS A DRAIN PAN OR DROP CLOTH, TO CATCH SPILLS OR LEAKS WHEN REMOVING OR CHANGING FLUIDS.
   e. PLACE DRIP PANS OR ABSORBENT MATERIALS UNDER PAVING EQUIPMENT WHEN NOT IT USE.
   f. USE ABSORBENT MATERIALS ON SMALL SPILLS RATHER THAN HOSING DOWN OR BURYING THE SPILL. REMOVE THE ABSORBENT MATERIALS PROMPTLY AND DISPOSE OF PROPERLY.
   g. PROMPTLY TRANSFER USED FLUIDS TO THE PROPER WASTE OR RECYCLING DRUMS. DON'T LEAVE FULL DRIP PANS OF OTHER OPEN CONTAINERS LYING AROUND.
   h. OIL FILTERS DISPOSED OF IN TRASH CANS OR DUMPSTERS CAN LEAK OIL AND POLLUTE STORMWATER. PLACE THE OIL FILTER IN A FUNNEL OVER A WASTE OIL-RECYCLING DRUM TO DRAIN EXCESS OIL BEFORE DISPOSAL. OIL FILTER CAN ALSO BE RECYCLED. ASK THE OIL SUPPLIER OR RECYCLER ABOUT RECYCLING OIL FITERS
   i. STORE CRACKED BATTERIES IN A NON-LEAKING SECONDARY CONTAINER. DO THIS WITH ALL CRACKED BATTERIES EVEN IF YOU THINK ALL THE ACID HAS DRAINED OUT. IF YOU DROP A BATTERY, TREAT IT AS IF IT IS CRACKED. PUT IT INTO THE CONTAINMENT AREA UNTIL YOU ARE SURE IT IS NOT LEAKING.
3. VEHICLE AND EQUIPMENT FUELING.
   a. IF FUELING MUST OCCUR ON SITE, USE DESIGNATED AREAS, LOCATED AWAY FROM DRAINAGE COURSES, TO PREVENT THE RUN-ON OF STORMWATER AND THE RUN-OFF OF SPILLS.
   b. DISCOURAGE "TOPPING OFF" OF FUEL TANKS.
   c. ALWAYS USE SECONDARY CONTAINMENT, SUCH AS A DRAIN PAN, WHEN FUELING TO CATCH SPILLS/LEAKS.
4. SPILL RESPONSE ACTIONS
   a. NO HAZARDOUS WASTE IS EXPECTED TO BE GENERATED IN CONNECTION WITH THE CONSTRUCTION ACTIVITIES. HOWEVER, ANY HAZARDOUS WASTE THAT IS GENERATED SHALL BE DISPOSED OF IN A MANNER SPECIFIED BY LOCAL, STATE, AND FEDERAL REGULATIONS AND/OR MANUFACTURER'S RECOMMENDATIONS.
   b. THE THRESHOLD QUANTITY THAT TRIGGERS THE REQUIREMENT TO REPORT A SPILL IS CALLED THE REPORTABLE QUANTITY (RQ). THE RQ DEPENDS ON THE TYPE OF SUBSTANCE RELEASED AND WHERE RELEASED (E.G., INTO WATER VS ON LAND); DIFFERENT KINDS OF SPILLS ARE SUBJECT TO DIFFERENT PROVISIONS OF STATE AND FEDERAL RULES. IF A SPILL OF REPORTABLE QUANTITY OF A HAZARDOUS MATERIAL (I.E., DIESEL, GASOLINE, OR OIL) OCCURS, THE TCEQ REGION 11 OFFICE LOCATED IN AUSTIN MAY BE REACHED AT (512) 339-2929. ADDITIONAL INFORMATION IS AVAILABLE IN 30 TAC 327.4, 40 CFR 302.4, AND https://www.tceq.texas.gov/response/spills/spill_rq.html.
   c. IF A RELEASE OCCURS CONTAINING HAZARDOUS SUBSTANCES IN ANY AMOUNT EQUAL TO OR IN EXCESS OF A REPORTABLE QUANTITY, THEN NOTIFY THE NATIONAL RESPONSE CENTER AT (800) 424-8802 AS SOON AS THE SPILL IS DISCOVERED.
   d. IF A HAZARDOUS SPILL OCCURS AND THREATENS A SURFACE WATER SYSTEM, THEN NOTIFY THE TCEQ AND THE STATE EMERGENCY RESPONSE COMMISSION (SERC) THROUGH THE STATE OF TEXAS SPILL-REPORTING HOTLINE AT (800) 832-8224

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TCEQ NOTES

03/31/2023 DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C005

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ABS	ACRYLONITRILE – BUTADIENE – STYRENE
AC	ASPHALTIC CONCRETE
APPROX	APPROXIMATE
ARV	AIR RELEASE VALVE
ACP	ASBESTOS CEMENT PIPE
ALT	ALTERNATE
AWG	AMERICAN WIRE GAGE
BEG	BEGIN
BF	BLIND FLANGE
BFV	BUTTERFLY VALVE
B.I.W.	BEGIN INLET WING
℄	BASELINE
BM	BENCH MARK
BC	BACK OF CURB
BW	BOTTOM OF WALL
CATV	CABLE TV
CB	CATCH BASIN
C–C	CENTER TO CENTER
CCFRPM	CENTRIFUGALLY CAST FIBERGLASS REINFORCED POLYMER MORTAR PIPE
CFS	CUBIC FEET PER SECOND
CIP	CAST IRON PIPE
CJ	CONTROL JOINT
℄	CENTER LINE
CLBM	CRUSHED LIMESTONE BASE MATERIAL
CLR	CLEAR
CO	CLEANOUT
CMP	CORRUGATED METAL PIPE
CONC	CONCRETE
CONST	CONSTRUCT, CONSTRUCTION
CONT	CONTINUOUS
CTB	CEMENT TREATED BASE
CV	CHECK VALVE
CY	CUBIC YARD
C&G	CURB AND GUTTER
DA	DRAINAGE AREA
DE	DRAINAGE EASEMENT
DBL	DOUBLE
DET	DETAIL
DIA	DIAMETER
DI	DUCTILE IRON
DIP	DUCTILE IRON PIPE
DN	DOWN
DW	DRIVEWAY
DWG	DRAWING
E	EAST
EP	EDGE OF PAVEMENT
EA	EACH
EF	EACH FACE
E.I.W.	END INLET WING
EL	ELEVATION
EJ	EXPANSION JOINT
ENGR	ENGINEER
EQ	EQUAL
ER	END RETURN
EW	EACH WAY
EXC	EXCAVATE
EXP JT	EXPANSION JOINT
EX	EXISTING
FH	FIRE HYDRANT
FFE	FINISHED FLOOR ELEVATION
FG	FINISHED GRADE
℄	FLOWLINE
FM	FORCE MAIN
FIC	FIBER OPTIC CABLE
FC	FACE OF CURB
FT	FEET OR FOOT
FH	FIRE HYDRANT
G	GAS LINE
GA	GAUGE
GALV	GALVANIZED
GRND	GROUND
GV	GATE VALVE
HDWL	HEADWALL
HP	HIGH POINT OR HORSE POWER
HGL	HYDRAULIC GRADE LINE
HORIZ	HORIZONTAL
HW	HEAD WATER
HMAC	HOT MIXED ASPHALTIC CONCRETE

ID	INSIDE DIAMETER
IN	INCH
INCL	INCLUDE (D) (ING)
INSL	INSULATION OR INSULATED
INV	INVERT
IP	IRON PIPE OR IRON PIN
JT	JOINT
KV	KILOVOLT
L	LENGTH
LP	LOW POINT
LF	LINEAR FOOT
LG	LIP OF GUTTER
LSS	LIME–STABILIZED SUBGRADE
LT	LEFT
MTL	MATERIAL
MAX	MAXIMUM
MBGF	METAL BEAM GAURD FENCE
MED	MEDIUM
MH	MANHOLE
MIN	MINIMUM
MISC	MISCELLANEOUS
M&M	MEET AND MATCH
MO	MOTOR OPERATED
MP	MIDPOINT
N	NORTH
NC	NORMALLY CLOSED
NFV	NOT FIELD VERIFIED
NG	NATURAL GROUND
NTS	NOT TO SCALE
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
OC	ON CENTER
OD	OUTSIDE DIAMETER
OHEW	OVERHEAD ELECTRIC WIRE
OPNG	OPENING
OPP	OPPOSITE
OCEW	ON CENTER EACH WAY
PC	POINT OF CURVATURE OR PORTLAND CEMENT
PGL	PROPOSED GRADE LINE
PI	POINT OF INTERSECTION
℄	PROPERTY LINE
POB	POINT OF BEGINNING
PP	POWER POLE
PRC	POINT OF REVERSE CURVATURE
PSI	POUNDS PER SQUARE INCH
PT	POINT OF TANGENCY
PUE	PUBLIC UTILITY EASEMENT
PVC	POLYVINYL CHLORIDE OR POINT OF VERTICAL CURVATURE
PVI	POINT OF VERTICAL INFLECTION
PVMT	PAVEMENT
PVT	POINT OF VERTICAL TANGENCY
PCC	POINT OF COMPOUND CURVATURE
Q	FLOW RATE, CUBIC FEET PER SECOND
R	RADIUS
ROW	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
RD	ROAD
REF	REFERENCE OR REFER
REINF	REINFORCE OR REINFORCED
REQD	REQUIRED
REV	REVISION
RT	RIGHT
RP	RADIUS POINT

S	SOUTH
SCH	SCHEDULE
SD	STORM DRAIN
SF	SQUARE FOOT
SHT	SHEET
SIM	SIMILAR
SPEC	SPECIFICATION
SQ	SQUARE
STA	STATION
STD	STANDARD
STR	STRUCTURAL
STRM	STORM
SW	SIDEWALK
SWBT	SOUTHWESTERN BELL TELEPHONE CO.
SY	SQUARE YARD
SYM	SYMMETRICAL
SYS	SYSTEM
TBM	TEMPORARY BENCHMARK
TEL	TELEPHONE
TEMP	TEMPORARY
THK	THICK
TB	TOP OF BANK (BERM)
TC	TOP OF CURB
TG	TOP OF GRATE
TP	TOP OF PAVEMENT
TYP	TYPICAL
TW	TOP OF WALL
UE	UNDERGROUND ELECTRIC CABLE
UNO	UNLESS NOTED OTHERWISE
V	VELOCITY
VC	VERTICAL CURVE
VERT	VERTICAL
W	WEST
WL	WATERLINE
W/	WITH
W/O	WITHOUT
WM	WATER METER
WSEL	WATER SURFACE ELEVATION
WT	WEIGHT
WWF	WELDED WIRE FABRIC
WW	WASTE WATER

A1	ABBREVIATIONS
N.T.S.	

TBM
BORE LOCATION
TELEVISION RISER
CLEANOUT
FIRE HYDRANT
GAS METER
GATE VALVE
IRON PIPE FOUND
IRON ROD FOUND
IRON ROD SET
LIGHT POLE
MONUMENT FOUND
MONUMENT SET
SET 60D NAIL
MANHOLE
MAILBOX
PANEL MARKER
POWER POLE
WATER METER
WATER VALVE
SIGN
TELEPHONE RISER
TRAVERSE POINT
GUY WIRE
SHRUB
TREE

BRUSH LINE
EX. EDGE OF PAVEMENT
BOUNDARY LINE
ROAD CENTERLINE
EX. RAILROAD
EX. FENCE
WASTEWATER LINE
EX. WATER LINE
EX. UNDERGROUND TELEVISION LINE
EX. AERIAL TELEVISION LINE
EX. UNDERGROUND TELEPHONE LINE
EX. ABOVE GROUND TELEPHONE LINE
EX. STORM DRAIN
EX. GASLINE
EX. FORCEMAIN
EX. CONTOUR LINE
EX. CONCRETE
EX. GRAVEL
EX. BUILDING

A8	SURVEY LEGEND
N.T.S.	

AUTOMATIC FLUSH VALVE
GATE VALVE
CHECK VALVE
PLUG VALVE
BUTTERFLY VALVE
QUICK DISCONNECT COUPLER
CAPPED END OR PLUGGED END
BLIND FLANGE
REDUCER OR INCREASER
BACKFLOW PREVENTOR
AIR VACUUM AND AIR RELEASE ASSEMBLY
GRATE INLET
BLOW–OFF ASSEMBLY
CENTRIFUGAL OR TURBINE PUMP OR FAN
FIRE HYDRANT & VALVE
CLEANOUT TO GRADE
MANHOLE
123.00 PROPOSED SPOT ELEVATION
JUNCTION BOX
CURB INLET
NEW FENCE
TEMPORARY LIVESTOCK FENCE
EASEMENT LINE
BOUNDARY LINE

A11	GENERAL SYMBOLS
N.T.S.	

F11	CIVIL SYMBOLS
N.T.S.	

SECTION IDENTIFICATION

A1 / C400 — SECTION NUMBER; DRAWING ON WHICH SECTION APPEARS

DETAIL IDENTIFICATION

A1 / C400 — DETAIL NUMBER; DRAWING ON WHICH DETAIL IS SHOWN

A1 / M100 — ELEVATION MARKER; DRAWING ON WHICH ELEV. IS SHOWN

MATERIALS LEGEND

CEMENT TREATED BASE
CRUSHED LIMESTONE
COARSE AGGREGATE
GRAVEL
TOPSOIL
EARTH (COMPACTED)
EARTH (UNDISTURBED)
CONCRETE
SAND
ASPHALT
RIP–RAP
MASONRY
STEEL
ALUMINUM
GRATING
CHECKERED PLATE
GROUT
BRICK

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

LEGENDS ABBREVIATIONS & SYMBOLS

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C006

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-LEGEND AND ABREV.DWG, C006 LEGENDS ABBREVIATIONS & SYMBOLS, 8/14/2023 2:39:51 PM, rcuellar

CONTROL POINT: 40
N: 10222522.46
E: 3145658.78
ELEV: 653.84
½" IRON ROD WITH CAP STAMPED "WALKER PARTNERS"

CONTROL POINT: 39
N: 10223048.11
E: 3144955.06
ELEV: 652.74
½" IRON ROAD WITH CAP STAMPED "WALKER PARTNERS"

CONTROL POINT: 21
N: 10224392.09
E: 3144427.95
ELEV: 657.18
MAG NAIL WITH WASHER STAMPED "WALKER PARTNERS"

CONTROL POINT: 19
N: 10220892.13
E: 3150456.19
ELEV: 642.79
CONCRETE MONUMENT WITH BRASS MARKER

CONTROL POINT: 8
N: 10221071.80
E: 3150103.71
ELEV: 640.51
MAG NAIL WITH WASHER STAMPED "WALKER PARTNERS"

CONTROL POINT: 7
N: 10221208.58
E: 3150629.33
ELEV: 637.04
½" IRON ROD WITH CAP STAMPED "WALKER PARTNERS"

CONTROL POINT: 42
N: 10221283.39
E: 3151211.62
ELEV: 635.23
MAG NAIL WITH WASHER STAMPED "WALKER PARTNERS"

CONTROL POINT: 44
N: 10226596.94
E: 3140063.68
ELEV: 679.28
½" IRON ROD WITH CAP STAMPED "WALKER PARTNERS" SET

CONTROL POINT: 45
N: 10226835.19
E: 3139813.41
ELEV: 683.44
½" IRON ROD WITH CAP STAMPED "WALKER PARTNERS" SET

CONTROL POINT: 6
N: 10227312.08
E: 3138927.15
ELEV: 686.57
MAG NAIL WITH WASHER STAMPED" WALKER PARTNERS" SET

CONTROL POINT: 3
N: 10227720.84
E: 3138511.68
ELEV: 688.30
MAG NAIL WITH WASHER STAMPED" WALKER PARTNERS" SET

CONTROL POINT: 49
N: 10230848.59
E: 3135049.91
ELEV: 688.75
½" IRON ROD WITH CAP STAMPED "WALKER PARTNERS" SET

CONTROL POINT: 50
N: 10230851.46
E: 3134936.24
ELEV: 686.02
½" IRON ROD WITH CAP STAMPED "WALKER PARTNERS" SET

CONTROL POINT: 9
N: 10230945.94
E: 3135092.71
ELEV: 703.70
MAG NAIL WITH WASHER STAMPED" WALKER PARTNERS" SET

FM 971
CR 152
MARKET ST.
IH-35
ARPORT RD.
MATCHLINE 120+00.00
MATCHLINE 120+00.00

208+60.13 BERRY CREEK INTERCEPTOR
6' WW MANHOLE W-VENT
FUTURE 100-YR FLOODPLAIN ELEV=693.0
MIN. VENT ELEV=694.0
(RE: G1/D107) (MH-33)

PROPERTY OWNER AND DESCRIPTION

1. CITY OF GEORGETOWN CALLED 26.466 ACRES TRACT ONE W.C.C.D. 2004020462 O.P.R.W.C.T.
2. JL ENTERPRISES, L.L.P. CALLED 116.60 ACRES W.C.C.D. 9806494 O.R.W.C.T.
3. THOMAS E. BYRD AND TRACIE J. BYRD CALLED 56.3602 ACRES VOLUME 2416, PAGE 424 O.R.W.C.T.
4. TRUMAN M. WHITEAKER CALLED 58.6 ACRES VOLUME 1025, PAGE 800 O.R.W.C.T. (NO DESCRIPTION PROVIDED IN DEED) DESCRIBED IN VOLUME 400, PAGE 36 D.R.W.C.T.
5. CONTACT OF SALE AND PURCHASE TO DON ARTHUR DODGE CALLED 10.21 ACRES W.C.C.D. 2016028154 O.P.R.W.C.T. DESCRIBED IN VOLUME 770, PAGE 405 D.R.W.C.T.
6. DON ARTHUR DODGE CALLED 8.90 ACRES VOLUME 770, PAGE 392 D.R.W.C.T.
7. RONNIE R. RUSSELL AND BONNIE L. RUSSELL CALLED 15.001 ACRES TRACT 1 W.C.C.D. 2015066953 O.P.R.W.C.T.
8. CHAMBERLIN, HENRY B TRUSTEE OF CHAMBERLIN FAMILY TRUST A LOT 1 AMENDED PLAT LOTS 1 & 3 DRY BERRY SUBDIVISION CABINET U, SLIDE 165 P.R.W.C.T. (APRIL 2001)
9. DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN CALLED 22.9218 ACRES W.C.C.D. 2002100427 O.P.W.C.T.
10. DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN LOT 3, BLOCK 1 DRY BERRY SUBDIVISION VOLUME 2703, PAGE 353 O.P.W.C.T.
11. BECKY SNOW W.C.C.D. 2013040491 O.P.R.W.C.T.
12. CHARLES D. SCHWEGMANN W.C.C.D. 2013035807 O.P.R.W.C.T.
13. DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN REMAINDER OF CALLED 23.63 ACRES W.C.C.D. 9613146 O.P.W.C.T.
14. DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN CALLED 12.003 ACRES TRACT "O" VOLUME 639, PAGE 779 D.R.W.C.T
15. DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN CALLED 0.38 ACRES VOLUME 639, PAGE 779 D.R.W.C.T
16. DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN CALLED 12.003 ACRES TRACT "B" VOLUME 639, PAGE 779 D.R.W.C.T
17. DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN CALLED 12.003 ACRES TRACT "A" VOLUME 639, PAGE 779 D.R.W.C.T
18. LEROY HOMEYER AND ALICE HOMEYER CALLED 38.1297 ACRES SHARE NO. THREE VOLUME 609, PAGE 82 D.R.W.C.T.
19. ANTHONY J. SARAGUSA, SR. CALLED 20.6977 ACRES W.C.C.D. 2015017937 O.P.R.W.C.T.
20. MARTHA ANN EDWARDS CALLED 14.34 ACRES W.C.C.D. 2016029312 O.P.R.W.C.T. (DESCRIBED IN W.C.C.D. 1995-9540790, O.P.R.W.C.T.)
21. THREE FORKS PARTNERSHIP, LTD. CALLED 382.15 ACRES (370.893 ACRES-NET) W.C.C.D. 2005003918 O.P.R.W.C.T. 382.15 ACRES SAVE & EXCEPT 1.457 ACRES, W.C.C.D. 8711458, O.P.R. 0.5 ACRE, W.C.C.D. 2001014355, O.P.R. 9.30 ACRES DESC. IN W.C.C.D. 2005003918
22. JOE L. LYKES CALLED 386.05 ACRES EXHIBIT "A" W.C.C.D. 19932320 O.P.R.W.C.T.
23. GARY L. SHIPMAN AND LAURA M. SHIPMAN, HUSBAND AND WIFE CALLED 5.73 ACRES. W.C.C.D. 2000048959 O.P.R.W.C.T.

LEGEND

BERRY CREEK INTERCEPTOR

0 200 400 800
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

KEY MAP

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C007

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-KEY MAP.DWG, C007 KEY MAP, 8/15/2023 8:11:31 AM, trobles



LEGEND

BERRY CREEK INTERCEPTOR

0 20 40 80

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners
engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

KEY MAP OFF-SITE WASTEWATER INTERCEPTOR CONNECTION

08/14/2023
DATE

TRISTAN A. ROBLES

STATE OF TEXAS
TRISTAN A. ROBLES
145927
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	JB
PROJECT NO.	3-00582

DRAWING NO.
C008

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-KEY MAP-DWG, KEY MAP OFF-SITE WASTEWATER INTERCEPTOR CONNECTION, 8/15/2023 2:51:29 PM, trobles

NUMBER	NORTHING	EASTING	TYPE	TRUNK DIAMETER (INCHES)	TO BE REMOVED
20	10221741.81	3149089.607	ELM	23.5	
21	10221758.25	3149094.982	ELM	15.5	
22	10221820.36	3149093.193	ASH	19.5	
23	10221818.33	3149057.964	ELM	17.5	
24	10221766.76	3149025.551	ELM	14	X
25	10221766.26	3149056.203	ELM	17	
26	10221773.14	3149078.898	ELM	12.5	
27	10221884.3	3149060.723	PEC	26.5	
28	10221822.14	3149031.545	ASH	30	
29	10221846.28	3149030.592	ASH	16	
30	10221840.01	3149001.319	ASH	16	X
31	10221786.42	3148994.746	ELM	14	X
32	10221776.96	3149025.686	ELM	12.5	X
33	10221920.33	3149033.192	PEC	24	
34	10221931.21	3148890.207	PEC	25.5	
35	10221978.64	3148838.837	ELM	17	
36	10221929.6	3148789.033	PEC	20	X
37	10221877.44	3148949.739	ELM	23	X
38	10221869.61	3148912.972	ELM	13.5	X
39	10221889.24	3148905.123	ELM	13.5	X
40	10221884.05	3148902.7	ELM	22	X
41	10221855.99	3148893.707	ELM	22.5	X
42	10221841.7	3148898.682	ELM	17.5	
43	10221802.27	3148905.754	ELM	13	
44	10221846.95	3148783.942	ELM	20	
45	10221832.72	3148758.893	ELM	12.5	
46	10221880.61	3148812.895	ELM	32	X
47	10221913.33	3148786.125	ELM	12.5	X
48	10221946	3148701.102	ELM	14	X
49	10221876.15	3148736.374	RO	26	
50	10221848.13	3148674.564	ELM	24.5	
51	10221879.02	3148652.26	ELM	13.5	
52	10221963.91	3148639.434	ELM	20	X
53	10221974.28	3148585.499	ELM	13	X
54	10221976.54	3148572.905	ELM	14.5	X
55	10221877.91	3148584.098	ELM	21.5	
56	10221878.26	3148585.572	ELM	15.5	
57	10221898.82	3148548.668	ELM	16	
58	10221919.31	3148521.249	ELM	17	
59	10221988.65	3148534.576	ELM	13.5	X
60	10221993.6	3148504.363	ELM	15.5	X
61	10221996.38	3148509.606	ELM	13.5	X
62	10221999.17	3148482.823	ELM	16.5	X
63	10222014.49	3148477.135	ELM	17.5	X
64	10222006.64	3148427.706	ELM	15	X
65	10222010.2	3148405.416	ELM	14.5	X
66	10222017.39	3148393.154	ELM	15	X
67	10222019.33	3148379.915	ELM	14	X
68	10222017.78	3148366.939	ELM	12	X
69	10222103.34	3148397.5	PEC	34	
70	10222128.49	3148435.078	PEC	15.5	
71	10222005.77	3148330.637	ELM	13.5	
72	10221975.16	3148321.22	ELM	16.5	
73	10222021.89	3148284.72	ELM	15	
74	10222027.62	3148311.619	ELM	13	X
75	10222057.95	3148273.453	ELM	13	X
76	10222060.34	3148262.032	ELM	18	X
77	10222055.41	3148249.566	ELM	18	X
78	10222026.16	3148251.262	ELM	14	
79	10222059.42	3148236.398	ELM	13.5	X
80	10222063.52	3148228.121	ELM	17	X
81	10222175.79	3148027.248	ELM	18	X
82	10222228.06	3148022.941	ELM	15	
83	10222212.05	3148011.204	ELM	16	
84	10222212.64	3148003.317	ELM	24.5	
85	10222220.3	3147980.906	ELM	14.5	
86	10222224.25	3147983.06	ELM	12.5	
87	10222258.93	3147959.759	ELM	13	
88	10222256.6	3147959.709	ELM	12	
89	10222241.67	3147955.808	ELM	12.5	
90	10222249.53	3147936.982	ELM	12	
91	10222236.46	3147923.274	ELM	15	
92	10222199.07	3147905.717	ELM	14	X
93	10222170.85	3147954.241	ELM	14	X
94	10222165.32	3147981.458	ELM	26	X

NUMBER	NORTHING	EASTING	TYPE	TRUNK DIAMETER (INCHES)	TO BE REMOVED
95	10222127.02	3147966.732	ELM	14	
96	10222114.27	3147974.139	ELM	12.5	
97	10222121.15	3147996.952	ELM	14.5	
98	10222104.2	3148001.341	ELM	13	
99	10222116.56	3148034.415	ELM	13.5	X
100	10222107.64	3148050	ELM	12.5	X
101	10222105.14	3148064.369	ELM	16	X
102	10222063.1	3148106.294	ELM	12.5	
103	10222078.82	3148170.437	ELM	18.5	X
104	10221997.39	3148175.065	ELM	18	
105	10222007.05	3148148.358	ELM	12.5	
106	10222014.19	3148098.869	ELM	12.5	
107	10222047.74	3148034.612	ELM	13.5	
108	10222077.94	3148051.543	ELM	14	
109	10222083.09	3147977.319	ELM	12	
110	10222096.42	3147919.154	ELM	14	
111	10222092.62	3147916.969	ELM	34	
112	10222149.41	3147909.681	ELM	16	
113	10222151.34	3147887.865	ELM	15.5	
114	10222112.53	3147824.54	ELM	12	
115	10222134.44	3147802.439	ELM	20	
116	10222211.64	3147872.313	ELM	16.5	X
117	10222204.3	3147862.67	ELM	14	X
118	10222219.6	3147862.695	ELM	12	X
119	10222205.6	3147841.678	ELM	12.5	X
120	10222242.67	3147835.243	ELM	12	
121	10222291.67	3147880.048	ELM	26	
122	10222240.45	3147782.151	ELM	14.5	X
123	10222121.47	3147764.774	ELM	22.5	
124	10222158.12	3147728.035	ELM	16	
125	10222176.95	3147702.767	ELM	14	
126	10222212.61	3147691.079	ELM	14.5	
127	10222285.29	3147708.934	ELM	26.5	
128	10222191.92	3147628.93	ELM	13.5	
129	10222193.81	3147625.75	ELM	14	
130	10222267.41	3147576.828	ELM	15	X
131	10222342.52	3147499.473	ELM	12.5	
132	10222304.31	3147454.915	ELM	12	X
133	10222208.74	3147498.305	LO	20	
134	10222241.69	3147479.335	LO	16.5	
135	10222231.06	3147455.272	LO	27.5	
136	10222264.21	3147402.829	LO	23.5	
137	10222310.92	3147401.826	ELM	39	X
138	10222250.13	3147380.429	LO	20.5	
139	10222258.57	3147376.583	LO	17	
140	10222297.79	3147360.758	ELM	14	
141	10222366.59	3147430.89	ELM	21	
142	10222391.23	3147453.888	ELM	15	
143	10222411.7	3147470.512	ELM	17.5	
144	10222421.63	3147466.429	ELM	13	
145	10222420.6	3147395.686	ELM	13	
146	10222432.49	3147165.168	ELM	12.5	X
147	10222478.73	3147259.797	ELM	26.5	
148	10222393.66	3147168.941	ELM	13	X
149	10222364.09	3147173.969	ELM	15	
150	10222361.12	3147200.821	ELM	17.5	
151	10222292.74	3147184.128	ELM	12	
152	10222304.47	3147242.49	ELM	19	
153	10222357.42	3147292.902	ELM	13	X
154	10222364.97	3147305.7	ELM	12.5	X
155	10222394.19	3147255.908	ELM	12.5	X
156	10222446.77	3147326.953	ELM	12	
157	10221145.98	3150200.825	ELM	25	
158	10221153.54	3150236.586	ELM	23.5	
159	10220981.05	3149413.594	ELM	26.5	
160	10220967.72	3149349.886	ELM	16.5	
161	10222445.9	3147163.821	ELM	13	
162	10222538.98	3147176.132	ELM	16.5	
163	10222560.63	3147178.846	ELM	12	
164	10222597.43	3147171.444	ELM	15.5	
165	10222606.41	3147210.851	ELM	16	
166	10220993.94	3150363.737	PEC	13.5	
167	10221052.21	3150345.551	PEC	33.5	
168	10221079.95	3150277.047	HACK	11.5	
169	10220816.69	3150500.891	HACK	17	

NUMBER	NORTHING	EASTING	TYPE	TRUNK DIAMETER (INCHES)	TO BE REMOVED
170	10220812.61	3150502.582	HACK	10	
171	10222919.46	3147111.54	ELM	18.5	
172	10222818.64	3147099.389	ELM	21.5	
173	10222827.6	3147159.865	ELM	24	
174	10222772.37	3147130.084	ELM	12	
175	10222727.27	3147126.548	ASH	24	
176	10223163.02	3145886.616	LO	28.5	
177	10223176.29	3145831.322	LO	30.5	
178	10223180.09	3145827.665	LO	16	
179	10223190.28	3145770.675	LO	37	
180	10224564.67	3144901.763	LO	14	
181	10224593.74	3144979.314	LO	16	
182	10227145.12	3140417.135	LO	28	
183	10227153.95	3140458.821	LO12	127.5	
184	10227483.43	3139841.946	LO	37.5	
185	10227475.36	3139853.922	LO	53.5	
186	10227454.75	3139822.104	LO	28	
187	10227171.07	3140355.367	LO	29.5	
188	10227180.27	3140366.462	LO	40	
191	10226581.97	3144500.902	ELM	17	
192	10226602.67	3144530.293	ELM	14	
193	10226621.15	3144535.412	ELM	13	
194	10226653.81	3144579.945	ELM	14	
202	10227797.15	3137549.084	ASH	19	
203	10227865.48	3137573.852	ELM	17	X
204	10227934.01	3137536.923	ASH	14	
205	10227930.87	3137491.105	ASH	13	
206	10227948	3137573.323	LO	36	
207	10227991.73	3137640.363	LO	27.5	
208	10227893.49	3137662.628	ELM	17	X
209	10227881.56	3137642.733	LO	17.5	X
210	10227870.58	3137660.048	LO	24	X
211	10227851.48	3137654.464	LO	17.5	
212	10227849.69	3137648.736	LO	52.5	
213	10228301.13	3138086.176	ELM	17	
214	10228306.17	3138075.69	ELM	17.5	
215	10229782.12	3135272.009	ELM	14.5	
216	10229781.96	3135126.631	LO	19	
217	10229830.31	3135252.086	ELM	15.5	
218	10230370.99	3135189.645	ELM	17	
219	10230473.57	3135176.962	ELM	16.5	
220	10228346.98	3137291.518	ELM	15	
221	10228328.23	3137293.592	ELM	17	
222	10228307.78	3137307.774	ELM	13	X
223	10228350.8	3137384.32	LO	17	
224	10228236.68	3137386.023	ELM	13	
225	10228139.71	3137385.039	ELM	13.5	
226	10228046.58	3137396.783	ASH	23.5	
227	10227968.14	3137329.606	ELM	13.5	
228	10227977.06	3137337.643	ELM	18.5	X
229	10227959.61	3137407.658	ASH	19.5	
230	10227913.63	3137400.831	ELM	18	
231	10227874.67	3137434.526	ASH	16.5	
232	10227850.08	3137448.051	ASH	25	
233	10227826.73	3137406.648	LO	32.5	
234	10227813.92	3137444.227	ASH	15	
235	10227798.11	3137439.094	ASH	13	
236	10227802.32	3137432.707	ASH	16	
237	10227793.62	3137460.495	ASH	13.5	
238	10227780.81	3137446.083	ASH	29.5	
239	10227777.89	3137461.87	ASH	14	
240	10227773.88	3137368.348	ELM	12.5	
241	10227766.93	3137427.462	RO	20	
242	10228274.87	3137174.248	LO	48.5	
243	10228232.5	3137258.403	LO	44	
244	10228171.38	3137231.324	LO	46.5	
245	10228163.75	3137215.056	LO	17	
246	10227838.23	3137352.474	ELM	25.5	X
247	10227827.09	3137367.411	ELM	13	
248	10227793.14	3137366.117	ELM	13	
249	10227794.55	3137378.759	ELM	19.5	
250	10227728.05	3137461.552	ASH	45	
289	10224542.74	3144833.91	LO	46	
290	10227445.77	3139968.16	PEC	5.5	
291	10227386.21	3139972.558	PEC	12	

TREE REMOVAL AND MITIGATION NOTES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DAMAGES TO TREES DUE TO HIS/HER OPERATIONS.
2. THE CONTRACTOR SHALL PROTECT THE TREES SHOWN ON THE PLANS AND AS DIRECTED BY THE CITY INSPECTOR OR ENGINEER. DAMAGES TO TREES SHALL BE CORRECTED BY THE CONTRACTOR IN ACCORDANCE WITH CITY SPECIFICATION SECTION CIP9.
3. ANY PERSON WHO REMOVES A PROTECTED OR HERITAGE TREE IN VIOLATION OF THE UNIFIED DEVELOPMENT CODE (UDC), ACCIDENTALLY OR OTHERWISE, SHALL BE REQUIRED TO COMPLY WITH THE MITIGATION PROVISIONS IN THE UDC, AND IF THE ACT IS INTENTIONAL, TO PAY A FINE FOR EACH TREE THAT IS REMOVED, AS ALLOWED BY LAW, IN ADDITION TO ANY PENALTIES ALLOWED BY LAW. MITIGATION SHALL BE BASED ON THE MITIGATION PROVISIONS APPLICABLE AT THE TIME OF THE VIOLATION, NOT THOSE AT THE TIME OF ADVERTISEMENT, BIDDING, OR AWARD OF THE CONTRACT.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TREE LIST (1 OF 3)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C009

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-TREE LIST.DWG, TREE LIST (1 OF 3), 8/14/2023 2:48:24 PM, rcuellar

NUMBER	NORTHING	EASTING	TYPE	TRUNK DIAMETER (INCHES)	TO BE REMOVED
292	10227346.16	3139969.52	PEC	6	X
293	10227337.79	3140039.834	PEC	6.5	
294	10227293.9	3140038.946	PEC	13	X
295	10227270.51	3140071.599	PEC	12	X
296	10227288.66	3140106.784	PEC	10.5	
297	10227328.8	3140127.538	PEC	7	
298	10227305.61	3140159.58	PEC	7	
299	10227282.36	3140191.913	PEC	4.5	
300	10227243.59	3140168.626	PEC	8.5	
406	10222593.57	3146611.53	ELM	15	
407	10222492.17	3146884.47	ELM	12.5	X
408	10222415.13	3146913.42	ELM	16	
409	10222464.5	3146762.23	ELM	15	X
410	10222424.75	3146957.42	ELM	12.5	
411	10222445.04	3147035.85	ELM	14	X
412	10222367.49	3147150.39	ELM	12	
413	10222416.65	3147148.804	ELM	19	X
414	10223114.01	3145574.57	LO	42	
415	10223071.51	3145609.11	LO	31	X
416	10223009.92	3145629.29	ELM	22	X
417	10222955.13	3145644.17	ELM	20	
418	10222949.27	3145674.58	LO	13	X
419	10222949.39	3145675.99	LO	18	X
420	10222959.57	3145680.02	LO	19.5	X
421	10222843.19	3145676.85	LO	34	X
422	10222829.73	3145695.53	ELM	16	
423	10222721.82	3145753.48	ASH	18	
424	10222722.34	3145776.77	ASH	32	
425	10222694.68	3145827.5	SYC	13.5	
426	10222687.26	3145780.34	ASH	17.5	
427	10222777.25	3145815.07	ELM	32.5	
428	10222975.3	3145726.29	LO	31	
429	10222996.79	3145715.11	LO	47	
930	10227841.2	3143369.391	ELM	12	
931	10227835.79	3143364.102	ELM	15.5	
936	10227905.46	3143341.343	ELM	12	
938	10227907.65	3143314.031	ELM	12.5	
939	10227947.72	3143273.866	ELM	18.5	
940	10227953.89	3143297.099	ELM	16.5	
947	10228059.72	3143208.655	LO	30	
948	10228059.65	3143203.514	LO	17.5	
951	10228080.75	3143215.554	ELM	13.5	
953	10228112.44	3143158.625	ELM	30	
956	10228141.67	3143085.392	ELM	25.5	
957	10228137.55	3143112.228	ELM	13	
960	10228147.47	3143134.22	ELM	12.5	
961	10228145.5	3143141.133	ELM	17	
962	10227554.36	3143471.797	ELM	24.5	
963	10227486.89	3143525.141	ELM	14	
964	10227409.42	3143539.372	ELM	21	
965	10227167.91	3143575.57	ELM	22	
966	10227160.64	3143575.341	ELM	22	
967	10226592.7	3143635.95	ELM	27	
968	10226550.43	3143626.276	ELM	22	X
969	10226527.46	3143624.82	ELM	14	
970	10226509.45	3143638.436	ELM	1	
971	10226505.25	3143642.05	ELM	14.5	
972	10226500.71	3143635.256	ELM	16	
973	10226503.75	3143629.883	ELM	13.5	
974	10226493.06	3143624.367	ELM	17.5	
975	10226841.33	3143627.879	ELM	28.5	
1044	10230632.18	3135779.383	LO	12	X
1045	10230688.85	3135478.799	ELM	13	
1046	10230670.47	3135405.337	ELM	12	
1047	10230648.7	3135781.84	LO	17.5	
1071	10227223.69	3140135.772	PEC	10	X
1072	10227201.93	3140165.745	PEC	6	X
1073	10227177.22	3140199.312	PEC	10	X
1074	10227153.66	3140231.297	PEC	12	X
1075	10227147.47	3140250.441	HAC	13	X
1076	10227131.01	3140263.749	PEC	12.5	X
1077	10227190.37	3140233.827	PEC	13.5	X
1078	10227187.41	3140321.879	PEC	9.5	
1079	10227210.93	3140288.642	PEC	9.5	
1080	10227234.95	3140255.267	PEC	10.5	

NUMBER	NORTHING	EASTING	TYPE	TRUNK DIAMETER (INCHES)	TO BE REMOVED
1081	10227258.62	3140224.354	PEC	10	
1082	10227247.41	3140103.763	PEC	11	X
1083	10227168.5	3140246.746	PEC	3	
1084	10228333.41	3142958.351	PEC	33	
1085	10228315.66	3142968.065	PEC	17.5	
1086	10228236.37	3143002.096	ELM	15	X
1087	10228250.06	3143052.561	ELM	13	
1088	10228236.61	3143074.325	ELM	14	
1089	10228226.9	3143011.604	ELM	15	X
1107	10226952.65	3139746.262	LO	70	
1736	10230636.75	3135784.957	LO	13	X
1737	10230638.45	3135790.293	LO	13	X
1738	10230640.19	3135790.911	LO	12	X
1739	10230644.39	3135800.209	LO	13	X
1740	10230548.45	3135590.152	LO	14	
1741	10230554.46	3135584.853	LO	13	
1742	10230575.87	3135647.872	LO	33.5	
1743	10230569.13	3135643.94	LO	16	
1744	10230563.6	3135642.534	LO	15.5	
1745	10230558.25	3135644.102	LO	17	
1746	10230571.44	3135632.831	LO	16.5	
1747	10230554.93	3135620.454	LO	42.5	
1748	10230579.18	3135539.474	ELM	16.5	
1749	10230604.52	3135370.716	ELM	13	X
1750	10230631.35	3135267.221	ELM	17.5	X
1751	10230667.23	3135788.222	ELM	20	
1752	10230642.88	3135819.005	ELM	16.5	X
1753	10230658.6	3135832.034	ELM	13	
1754	10230645.95	3135840.267	ELM	12.5	
1755	10230649.61	3135870.862	LO	15	
1756	10230651.87	3135872.94	LO	18.5	
1757	10230654.18	3135872.662	LO	14.5	
1758	10230643.66	3135879.581	ELM	15	
1759	10230656.18	3135886.708	ELM	19.5	
1760	10230570.82	3135837.111	ELM	17	
1761	10230553.36	3135858.265	LO	25.5	
1762	10230550.63	3135870.994	LO	28	
1763	10230541.7	3135910.52	ELM	21	
1764	10230539.9	3135920.418	LO	19	
1765	10230531.52	3135913.364	LO	20.5	
1766	10230545.91	3135992.92	ELM	12	
1767	10230686.22	3136104.058	ELM	13.5	
1768	10230674.15	3136115.001	ELM	12.5	
1769	10230671.02	3136203.993	ELM	14.5	
1770	10230607.76	3136142.978	LO	18	X
1771	10230563.63	3136145.951	ELM	23.5	
1772	10230531.34	3136118.725	ELM	12.5	
1773	10230584.7	3136280.464	ELM	16	
1774	10230686.54	3136823.474	LO	12	
1775	10230686.75	3136826.782	LO	14.5	
1776	10230718.83	3136827.917	LO	13.5	
1777	10230582.67	3136897.746	LO	19	
1778	10230593.71	3137005.993	LO	28.5	
1779	10230631.21	3136954.499	LO	12.5	
1780	10230633.39	3136953.091	LO	12	X
1781	10230657.97	3136944.723	LO	13.5	X
1782	10230637.69	3136922.588	LO	12.5	X
1783	10230719.49	3136948.547	LO	15.5	
1784	10230664.32	3137070.534	RO	17	X
1785	10230696.23	3137092.811	PEC	12.5	X
1786	10230724.88	3137061.882	PEC	20	
1787	10230780.4	3137106.876	PEC	19.5	
1788	10230781.4	3137123.027	PEC	32	
1789	10230792.28	3137245.658	BUR	28	
1790	10230772.53	3137231.918	ELM	15	
1791	10230780.64	3137221.616	PEC	15.5	
1792	10230775.94	3137205.823	PEC	15.5	
1793	10230774.54	3137171.877	PEC	12	
1794	10230749.91	3137126.793	PEC	23	
1795	10230737.61	3137136.65	PEC	19.5	
1796	10230747.46	3137172.141	PEC	23	
1797	10230756.24	3137245.069	PEC	17.5	
1798	10230731.86	3137251.008	PEC	14.5	
1799	10230718.18	3137223.68	PEC	23	

NUMBER	NORTHING	EASTING	TYPE	TRUNK DIAMETER (INCHES)	TO BE REMOVED
1800	10230717.99	3137207.394	PEC	17	
1801	10230703.83	3137251.668	PEC	24	
1802	10230661.31	3137201.868	BUR	19	X
1803	10230667.25	3137165.166	ELM	13	X
1804	10230658.01	3137252.675	PEC	22	
1805	10230645.2	3137266.536	ELM	25.5	
1806	10230647.8	3137301.047	ELM	32.5	
1807	10230594.3	3137314.091	PEC	32	
1808	10230568.65	3137225.4	ELM	12	X
1809	10230479.06	3137267.012	ELM	14.5	X
1810	10230462.06	3137213.532	ELM	12.5	
1811	10230459.26	3137235.594	ELM	12.5	X
1812	10230440.42	3137289.975	ELM	21.5	X
1813	10230425.96	3137333.673	ELM	12	
1814	10230417.07	3137348.228	ELM	14.5	
1815	10230388.62	3137305.172	ELM	13.5	X
1816	10230392.14	3137292.488	ELM	14	X
1817	10230358.56	3137303.688	ELM	16.5	X
1818	10230418.97	3137226.894	ELM	16.5	
1819	10230388.97	3137177.815	LO	37	
1820	10230281.08	3137259.943	ELM	12	
1821	10230254.1	3137267.453	ELM	15	
1822	10230318.37	3137291.393	ELM	13.5	X
1823	10230209.55	3137241.892	LO	13	
1824	10230190.04	3137348.708	ELM	16.5	X
1825	10230277.41	3137373.337	ELM	18.5	
1826	10230301.23	3137422.383	ELM	20.5	
1827	10230202.88	3137436.733	ELM	13.5	
1828	10230193.3	3137434.365	PEC	23.5	
1829	10230167.22	3137324.203	LO	35	X
1830	10230160.42	3137325.667	LO	20	X
1831	10229982.93	3137300.013	ELM	16	
1832	10230141.7	3137481.518	LO	28	
1833	10230071.49	3137477.044	PEC	14.5	
1834	10230064.11	3137451.73	ELM	14.5	
1835	10230048.69	3137449.056	ELM	23.5	
1836	10230010.27	3137424.634	LO	13.5	
1837	10230035.8	3137491.554	PEC	18	
1838	10229937.34	3137474.298	ELM	20.5	
1839	10229931.79	3137452.9	ELM	18	
1840	10229887.28	3137474.954	LO	14	
1841	10229871.82	3137460.118	PEC	13	
1842	10229831.98	3137490.274	ELM	22	
1843	10229794.52	3137489.62	ELM	19	
1844	10229781.38	3137519.899	PEC	25	
1845	10229768.03	3137544.986	PEC	15	
1846	10229694.79	3137520.126	PEC	22	
1847	10229663.9	3137518.179	PEC	29.5	
1848	10229647.45	3137508.452	PEC	24.5	
1849	10229625.02	3137491.481	PEC	21.5	
1850	10229638.11	3137477.182	PEC	18	
1851	10229612.56	3137492.013	PEC	19.5	
1852	10229715.03	3137392.531	ELM	17.5	X
1853	10229821.95	3137386.437	ELM	18	
1854	10229755.61	3137356.315	ELM	12.5	
1855	10229705.93	3137370.795	ELM	15	
1856	10229705.67	3137332.834	LO	44	
1857	10229635.23	3137374.013	ELM	12.5	X
1858	10229663.99	3137412.467	ELM	14	X
1859	10229531.79	3137414.476	LO	32	
1860	10229523.79	3137453.337	ASH	16.5	
1861	10229289.33	3137273.586	LO	26	
1862	10229289.23	3137266.479	LO	30.5	
1863	10229160.14	3137370.658	LO	37.5	
1864	10229167.19	3137375.617	LO	29	
1865	10228963.66	3137383.167	LO	40.5	
1866	10228920.29	3137410.671	LO	15	
1867	10228926.58	3137389.023	LO	18	
1868	10228857.83	3137433.505	LO	16.5	
1869	10228863.68	3137438.319	LO	15	
1870	10228798.24	3137304.189	ELM	15.5	X
1871	10228800.21	3137295.569	LO	40.5	X
1872	10228815.49	3137308.712	ELM	14	X
1873	10228823.82	3137324.798	ELM	12.5	X
1874	10228810.48	3137293.249	ELM	13.5	X

TREE REMOVAL AND MITIGATION NOTES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DAMAGES TO TREES DUE TO HIS/HER OPERATIONS.
2. THE CONTRACTOR SHALL PROTECT THE TREES SHOWN ON THE PLANS AND AS DIRECTED BY THE CITY INSPECTOR OR ENGINEER. DAMAGES TO TREES SHALL BE CORRECTED BY THE CONTRACTOR IN ACCORDANCE WITH CITY SPECIFICATION SECTION CIP9.
3. ANY PERSON WHO REMOVES A PROTECTED OR HERITAGE TREE IN VIOLATION OF THE UNIFIED DEVELOPMENT CODE (UDC), ACCIDENTALLY OR OTHERWISE, SHALL BE REQUIRED TO COMPLY WITH THE MITIGATION PROVISIONS IN THE UDC, AND IF THE ACT IS INTENTIONAL, TO PAY A FINE FOR EACH TREE THAT IS REMOVED, AS ALLOWED BY LAW, IN ADDITION TO ANY PENALTIES ALLOWED BY LAW. MITIGATION SHALL BE BASED ON THE MITIGATION PROVISIONS APPLICABLE AT THE TIME OF THE VIOLATION, NOT THOSE AT THE TIME OF ADVERTISEMENT, BIDDING, OR AWARD OF THE CONTRACT.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TREE LIST (2 OF 3)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C010

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-TREE LIST.DWG, TREE LIST (2 OF 3), 8/14/2023 2:48:26 PM, rcuellar

NUMBER	NORTHING	EASTING	TYPE	TRUNK DIAMETER (INCHES)	TO BE REMOVED
1875	10228821	3137271.165	ELM	14	
1876	10228842.59	3137264.688	ELM	16.5	
1877	10228935.03	3137233.904	ELM	16	
1878	10228939.88	3137238.391	ELM	21.5	
1879	10228943.15	3137237.265	ELM	13.5	
1880	10228974.25	3137219.249	ELM	18	
1881	10228743.61	3137298.542	ASH	21.5	X
1882	10228724.55	3137325.412	ASH	12.5	X
1883	10228741.29	3137325.17	ELM	24.5	X
1884	10228721.24	3137332.384	ASH	15	X
1885	10228706.99	3137337.481	ASH	18.5	X
1886	10228684.41	3137349.969	ASH	15.5	
1887	10228717.9	3137369.963	ASH	14	
1888	10228755.02	3137390.325	ASH	14.5	
1889	10228759.04	3137429.629	ELM	20.5	
1890	10228738.06	3137432.835	LO	34.5	
1891	10228667.47	3137409.675	ELM	20.5	
1892	10228619.27	3137425.953	ELM	16.5	
1893	10228622.96	3137312.955	ASH	15.5	X
1894	10228643.92	3137308.752	ASH	20	X
1895	10228659.62	3137298.478	ASH	16	X
1896	10228683.53	3137293.012	ASH	18.5	X
1898	10230678.86	3135668.636	ELM	15	
1899	10230687.14	3135280.363	ELM	14	
1900	10230688	3135531.478	ELM	12	
1901	10228693.7	3137286.447	ASH	13.5	X
1902	10228680.24	3137237.753	ELM	13.5	
1903	10228628.13	3137236.556	ELM	14	
1904	10228605.22	3137295.648	ELM	14.5	X
1905	10228547.23	3137265.052	ELM	13	
1906	10228549.48	3137264.343	ELM	15	
1907	10228554.68	3137261.55	ELM	15	
1908	10228564.23	3137257.713	ELM	25.5	
1909	10228568.14	3137256.783	ELM	18	
1910	10228577.15	3137253.277	ELM	14	
1911	10228475.5	3137290.298	ELM	16.5	
1912	10228468.92	3137297.038	ELM	18.5	
1913	10228503.24	3137357.547	ELM	17	
1914	10228503.9	3137363.941	ELM	23.5	
1915	10228507.72	3137359.872	ELM	12.5	
1916	10228466.2	3137342.894	ELM	14.5	
1917	10228419.62	3137393.441	LO	14	
1919	10228391.16	3137452.474	ELM	13	
1920	10228536.04	3137413.898	ASH	25	
1921	10228595.45	3137422.712	ELM	15.5	
1922	10228589.41	3137417.952	ELM	12	
1923	10228580.13	3137406.079	ELM	12	
1924	10228564.76	3137471.304	ELM	14	
1925	10228557.93	3137347.254	ELM	13	
1972	10230937.3	3135205.251	ELM	14.5	
1973	10230948.3	3135221.824	ELM	19.5	
1974	10230878.11	3135190.24	ELM	14	X
1998	10230637.89	3135532.432	ELM	14	X
1999	10230669.45	3135545.949	ELM	12	
4192	10230673.44	3135211.804	ELM	13	
4193	10230699.57	3135207.222	ELM	14	
4194	10230694.65	3135229.264	ELM	15	
4195	10230679.1	3135264.55	ELM	14	
4196	10230671.81	3135692.37	ELM	15	
4197	10230672.77	3135716.175	ELM	12.5	
4198	10230637.57	3135776.181	LO	23.5	X
4199	10230649.18	3135754.462	ELM	13.5	
4200	10230651.56	3135781.49	LO	12.5	
5115	10227452.95	3141225.772	PEC	12.5	
5116	10227464.3	3141255.821	PEC	16	
5117	10227476.95	3141289.059	PEC	16	
5118	10227487.54	3141318.976	PEC	14	
5119	10227498.63	3141349.317	PEC	13.5	
5120	10227523.39	3141412.33	PEC	16.5	
5121	10227536.36	3141442.143	PEC	16	
5122	10227547.44	3141473.305	PEC	14	
5123	10227570.23	3141534.998	PEC	15.5	
5124	10227594.25	3141597.733	PEC	15	
5125	10227606.22	3141628.098	PEC	17	
5126	10227617	3141658.732	PEC	17	

NUMBER	NORTHING	EASTING	TYPE	TRUNK DIAMETER (INCHES)	TO BE REMOVED
5127	10227628.92	3141688.854	PEC	15.5	
5128	10227641.53	3141720.027	PEC	17.5	
5129	10227664.86	3141781.593	PEC	14.5	
5130	10227677.05	3141811.4	PEC	12.5	
5131	10227687.35	3141843.533	PEC	11	
5132	10227699.75	3141874.589	PEC	10.5	
5133	10227712.47	3141904.068	PEC	13.5	
5134	10227723.7	3141936.37	PEC	9.5	
5135	10227745.98	3141990.133	PEC	8	
5136	10227759.86	3142024.931	PEC	6	
5137	10227771.38	3142057.286	PEC	6.5	
5138	10227784.48	3142090.78	PEC	7	
5139	10227796.2	3142125.245	PEC	7	
5140	10227810.23	3142157.861	PEC	9	
5141	10227823.27	3142192.928	PEC	8	
5142	10227836.16	3142226.419	PEC	8.5	
5143	10227848.95	3142259.445	PEC	5.5	
5144	10227861.65	3142294.007	PEC	9	
5145	10227875.28	3142327.903	PEC	8	
5146	10227888.46	3142359.891	PEC	7.5	
5147	10227913.52	3142427.595	PEC	4.5	
5148	10227926.77	3142461.107	PEC	7	
5149	10227939.59	3142494.532	PEC	7	
5150	10227952.11	3142527.422	PEC	6.5	
5151	10227966.92	3142567.452	PEC	1	
5152	10227990.78	3142629.049	PEC	2	
5153	10228001.55	3142661.067	PEC	4.5	
5154	10228013.77	3142690.552	PEC	4	
5155	10228025.23	3142720.76	PEC	2	
5156	10228037.39	3142752.171	PEC	8	
5157	10228049.17	3142782.679	PEC	3	
5158	10228061.76	3142812.929	PEC	8	
5159	10228073.48	3142843.679	PEC	10	
5160	10228085.37	3142874.417	PEC	12.5	
5161	10228096.19	3142905.544	PEC	11.5	
5162	10228107.82	3142937.036	PEC	14	
5163	10228119.09	3142966.625	PEC	10.5	
5164	10228143.13	3142974.501	PEC	15.5	
5165	10228164.65	3143005.544	ELM	16.5	X
5166	10228179.53	3143018.796	ELM	20	X
5167	10228146.26	3143041.875	ELM	14.5	
5168	10228145.23	3143037.346	ELM	23.5	
5169	10228114.35	3143021.431	ELM	13	
5170	10228111.87	3143024.222	ELM	17	
5173	10228088.95	3143041.596	ELM	33.5	
5174	10228038.69	3143033.682	PEC	10.5	
5175	10228065.35	3143067.155	ELM	30.5	
5178	10228055.99	3143079.204	ELM	12	
5179	10228046.07	3143082.144	ELM	14	
5182	10228027.48	3143101.087	ELM	29	
5183	10228098.84	3143076.055	ELM	20	
5184	10228048.32	3143138.034	ELM	19.5	
5185	10228040.3	3143144.419	ELM	12.5	
5186	10228009.93	3143116.92	ELM	16	
5187	10228002.34	3143131.427	ELM	16	
5188	10227982.02	3143144.858	ELM	16	
5189	10227964.86	3143157.901	ELM	13.5	
5190	10227990.03	3143088.237	PEC	10	
5191	10227940.44	3143142.836	PEC	8	
5192	10227954.01	3143168.827	ELM	21.5	
5193	10227973.12	3143222.749	ELM	12.5	
5194	10227948.77	3143224.858	ELM	19	X
5195	10227941.99	3143253.524	ELM	14	
5196	10227912.62	3143229.545	ELM	13	
5197	10227938.7	3143181.987	ELM	18	
5198	10227909.83	3143156.164	PEC	9.5	
5199	10227891.72	3143199.42	PEC	8	
5200	10227895.32	3143222.255	PEC	19.5	
5201	10227890.3	3143242.128	ELM	21.5	
5202	10227860.45	3143210.538	PEC	5.5	
5203	10227811.6	3143266.144	PEC	6	
5204	10227787.65	3143318.88	ELM	25.5	
5205	10227779.67	3143340.722	ELM	19	
5206	10227758.36	3143340.151	ELM	14.5	
5207	10227755.49	3143350.442	ELM	30.5	

NUMBER	NORTHING	EASTING	TYPE	TRUNK DIAMETER (INCHES)	TO BE REMOVED
5208	10227780.73	3143278.733	PEC	4.5	
5209	10227731.13	3143332.846	PEC	6	
5210	10227813.62	3143361.92	ELM	15	
5211	10227834.55	3143370.212	ELM	17.5	
5212	10227789.63	3143389.085	ELM	12	
5213	10227681.38	3143387.157	PEC	8.5	
5214	10227650.25	3143399.586	PEC	8	
5215	10227667.9	3143435.794	ELM	14	
5220	10227722.81	3143451.056	LO	20	
5221	10227697.69	3143478.761	ELM	21	
5222	10227626.39	3143471.465	ELM	23.5	
5223	10227589.47	3143498.854	ELM	23.5	
5224	10227494.19	3143619.291	LO	33.5	X
5225	10227268.92	3143987.315	ASH	28.5	
5226	10226900.31	3144394.763	ELM	15	X
5519	10228177.18	3142962.735	PEC	30	X
5520	10228180.48	3142943.119	ELM	16	X
5521	10228208.44	3142934.961	PEC	12.5	X
5522	10228222.48	3142965.851	ELM	16	X
5523	10228234.43	3142974.92	ELM	25	X
5526	10228191.65	3142979.73	ELM	16.5	X
5529	10228186.22	3142983.812	ELM	21	X
5560	10225888.19	3144674.717	ELM	15.5	
5561	10225888.43	3144677.112	ELM	17	

TREE REMOVAL AND MITIGATION NOTES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DAMAGES TO TREES DUE TO HIS/HER OPERATIONS.
2. THE CONTRACTOR SHALL PROTECT THE TREES SHOWN ON THE PLANS AND AS DIRECTED BY THE CITY INSPECTOR OR ENGINEER. DAMAGES TO TREES SHALL BE CORRECTED BY THE CONTRACTOR IN ACCORDANCE WITH CITY SPECIFICATION SECTION CIP9.
3. ANY PERSON WHO REMOVES A PROTECTED OR HERITAGE TREE IN VIOLATION OF THE UNIFIED DEVELOPMENT CODE (UDC), ACCIDENTALLY OR OTHERWISE, SHALL BE REQUIRED TO COMPLY WITH THE MITIGATION PROVISIONS IN THE UDC, AND IF THE ACT IS INTENTIONAL, TO PAY A FINE FOR EACH TREE THAT IS REMOVED, AS ALLOWED BY LAW, IN ADDITION TO ANY PENALTIES ALLOWED BY LAW. MITIGATION SHALL BE BASED ON THE MITIGATION PROVISIONS APPLICABLE AT THE TIME OF THE VIOLATION, NOT THOSE AT THE TIME OF ADVERTISEMENT, BIDDING, OR AWARD OF THE CONTRACT.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TREE LIST (3 OF 3)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C011

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LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE (RE: A5/D100)
- SF — SILT FENCE (RE: G10/D100)
- Loc — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

1. SOIL RETENTION BLANKETS SHALL BE INSTALLED OVER EXCAVATION BACKFILL AND/OR GRADING WITHIN THE 100-YR FLOODPLAIN. THE FLOODPLAIN LIMITS ARE HATCHED TO SHOW MAXIMUM LIMITS AND QUANTITY FOR THE BLANKETS INSIDE THE LIMITS OF CONSTRUCTION. PAYMENT FOR SOIL RETENTION BLANKETS WILL BE BASED ON ACTUAL QUANTITIES INSTALLED.
2. TREE SURVEY ONLY INCLUDES HARDWOOD TREES 12 INCHES IN DIAMETER AND GREATER. TREES LESS THAN 12 INCHES IN DIAMETER MAY BE REMOVED FROM TEMPORARY CONSTRUCTION EASEMENT, IF APPROVED BY INSPECTOR IN WRITING.

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN (1 OF 11)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C012

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LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
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- LOC — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

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0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN (2 OF 11)

03/31/2023 — DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C013

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15' PEDERNALES ELECTRIC COOPERATIVE, INC. EASEMENT W.C.C.D. 97057078 D.R.W.C.T.

100' TEXAS POWER & LIGHT COMPANY EASEMENT VOLUME 670, PAGE 38 D.R.W.C.T.

PEDERNALES ELECTRIC COOPERATIVE 15' WIDE EASEMENT

PROPOSED RETENTION BLANKET TYPE F (13559 SY)

(RE: A1/C024)

PROVIDE TEMPORARY GATE IN LIVESTOCK SAFETY FENCE

THOMAS E. BYRD AND TRACIE J. BYRD
CALLED 56.3602 ACRES
VOLUME 2416, PAGE 424
O.P.R.W.C.T.

PROPOSED SEDIMENT CONTROL FENCE 1423 LF

40' TEMP. ESMT. W.C.C.D. 202104912

PROPOSED SEDIMENT CONTROL FENCE 628 LF

TEMPORARY LIVESTOCK SAFETY FENCE (943 LF) (SEE NOTES ON C004)

60' PROP. ESMT. W.C.C.D. 202116024

40' TEMP. ESMT. W.C.C.D. 202116021

MATCHLINE 48+00.00

BERRY CREEK

40' TEMP. ESMT. W.C.C.D. 202104912

60' PROP. ESMT. W.C.C.D. 202104913

NATIVE GRASS SEEDING 13559 SY PER SPECIFICATION G7

PROPOSED SEDIMENT CONTROL FENCE 197 LF

PROPOSED RETENTION BLANKET TYPE F (1577 SY)

NATIVE GRASS SEEDING 1518 SY PER SPECIFICATION G7

MATCHLINE 60+00.00

ALLENE WHITEAKER
CALLED 2.09 ACRES
W.C.C.D. 1998-9802947
O.P.R.W.C.T.

PROVIDE TEMPORARY GATE IN LIVESTOCK SAFETY FENCE

60' PROP. ESMT. W.C.C.D. 202116023

PROPOSED RETENTION BLANKET TYPE F (7841 SY)

NATIVE GRASS SEEDING 18258 SY PER SPECIFICATION G7

PROPOSED SEDIMENT CONTROL FENCE 1209 LF

LIVESTOCK SAFETY FENCE (635 LF) (SEE NOTES ON C004)

MATCHLINE 60+00.00

489.73'

VARIABLE WIDTH TEMP. ESMT. W.C.C.D. 202116022

PROPOSED SEDIMENT CONTROL FENCE 1290 LF

LIVESTOCK SAFETY FENCE (724 LF) (SEE NOTES ON C004)

PROVIDE TEMPORARY GATE IN LIVESTOCK SAFETY FENCE

MATCHLINE 72+00.00

LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

1. SOIL RETENTION BLANKETS SHALL BE INSTALLED OVER EXCAVATION BACKFILL AND/OR GRADING WITHIN THE 100-YR FLOODPLAIN. THE FLOODPLAIN LIMITS ARE HATCHED TO SHOW MAXIMUM LIMITS AND QUANTITY FOR THE BLANKETS INSIDE THE LIMITS OF CONSTRUCTION. PAYMENT FOR SOIL RETENTION BLANKETS WILL BE BASED ON ACTUAL QUANTITIES INSTALLED.
2. TREE SURVEY ONLY INCLUDES HARDWOOD TREES 12 INCHES IN DIAMETER AND GREATER. TREES LESS THAN 12 INCHES IN DIAMETER MAY BE REMOVED FROM TEMPORARY CONSTRUCTION EASEMENT, IF APPROVED BY INSPECTOR IN WRITING.

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN (3 OF 11)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C014

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ALLENE WHITEAKER
CALLED 2.09 ACRES
W.C.C.D. 1998-9802947
O.P.R.W.C.T.

DAVID WHITEAKER
AND WIFE, BONNIE WHITEAKER
CALLED 2.09 ACRES
(SAVE AND EXCEPT 0.05 ACRES=NET
2.04 ACRES)
TRACT ONE
W.C.C.D. 2010074143
O.P.R.W.C.T.

WCAD SHOWS OWNER AS BONNIE
NELL WHITEAKER

JAMES O. CHAFFIN
AND WIFE DIANNA M. CHAFFIN
CALLED 4.99 ACRES
W.C.C.D. 2009021581
O.P.R.W.C.T.

MAGDALENA FREDERICK AND
FREFERICK FERNANDES, WIFE
AND HUSBAND
CALLED 5.00 ACRES
EXHIBIT "A"
W.C.C.D. 2015039030
O.P.R.W.C.T.

CONTRACT OF SALE AND
PURCHASE
TO
JOHN WILLIAM MYRTLE
AND TONYA MYRTLE
CALLED 5.00 ACRES
W.C.C.D. 20011027118
O.P.R.W.C.T.

CONTRACT OF SALE AND
PURCHASE
TO
DON ARTHUR DODGE
CALLED 10.21 ACRES
VOLUME 770, PAGE 405
D.R.W.C.T.

DON ARTHUR DODGE
CALLED 8.90 ACRES
VOLUME 770, PAGE 392
D.R.W.C.T.

MATCHLINE 72+00.00

MATCHLINE 84+00.00

MATCHLINE 96+00.00

CR 152

60' PROP. ESMT.
W.C.C.D. 2021116023

VARIABLE WIDTH
TEMP. ESMT.
W.C.C.D. 2021116022

NATIVE GRASS SEEDING
17530 SY PER
SPECIFICATION G7

LIVESTOCK SAFETY
FENCE (757 LF)
(SEE NOTES ON C004)

PROPOSED
SEDIMENT
CONTROL
FENCE 764 LF

PROVIDE TEMPORARY
GATE IN LIVESTOCK
SAFETY FENCE

EXISTING POND

FURNISH & PLACE 50 SY OF
TOPSOIL & BLOCK SOD

LIVESTOCK SAFETY
FENCE (229 LF)
(SEE NOTES ON C004)

PROPOSED
SEDIMENT
CONTROL
FENCE 193 LF

30'

LIVESTOCK SAFETY
FENCE (774 LF)
(SEE NOTES ON C004)

PROVIDE TEMPORARY
GATE IN LIVESTOCK
SAFETY FENCE

PROPOSED
SEDIMENT
CONTROL
FENCE 1074 LF

PROPOSED STABILIZED
CONSTRUCTION ENTRANCE
(RE: DETAIL A1/D100)
PROJECT SIGN TYPE II
(RE. DETAIL G1/D118)

JONAH WATER SPECIAL UTILITY DISTRICT,
15' WIDE RIGHT OF WAY EASEMENT FOR WATER LINE
VOLUME 2709, PAGE 471, O.P.R.W.C.T.

JONAH WATER SPECIAL UTILITY DISTRICT
RIGHT OF WAY EASEMENT
FOR PRESSURE STATION
VOLUME 2709, PAGE 471
O.P.R.W.C.T.

NATIVE GRASS SEEDING
2996 SY PER
SPECIFICATION G7

30' WIDE INGRESS AND
EGRESS EASEMENT
VOLUME 814, PAGE 439
& EAST 1/2 OF EASEMENT
IN VOLUME 770, PAGE 405,
D.R.W.C.T.

PROPOSED STABILIZED
CONSTRUCTION ENTRANCE
(RE: DETAIL A1/D101)
PROJECT SIGN TYPE II
(RE. DETAIL G1/D118

PROPOSED
SEDIMENT
CONTROL
FENCE 842 LF

40' TEMP. ESMT.
W.C.C.D. 2021179516

30' PROP. ESMT.
W.C.C.D. 2021179516

15' WIDE WATERLINE EASEMENT –
W.C.C.D. 9611843, O.P.R.W.C.T.

JONAH WATER SPECIAL UTILITY DISTRICT
15' WIDE RIGHT OF WAY EASEMENT FOR WATER LINE
VOLUME 2417, PAGE 8,
O.P.R.W.C.T.

30' WIDE INGRESS AND
EGRESS EASEMENT
VOL. 814, PG. 439, D.R.W.C.T.

30' WIDE INGRESS AND
EGRESS EASEMENT, TRACT TWO
W.C.C.D. 2003019218, O.P.R.W.C.T.

NO SURFACE
DISRUPTION /
ACCESS ALLOWED

NATIVE GRASS SEEDING
11883 SY PER
SPECIFICATION G7

40' TEMP. ESMT.
W.C.C.D. 2021179517

30' PROP. ESMT.
W.C.C.D. 2021179517

150' TEMP. ESMT.
W.C.C.D. 2021179517

PROPOSED
SEDIMENT
CONTROL
FENCE 827 LF

30' PROP. ESMT.
W.C.C.D. 2021196693

LEGEND

- TREES TO BE REMOVED
- SPRING BUFFER
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100–YEAR FLOODPLAIN

GENERAL NOTES

1. SOIL RETENTION BLANKETS SHALL BE INSTALLED OVER EXCAVATION BACKFILL AND/OR GRADING WITHIN THE 100–YR FLOODPLAIN. THE FLOODPLAIN LIMITS ARE HATCHED TO SHOW MAXIMUM LIMITS AND QUANTITY FOR THE BLANKETS INSIDE THE LIMITS OF CONSTRUCTION. PAYMENT FOR SOIL RETENTION BLANKETS WILL BE BASED ON ACTUAL QUANTITIES INSTALLED.

2. TREE SURVEY ONLY INCLUDES HARDWOOD TREES 12 INCHES IN DIAMETER AND GREATER. TREES LESS THAN 12 INCHES IN DIAMETER MAY BE REMOVED FROM TEMPORARY CONSTRUCTION EASEMENT, IF APPROVED BY INSPECTOR IN WRITING.

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners
engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN (4 OF 11)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C015

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MATCHLINE 96+00.00

MATCHLINE 108+00.00

MATCHLINE 108+00.00

MATCHLINE 120+00.00

(RE: C025)

(RE: C025)

NO SURFACE DISRUPTION / ACCESS ALLOWED

RONNIE R. RUSSELL AND BONNIE L. RUSSELL CALLED 15.001 ACRES TRACT 1 W.C.C.D. 2015066953 O.P.R.W.C.T.

DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN CALLED 22.9218 ACRES W.C.C.D. 2002100427 O.P.R.W.C.T.

DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN CALLED 22.9218 ACRES W.C.C.D. 2002100427 O.P.R.W.C.T.

DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN CALLED 12.003 ACRES TRACT "B" VOLUME 639, PAGE 779 D.R.W.C.T.

DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN CALLED 0.38 ACRE VOLUME 639, PAGE 779 D.R.W.C.T.

PROPOSED RETENTION BLANKET TYPE F (13024 SY)

PROPOSED SEDIMENT CONTROL FENCE 570 LF

PROPOSED TEMPORARY LIVESTOCK SAFETY FENCE 570 LF (SEE NOTES ON C004)

100' TEMP. ESMT. W.C.C.D. 2022105152

30' PROP. ESMT. W.C.C.D. 2021196893

60' PROP. ESMT. W.C.C.D. 2022105152

PROPOSED SEDIMENT CONTROL FENCE 1342 LF

NATIVE GRASS SEEDING 13027 SY PER SPECIFICATION G7

PROPOSED TEMPORARY LIVESTOCK SAFETY FENCE 280 LF (SEE NOTES ON C004)

PROPOSED SEDIMENT CONTROL FENCE 485 LF

PROPOSED TEMPORARY LIVESTOCK SAFETY FENCE 487 LF (SEE NOTES ON C004)

PROPOSED SEDIMENT CONTROL FENCE 814 LF

16' WIDE ACCESS PATH CLEAR BRUSH AND TRIM TREE LIMBS TO PROVIDE 15' CLEARANCE OVER PATH

60' PROP. ESMT. W.C.C.D. 2022105152

VAIRABLE WIDTH TEMP. ESMT. W.C.C.D. 2022105152

NATIVE GRASS SEEDING 14344 SY PER SPECIFICATION G7

PROPOSED RETENTION BLANKET TYPE F (991 SY)

PROPOSED RETENTION BLANKET TYPE F (11051 SY)

PROPOSED SEDIMENT CONTROL FENCE 1200 LF

PROPOSED SEDIMENT CONTROL FENCE 1115 LF

R100'

LEGEND

- TREES TO BE REMOVED
- SPRING BUFFER
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

1. SOIL RETENTION BLANKETS SHALL BE INSTALLED OVER EXCAVATION BACKFILL AND/OR GRADING WITHIN THE 100-YR FLOODPLAIN. THE FLOODPLAIN LIMITS ARE HATCHED TO SHOW MAXIMUM LIMITS AND QUANTITY FOR THE BLANKETS INSIDE THE LIMITS OF CONSTRUCTION. PAYMENT FOR SOIL RETENTION BLANKETS WILL BE BASED ON ACTUAL QUANTITIES INSTALLED.
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0 25 50 100

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors

T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN (5 OF 11)

03/31/2023

DATE

ERIC LEE NELSON

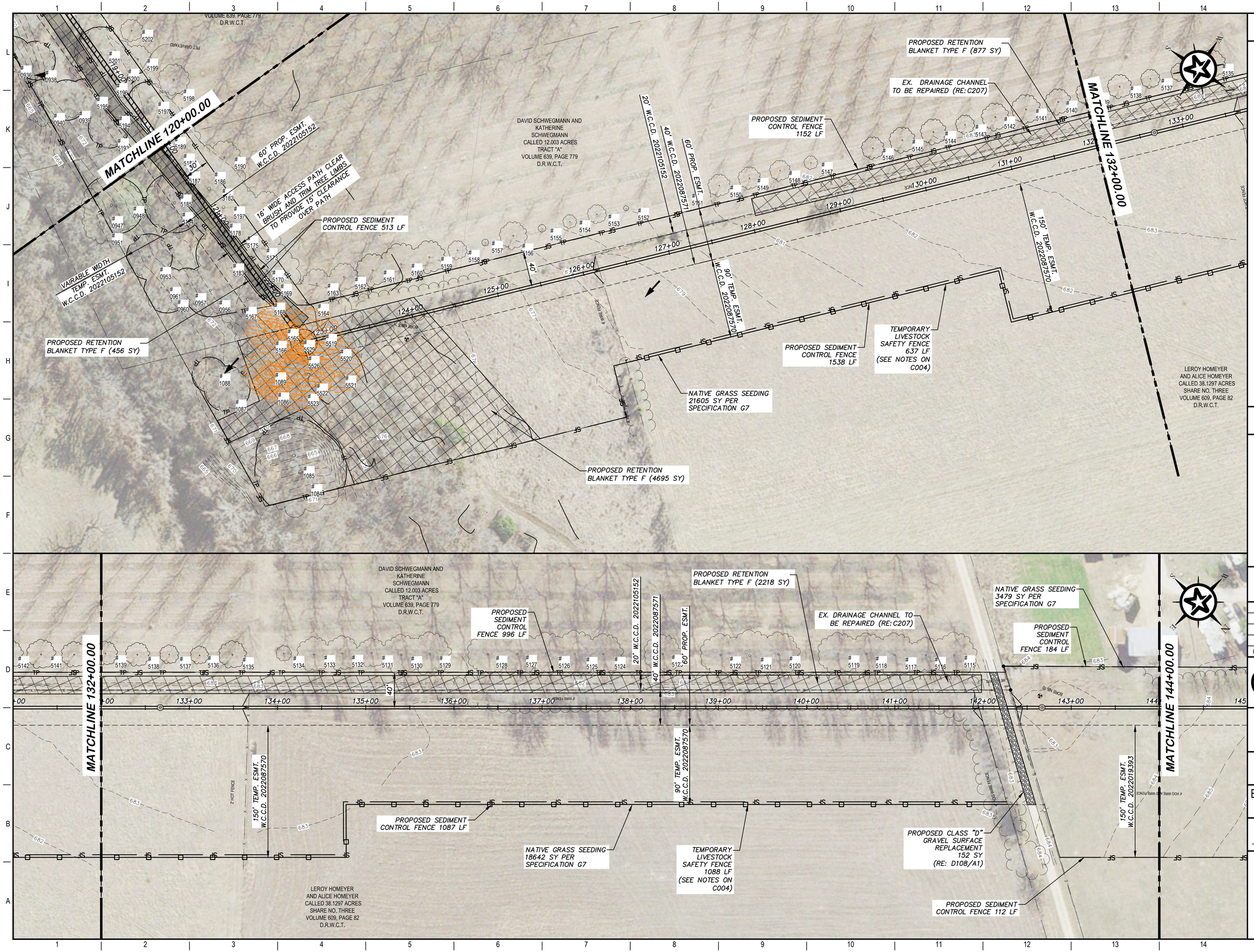
PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

DRAWING NO.

C016

G:\PROJECTS\3-00582\(2 DESIGN)\2.0 CAD\3-00582-EROSION.DWG, EROSION CONTROL & TREE PLAN (5 OF 11), 8/14/2023 2:56:20 PM, rcuellar



LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

1. SOIL RETENTION BLANKETS SHALL BE INSTALLED OVER EXCAVATION BACKFILL AND/OR GRADING WITHIN THE 100-YR FLOODPLAIN. THE FLOODPLAIN LIMITS ARE HATCHED TO SHOW MAXIMUM LIMITS AND QUANTITY FOR THE BLANKETS INSIDE THE LIMITS OF CONSTRUCTION. PAYMENT FOR SOIL RETENTION BLANKETS WILL BE BASED ON ACTUAL QUANTITIES INSTALLED.
2. TREE SURVEY ONLY INCLUDES HARDWOOD TREES 12 INCHES IN DIAMETER AND GREATER. TREES LESS THAN 12 INCHES IN DIAMETER MAY BE REMOVED FROM TEMPORARY CONSTRUCTION EASEMENT, IF APPROVED BY INSPECTOR IN WRITING.

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN (6 OF 11)

03/31/2023
DATE

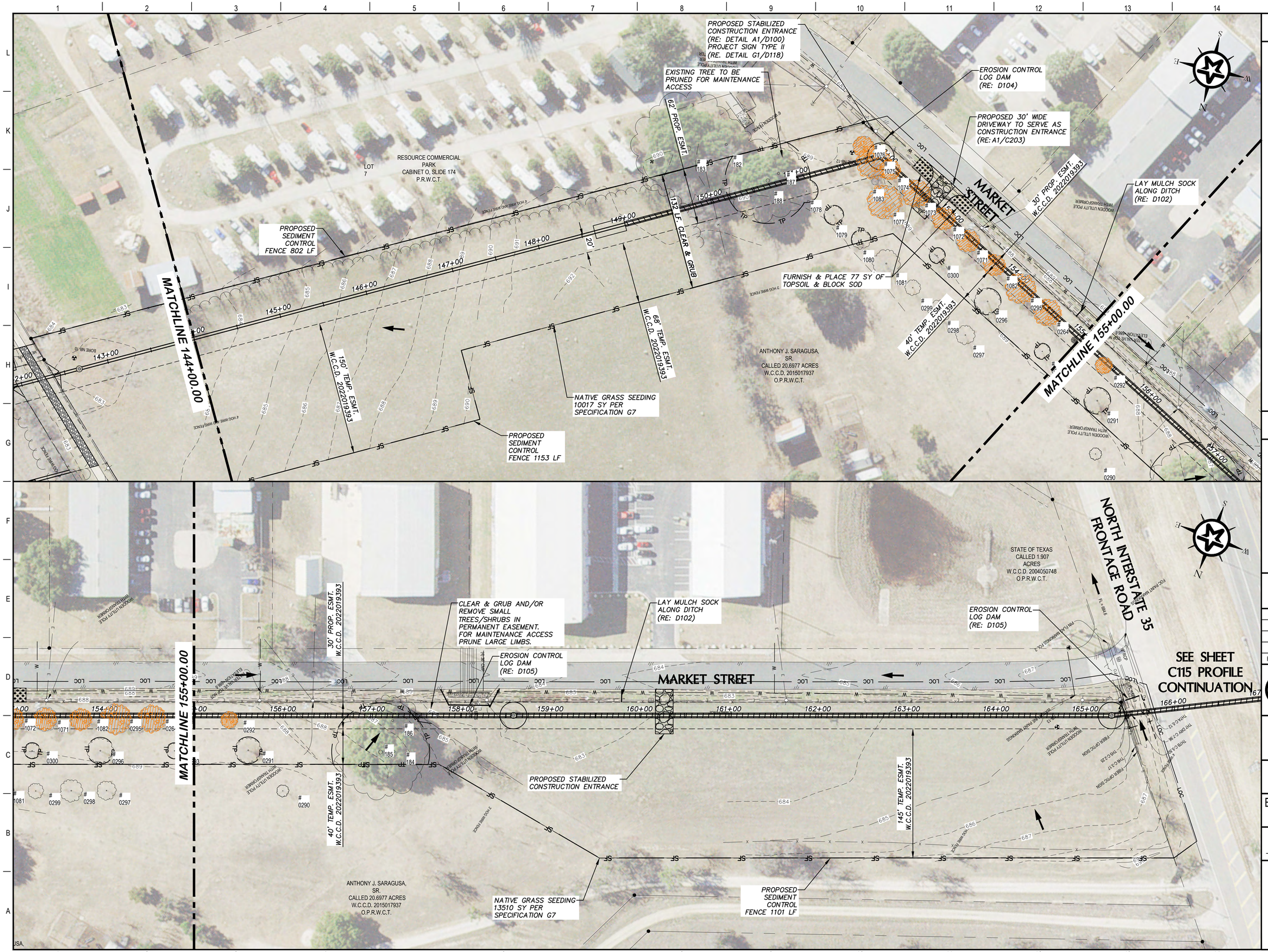
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C017

G:\PROJECTS\3-00582\(2 DESIGN)\2.0 CAD\3-00582-EROSION.DWG, EROSION CONTROL & TREE PLAN (6 OF 11), 8/14/2023 2:57:18 PM, rcuellar



LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

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0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN (7 OF 11)

03/31/2023 DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C018

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SOUTH INTERSTATE 35 FRONTAGE ROAD

STATE OF TEXAS CALLED 0.13 ACRE W.C.C.D. 2004071933 O.P.R.W.C.T.

PROPOSED SEDIMENT CONTROL FENCE 411 LF

NATIVE GRASS SEEDING 13619 SY PER SPECIFICATION G7

MATCHLINE 176+00.00

PROPOSED RETENTION BLANKET TYPE F (160 SY)

60' PROP. ESMT. W.C.C.D. 2021085107

222.81' TEMP. ESMT. W.C.C.D. 2021085106

MARTHA ANN EDWARDS CALLED 14.34 ACRES W.C.C.D. 2016029312 O.P.R.W.C.T. (DESCRIBED IN W.C.C.D. 1995-9540790, O.P.R.W.C.T.)

CLEAR & GRUB FOR CONSTRUCTION AND MAINTENANCE ACCESS

PROPOSED SEDIMENT CONTROL FENCE 557 LF

EROSION CONTROL LOG DAM (RE: D105)

PROPOSED SEDIMENT CONTROL FENCE 2161 LF

MASCUS CORPORATION CALLED 2.5265 ACRES W.C.C.D. 2002010038 O.P.R.W.C.T.

NATIVE GRASS SEEDING 16300 SY PER SPECIFICATION G7

40' TEMP. ESMT. W.C.C.D. 2021095105

60' PROP. ESMT. W.C.C.D. 2021085107

MASCUS SUBDN. CALLED 4.0 ACRES VOLUME 1291, PAGE 464 D.R.W.C.T.

MATCHLINE 176+00.00

LOWER COLORADO RIVER AUTHORITY EASEMENT AND RIGHT OF WAY W.C.C.D. 1987-9806890 O.P.R.W.C.T.

PROPOSED RETENTION BLANKET TYPE F (14058 SY)

CONTRACTOR SHALL NOT DISTURB WETLANDS. PROVIDE TEMPORARY BRIDGE OVER WETLANDS AND SEDIMENT CONTROL FENCE AROUND WETLANDS IN ACCORDANCE WITH SECTION CIP9 ENVIRONMENTAL PROTECTION PROCEDURES.

MARTHA ANN EDWARDS CALLED 14.34 ACRES W.C.C.D. 2016029312 O.P.R.W.C.T. (DESCRIBED IN W.C.C.D. 1995-9540790, O.P.R.W.C.T.)

MARTHA ANN EDWARDS CALLED 14.34 ACRES W.C.C.D. 2016029312 O.P.R.W.C.T. (DESCRIBED IN W.C.C.D. 1995-9540790, O.P.R.W.C.T.)

PROPOSED SEDIMENT CONTROL FENCE 992 LF

MATCHLINE 188+00.00

PROPOSED RETENTION BLANKET TYPE F (3650 SY)

NATIVE GRASS SEEDING 9441 SY PER SPECIFICATION G7

TEMPORARY LIVESTOCK SAFETY FENCE 515 LF (SEE NOTES ON C004)

40' TEMP. ESMT W.C.C.D. 2022122787

60' PROP. ESMT. W.C.C.D. 2022122785

ACCESS ESMT. W.C.C.D. 2022122786

LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

1. SOIL RETENTION BLANKETS SHALL BE INSTALLED OVER EXCAVATION BACKFILL AND/OR GRADING WITHIN THE 100-YR FLOODPLAIN. THE FLOODPLAIN LIMITS ARE HATCHED TO SHOW MAXIMUM LIMITS AND QUANTITY FOR THE BLANKETS INSIDE THE LIMITS OF CONSTRUCTION. PAYMENT FOR SOIL RETENTION BLANKETS WILL BE BASED ON ACTUAL QUANTITIES INSTALLED.
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0 25 50 100

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors

T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN (8 OF 11)

03/31/2023 DATE

ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. C019

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PROVIDE TEMPORARY GATES IN LIVESTOCK FENCE. COORDINATE GATE LOCATIONS WITH LANDOWNER.

PROPOSED SEDIMENT CONTROL FENCE 724 LF

PROPOSED SEDIMENT CONTROL FENCE 1335 LF

TEMPORARY LIVESTOCK SAFETY FENCE 722 LF (SEE NOTES ON C004)

(RE: A1/C026)

THREE FORKS PARTNERSHIP, LTD.
CALLED 382.15 ACRES
(370.893 ACRES - NET)
W.C.C. D. 2005003918
O.P.R.W.C.T.

382.15 ACRES SAVE & EXCEPT

1.457 ACRES, W.C.C.D. 8711458, O.P.R.
0.50 ACRE, W.C.C.D. 2001014355, O.P.R.
9.30 ACRES DESC. IN W.C.C.D. 2005003918

TEMPORARY LIVESTOCK SAFETY FENCE 920 LF (SEE NOTES ON C004)

VARIABLE WIDTH TEMP. ACCESS ESMT. W.C.C.D. 2022122786

60' PROP. ESMT. W.C.C.D. 2022122785

MATCHLINE 188+00.00

MATCHLINE 200+00.00

40' TEMP. ESMT. W.C.C.D. 2022122787

PROPOSED SEDIMENT CONTROL FENCE 1297 LF

NATIVE GRASS SEEDING 22730 SY PER SPECIFICATION G7

PROPOSED RETENTION BLANKET TYPE F (17517 SY)

WOOD ROAD PROPERTIES, INC.
W.C.C.D. 2006105681
O.P.R.W.C.T.
(CALLED 54.41 ACRES, IN TRACT TWO, DESCRIBED IN VOLUME 1969, PAGE 104, O.P.R.W.C.T.)

THREE FORKS PARTNERSHIP, LTD.
CALLED 382.15 ACRES
(370.893 ACRES - NET)
W.C.C. D. 2005003918
O.P.R.W.C.T.

382.15 ACRES SAVE & EXCEPT

1.457 ACRES, W.C.C.D. 8711458, O.P.R.
0.50 ACRE, W.C.C.D. 2001014355, O.P.R.
9.30 ACRES DESC. IN W.C.C.D. 2005003918

TEMPORARY LIVESTOCK SAFETY FENCE 793 LF (SEE NOTES ON C004)

PROPOSED SEDIMENT CONTROL FENCE 1204 LF

PROPOSED SEDIMENT CONTROL FENCE 1240 LF

PROPOSED RETENTION BLANKET TYPE F (17722 SY)

NATIVE GRASS SEEDING 21382 SY PER SPECIFICATION G7

WOOD ROAD PROPERTIES, INC.
W.C.C.D. 2006105681
O.P.R.W.C.T.
(CALLED 54.41 ACRES, IN TRACT TWO, DESCRIBED IN VOLUME 1969, PAGE 104, O.P.R.W.C.T.)

THREE FORKS PARTNERSHIP, LTD.
CALLED 382.15 ACRES
(370.893 ACRES - NET)
W.C.C. D. 2005003918
O.P.R.W.C.T.

382.15 ACRES SAVE & EXCEPT

1.457 ACRES, W.C.C.D. 8711458, O.P.R.
0.50 ACRE, W.C.C.D. 2001014355, O.P.R.
9.30 ACRES DESC. IN W.C.C.D. 2005003918

LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

1. SOIL RETENTION BLANKETS SHALL BE INSTALLED OVER EXCAVATION BACKFILL AND/OR GRADING WITHIN THE 100-YR FLOODPLAIN. THE FLOODPLAIN LIMITS ARE HATCHED TO SHOW MAXIMUM LIMITS AND QUANTITY FOR THE BLANKETS INSIDE THE LIMITS OF CONSTRUCTION. PAYMENT FOR SOIL RETENTION BLANKETS WILL BE BASED ON ACTUAL QUANTITIES INSTALLED.
2. TREE SURVEY ONLY INCLUDES HARDWOOD TREES 12 INCHES IN DIAMETER AND GREATER. TREES LESS THAN 12 INCHES IN DIAMETER MAY BE REMOVED FROM TEMPORARY CONSTRUCTION EASEMENT, IF APPROVED BY INSPECTOR IN WRITING.

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN (9 OF 11)

03/31/2023 — DATE
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C020

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MATCHLINE 212+00.00

MATCHLINE 224+00.00

MATCHLINE 224+00.00

MATCHLINE 235+50.00

(RE: A1/C026)

(RE: C022)

PROPOSED SEDIMENT CONTROL FENCE 1072 LF

NATIVE GRASS SEEDING 15110 SY PER SPECIFICATION G7

VARIABLE WIDTH TEMP. ACCESS ESMT. W.C.C.D. 2022122786

PROPOSED RETENTION BLANKET TYPE F (10547 SY)

60' PROP. ESMT. W.C.C.D. 2022122785

40' TEMP. ESMT. W.C.C.D. 2022122787

PROPOSED SEDIMENT CONTROL FENCE 1308 LF

THREE FORKS PARTNERSHIP, LTD. CALLED 382.15 ACRES (370.893 ACRES - NET) W.C.C. D. 2005003918 O.P.R.W.C.T.

382.15 ACRES SAVE & EXCEPT

1.457 ACRES, W.C.C.D. 8711458, O.P.R. 0.50 ACRE, W.C.C.D. 2001014355, O.P.R. 9.30 ACRES DESC. IN W.C.C.D. 2005003918

PROPOSED SEDIMENT CONTROL FENCE 1050 LF

TEMPORARY LIVESTOCK SAFETY FENCE 1046 LF (SEE NOTES ON C004)

PROPOSED SEDIMENT CONTROL FENCE 294 LF

PROPOSED SEDIMENT CONTROL FENCE 972 LF

NATIVE GRASS SEEDING 23949 SY PER SPECIFICATION G7

PROPOSED RETENTION BLANKET TYPE F (8716 SY)

FURNISH & PLACE 452 SY OF TOPSOIL & BLOCK SOD

PROPOSED STABILIZED CONSTRUCTION ENTRANCE (RE: DETAIL A1/D100) PROJECT SIGN TYPE II DETAIL G1/D118)

PROPOSED 30' WIDE DRIVEWAY (RE: A1/C201). CONTRACTOR TO MAINTAIN ACCESS TO LANDOWNER AT ALL TIMES.

NATIVE GRASS SEEDING 2087 SY PER SPECIFICATION G7

PROPOSED RETENTION BLANKET TYPE F (510 SY)

CITY OF GEORGETOWN 15' WIDE WASTEWATER EASEMENT TRACT "B1" W.C.C.D. 2004078807, O.P.R.W.C.T.

JOE L LYKES CALLED 386.05 ACRES EXHIBIT "A" W.C.C. D. 1993230 O.P.R.W.C.T.

PROPOSED SEDIMENT CONTROL FENCE 406 LF

LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

1. SOIL RETENTION BLANKETS SHALL BE INSTALLED OVER EXCAVATION BACKFILL AND/OR GRADING WITHIN THE 100-YR FLOODPLAIN. THE FLOODPLAIN LIMITS ARE HATCHED TO SHOW MAXIMUM LIMITS AND QUANTITY FOR THE BLANKETS INSIDE THE LIMITS OF CONSTRUCTION. PAYMENT FOR SOIL RETENTION BLANKETS WILL BE BASED ON ACTUAL QUANTITIES INSTALLED.
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0 25 50 100

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors

T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN (10 OF 11)

03/31/2023

DATE

ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.

C021

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PROPOSED STABILIZED CONSTRUCTION ENTRANCE PROJECT SIGN TYPE II (RE: DETAIL G1/D118)

PROPOSED 30' WIDE DRIVEWAY (RE: A1/C203). CONTRACTOR TO MAINTAIN ACCESS TO LANDOWNER AT ALL TIMES.

FURNISH & PLACE 452 SY OF TOPSOIL & BLOCK SOD

MICHAEL E. MERSIOSKY AND ROBBIE G. MERIOSKY, HUSBAND AND WIFE CALLED 5.65 ACRES, W.C.C.D. 2006013183 O.P.R.W.C.T.

CITY OF GEORGETOWN 15' WIDE WASTEWATER EASEMENT W.C.C.D. 2005033568, O.P.R.W.C.T.

PROPOSED RETENTION BLANKET TYPE F (2041 SY)

PROPOSED SEDIMENT CONTROL FENCE 918 LF

MATCHLINE 236+00.00

JOE L. LYKES CALLED 386.05 ACRES EXHIBIT "A" W.C.C.D. 19932320 O.P.R.W.C.T.

CITY OF GEORGETOWN 15' WIDE WASTEWATER EASEMENT TRACT "B1" W.C.C.D. 2004078807, O.P.R.W.C.T.

(RE: C021)

PROPOSED SEDIMENT CONTROL FENCE 1779 LF

NATIVE GRASS SEEDING 7222 SY PER SPECIFICATION G7

CITY OF GEORGETOWN WASTEWATER EASEMENT W.C.C.D. 2019072558, O.P.R.W.C.T.

INSTALL TEMPORARY SAFETY FENCE AND/OR TEMPORARY RAILINGS FOR FALL PROTECTION ALONG CLOSED BRIDGE.

CITY OF GEORGETOWN CALLED 0.218 ACRES W.C.C.D. 2004078352 O.P.R.W.C.T.

GARY L. SHIPMAN AND LAURA M. SHIPMAN, HUSBAND AND WIFE CALLED 5.73 ACRES, W.C.C.D. 2000048959 O.P.R.W.C.T.

PROPOSED STABILIZED CONSTRUCTION ENTRANCE

CITY OF GEORGETOWN 25' WIDE WASTEWATER AND ACCESS EASEMENT W.C.C.D. 2004078808 O.P.R.W.C.T.

NATIVE GRASS SEEDING 8134 SY PER SPECIFICATION G7

PROPOSED SEDIMENT CONTROL FENCE 1138 LF

PROPOSED STABILIZED CONSTRUCTION ENTRANCE

CITY OF GEORGETOWN WASTEWATER EASEMENT TRACT "A" W.C.C.D. 2004078807 O.P.R.W.C.T.

AIRPORT RD.

LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
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- TEMP LIVESTOCK SAFETY FENCE
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GENERAL NOTES

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0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN (11 OF 11)

03/31/2023 DATE

ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. C022

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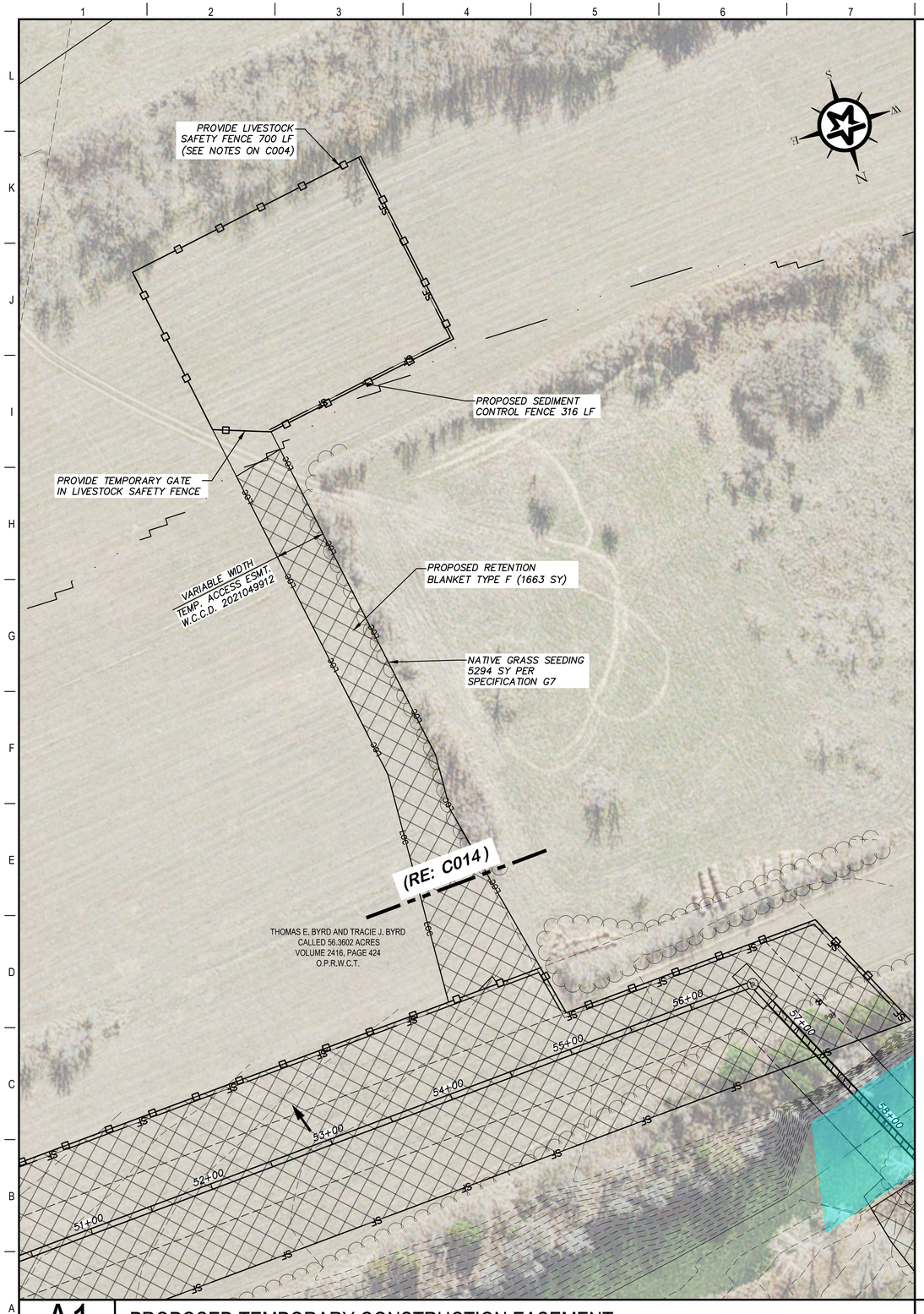

LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
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- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

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0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN-BYRD 1

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C023

A1	PROPOSED TEMPORARY CONSTRUCTION EASEMENT	A8	NOT USED
SCALE: 1"=50'			

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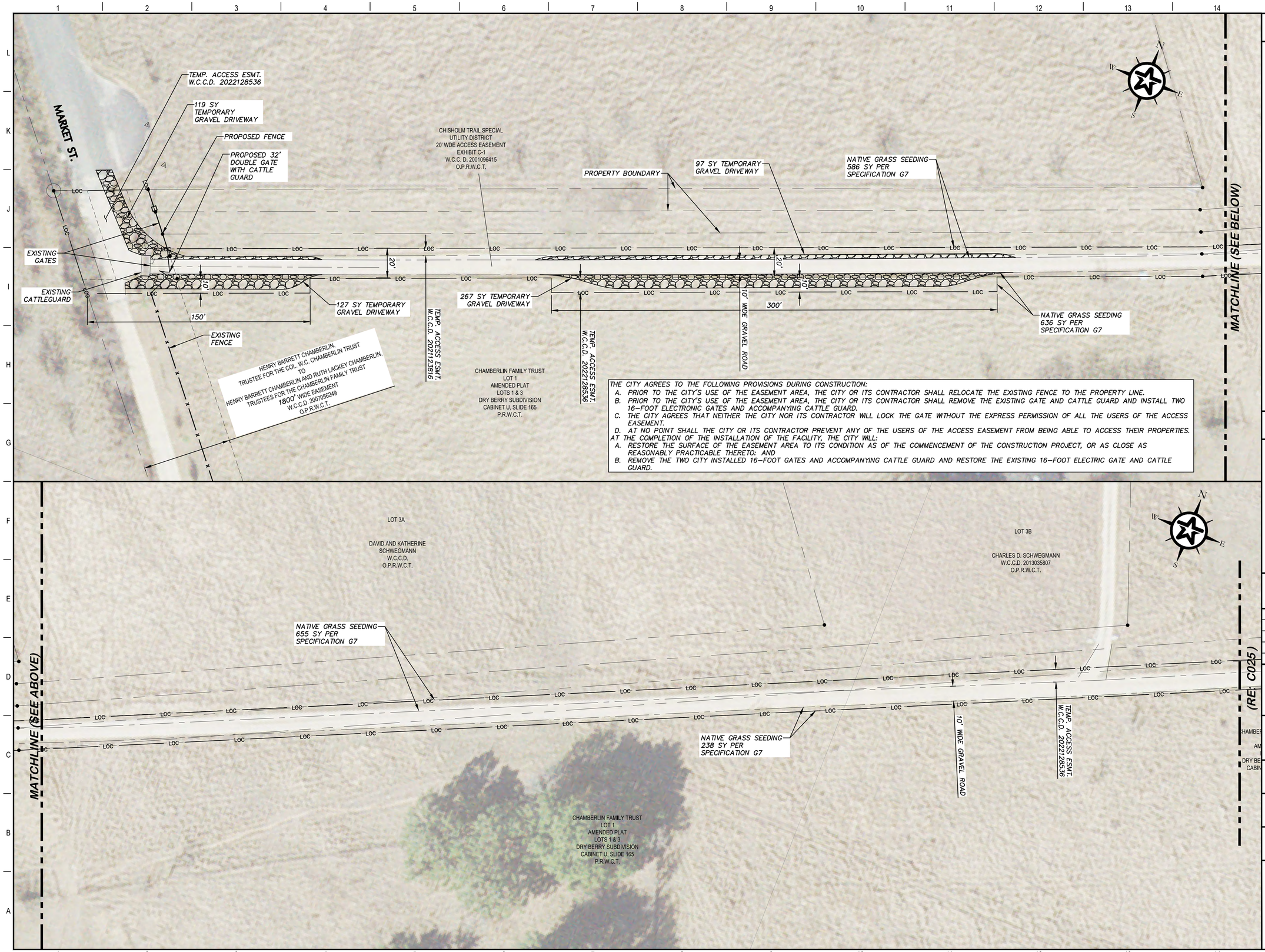


THE CITY AGREES TO THE FOLLOWING PROVISIONS DURING CONSTRUCTION:

A. PRIOR TO THE CITY'S USE OF THE EASEMENT AREA, THE CITY OR ITS CONTRACTOR SHALL RELOCATE THE EXISTING FENCE TO THE PROPERTY LINE.
B. PRIOR TO THE CITY'S USE OF THE EASEMENT AREA, THE CITY OR ITS CONTRACTOR SHALL REMOVE THE EXISTING GATE AND CATTLE GUARD AND INSTALL TWO 16-FOOT ELECTRONIC GATES AND ACCOMPANYING CATTLE GUARD.
C. THE CITY AGREES THAT NEITHER THE CITY NOR ITS CONTRACTOR WILL LOCK THE GATE WITHOUT THE EXPRESS PERMISSION OF ALL THE USERS OF THE ACCESS EASEMENT.
D. AT NO POINT SHALL THE CITY OR ITS CONTRACTOR PREVENT ANY OF THE USERS OF THE ACCESS EASEMENT FROM BEING ABLE TO ACCESS THEIR PROPERTIES.

AT THE COMPLETION OF THE INSTALLATION OF THE FACILITY, THE CITY WILL:

A. RESTORE THE SURFACE OF THE EASEMENT AREA TO ITS CONDITION AS OF THE COMMENCEMENT OF THE CONSTRUCTION PROJECT, OR AS CLOSE AS REASONABLY PRACTICABLE THERETO; AND
B. REMOVE THE TWO CITY INSTALLED 16-FOOT GATES AND ACCOMPANYING CATTLE GUARD AND RESTORE THE EXISTING 16-FOOT ELECTRIC GATE AND CATTLE GUARD.

LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

1. SOIL RETENTION BLANKETS SHALL BE INSTALLED OVER EXCAVATION BACKFILL AND/OR GRADING WITHIN THE 100-YR FLOODPLAIN. THE FLOODPLAIN LIMITS ARE HATCHED TO SHOW MAXIMUM LIMITS AND QUANTITY FOR THE BLANKETS INSIDE THE LIMITS OF CONSTRUCTION. PAYMENT FOR SOIL RETENTION BLANKETS WILL BE BASED ON ACTUAL QUANTITIES INSTALLED.
2. TREE SURVEY ONLY INCLUDES HARDWOOD TREES 12 INCHES IN DIAMETER AND GREATER. TREES LESS THAN 12 INCHES IN DIAMETER MAY BE REMOVED FROM TEMPORARY CONSTRUCTION EASEMENT, IF APPROVED BY INSPECTOR IN WRITING.

0 15 30 60
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN-SCHWEGMANN 1

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C024

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-EROSION.DWG, EROSION CONTROL & TREE PLAN-SCHWEGMANN 1, 8/14/2023 3:03:18 PM, rcuellar

KATHERINE SCHWEGMANN
CALLED 0.38 ACRE
VOLUME 639, PAGE 779
D.R.W.C.T.

TEMPORARY LIVE STOCK FENCE (RE: C016 FOR LIMITS OF LIVE STOCK FENCE) (SEE NOTES ON C004)

PROPOSED TEMPORARY LIVESTOCK SAFETY FENCE 91 LF (SEE NOTES ON C004)

(RE: C016)

TEMPORARY GATE

PROPOSED TEMPORARY LIVESTOCK SAFETY FENCE 14 LF (SEE NOTES ON C004)

NATIVE GRASS SEEDING 7866 SY PER SPECIFICATION G7

PROPOSED INTERCEPTOR ALIGNMENT

PROPOSED RETENTION BLANKET TYPE F (6669 SY)

PROPOSED SEDIMENT CONTROL FENCE 306 LF

PROPOSED SEDIMENT CONTROL FENCE 729 LF

TEMP. ACCESS ESMT. W.C.C.D. 2022105152

EXISTING GATE

DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN LOT 3, BLOCK 1 DRY BERRY SUBDIVISION VOLUME 2703, PAGE 353 O.R.W.C.T.

DAVID AND KATHERINE SCHWEGMANN W.C.C.D. O.P.R.W.C.T.

LOT 3D

LOT 3C

BECKY SNOW W.C.C.D. 2013040491 O.P.R.W.C.T.

NATIVE GRASS SEEDING 442 SY PER SPECIFICATION G7

CHISHOLM TRAIL SPECIAL UTILITY DISTRICT ACCESS EASEMENT EXHIBIT C-3 W.C.C. D. 2001096415 O.P.R.W.C.T.

CHISHOLM TRAIL SPECIAL UTILITY DISTRICT ACCESS EASEMENT EXHIBIT C-4 W.C.C. D. 2001096415 O.P.R.W.C.T.

REPLAT OF LOT 3, AMENDED CONVEYANCE PLAT OF LOT 1 & 3 DRY BERRY SUBDIVISION W.C.C.D. 2012106529 O.P.R.W.C.T.

10' WIDE GRAVEL ROAD

(RE: C024)

CHAMBERLIN FAMILY TRUST LOT 1 AMENDED PLAT LOTS 1 & 3 DRY BERRY SUBDIVISION CABINET U, SLIDE 165 P.R.W.C.T.

NATIVE GRASS SEEDING 182 SY PER SPECIFICATION G7

10' WIDE GRAVEL ROAD

WELL 8" PVC

TEMPORARY GATE

PROPOSED TEMPORARY LIVESTOCK SAFETY FENCE 474 LF (SEE NOTES ON C004)

CONTRACTOR TO PROVIDE ACCESS ACROSS EASEMENT TO LANDOWNER

PROPOSED SEDIMENT CONTROL FENCE 665 LF

TEMP. ACCESS ESMT. W.C.C.D. 2022105152

(RE: C016)

DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN CALLED 22.9218 ACRES W.C.C.D. 2002100427 O.P.R.W.C.T.

TEMPORARY LIVE STOCK FENCE (RE: C016 FOR LIMITS OF LIVE STOCK FENCE) (SEE NOTES ON C004)

PROP. ESMT. W.C.C.D. 2022105152

TEMP. ESMT. W.C.C.D. 2022105152

DAVID SCHWEGMANN AND KATHERINE SCHWEGMANN CALLED 22.9218 ACRES W.C.C.D. 2002100427 O.P.R.W.C.T.

LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

1. SOIL RETENTION BLANKETS SHALL BE INSTALLED OVER EXCAVATION BACKFILL AND/OR GRADING WITHIN THE 100-YR FLOODPLAIN. THE FLOODPLAIN LIMITS ARE HATCHED TO SHOW MAXIMUM LIMITS AND QUANTITY FOR THE BLANKETS INSIDE THE LIMITS OF CONSTRUCTION. PAYMENT FOR SOIL RETENTION BLANKETS WILL BE BASED ON ACTUAL QUANTITIES INSTALLED.
2. TREE SURVEY ONLY INCLUDES HARDWOOD TREES 12 INCHES IN DIAMETER AND GREATER. TREES LESS THAN 12 INCHES IN DIAMETER MAY BE REMOVED FROM TEMPORARY CONSTRUCTION EASEMENT, IF APPROVED BY INSPECTOR IN WRITING.

0 30 60 120
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN-SCHWEGMANN 2

03/31/2023
DATE

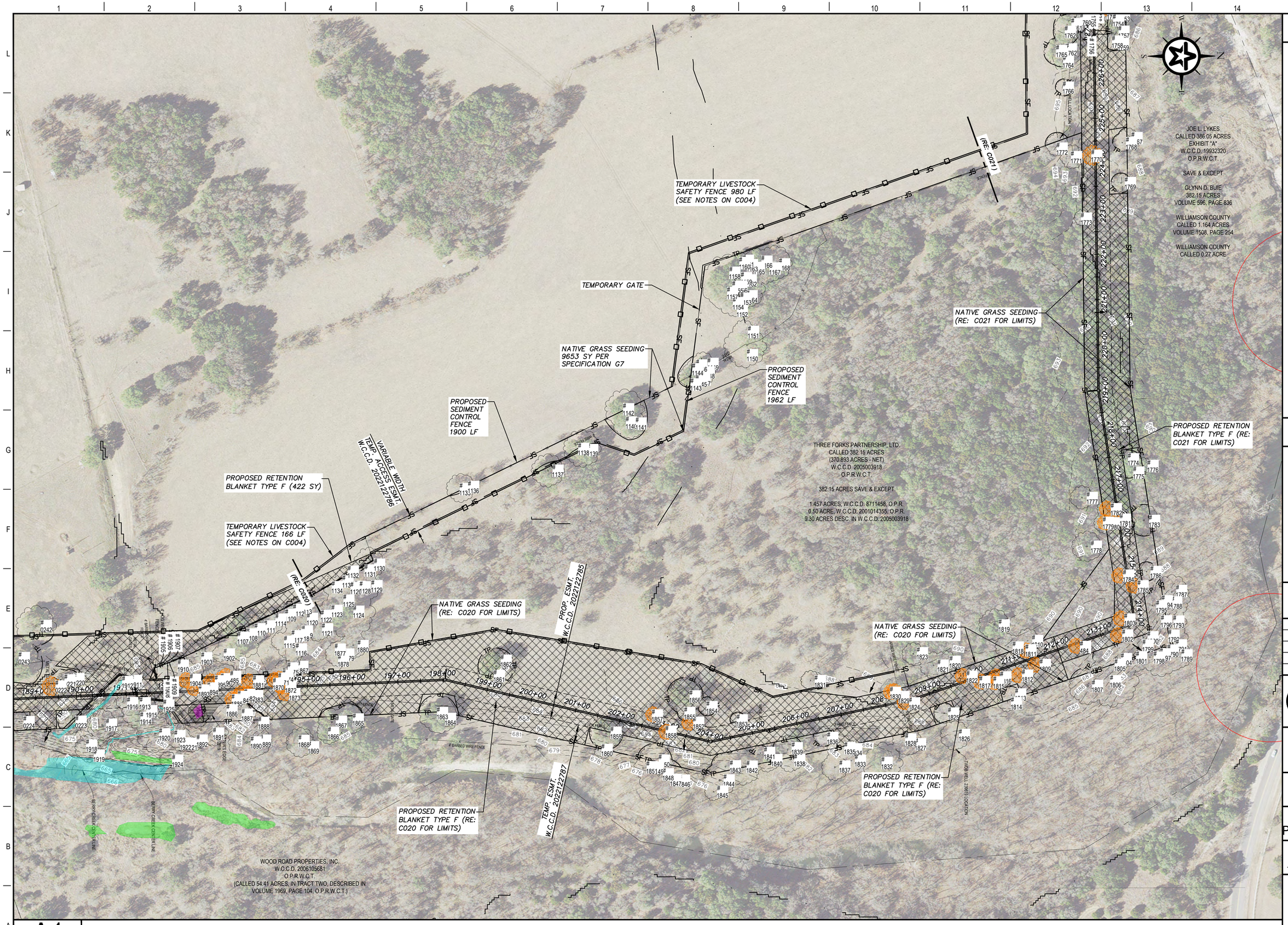
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C025

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-EROSION.DWG, EROSION CONTROL & TREE PLAN-SCHWEGMANN 2, 8/14/2023 3:03:50 PM, rcuellar



LEGEND

- TREES TO BE REMOVED
- SPRING BUFFER
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- TOPSOIL AND SOD PLACEMENT (SPECIFICATION SECTION G7)
- WATERWAY
- POND
- WETLANDS
- PROPOSED TRENCHLESS
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
- TEMP LIVESTOCK SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

1. SOIL RETENTION BLANKETS SHALL BE INSTALLED OVER EXCAVATION BACKFILL AND/OR GRADING WITHIN THE 100-YR FLOODPLAIN. THE FLOODPLAIN LIMITS ARE HATCHED TO SHOW MAXIMUM LIMITS AND QUANTITY FOR THE BLANKETS INSIDE THE LIMITS OF CONSTRUCTION. PAYMENT FOR SOIL RETENTION BLANKETS WILL BE BASED ON ACTUAL QUANTITIES INSTALLED.
2. TREE SURVEY ONLY INCLUDES HARDWOOD TREES 12 INCHES IN DIAMETER AND GREATER. TREES LESS THAN 12 INCHES IN DIAMETER MAY BE REMOVED FROM TEMPORARY CONSTRUCTION EASEMENT, IF APPROVED BY INSPECTOR IN WRITING.

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN-THREE FORKS PARTNERSHIP

03/31/2023 — DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C026

A1
SCALE: 1"=100'

PROPOSED TEMPORARY CONSTRUCTION EASEMENT

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CONTRACTOR MAY NEED TO PRUNE TREE TO CONSTRUCT THE WASTEWATER LINE CONNECTION. ANY AND ALL TREE PRUNING AND/OR TREATMENTS SHALL BE PERFORMED UNDER THE DIRECT SUPERVISION OF A QUALIFIED ARBORIST.

CONTRACTOR SHALL NOT DISTURB TRAIL OR BLOCK TRAIL WITHOUT APPROVAL FROM CITY INSPECTOR

TREE REMOVAL SCHEDULE		
DESCRIPTION	NORTHING	EASTING
9" HACKBERRY	10236620.46	3124302.91
9" HACKBERRY	10236644.58	3124332.14
14" ELM	10236648.79	3124337.93
10" HACKBERRY	1026665.26	3124341.81

NATIVE GRASS SEDDING 4301 SY PER SPECIFICATION G7

PROPOSED SEDIMENT CONTROL FENCE (677 LF)

CITY OF GEORGETOWN 30' WASTEWATER EASEMENT W.C.C.D. 1995038969 O.P.R.W.C.T

CLEAR & GRUB AND/OR REMOVE SMALL TREES/SHRUBS. CONTRACTOR TO ONLY CLEAR SCRUB BRUSH AND MUST PROTECT TREES LARGER THAN 12".

DRIVEWAY IS USED BY PEDESTRIANS TO ACCESS TRAIL, CONTRACTOR TO SECURE WORK SITE WITH TEMPORARY CHAINLINK FENCE AND VEHICULAR ACCESS GATE, WITH LOCK. CONTRACTOR SHALL ALSO POST SIGNS 30-DAYS IN ADVANCE OF INSTALLING TEMPORARY FENCE TO NOTIFY THE PUBLIC OF TRAIL ACCESS CLOSURE DATES.

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 8+67

STETSON TRAIL

PROPOSED RETENTION BLANKET TYPE F (980 SY)

CONTRACTOR TO MAINTAIN ACCESS TO PROPERTY OWNER AT ALL TIMES

CITY OF GEORGETOWN, TEXAS
PARCEL 1
CALLED 13.063 ACRES
W.C.C.D. 2015053851
O.P.R.W.C.T.

CITY OF GEORGETOWN 30' WASTEWATER EASEMENT W.C.C.D. 1995038969 O.P.R.W.C.T

TRACT "T" WASTEWATER LIFT STATION AND P.U.E. CABINET M, SLIDE 95-116 W.C.C.D. 1995038969 O.P.R.W.C.T.

PROPOSED STABILIZED CONSTRUCTION ENTRANCE (RE: DETAIL A1/D100)

NATIVE GRASS SEDDING 6435 SY PER SPECIFICATION G7

CLEAR & GRUB AND MAINTAIN A TEMPORARY 15-FOOT WIDE ACCESS PATH WHEN PAVED DRIVEWAY IS NOT ACCESSIBLE (778 SY).

PROPOSED SEDIMENT CONTROL FENCE (725 LF)



CONTRACTOR WILL BE RESPONSIBLE FOR THE REMOVAL AND REPLACEMENT OF PROPERTY OWNERS LANDSCAPING THAT IS LOCATED WITHIN LIMITS OF CONSTRUCTION (TRACT "T" WASTEWATER LIFT STATION AND P.U.E. CABINET M, SLIDE 95-116 W.C.C.D. 1995038969 O.P.R.W.C.T.)

LEGEND

- TREES TO BE REMOVED
- SOIL RETENTION BLANKET (SEE GENERAL NOTE 1) (SPECIFICATION SECTION G6)
- STABILIZED CONSTRUCTION ENTRANCE (SPECIFICATION SECTION G6) (RE: A1/D100)
- CLEARING AND GRUBBING (SPECIFICATION SECTION G3)
- TP — TREE PROTECTION FENCE
- SF — SILT FENCE
- LOC — LIMITS OF CONSTRUCTION
- TEMP SAFETY FENCE
- FLOW ARROW
- FEMA 100-YEAR FLOODPLAIN

GENERAL NOTES

1. SOIL RETENTION BLANKETS SHALL BE INSTALLED OVER EXCAVATION BACKFILL AND/OR GRADING WITHIN THE 100-YR FLOODPLAIN. THE FLOODPLAIN LIMITS ARE HATCHED TO SHOW MAXIMUM LIMITS AND QUANTITY FOR THE BLANKETS INSIDE THE LIMITS OF CONSTRUCTION. PAYMENT FOR SOIL RETENTION BLANKETS WILL BE BASED ON ACTUAL QUANTITIES INSTALLED.
2. TREE SURVEY ONLY INCLUDES HARDWOOD TREES 12 INCHES IN DIAMETER AND GREATER. TREES LESS THAN 12 INCHES IN DIAMETER MAY BE REMOVED FROM TEMPORARY CONSTRUCTION EASEMENT, IF APPROVED BY INSPECTOR IN WRITING.
3. CONTRACTOR IS ALLOWED TO CLEAR AND GRUB UNDER BRUSH AND SCRUB BRUSH IN ORDER TO ACCESS THE SITE AND PERFORM THE PROPOSED WORK.
4. CONTRACTORS SHALL NOT PARK WITHIN THE CUL-DE-SAC. ALL WORKERS MUST PARK WITHIN THE LIFT STATION PROPERTY. HOWEVER CONTRACTOR MUST MAINTAIN ACCESS TO THE LIFT STATION AT ALL TIMES.

0 20 40 80
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION CONTROL & TREE PLAN OFF SITE

08/14/2023
DATE

TRISTAN A. ROBLES

STATE OF TEXAS
TRISTAN A. ROBLES
145927
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	JB
PROJECT NO.	3-00582

DRAWING NO.
C027

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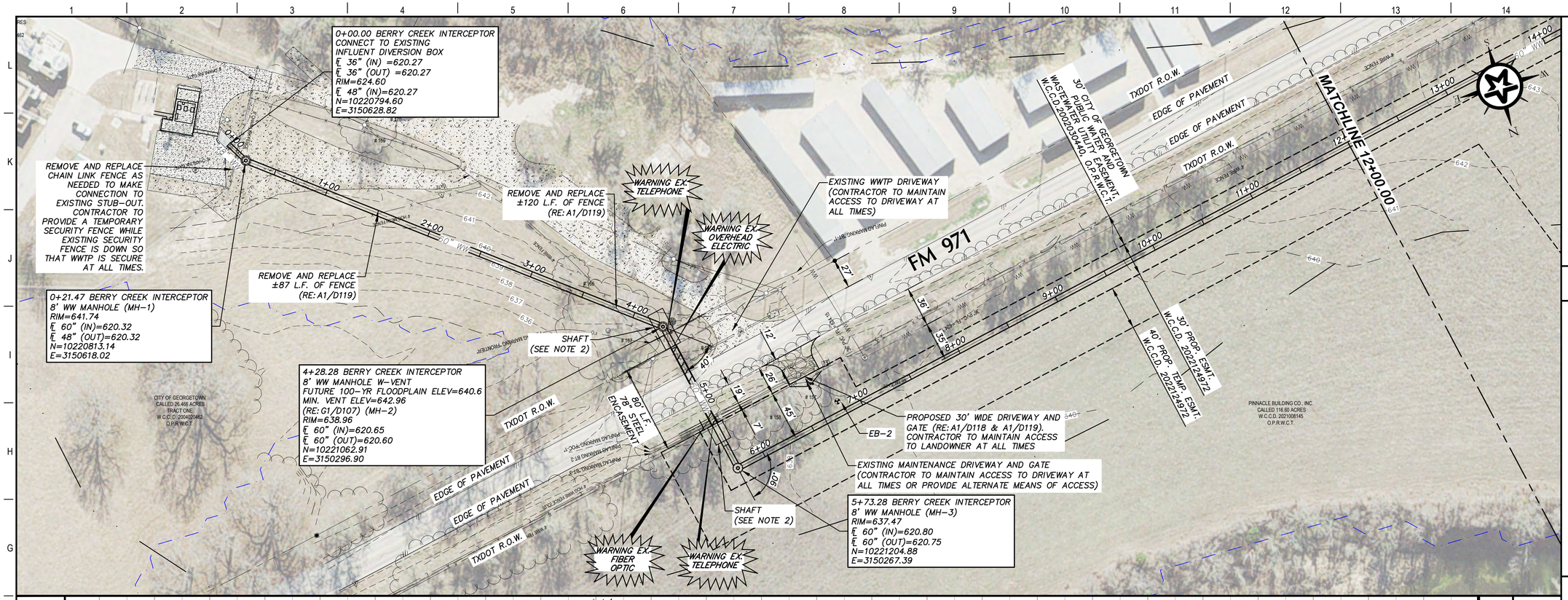

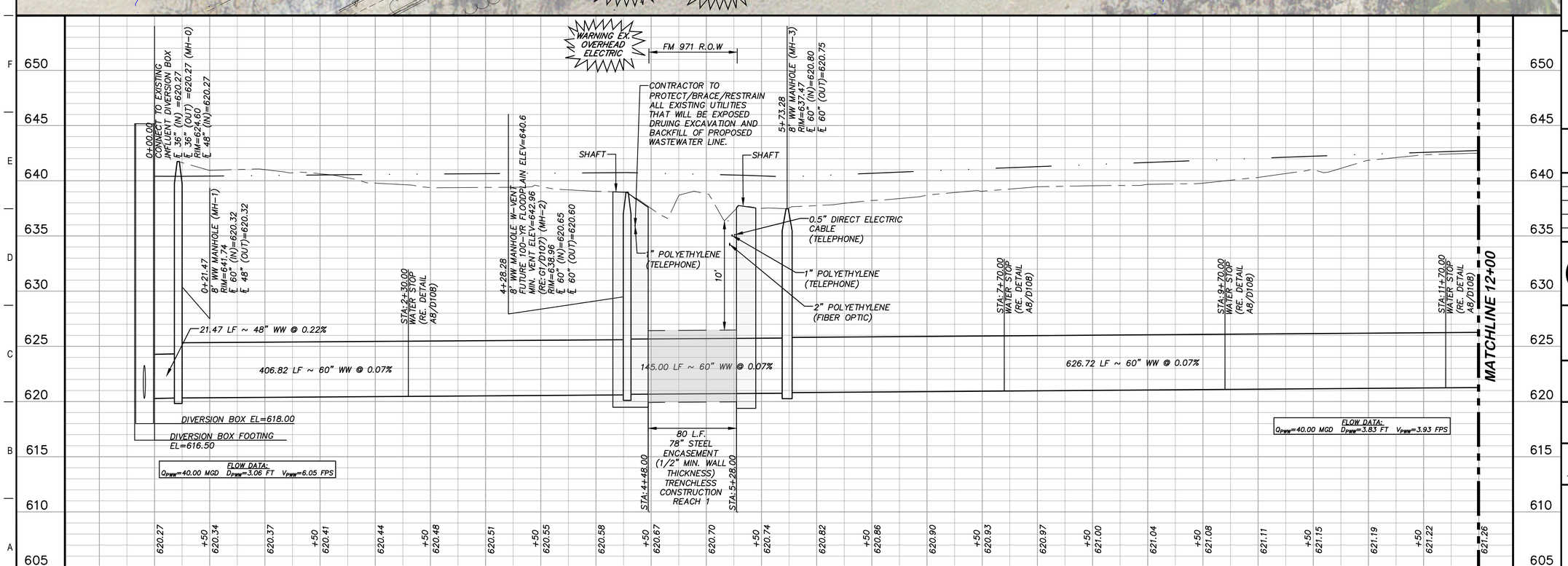

GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
3. FOR ALL TRENCHLESS WORK REFER TO SHEET C003.
4. TRENCHLESS CONSTRUCTION UNDER FM971 MAY BE INSTALLED BY HAND TUNNELING PER SPEC SECTION 33 30 04.
5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

5-YEAR FUTURE FLOODPLAIN
FEMA 100-YEAR FLOODPLAIN
N.G. ~ CENTERLINE

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 0+00 TO 12+00

03/31/2023
DATE
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C101

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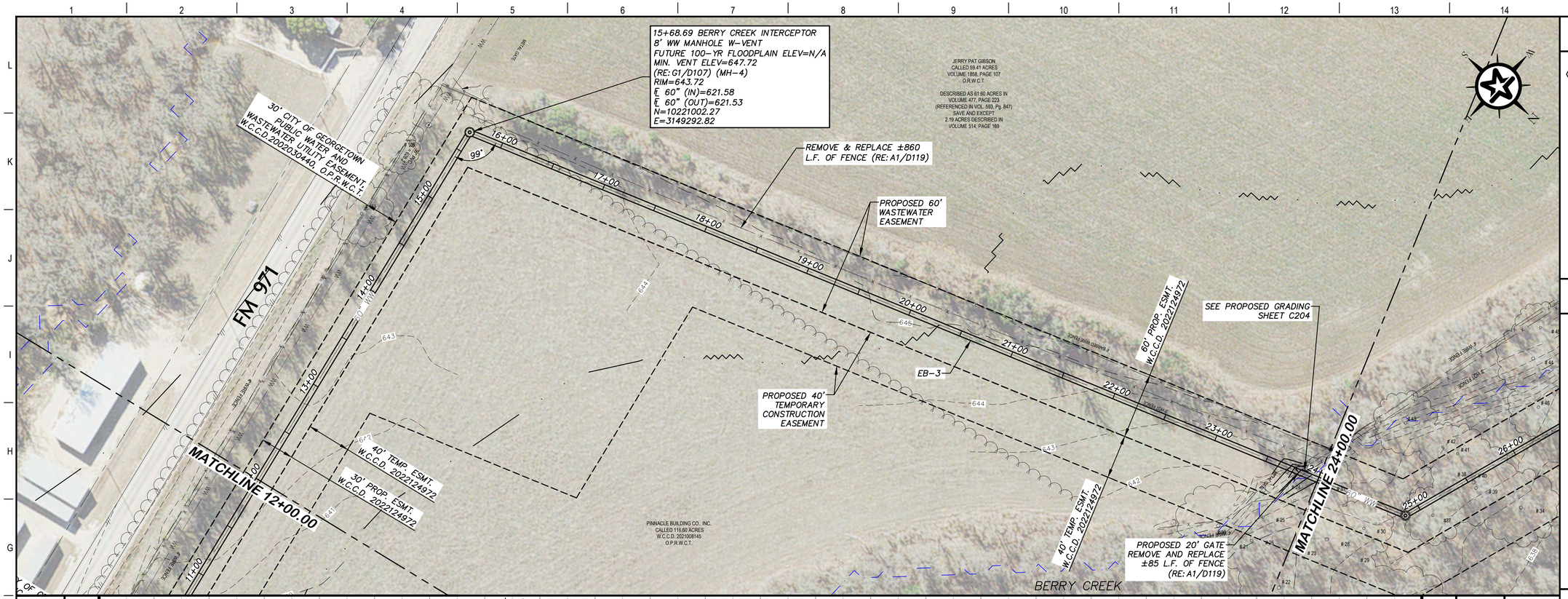

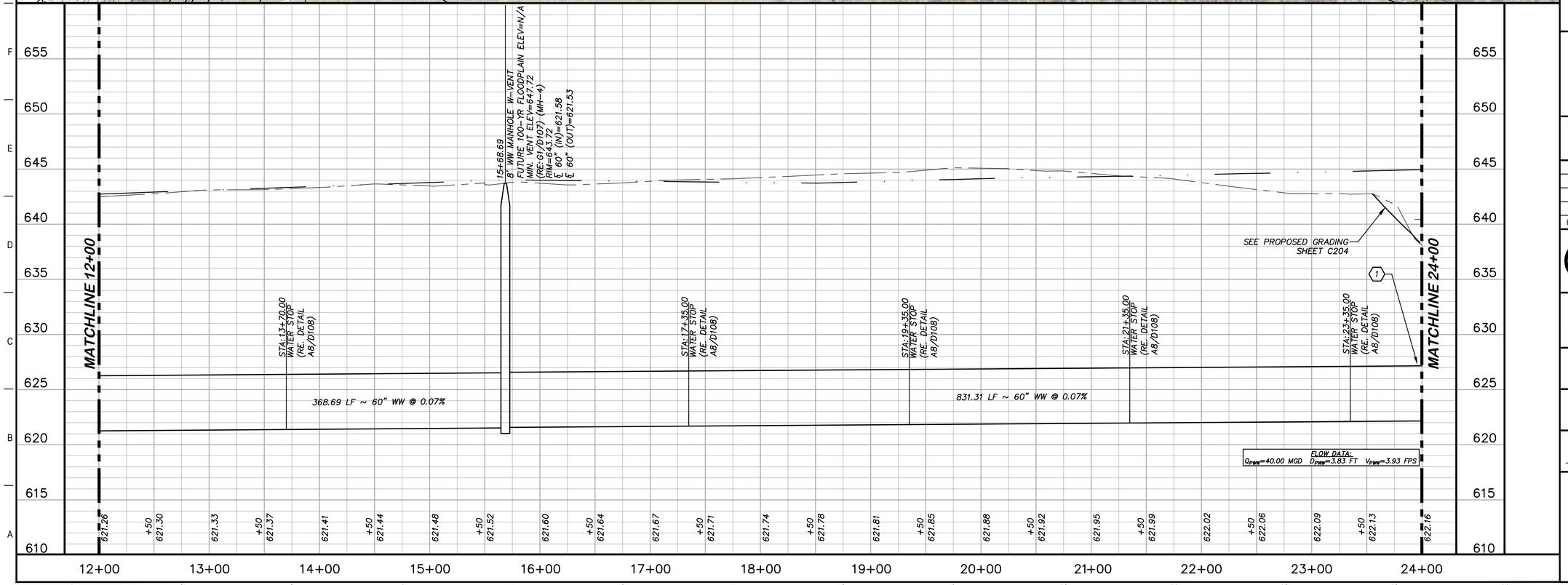

KEY NOTES

1. INSTALL CONCRETE TRENCH CAP STA. 23+84 TO 24+00 (RE. DETAIL G6/D107)

GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
3. FOR ALL TRENCHLESS WORK REFER TO SHEET C003.
4. TRENCHLESS CONSTRUCTION UNDER FM971 MAY BE INSTALLED BY HAND TUNNELING PER SPEC SECTION 33 30 04.
5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

5-YEAR FUTURE FLOODPLAIN
FEMA 100-YEAR FLOODPLAIN
N.G. ~ CENTERLINE

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 12+00 TO 24+00

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C102

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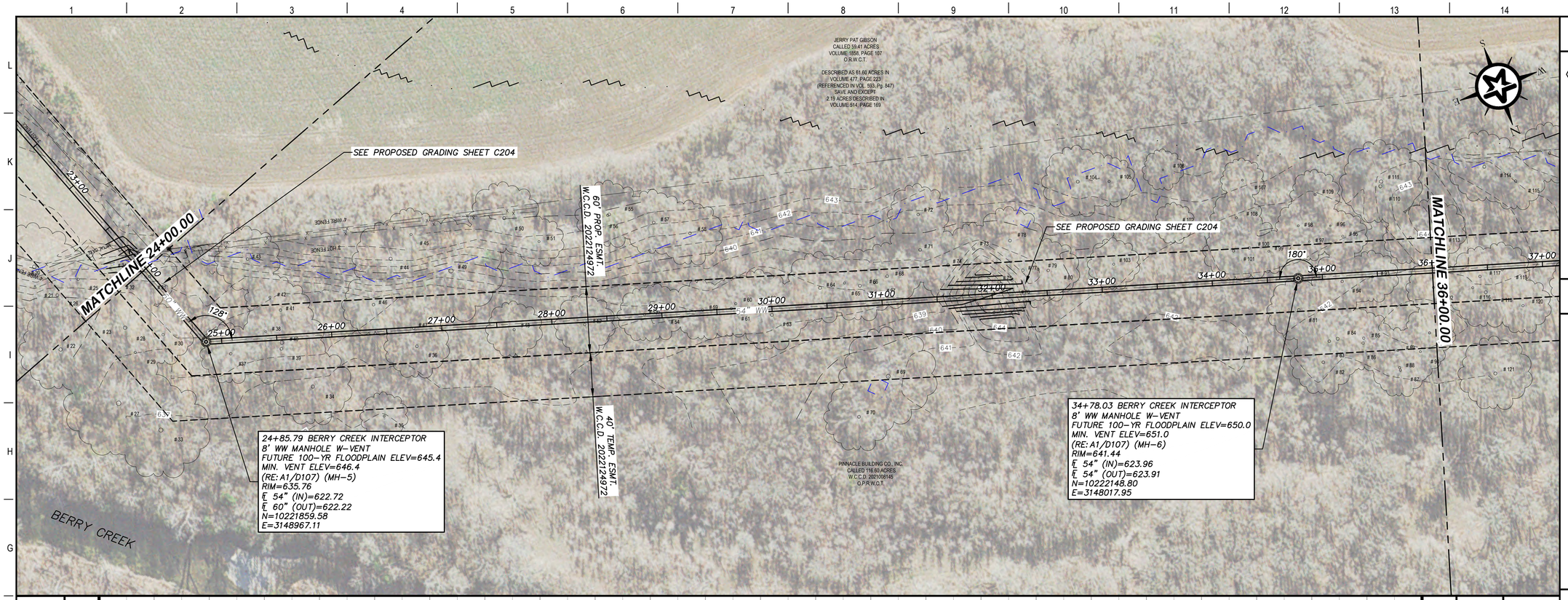

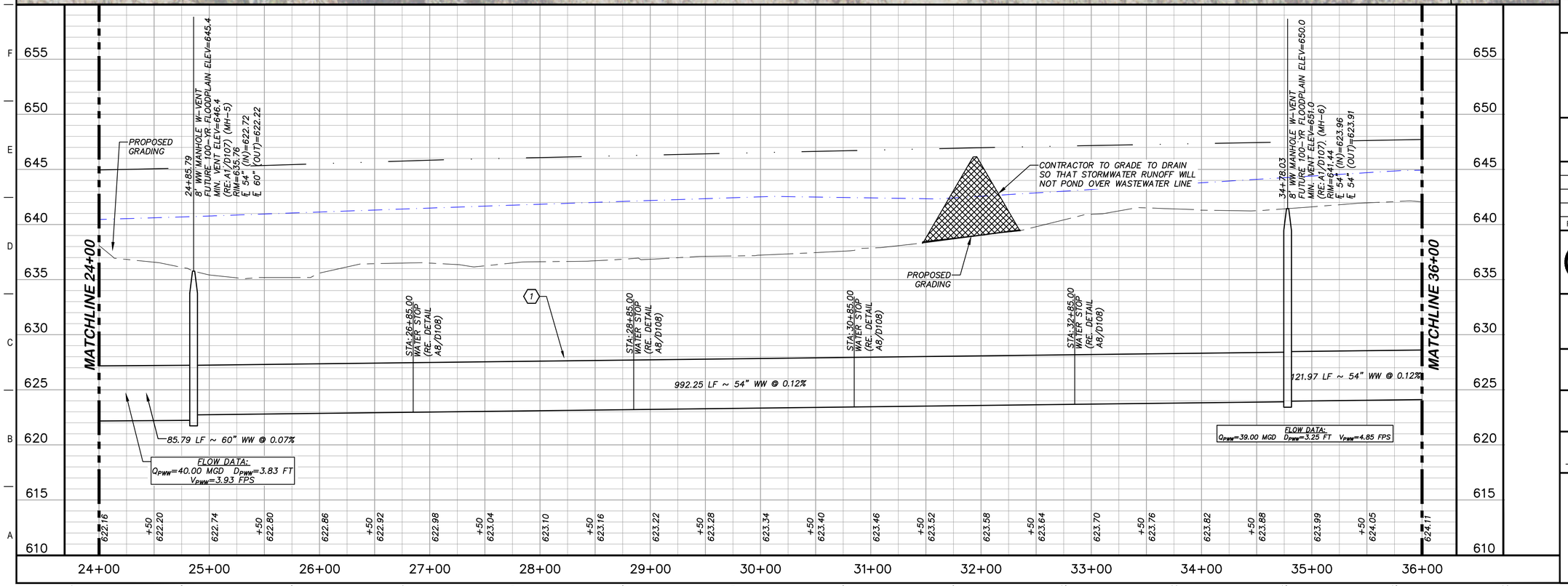

KEY NOTES

1. INSTALL CONCRETE TRENCH CAP STA. 24+00 TO 36+00 (RE. DETAIL G6/D107)

GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
3. FOR ALL TRENCHLESS WORK REFER TO SHEET C003.
4. TRENCHLESS CONSTRUCTION UNDER FM971 MAY BE INSTALLED BY HAND TUNNELING PER SPEC SECTION 33 30 04.
5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

5-YEAR FUTURE FLOODPLAIN

FEMA 100-YEAR FLOODPLAIN

N.G. ~ CENTERLINE

0 25 50 100

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 24+00 TO 36+00

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C103

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JERRY PAT GIBSON
CALLED 59.41 ACRES
VOLUME 1858, PAGE 107
O.R.W.C.T.

DESCRIBED AS 61.60 ACRES IN
VOLUME 477, PAGE 223
(REFERENCED IN VOL. 593, Pg. 847)
SAVE AND EXCEPT
2.19 ACRES DESCRIBED IN
VOLUME 514, PAGE 165

PROPOSED 60' WASTEWATER EASEMENT

60' PROP. ESMT. W.C.C.D. 2022124972

PROPOSED 20' GATE, REMOVE AND REPLACE ±104 L.F. OF FENCE. (RE: A1/D119)

60' PROP. ESMT. W.C.C.D. 2021116024

WARNING OVERHEAD ELECTRIC

MATCHLINE 36+00.00

MATCHLINE 48+00.00

178°

54" WW

PROPOSED 40' TEMPORARY CONSTRUCTION EASEMENT

40' TEMP. ESMT. W.C.C.D. 2022124972

40' TEMP. ESMT. W.C.C.D. 2021116021

43+54.40 BERRY CREEK INTERCEPTOR
8' WW MANHOLE W-VENT
FUTURE 100-YR FLOODPLAIN ELEV=652.2
MIN. VENT ELEV=653.2
(RE: A1/D107) (MH-7)
RIM=644.98
℄ 54" (IN)=625.06
℄ 54" (OUT)=625.01
N=10222404.25
E=3147179.64

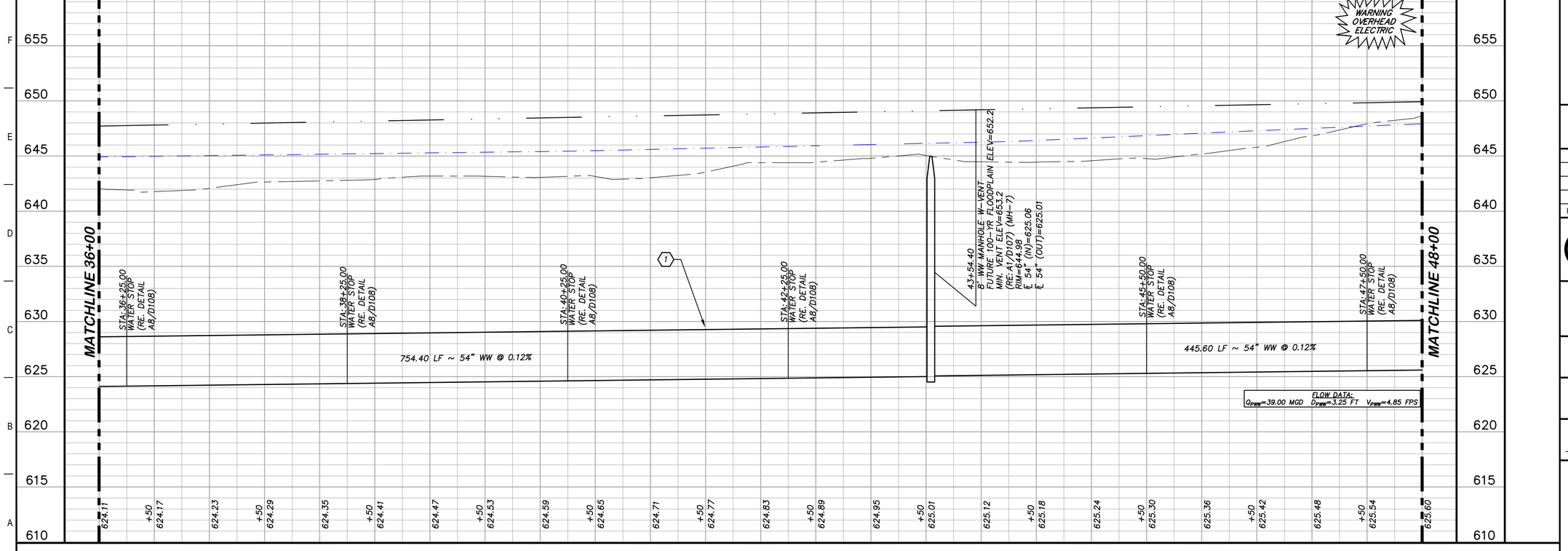
PINNACLE BUILDING CO., INC.
CALLED 116.60 ACRES
W.C.C.D. 2021008146
O.P.R.W.C.T.

TRUMAN M. WHITEAKER
CALLED 59.6 ACRES
VOLUME 1025, PAGE 800
D.R.W.C.T.
(NO DESCRIPTION PROVIDED IN DEED)

DESCRIBED IN VOLUME 400, PAGE 36
D.R.W.C.T.

BERRY CREEK

WARNING OVERHEAD ELECTRIC



KEY NOTES

1. INSTALL CONCRETE TRENCH CAP STA. 36+00 TO 48+00 (RE. DETAIL G6/D107)

GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
3. FOR ALL TRENCHLESS WORK REFER TO SHEET C003.
4. TRENCHLESS CONSTRUCTION UNDER FM971 MAY BE INSTALLED BY HAND TUNNELING PER SPEC SECTION 33 30 04.
5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

5-YEAR FUTURE FLOODPLAIN

FEMA 100-YEAR FLOODPLAIN

N.G. ~ CENTERLINE

WATERWAY

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 36+00 TO 48+00

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C104

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\VFG - BERRY CREEK INTERCEPTOR - (1).DWG, C104 WW LINE STA. 36+00 TO 48+00, 8/14/2023 2:52:38 PM, rcuellar

CONTRACTOR SHALL READ AND UNDERSTAND ENCROACHMENT ON ONCOR EASEMENT BEFORE ACCESSING ONCOR EASEMENT. IT IS THE CONTRACTOR'S RESPONSIBILITY TO COMPLY WITH ALL TERMS AND CONDITIONS IN THE ENCROACHMENT DOCUMENT. CONTRACTOR MUST CONTACT ONCOR TRANSMISSION AT 903-439-6910 48 HOURS PRIOR TO START OF ANY CONSTRUCTION.

15' PEDERNALES ELECTRIC COOPERATIVE, INC. EASEMENT W.C.C.D. 97057078 D.R.W.C.T.

100' TEXAS POWER & LIGHT COMPANY EASEMENT VOLUME 670, PAGE 38 D.R.W.C.T.

PEDERNALES ELECTRIC COOPERATIVE 15' WIDE EASEMENT

40' TEMP. ESMT. W.C.C.D. 202104912

60' PROP. ESMT. W.C.C.D. 202116024

40' TEMP. ESMT. W.C.C.D. 202116021

WARNING OVERHEAD ELECTRIC

PROPOSED 20' GATE, REMOVE AND REPLACE ±144 L.F. OF FENCE (SEE SHEET D119)

MATCHLINE 48+00.00

49+47.22 BERRY CREEK INTERCEPTOR
8' DIA. MANHOLE (MH-8)
RIM=650.22
℄ 54" (IN)=625.83
℄ 54" (OUT)=625.78
N=10222555.60
E=3146606.47

56+51.39 BERRY CREEK INTERCEPTOR
8' WW MANHOLE W-VENT
FUTURE 100-YR FLOODPLAIN ELEV=656.9
MIN. VENT ELEV=658.36
(RE: G1/D107) (MH-9)
RIM=654.36
℄ 54" (IN)=626.72
℄ 54" (OUT)=626.67
N=10222515.89
E=3145903.42

59+57.19 BERRY CREEK INTERCEPTOR
8' DIA. MANHOLE (MH-10)
RIM=643.35
℄ 54" (IN)=627.19
℄ 54" (OUT)=627.09
N=10222790.33
E=3145768.51

SHAFT (SEE NOTE 2)

EB-5

EB-6

279' L.F. 72" ENCASEMENT

MATCHLINE 60+00.00

BERRY CREEK

TRUMAN M. WHITEAKER CALLED 58.6 ACRES VOLUME 1025, PAGE 800 D.R.W.C.T. (NO DESCRIPTION PROVIDED IN DEED) DESCRIBED IN VOLUME 400, PAGE 36 D.R.W.C.T.

CREEK CENTERLINE COLLECTED 03-26-2020

47+00 48+00 49+00 50+00 51+00 52+00 53+00 54+00 55+00 56+00 57+00 58+00 59+00 60+00 61+00

162° 113°

54" WW

KEY NOTES

(1) INSTALL CONCRETE TRENCH CAP STA. 48+00 TO 60+00 (RE. DETAIL G6/D107)

GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
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4. TRENCHLESS CONSTRUCTION UNDER FM971 MAY BE INSTALLED BY HAND TUNNELING PER SPEC SECTION 33 30 04.
5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

5-YEAR FUTURE FLOODPLAIN

FEMA 100-YEAR FLOODPLAIN

N.G. ~ CENTERLINE

WATERWAY

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 48+00 TO 60+00

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C105

WARNING OVERHEAD ELECTRIC

100' TEXAS POWER & LIGHT COMPANY 100' WIDE EASEMENT VOLUME 670, PAGE 38 D.R.W.C.T.

MATCHLINE 48+00

MATCHLINE 60+00

49+47.22 8' DIA. MANHOLE (MH-8) RIM=650.22 ℄ 54" (IN)=625.83 ℄ 54" (OUT)=625.78

STA. 51+00.00 WATER STOP (RE: DETAIL A8/D108)

STA. 53+00.00 WATER STOP (RE: DETAIL A8/D108)

STA. 55+00.00 WATER STOP (RE: DETAIL A8/D108)

56+51.39 8' WW MANHOLE W-VENT FUTURE 100-YR FLOODPLAIN ELEV=656.9 MIN. VENT ELEV=658.36 (RE: G1/D107) (MH-9) RIM=654.36 ℄ 54" (IN)=626.72 ℄ 54" (OUT)=626.67

59+57.19 8' DIA. MANHOLE (MH-10) RIM=643.35 ℄ 54" (IN)=627.19 ℄ 54" (OUT)=627.09

SHAFT

SHAFT

147.22 LF ~ 54" WW @ 0.12%

704.17 LF ~ 54" WW @ 0.12%

305.80 LF ~ 54" WW @ 0.12%

42.81 LF ~ 54" WW @ 0.15%

FLOW DATA: Q_{PWW}=39.00 MGD D_{PWW}=3.25 FT V_{PWW}=4.85 FPS

FLOW DATA: Q_{PWW}=39.00 MGD D_{PWW}=2.99 FT V_{PWW}=5.32 FPS

3'

279' L.F. 72" ENCASEMENT TRENCHLESS CONSTRUCTION REACH 2

STA. 56+71.00

STA. 59+50.00

660 655 650 645 640 635 630 625 620 615

626.60 +50 625.66 625.72 +50 625.82 625.89 +50 625.95 626.01 +50 626.07 626.13 +50 626.19 626.25 +50 626.31 626.37 +50 626.43 626.49 +50 626.55 626.61 +50 626.68 626.78 +50 626.84 626.90 +50 626.96 627.02 +50 627.08 627.25

48+00 49+00 50+00 51+00 52+00 53+00 54+00 55+00 56+00 57+00 58+00 59+00 60+00

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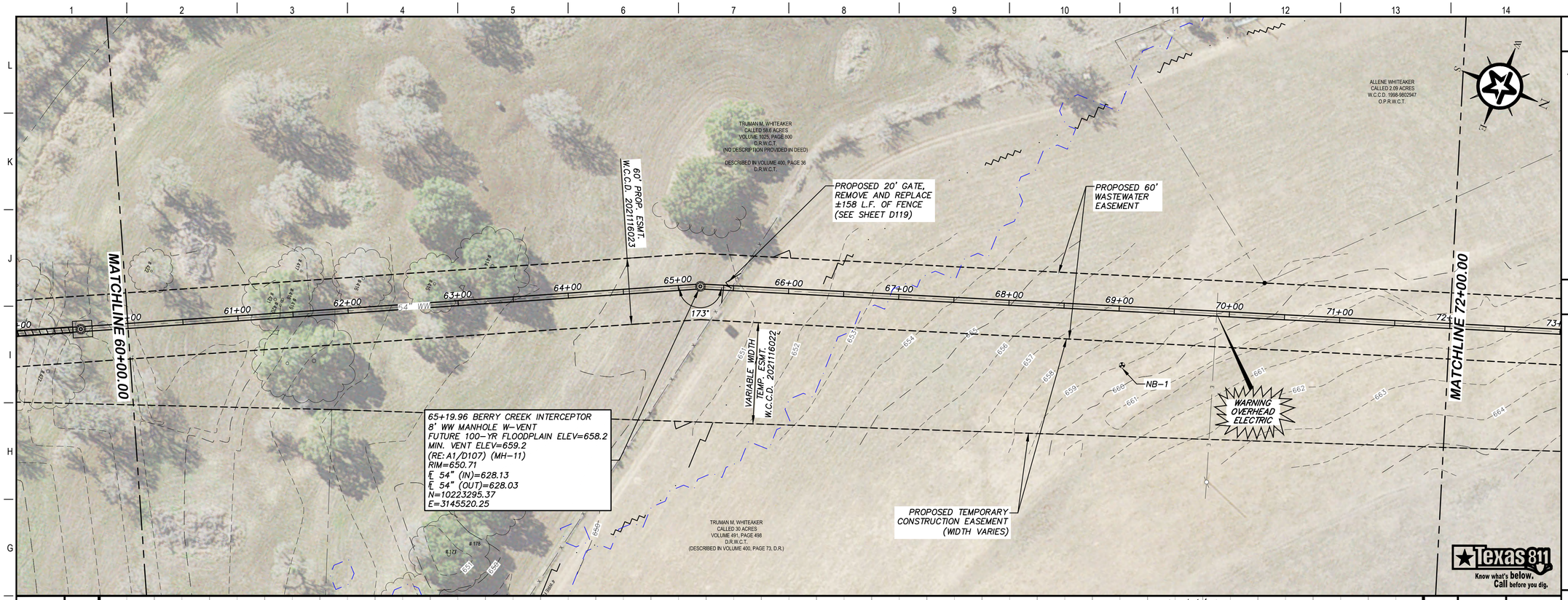

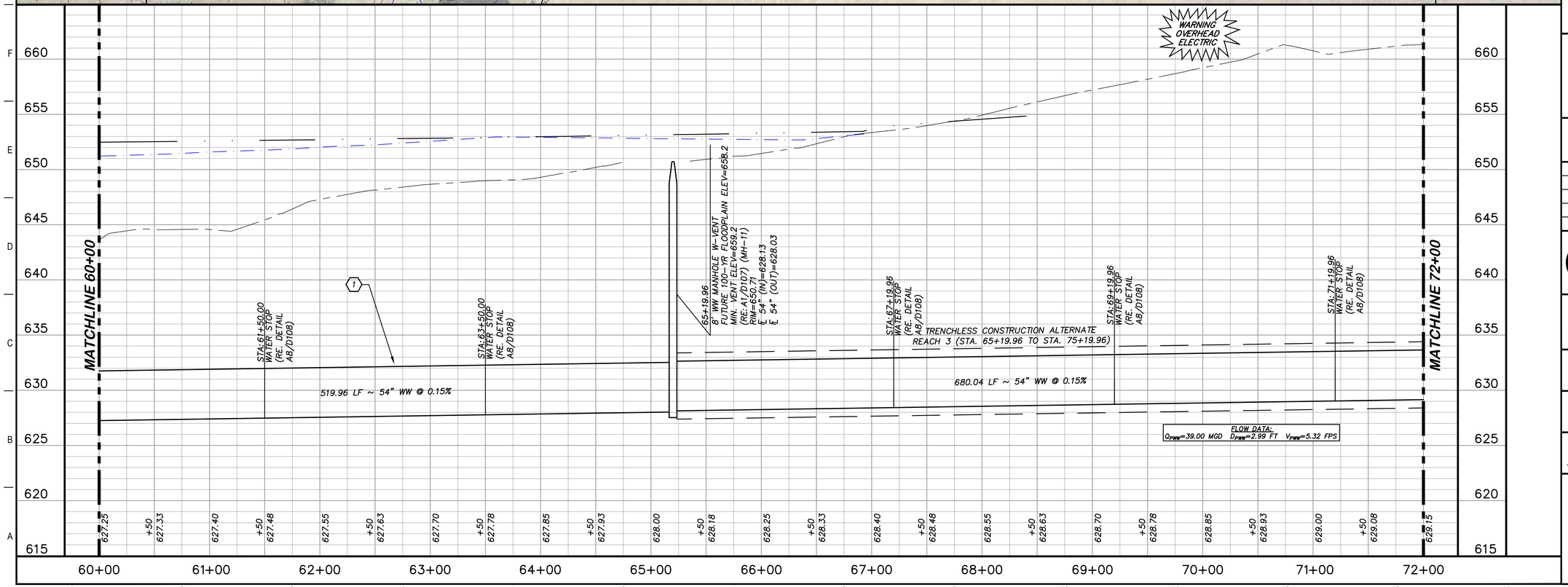

KEY NOTES

1. INSTALL CONCRETE TRENCH CAP STA. 60+00 TO 66+93 (RE. DETAIL G6/D107)

GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
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4. TRENCHLESS CONSTRUCTION UNDER FM971 MAY BE INSTALLED BY HAND TUNNELING PER SPEC SECTION 33 30 04.
5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

5-YEAR FUTURE FLOODPLAIN
FEMA 100-YEAR FLOODPLAIN
N.G. ~ CENTERLINE

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 60+00 TO 72+00

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C106

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\VFG - BERRY CREEK INTERCEPTOR - (1).DWG, C106 WW LINE STA. 60+00 TO 72+00, 8/14/2023 2:54:02 PM, rcuellar

ALLENE WHITEAKER
CALLED 2.09 ACRES
W.C.C.D. 1998-5802947
O.P.R.W.C.T.

75+19.96 BERRY CREEK INTERCEPTOR
8' DIA. MANHOLE (MH-12)
RIM=666.78
℄ 54" (IN)=629.73
℄ 54" (OUT)=629.63
N=10224239.65
E=3145191.11

DAVID WHITEAKER
AND WIFE, BONNIE WHITEAKER
CALLED 2.09 ACRES
(SAVE AND EXCEPT 0.05 ACRES=NET 2.04 ACRES)
TRACT ONE
W.C.C.D. 2010014143
O.P.R.W.C.T.

WCAD SHOWS OWNER AS BONNIE NELL WHITEAKER

79+15.59 BERRY CREEK INTERCEPTOR
8' WW MANHOLE W-VENT
FUTURE 100-YR FLOODPLAIN ELEV=N/A
MIN. VENT ELEV=673.51
(RE: G1/D107) (MH-13)
RIM=669.51
℄ 54" (IN)=630.42
℄ 54" (OUT)=630.32
N=10224554.25
E=3144951.22

JONAH WATER SPECIAL UTILITY DISTRICT,
15' WIDE RIGHT OF WAY EASEMENT FOR WATER LINE
VOLUME 2709, PAGE 471, O.P.R.W.C.T.

ALFONSO C CHICHARRO AZNAR AND
MONICA SIERRA, HUSBAND AND WIFE
CALLED 5.062 ACRES
W.C.C. D. 2018050828
O.P.R.W.C.T.

JONAH WATER SPECIAL UTILITY DISTRICT
RIGHT OF WAY EASEMENT
FOR PRESSURE STATION
VOLUME 2709, PAGE 471
O.P.R.W.C.T.

JAMES O. CHAFFIN
AND WIFE DIANNA M. CHAFFIN
CALLED 4.99 ACRES
W.C.C.D. 2009021581
O.P.R.W.C.T.

MATCHLINE 72+00.00

MATCHLINE 84+00.00

60' PROP. ESMT.
W.C.C.D. 2021116023

VARIABLE WIDTH
TEMP. ESMT.
W.C.C.D. 2021116022

SHAFT
(SEE NOTE 2)

CONTRACTOR
TO PROTECT
PUMP HOUSE

388' L.F. 72" ENCASEMENT

PROPOSED TEMPORARY
CONSTRUCTION
EASEMENT

PROPOSED 30' WIDE
DRIVEWAY & GATE
(RE: A1/D119)

WARNING
OVERHEAD
ELECTRIC

REMOVE AND REPLACE
±70 L.F. OF FENCE
(RE: A1/D119)

40' TEMP. ESMT.
W.C.C.D. 2021179516

30' PROP. ESMT.
W.C.C.D. 2021179516

15' WIDE WATERLINE EASEMENT -
W.C.C.D. 9611843, O.P.R.W.C.T.

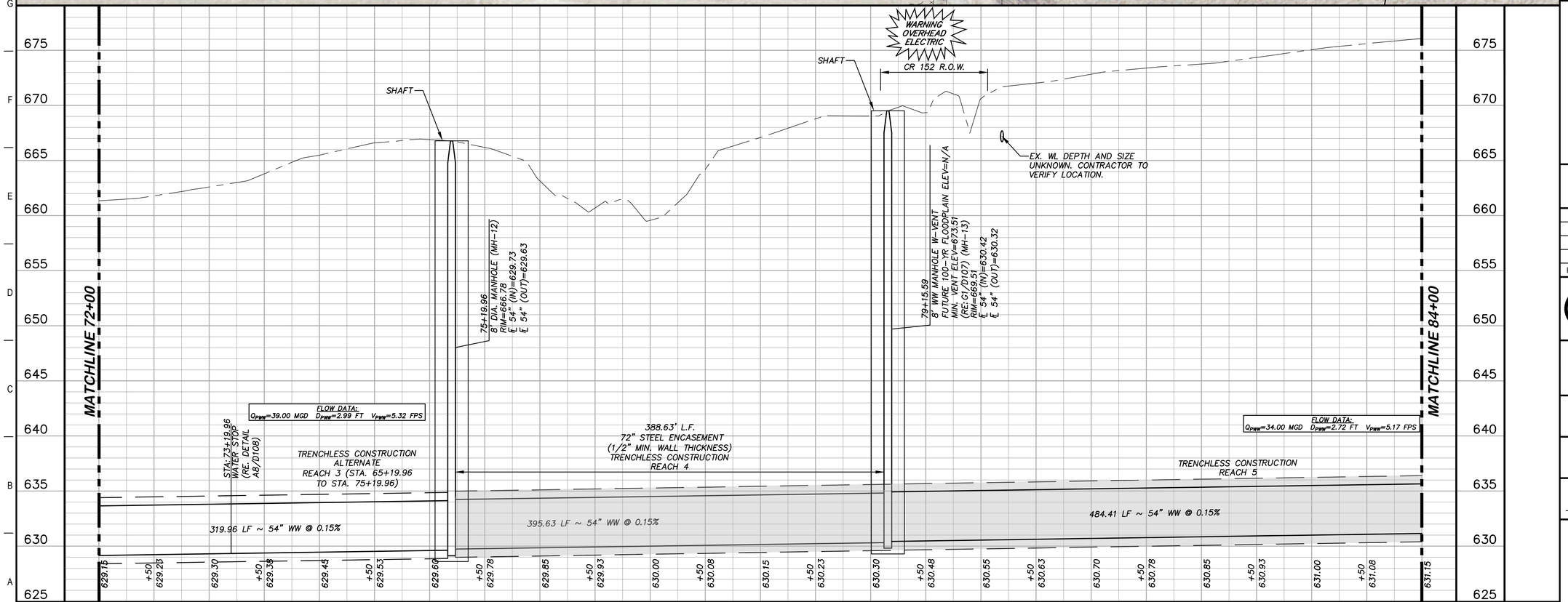
JONAH WATER SPECIAL UTILITY DISTRICT
15' WIDE RIGHT OF WAY EASEMENT FOR WATER LINE
VOLUME 2417, PAGE 8,
O.P.R.W.C.T.

CR 152

TRUMAN M. WHITEAKER
CALLED 30 ACRES
VOLUME 491, PAGE 498
D.R.W.C.T.
(DESCRIBED IN VOLUME 400, PAGE 73, D.R.)

CONTRACT OF SALE AND PURCHASE
TO
DON ARTHUR DODGE
CALLED 10.21 ACRES
VOLUME 770, PAGE 405
D.R.W.C.T.

Texas 811
Know what's below. Call before you dig.



GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
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4. TRENCHLESS CONSTRUCTION UNDER FM971 MAY BE INSTALLED BY HAND TUNNELING PER SPEC SECTION 33 30 04.
5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

5-YEAR FUTURE FLOODPLAIN
FEMA 100-YEAR FLOODPLAIN
N.G. ~ CENTERLINE
POND

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners
engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 72+00 TO 84+00

03/31/2023
DATE
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C107

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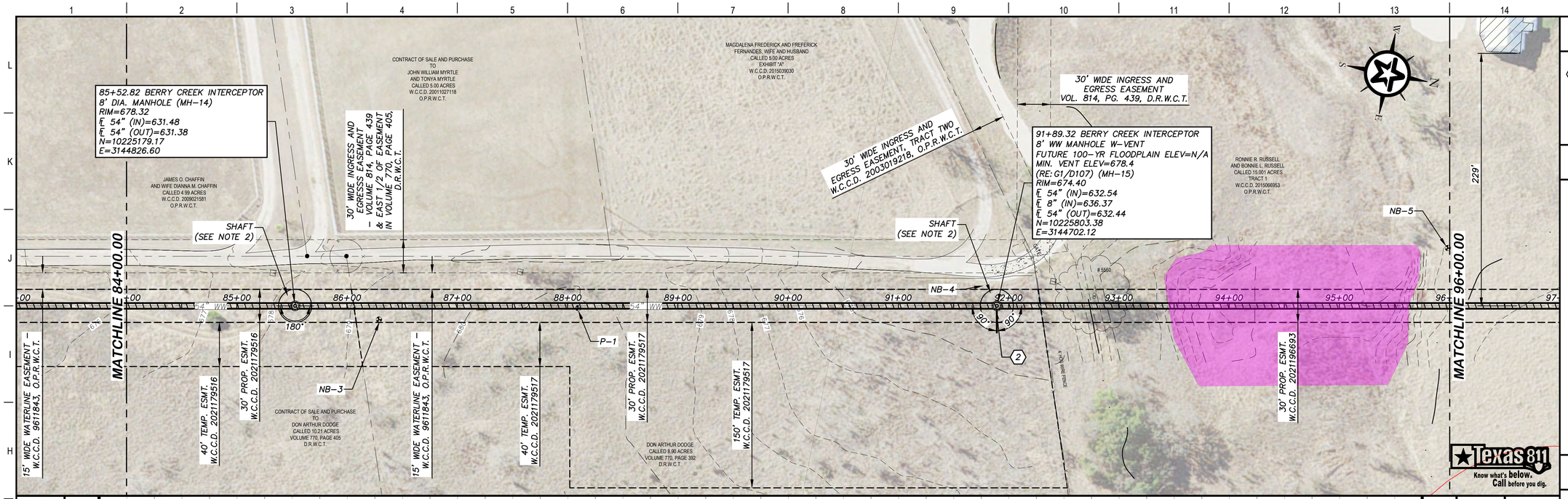

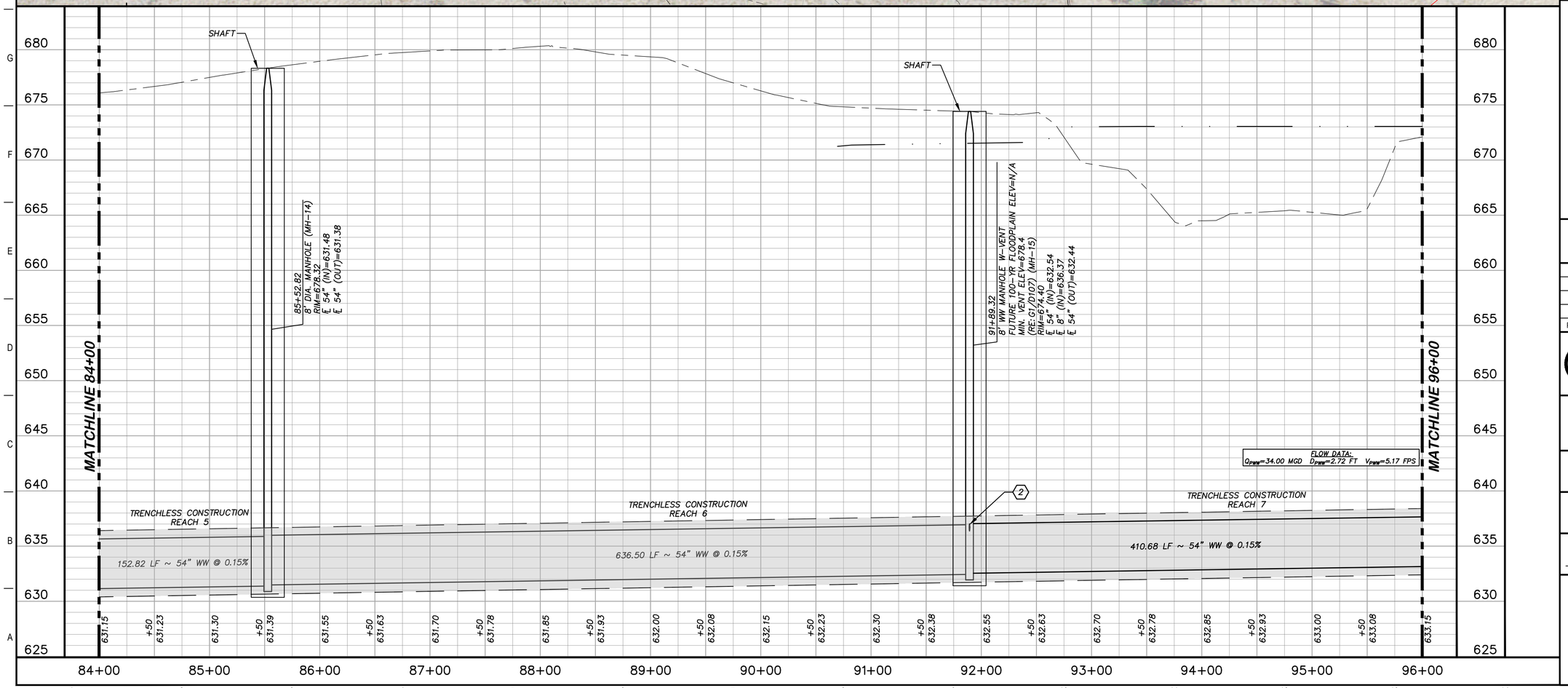

KEY NOTES

(2) DROP CONNECTION – PRECAST MANHOLE TYPE "C" (RE: A10/D107)

GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
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5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

5-YEAR FUTURE FLOODPLAIN
FEMA 100-YEAR FLOODPLAIN
N.G. ~ CENTERLINE
50-METER SPRING BUFFER
POND

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 84+00 TO 96+00

03/31/2023 DATE
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C108

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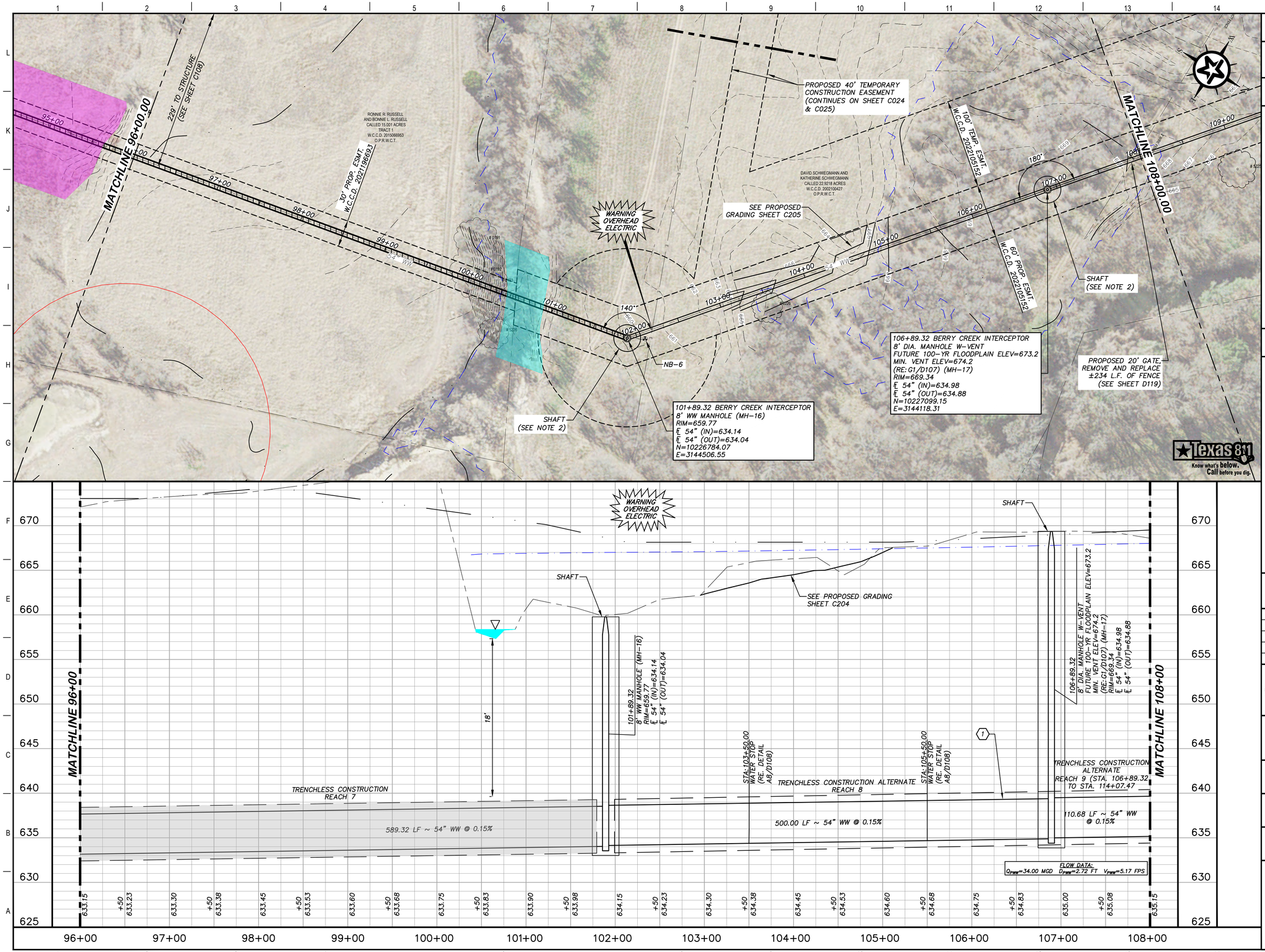

KEY NOTES

1. INSTALL CONCRETE TRENCH CAP STA. 100+40 TO 108+00 (RE. DETAIL G6/D107)

GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
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5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

- 5-YEAR FUTURE FLOODPLAIN
- FEMA 100-YEAR FLOODPLAIN
- N.G. ~ CENTERLINE
- SPRING BUFFER
- WATERWAY
- POND

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 96+00 TO 108+00

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C109

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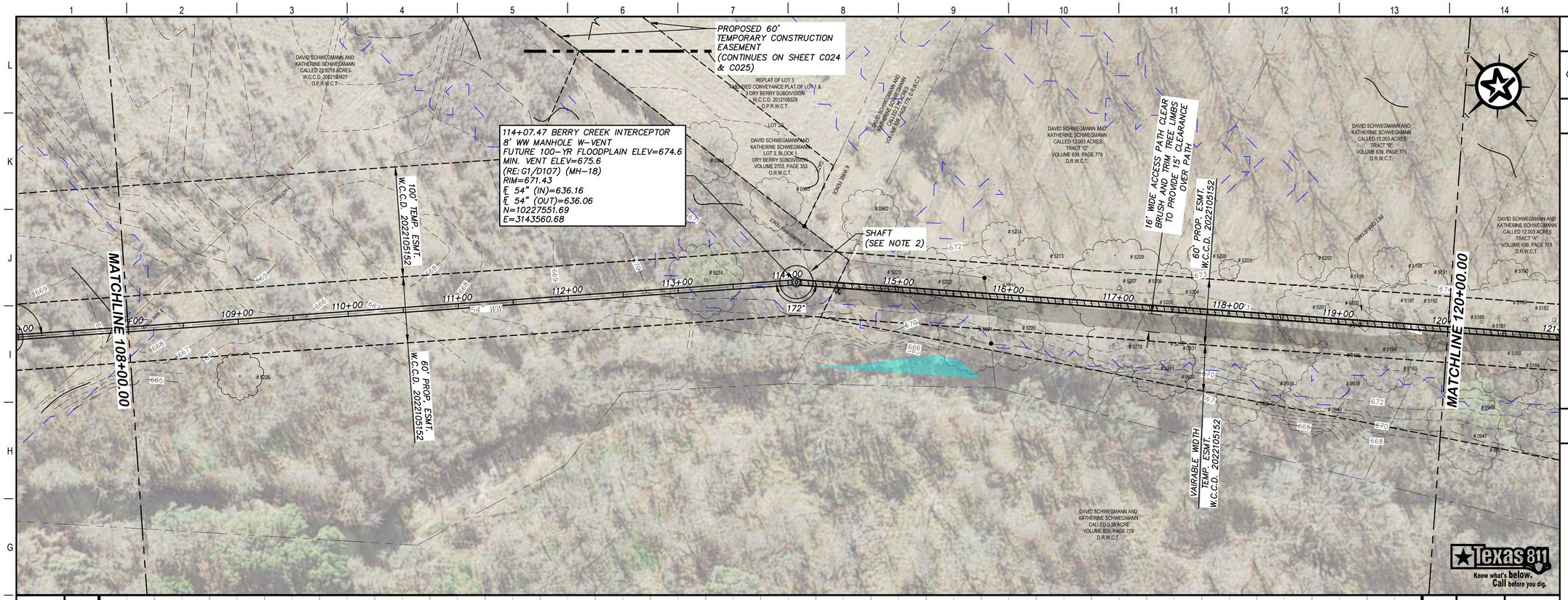

KEY NOTES

(1) INSTALL CONCRETE TRENCH CAP STA. 108+00 TO 113+11 (RE. DETAIL G6/D107)

GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
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5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

- 5-YEAR FUTURE FLOODPLAIN
- FEMA 100-YEAR FLOODPLAIN
- N.G. ~ CENTERLINE
- SPRING BUFFER
- WATERWAY
- POND
- 16' WIDE ACCESS PATH

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 108+00 TO 120+00

03/31/2023 DATE

ERIC LEE NELSON

STATE OF TEXAS ERIC LEE NELSON 114449 LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. C110

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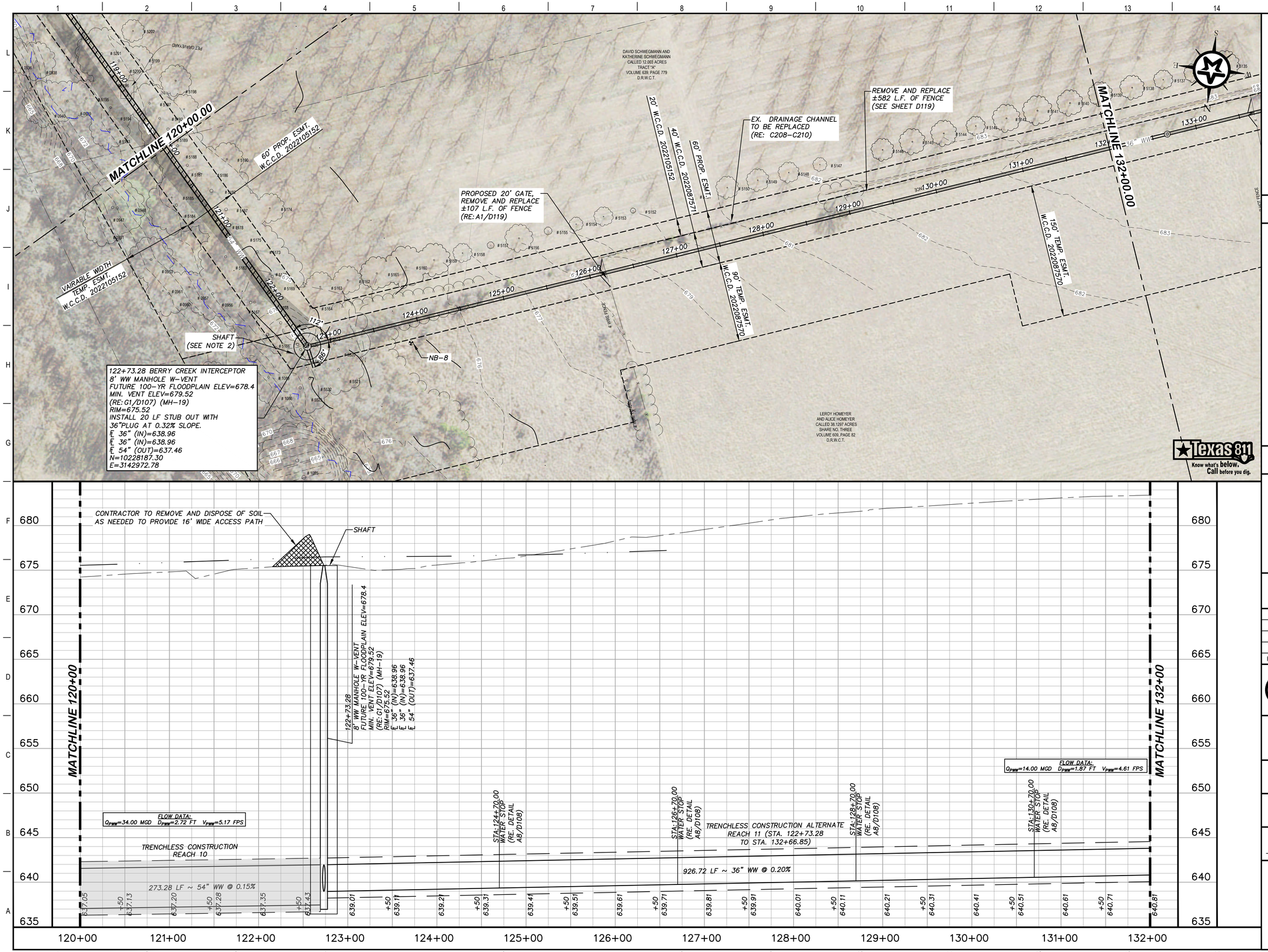


GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
3. FOR ALL TRENCHLESS WORK REFER TO SHEET C003.
4. TRENCHLESS CONSTRUCTION UNDER FM971 MAY BE INSTALLED BY HAND TUNNELING PER SPEC SECTION 33 30 04.
5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

5–YEAR FUTURE FLOODPLAIN
FEMA 100–YEAR FLOODPLAIN
N.G. ~ CENTERLINE
16' WIDE ACCESS PATH

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 120+00 TO 132+00

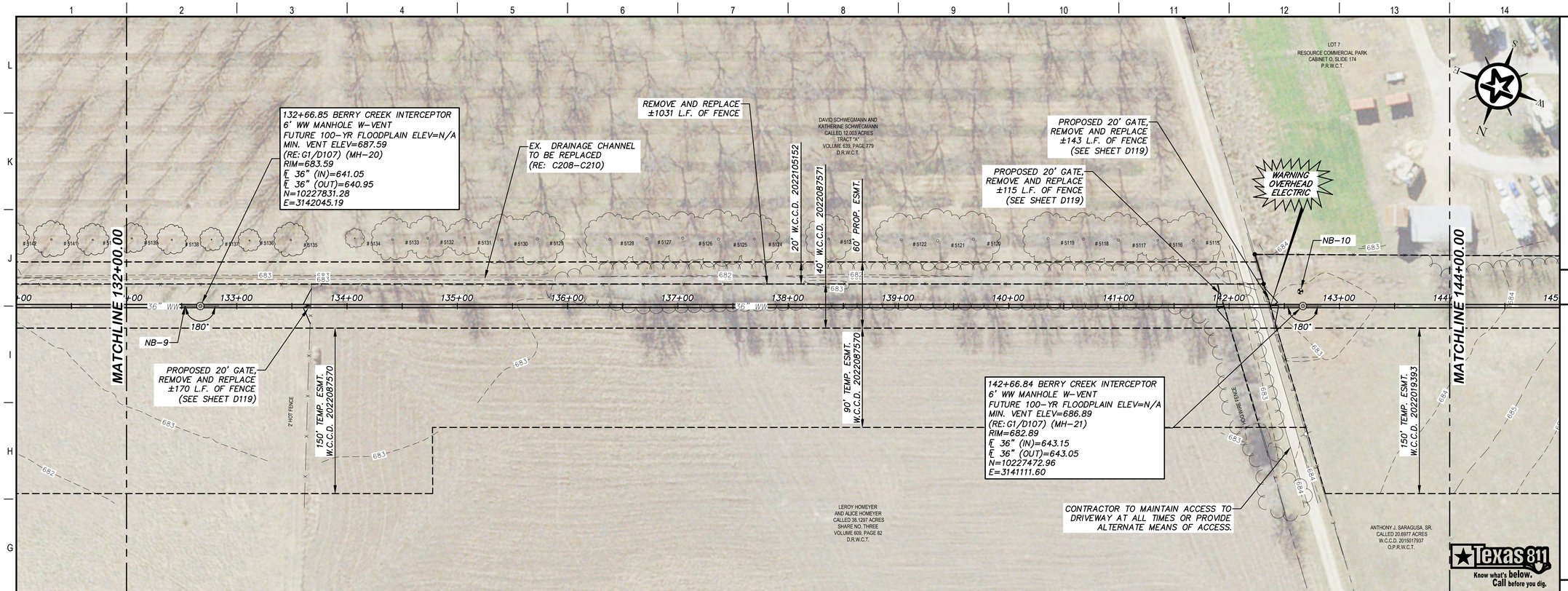
03/31/2023
DATE
ERIC LEE NELSON

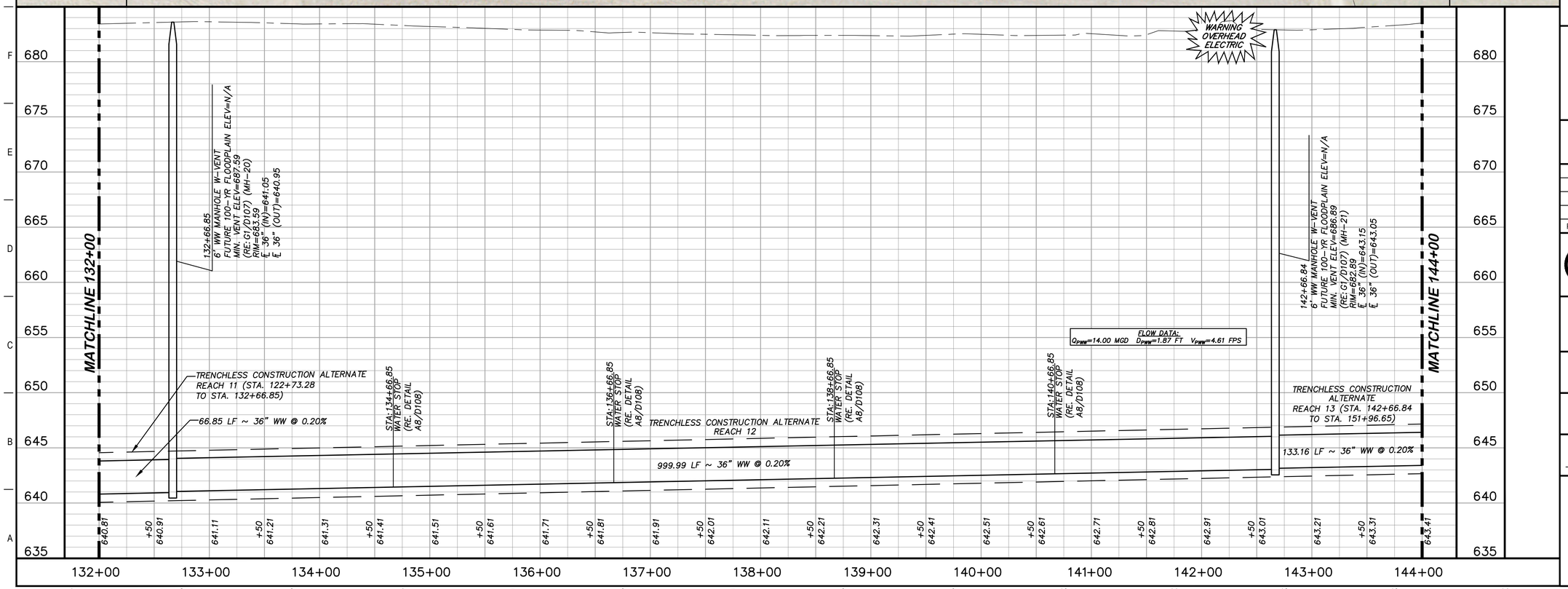
STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C111

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\VFG - BERRY CREEK INTERCEPTOR - (2).DWG, C111 WW LINE STA. 120+00 TO 132+00, 8/14/2023 2:59:24 PM, rcuellar





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LEGEND

5-YEAR FUTURE FLOODPLAIN
FEMA 100-YEAR FLOODPLAIN
N.G. ~ CENTERLINE

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 132+00 TO 144+00

03/31/2023 DATE
ERIC LEE NELSON

STATE OF TEXAS ERIC LEE NELSON 114449 LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C112

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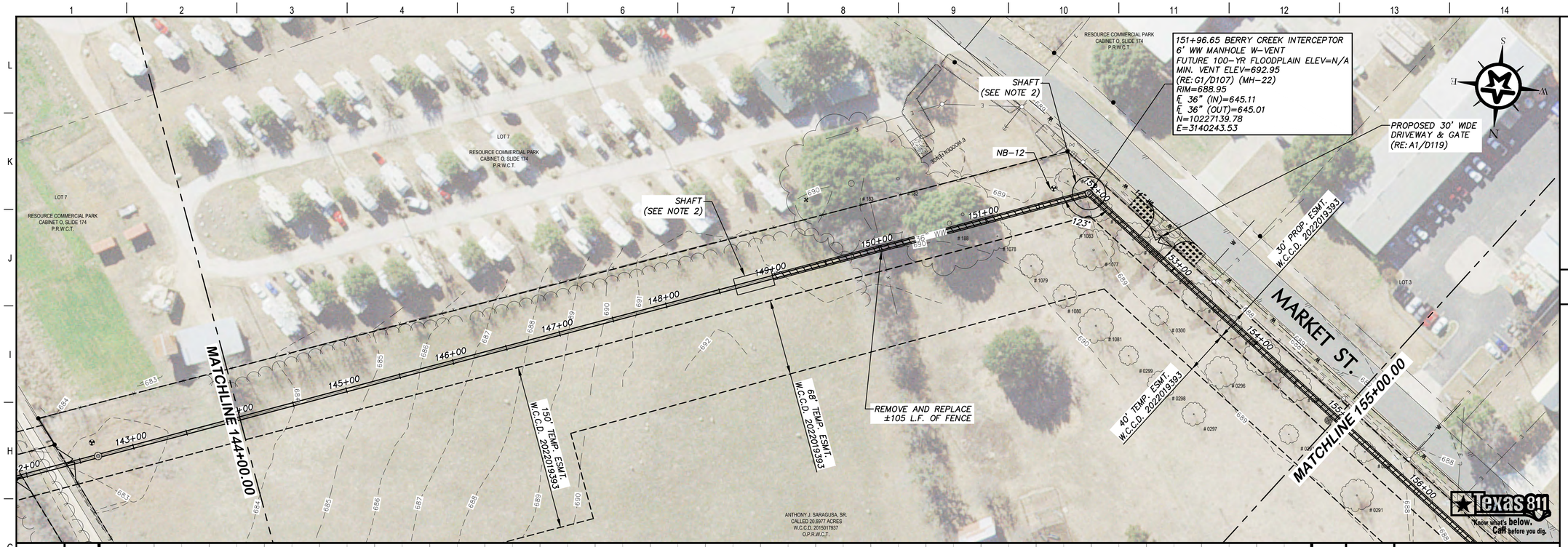

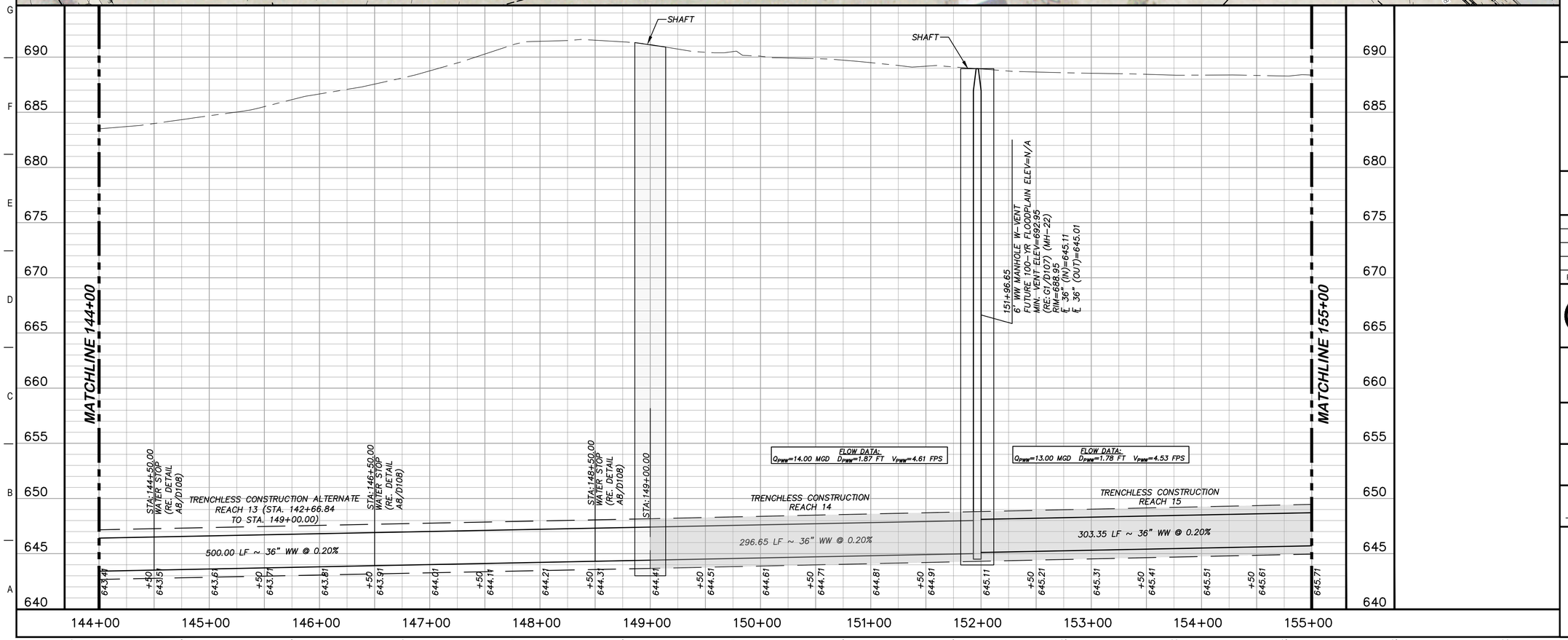

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LEGEND

5-YEAR FUTURE FLOODPLAIN
FEMA 100-YEAR FLOODPLAIN
N.G. ~ CENTERLINE

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 144+00 TO 155+00

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C113

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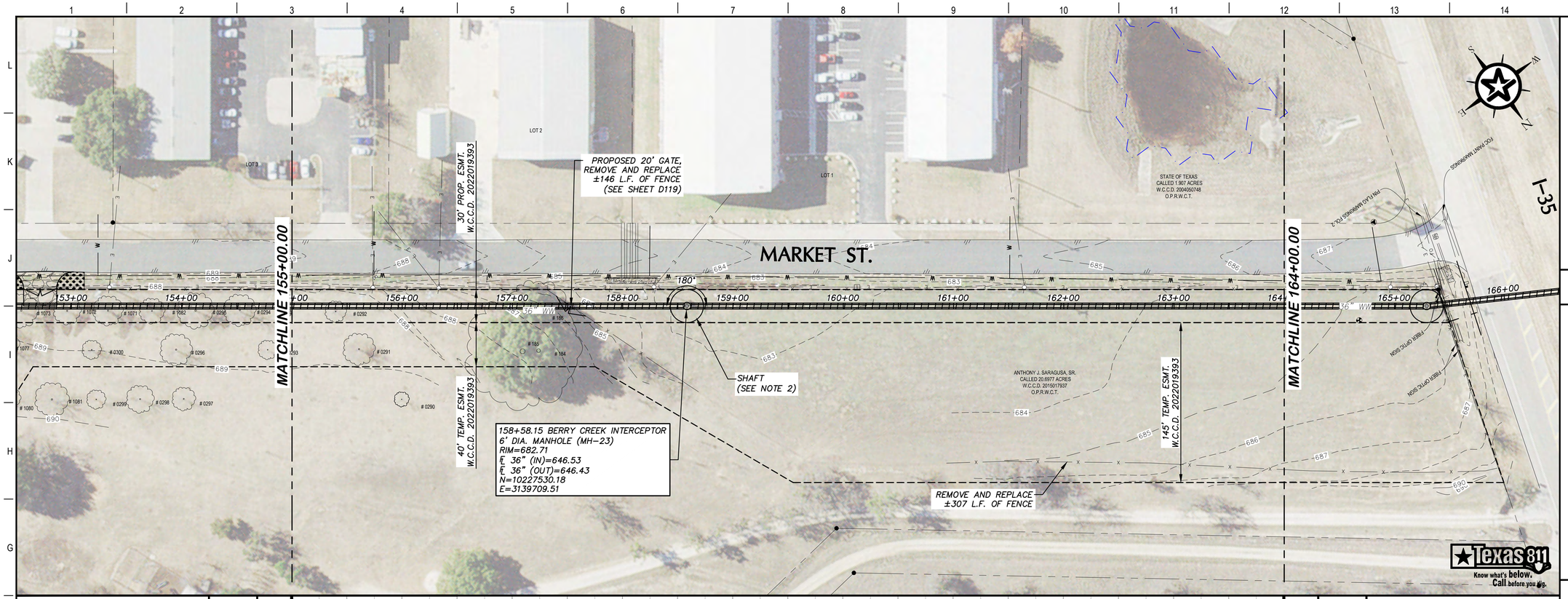

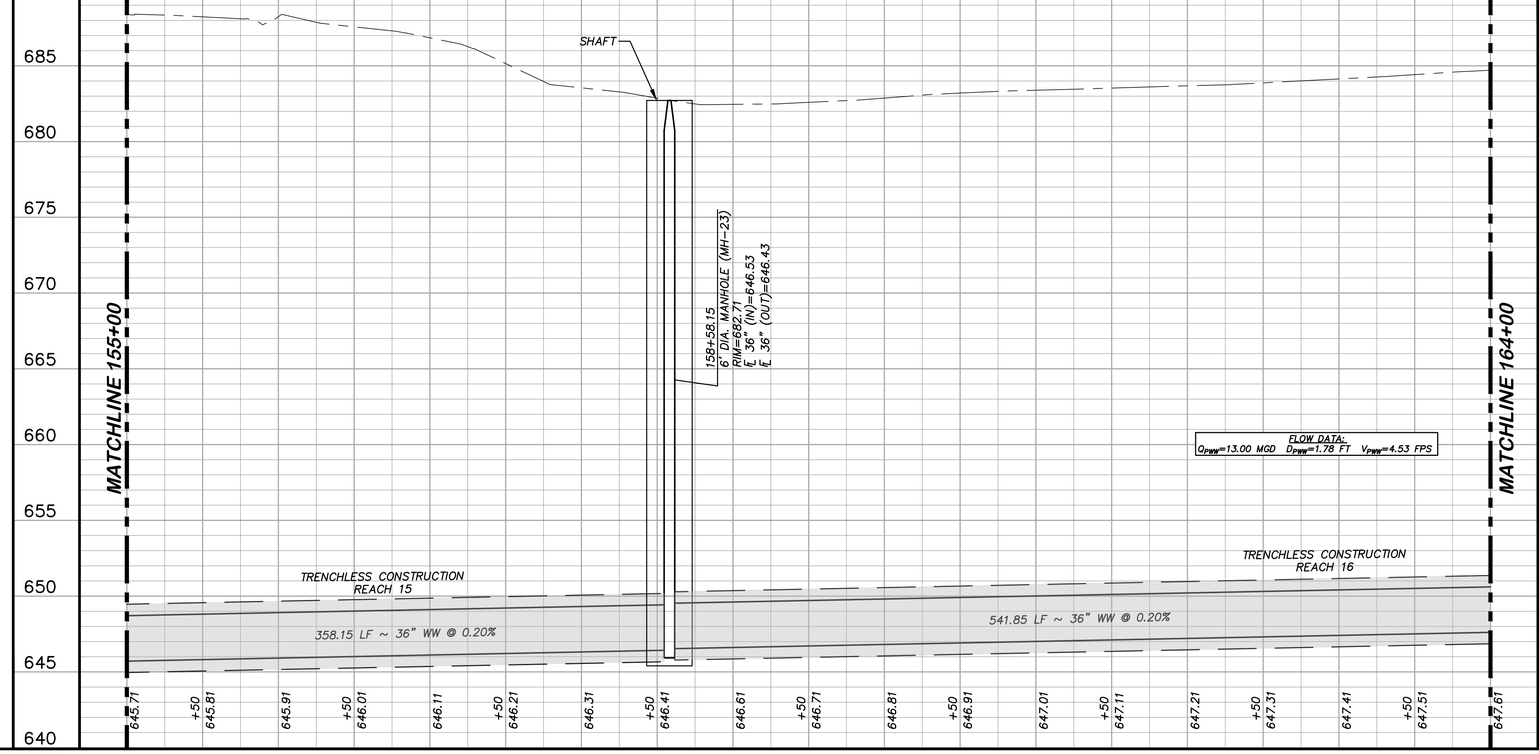

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LEGEND

5-YEAR FUTURE FLOODPLAIN
FEMA 100-YEAR FLOODPLAIN
N.G. ~ CENTERLINE

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 155+00 TO 164+00

03/31/2023
DATE
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C114

Texas 811 Know what's below. Call before you dig.

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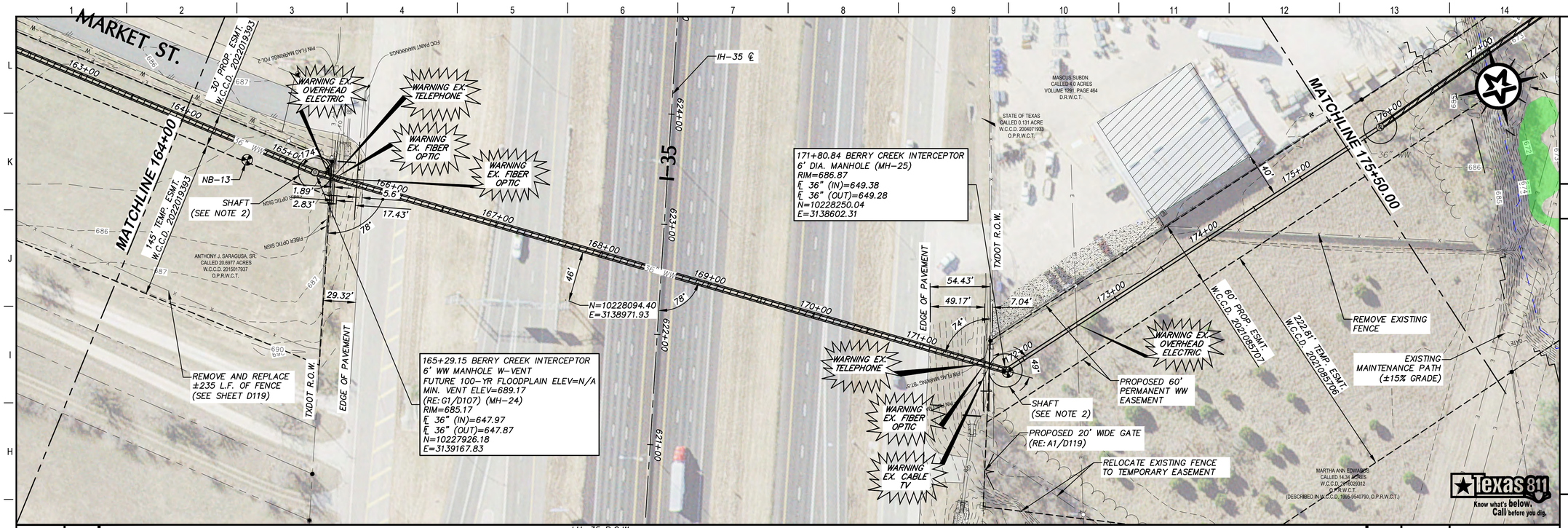

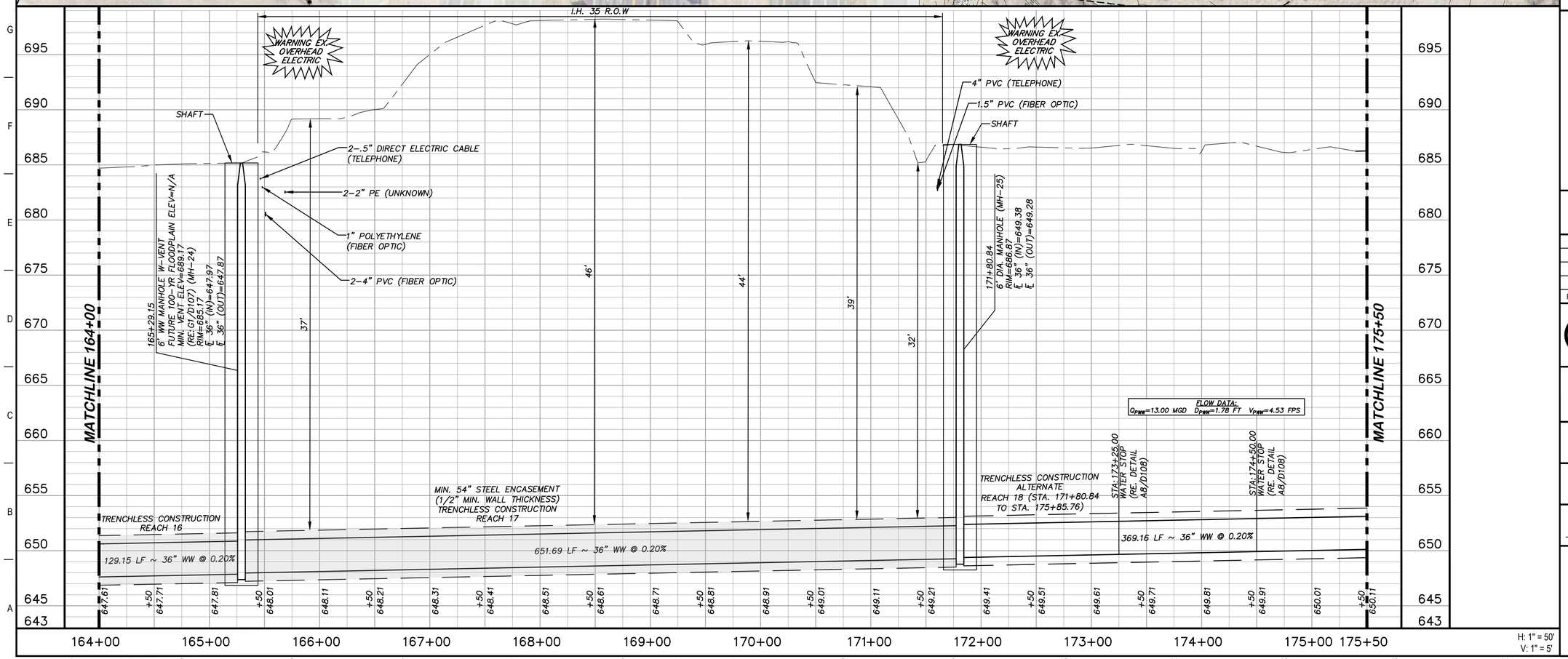

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LEGEND

5-YEAR FUTURE FLOODPLAIN
FEMA 100-YEAR FLOODPLAIN
N.G. ~ CENTERLINE
WETLANDS

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 164+00 TO 176+00

03/31/2023
DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C115

H: 1" = 50'
V: 1" = 5'

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\VFG - BERRY CREEK INTERCEPTOR - (3).DWG, C115 WW LINE STA. 164+00 TO 176+00, 8/14/2023 3:03:44 PM, rcuellar

CONTRACTOR SHALL CONTACT LCRA TRANSMISSION SERVICES LINE OPERATIONS, JUAN GUERRA, AT (830)596-7261 PRIOR TO BEGINNING CONSTRUCTION. CONTRACTOR SHALL ALSO CONTACT LCRA SYSTEMS OPERATION CONTROL CENTER AT LEAST 72 HOURS PRIOR TO BEGINNING WORK IN LCRA EASEMENTS OR NEAR LCRA FACILITIES.

183+06.42 BERRY CREEK INTERCEPTOR
6' DIA. MANHOLE (MH-27)
RIM=670.65
℄ 36" (IN)=651.83
℄ 36" (OUT)=651.73
N=10227858.02
E=3137547.35

175+85.76 BERRY CREEK INTERCEPTOR
6' WW MANHOLE W-VENT
FUTURE 100-YR FLOODPLAIN ELEV=688.0
MIN. VENT ELEV=690.36
(RE: G1/D107) (MH-26)
RIM=686.36
℄ 36" (IN)=650.29
℄ 36" (OUT)=650.19
N=10228117.07
E=3138219.84

187+70.82 BERRY CREEK INTERCEPTOR
6' WW MANHOLE W-VENT
FUTURE 100-YR FLOODPLAIN ELEV=688.3
MIN. VENT ELEV=689.3
(RE: G1/D107) (MH-29)
RIM=684.75
℄ 36" (IN)=653.30
℄ 12" (IN)=655.30
℄ 36" (OUT)=653.20
N=10228144.03
E=3137338.98

184+77.83 BERRY CREEK INTERCEPTOR
6' DIA. MANHOLE (MH-28)
RIM=678.94
℄ 36" (IN)=652.32
℄ 12" (IN)=654.32
℄ 36" (OUT)=652.22
N=10227853.38
E=3137376.00

WILLIAMSON COUNTY TRACT I - EXH B CALLED 32.3411 ACRES W.C.C.D. 2011095293 O.P.R.W.C.T.

MASCUS CORPORATION CALLED 2.5265 ACRES W.C.C.D. 2002010038 O.P.R.W.C.T.

MARTHA ANN EDWARDS CALLED 14.34 ACRES W.C.C.D. 2019029312 O.P.R.W.C.T. (DESCRIBED IN W.C.C.D. 1995-9540700, O.P.R.W.C.T.)

THREE FORKS PARTNERSHIP, LTD. CALLED 382.15 ACRES (370.893 ACRES - NET) W.C.C.D. 2005003918 O.P.R.W.C.T.

382.15 ACRES SAVE & EXCEPT
1.457 ACRES, W.C.C.D. 8711458, O.P.R.
0.50 ACRE, W.C.C.D. 2001014355, O.P.R.
9.30 ACRES DESC. IN W.C.C.D. 2005003918

WARNING OVERHEAD ELECTRIC

SHAFT (SEE NOTE 2)

SEE PROPOSED GRADING SHEET C205

154 L.F. 54" STEEL ENCASEMENT

WB-18

40' TEMP. ESMT W.C.C.D. 2022122787

60' PROP. ESMT. W.C.C.D. 2022122785

ACCESS ESMT. W.C.C.D. 2022122786

40' TEMP. ESMT. W.C.C.D. 2021085706

60' PROP. ESMT. W.C.C.D. 2021085707

LOWER COLORADO RIVER AUTHORITY EASEMENT AND RIGHT OF WAY W.C.C.D. 1997-9806890 O.P.R.W.C.T.

REMOVE AND REPLACE ±3900 L.F. OF FENCE

REMOVE AND REPLACE ±75 L.F. OF FENCE (SEE SHEET D119)

NB-15

MATCHLINE 175+50.00

MATCHLINE 188+00.00

LCRA R.O.W

KEY NOTES

1. INSTALL CONCRETE TRENCH CAP STA. 177+00 TO 184+69, 185+02 TO 187+38, (RE. DETAIL G6/D107)
2. DROP CONNECTION – PRECAST MANHOLE TYPE "C" (RE: A10/D107)

GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
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LEGEND

5-YEAR FUTURE FLOODPLAIN
FEMA 100-YEAR FLOODPLAIN
N.G. ~ CENTERLINE
WATERWAY
WETLANDS

GRAPHIC SCALE (FEET) 0 25 50 100

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 176+00 TO 188+00

03/31/2023 DATE
ERIC LEE NELSON

STATE OF TEXAS ERIC LEE NELSON 114449 LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. C116

H: 1" = 50'
V: 1" = 5'

MATCHLINE 175+50

MATCHLINE 188+00

SHAFT

175+85.76
6' WW MANHOLE W-VENT
FUTURE 100-YR. FLOODPLAIN ELEV=688.0
MIN. VENT ELEV=690.36
(RE: G1/D107) (MH-26)
RIM=686.36
℄ 36" (IN)=650.29
℄ 36" (OUT)=650.19

STA: 175+89.26

TRENCHLESS CONSTRUCTION ALTERNATE REACH 18 (STA. 171+80.84 TO STA. 175+85.76)

35.76 LF ~ 36" WW @ 0.20%

TRENCHLESS CONSTRUCTION REACH 19

364.24 LF ~ 36" WW @ 0.20%

STA:179+50.00

TRENCHLESS CONSTRUCTION ALTERNATE REACH 20

356.42 LF ~ 36" WW @ 0.20%

STA:181+25.00 WATER STOP (RE. DETAIL A8/D108)

FLOW DATA: Q_{PWW}=13.00 MGD D_{PWW}=1.78 FT V_{PWW}=4.53 FPS

SHAFT

PROP. GRADING

STA:183+13.98

6'

154 L.F. 54" ENCASEMENT

TRENCHLESS CONSTRUCTION REACH 21

171.41 LF ~ 36" WW @ 0.23%

STA:184+67.98

SHAFT

TRENCHLESS CONSTRUCTION ALTERNATE REACH 22

FLOW DATA: Q_{PWW}=12.00 MGD D_{PWW}=1.50 FT V_{PWW}=5.19 FPS

STA:186+25.00 WATER STOP (RE. DETAIL A8/D108)

292.99 LF ~ 36" WW @ 0.30%

PROP. GRADING

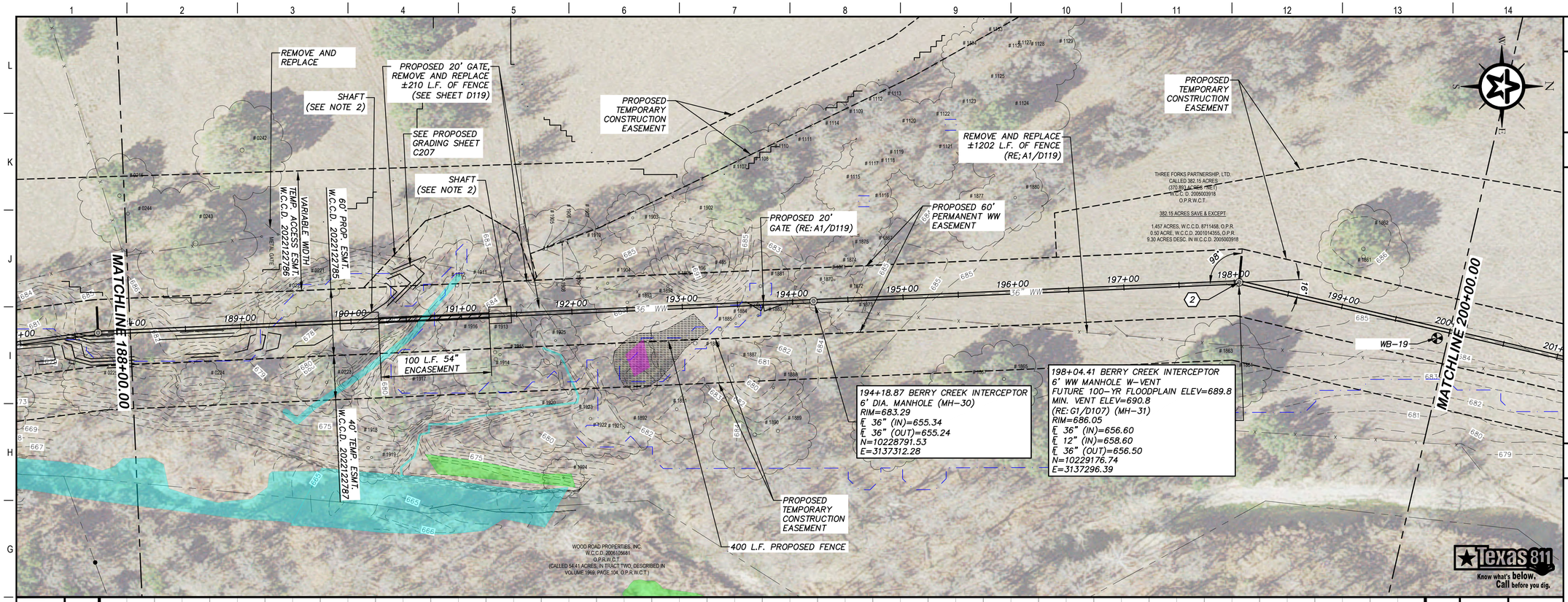
187+70.82
6' WW MANHOLE W-VENT
FUTURE 100-YR. FLOODPLAIN ELEV=688.3
MIN. VENT ELEV=689.3
(RE: G1/D107) (MH-29)
RIM=684.75
℄ 36" (IN)=653.30
℄ 12" (IN)=655.30
℄ 36" (OUT)=653.20

TRENCHLESS CONSTRUCTION ALTERNATE REACH 23 (STA. 187+70.82 TO STA. 190+25.00)

29.18 LF ~ 36" WW @ 0.30%

Texas 811 Know what's below. Call before you dig.

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\VFG - BERRY CREEK INTERCEPTOR - (3).DWG, C116 WW LINE STA. 176+00 TO 188+00, 8/14/2023 3:04:24 PM, rcuellar



KEY NOTES

1. INSTALL CONCRETE TRENCH CAP STA. 189+31 TO 189+90, 193+52 TO 193+73 (RE. DETAIL G6/D107)
2. DROP CONNECTION – PRECAST MANHOLE TYPE "C" (RE: A10/D107)

GENERAL NOTES

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LEGEND

- 5-YEAR FUTURE FLOODPLAIN
- FEMA 100-YEAR FLOODPLAIN
- N.G. ~ CENTERLINE
- WATERWAY
- WETLANDS
- PONDS

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 188+00 TO 200+00

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C117

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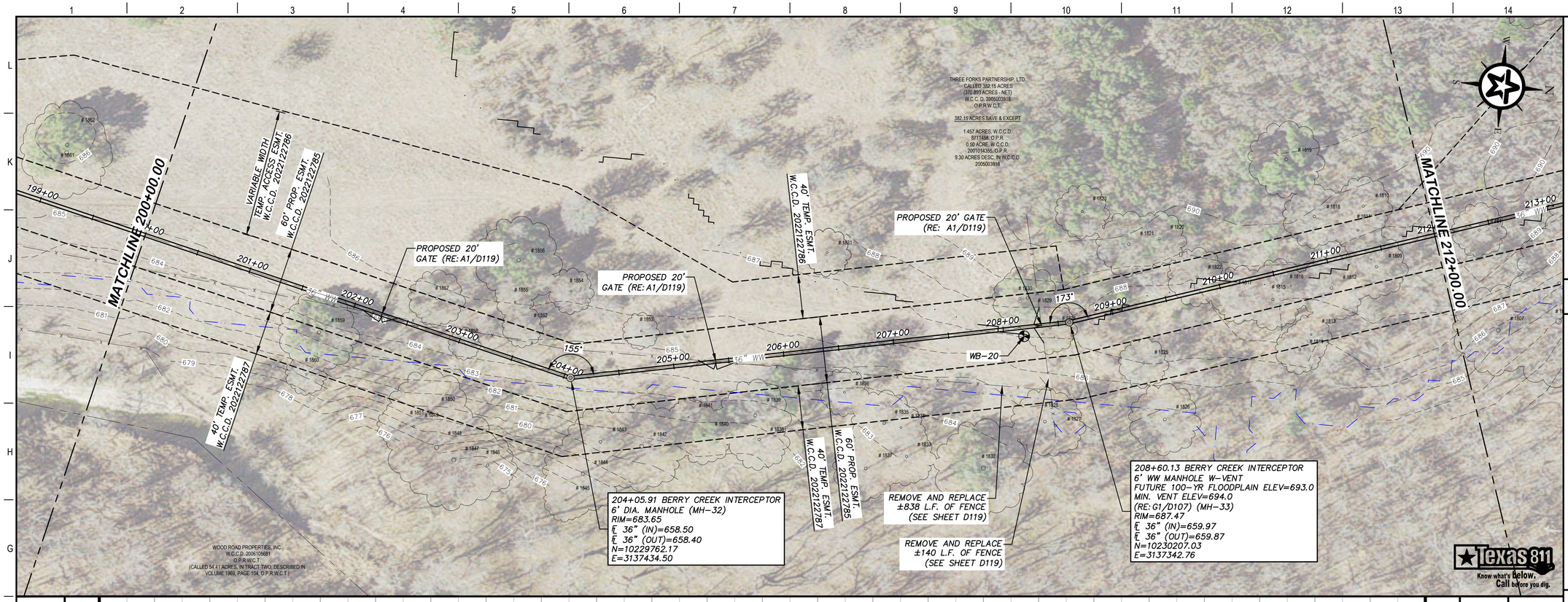

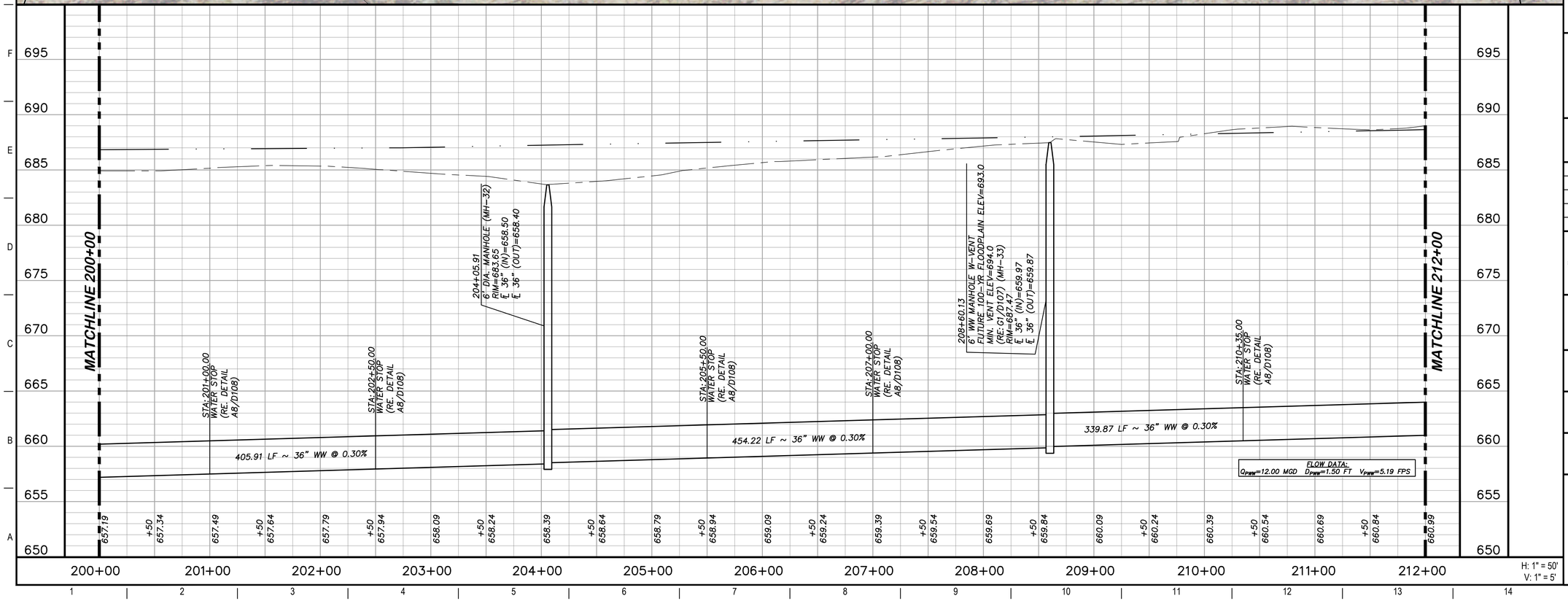

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LEGEND

5-YEAR FUTURE FLOODPLAIN
FEMA 100-YEAR FLOODPLAIN
N.G. ~ CENTERLINE

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 200+00 TO 212+00

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C118

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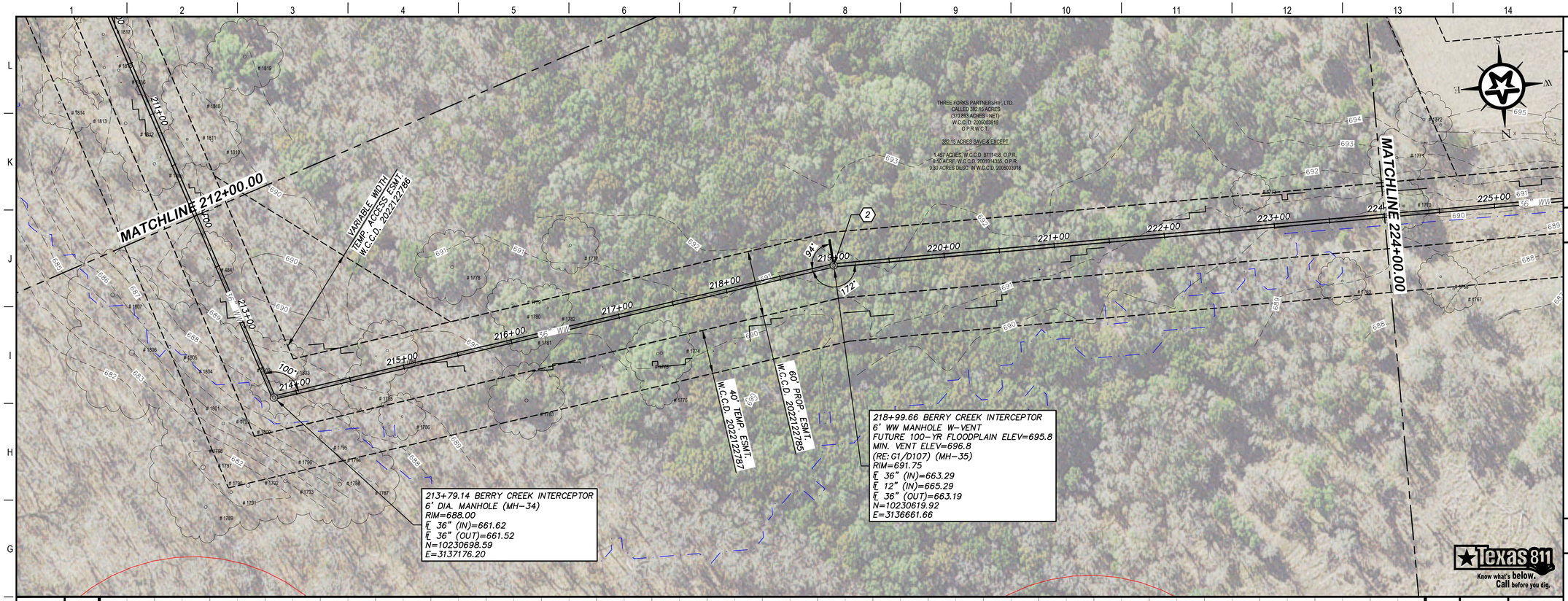

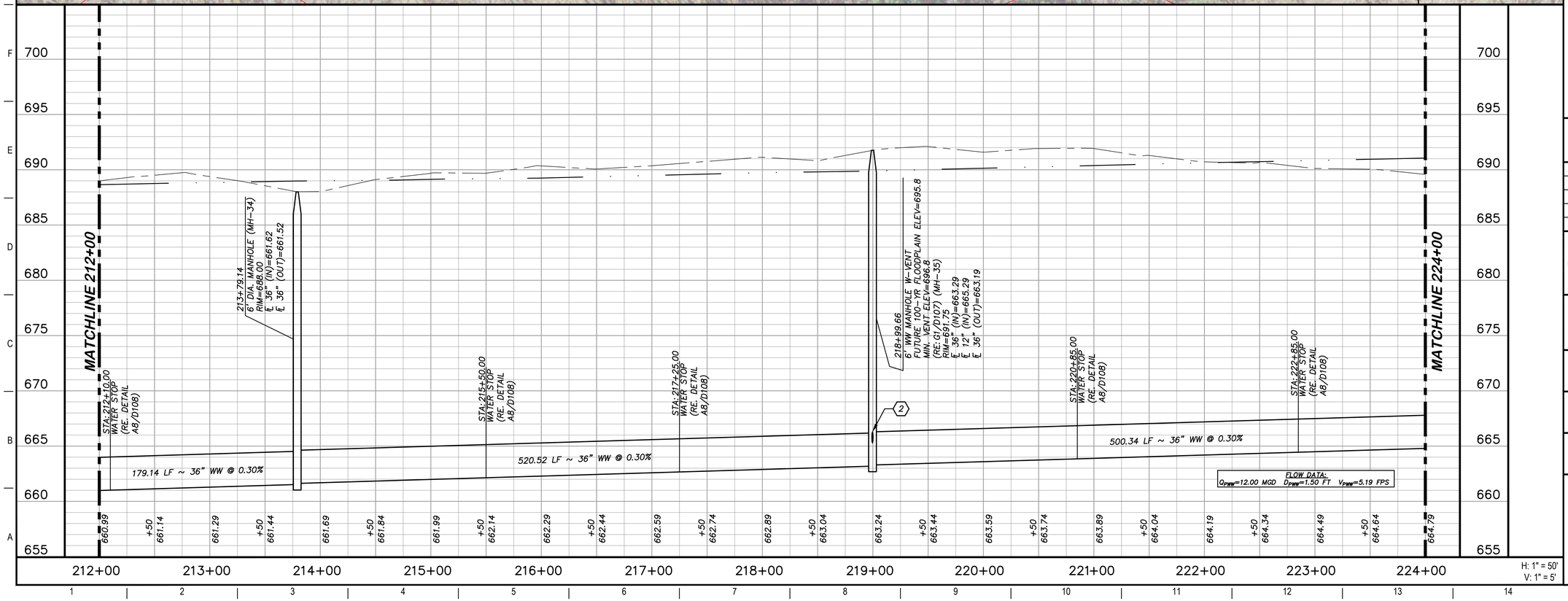

KEY NOTES

(2) DROP CONNECTION – PRECAST MANHOLE TYPE "C" (RE: A10/D107)

GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
3. FOR ALL TRENCHLESS WORK REFER TO SHEET C003.
4. TRENCHLESS CONSTRUCTION UNDER FM971 MAY BE INSTALLED BY HAND TUNNELING PER SPEC SECTION 33 30 04.
5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

5-YEAR FUTURE FLOODPLAIN
FEMA 100-YEAR FLOODPLAIN
N.G. ~ CENTERLINE
SPRING BUFFER

0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 212+00 TO 224+00

03/31/2023
DATE
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C119

H: 1" = 50'
V: 1" = 5'

Texas 811 Know what's below. Call before you dig.

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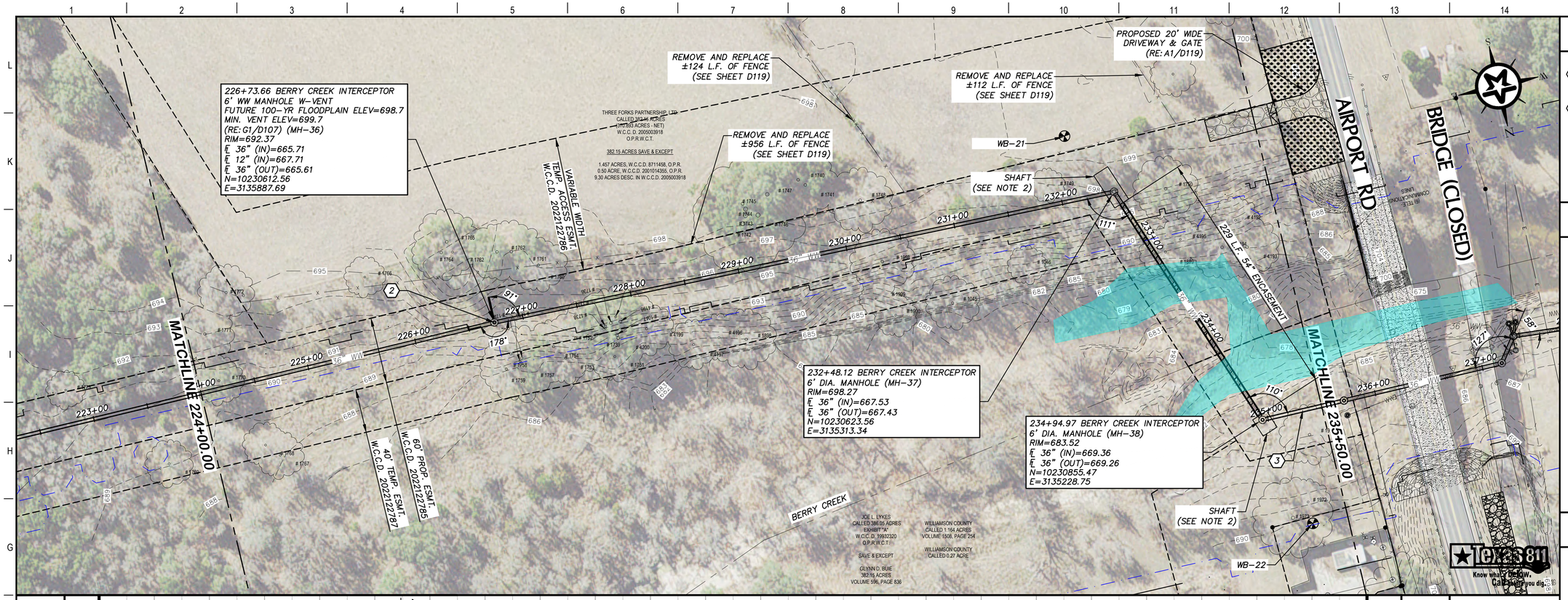
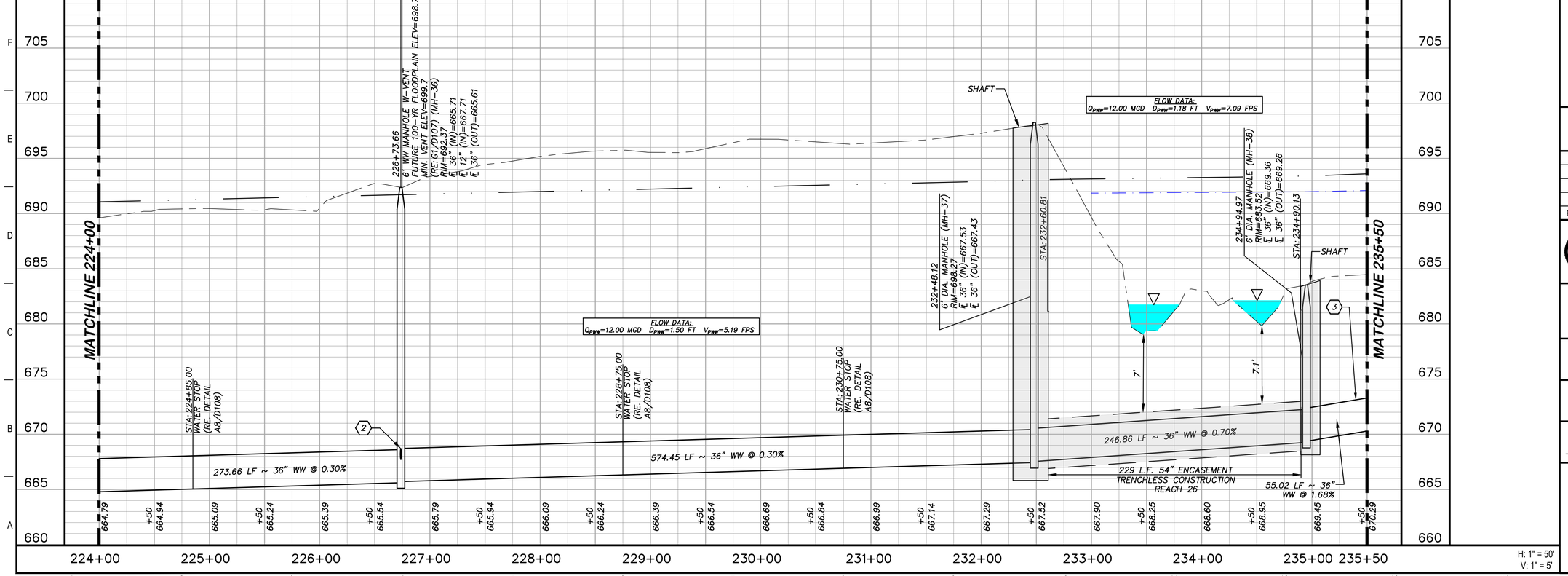




KEY NOTES

(2) DROP CONNECTION – PRECAST MANHOLE TYPE "C" (RE: A10/D107)

(3) INSTALL CONCRETE ENCASEMENT STA. 234+95 TO 235+50 (RE. DETAIL A6/D107)

GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
3. FOR ALL TRENCHLESS WORK REFER TO SHEET C003.
4. TRENCHLESS CONSTRUCTION UNDER FM971 MAY BE INSTALLED BY HAND TUNNELING PER SPEC SECTION 33 30 04.
5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

5-YEAR FUTURE FLOODPLAIN

FEMA 100-YEAR FLOODPLAIN

N.G. ~ CENTERLINE

WATERWAY

0 25 50 100

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 224+00 TO 235+50

03/31/2023
DATE

ERIC LEE NELSON

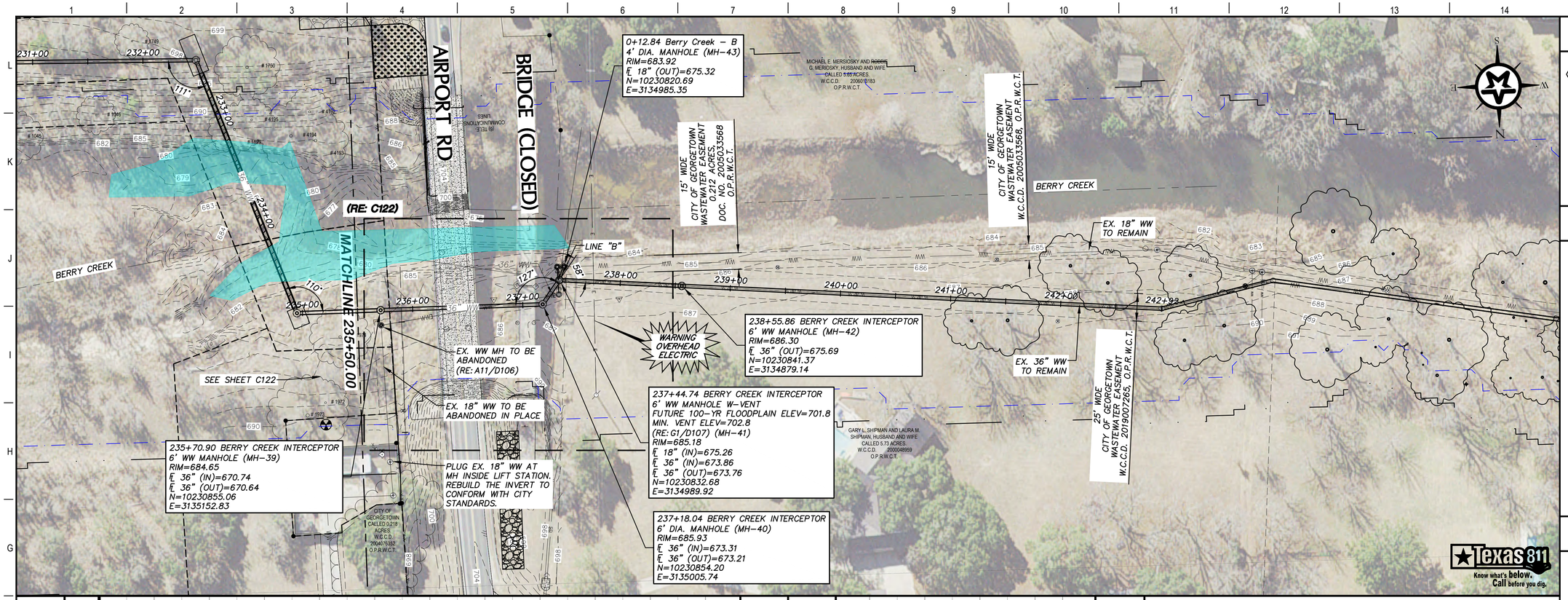
STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C120

H: 1" = 50'
V: 1" = 5'

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\VFG - BERRY CREEK INTERCEPTOR - (3).DWG, C120 WW LINE STA. 224+00 TO 235+50, 8/14/2023 3:07:18 PM, rcuellar



KEY NOTES

(3) INSTALL CONCRETE ENCASEMENT STA. 235+50 TO END (RE. DETAIL A6/D107)

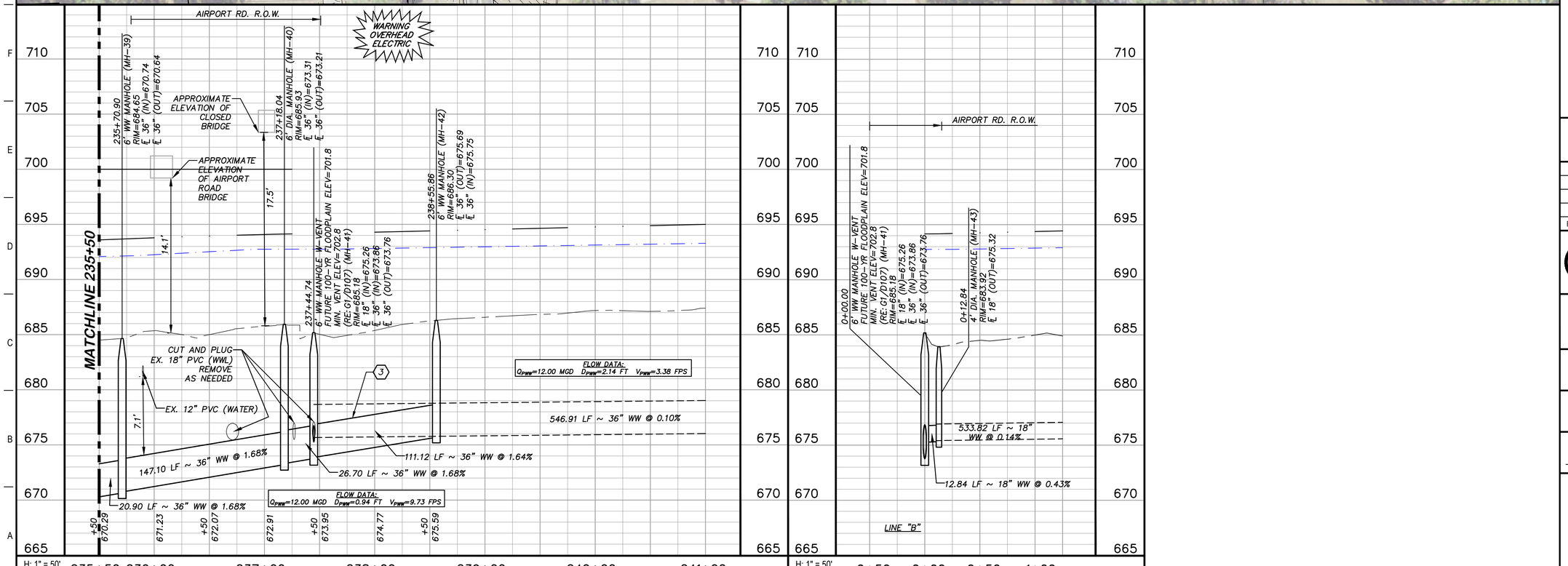
GENERAL NOTES

1. ALL MANHOLES SHALL BE WATERTIGHT, WITH WATERTIGHT RINGS AND COVERS.
2. SHAFT DIMENSIONS SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR THEIR EXACT LOCATIONS, INCLUDING LOCATIONS OF INTERMEDIATE SHAFTS, AND SELECTING DIMENSIONS TO FACILITATE UTILIZATION OF THEIR MEANS AND METHODS WITHIN THE AVAILABLE EASEMENT SHOWN AND WITHOUT CONFLICTING WITH OR IMPACTING UTILITIES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DEISGN OF THE SUPPORT OF EXCAVATION SYSTEM AND THE CONTROL OF GROUNDWATER FOR EACH SHAFT IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS.
3. FOR ALL TRENCHLESS WORK REFER TO SHEET C003.
4. TRENCHLESS CONSTRUCTION UNDER FM971 MAY BE INSTALLED BY HAND TUNNELING PER SPEC SECTION 33 30 04.
5. REFER TO ESC PLAN SHEETS FOR PLACEMENT OF LIVESTOCK FENCE.

LEGEND

5–YEAR FUTURE FLOODPLAIN
FEMA 100–YEAR FLOODPLAIN
N.G. ~ CENTERLINE
WATERWAY

Texas 811 Know what's below. Call before you dig.



0 25 50 100
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WW LINE STA. 235+50 TO END

03/31/2023
DATE

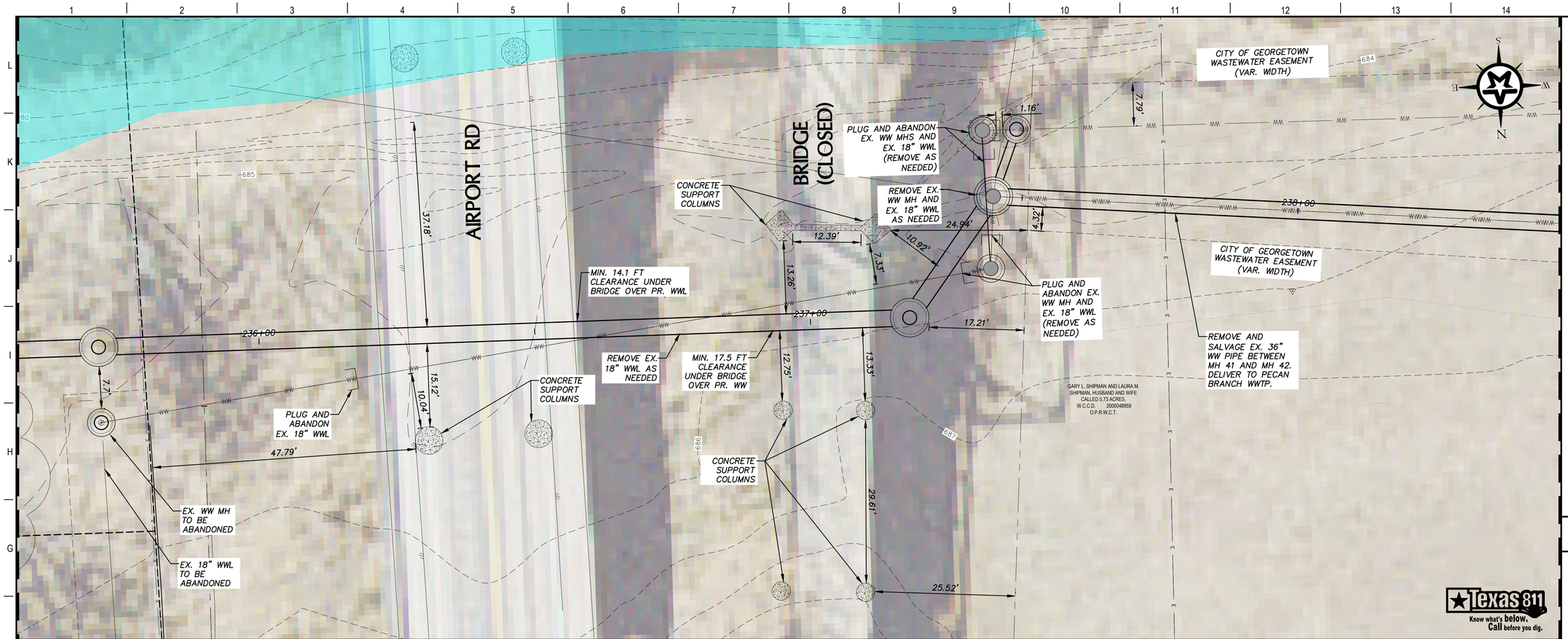
ERIC LEE NELSON

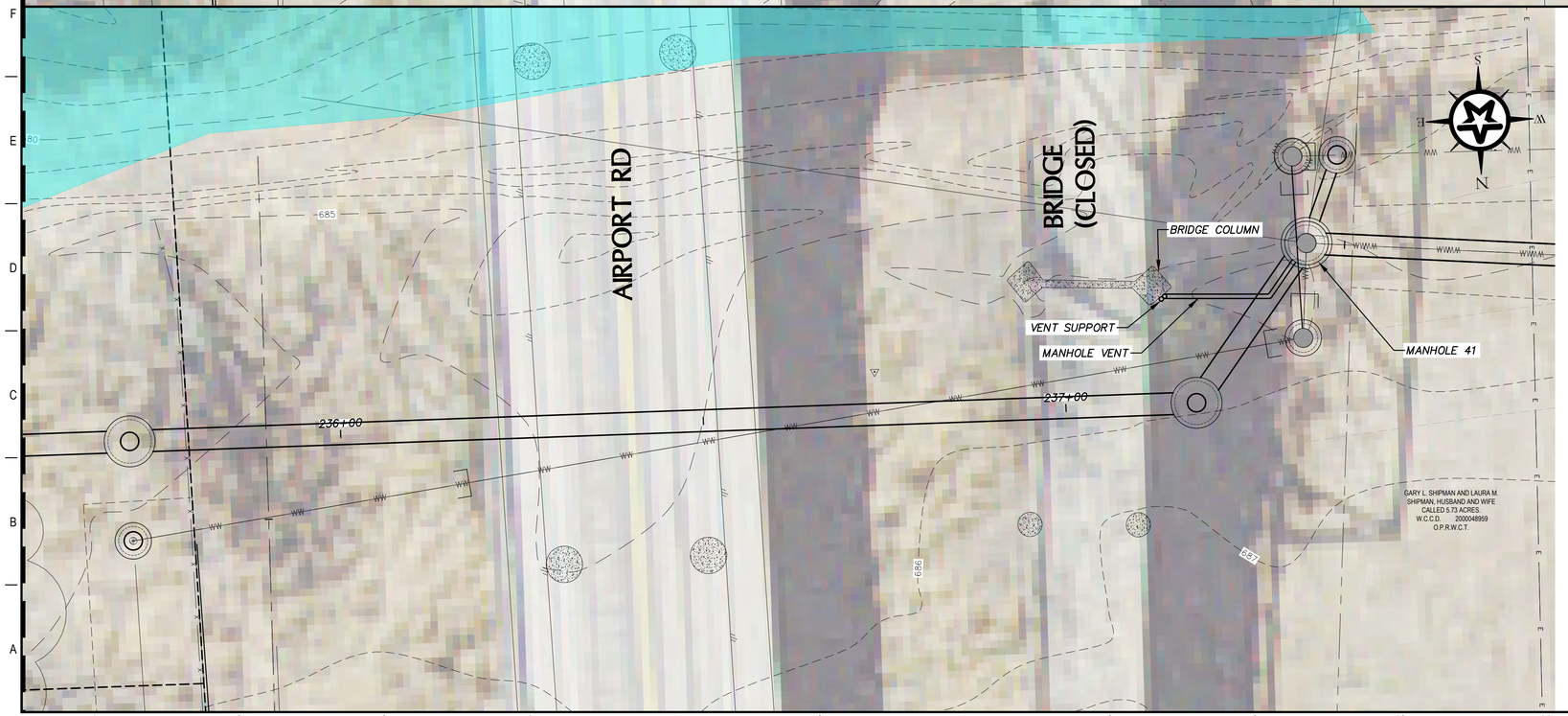
STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

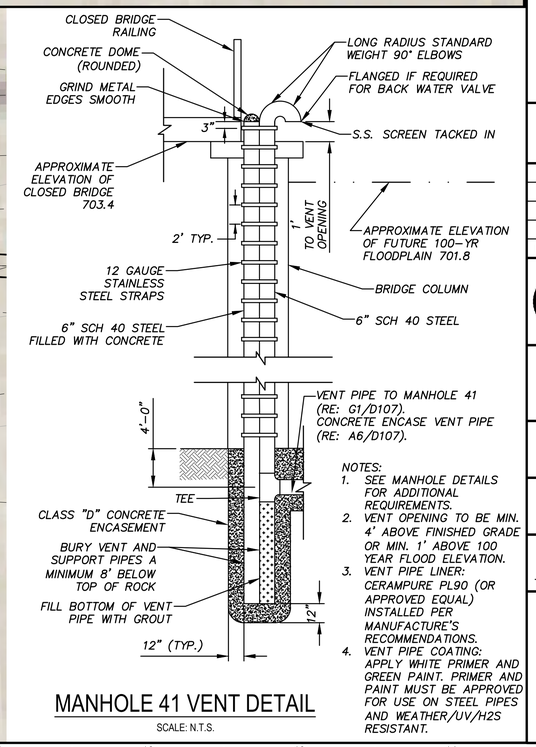
PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C121

G:\PROJECTS\3-00582\2 DESIGN\2.0 CADVFG - BERRY CREEK INTERCEPTOR - (3).DWG, C121 WW LINE STA. 235+50 TO END, 8/14/2023 3:08:09 PM, rcuellar







MANHOLE 41 VENT DETAIL

SCALE: N.T.S.

NOTES:
1. SEE MANHOLE DETAILS FOR ADDITIONAL REQUIREMENTS.
2. VENT OPENING TO BE MIN. 4' ABOVE FINISHED GRADE OR MIN. 1' ABOVE 100 YEAR FLOOD ELEVATION.
3. VENT PIPE LINER: CERAMPURE PL90 (OR APPROVED EQUAL) INSTALLED PER MANUFACTURE'S RECOMMENDATIONS.
4. VENT PIPE COATING: APPLY WHITE PRIMER AND GREEN PAINT. PRIMER AND PAINT MUST BE APPROVED FOR USE ON STEEL PIPES AND WEATHER/UV/H2S RESISTANT.

LEGEND

5-YEAR FUTURE FLOODPLAIN

FEMA 100-YEAR FLOODPLAIN

WATERWAY

0 5 10 20

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

AIRPORT ROAD PLAN VIEW

03/31/2023
DATE

ERIC LEE NELSON

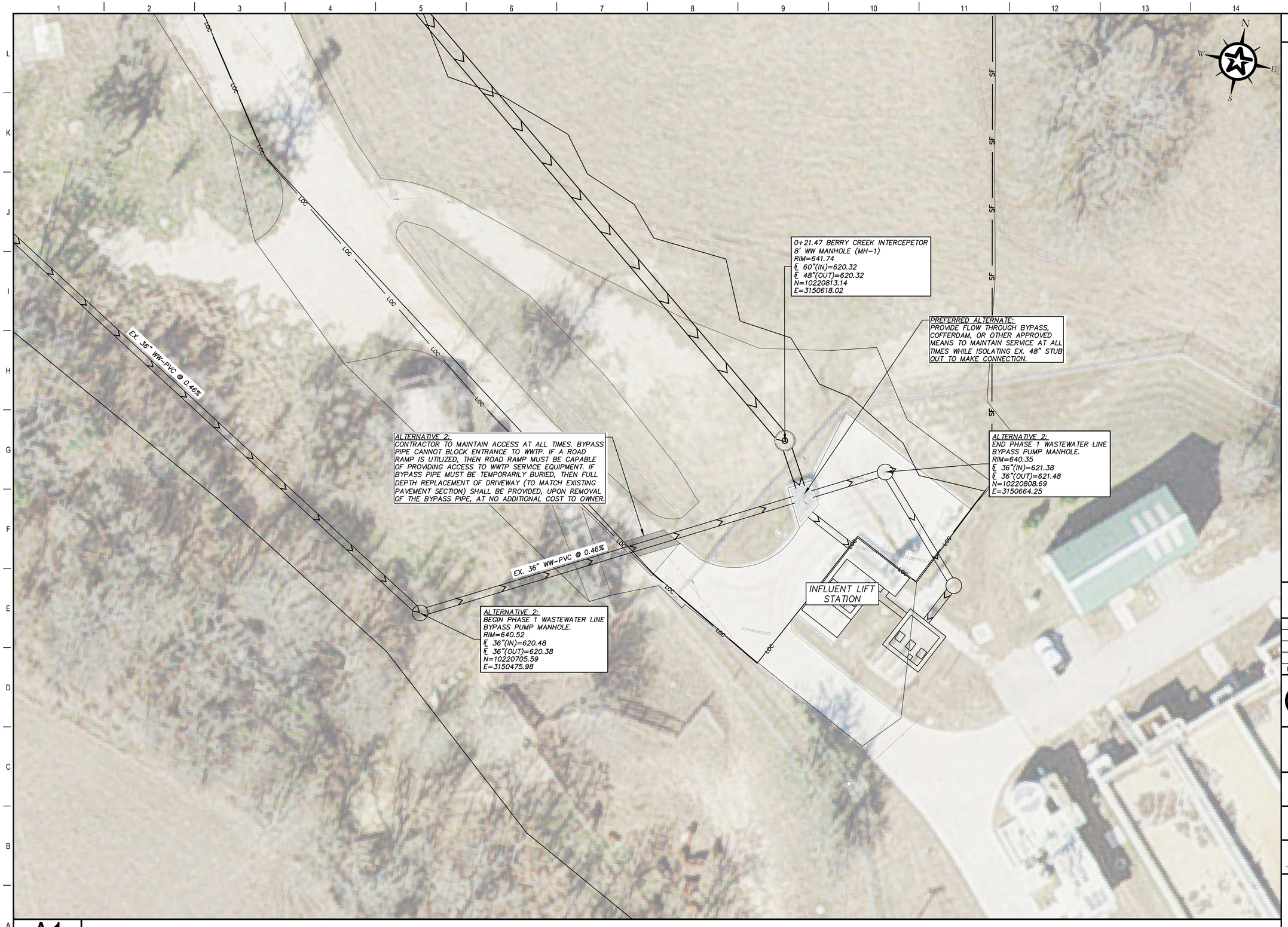
STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C122

Texas 811 Know what's below. Call before you dig.

G:\PROJECTS\3-00582\2 DESIGN\2.0 CADVFG - BERRY CREEK INTERCEPTOR - (3).DWG, AIRPORT ROAD PLAN VIEW, 8/14/2023 3:09:14 PM, rcuellar



GENERAL NOTES

1. THE BY-PASS PUMPING SYSTEM SHALL BE INSTALLED, OPERATED, MAINTAINED, AND REMOVED IN ACCORDANCE WITH THE SPECIFICATION SECTION WW3 – CONNECTIONS TO AND WORK ON THE EXISTING WASTEWATER SYSTEMS. THIS WORK SHALL BE SUBSIDIARY TO SECTION WW3.
2. CONTRACTOR TO PROVIDE BY-PASS PLANS, DETAILS, AND WRITTEN NARRATIVE TO ENGINEER FOR REVIEW AND APPROVAL AT LEAST 30 DAYS PRIOR TO COMMENCING BY-PASS SYSTEM PLAN.
3. CONTRACTOR MAY NEED TO WORK AFTER REGULAR HOURS AND DURING LOW FLOW CONDITIONS TO BEGIN BY-PASS SYSTEM PLAN. COORDINATE WITH PECAN BRANCH WASTEWATER TREATMENT PLANT OPERATORS AT LEAST 72 HOURS BEFORE BY-PASS SYSTEMS BEGINS.

GRAPHIC SCALE (FEET): 0 10 20 40

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WASTEWATER BYPASS PLAN (1 OF 2)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

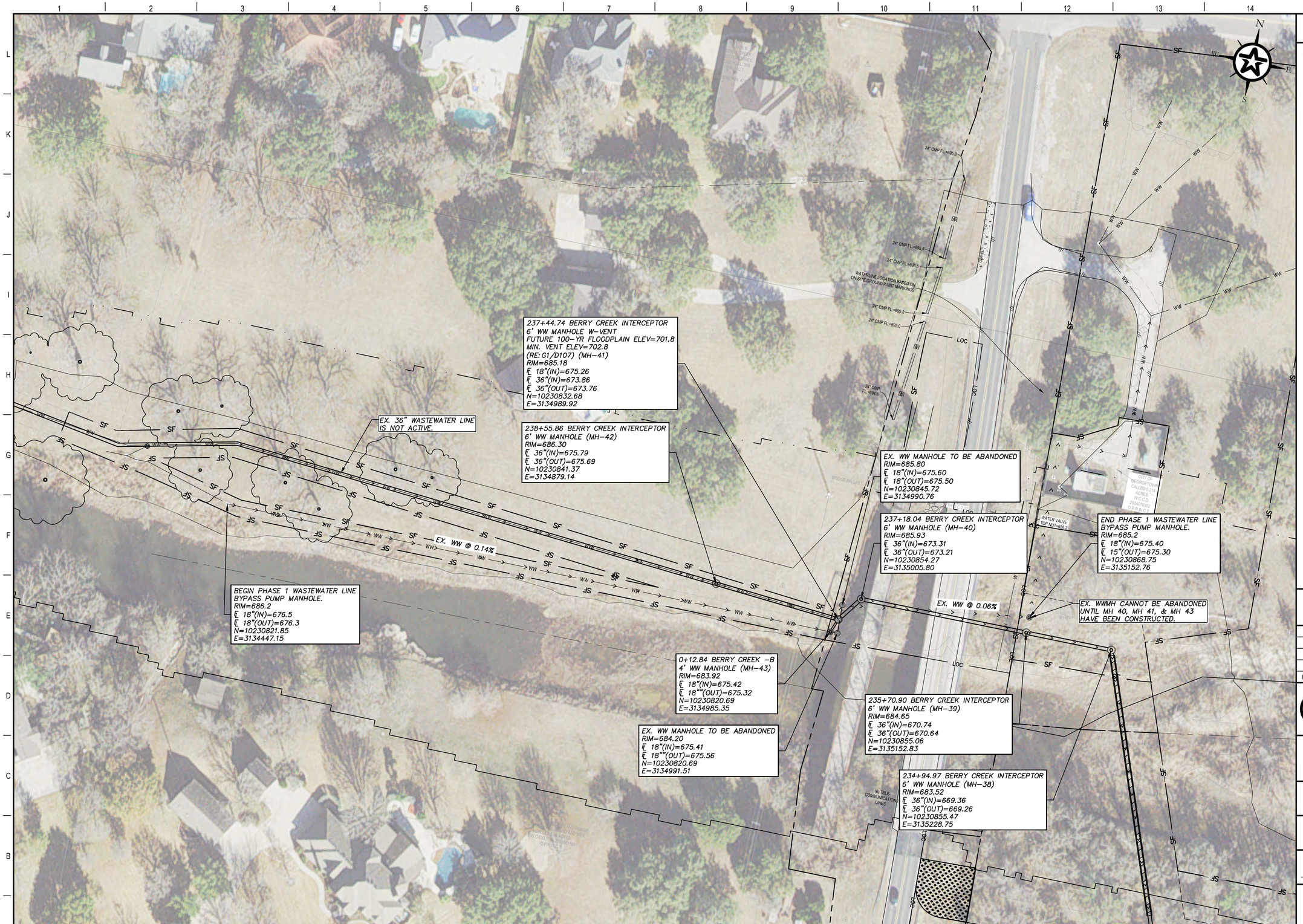
PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C123

A1
1"=20'

WASTEWATER MANHOLE BYPASS AT PECAN BRANCH WWTP

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-WW BYPASS PLAN.DWG, WASTEWATER BYPASS PLAN (1 OF 2), 8/14/2023 3:10:24 PM, rcuellar



GENERAL NOTES

1. THE BY-PASS PUMPING SYSTEM SHALL BE INSTALLED, OPERATED, MAINTAINED, AND REMOVED IN ACCORDANCE WITH THE SPECIFICATION SECTION WW3 – CONNECTIONS TO AND WORK ON THE EXISTING WASTEWATER SYSTEMS. THIS WORK SHALL BE SUBSIDIARY TO SECTION WW3.
2. CONTRACTOR TO PROVIDE BY-PASS PLANS, DETAILS, AND WRITTEN NARRATIVE TO ENGINEER FOR REVIEW AND APPROVAL AT LEAST 30 DAYS PRIOR TO COMMENCING BY-PASS SYSTEM PLAN.
3. CONTRACTOR MAY NEED TO WORK AFTER REGULAR HOURS AND DURING LOW FLOW CONDITIONS TO BEGIN BY-PASS SYSTEM PLAN. COORDINATE WITH AIRPORT ROAD LIFT STATION OPERATORS AT LEAST 72 HOURS BEFORE BY-PASS SYSTEMS BEGINS.

0 20 40 80
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WASTEWATER BYPASS PLAN (2 OF 2)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

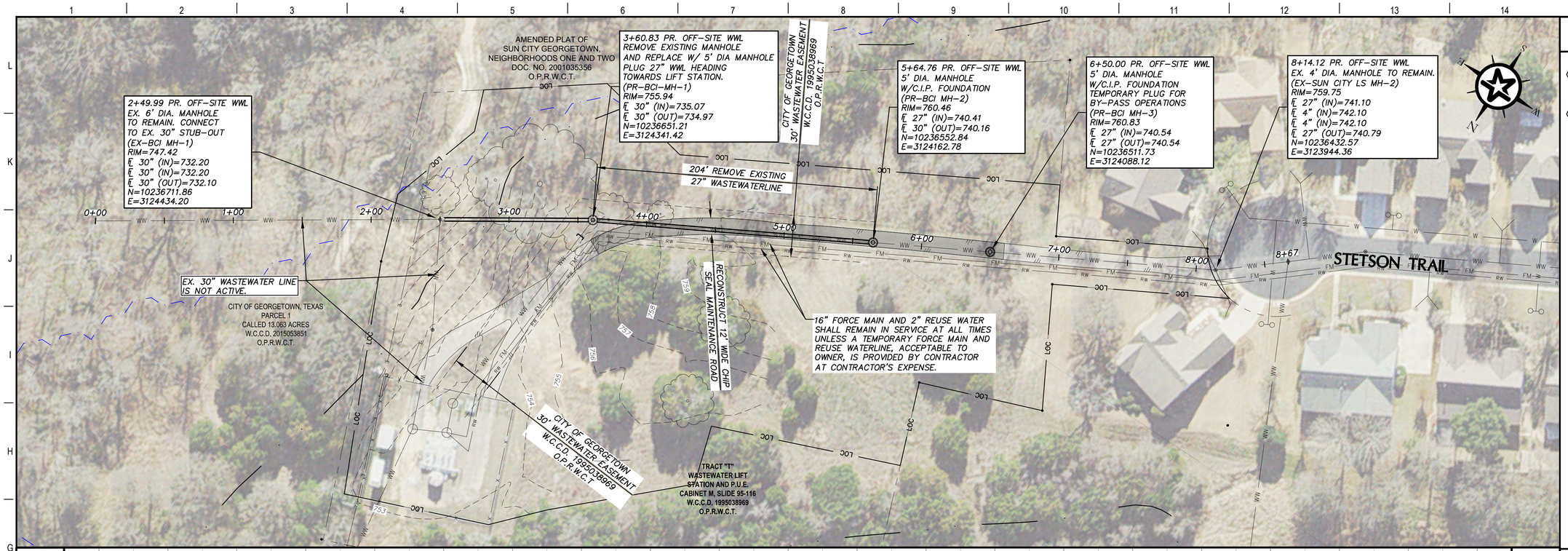
PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

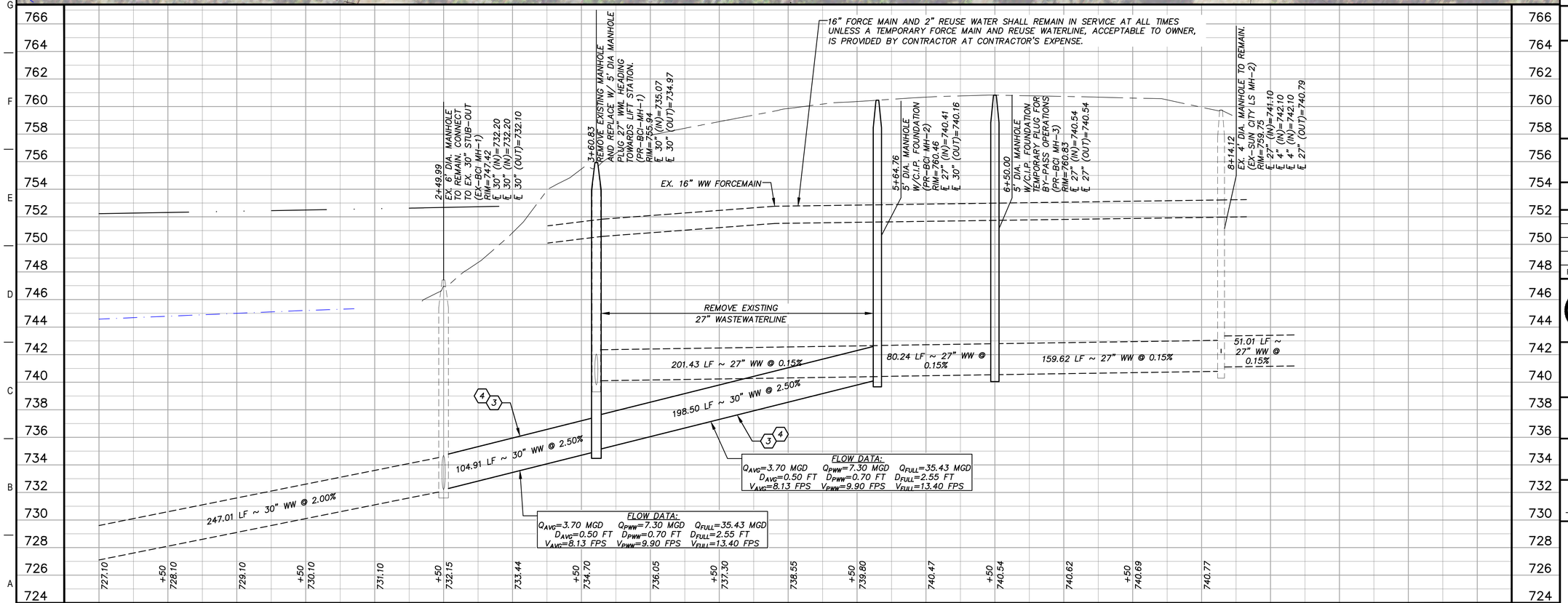
DRAWING NO.
C124

A1
1"=40'

WASTEWATER MANHOLE BYPASS AT END OF PROJECT

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-WW BYPASS PLAN.DWG, C124 WASTEWATER BYPASS PLAN (2 OF 2), 8/14/2023 3:10:55 PM, rcuellar





KEY NOTES

(3) INSTALL CONCRETE ENCASEMENT STA. 2+49.99 TO 5+64.76 (RE: DETAIL A6/D107)

(4) SANITARY SEWER PIPE, UNLESS OTHERWISE SPECIFIED ON THE PLANS SHALL BE CCFRPM-ASTM D3262-SN 72

LEGEND

5-YEAR FUTURE FLOODPLAIN

FEMA 100-YEAR FLOODPLAIN

N.G. ~ CENTERLINE

0 20 40 80

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

OFF SITE WASTEWATER INTERCEPTOR CONNECTION

08/14/2023
DATE

TRISTAN A. ROBLES

STATE OF TEXAS
TRISTAN A. ROBLES
145927
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	JB
PROJECT NO.	3-00582

DRAWING NO.
C125

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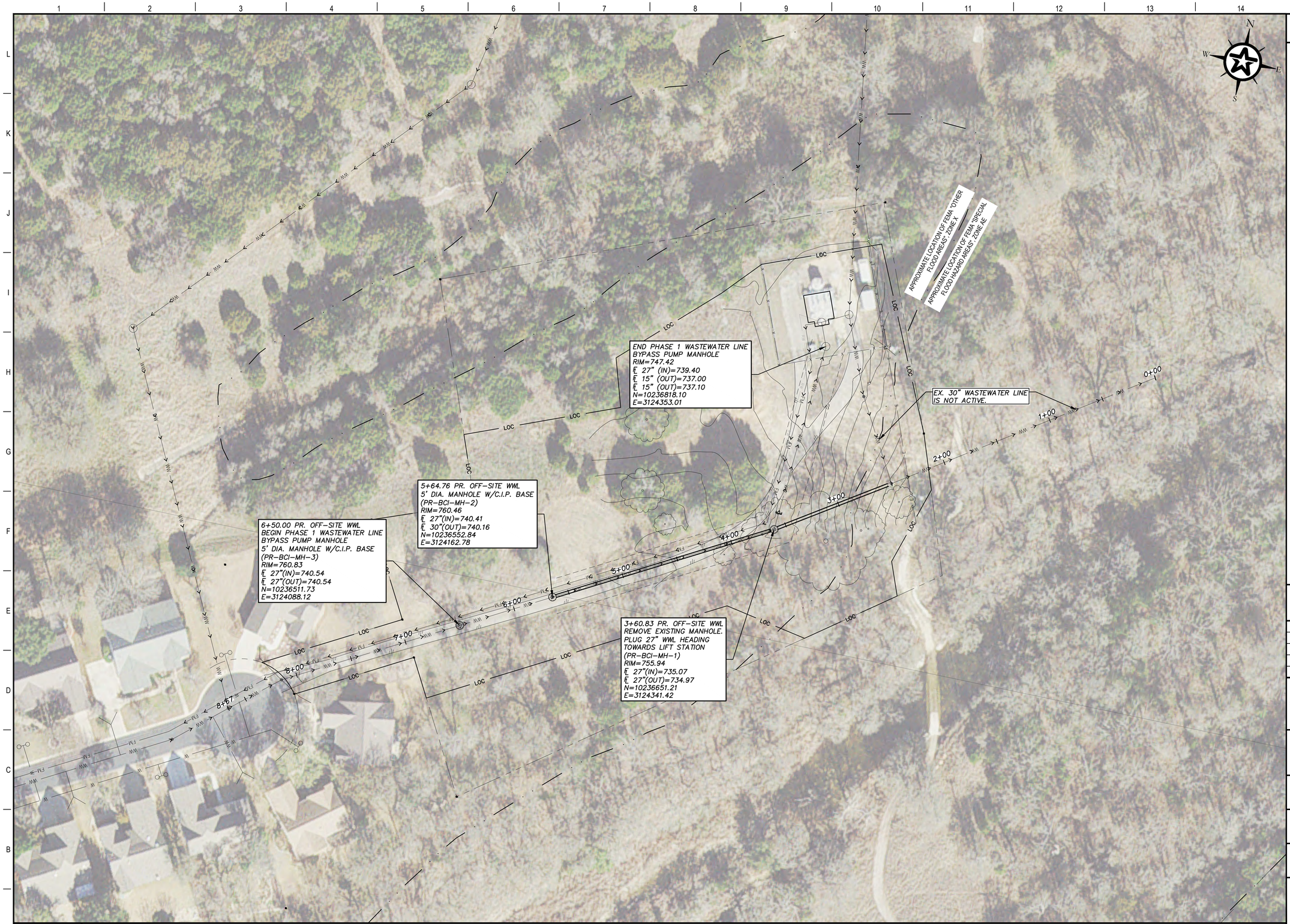

GENERAL NOTES

1. THE BY-PASS PUMPING SYSTEM SHALL BE INSTALLED, OPERATED, MAINTAINED, AND REMOVED IN ACCORDANCE WITH THE SPECIFICATION SECTION WW3 – CONNECTIONS TO AND WORK ON THE EXISTING WASTEWATER SYSTEMS. THIS WORK SHALL BE SUBSIDIARY TO SECTION WW3.
2. CONTRACTOR TO PROVIDE BY-PASS PLANS, DETAILS, AND WRITTEN NARRATIVE TO ENGINEER FOR REVIEW AND APPROVAL AT LEAST 30 DAYS PRIOR TO COMMENCING BY-PASS SYSTEM PLAN.
3. CONTRACTOR MAY NEED TO WORK AFTER REGULAR HOURS AND DURING LOW FLOW CONDITIONS TO BEGIN BY-PASS SYSTEM PLAN. COORDINATE WITH SUN CITY LIFT STATION OPERATORS AT LEAST 72 HOURS BEFORE BY-PASS SYSTEMS BEGINS.

0 20 40 80
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

OFF-SITE WASTEWATER BYPASS PLAN

08/14/2023
DATE

TRISTAN A. ROBLES

STATE OF TEXAS
TRISTAN A. ROBLES
145927
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	JB
PROJECT NO.	3-00582

DRAWING NO.
C126

A1
1"=40'

WASTEWATER MANHOLE BYPASS AT SUN CITY LIFT STATION

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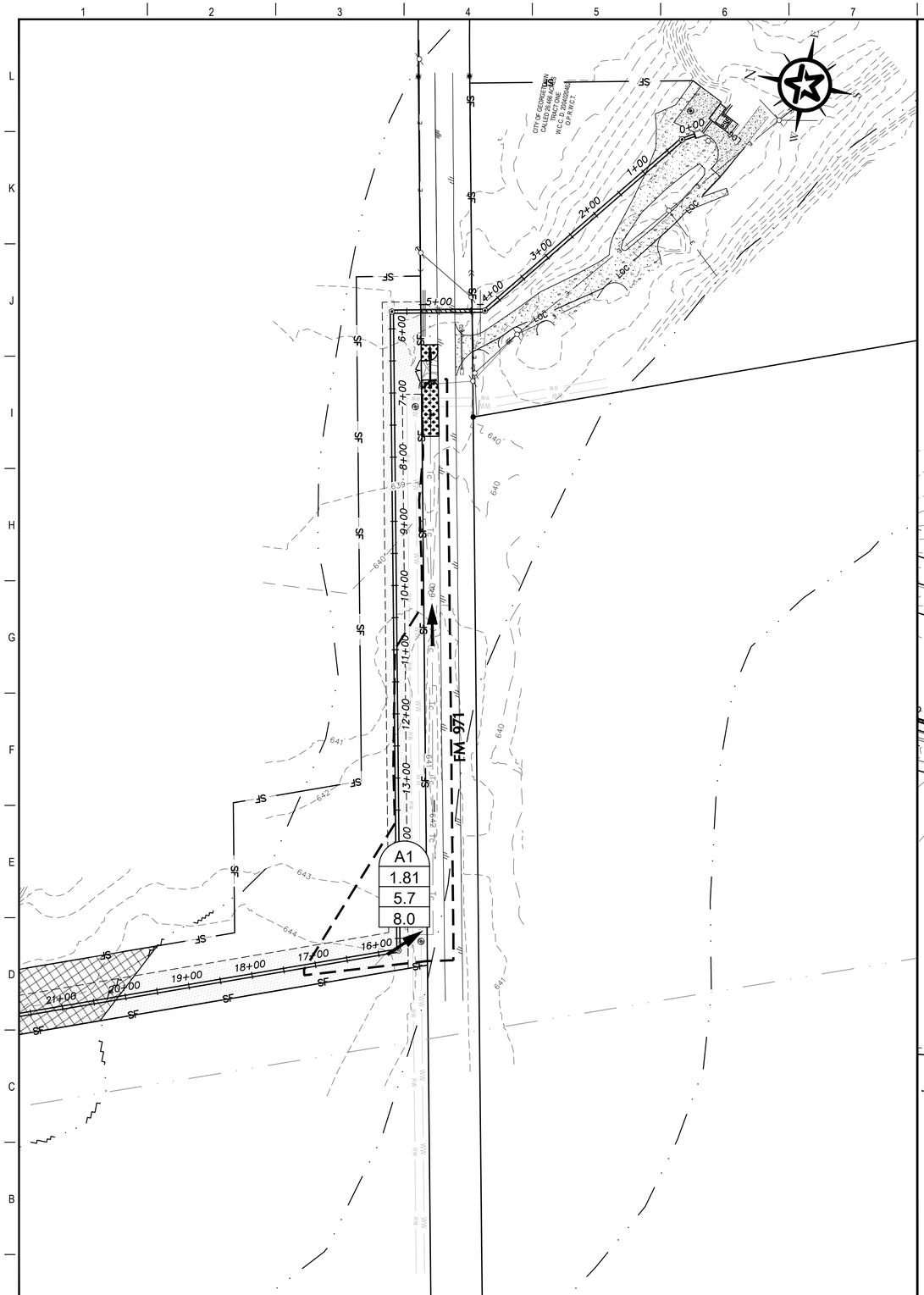

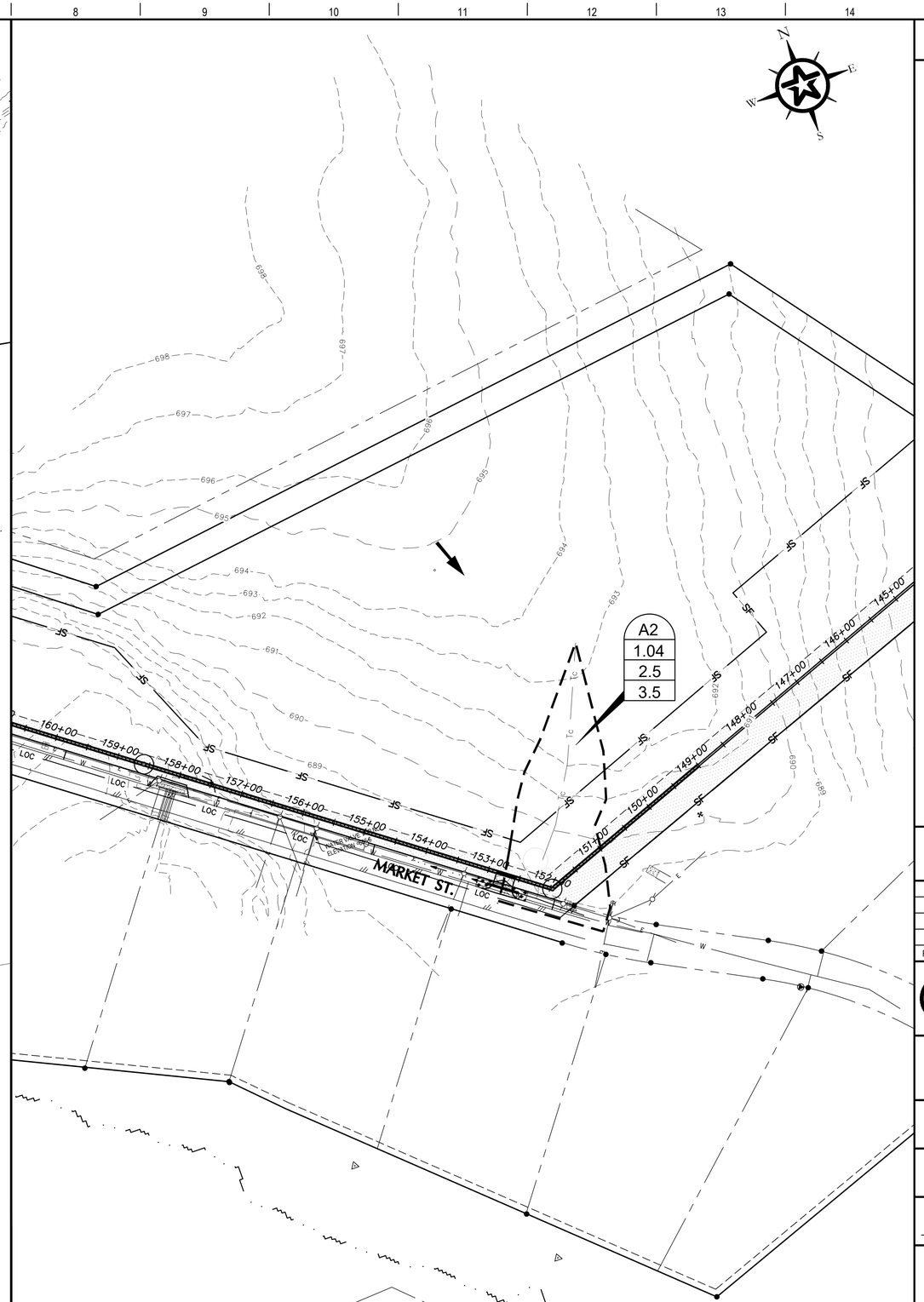

DRAINAGE LEGEND

BOUNDARY DESCRIPTIONS

- DRAINAGE AREA BOUNDARY
- A1 — MAJOR TRIBUTARY
- FEMA 100–YR FLOODPLAIN

SUB-AREA DESCRIPTION

A 1 a
- DRAINAGE SUB–AREA ID
- DRAINAGE AREA ID
- DRAINAGE BASIN ID

SUB-AREA LABELS

A3	DRAINAGE AREA DESIGNATION
0.19	AREA IN ACRES
0.8	"Q" DESIGN STORM (25–YR) (CFS) RATIONAL METHOD
1.1	"Q" DESIGN STORM (100–YR) (CFS) RATIONAL METHOD

0 50 100 200
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

DRAINAGE AREA MAP

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C200

A1 DRAINAGE AREA A1
1"=100'
CULVERT - FM 971

A8 DRAINAGE AREA A2
1"=100'
CULVERT - MARKET ST.

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-CULVERT DAM.DWG, DRAINAGE AREA MAP, 8/15/2023 8:16:01 AM, rcuellar

TIME OF CONCENTRATION - TC EQUATIONS COME FROM COG DCM			
	OVERLAND SHEET FLOW (t_1)	SHALLOW CONCENTRATED FLOW (t_2)	OPEN CHANNEL OR STORM SEWER FLOW (t_3)	TOTAL TIME OF CONCENTRATION (Tc)
			$t_3 = L/(60*V)$ COG DCM Eq. 3-4	$Tc = t_1 + t_2 + t_3$
	$t_1 = (1/42)*L*n*S^{-0.5}$ COG DCM Eq. 3-2	$t_2 = Ln/(60*s^{0.5})$ COG DCM Eq. 3-3	$tc=0.0078*[L^{0.77}/S^{0.385})$ Kirpich Eq.	

TIME OF CONCENTRATIONS - EXISTING DRAINAGE AREA MAP

	OVERLAND SHEET FLOW (t_1)					SHALLOW CONCENTRATED FLOW (t_2)				OPEN CHANNEL OR STORM SEWER FLOW (t_3)							TOTAL TIME OF CONCENTRATION (Tc)
AREA	LENGTH (FEET)	SELECTED LENGTH (FT)	SLOPE (FT/FT)	n	t_1 (OVER) (MIN)	LENGTH (FEET)	SLOPE (FT/FT)	n	t_2 (SHALLOW) (MIN)	TYPE OF CHANNEL	LENGTH (FEET)	SLOPE (FT/FT)	n	R_H (ft)	VELOCITY (FT/S)	t_3 (FLOW) (MIN)	TOTAL Tc (MIN)
Culvert FM 971 - A1	106	106	0.019	0.3	5.4929					Grass lined	901	0.005	0.030		1.3288	11.3013	**16.7942**
Culvert Market St. - A2	187	187	0.006	0.3	17.2440												**28.3657**
	98	98	0.021	0.3	4.8305	75	0.013	0.3	3.2890								
						45	0.011	0.3	2.1453	Grass lined	40	0.008	0.03		0.7779	0.8570	

MANNINGS "n" FOR OVERLAND & SHALLOW CONCENTRATED FLOW	
0.016	CONCRETE (ROUGH OR SMOOTHED FINISH)
0.02	ASPHALT
0.10	0-50% vegetated ground cover, remaining bare soil or rock outcrops, minimum brush or tree cover
0.20	0-50% vegetated ground cover, remaining bare soil or rock outcrops, minimum brush or tree cover
0.30	100% vegetated ground cover, meduim-dense grasses (lawns, grassy fields etc.) medium brush or tree cover.
0.60	100% vegetated ground cover,with areas of heacy vegetation (parks, green-belts, riparian areas etc.) dense under-growth with medium to heav tree growth

I1 PROPOSED TIME OF CONCENTRATION CALCULATIONS

RATIONAL METHOD OUTPUT

				RUNOFF COEFFICIENTS COMPOSITE VALUES COG DCM TABLE 3-1				INTENSITY (IN/HR) COG DCM TABLE 3-5 IDF CURVE COEFFICIENTS INTO EQ. 2-1: (i = a/(t+b)^c)				FLOWS (CFS) RATIONAL METHOD COG DCM EQ. 3-1: Q=CiA			
AREA	AREA (FT^2)	AREA (ACRES)	T_c (MIN)	2-YR	10-YR	25-YR	100-YR	2-YR I (IN/HR)	10-YR I (IN/HR)	25-YR I (IN/HR)	100-YR I (IN/HR)	2-YR Q (FT^3/S)	10-YR Q (FT^3/S)	25-YR Q (FT^3/S)	100-YR Q (FT^3/S)
Culvert FM 971 - A1	78,659	1.81	16.79	0.36	0.41	0.45	0.52	4.38	6.05	7.06	8.65	2.9	4.5	5.7	8.0
Culvert MARKET ST - A2	45,119	1.04	28.37	0.33	0.38	0.42	0.49	3.35	4.76	5.61	6.94	1.2	1.9	2.5	3.5

CITY OF GEORGETOWN DRAINAGE CRITERIA MANUAL TABLE 3-3 IDF EQUATION COEFFICIENTS

	2yr	10yr	25yr	100yr
a	106.29	96.84	111.07	129.03
b (MIN)	16.810	15.880	17.230	17.830
c (IN)	0.9076	0.7952	0.7815	0.7625

EQUATION: i = a/(t+b)^c
i=INCHES PER HOUR
t=STORM DURATION IN MINUTES

F1 PROPOSED RATIONAL METHOD CALCULATIONS

Crossing Summary Table -Proposed Driveway Culverts (HY-8)						
	Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	DWY Culvert Size (in)	DWY Culvert Discharge (cfs)	Driveway Discharge (cfs)
Culvert FM 971 - A1	638.33	2YR	2.90	15	2.90	0.00
	638.67	10YR	4.50		4.50	0.00
	638.97	25YR	5.70		5.70	0.00
	639.43	100YR	8.00		7.20	0.80
	639.33	Overtopping	6.89		6.89	Overtopping
Culvert MARKET ST - A2	688.20	2YR	1.20	2-12	1.20	0.00
	688.33	10YR	1.90		1.90	0.00
	688.43	25YR	2.50		2.50	0.00
	688.58	100YR	3.50		3.50	0.00
	688.59	Overtopping	3.58		3.58	Overtopping

A1 PROPOSED CULVERT CALCULATIONS

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

DRAINAGE & CULVERT CALCULATIONS

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C201

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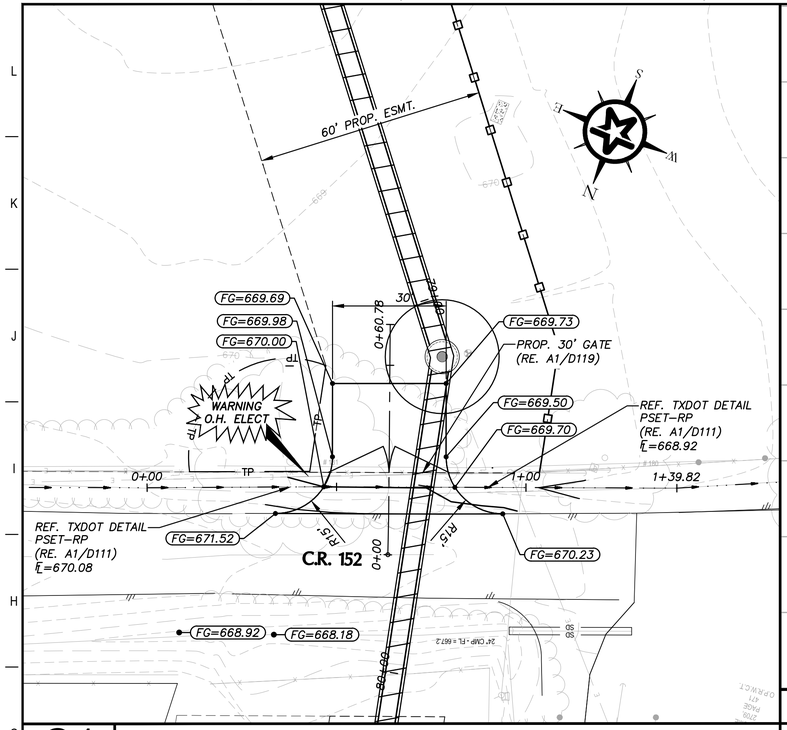
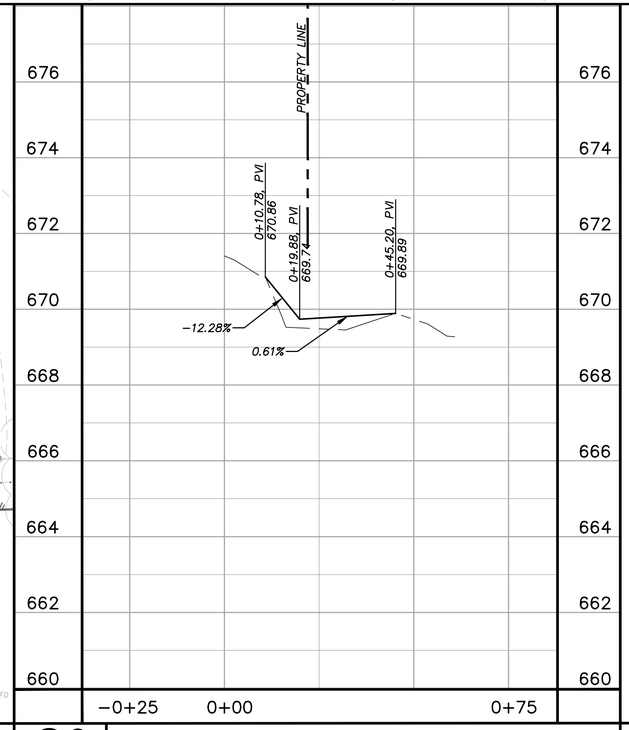




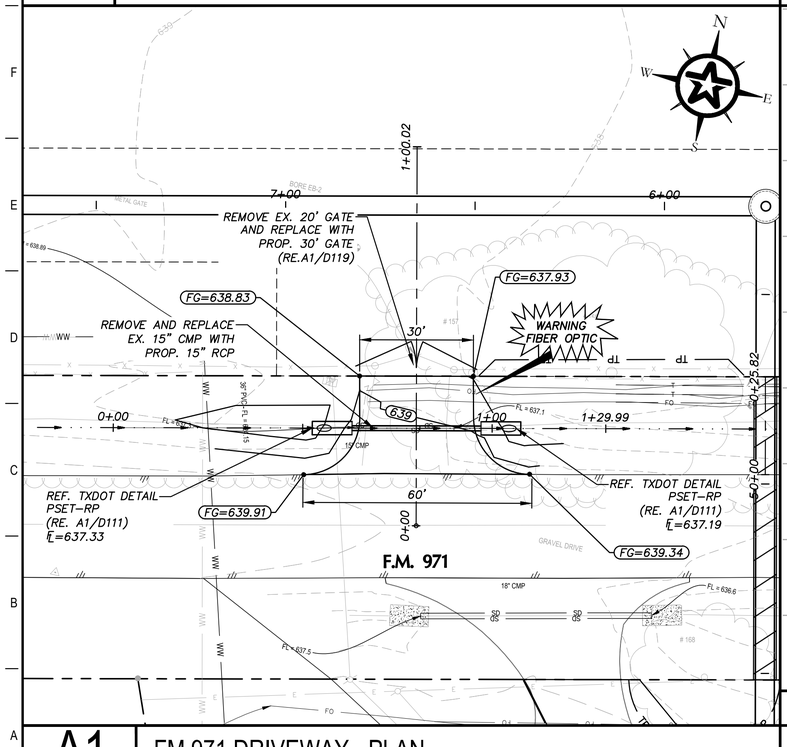
G1 CR 152 DRIVEWAY - PLAN

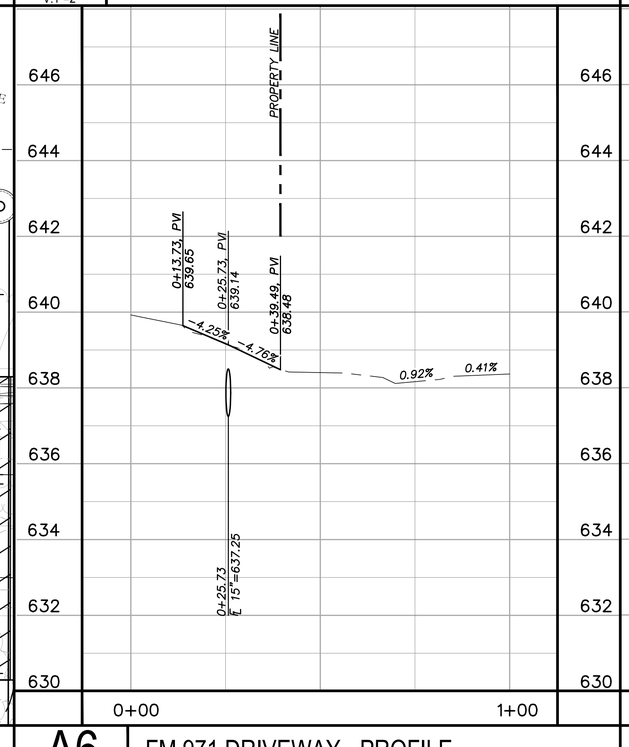
1"=20'

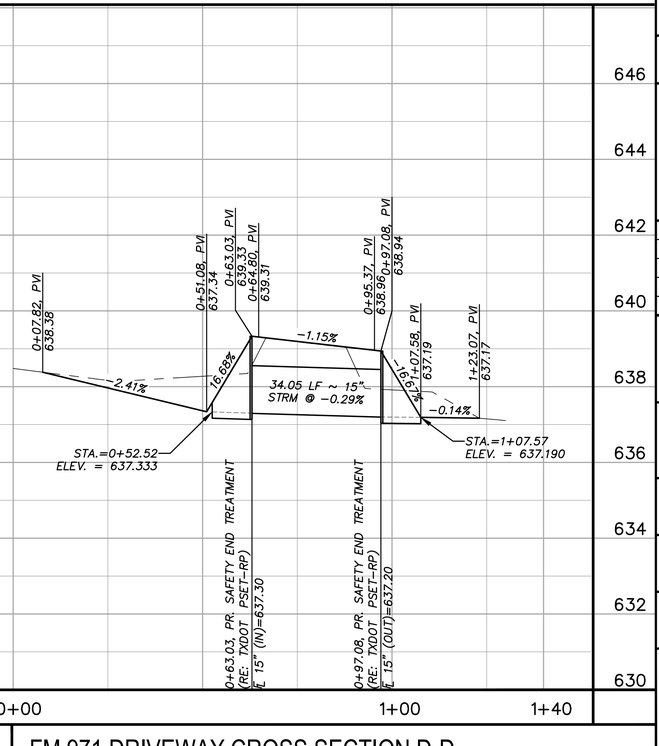
G6 CR 152 DRIVEWAY - PROFILE

H:1"=20'
V:1"=2'

G10 NOT USED







A1 FM 971 DRIVEWAY - PLAN

1"=20'

A6 FM 971 DRIVEWAY - PROFILE

H:1"=20'
V:1"=2'

A10 FM 971 DRIVEWAY CROSS SECTION D-D

H:1"=20'
V:1"=2'

LEGEND

FLOW ARROWS

PROFILE LEGEND

EXISTING GROUND ~ CENTERLINE

PROPOSED GROUND ~ CENTERLINE

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 6053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

DRIVEWAY PLAN & PROFILES (1 OF 2)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C202

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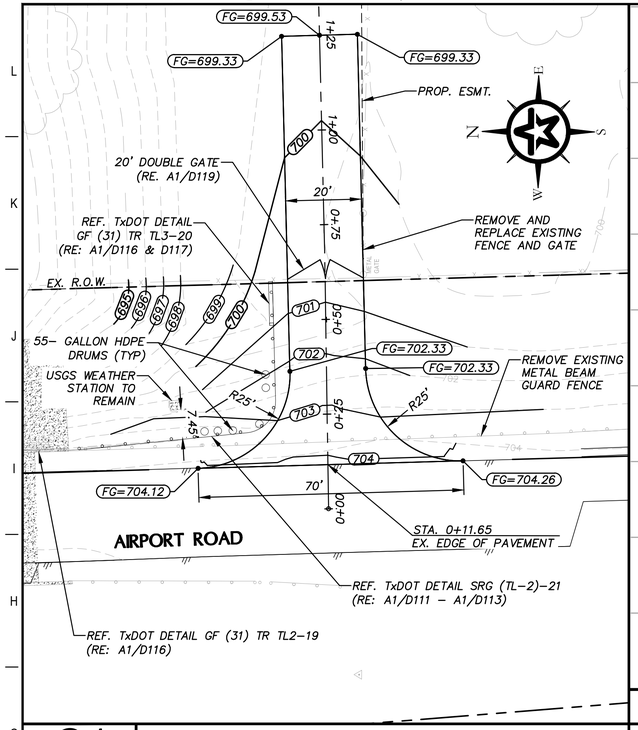
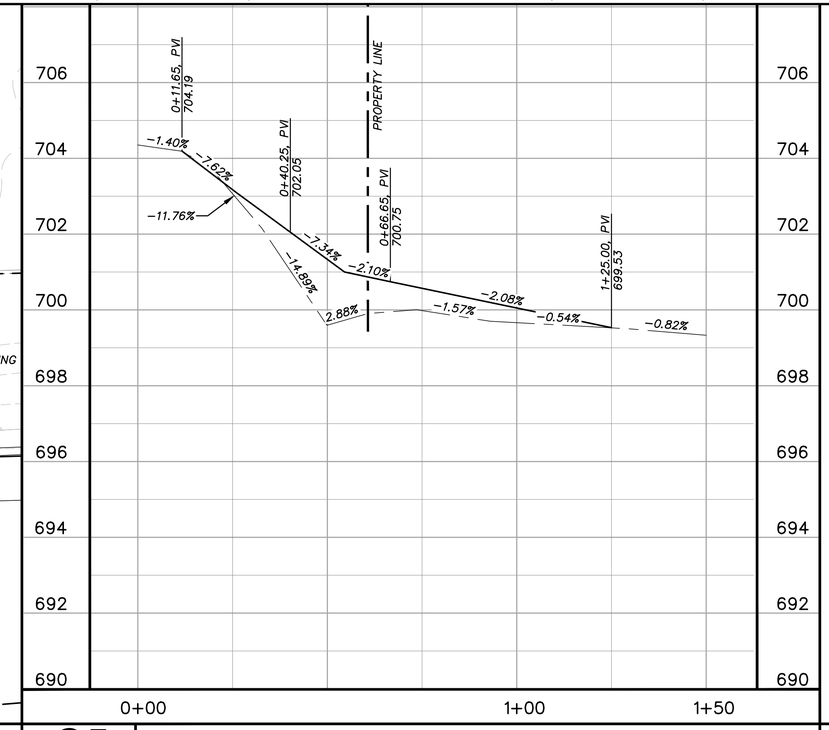
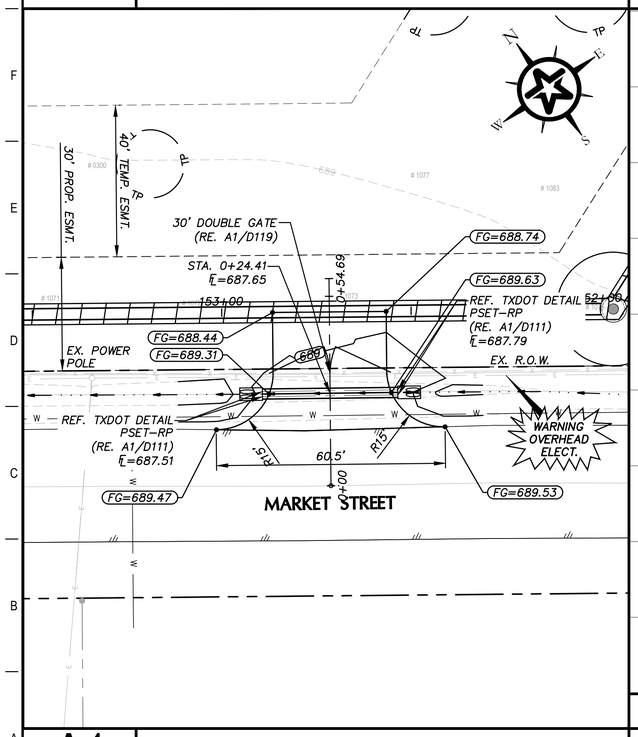


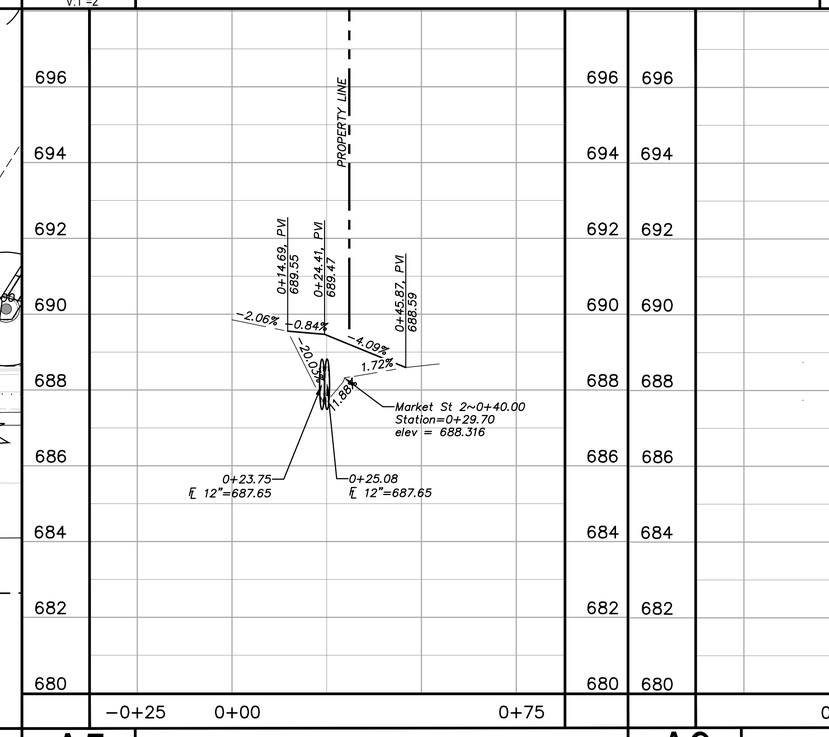


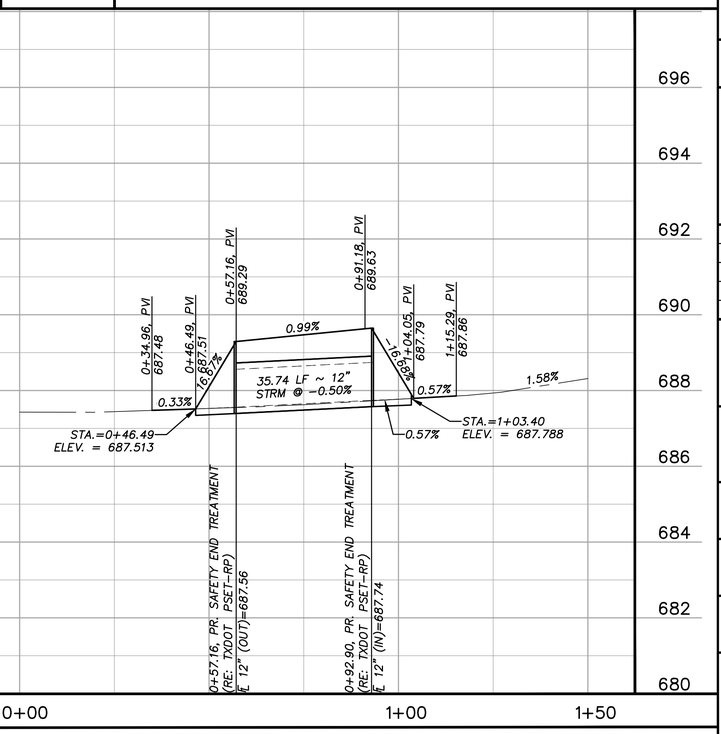
G1	AIRPORT ROAD DRIVEWAY - PLAN
1"=20'	

G5	AIRPORT ROAD DRIVEWAY - PROFILE
H:1"=20' V:1"=2'	

G9	NOT USED







A1	MARKET STREET DRIVEWAY - PLAN
1"=20'	

A5	MARKET STREET DRIVEWAY - PROFILE
H:1"=20' V:1"=2'	

A9	MARKET STREET DRIVEWAY CROSS SECTION
H:1"=20' V:1"=2'	

LEGEND

FLOW ARROWS

PROFILE LEGEND

EXISTING GROUND ~ CENTERLINE

PROPOSED GROUND ~ CENTERLINE

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 6053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

DRIVEWAY PLAN & PROFILES (2 OF 2)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C203

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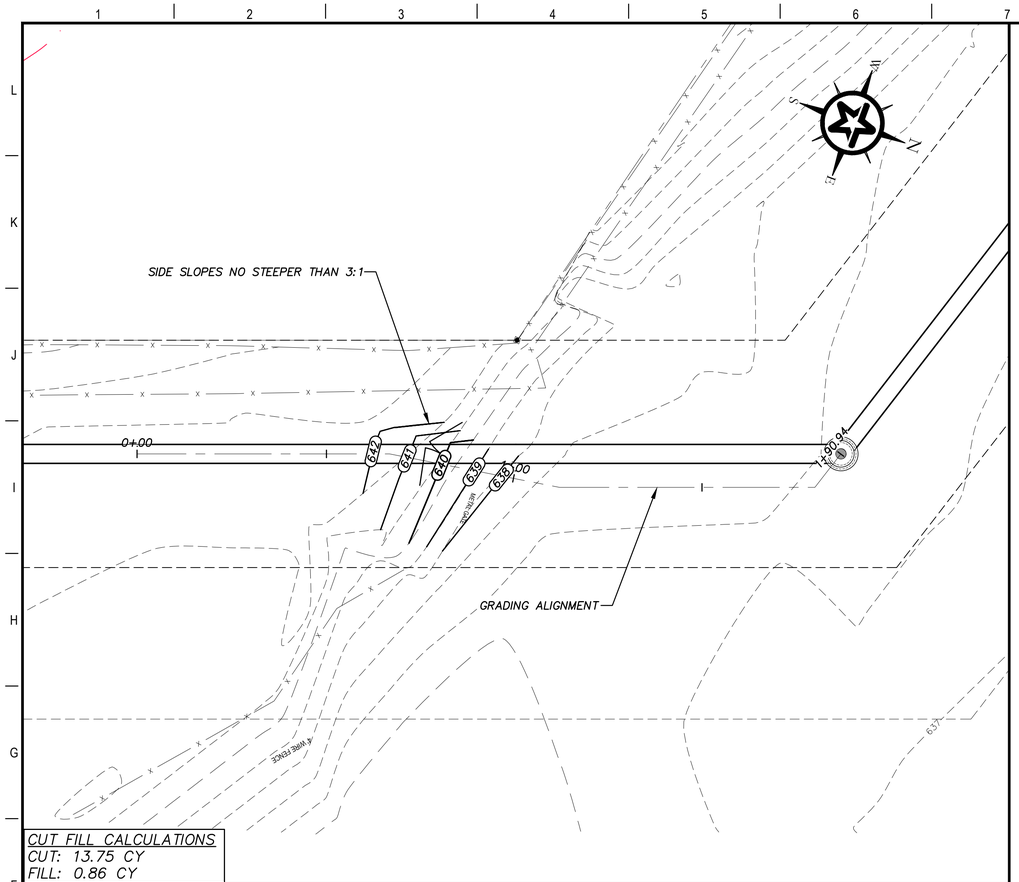
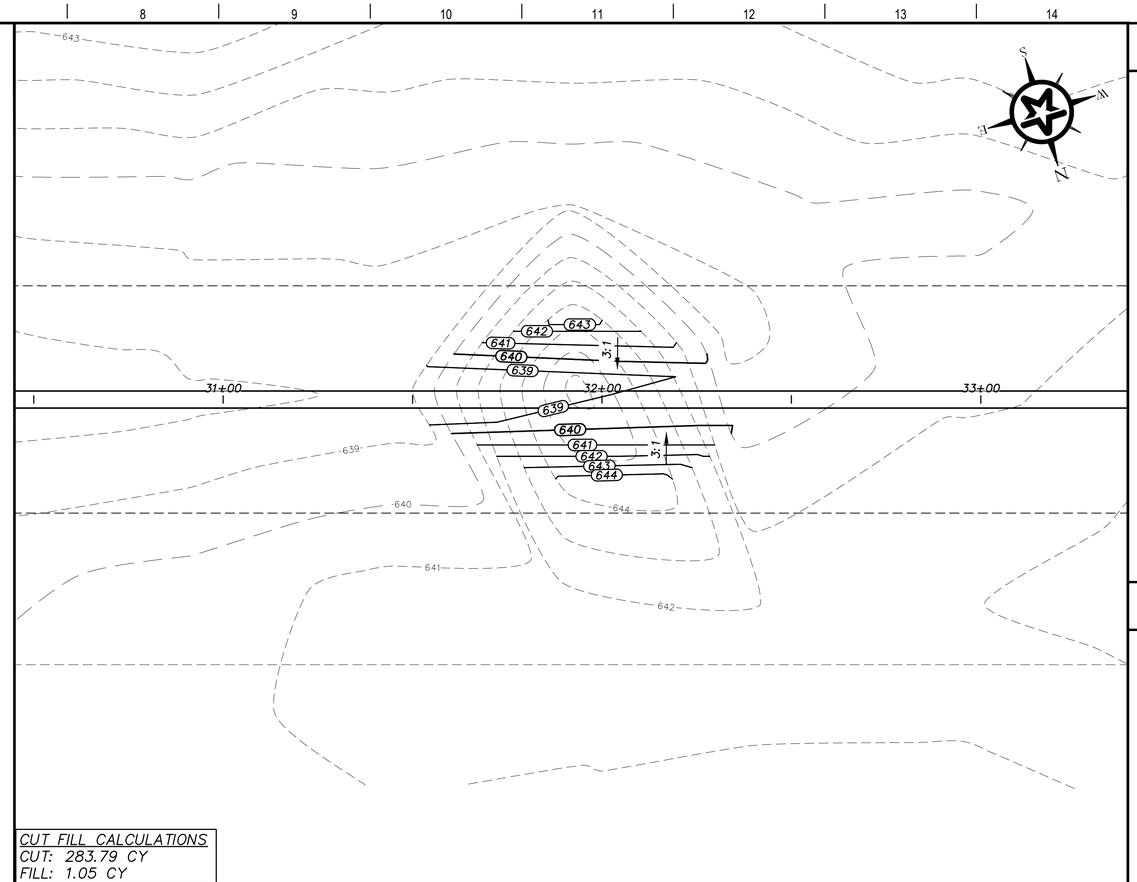
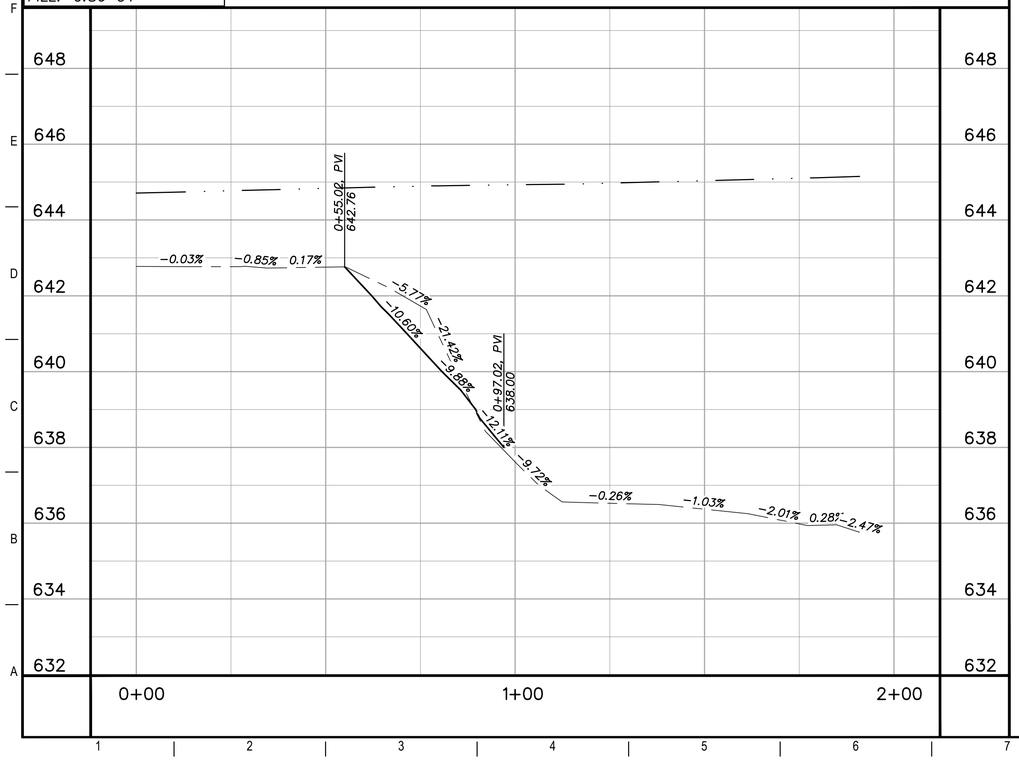
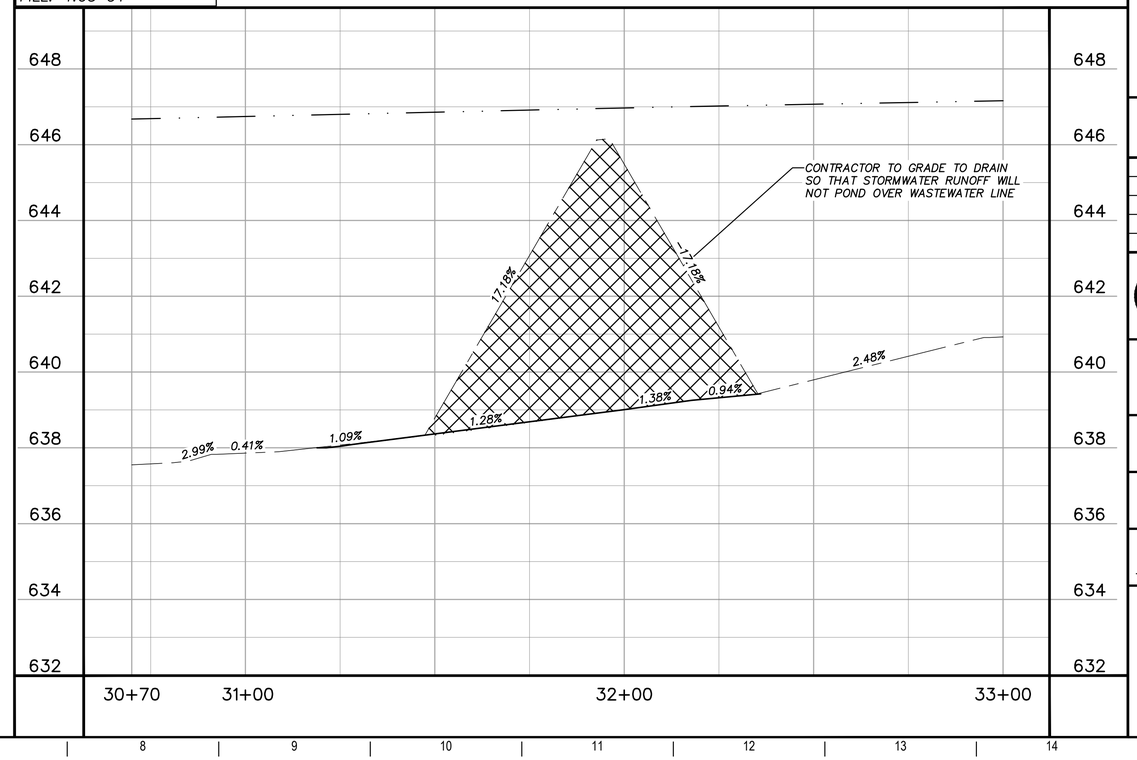


CUT FILL CALCULATIONS
CUT: 13.75 CY
FILL: 0.86 CY



CUT FILL CALCULATIONS
CUT: 283.79 CY
FILL: 1.05 CY





GENERAL NOTES

1. ALL FILL MATERIAL USED WITHIN THE FEMA 100-YR FLOODPLAIN SHALL BE WITH MATERIAL EXCAVATED WITHIN THE FLOODPLAIN.

LEGEND

FEMA 100-YEAR FLOODPLAIN

N.G. ~ CENTERLINE

667 EXISTING CONTOUR LABEL

667 PROPOSED CONTOUR LABEL

WETLANDS

WATERWAYS

0 10 20 40
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

GRADING PLAN & PROFILES (1 OF 4)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C204

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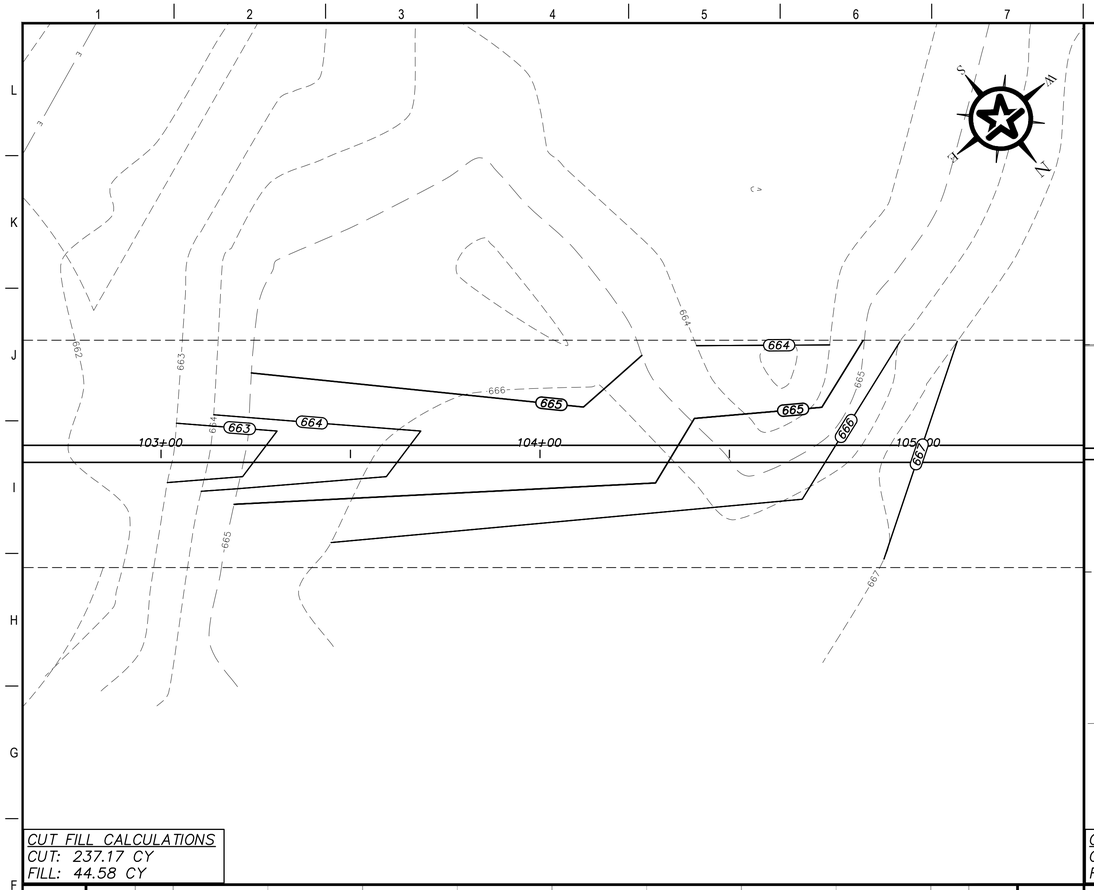

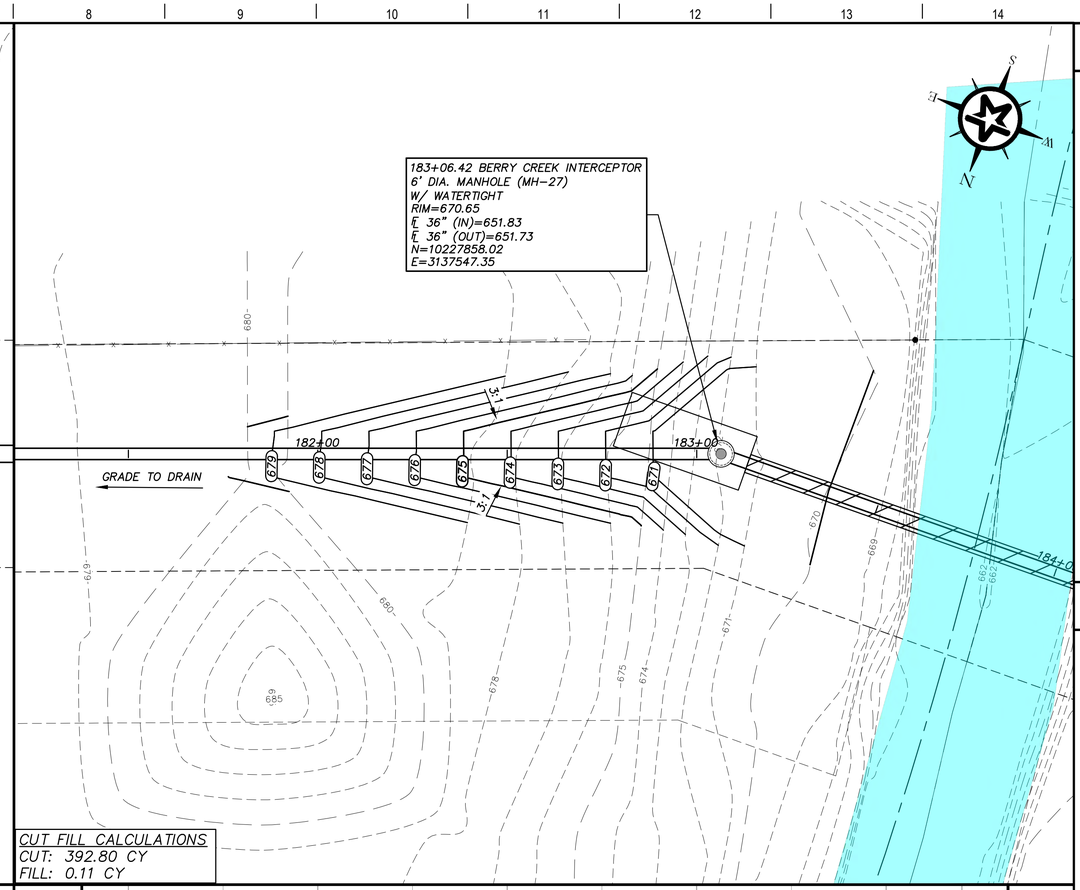

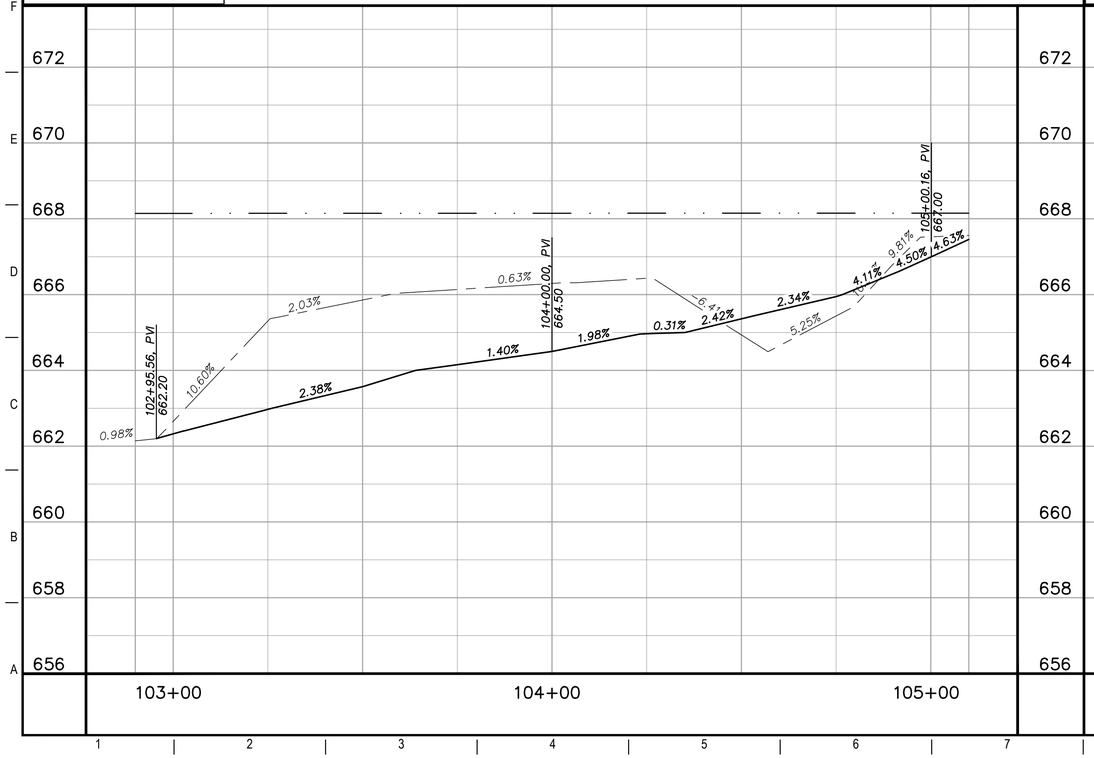

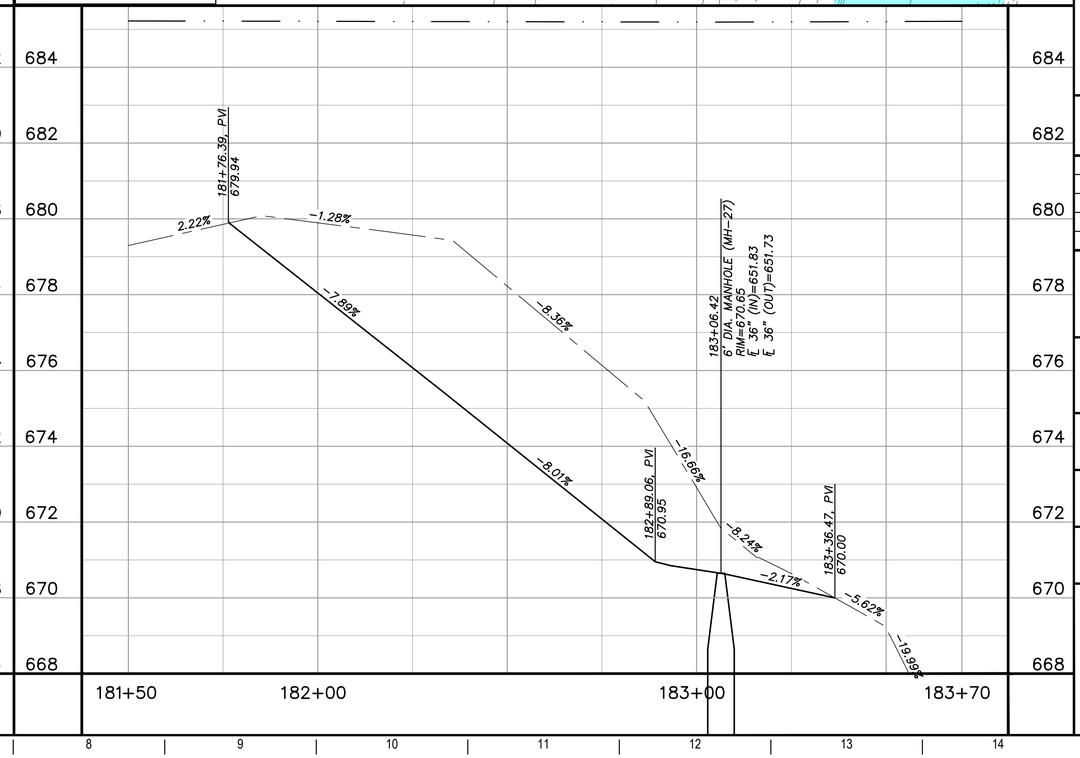

GENERAL NOTES

1. ALL FILL MATERIAL USED WITHIN THE FEMA 100-YR FLOODPLAIN SHALL BE WITH MATERIAL EXCAVATED WITHIN THE FLOODPLAIN.

LEGEND

- FEMA 100-YEAR FLOODPLAIN
- N.G. ~ CENTERLINE
- 667 EXISTING CONTOUR LABEL
- (667) PROPOSED CONTOUR LABEL
- WETLANDS
- WATERWAYS

0 10 20 40
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 6053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

GRADING PLAN & PROFILES (2 OF 4)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C205

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184+77.83 BERRY CREEK INTERCEPTOR
6' DIA. MANHOLE (MH-28)
W/ WATERTIGHT
RIM=678.94
℄ 36" (IN)=652.32
℄ 12" (IN)=654.32
℄ 36" (OUT)=652.22
N=10227853.38
E=3137376.00

187+70.82 BERRY CREEK INTERCEPTOR
6' WW MANHOLE W-VENT
FUTURE 100-YR FLOODPLAIN ELEV=688.3
MIN. VENT ELEV=689.3
(RE: G1/D107) (MH-29)
W/ WATERTIGHT
RIM=684.75
℄ 36" (IN)=653.30
℄ 12" (IN)=655.30
℄ 36" (OUT)=653.20
N=10228144.03
E=3137338.98

GRADING ALIGNMENT

MATCHLINE 5+00.00

METAL GATE

CUT FILL CALCULATIONS
CUT: 154.72 CY
FILL: 73.38 CY

0+00.00, PVI
678.59
0.54%
6.28%
-1.16%
-1.30%
-1.12%
-5.32%
1+02.56, PVI
677.86
-0.48%
-10.81%
2.79%
0.99%
0.50%
-0.39%
2+02.94, PVI
677.87
0.92%
0.03%
0.67%
1.01%
11.91%
16.06%
14.96%
11.30%
2+84.34
681.88
1.12%
4.76%
3+06.41, PVI
681.75
-16.40%
4.21%
-2.16%
2.60%
6.18%
-3.1%
-7.29%
1.60%
-10.74%
-5.10%
4+12.97, PVI
681.75
0.00%
0.00%
-7.21%
-7.09%
-7.23%
-1.76%
-2.94%
4+68.22
678.23
-3.89%
0.18%
-1.68%
-0.14%

GENERAL NOTES

1. ALL FILL MATERIAL USED WITHIN THE FEMA 100-YR FLOODPLAIN SHALL BE WITH MATERIAL EXCAVATED WITHIN THE FLOODPLAIN.

LEGEND

FEMA 100-YEAR FLOODPLAIN

N.G. ~ CENTERLINE

667 EXISTING CONTOUR LABEL

(667) PROPOSED CONTOUR LABEL

WETLANDS

WATERWAYS

0 10 20 40
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

GRADING PLAN & PROFILES (3 OF 4)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C206

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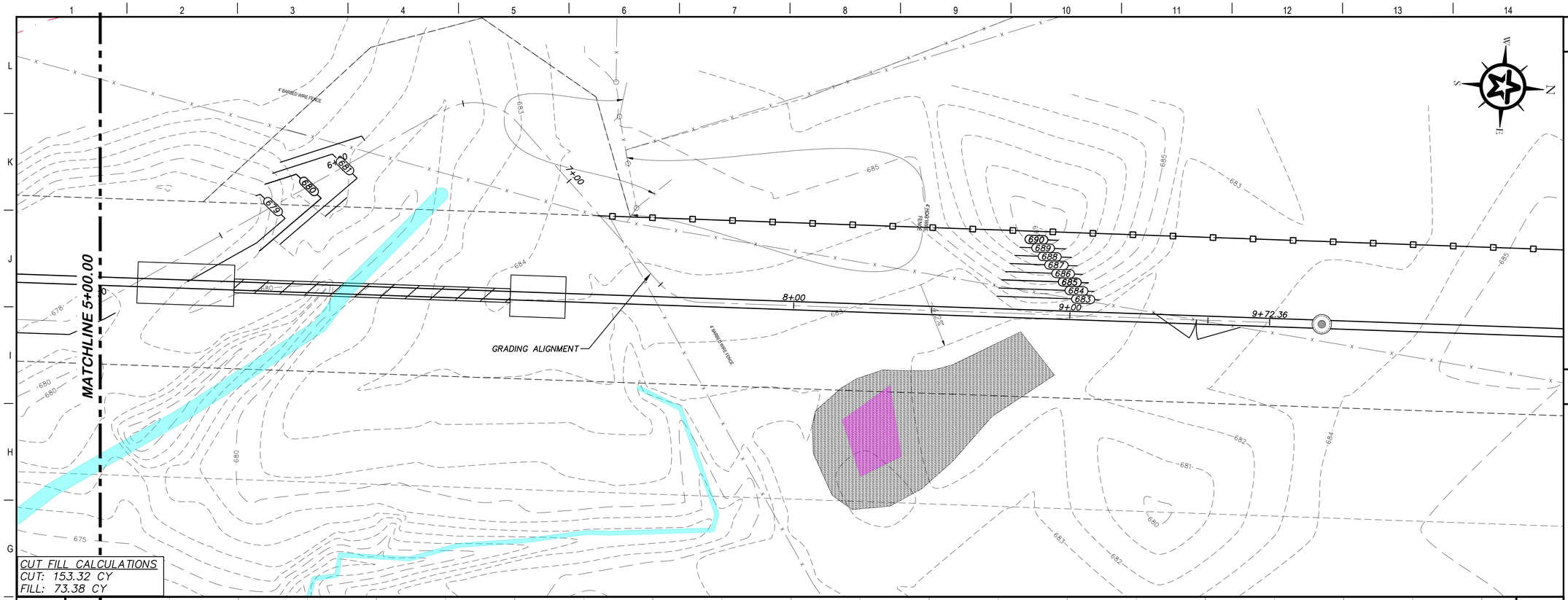

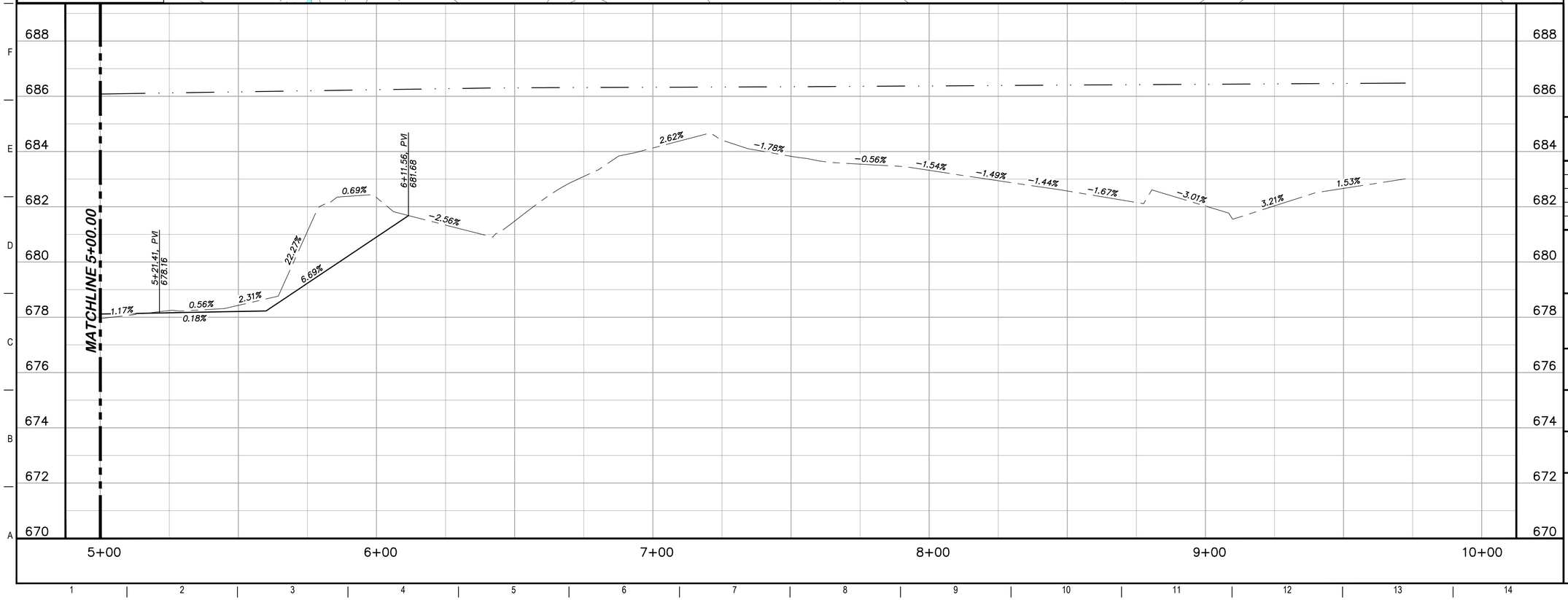

GENERAL NOTES

1. ALL FILL MATERIAL USED WITHIN THE FEMA 100-YR FLOODPLAIN SHALL BE WITH MATERIAL EXCAVATED WITHIN THE FLOODPLAIN.

LEGEND

- FEMA 100-YEAR FLOODPLAIN
- N.G. ~ CENTERLINE
- 667 EXISTING CONTOUR LABEL
- (667) PROPOSED CONTOUR LABEL
- WETLANDS
- POND
- WATERWAYS

0 10 20 40
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

GRADING PLAN & PROFILES (4 OF 4)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C207

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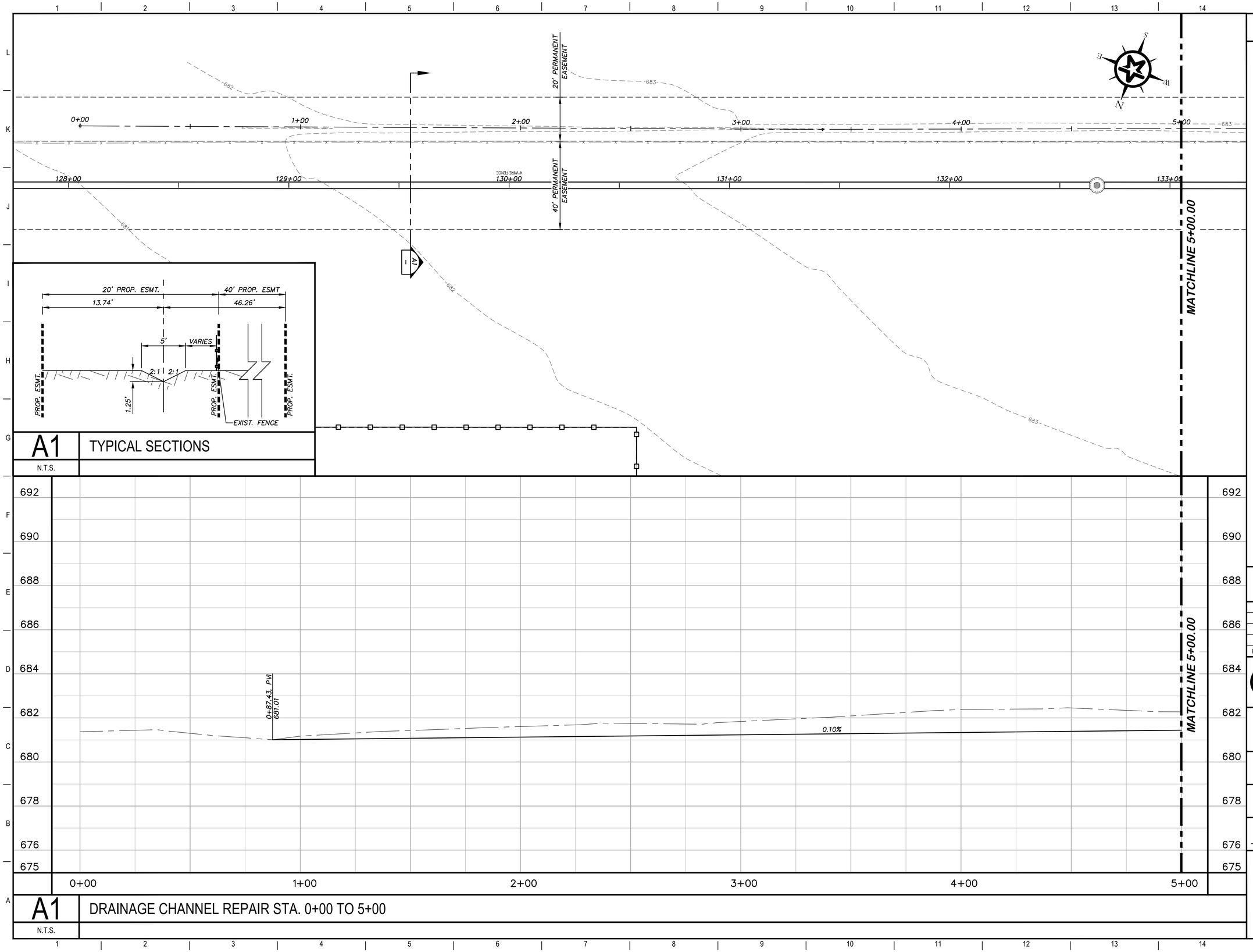

LEGEND

FEMA 100-YEAR FLOODPLAIN

F.G. ~ CENTERLINE

N.G. ~ CENTERLINE

667 EXISTING CONTOUR LABEL

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

IRRIGATION CHANNEL REPAIR (1 OF 3)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C208

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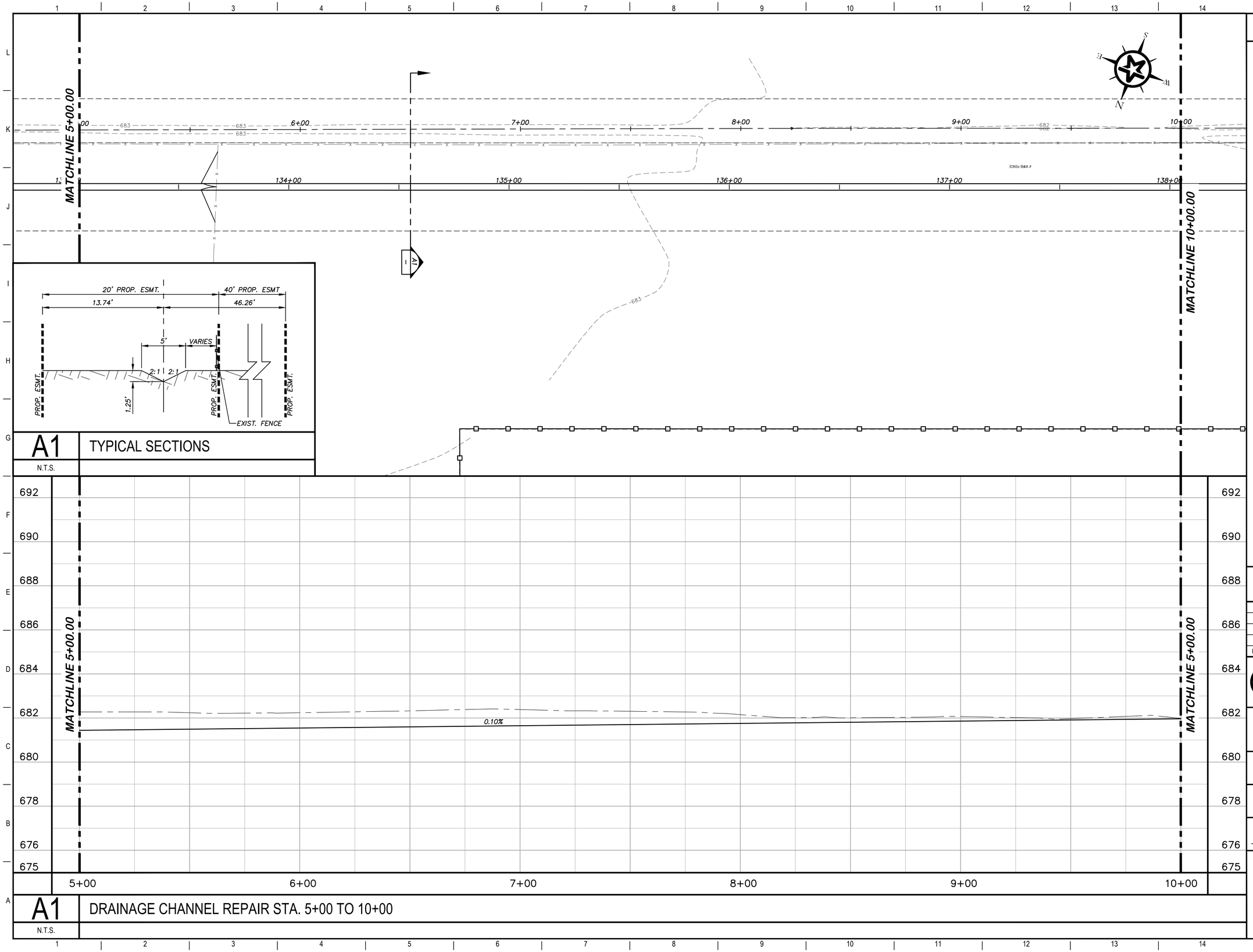

A1 TYPICAL SECTIONS

N.T.S.

A1 DRAINAGE CHANNEL REPAIR STA. 5+00 TO 10+00

N.T.S.

LEGEND

FEMA 100-YEAR FLOODPLAIN

F.G. ~ CENTERLINE

N.G. ~ CENTERLINE

667 EXISTING CONTOUR LABEL

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

IRRIGATION CHANNEL REPAIR (2 OF 3)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C209

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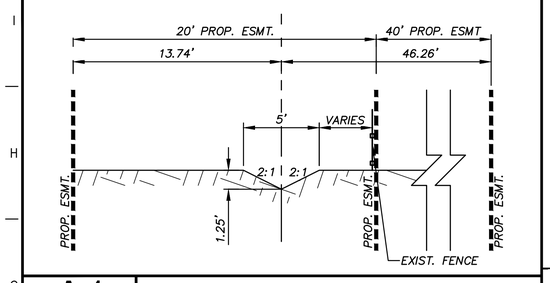
MATCHLINE 10+00.00

11+00 12+00 13+00 13+93.08

139+00 140+00 141+00 142+00 143+00



A1 TYPICAL SECTIONS

N.T.S.

MATCHLINE 10+00.00

692 690 688 686 684 682 680 678 676 675

0.10%

13+41.45, PVI
682.32

10+00 11+00 12+00 13+00 14+00 15+00

A1 DRAINAGE CHANNEL REPAIR STA. 10+00 TO END

N.T.S.

LEGEND

FEMA 100-YEAR FLOODPLAIN

F.G. ~ CENTERLINE

N.G. ~ CENTERLINE

667 EXISTING CONTOUR LABEL

0 10 20 40

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors

T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

IRRIGATION CHANNEL REPAIR (3 OF 3)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.

C210

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-GRADING PLAN & PROFILES.DWG, IRRIGATION CHANNEL REPAIR (3 OF 3), 8/14/2023 4:40:43 PM, trobles

GUIDELINES FOR DESIGN AND INSTALLATION OF
TEMPORARY EROSION AND SEDIMENTATION CONTROLS

TYPE OF STRUCTURE	REACH LENGTH	MAXIMUM DRAINAGE AREA	SLOPE
SILT FENCE	N/A	2 ACRES	0 – 10%
	200 FEET	2 ACRES	10 – 20%
	100 FEET	1 ACRE	20 – 30%
	50 FEET	1/2 ACRE	> 30%
TRIANGLE FILTER DIKE	100 FEET	1/2 ACRE	< 30% SLOPE
	50 FEET	1/4 ACRE	> 30% SLOPE
ROCK BERM *, **	500 FEET	< 5 ACRES	0 – 10%

* FOR ROCK BERM DESIGN WHERE PARAMETERS ARE OTHER THAN STATED, DRAINAGE AREA CALCULATIONS AND ROCK BERM DESIGN MUST BE SUBMITTED FOR REVIEW.

** HIGH SERVICE ROCK BERMS MAY BE REQUIRED IN AREAS OF ENVIRONMENTAL SIGNIFICANCE AS DETERMINED BY THE CITY OF GEORGETOWN.

The Architect/Engineer assumes responsibility for appropriate use of this standard.

REVISION NOTE: ADOPTED 6/21/2006
DRAWING NAME: EC01
CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS
TEMPORARY EROSION AND SEDIMENTATION CONTROL GUIDELINES
SCALE: NTS | DATE: 1/2003 | DRAWN BY: MRS | APPROVED BY: TRB

G1 TEMPORARY EROSION AND SEDIMENTATION GUIDELINES

EC01 | SPECIFICATION SECTION: G6 - SEDIMENTATION AND TEMPORARY EROSION CONTROL | SCALE: N.T.S.

NOTE: THIS SECTION IS INTENDED TO ASSIST THOSE PERSONS PREPARING WATER POLLUTION ABATEMENT PLANS (WPAP) OR STORM WATER POLLUTION PREVENTION PLANS (SWSP) THAT COMPLY WITH FEDERAL, STATE AND/OR LOCAL STORM WATER REGULATIONS.

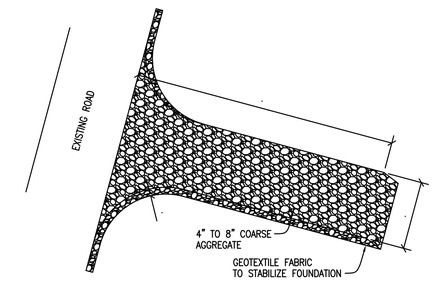
1. THE CONTRACTOR TO INSTALL AND MAINTAIN EROSION/SEDIMENTATION CONTROLS AND TREE/NATURAL AREA PROTECTIVE FENCING PRIOR TO ANY SITE PREPARATION WORK (CLEARING, GRUBBING, GRADING, OR EXCAVATION). CONTRACTOR TO REMOVE EROSION/SEDIMENTATION CONTROLS AT THE COMPLETION OF PROJECT AND GRASS RESTORATION.
2. ALL PROJECTS WITHIN THE RECHARGE ZONE OF THE EDWARD'S AQUIFER SHALL SUBMIT A BEST MANAGEMENT PRACTICES AND WATER POLLUTION AND ABATEMENT PLAN TO THE TNRCC FOR APPROVAL PRIOR TO ANY CONSTRUCTION.
3. THE PLACEMENT OF EROSION/SEDIMENTATION CONTROLS TO BE IN ACCORDANCE WITH THE APPROVED EROSION AND SEDIMENTATION CONTROL PLAN AND WATER POLLUTION ABATEMENT PLAN. DEVIATIONS FROM THE APPROVED PLAN MUST BE SUBMITTED TO AND APPROVED BY THE OWNER'S REPRESENTATIVE.
4. ALL PLANTING SHALL BE DONE BETWEEN MAY 1 AND SEPTEMBER 15 EXCEPT AS SPECIFICALLY AUTHORIZED IN WRITING. IF PLANTING IS AUTHORIZED TO BE DONE OUTSIDE THE DATES SPECIFIED, THE SEED SHALL BE PLANTED WITH THE ADDITION OF WINTER ANNUAL RYEGRASS (KENTUCKY 31) AT A RATE OF 100lb/ACRE. GRASS SHALL BE COMMON BERMUDA GRASS, HULLED, MINIMUM 82% PURE LIVE SEED. ALL GRASS SEED SHALL BE FREE FROM NOXIOUS WEED, GRADE "A" RECENT CROP, RECLEANED AND TREATED WITH APPROPRIATE FUNGICIDE AT TIME OF MIXING. SEED SHALL BE FURNISHED IN SEALED, STANDARD CONTAINERS WITH DEALER'S GUARANTEED ANALYSIS.
5. ALL DISTURBED AREAS TO BE RESTORED AS NOTED IN THE WATER POLLUTION ABATEMENT PLAN.
6. THE PLANTED AREA TO BE IRRIGATED OR SPRINKLED IN A MANNER THAT WILL NOT ERODE THE TOPSOIL, BUT WILL SUFFICIENTLY SOAK THE SOIL TO A DEPTH OF FOUR (4) INCHES. THE IRRIGATION TO OCCUR AT 10–DAY INTERVALS DURING THE FIRST TWO MONTHS TO INSURE GERMINATION AND ESTABLISHMENT OF THE GRASS . RAINFALL OCCURRENCES OF 1/2 INCH OR GREATER TO POSTPONE THE WATERING SCHEDULE ONE WEEK.
7. RESTORATION TO BE ACCEPTABLE WHEN THE GRASS HAS GROWN AT LEAST 1-1/2 INCHES HIGH WITH 95% COVERAGE, PROVIDED NO BARE SPOTS LARGER THAN 25 SQUARE FEET EXIST.
8. A MINIMUM OF FOUR (4) INCHES OF TOPSOIL TO BE PLACED IN ALL AREAS DISTURBED BY CONSTRUCTION.
9. THE CONTRACTOR TO HYDROMULCH OR SOD (AS SHOWN ON PLANS) ALL EXPOSED CUTS AND FILLS UPON COMPLETION OF CONSTRUCTION.
10. EROSION AND SEDIMENTATION CONTROLS TO BE INSTALLED OR MAINTAINED IN A MANNER WHICH DOES NOT RESULT IN SOIL BUILDUP WITHIN TREE DRIPLINE.
11. TO AVOID SOIL COMPACTION, CONTRACTOR SHALL NOT ALLOW VEHICULAR TRAFFIC, PARKING, OR STORAGE OF EQUIPMENT OR MATERIALS IN THE TREE DRIPLINE AREAS.
12. WHERE A FENCE IS CLOSER THAN FOUR (4) FEET TO A TREE TRUNK, PROTECT THE TRUNK WITH STRAPPED–ON PLANKING TO A HEIGHT OF EIGHT (8) FEET (OR TO THE LIMITS OF LOWER BRANCHING) IN ADDITION TO THE FENCING.
13. TREES TO BE REMOVED IN A MANNER WHICH DOES NOT IMPACT TREES TO BE PRESERVED.
14. ANY ROOT EXPOSED BY CONSTRUCTION ACTIVITY TO BE PRUNED FLUSH WITH THE SOIL. BACKFILL ROOT AREAS WITH GOOD QUALITY TOPSOIL AS SOON AS POSSIBLE. IF EXPOSED ROOT AREAS ARE NOT BACKFILLED WITHIN TWO DAYS, COVER THEM WITH ORGANIC MATERIAL IN A MANNER WHICH REDUCES SOIL TEMPERATURE AND MINIMIZES WATER LOSS DUE TO EVAPORATION.
15. CONTRACTOR TO PRUNE VEGETATION TO PROVIDE CLEARANCE FOR STRUCTURES, VEHICULAR TRAFFIC, AND EQUIPMENT BEFORE DAMAGE OCCURS (RIPPING OF BRANCHES, ETC.). ALL FINISHED PRUNING TO BE DONE ACCORDING TO RECOGNIZED, APPROVED STANDARDS OF THE INDUSTRY (REFERENCE THE "NATIONAL ARBORIST ASSOCIATION PRUNING STANDARDS FOR SHADE TREES").
16. THE CONTRACTOR IS TO INSPECT THE CONTROLS AT WEEKLY INTERVALS AND AFTER EVERY RAINFALL EXCEEDING 1/4 INCH TO VERIFY THAT THEY HAVE NOT BEEN SIGNIFICANTLY DISTURBED. ANY ACCUMULATED SEDIMENT AFTER A SIGNIFICANT RAINFALL TO BE REMOVED AND PLACED IN THE OWNER DESIGNATED SPOIL DISPOSAL SITE. THE CONTRACTOR TO CONDUCT PERIODIC INSPECTIONS OF ALL EROSION/SEDIMENTATION CONTROLS AND TO MAKE ANY REPAIRS OR MODIFICATIONS NECESSARY TO ASSURE CONTINUED EFFECTIVE OPERATION OF EACH DEVICE.
17. WHERE THERE IS TO BE AN APPROVED GRADE CHANGE, IMPERMEABLE PAVING SURFACE, TREE WELL, OR OTHER SUCH SITE DEVELOPMENT IMMEDIATELY ADJACENT TO A PROTECTED TREE, ERECT THE FENCE APPROXIMATELY TWO TO FOUR FEET (2'–4') BEHIND THE AREA IN QUESTION.
18. NO ABOVE AND/OR BELOW GROUND TEMPORARY FUEL STORAGE FACILITIES TO BE STORED ON THE PROJECT SITE.
19. IF EROSION AND SEDIMENTATION CONTROL SYSTEMS ARE EXISTING FROM PRIOR CONTRACTS, OWNER'S REPRESENTATIVE AND THE CONTRACTOR TO EXAMINE THE EXISTING EROSION AND SEDIMENTATION CONTROL SYSTEMS FOR DAMAGE PRIOR TO CONSTRUCTION. ANY DAMAGE TO PREEXISTING EROSION AND SEDIMENTATION CONTROLS NOTED TO BE REPAIRED AT OWNERS EXPENSE.
20. INTENTIONAL RELEASE OF VEHICLE OR EQUIPMENT FLUIDS ONTO THE GROUND IS NOT ALLOWED. CONTAMINATED SOIL RESULTING FROM ACCIDENTAL SPILL TO BE REMOVED AND DISPOSED OF PROPERLY.

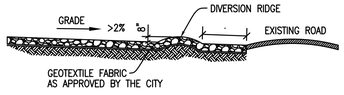
The Architect/Engineer assumes responsibility for appropriate use of this standard.

REVISION NOTE: ADOPTED 6/21/2006
DRAWING NAME: EC01A
CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS
EROSION AND SEDIMENTATION AND TREE PROTECTION NOTES
SCALE: NTS | DATE: 1/2003 | DRAWN BY: MRS | APPROVED BY: TRB

G5 TEMPORARY EROSION AND SEDIMENTATION GUIDELINES

EC01A | SPECIFICATION SECTION: G6 - SEDIMENTATION AND TEMPORARY EROSION CONTROL | SCALE: N.T.S.





INSTALLATION:

- CLEAR THE AREA OF DEBRIS, ROCKS OR PLANTS THAT WILL INTERFERE WITH INSTALLATION.
- GRADE THE AREA FOR THE ENTRANCE TO FLOW BACK ON TO THE CONSTRUCTION SITE. RUNOFF FROM THE STABILIZED CONSTRUCTION
- PLACE GEOTEXTILE FABRIC AS APPROVED BY THE CITY.
- PLACE ROCK AS APPROVED BY THE CITY.

INSPECTIONS AND MAINTENANCE GUIDELINES:

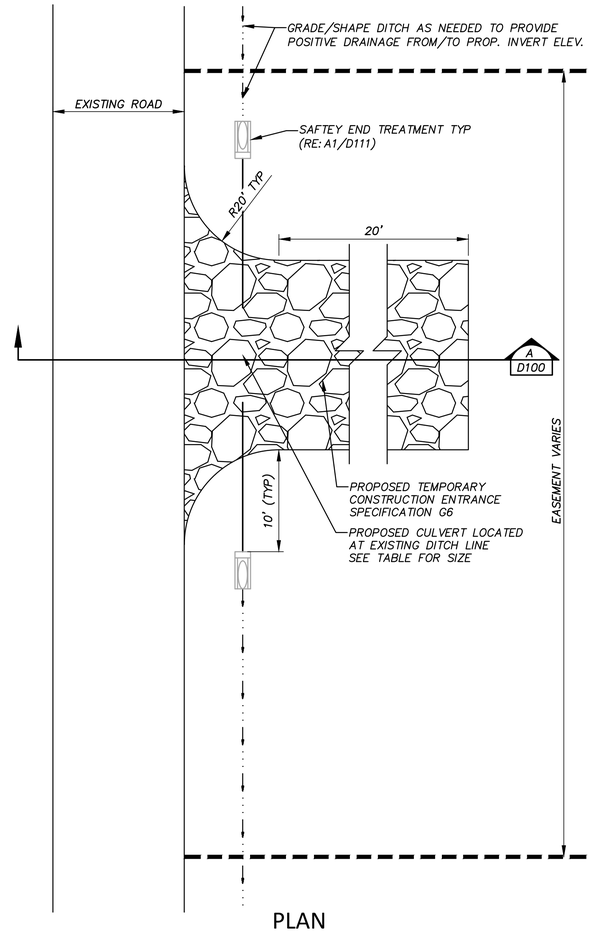
- THE ENTRANCE SHOULD BE MAINTAINED IN A CONDITION, WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS–OF–WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.
- ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ON TO PUBLIC RIGHTS–OF–WAY SHOULD BE REMOVED IMMEDIATELY BY CONTRACTOR.
- WHEN NECESSARY, WHEELS SHOULD BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTRANCE ONTO PUBLIC RIGHTS–OF–WAY.
- WHEN WASHING IS REQUIRED, IT SHOULD BE DONE ON AN AREA STABILIZED WITH CRUSHED STONE THAT DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN.
- ALL SEDIMENT SHOULD BE PREVENTED FROM ENTERING ANY STORM DRAIN, DITCH OR WATER COURSE BY USING APPROVED METHODS.

The Architect/Engineer assumes responsibility for appropriate use of this standard.

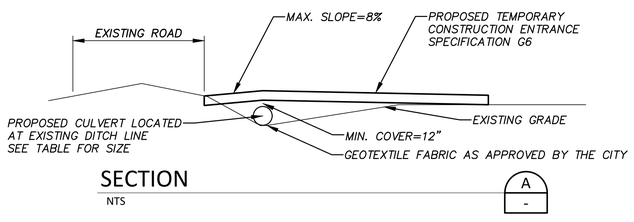
REVISION NOTE: ADOPTED 6/21/2006
DRAWING NAME: EC06
CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS
STABILIZED CONSTRUCTION ENTRANCE
SCALE: NTS | DATE: 1/2003 | DRAWN BY: MRS | APPROVED BY: TRB

A1 STABILIZED CONSTRUCTION ENTRANCE

EC06 | SPECIFICATION SECTION: G6 - SEDIMENTATION AND TEMPORARY EROSION CONTROL | SCALE: N.T.S.



PLAN



SECTION
NTS
A
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CULVERT TABLE

STREET NAME	APPROX. STA.	SIZE (IN)	UPSTREAM DIRECTION	UPSTREAM IE (FT)	DOWNSTREAM DIRECTION	DOWNSTREAM IE (FT)	LENGTH (FT)	SLOPE (%)
FM 971	13+50	15"	WEST	641.83	EAST	641.72	25	0.44
CR 152	80+11	24"	EAST	668.92	WEST	668.18	25	2.96

A8 TEMPORARY DRIVEWAY CULVERT WITH SAFETY END TREATMENT

NTS | SCALE: N.T.S.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION & SEDIMENT CONTROL DETAILS (1 OF 5)

03/31/2023
DATE
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D100

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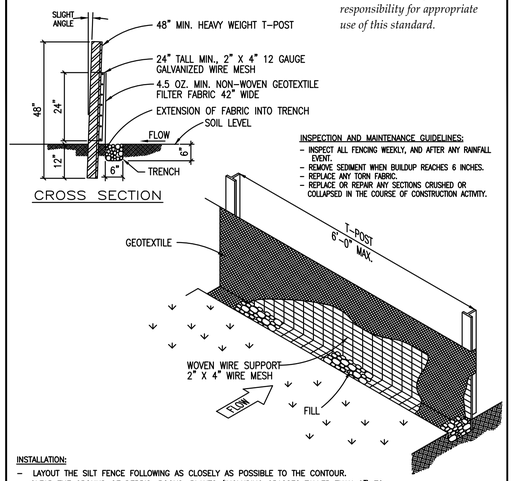


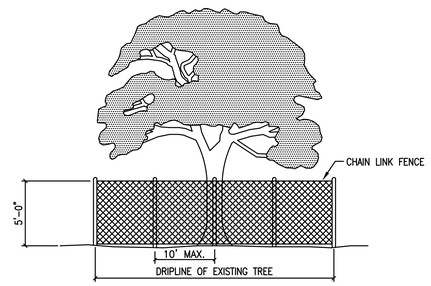
The Architect/Engineer assumes responsibility for appropriate use of this standard.

INSPECTION AND MAINTENANCE GUIDELINES:
- INSPECT ALL FENCING WEEKLY, AND AFTER ANY RAINFALL EVENT.
- REMOVE SEDIMENT WHEN BUILDUP REACHES 6 INCHES.
- REPLACE ANY TORN FABRIC.
- REPLACE OR REPAIR ANY SECTIONS CRUSHED OR COLLAPSED IN THE COURSE OF CONSTRUCTION ACTIVITY.

INSTALLATION:
- LAYOUT THE SILT FENCE FOLLOWING AS CLOSELY AS POSSIBLE TO THE CONTOUR.
- CLEAR THE GROUND OF DEBRIS, ROCKS, PLANTS (INCLUDING GRASSES TALLER THAN 2") TO PROVIDE A SMOOTH FLOW APPROACH SURFACE. EXCAVATE 6" DEEP X 6" WIDE TRENCH ON UPSTREAM SIDE OF FACE PER PLANS.
- DRIVE THE HEAVY DUTY T-POST AT LEAST 12 INCHES INTO THE GROUND AND AT A SLIGHT ANGLE TOWARDS THE FLOW.
- ATTACH THE 2" X 4" 12 GAUGE WELDED WIRE MESH TO THE T-POST WITH 11 1/2 GAUGE GALVANIZED T-POST CLIPS. THE TOP OF THE WIRE TO BE 24" ABOVE GROUND LEVEL. THE WELDED WIRE MESH TO BE OVERLAPPED 6" AND TIED AT LEAST 6 TIMES WITH HOG RINGS.
- THE SILT FENCE TO BE INSTALLED WITH A SKIRT A MINIMUM OF 6" WIDE PLACED ON THE UPHILL SIDE OF THE FENCE INSIDE EXCAVATED TRENCH. THE FABRIC TO OVERLAP THE TOP OF THE WIRE BY 1".
- ANCHOR THE SILT FENCE BY BACKFILLING WITH EXCAVATED DIRT AND ROCKS (NOT LARGER THAN 2").
- GEOTEXTILE SPLICES SHOULD BE A MINIMUM OF 18" WIDE ATTACHED IN AT LEAST 6 PLACES. SPLICES IN CONCENTRATED FLOW AREAS WILL NOT BE ACCEPTED.
- SILT FENCE SHALL BE REMOVED WHEN THE SITE IS COMPLETELY STABILIZED SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.

REVISION NOTE: ADOPTED 6/21/2006
DRAWING NAME: EC02
CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS
SILT FENCE DETAIL
SCALE: NTS | DATE: 1/2003 | DRAWN BY: MRS | APPROVED BY: TRB

G1 SILT FENCE DETAIL
EC02 | SPECIFICATION SECTION: G6 - SEDIMENTATION AND TEMPORARY EROSION CONTROL | SCALE: N.T.S.

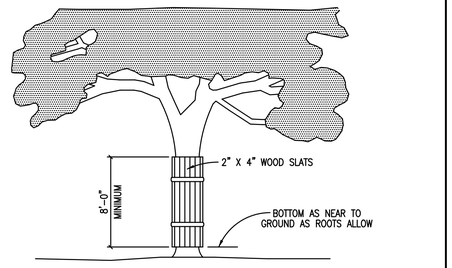


NOTES:
1. TREE PROTECTION FENCES SHALL BE INSTALLED PRIOR TO THE COMMENCEMENT OF ANY SITE PREPARATION WORK (CLEARING, GRUBBING OR GRADING).
2. FENCES SHALL COMPLETELY SURROUND THE TREE, OR CLUSTERS OF TREES; WILL BE LOCATED AT THE OUTERMOST LIMIT OF THE TREE BRANCHES (DRIPLINE), AND WILL BE MAINTAINED THROUGHOUT THE CONSTRUCTION PROJECT IN ORDER TO PREVENT THE FOLLOWING:
   A. SOIL COMPACTION IN THE ROOT ZONE AREA RESULTING FROM VEHICULAR TRAFFIC, OR STORAGE OF EQUIPMENT OR MATERIALS.
   B. ROOT ZONE DISTURBANCES DUE TO GRADE CHANGES (GREATER THAN SIX INCHES (6") CUT OR FILL, OR TRENCHING NOT REVIEWED AND AUTHORIZED BY THE CITY.
   C. WOUNDS TO EXPOSED ROOTS, TRUNKS OR LIMBS BY MECHANICAL EQUIPMENT.
   D. OTHER ACTIVITIES DETRIMENTAL TO TREES, SUCH AS CHEMICAL STORAGE, CEMENT TRUCK CLEANING AND FIRE.
3. EXCEPTIONS TO INSTALLING FENCES AT TREE DRIPLINES MAY BE PERMITTED IN THE FOLLOWING CASES:
   A. WHERE PERMEABLE PAVING IS TO BE INSTALLED, ERECT THE FENCE AT THE OUTER LIMITS OF THE PERMEABLE PAVING AREA.
   B. WHERE TREES ARE CLOSE TO PROPOSED BUILDINGS, ERECT THE FENCE NO CLOSER THAN SIX FEET (6'-0") TO BUILDING.

The Architect/Engineer assumes responsibility for appropriate use of this standard.

REVISION NOTE: ADOPTED 6/21/2006
DRAWING NAME: EC09
CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS
TREE PROTECTION – CHAIN LINK FENCE
SCALE: NTS | DATE: 1/2003 | DRAWN BY: MRS | APPROVED BY: TRB

G5 TREE PROTECTION - CHAIN LINK FENCE
EC09 | SPECIFICATION SECTION: G6 - SEDIMENTATION AND TEMPORARY EROSION CONTROL | SCALE: N.T.S.

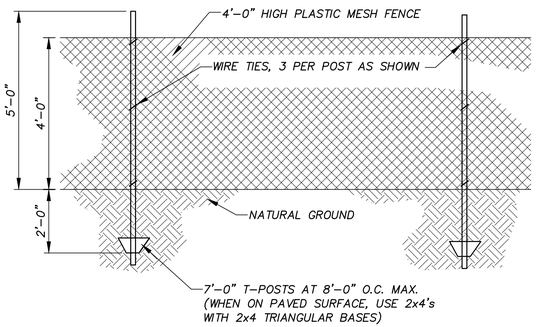


NOTES:
1. WHERE ANY EXCEPTIONS RESULT IN A FENCE BEING CLOSER THAN FOUR FEET (4'-0") TO A TREE TRUNK; PROTECT THE TRUNK WITH STRAPPED-ON-PLANKING TO A HEIGHT OF EIGHT FEET (8'-0"), OR TO THE LIMITS OF LOWER BRANCHING IN ADDITION TO THE REDUCED FENCING PROVIDED.
2. ANY ROOTS EXPOSED BY CONSTRUCTION ACTIVITY SHALL BE PRUNED FLUSH WITH THE SOIL. BACKFILL ROOT AREAS WITH GOOD QUALITY TOP SOIL AS SOON AS POSSIBLE. IF EXPOSED ROOT AREAS ARE NOT BACKFILLED WITHIN TWO (2) DAYS, COVER THEM WITH ORGANIC MATERIAL IN A MANNER WHICH REDUCES SOIL TEMPERATURE, AND MINIMIZES WATER LOSS DUE TO EVAPORATION.
3. PRIOR EXCAVATION OR GRADE CUTTING WITHIN TREE DRIPLINE, MAKE A CLEAN CUT BETWEEN THE DISTURBED AND UNDISTURBED ROOT ZONES WITH A ROCK SAW OR SIMILAR EQUIPMENT, TO MINIMIZE DAMAGE TO REMAINING ROOTS.
4. TREES MOST HEAVILY IMPACTED BY CONSTRUCTION ACTIVITIES SHOULD BE WATERED DEEPLY ONCE A WEEK DURING PERIODS OF HOT, DRY WEATHER. TREE CROWNS SHOULD BE SPRAYED WITH WATER PERIODICALLY TO REDUCE DUST ACCUMULATION ON THE LEAVES.
5. ANY TRENCHING REQUIRED FOR THE INSTALLATION OF LANDSCAPE IRRIGATION SHALL BE PLACED AS FAR FROM EXISTING TREE TRUNKS AS POSSIBLE.
6. NO LANDSCAPE TOPSOIL DRESSING GREATER THE FOUR INCHES (4") SHALL BE PERMITTED WITHIN THE DRIPLINE OF A TREE. NO SOIL IS PERMITTED ON THE ROOT FLARE OF ANY TREE.
7. PRUNING TO PROVIDE CLEARANCE FOR STRUCTURES, VEHICULAR TRAFFIC AND EQUIPMENT SHALL TAKE PLACE BEFORE CONSTRUCTION BEGINS.

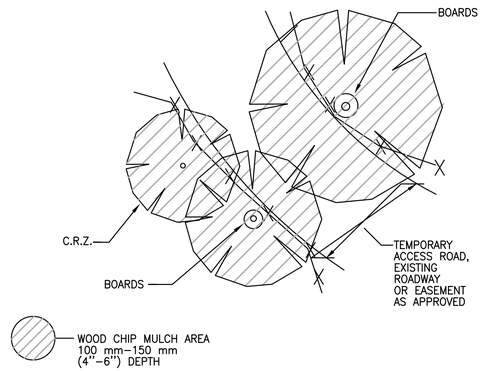
The Architect/Engineer assumes responsibility for appropriate use of this standard.

REVISION NOTE: ADOPTED 6/21/2006
DRAWING NAME: EC10
CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS
TREE PROTECTION – WOOD SLATS
SCALE: NTS | DATE: 1/2003 | DRAWN BY: MRS | APPROVED BY: TRB

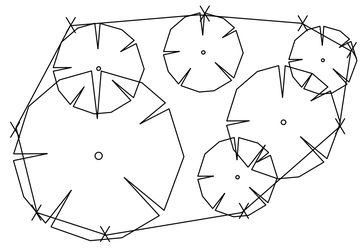
G10 TREE PROTECTION - WOOD SLATS
EC10 | SPECIFICATION SECTION: G6 - SEDIMENTATION AND TEMPORARY EROSION CONTROL | SCALE: N.T.S.



A1 TEMPORARY SAFETY FENCE
DETAIL NO. 7110 | SPECIFICATION SECTION: 01 50 00 - TEMPORARY FACILITIES AND CONTROLS



A5 TREE PROTECTION - LINEAR CONSTRUCTION THROUGH TREES
NTS



A10 TREE PROTECTION - GROUP OF TREES
NTS

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION & SEDIMENT CONTROL DETAILS (2 OF 5)

03/31/2023 — DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D101

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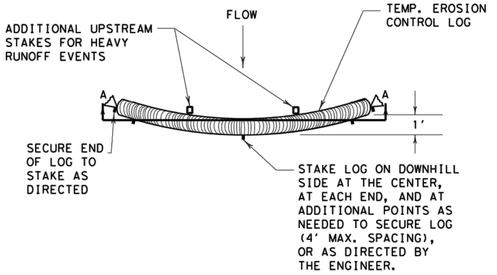
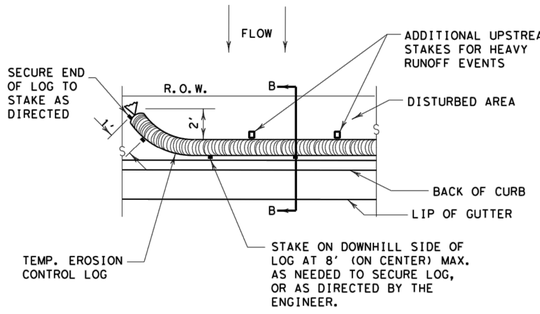
DATE:
FILE:



PLAN VIEW



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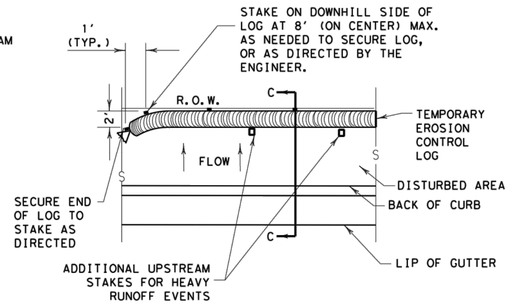

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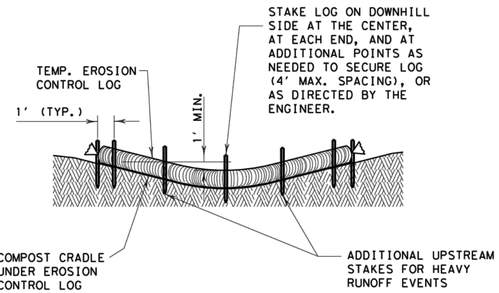
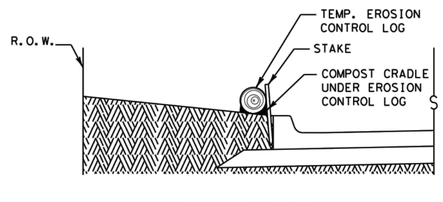


SECTION A-A

EROSION CONTROL LOG DAM

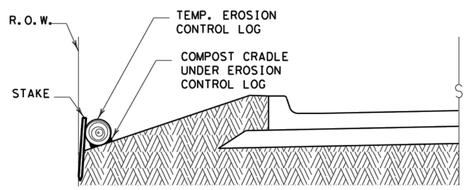
CL-D



SECTION B-B

EROSION CONTROL LOG AT BACK OF CURB

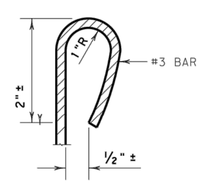
CL-BOC



SECTION C-C

EROSION CONTROL LOG AT EDGE OF RIGHT-OF-WAY

CL-ROW



REBAR STAKE DETAIL

LEGEND

CL-D	EROSION CONTROL LOG DAM
CL-BOC	EROSION CONTROL LOG AT BACK OF CURB
CL-ROW	EROSION CONTROL LOG AT EDGE OF RIGHT-OF-WAY
CL-SST	EROSION CONTROL LOGS ON SLOPES STAKE AND TRENCHING ANCHORING
CL-SSL	EROSION CONTROL LOGS ON SLOPES STAKE AND LASHING ANCHORING
CL-DI	EROSION CONTROL LOG AT DROP INLET
CL-CI	EROSION CONTROL LOG AT CURB INLET
CL-GI	EROSION CONTROL LOG AT CURB & GRATE INLET

SEDIMENT BASIN & TRAP USAGE GUIDELINES

An erosion control log sediment trap may be used to filter sediment out of runoff draining from an unstabilized area.

Log Traps: The drainage area for a sediment trap should not exceed 5 acres. The trap capacity should be 1800 CF/Acre (0.5" over the drainage area).

Control logs should be placed in the following locations:

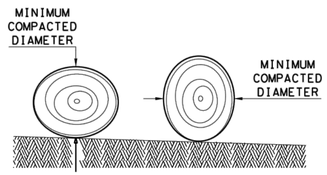
1. Within drainage ditches spaced as needed or min. 500' on center
2. Immediately preceding ditch inlets or drain inlets
3. Just before the drainage enters a water course
4. Just before the drainage leaves the right of way
5. Just before the drainage leaves the construction limits where drainage flows away from the project.

The logs should be cleaned when the sediment has accumulated to a depth of 1/2 the log diameter.

Cleaning and removal of accumulated sediment deposits is incidental and will not be paid for separately.

GENERAL NOTES:

1. EROSION CONTROL LOGS SHALL BE INSTALLED IN ACCORDANCE WITH MANFACTURER'S RECOMMENDATIONS, OR AS DIRECTED BY THE ENGINEER.
2. LENGTHS OF EROSION CONTROL LOGS SHALL BE IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND AS REQUIRED FOR THE PURPOSE INTENDED.
3. UNLESS OTHERWISE DIRECTED, USE BIODEGRADABLE OR PHOTODEGRADABLE CONTAINMENT MESH ONLY WHERE LOG WILL REMAIN IN PLACE AS PART OF A VEGETATIVE SYSTEM. FOR TEMPORARY INSTALLATIONS, USE RECYCLABLE CONTAINMENT MESH.
4. FILL LOGS WITH SUFFICIENT FILTER MATERIAL TO ACHIEVE THE MINIMUM COMPACTED DIAMETER SPECIFIED IN THE PLANS WITHOUT EXCESSIVE DEFORMATION.
5. STAKES SHALL BE 2" X 2" WOOD OR #3 REBAR, 2'-4' LONG, EMBEDDED SUCH THAT 2" PROTRUDES ABOVE LOG, OR AS DIRECTED BY THE ENGINEER.
6. DO NOT PLACE STAKES THROUGH CONTAINMENT MESH.
7. COMPOST CRADLE MATERIAL IS INCIDENTAL & WILL NOT BE PAID FOR SEPARATELY.
8. SANDBAGS USED AS ANCHORS SHALL BE PLACED ON TOP OF LOGS & SHALL BE OF SUFFICIENT SIZE TO HOLD LOGS IN PLACE.
9. TURN THE ENDS OF EACH ROW OF LOGS UPSLOPE TO PREVENT RUNOFF FROM FLOWING AROUND THE LOG.
10. FOR HEAVY RUNOFF EVENTS, ADDITIONAL UPSTREAM STAKES MAY BE NECESSARY TO KEEP LOG FROM FOLDING IN ON ITSELF.



DIAMETER MEASUREMENTS OF EROSION CONTROL LOGS SPECIFIED IN PLANS

SHEET 1 OF 3

Texas Department of Transportation — Design Division Standard

TEMPORARY EROSION, SEDIMENT AND WATER POLLUTION CONTROL MEASURES

EROSION CONTROL LOG

EC(9)-16

FILE: ec916	DN: TxDOT	CK: KM	DW: LS/PT	CK: LS
© TxDOT: JULY 2016	CONT	SECT	JOB	HIGHWAY
REVISIONS				
	DIST	COUNTY		SHEET NO.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION & SEDIMENT CONTROL DETAILS (3 OF 5)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED — PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D102

A1

TEMPORARY EROSION SEDIMENT AND WATER POLLUTION CONTROL MEASURES - EROSION CONTROL LOG (1 OF 3)

TEXAS DEPARTMENT OF TRANSPORTATION

SCALE: N.T.S.

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-ESC DETAILS.DWG, EROSION & SEDIMENT CONTROL DETAILS (3 OF 5), 8/14/2023 2:48:21 PM, rcuellar

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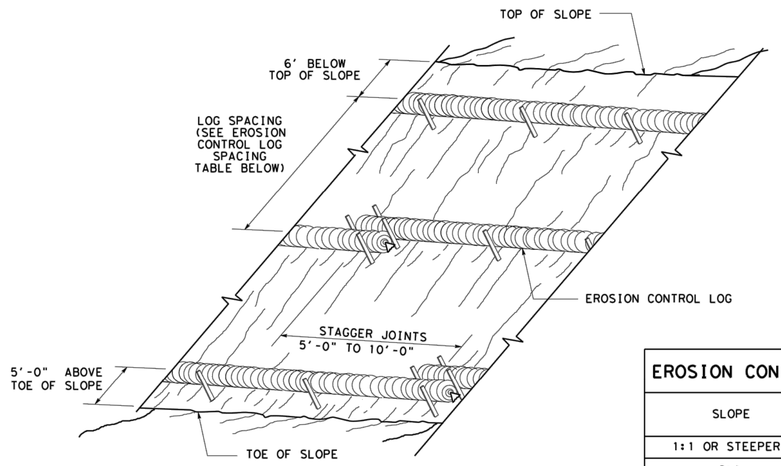
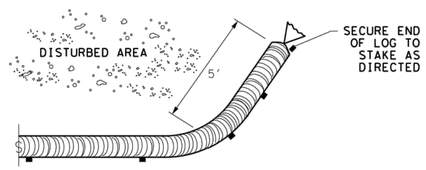


EROSION CONTROL LOGS ON SLOPES
STAKE AND TRENCHING ANCHORING

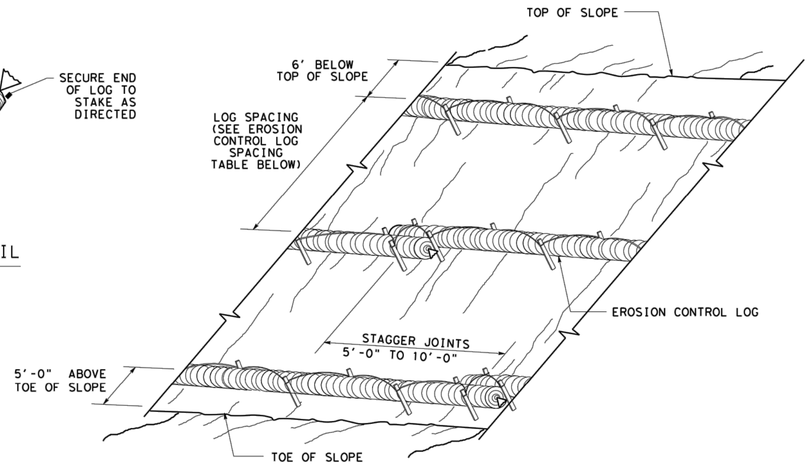
CL-SST



END SECTION RAP DETAIL

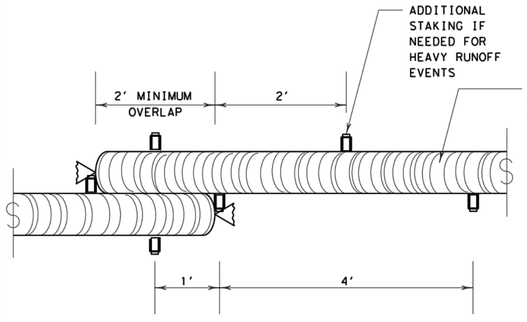
EROSION CONTROL LOG SPACING TABLE				
SLOPE	LOG DIAMETER			
	6"	8"	12"	18"
1:1 OR STEEPER	5'	10'	15'	20'
2:1	10'	20'	30'	40'
3:1	15'	30'	45'	60'
4:1 OR FLATTER	20'	40'	60'	80'

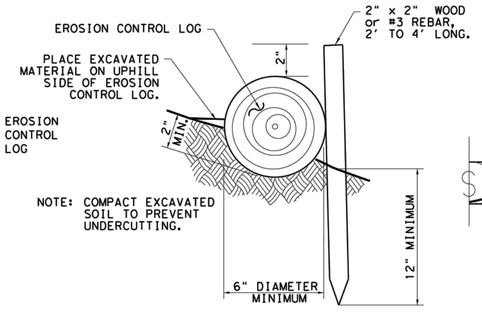
* ADJUSTMENTS CAN BE MADE FOR SOIL TYPE:
SOFT, LOAMY SOILS-ADJUST ROWS CLOSER TOGETHER;
HARD, ROCKY SOILS- ADJUST ROWS FARTHER APART



EROSION CONTROL LOGS ON SLOPES
STAKE AND LASHING ANCHORING

CL-SSL

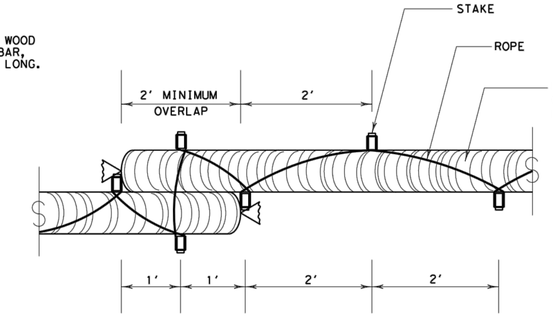


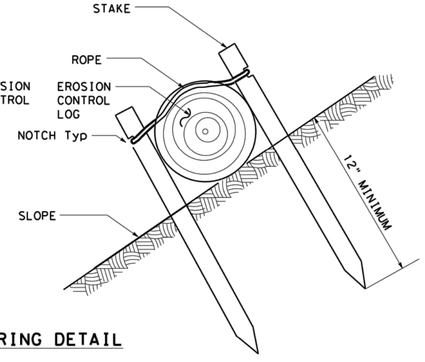


STAKE AND TRENCHING ANCHORING DETAIL

CL-SST

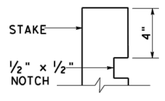
TRENCH DEPTH TABLE	
LOG DIAMETER	DEPTH
6"	2"
8"	3"
12"	4"
18"	5"





STAKE AND LASHING ANCHORING DETAIL

CL-SSL



STAKE NOTCH DETAIL

SHEET 2 OF 3

Texas Department of Transportation | Design Division Standard

TEMPORARY EROSION, SEDIMENT AND WATER POLLUTION CONTROL MEASURES

EROSION CONTROL LOG

EC(9)-16

FILE: ec116	DN: TxDOT	CK: KM	DW: LS/PT	CK: LS
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REVISIONS				
	DIST	COUNTY		SHEET NO.

DATE:
FILE:

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION & SEDIMENT CONTROL DETAILS (4 OF 5)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D103

A1 | TEMPORARY EROSION SEDIMENT AND WATER POLLUTION CONTROL MEASURES - EROSION CONTROL LOG (2 OF 3)

TEXAS DEPARTMENT OF TRANSPORTATION | SCALE: N.T.S.

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-ESC DETAILS.DWG, EROSION & SEDIMENT CONTROL DETAILS (4 OF 5), 8/14/2023 2:48:23 PM, rcuellar

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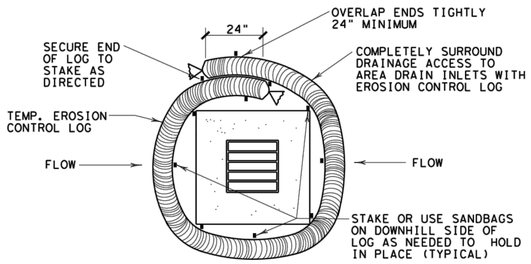
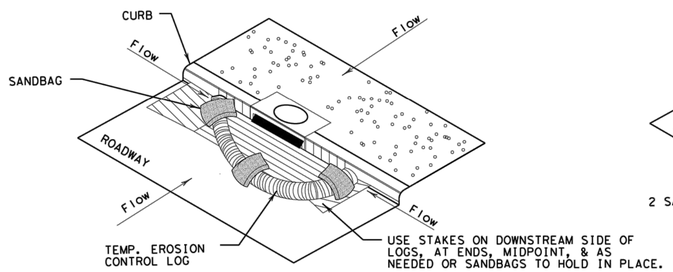


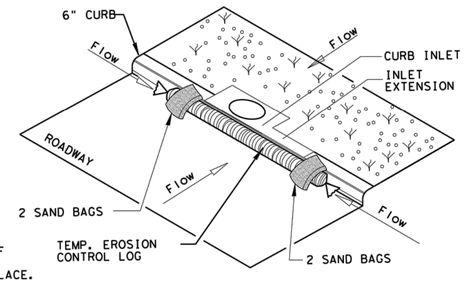
EROSION CONTROL LOG AT DROP INLET

CL-DI



EROSION CONTROL LOG AT CURB INLET

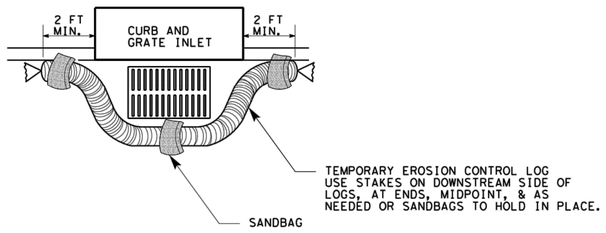
CL-CI



EROSION CONTROL LOG AT CURB INLET

CL-CI

NOTE:
EROSION CONTROL LOGS USED AT CURB INLETS SHOULD ONLY BE USED IF THEY WILL NOT IMPEDE TRAFFIC OR FLOOD THE ROADWAY OR WHEN THE STORM SEWER SYSTEM IS NOT FULLY FUNCTIONAL.

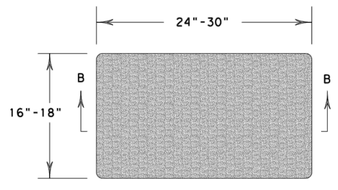


EROSION CONTROL LOG AT CURB & GRADE INLET

CL-GI



SECTION B-B



SANDBAG DETAIL

DATE:
FILE:

SHEET 3 OF 3

Texas Department of Transportation — Design Division Standard

TEMPORARY EROSION, SEDIMENT AND WATER POLLUTION CONTROL MEASURES

EROSION CONTROL LOG

EC(9)-16

FILE: ec916	DN: TxDOT	CK: KM	DW: LS/PT	CK: LS
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Walker Partners engineers | surveyors
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CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

EROSION & SEDIMENT CONTROL DETAILS (5 OF 5)

03/31/2023 — DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D104

A1 — TEMPORARY EROSION SEDIMENT AND WATER POLLUTION CONTROL MEASURES - EROSION CONTROL LOG (3 OF 3)

TEXAS DEPARTMENT OF TRANSPORTATION — SCALE: N.T.S.

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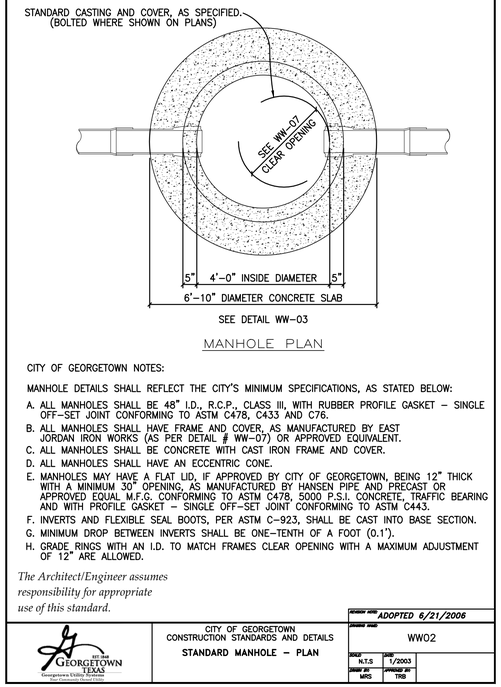


MANHOLE PLAN

CITY OF GEORGETOWN NOTES:

MANHOLE DETAILS SHALL REFLECT THE CITY'S MINIMUM SPECIFICATIONS, AS STATED BELOW:

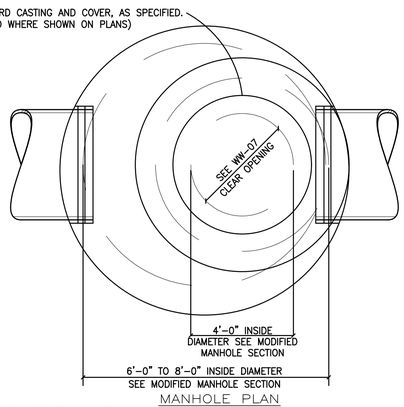
A. ALL MANHOLES SHALL BE 48" I.D., R.C.P., CLASS III, WITH RUBBER PROFILE GASKET – SINGLE OFF–SET JOINT CONFORMING TO ASTM C478, C433 AND C76.
B. ALL MANHOLES SHALL HAVE FRAME AND COVER, AS MANUFACTURED BY EAST JORDAN IRON WORKS (AS PER DETAIL # WW–07) OR APPROVED EQUIVALENT.
C. ALL MANHOLES SHALL BE CONCRETE WITH CAST IRON FRAME AND COVER.
D. ALL MANHOLES SHALL HAVE AN ECCENTRIC CONE.
E. MANHOLES MAY HAVE A FLAT LID, IF APPROVED BY CITY OF GEORGETOWN, BEING 12" THICK WITH A MINIMUM 30" OPENING, AS MANUFACTURED BY HANSEN PIPE AND PRECAST OR APPROVED EQUAL M.F.G. CONFORMING TO ASTM C478, 5000 P.S.I. CONCRETE, TRAFFIC BEARING AND WITH PROFILE GASKET – SINGLE OFF–SET JOINT CONFORMING TO ASTM C443.
F. INVERTS AND FLEXIBLE SEAL BOOTS, PER ASTM C–923, SHALL BE CAST INTO BASE SECTION.
G. MINIMUM DROP BETWEEN INVERTS SHALL BE ONE–TENTH OF A FOOT (0.1').
H. GRADE RINGS WITH AN I.D. TO MATCH FRAMES CLEAR OPENING WITH A MAXIMUM ADJUSTMENT OF 12" ARE ALLOWED.

The Architect/Engineer assumes responsibility for appropriate use of this standard.

	CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS STANDARD MANHOLE – PLAN	REVISION NOTE: ADOPTED 6/21/2006 DRAWING NAME: WW02 SCALE: N.T.S. DATE: 1/2003 DRAWN BY: MRS APPROVED BY: TRB

G1 STANDARD MANHOLE - PLAN

DETAIL NO. WW02 | CITY OF GEORGETOWN | SCALE: N.T.S.



MANHOLE PLAN

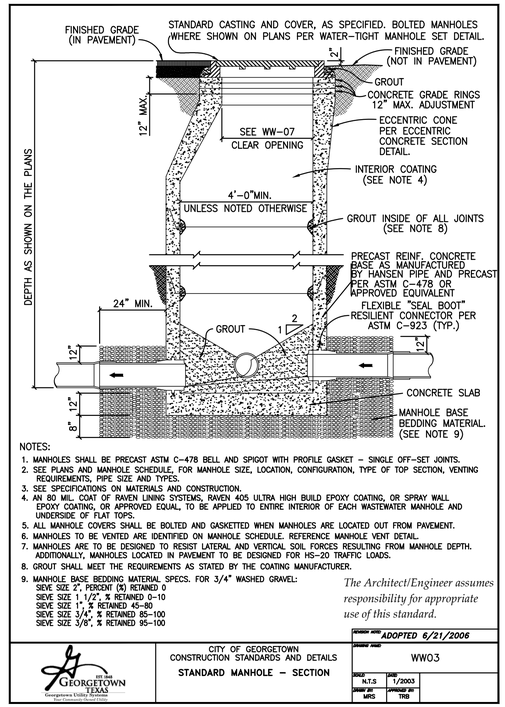
CITY OF GEORGETOWN NOTES:

MANHOLE DETAILS SHALL REFLECT THE CITY'S MINIMUM SPECIFICATIONS, AS STATED BELOW:

A. ALL MANHOLES SHALL BE R.C.P., CLASS III, WITH RUBBER PROFILE GASKET – SINGLE OFF–SET JOINT CONFORMING TO ASTM C478, C433 AND C76.
B. ALL MANHOLES SHALL HAVE FRAME AND COVER, AS MANUFACTURED BY EAST JORDAN IRON WORKS (AS PER DETAIL # WW–07) OR APPROVED EQUIVALENT.
C. ALL MANHOLES SHALL BE CONCRETE WITH CAST IRON FRAME AND COVER.
D. ALL MANHOLES SHALL HAVE AN ECCENTRIC CONE.
E. MANHOLES MAY HAVE A FLAT LID, IF APPROVED BY CITY OF GEORGETOWN, BEING 12" THICK WITH A MINIMUM 30" OPENING, AS MANUFACTURED BY HANSEN PIPE AND PRECAST OR APPROVED EQUAL M.F.G. CONFORMING TO ASTM C478, 5000 P.S.I. CONCRETE, TRAFFIC BEARING AND WITH PROFILE GASKET – SINGLE OFF–SET JOINT CONFORMING TO ASTM C443.
F. INVERTS AND FLEXIBLE SEAL BOOTS, PER ASTM C–923, SHALL BE CAST INTO BASE SECTION.
G. UNLESS NOTED OTHERWISE ON PLANS, MINIMUM DROP BETWEEN INVERTS SHALL BE ONE–TENTH OF A FOOT (0.1').
H. GRADE RINGS WITH AN I.D. TO MATCH FRAMES CLEAR OPENING WITH A MAXIMUM ADJUSTMENT OF 12" ARE ALLOWED.

A1 STANDARD MANHOLE - PLAN (72" TO 96")

DETAIL NO. WW02 | MODIFIED | SCALE: N.T.S.



NOTES:

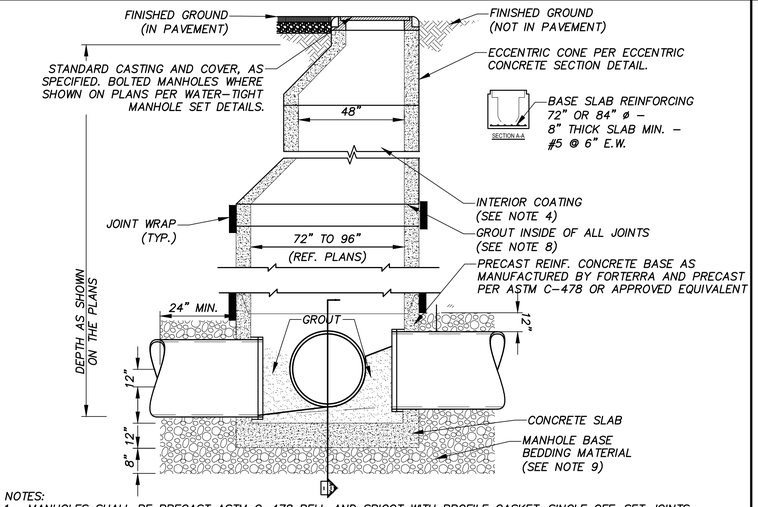
1. MANHOLES SHALL BE PRECAST ASTM C–478 BELL AND SPIGOT WITH PROFILE GASKET – SINGLE OFF–SET JOINTS.
2. SEE PLANS AND MANHOLE SCHEDULE, FOR MANHOLE SIZE, LOCATION, CONFIGURATION, TYPE OF TOP SECTION, VENTING REQUIREMENTS, PIPE SIZE AND TYPES.
3. SEE SPECIFICATIONS ON MATERIALS AND CONSTRUCTION.
4. AN 80 MIL. COAT OF RAVEN LINING SYSTEMS, RAVEN 405 ULTRA HIGH BUILD EPOXY COATING, OR SPRAY WALL EPOXY COATING, OR APPROVED EQUAL, TO BE APPLIED TO ENTIRE INTERIOR OF EACH WASTEWATER MANHOLE AND UNDERSIDE OF FLAT TOPS.
5. ALL MANHOLE COVERS SHALL BE BOLTED AND GASKETTED WHEN MANHOLES ARE LOCATED OUT FROM PAVEMENT.
6. MANHOLES TO BE VENTED ARE IDENTIFIED ON MANHOLE SCHEDULE. REFERENCE MANHOLE VENT DETAIL.
7. MANHOLES ARE TO BE DESIGNED TO RESIST LATERAL AND VERTICAL SOIL FORCES RESULTING FROM MANHOLE DEPTH. ADDITIONALLY, MANHOLES LOCATED IN PAVEMENT TO BE DESIGNED FOR HS–20 TRAFFIC LOADS.
8. GROUT SHALL MEET THE REQUIREMENTS AS STATED BY THE COATING MANUFACTURER.
9. MANHOLE BASE BEDDING MATERIAL SPECS. FOR 3/4" WASHED GRAVEL:
   SIEVE SIZE 2", PERCENT (%) RETAINED 0
   SIEVE SIZE 1 1/2", % RETAINED 0–10
   SIEVE SIZE 1", % RETAINED 45–80
   SIEVE SIZE 3/4", % RETAINED 85–100
   SIEVE SIZE 3/8", % RETAINED 95–100

The Architect/Engineer assumes responsibility for appropriate use of this standard.

	CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS STANDARD MANHOLE – SECTION	REVISION NOTE: ADOPTED 6/21/2006 DRAWING NAME: WW03 SCALE: N.T.S. DATE: 1/2003 DRAWN BY: MRS APPROVED BY: TRB

G5 STANDARD MANHOLE - SECTION

DETAIL NO. WW03 | CITY OF GEORGETOWN | SCALE: N.T.S.

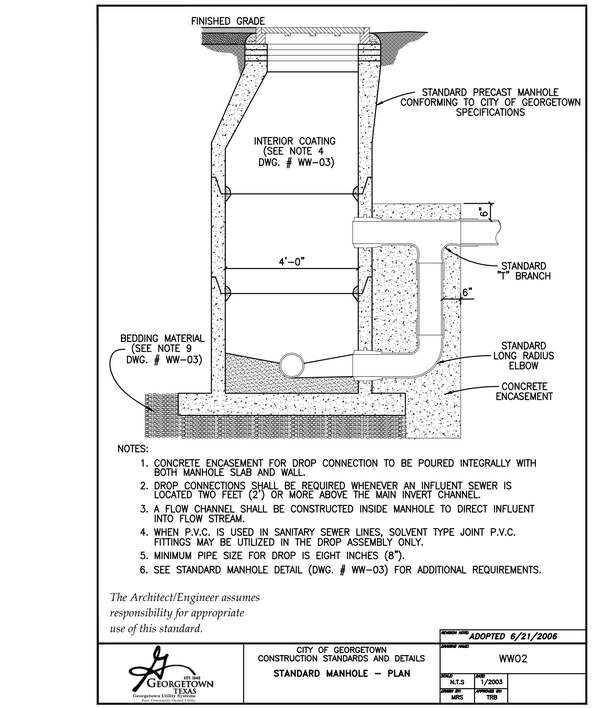


NOTES:

1. MANHOLES SHALL BE PRECAST ASTM C–478 BELL AND SPIGOT WITH PROFILE GASKET–SINGLE OFF–SET JOINTS.
2. SEE PLANS AND MANHOLE SCHEDULE, FOR MANHOLE SIZE, LOCATION, CONFIGURATION, TYPE OF TOP SECTION, VENTING REQUIREMENTS, PIPE SIZE AND TYPES.
3. SEE SPECIFICATIONS ON MATERIALS AND CONSTRUCTION.
4. AN 80 MIL. COAT OF RAVEN LINING SYSTEMS, RAVEN 405 ULTRA HIGH BUILD EXPOXY COATING, OR SPRAY WALL EPOXY COATING, OR APPROVED EQUAL, TO BE APPLIED TO ENTIRE INTERIOR OF EACH WASTEWATER MANHOLE AND UNDERSIDE OF FLAT TOPS.
5. ALL MANHOLE COVERS SHALL BE BOLTED AND GASKETTED WHEN MAHOLES ARE LOCATED OUT FROM PAVEMENT.
6. MANHOLES TO BE VENTED ARE IDENTIFIED ON MANHOLE SCHEDULE. REFERENCE MANHOLE VENT DETAIL.
7. MANHOLES ARE TO BE DESIGNED TO RESIST LATERAL AND VERTICAL SOIL FORCES RESULTING FROM MANHOLE DEPTH. ADDITIONALLY, MANHOLES SHALL BE DESIGNED FOR HS–20 TRAFFIC LOADS.
8. GROUT SHALL MEET THE REQUIREMENTS AS STATED BY THE COATING MANUFACTURERS.
9. MANHOLE BASE BEDDING MATERIAL SPECS. FOR 3–4" WASHED GRAVEL:
   SIEVE SIZE 2", % RETAINED 0 — SIEVE SIZE 1 1/2", % RETAINED 0–10
   SIEVE SIZE 1", % RETAINED 45–80 — SIEVE SIZE 3/4", % RETAINED 85–100
   SIEVE SIZE 3/8", % RETAINED 95–100

A5 STANDARD MANHOLE SECTION (72" TO 96")

DETAIL NO. WW03 | MODIFIED | SCALE: N.T.S.



NOTES:

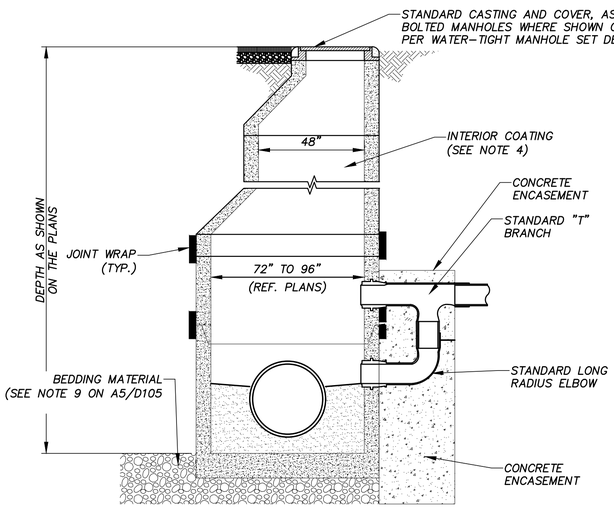
1. CONCRETE ENCASEMENT FOR DROP CONNECTION TO BE POURED INTEGRALLY WITH BOTH MANHOLE SLAB AND WALL.
2. DROP CONNECTIONS SHALL BE REQUIRED WHENEVER AN INFLUENT SEWER IS LOCATED TWO FEET (2') OR MORE ABOVE THE MAIN INVERT CHANNEL.
3. A FLOW CHANNEL SHALL BE CONSTRUCTED INSIDE MANHOLE TO DIRECT INFLUENT INTO FLOW STREAM.
4. WHEN P.V.C. IS USED IN SANITARY SEWER LINES, SOLVENT TYPE JOINT P.V.C. FITTINGS MAY BE UTILIZED IN THE DROP ASSEMBLY ONLY.
5. MINIMUM PIPE SIZE FOR DROP IS EIGHT INCHES (8").
6. SEE STANDARD MANHOLE DETAIL (DWG. # WW–03) FOR ADDITIONAL REQUIREMENTS.

The Architect/Engineer assumes responsibility for appropriate use of this standard.

	CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS STANDARD MANHOLE – PLAN	REVISION NOTE: ADOPTED 6/21/2006 DRAWING NAME: WW02 SCALE: N.T.S. DATE: 1/2003 DRAWN BY: MRS APPROVED BY: TRB

G10 DROP CONNECTION-PRECAST MANHOLE TYPE "A"

DETAIL NO. WW04 | CITY OF GEORGETOWN | SCALE: N.T.S.



NOTES:

1. CONCRETE ENCASEMENT FOR DROP CONNECTION TO BE POURED INTEGRALLY WITH BOTH MANHOLE SLAB AND WALL.
2. DROP CONNECTIONS SHALL BE REQUIRED WHENEVER AN INFLUENT SEWER IS LOCATED TWO FEET (2') OR MORE ABOVE THE MAIN INVERT CHANNEL.
3. A FLOW CHANNEL SHALL BE CONSTRUCTED INSIDE MANHOLE TO DIRECT INFLUENT INTO FLOW STREAM.
4. WHEN P.V.C. IS USED IN SANITARY SEWER LINES, SOLVENT TYPE JOINT P.V.C. FITTINGS MAY BE UTILIZED IN THE DROP ASSEMBLY ONLY.
5. MINIMUM PIPE SIZE FOR DROP IS EIGHT INCHES (8").
6. SEE MODIFIED MANHOLE DETAIL FOR ADDITIONAL REQUIREMENTS

A10 DROP CONNECTION - PRECAST MANHOLE TYPE "A"

DETAIL NO. WW04 | MODIFIED | SCALE: N.T.S.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WASTEWATER DETAILS (1 OF 6)

03/31/2023
DATE

ERIC LEE NELSON

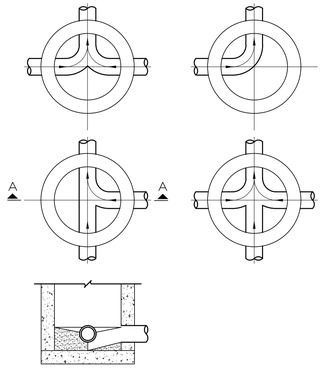
STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D105

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-WW DETAILS.DWG, D105 WASTEWATER DETAILS (1 OF 6), 8/14/2023 2:48:42 PM, rcuellar

FLOW PATTERNS FOR INVERT CHANNELS



SECTION "A–A"

NOTES:

1. INVERT CHANNELS TO BE CONSTRUCTED FOR SMOOTH FLOW WITH NO OBSTRUCTIONS.
2. SPILLWAYS SHALL BE CONSTRUCTED BETWEEN PIPES WITH DIFFERENT INVERT ELEVATIONS PROVIDING FOR SMOOTH FLOW.
3. CHANNELS FOR FUTURE CONSTRUCTIONS (STUBS) SHALL BE CONSTRUCTED, FILLED WITH SAND, AND COVERED WITH 1" OF MORTAR.
4. SLOPE MANHOLE ITSELF WITH A 1:2 SLOPE FROM MANHOLE WALL TO CHANNEL.
5. INVERT SHALL BE A MINIMUM OF 1/2 THE DIAMETER OF THE LARGEST PIPE OR 4" DEEP.

The Architect/Engineer assumes responsibility for appropriate use of this standard.

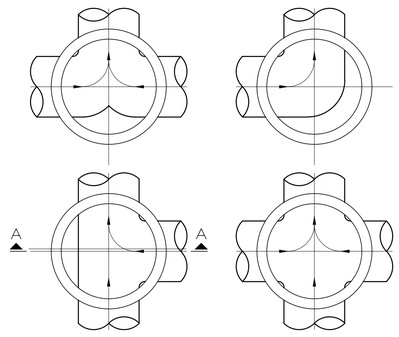
REVISION NOTES	ADOPTED 6/21/2006
DRAWING NAME	WW06
SCALE: NTS	DATE: 1/2003
DRAWN BY: MRS	APPROVED BY: TRB

CITY OF GEORGETOWN
CONSTRUCTION STANDARDS AND DETAILS
FLOW PATTERNS FOR INVERT CHANNELS

G1 FLOW PATTERNS FOR INVERT CHANNELS

DETAIL NO. WW06 | CITY OF GEORGETOWN | SCALE: N.T.S.

FLOW PATTERNS FOR INVERT CHANNELS



SECTION "A–A"

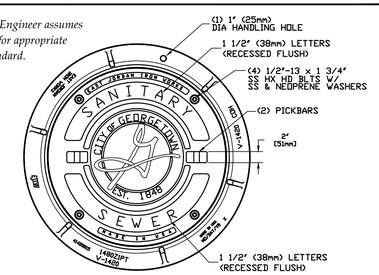
NOTES:

1. INVERT CHANNELS TO BE CONSTRUCTED FOR SMOOTH FLOW WITH NO OBSTRUCTIONS.
2. SPILLWAYS SHALL BE CONSTRUCTED BETWEEN PIPES WITH DIFFERENT INVERT ELEVATIONS PROVIDING FOR SMOOTH FLOW.
3. CHANNELS FOR FUTURE CONSTRUCTIONS (STUBS) SHALL BE CONSTRUCTED, FILLED WITH SAND, AND COVERED WITH 1" OF MORTAR.
4. SLOPE MANHOLE ITSELF WITH A 1:2 SLOPE FROM MANHOLE WALL TO CHANNEL.
5. INVERTS SHALL BE SPECIFICALLY SIZED FOR CONNECTING PIPES AND SHALL BE U–SHAPED WITH THE MINIMUM DEPTH 3/4 OF THE LARGEST PIPE DIAMETER.

A1 FLOW PATTERNS FOR INVERT CHANNELS

DETAIL NO. WW06 | MODIFIED | SCALE: N.T.S.

The Architect/Engineer assumes responsibility for appropriate use of this standard.



NOTES:

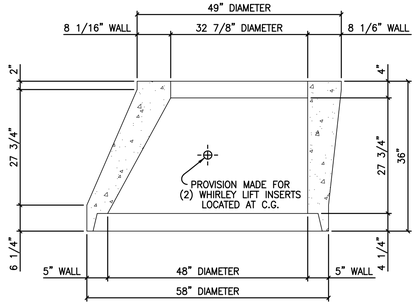
1. BOLTED WASTEWATER MANHOLE SET TO BE EAST JORDAN IRON WORKS, INC. CATALOG NO. 1480APT V-1420/1480Z1PT, COVER TO BE STAMPED WITH "SANITARY SEWER".
2. BOLTED WASTEWATER MANHOLE SET TO BE HEAVY DUTY LOAD RATED.
3. FOR MORE DETAILED SPECIFICATIONS REFER TO EAST JORDAN IRON WORKS, INC. REFERENCE PRODUCT DRAWING 00148392 41420015.
4. FOR STANDARD WASTEWATER MANHOLE SET REFER TO DETAIL WW07.

REVISION NOTES	ADOPTED 6/21/2006
DRAWING NAME	WW07
SCALE: NTS	DATE: 1/2003
DRAWN BY: MRS	APPROVED BY: TRB

CITY OF GEORGETOWN
CONSTRUCTION STANDARDS AND DETAILS
BOLTED WASTEWATER MANHOLE SET

G5 BOLTED WASTEWATER MANHOLE SET

DETAIL NO. WW7A | CITY OF GEORGETOWN | SCALE: N.T.S.



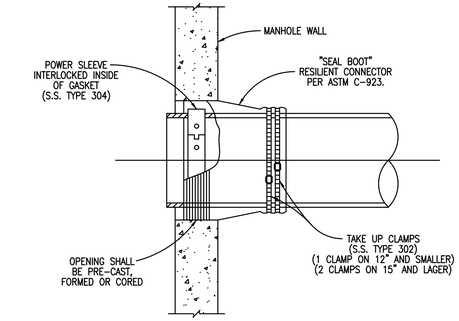
The Architect/Engineer assumes responsibility for appropriate use of this standard.

REVISION NOTES	ADOPTED 6/21/2006
DRAWING NAME	WW08
SCALE: NTS	DATE: 1/2003
DRAWN BY: MRS	APPROVED BY: TRB

WW07
CITY OF GEORGETOWN
CONSTRUCTION STANDARDS AND DETAILS
48"X5" TO 33"X8"X36" TALL ECCENTRIC CONCRETE SECTION

A6 48"X5" TO 33"X8"X36" TALL ECCENTRIC CONCRETE SECTION

DETAIL NO. WW08 | CITY OF GEORGETOWN | SCALE: N.T.S.



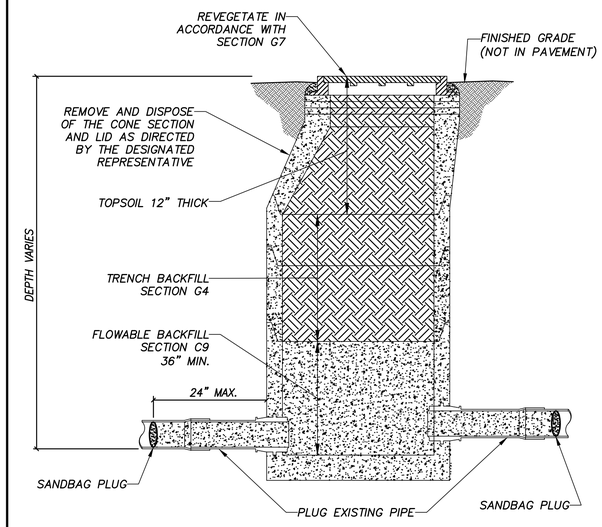
The Architect/Engineer assumes responsibility for appropriate use of this standard.

REVISION NOTES	ADOPTED 6/21/2006
DRAWING NAME	WW10
SCALE: NTS	DATE: 1/2003
DRAWN BY: MRS	APPROVED BY: TRB

CITY OF GEORGETOWN
CONSTRUCTION STANDARDS AND DETAILS
FLEXIBLE "SEAL BOOT" CONNECTOR

G11 FLEXIBLE "SEAL BOOT" CONNECTOR

DETAIL NO. WW10 | CITY OF GEORGETOWN | SCALE: N.T.S.



NOTES:

1. THE PLUG SHOULD BE COMPOSED OF A SANDBAG OR SIMILAR TYPE PLUG TO HOLD FLOWABLE BACKFILL UNTIL SET.

2. FLOWABLE BACKFILL SHALL COMPLETELY FILL VOID TO SANDBAG OR SIMILAR TYPE PLUG.

A11 MANHOLE ABANDONMENT

SCALE: N.T.S.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WASTEWATER DETAILS (2 OF 6)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D106

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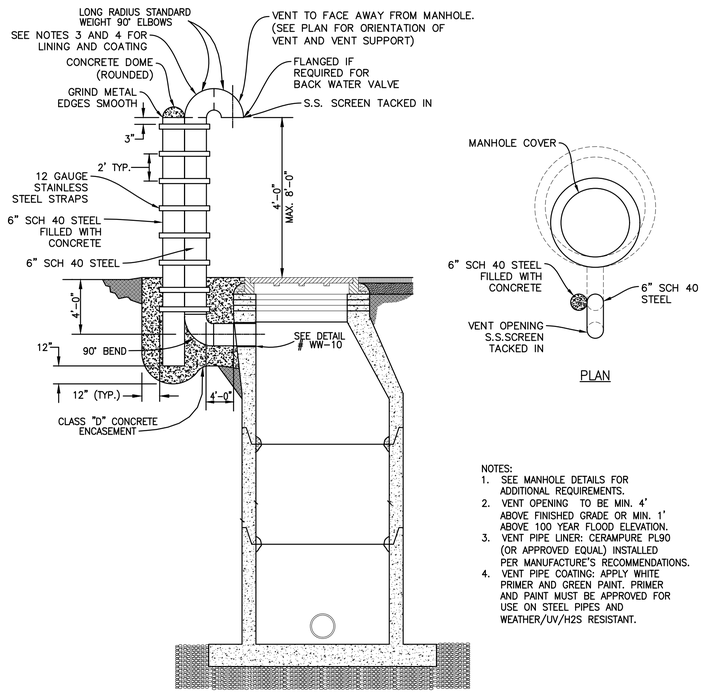
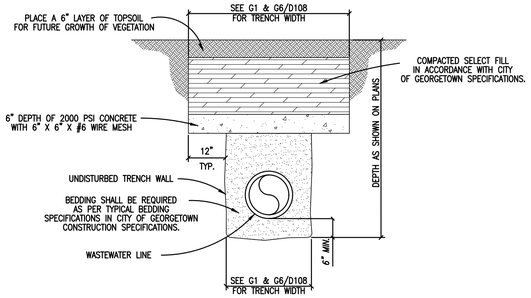


NOTES:
1. SEE MANHOLE DETAILS FOR ADDITIONAL REQUIREMENTS.
2. VENT OPENING TO BE MIN. 4' ABOVE FINISHED GRADE OR MIN. 1' ABOVE 100 YEAR FLOOD ELEVATION.
3. VENT PIPE LINER: CERAMPURE PL90 (OR APPROVED EQUAL) INSTALLED PER MANUFACTURE'S RECOMMENDATIONS.
4. VENT PIPE COATING: APPLY WHITE PRIMER AND GREEN PAINT. PRIMER AND PAINT MUST BE APPROVED FOR USE ON STEEL PIPES AND WEATHER/UV/H2S RESISTANT.

G1 TYPICAL MANHOLE WITH VENT 4' - 8'

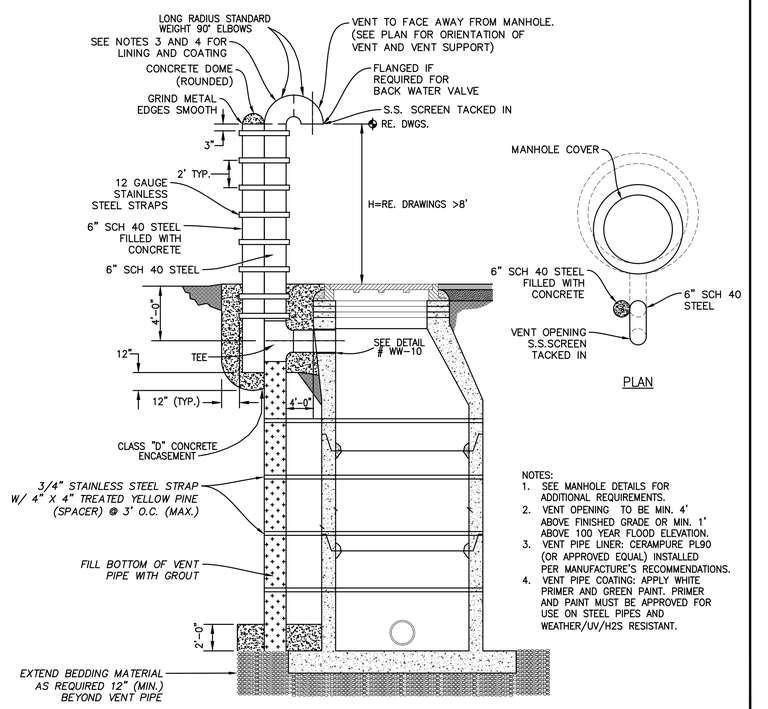
DETAIL NO. WW19 | MODIFIED | SCALE: N.T.S.



G6 CONCRETE TRENCH CAP

SCALE: N.T.S.

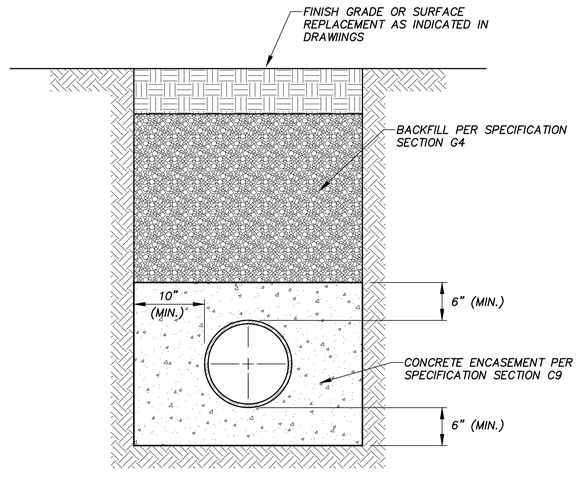
G10 NOT USED



NOTES:
1. SEE MANHOLE DETAILS FOR ADDITIONAL REQUIREMENTS.
2. VENT OPENING TO BE MIN. 4' ABOVE FINISHED GRADE OR MIN. 1' ABOVE 100 YEAR FLOOD ELEVATION.
3. VENT PIPE LINER: CERAMPURE PL90 (OR APPROVED EQUAL) INSTALLED PER MANUFACTURE'S RECOMMENDATIONS.
4. VENT PIPE COATING: APPLY WHITE PRIMER AND GREEN PAINT. PRIMER AND PAINT MUST BE APPROVED FOR USE ON STEEL PIPES AND WEATHER/UV/H2S RESISTANT.

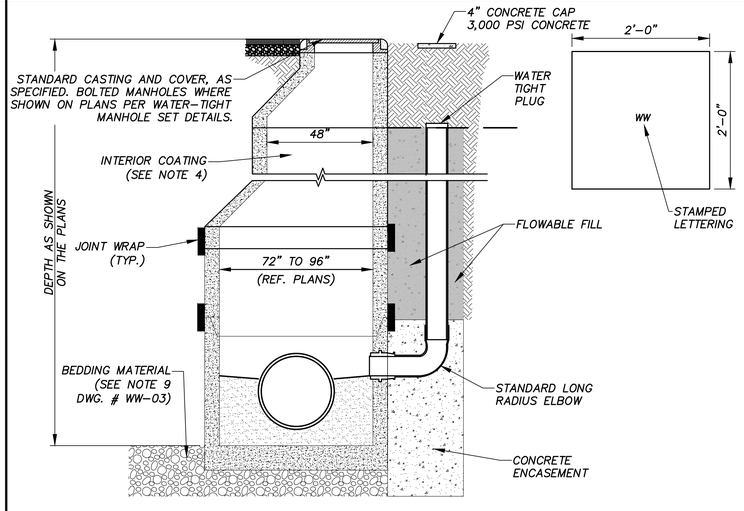
A1 TYPICAL MANHOLE WITH VENT > 8'

DETAIL NO. WW19 | MODIFIED | SCALE: N.T.S.



A6 CONCRETE ENCASEMENT DETAIL

SCALE: N.T.S.



NOTES:
1. CONCRETE ENCASEMENT FOR DROP CONNECTION TO BE POURED INTEGRALLY WITH BOTH MANHOLE SLAB AND WALL.
2. DROP CONNECTIONS SHALL BE REQUIRED WHENEVER AN INFLUENT SEWER IS LOCATED TWO FEET (2') OR MORE ABOVE THE MAIN INVERT CHANNEL.
3. A FLOW CHANNEL SHALL BE CONSTRUCTED INSIDE MANHOLE TO DIRECT INFLUENT INTO FLOW STREAM.
4. WHEN P.V.C. IS USED IN SANITARY SEWER LINES, SOLVENT TYPE JOINT P.V.C. FITTINGS MAY BE UTILIZED IN THE DROP ASSEMBLY ONLY.
5. MINIMUM PIPE SIZE FOR DROP IS EIGHT INCHES (8").
6. SEE STANDARD MANHOLE DETAIL (DWG. #WW-03) FOR ADDITIONAL REQUIREMENTS.

A10 DROP CONNECTION - PRECAST MANHOLE TYPE "C"

SCALE: N.T.S.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WASTEWATER DETAILS (3 OF 6)

03/31/2023 DATE

ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO	3-00582

DRAWING NO. D107

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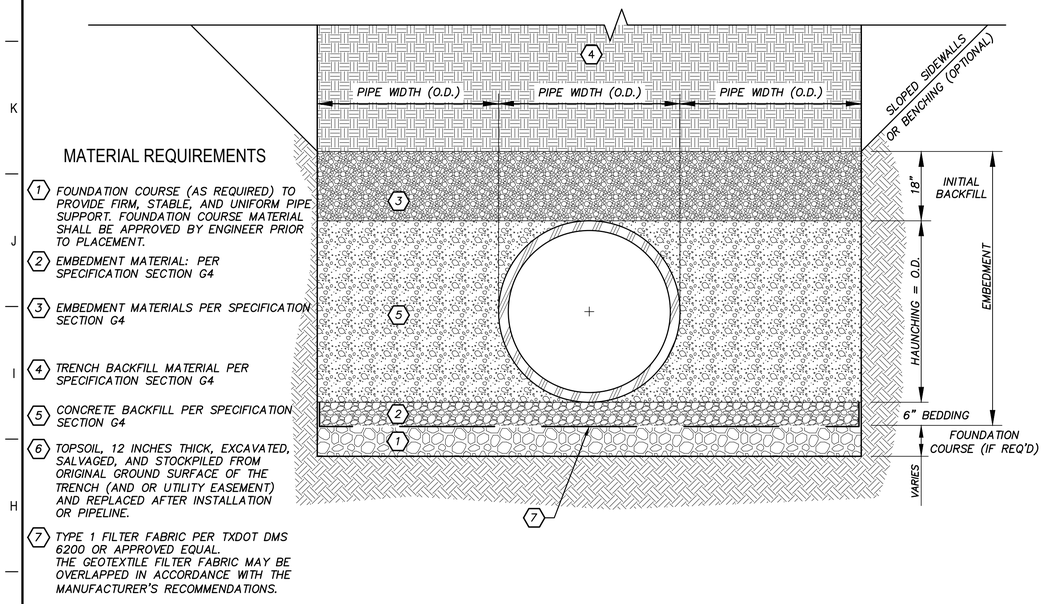
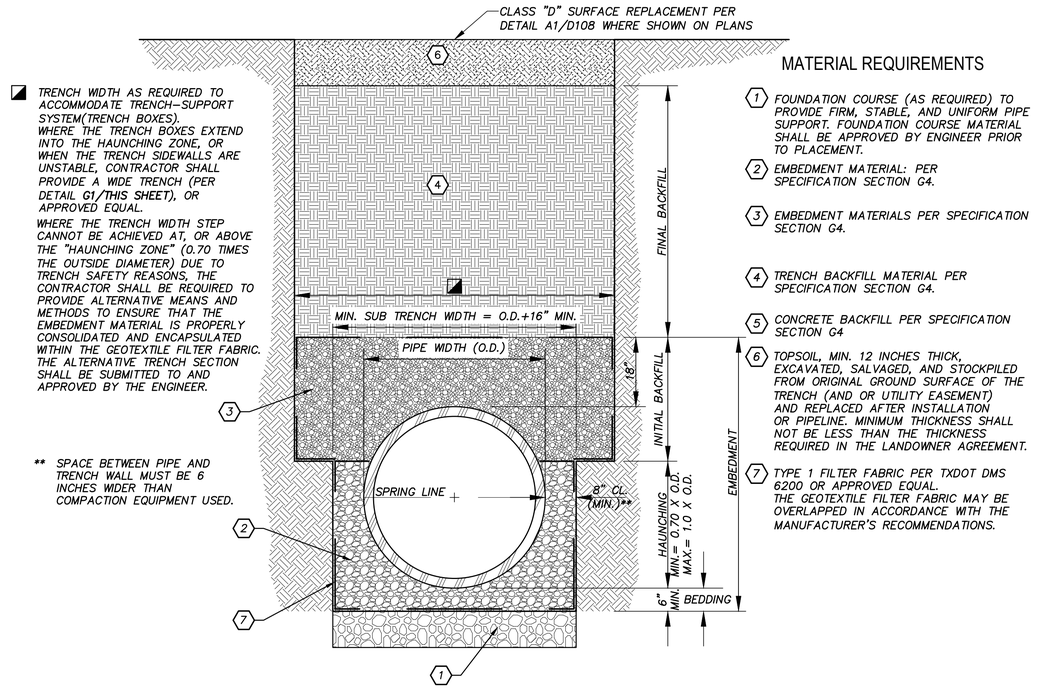


MATERIAL REQUIREMENTS

1. FOUNDATION COURSE (AS REQUIRED) TO PROVIDE FIRM, STABLE, AND UNIFORM PIPE SUPPORT. FOUNDATION COURSE MATERIAL SHALL BE APPROVED BY ENGINEER PRIOR TO PLACEMENT.
2. EMBEDMENT MATERIAL: PER SPECIFICATION SECTION G4
3. EMBEDMENT MATERIALS PER SPECIFICATION SECTION G4
4. TRENCH BACKFILL MATERIAL PER SPECIFICATION SECTION G4
5. CONCRETE BACKFILL PER SPECIFICATION SECTION G4
6. TOPSOIL, 12 INCHES THICK, EXCAVATED, SALVAGED, AND STOCKPILED FROM ORIGINAL GROUND SURFACE OF THE TRENCH (AND OR UTILITY EASEMENT) AND REPLACED AFTER INSTALLATION OR PIPELINE.
7. TYPE 1 FILTER FABRIC PER TXDOT DMS 6200 OR APPROVED EQUAL. THE GEOTEXTILE FILTER FABRIC MAY BE OVERLAPPED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

G1 WIDE TRENCH SECTION FOR UNSTABLE SOILS

SCALE: N.T.S.



TRENCH WIDTH AS REQUIRED TO ACCOMMODATE TRENCH-SUPPORT SYSTEM(TRENCH BOXES). WHERE THE TRENCH BOXES EXTEND INTO THE HAUNCHING ZONE, OR WHEN THE TRENCH SIDEWALLS ARE UNSTABLE, CONTRACTOR SHALL PROVIDE A WIDE TRENCH (PER DETAIL G1/THIS SHEET), OR APPROVED EQUAL.

WHERE THE TRENCH WIDTH STEP CANNOT BE ACHIEVED AT, OR ABOVE THE "HAUNCHING ZONE" (0.70 TIMES THE OUTSIDE DIAMETER) DUE TO TRENCH SAFETY REASONS, THE CONTRACTOR SHALL BE REQUIRED TO PROVIDE ALTERNATIVE MEANS AND METHODS TO ENSURE THAT THE EMBEDMENT MATERIAL IS PROPERLY CONSOLIDATED AND ENCAPSULATED WITHIN THE GEOTEXTILE FILTER FABRIC. THE ALTERNATIVE TRENCH SECTION SHALL BE SUBMITTED TO AND APPROVED BY THE ENGINEER.

** SPACE BETWEEN PIPE AND TRENCH WALL MUST BE 6 INCHES WIDER THAN COMPACTION EQUIPMENT USED.

MATERIAL REQUIREMENTS

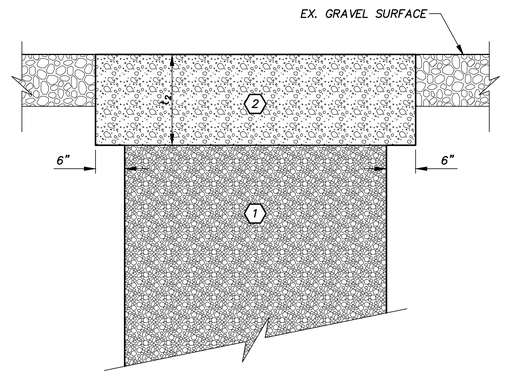
1. FOUNDATION COURSE (AS REQUIRED) TO PROVIDE FIRM, STABLE, AND UNIFORM PIPE SUPPORT. FOUNDATION COURSE MATERIAL SHALL BE APPROVED BY ENGINEER PRIOR TO PLACEMENT.
2. EMBEDMENT MATERIAL: PER SPECIFICATION SECTION G4.
3. EMBEDMENT MATERIALS PER SPECIFICATION SECTION G4.
4. TRENCH BACKFILL MATERIAL PER SPECIFICATION SECTION G4.
5. CONCRETE BACKFILL PER SPECIFICATION SECTION G4
6. TOPSOIL, MIN. 12 INCHES THICK, EXCAVATED, SALVAGED, AND STOCKPILED FROM ORIGINAL GROUND SURFACE OF THE TRENCH (AND OR UTILITY EASEMENT) AND REPLACED AFTER INSTALLATION OR PIPELINE. MINIMUM THICKNESS SHALL NOT BE LESS THAN THE THICKNESS REQUIRED IN THE LANDOWNER AGREEMENT.
7. TYPE 1 FILTER FABRIC PER TXDOT DMS 6200 OR APPROVED EQUAL. THE GEOTEXTILE FILTER FABRIC MAY BE OVERLAPPED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

G8 TYPICAL TRENCH SECTION FOR LARGE DIA. PIPE

SCALE: N.T.S.

MATERIAL REQUIREMENTS

1. BACKFILL MATERIAL IN AREAS SUBJECT TO OR INFLUENCED BY VEHICULAR TRAFFIC: PER SPECIFICATION SECTION G4 – PIPE EXCAVATION,TRENCHING, EMBEDMENT, ENCASEMENT AND BACKFILLING
2. FLEXIBLE BASE PER SPECIFICATION SECTION SD4 – FLEXIBLE BASE. MINIMUM THICKNESS SHALL BE 12", OR MATCH THE EXISTING BASE THICKNESS, WHICHEVER IS GREATER.

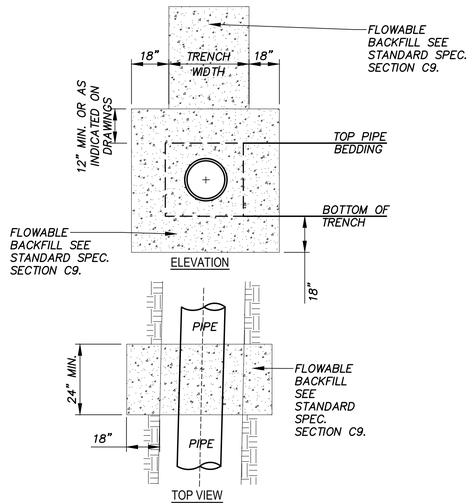


CLASS "D"

SURFACE REPLACEMENT FOR GRAVEL SURFACE

A1 SURFACE REPLACEMENT DETAILS

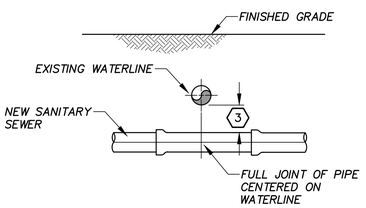
SCALE: N.T.S.



NOTE:
UNLESS OTHERWISE SPECIFIED IN PLANS. FLOWABLE BACKFILL WATER STOP SHALL BE CONSTRUCTED WITH DIMENSIONS AS SHOWN IN THIS STANDARD.

A8 WATER STOP DETAIL

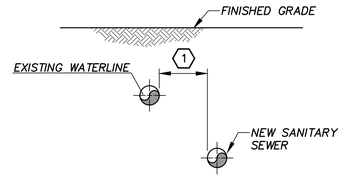
SCALE: N.T.S.



NEW SANITARY SEWER CROSSING EXIST. WATERLINE

KEY NOTES:

1. ALL WATER AND SEWER LINE CONSTRUCTION RUNNING PARALLEL WITH EACH OTHER SHALL MAINTAIN A 9' HORIZONTAL SEPARATION, PIPE WALL TO PIPE WALL.
2. SEPARATION REQUIREMENTS SHOWN HERE DO NOT APPLY TO SERVICE CONNECTIONS – REFER TO INTERNATIONAL PLUMBING CODE FOR APPLICABLE REQUIREMENTS.
3. ALL SEWER AND WATERLINE CROSSINGS SHALL COMPLY WITH THE TCEQ CHAPTER 290, PUBLIC DRINKING WATER SECTION 290.44 WATER DISTRIBUTION, SUB SECTION B, NEW WATERLINE INSTALLATION–CROSSING LINES, PARAGRAPHS (1) THROUGH (I) AND ALL SUB PARAGRAPHS THEREIN.



A12 WATER & SANITARY SEWER CROSSING

SCALE: N.T.S.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WASTEWATER DETAILS (4 OF 6)

03/31/2023
DATE

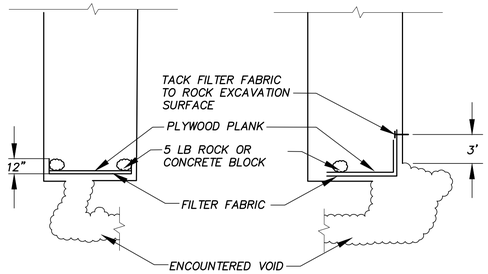
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

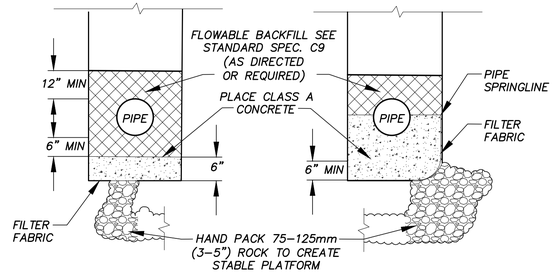
DRAWING NO.
D108

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-WW DETAILS.DWG, D108 WASTEWATER DETAILS (4 OF 6), 8/14/2023 2:48:51 PM, rcuellar



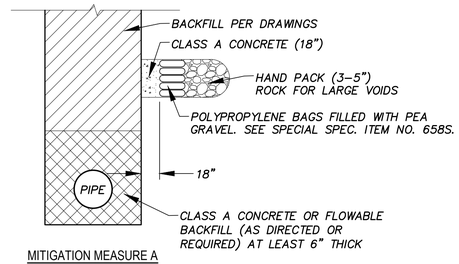
NOTES:
1. PLACE TEMPORARY PROTECTION WITHIN TRENCH TO COVER VOID AS INDICATED. FILTER FABRIC SHALL EXTEND A MINIMUM OF 3 FEET BEYOND EDGE OF VOID. PLACE A PLYWOOD PLANK (MINIMUM 0.75" THICK) OVER FABRIC. PLANK AND FABRIC SHALL BE WEIGHTED AS REQUIRED BY ROCK 5 LB OR CONCRETE BLOCK TO SECURE FILTER FABRIC.
2. TEMPORARY PROTECTION SHALL BE IN PLACE AT ALL TIMES THAT CONSTRUCTION OPERATIONS ARE NOT IN ACTUAL PROGRESS.
3. CONSTRUCTION OPERATIONS WITHIN 50 FEET SHALL NOT PROGRESS DURING OCCURRENCE OF RAIN TO ALLOW FOR PROTECTION OF VOID DURING A RAIN EVENT.
4. LOCALIZED EROSION MEASURES (SILT FENCE OR EROSION CONTROL LOG) SHALL BE INSTALLED ALONG THE TRENCH TO ENSURE THAT LOOSE SPOILS OR RUNOFF DO NOT ENTER THE TRENCH OR AFFECT PERFORMANCE OF TEMPORARY PROTECTION. USE EARTHEN BERM TO DIVERT WATER AWAY FROM TRENCH.
5. SPECIAL CARE SHALL BE TAKEN TO ENSURE THAT EROSION CONTROL MEASURES REQUIRED ALONG THE TRENCH ARE MAINTAINED, CLEANED AND FULLY FUNCTIONAL.
6. PROCEDURES AND MATERIAL REQUIREMENTS OUTLINED IN SPECIAL SPEC. ITEM NO. 658S SHALL BE FOLLOWED.
7. FILTER FABRIC AND ROCK OR CONCRETE BLOCKS AND PLYWOOD PLANK SHALL BE REMOVED FROM THE TRENCH WHEN PERMANENT VOID MITIGATION MEASURES ARE INSTALLED.

G1 CLASS I - TEMPORARY PROTECTION OF VOID AT BOTTOM OF TRENCH — SCALE: N.T.S.

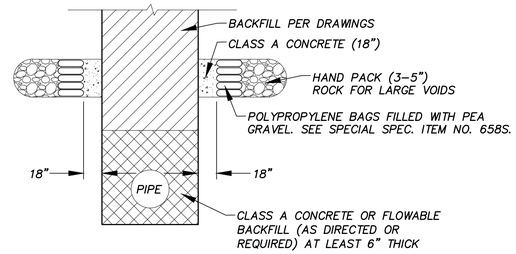


NOTES:
1. PROCEDURES AND MATERIAL REQUIREMENTS OUTLINED IN SPECIAL SPEC. ITEM 658S SHALL BE FOLLOWED.
2. VOID OPENING MAY REQUIRE REINFORCEMENT OR SUPPORT IF LARGER THAN 3 FEET IN WIDTH OR LENGTH. INSTALL AT DIRECTION OF THE ENGINEER OR DESIGNATED REPRESENTATIVE.
3. CLASS A CONCRETE SHALL CONFORM TO STANDARD SPEC SECTION C2. PLACE A FORM TO ENSURE MINIMUM THICKNESS OF 18 INCHES EXTENDING A MINIMUM OF 6 INCHES BEYOND THE EDGE OF THE VOID.

G8 CLASS II - PERMANENT VOID MITIGATION MEASURES — SCALE: N.T.S.

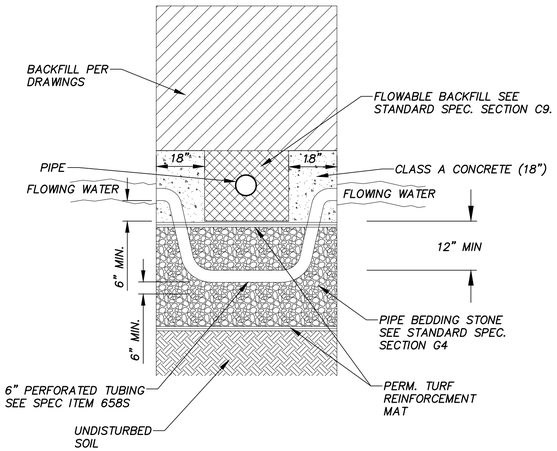


MITIGATION MEASURE A

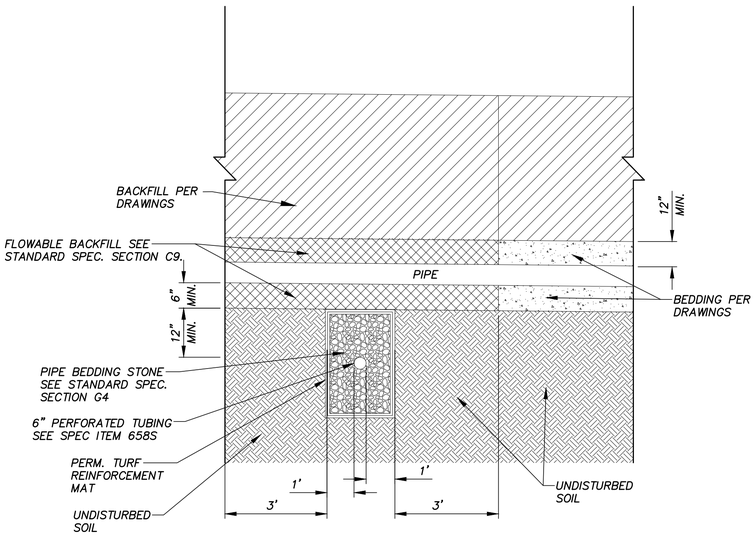


MITIGATION MEASURE B

G11 CLASS III - VOID MITIGATION MEASURES — SCALE: N.T.S.

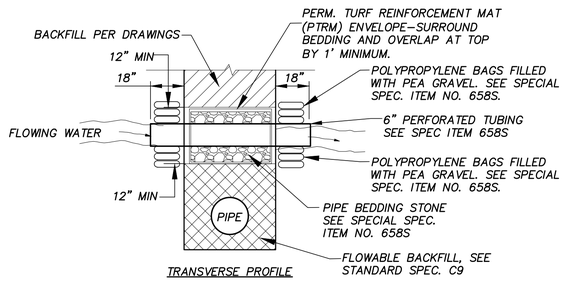


TRANSVERSE PROFILE



LONGITUDINAL PROFILE

A1 MODIFIED CLASS IV - WATER FLOW MITIGATION MEASURES WITHIN BEDDING MATERIAL DEPTH — SCALE: N.T.S.



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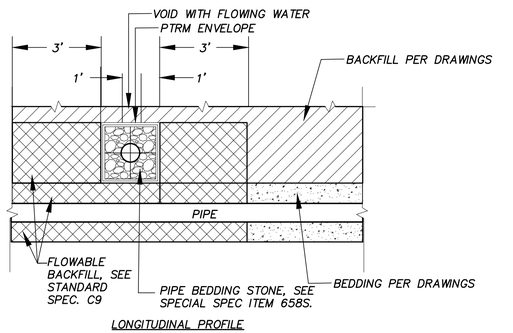


LONGITUDINAL PROFILE

A11 CLASS V - WATER FLOW MITIGATION MEASURES GROUNDWATER ABOVE BEDDING MATERIAL DEPTH — SCALE: N.T.S.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WASTEWATER DETAILS (5 OF 6)

03/31/2023 — DATE

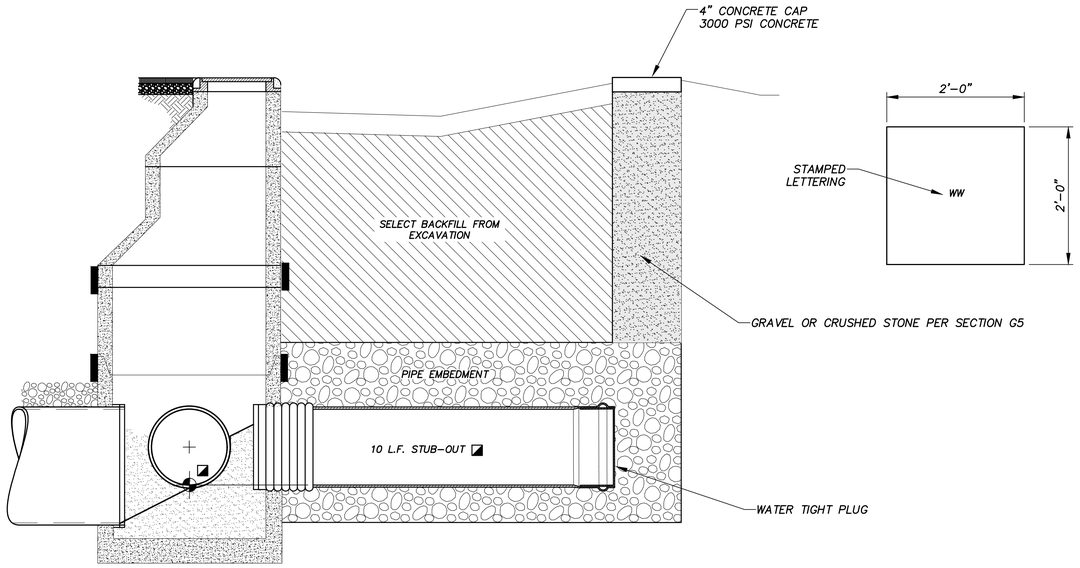
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D109

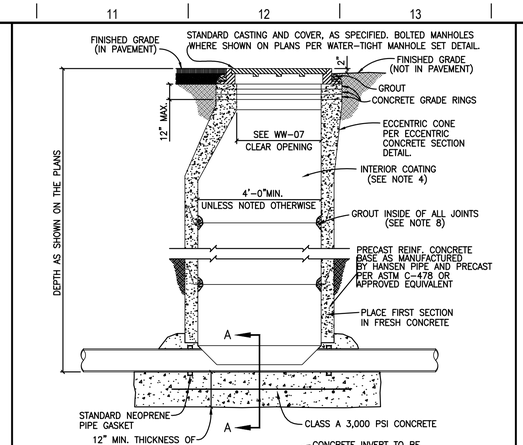
G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-WW DETAILS.DWG, D109 WASTEWATER DETAILS (5 OF 6), 8/14/2023 2:48:54 PM, rcuellar



RE. PLAN & PROFILE SHEETS FOR SLOPE AND FLOWLINE ELEVATIONS

G1 WASTEWATER MANHOLE STUB-OUT DETAIL

SCALE: N.T.S.



NOTES:
1. MANHOLES SHALL BE PRECAST ASTM C-478 BELL AND SPIGOT WITH PROFILE GASKET – SINGLE OFF-SET JOINTS.
2. SEE PLANS AND MANHOLE SCHEDULE, FOR MANHOLE SIZE, LOCATION, CONFIGURATION, TYPE OF TOP SECTION, VENTING REQUIREMENTS, PIPE SIZE AND TYPES.
3. SEE SPECIFICATIONS ON MATERIALS AND CONSTRUCTION.
4. AN 80 MIL COAT OF RAVEN LINING SYSTEMS, RAVEN 405 ULTRA HIGH BUILD EPOXY COATING, OR SPRAY WALL EPOXY COATING, OR APPROVED EQUAL, TO BE APPLIED TO ENTIRE INTERIOR OF EACH WASTEWATER MANHOLE AND UNDERSIDE OF FLAT TOPS.
5. ALL MANHOLE COVERS SHALL BE BOLTED AND GASKETTED WHEN MANHOLES ARE LOCATED OUT FROM PAVEMENT.
6. MANHOLES TO BE VENTED ARE IDENTIFIED ON MANHOLE SCHEDULE. REFERENCE MANHOLE VENT DETAIL.
7. MANHOLES ARE TO BE DESIGNED TO RESIST LATERAL AND VERTICAL SOIL FORCES RESULTING FROM MANHOLE DEPTH. ADDITIONALLY, MANHOLES LOCATED IN PAVEMENT TO BE DESIGNED FOR HS-20 TRAFFIC LOADS.
8. GROUT SHALL MEET THE REQUIREMENTS AS STATED BY THE COATING MANUFACTURER.
9. MANHOLE BASE BEDDING MATERIAL SPECS, FOR 3/4" WASHED GRAVEL:
   SIEVE SIZE 2", PERCENT (%) RETAINED 0 — SIEVE SIZE 1 1/2", % RETAINED 0-10
   SIEVE SIZE 1", % RETAINED 45-80 — SIEVE SIZE 3/4", % RETAINED 85-100
   SIEVE SIZE 3/8", % RETAINED 95-100
10. ALL PVC PIPE SHALL BE REMOVED FROM INVERT.

The Architect/Engineer assumes responsibility for appropriate use of this standard.

REVISION NOTES: ADOPTED 6/21/2006

CITY OF GEORGETOWN
CONSTRUCTION STANDARDS AND DETAILS
PRECAST MANHOLE ON CAST-IN-PLACE FOUNDATION

DRAWING NO.: WW20
SCALE: NTS | DATE: 1/2006
DRAWN BY: MRS | APPROVED BY: TRB

G10 PRECAST MANHOLE ON CAST-IN-PLACE FOUNDATION

DETAIL NO. WW20 | CITY OF GEORGETOWN | SCALE: N.T.S.

A1 NOT USED

A5 NOT USED

A10 NOT USED

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

WASTEWATER DETAILS (6 OF 6)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D110

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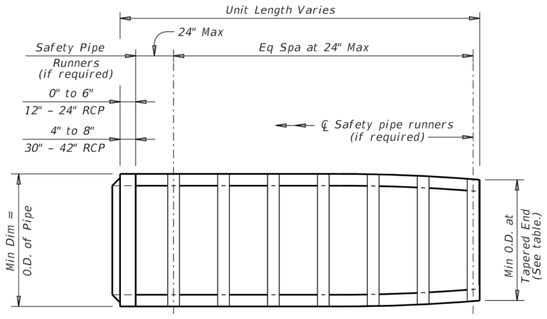
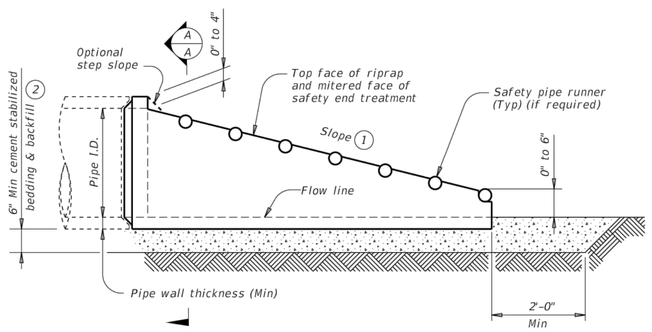


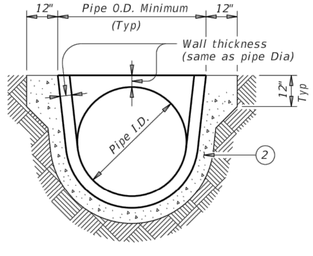
PLAN VIEW – 12" THRU 24"

(Showing spigot end connection.)

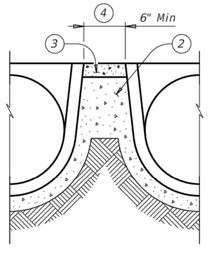


LONGITUDINAL ELEVATION - 12" THRU 24"

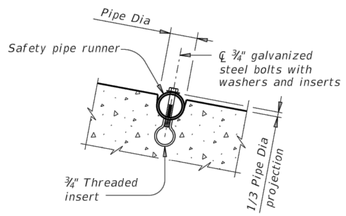
(Showing spigot end connection.)



SECTION A-A

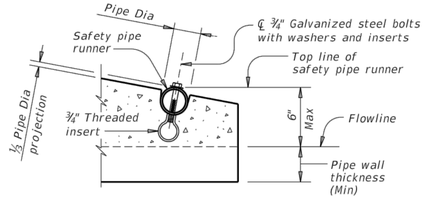


MULTIPLE PIPE INSTALLATION

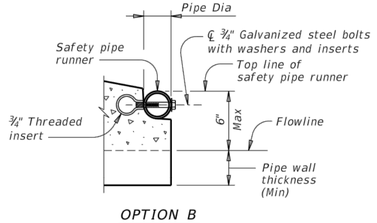


INSTALLATION DETAIL FOR SAFETY PIPE RUNNERS

(If required)



OPTION A



OPTION B

END DETAILS FOR INSTALLATION OF SAFETY PIPE RUNNERS

(If required)

1. Slope as shown elsewhere in the plans. Slope of 6:1 or flatter is required for vehicle safety.
2. Provide cement stabilized bedding and backfill in accordance with the Item, "Excavation and Backfill for Structures". Bedding and backfill is considered subsidiary to the Item 467, "Safety End Treatment". When concrete riprap is specified around the safety end treatment, backfill as directed by Engineer.
3. Fill the top 4" of void between precast end treatments with concrete riprap. Concrete riprap is considered subsidiary to the Item 467, "Safety End Treatment".
4. Adjust clear distance between pipes to provide for the minimum distance between safety end treatments.
5. Safety pipe runners are required for multiple pipe culverts with more than two pipes.

REQUIREMENTS FOR CULVERT PIPES AND SAFETY PIPE RUNNERS

Pipe I.D.	Min Wall Thickness	Min O.D.	Min O.D. at Tapered End	Min Reinf Requirements (sq. in. per ft. of Pipe)	Max Slope	Min Length of Unit	Pipe Runner Requirements		Required Pipe Runner Sizes		
							Single Pipe	Multiple Pipe	Nominal Dia	O.D.	I.D.
12"	2"	16"	16"	0.07 Circ.	6:1	4'–0"	No	(5)	3" STD	3.500"	3.068"
15"	2 ¼"	19 ½"	19"	0.07 Circ.	6:1	5'–8"	No	(5)	3" STD	3.500"	3.068"
18"	2 ½"	23"	21 ½"	0.07 Circ.	6:1	7'–3"	No	(5)	3" STD	3.500"	3.068"
24"	3"	30"	27"	0.07 Circ.	6:1	10'–6"	No	(5)	3" STD	3.500"	3.068"
30"	3 ½"	37"	31"	0.18 Circ.	6:1	12'–1"	No	Yes	4" STD	4.500"	4.026"
36"	4"	44"	36"	0.19 Ellip.	6:1	15'–4"	Yes	Yes	4" STD	4.500"	4.026"
42"	4 ½"	51"	41 ½"	0.23 Ellip.	6:1	18'–7"	Yes	Yes	4" STD	4.500"	4.026"

MATERIAL NOTES:

Synthetic fibers listed on the "Fibers for Concrete" Material Producer List (MPL) may be used in lieu of steel reinforcing in riprap concrete unless noted otherwise.

Provide pipe runners meeting the requirements of ASTM A53 (Type E or S, Gr B), ASTM A500 Gr B, or API 5LX52.

Galvanize steel components except reinforcing steel after fabrication. Repair galvanizing damaged during transport or construction in accordance with the specifications.

GENERAL NOTES:

Precast safety end treatment for reinforced concrete pipe (RCP) may be used for TYPE II end treatment as specified in Item 467, "Safety End Treatment".

When precast safety end treatment is used as a Contractor's alternate to mitered RCP, riprap will not be required unless noted otherwise on the plans.

Manufacture precast concrete end sections in accordance with Item 464, "Reinforced Concrete Pipe" and in accordance with ASTM Specification C-76, Class III, Wall B for circular pipe.

Provide precast concrete end sections with a spigot or bell end for compatibility to upstream or downstream end conditions with sufficient annular space to allow for grout, mortar, cold applied asphalt joint compound or pre-formed plastic gasket material.

Methods of lifting shall be provided by the manufacturer for ease of loading, unloading and installation.

Pipe runners are designed for a traversing load of 10,000 Lbs at yield as recommended by Research Report 280-2F, "Safety Treatment of Roadside Parallel-Drainage Structures", Texas Transportation Institute, March 1981.

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DATE:
FILE:

REV.	DESCRIPTION	DATE

Texas Department of Transportation — Bridge Division Standard

PRECAST SAFETY END TREATMENT

TYPE II ~ PARALLEL DRAINAGE

PSET-RP

FILE: psetrpss-20.dgn	DN: RLW	CK: KLR	DW: JTR	CK: GAF
©TxDOT February 2020	CONT	SECT	JOB	HIGHWAY
REVISIONS	DIST	COUNTY		SHEET NO.

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

SAFETY END TREATMENT

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D111

A1 PRECAST SAFETY END TREATMENT TYPE II - PARALLEL DRAINAGE

TEXAS DEPARTMENT OF TRANSPORTATION

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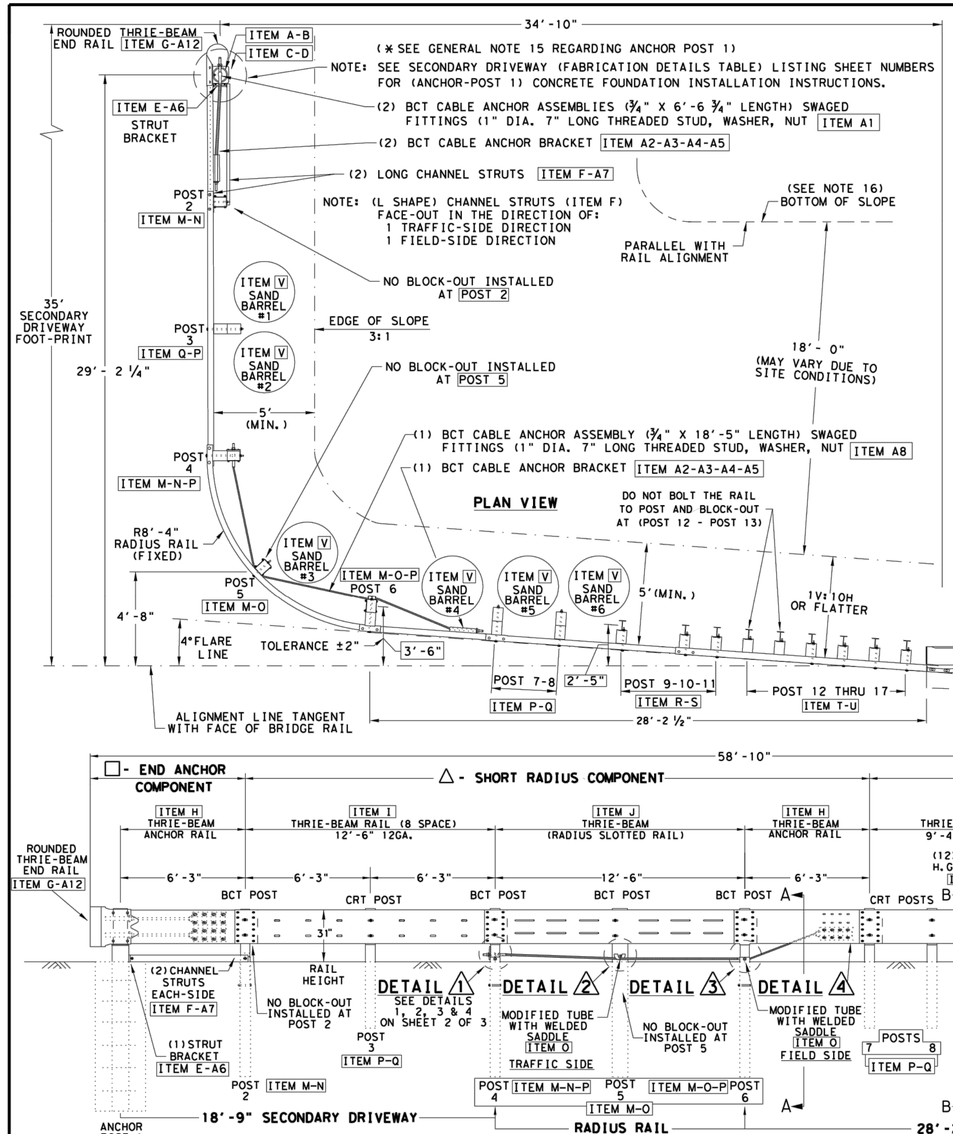


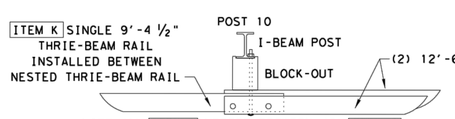
FULL-LENGTH ELEVATION VIEW

NOTE: ALL CABLE BRACKET ASSEMBLIES ARE LOCATED ON THE FIELD-SIDE. SHOWN HERE FOR CLARITY.

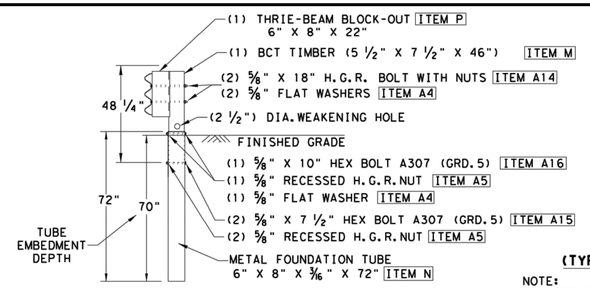
NOTE: FOR BCT POSTS 2-4-5-6 INSTALL (1) OR (2) ITEM A15-A4-A5 BOLT ASSEMBLIES TO PREVENT TIMBER POST SLIDING DOWN FOUNDATION TUBE.

ANCHOR POST 1 FABRICATION DETAILS	
SHEET DESCRIPTION	SHEET NUMBER
ANCHOR POST	SHEET 1 OF 8
ANCHOR SLEAVE	SHEET 2 OF 8
RADIUS RAIL	SHEET 3 OF 8
THRIE-BEAM RAILS	SHEET 4 OF 8
BCT TIMBER POST	SHEET 5 OF 8
STRUT RADIUS ANCHOR	SHEET 6 OF 8
FOUNDATION TUBE	SHEET 7 OF 8
ANCHOR CABLE	SHEET 8 OF 8

DATE:
FILE:

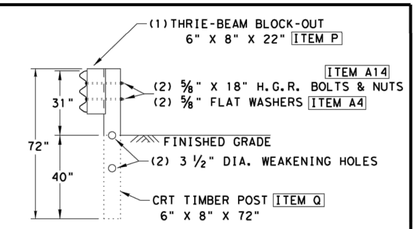


NESTED-GUARDRAIL SPLICE AT POST 10



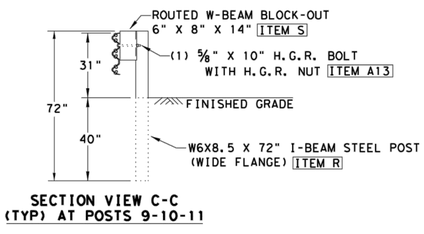
SECTION VIEW (A-A) TIMBER POST WITH METAL FOUNDATION TUBE (TYP) BCT POSTS 2-4-5-6

NOTE: NO BLOCK-OUTS INSTALLED AT BCT POST 2 - POST 5

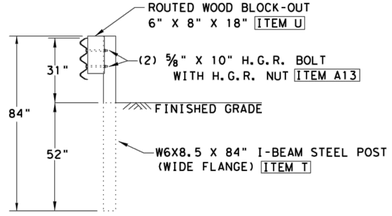


SECTION VIEW (B-B) (TYP) CRT TIMBER POSTS 3-7-8

NOTE:
SEE SPECIAL APPLICATION NOTES ON SHEET 3 OF 3.
CRT POST WILL REQUIRE AN ADDITIONAL ¾" HOLE TO ACCOMMODATE THE 22" LONG BLOCKOUT.



SECTION VIEW C-C (TYP) AT POSTS 9-10-11



* SECTION VIEW D-D (TYP) AT POSTS 12-13-14-15-16-17

DO NOT BOLT THE RAIL TO POST AND BLOCK-OUT AT (POST 12 & POST 13)

NOTE: FOR POST 12 & 13

(MASH TL-3 COMPLIANT)
TESTED TO MASH TL-3 WITH A 3:1 SLOPE

SHEET 1 OF 3

Texas Department of Transportation — Design Division Standard

TL-3 SHORT RADIUS GUARDRAIL MASH COMPLIANT

SRG(TL-3)-21

FILE: srgt1321	TxDOT	CK:KM	DN: VP	CK:CGL
© TxDOT: FEBRUARY 2021	CONT	SECT	JOB	HIGHWAY
REVISIONS	DIST	COUNTY		SHEET NO.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

SHORT RADIUS GUARDRAIL (1 OF 3)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D112

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G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-DRIVEWAY DETAILS.DWG, D112 SHORT RADIUS GUARDRAIL (1 OF 3), 8/15/2023 2:57:16 PM, trobles

A1 — TL-3 SHORT RADIUS GUARDRAIL MASH COMPLIANT (PAGE 1 OF 3)

TEXAS DEPARTMENT OF TRANSPORTATION

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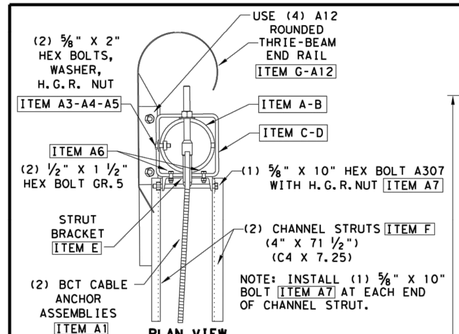
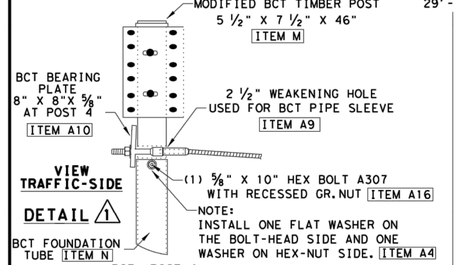
DATE:
FILE:



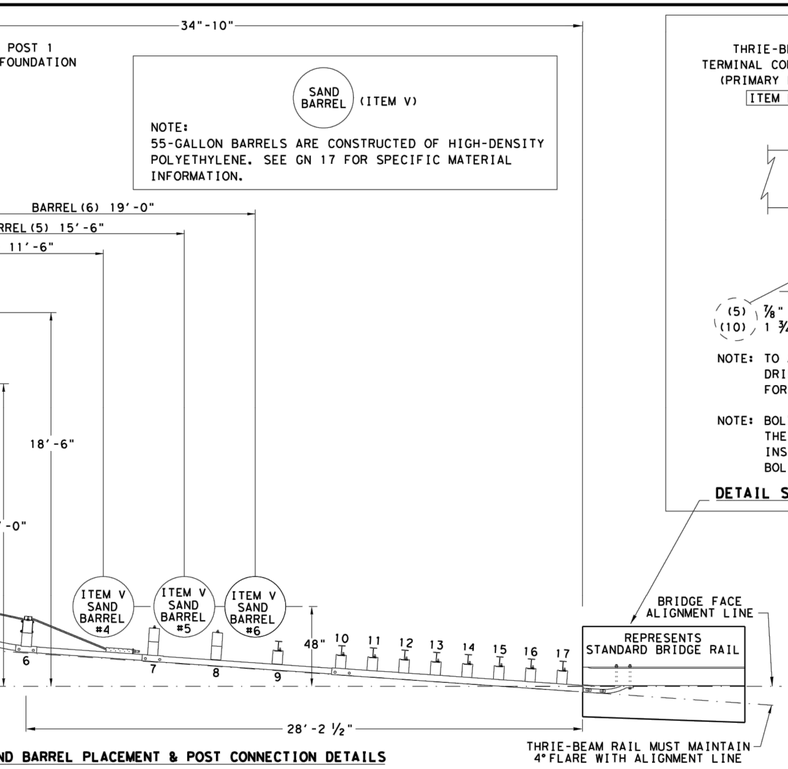
PLAN VIEW ANCHOR POST 1



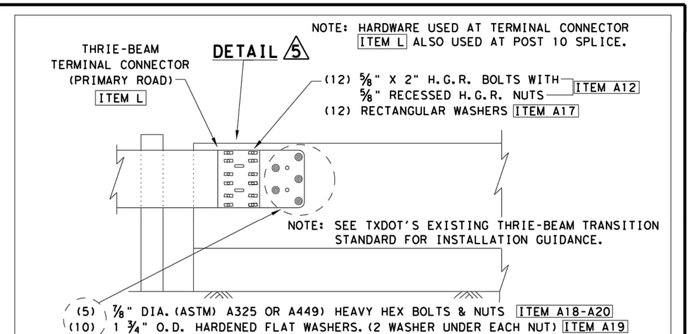
VIEW TRAFFIC-SIDE

DETAIL 1

BCT (POST 4) TIMBER POST WITH METAL FOUNDATION TUBE



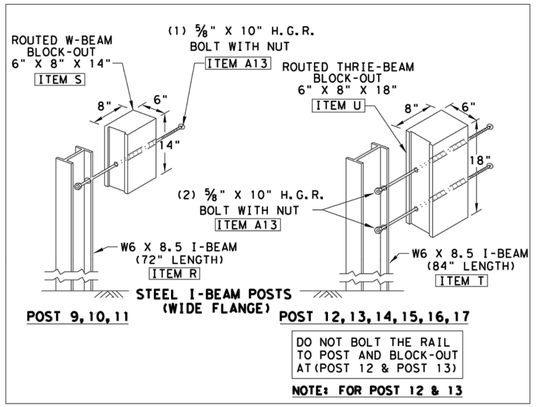
SAND BARREL PLACEMENT & POST CONNECTION DETAILS



NOTE: TO ACCOMMODATE THE THRIE-BEAM TERMINAL CONNECTOR AT THE BRIDGE RAIL. DRILL FIVE (5) 1" DIA. HOLES. USE THE CONNECTOR PLATE HAS A TEMPLATE FOR THE HOLE LOCATIONS.

NOTE: BOLTS SHALL BE OF SUFFICIENT LENGTH TO EXTEND THROUGH THE FULL THICKNESS OF THE BRIDGE-RAIL, WASHER & HEX NUT. INSTALL WITH BOLT HEADS ON TRAFFIC-SIDE. (LENGTH OF THE BOLTS SHALL BE VERIFIED BY CONTRACTOR PRIOR TO ORDERING.)

DETAIL SHOWING PRIMARY ROADWAY BRIDGE-RAIL CONNECTION



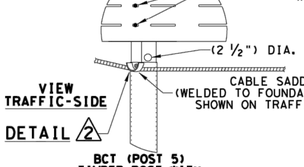
STEEL I-BEAM POSTS (WIDE FLANGE)

POST 9,10,11

POST 12,13,14,15,16,17

DO NOT BOLT THE RAIL TO POST AND BLOCK-OUT AT (POST 12 & POST 13)

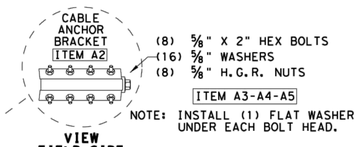
NOTE: FOR POST 12 & 13



VIEW TRAFFIC-SIDE

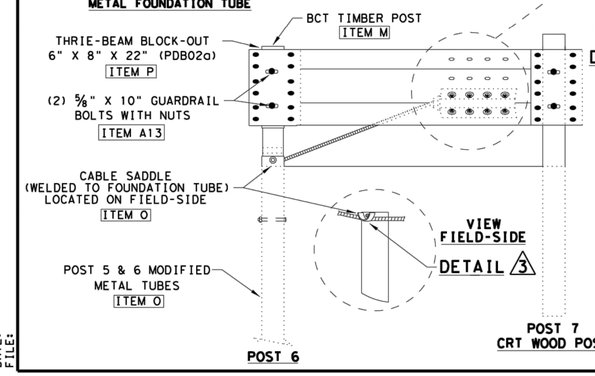
DETAIL 2

BCT (POST 5) TIMBER POST WITH METAL FOUNDATION TUBE



VIEW FIELD-SIDE

DETAIL 4



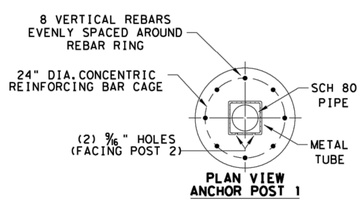
VIEW FIELD-SIDE

DETAIL 3

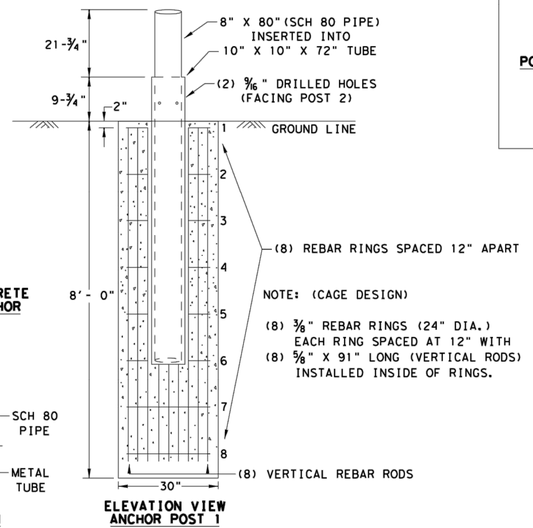
POST 6

POST 7 CRT WOOD POST

POST 1 REINFORCED CONCRETE FOUNDATION ANCHOR



PLAN VIEW ANCHOR POST 1



ELEVATION VIEW ANCHOR POST 1

(MASH TL-3 COMPLIANT)
TESTED TO MASH TL-3 WITH A 3:1 SLOPE

SHEET 2 OF 3

Texas Department of Transportation — Design Division Standard

TL-3 SHORT RADIUS GUARDRAIL MASH COMPLIANT

SRG(TL-3)-21

FILE: srgt1321	TxDOT	CK:KM	DN: VP	CK:CGL
© TxDOT: FEBRUARY 2021	CONT	SECT	JOB	HIGHWAY
REVISIONS				
	DIST	COUNTY		SHEET NO.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

SHORT RADIUS GUARDRAIL (2 OF 3)

03/31/2023 DATE

ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D113

A1 | TL-3 SHORT RADIUS GUARDRAIL MASH COMPLIANT (PAGE 2 OF 3)

TEXAS DEPARTMENT OF TRANSPORTATION

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-DRIVEWAY DETAILS.DWG, D113 SHORT RADIUS GUARDRAIL (2 OF 3), 8/15/2023 2:57:24 PM, trobles

DISCLAIMER:
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DATE:
FILE:

ITEM	ALL LARGE & SMALL COMPONENT DESCRIPTIONS	END ANCHOR (POST 1 & POST 2) □ ITEM	QTY	TL-3 SHORT RADIUS (POST 2 TO POST 7) △ ITEM	QTY	TL-3 TRANSITION (POST 7 TO POST 17) ○ ITEM	QTY	TL-3 SHORT RADIUS GUARDRAIL COMPLETE SYSTEM ITEM	TOTAL QTY
A	POST 1 TOP (SCH.80 PIPE) (8" X 80" LENGTH)	A	1					A	1
B	POST 1 TOP (WELDED SUPPORT COLLAR 10" X 10" X ½" ASTM A36)	B	1					B	1
C	POST 1 TUBE (HSS 10" X 10" X ½" X 72" LENGTH) A500 GR.B	C	1					C	1
D	POST 1 (WELDED PLATE 9 ¼" X 9 ¼" X ⅛") A36	D	1					D	1
E	POST 1 STRUT BRACKET (C8 X 11.50 A36)	E	1					E	1
F	(POST 1 & 2) CHANNEL STRUTS (4" X 71 ½")(C4 X 7.25)A36	F	2					F	2
G	THRIE-BEAM RAIL (END ANCHOR - ROUNDED TYPE) 12GA. (RTE02a)	G	1					G	1
H	THRIE-BEAM RAIL (ANCHOR) (6'-3" LENGTH) 12GA. (RWM14a)	H	1	H	1			H	2
I	THRIE-BEAM RAIL (8 SPACE) (12'-6" LENGTH) 12GA. (RTM08)			I	1	I	2	I	3
J	THRIE-BEAM RAIL (RADIUS 8'-4 ½") (SLOTTED) 12GA.			J	1			J	1
K	THRIE-BEAM RAIL (3 SPACE) (9'-4 ½" LENGTH) 12GA.					K	1	K	1
L	THRIE BEAM RAIL (TERMINAL CONNECTOR) (BRIDGE-RAIL) (RTE01b)					L	1	L	1
M	POST 2,4,5,6 BCT TIMBER (5 ½" X 7 ½" X 46") (PDF04)			M	4			M	4
N	POST 2,4, BCT TUBE (6" X 8" X 3/16" X 72" LENGTH) (PTE05)			N	2			N	2
O	POST 5,6 MODIFIED BCT TUBES (FOR WELDED CABLE SADDLES)			O	2			O	2
P	POST 3,4,6,7,8 THRIE-BEAM BLOCK-OUT (6" X 8" X 22")(PDB02a)			P	4	P	1	P	5
Q	POST 3,7,8 CRT TIMBER POSTS (6" X 8" X 72" LENGTH)(PDE09)			Q	2	Q	1	Q	3
R	POST 9,10,11 I-BEAM POSTS (W6X8.5 X 72" LENGTH) (PWE01)					R	3	R	3
S	POST 9,10,11 ROUTED W-BEAM BLOCK-OUT(6" X 8" X 14")(PDB01b)					S	3	S	3
T	POST 12 THRU 17 I-BEAM POSTS (W6X8.5 X 84" LENGTH) (PWE07)					T	6	T	6
U	POST 12 THRU 17 ROUTED BLOCK-OUT (6" X 8" X 18") (PDB??)					U	6	U	6
V	SAND BARRELS 700-715 LBS							V	6
A1	BCT CABLE ANCHOR ASSEMBLIES (¾" X 6'-6 ¾" LENGTH) (FCA01)	A1	2					A1	2
A2	BCT CABLE ANCHOR BRACKET (FPA01)	A2	2	A2	1			A2	3
A3	⅝" X 2" HEX BOLT A307 GRD.5 (FOR CABLE BRACKETS)	A3	18	A3	8			A3	26
A4	⅝" FLAT WASHER A307 GRD.5 (1 WASHER UNDER BOLT HEAD & 1 NUT)	A4	36	A4	40			A4	76
A5	⅝" RECESSED H.G.R NUT (NUTS FOR HEX BOLTS)	A5	22	A5	20			A5	42
A6	STRUT BRACKET HARDWARE (½" X 1 ½") HEX BOLT A307 GRD.5	A6	2					A6	2
A7	CHANNEL STRUT HARDWARE (⅝" X 10") HEX BOLT A307 GRD.5	A7	2					A7	2
A8	BCT CABLE ANCHOR ASSEMBLY (FCA02) (¾" X 18'-5" LENGTH)			A8	1			A8	1
A9	BCT POST SLEEVE (FMM02a) (POST 4 ONLY)			A9	1			A9	1
A10	BCT CABLE BEARING PLATE (⅝" X 8" X 8" (FPB01) (POST 4 ONLY)			A10	1			A10	1
A11	⅝" X 1 ¼" H.G.R. BOLTS (FBB01) (SPLICES AT POST 2,4,6,7)			A11	48			A11	48
A12	⅝" X 2" H.G.R. BOLTS (FBB02)(ROUND TERM-POST 10-END SPLICE)	A12	4			A12	24	A12	28
A13	⅝" X 10" H.G.R. BOLTS (FBB03) (I-BEAM POSTS RAIL & BLOCKOUT)					A13	18	A13	18
A14	⅝" X 18" H.G.R. BOLTS (FBB04) (POSTS 3,4,6,7,8)			A14	8	A14	2	A14	10
A15	⅝" X 7 ½" HEX BOLTS A307 GRD.5 (BCT POSTS 2,4,5,6)			A15	8			A15	8
A16	⅝" X 10" HEX BOLTS A307 GRD.5 (BCT POSTS 2,4,5,6)			A16	4			A16	4
A17	RECTANGULAR WASHERS (FWR03) (FOR TERMINAL CONNECTOR RTE01b)					A17	12	A17	12
A18	⅞" X (LENGTH VARIES) HEX BOLTS A325 OR A449 GR.5					A18	5	A18	5
A19	1 ¾" O.D. HARDENED FLAT WASHER A325					A19	10	A19	10
A20	⅞" HEX NUT GR.5 A325					A20	5	A20	5

GENERAL NOTES

1. FOR ADDITIONAL INSTALLATION INFORMATION AND GUIDANCE CONTACT: TEXAS DEPARTMENT OF TRANSPORTATION, (TXDOT'S DESIGN DIVISION), (512) 416-2678. THE EXACT POSITION OF MBGF SHALL BE SHOWN ELSEWHERE IN THE PLANS OR AS DIRECTED BY THE ENGINEER. THE SIGHT DISTANCE OF THE INSTALLATION WILL NEED TO BE VERIFIED WITH RESPECT TO THE SPECIFIC SITE PLACEMENT.
2. STEEL POSTS ARE NOT PERMITTED AT CRT OR BCT POST POSITIONS.
3. RAIL ELEMENT SHALL MEET THE REQUIREMENTS OF ITEM 540, "METAL BEAM GUARD FENCE" EXCEPT AS MODIFIED ON THE PLANS. THE CONTRACTOR MAY FURNISH RAIL ELEMENTS OF 12 ½" OR 25 FOOT NOMINAL LENGTHS.
4. BUTTON HEAD "POST BOLTS & NUTS" SHALL MEET THE REQUIREMENTS OF (ASTM A307), AND SHALL BE OF SUFFICIENT LENGTH TO EXTEND THROUGH THE FULL THICKNESS OF THE NUT AND ⅝" WASHER (FWC16a) AND NOT MORE THAN 1" BEYOND IT. TRIM REMAINING BOLT LENGTH TO MEET REQUIRED LENGTH.
5. FITTINGS (BOLTS, NUTS, AND WASHERS) SHALL BE GALVANIZED IN ACCORDANCE WITH ITEM 445, "GALVANIZING." FITTINGS SHALL BE SUBSIDIARY TO THE BID ITEM.
6. CROWN SHALL BE WIDENED TO ACCOMMODATE THE METAL BEAM GUARD FENCE.
7. THE LATERAL APPROACH TO THE GUARD FENCE, SHALL HAVE A SLOPE RATE OF NOT MORE THAN 1V:10H.
8. IT IS NOT RECOMMENDED THAT GUARD FENCE BE PLACED IN THE VICINITY OF CURBS.
9. GUARDRAIL POSTS SHALL NOT BE SET IN CONCRETE, OF ANY DEPTH.
10. SPECIAL FABRICATION WILL BE REQUIRED FOR THRIE BEAM RAIL RADIUS (ITEM J).
11. ALL MATERIAL AND WORK INVOLVED IS SUBSIDIARY TO SHORT RADIUS BID ITEM, INCLUDING, BUT NOT LIMITED TO FOUNDATIONS, GRADING, THRIE BEAM RAIL, SAND BARRELS, AND OTHER PARTS.
12. ALL CABLE ASSEMBLIES SHOULD BE TAUT AFTER INSTALLATION. WHEN CABLES ARE MANIPULATED BY HAND THE CABLES SHOULD NOT MOVE MORE THAN 1" IN ANY DIRECTION PERPENDICULAR TO THE CABLE.
13. THE BCT BEARING PLATE INSTALLED AT POST 4 SHOULD BE ORIENTED SUCH THAT THE 3" DIMENSION FROM PLATE EDGE TO CENTER OF BOLT HOLE IS ON THE BOTTOM AND 5" DIMENSION FROM PLATE EDGE TO CENTER OF BOLT HOLE IS ON THE TOP.
14. FOUNDATION AT POST 1 SHALL BE CLASS C CONCRETE.
*15. POST (1) IS NOT A CRASHWORTHY TERMINAL. THE DESIGN AND PLACEMENT OF POST (1) MUST BE OUTSIDE OF THE CLEAR ZONE OF THE SECONDARY ROADWAY USING THE RESPECTIVE CLEAR ZONE CRITERIA. PLEASE CONTACT THE DESIGN DIVISION (512) 416-2678 FOR ASSISTANCE IN DETERMINING THE APPROPRIATE USE AND/OR PLACEMENT OF THE SYSTEM IN CONSTRAINED LOCATIONS. THE PAYMENT OF THE COMPLETE SYSTEM WILL BE WITH BID ITEMS: 540 XXXX TL-3 31" SHORT RADIUS (COMPLETE).
16. TESTED TO MASH WITH A 3:1 SLOPE OR SHALLOWER IS PREFERABLE IN THE LIMITS OF THE TOP AND BOTTOM OF THE SLOPE AS SHOWN IN THE PLAN VIEW. IF FIELD CONDITIONS REQUIRE A STEEPER SLOPE, THIS MAY BE ALLOWABLE UP TO A 2:1 SLOPE. CONTACT THE DESIGN DIVISION FOR ADDITIONAL GUIDANCE.
17. THE BARRELS ARE ENERGY ABSORPTION ENERGITE III, MODEL 640 FILLED WITH 715 LB (+/-15) SAND; OR AN APPROVED EQUIVALENT. THE APPROXIMATE HEIGHT OF THE BARREL IS 41" (+/-).
18. ALTERNATE METHODS TO TERMINATE THE SRG ALONG THE PRIMARY ROADWAY ARE AVAILABLE WHEN SITE CONDITIONS DICTATE. CONTACT DESIGN DIVISION FOR DETAILS: 512 416-2678

NOTE: SEE SHEET 1 OF 3.

(MASH TL-3 COMPLIANT)
TESTED TO MASH TL-3 WITH A 3:1 SLOPE

SHEET 3 OF 3

SPECIAL APPLICATION NOTES.

1. THIS IS A MASH COMPLIANT TL-3 SHORT RADIUS GUARDRAIL SYSTEM WITH A TOP RAIL HEIGHT OF 31". AVAILABLE FOR USE ON ANY SPEED ROADWAY. THE SYSTEM REQUIRES A MINIMUM PLACEMENT FOOTPRINT OF 34'-10" ALONG THE PRIMARY ROAD AND A 35'-0" ALONG SECONDARY DRIVEWAY.
2. IT IS CRITICAL THAT THE PRIMARY GUARDRAIL MAINTAIN A (4 DEGREE FLARE) WITH THE SECONDARY DRIVEWAY.
3. THE SYSTEM REQUIRES A MINIMUM 5' WIDE (WORK ZONE) DIRECTLY BEHIND THE GUARDRAIL SYSTEM WITH A SLOPE AT 1V:10H OR FLATTER FROM THERE A MAXIMUM 3:1 SLOPE IS RECOMMENDED. SEE SHEET 1 OF 3 FOR FLARE AND SLOPE DETAILS.
4. NOTE FOR INSTALLER: THE THREE (3) CRT POSTS ITEM (Q), AT POST LOCATIONS, 3, 7, & 8.), REQUIRE THE FOLLOWING FIELD ADJUSTMENT. USING A ¾" X 10" LONG SPADE BIT DRILL ONE (1) ADDITIONAL HOLE 7-⅞" DIRECTLY BELOW THE EXISTING TOP HOLE TO ACCOMMODATE THE HARDWARE FOR THE 22" LONG BLOCKOUT.

   OPTION FOR ADDITIONAL ¾" HOLE. THE 22" LONG BLOCKOUT (PDB01a) IS MANUFACTURED WITH TWO ¾" DRILLED HOLES FOR THE POST HARDWARE, THEREFORE THE BLOCKOUT CAN BE USED AS A TEMPLATE GUIDE FOR THE BOTTOM ¾" HOLE. AFTER INSTALLING THE CRT POST USE THE TOP HOLE TO MOUNT THE 22" LONG BLOCKOUT TO POST, USE THE BLOCKOUT'S PRE-DRILLED HOLE AS A GUIDE FOR THE BOTTOM ¾" HOLE.

Texas Department of Transportation — Design Division Standard

TL-3 SHORT RADIUS GUARDRAIL MASH COMPLIANT

SRG(TL-3)-21

FILE: srgt1321	TxDOT	CK:KM	DN:VP	CK:CGL
© TxDOT: FEBRUARY 2021	CONT	SECT	JOB	HIGHWAY
REVISIONS				
	DIST	COUNTY		SHEET NO.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

SHORT RADIUS GUARDRAIL (3 OF 3)

03/31/2023 — DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D114

A1 — TL-3 SHORT RADIUS GUARDRAIL MASH COMPLIANT (PAGE 3 OF 3)

TEXAS DEPARTMENT OF TRANSPORTATION

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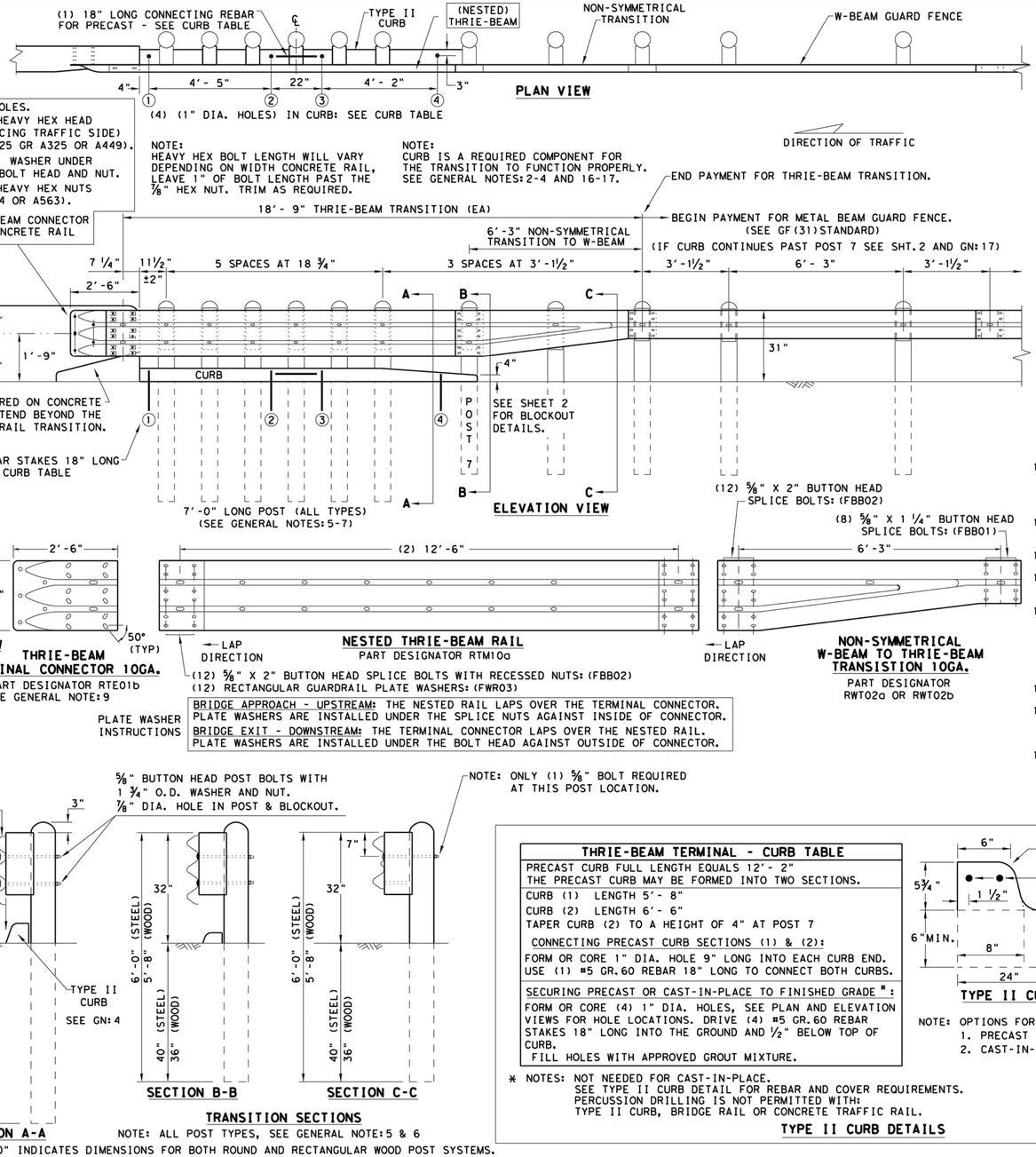
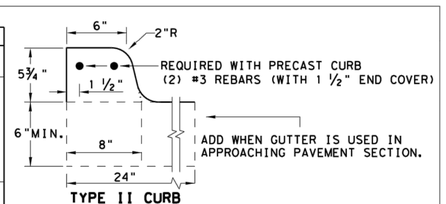


THRIE-BEAM TERMINAL - CURB TABLE
PRECAST CURB FULL LENGTH EQUALS 12'- 2" THE PRECAST CURB MAY BE FORMED INTO TWO SECTIONS.
CURB (1) LENGTH 5'- 8"
CURB (2) LENGTH 6'- 6"
TAPER CURB (2) TO A HEIGHT OF 4" AT POST 7
CONNECTING PRECAST CURB SECTIONS (1) & (2):
FORM OR CORE 1" DIA. HOLE 9" LONG INTO EACH CURB END. USE (1) #5 GR. 60 REBAR 18" LONG TO CONNECT BOTH CURBS.
SECURING PRECAST OR CAST-IN-PLACE TO FINISHED GRADE *:
FORM OR CORE (4) 1" DIA. HOLES, SEE PLAN AND ELEVATION VIEWS FOR HOLE LOCATIONS. DRIVE (4) #5 GR. 60 REBAR STAKES 18" LONG INTO THE GROUND AND ½" BELOW TOP OF CURB. FILL HOLES WITH APPROVED GROUT MIXTURE.



NOTE: OPTIONS FOR TYPE II CURB:
1. PRECAST
2. CAST-IN-PLACE

* NOTES: NOT NEEDED FOR CAST-IN-PLACE.
SEE TYPE II CURB DETAIL FOR REBAR AND COVER REQUIREMENTS.
PERCUSSION DRILLING IS NOT PERMITTED WITH:
TYPE II CURB, BRIDGE RAIL OR CONCRETE TRAFFIC RAIL.

TYPE II CURB DETAILS

DATE:
FILE:

GENERAL NOTES

1. CONTACT THE DESIGN DIVISION FOR DRAINAGE CUT OUT OPTIONS NEEDED WITHIN THE CURB SECTION OF THE THRIE-BEAM TRANSITION. (512) 416-2678
2. CONCRETE CURB MAY BE CAST-IN-PLACE OR PRECAST AS SHOWN ON THIS SHEET. WHEN USED IN CONJUNCTION WITH THE THRIE-BEAM TRANSITIONS, CURB SHALL BE TYPE II (5- ¾" HEIGHT); SEE CURRENT CCCG STANDARD SHEET FOR FURTHER DETAILS. IF OTHER CURB HEIGHTS ARE SHOWN IN THE PLANS IN CONJUNCTION WITH THE TRANSITION, THE CURB HEIGHT MAY BE FROM 4" TO 8" WITH A RELATIVELY VERTICAL FACE. CONCRETE CURB SHALL BE CONTINUOUS TO THE SEVENTH POST UNLESS OTHERWISE SHOWN IN THE PLANS. SEE GENERAL NOTE: 17 FOR CIRCUMSTANCES WHERE CURB CONTINUES PAST POST 7.
3. CONCRETE CURB TYPE II SUBSIDIARY TO "METAL BEAM GUARD FENCE TRANSITION". IF NO ADDITIONAL CURB IS INDICATED BEYOND THE TRANSITION, THEN ANY CURB HEIGHT GREATER THAN 4" WILL BE TAPERED DOWN BEGINNING AT THE LAST 7 FT. POST TO A MAXIMUM HEIGHT OF 4" AT POST 7. IF SHOWN ELSEWHERE IN THE PLANS, ADDITIONAL CURB UNDERNEATH GUARDRAIL WILL BE PAID FOR BY THE LINEAR FOOT.
4. UNLESS OTHERWISE SHOWN IN THE PLANS, TRANSITIONS SHALL BE PLACED WITH THE BLOCKOUT FACE IN FRONT OF OR DIRECTLY ABOVE THE CURB FACE. SEE SECTION A-A.
5. FOR ROUND WOOD POST SYSTEMS, ALL ROUND WOOD POSTS SHALL BE 7 ½" DIA. MINIMUM THROUGHOUT THE THRIE-BEAM TRANSITION.
6. THE TYPE OF POST (ROUND WOOD POST, RECTANGULAR WOOD POST OR STEEL POST) WILL BE AS SHOWN IN THE PLANS. REFER TO GF(31) STANDARD SHEET.
7. THE POST LENGTH SHALL BE MARKED ON ALL 7'- 0" LONG POSTS BY THE MANUFACTURER. THE MARK SHALL BE LOCATED WITHIN THE TOP 1 FT. REGION OF THE POST, AT LEAST ⅝" IN HEIGHT, AND VISIBLE AFTER INSTALLATION. WOODEN POSTS SHALL BE MARKED WITH A BRAND, AND STEEL POSTS WITH A STENCIL BEFORE GALVANIZING.
8. POSTS SHALL NOT BE SET IN CONCRETE, OF ANY DEPTH.
9. RAIL ELEMENTS SHALL MEET THE REQUIREMENTS OF ITEM 540, "METAL BEAM GUARD FENCE" EXCEPT AS MODIFIED ON THE PLANS. THE THRIE-BEAM TERMINAL CONNECTOR AND THE THRIE-BEAM TRANSITION TO W-BEAM SHALL BE OF THE SAME MATERIAL, BUT SHALL NOT BE LESS THAN 10 GAUGE. CONTRACTOR SHALL VERIFY THAT THE LOCATIONS OF BOLT HOLES MATCH THOSE IN THE THRIE-BEAM TERMINAL CONNECTOR PRIOR TO ORDERING MATERIALS.
10. BUTTON HEAD "POST BOLTS & NUTS" SHALL MEET THE REQUIREMENTS OF (ASTM A307), AND SHALL BE OF SUFFICIENT LENGTH TO EXTEND THROUGH THE FULL THICKNESS OF THE NUT AND ⅝" WASHER (FWC16a) AND NOT MORE THAN 1" BEYOND IT. TRIM REMAINING BOLT LENGTH TO MEET REQUIRED LENGTH.
11. FITTINGS (BOLTS, NUTS, AND WASHERS) SHALL BE GALVANIZED IN ACCORDANCE WITH ITEM 445, "GALVANIZING". FITTINGS SHALL BE SUBSIDIARY TO THE BID ITEM.
12. CROWN SHALL BE WIDENED TO ACCOMMODATE TRANSITIONS.
13. WHERE SOLID ROCK IS ENCOUNTERED, CONTACT THE DESIGN DIVISION FOR ADDITIONAL GUIDANCE. (512) 416-2678
14. UNLESS OTHERWISE SHOWN IN THE PLANS, A COMPOSITE MATERIAL BLOCK THAT MEETS THE REQUIREMENTS OF DMS-7210, "COMPOSITE MATERIAL POSTS AND BLOCKS FOR METAL BEAM GUARD FENCE" MAY BE SUBSTITUTED FOR BLOCKS OF SIMILAR DIMENSIONS. TXDOT'S MATERIALS AND TESTS DIVISION MAINTAINS A MATERIAL PRODUCER LIST (MPL) FOR PRODUCERS OF MATERIALS CONFORMING TO DMS-7210. ONLY PRODUCERS ON THE MPL CAN FURNISH COMPOSITE MATERIAL BLOCKS.
15. REFER TO GF(31) STANDARD SHEET & BRIDGE RAILING DETAILS FOR ADDITIONAL DETAILS.
16. THE INSTALLATION OF THE TYPE II CURB IS CRITICAL FOR THE PERFORMANCE OF THE THRIE-BEAM TRANSITION SYSTEM. THE CURB PREVENTS (VEHICLE WHEEL SNAGGING) AT THE CONCRETE RAIL AND IS REQUIRED TO MEET MASH CRASH TEST CRITERIA.
17. IF CURB EXTENDS BEYOND POST 7, 25' OF NESTED W-BEAM GUARDRAIL SHALL BE INSTALLED BEYOND THE PAY LIMITS OF THRIE-BEAM TRANSITION SECTION, (SEE SHT. 2). PAYMENT FOR THIS 25' SECTION WILL BE BY LINEAR FOOT, PAY ITEM "0540 6XXX MTL W-BEAM GD FEN (NESTED) (TIM POST)" OR "540 6XXX MTL W-BEAM GD FEN (NESTED) (STEEL POST)" AS APPLICABLE FOR POST TYPE. SEE SHT. 2 FOR ADDITIONAL INFORMATION.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

THRIE-BEAM TRANSITION (1 OF 2)

03/31/2023
DATE
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D115

HIGH-SPEED TRANSITION
SHEET 1 OF 2

Texas Department of Transportation — Design Division Standard

METAL BEAM GUARD FENCE THRIE-BEAM TRANSITION TL-3 MASH COMPLIANT

GF(31)TR TL3-20

FILE: gf31trt1320.dgn	DN: TxDOT	CK: KM	DW: VP	CK: CGL/AG
©TxDOT: NOVEMBER 2020	CONT	SECT	JOB	HIGHWAY
REVISIONS				
	DIST	COUNTY		SHEET NO.

A1 THRIE-BEAM TRANSITION TL-3 MASH COMPLIANT (PAGE 1 OF 2)

TEXAS DEPARTMENT OF TRANSPORTATION

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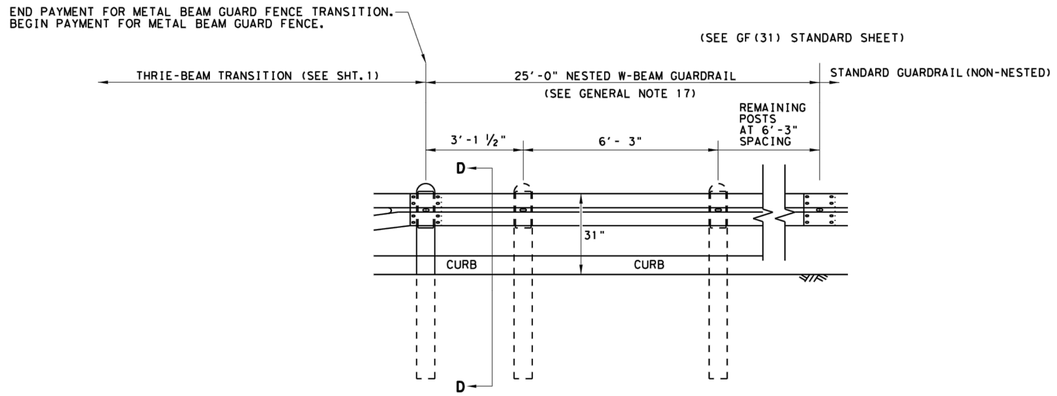
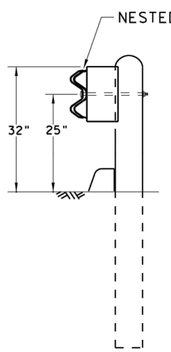
DISCLAIMER:
THE USE OF THIS STANDARD IS GOVERNED BY THE "TEXAS ENGINEERING PRACTICE ACT". NO WARRANTY OF ANY KIND IS MADE BY TXDOT FOR ANY PURPOSE WHATSOEVER. TXDOT ASSUMES NO RESPONSIBILITY FOR THE CONVERSION OF THIS STANDARD TO OTHER FORMATS OR FOR INCORRECT RESULTS OR DAMAGES RESULTING FROM ITS USE.

DATE:
FILE:

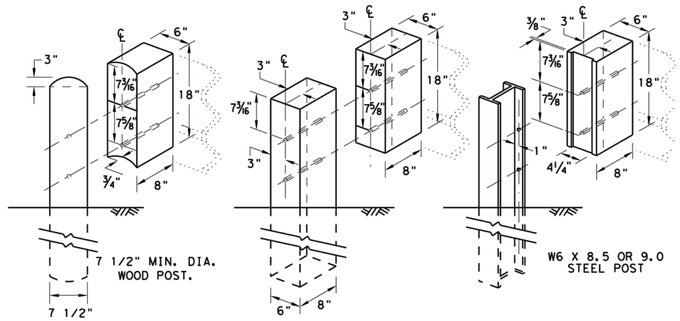
REQUIRED ALTERNATIVE FOR CONTINUOUS CURB EXTENDING PAST POST 7 (SEE SHT. 1 GENERAL NOTE 17)



ELEVATION VIEW



SECTION D-D



THRIE BEAM TRANSITION BLOCKOUT DETAILS

HIGH-SPEED TRANSITION

SHEET 2 OF 2

Texas Department of Transportation | Design Division Standard

METAL BEAM GUARD FENCE THRIE-BEAM TRANSITION TL-3 MASH COMPLIANT

GF(31)TR TL3-20

FILE: gf31trtl320.dgn	DN: TxDOT	CK: KM	DW: KM	CK: CGL/AG
©TxDOT: NOVEMBER 2020	CONT	SECT	JOB	HIGHWAY
REVISIONS				
	DIST	COUNTY		SHEET NO.

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

THRIE-BEAM TRANSITION (2 OF 2)

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D116

A1 | THRIE-BEAM TRANSITION TL-3 MASH COMPLIANT (PAGE 2 OF 2)
TEXAS DEPARTMENT OF TRANSPORTATION

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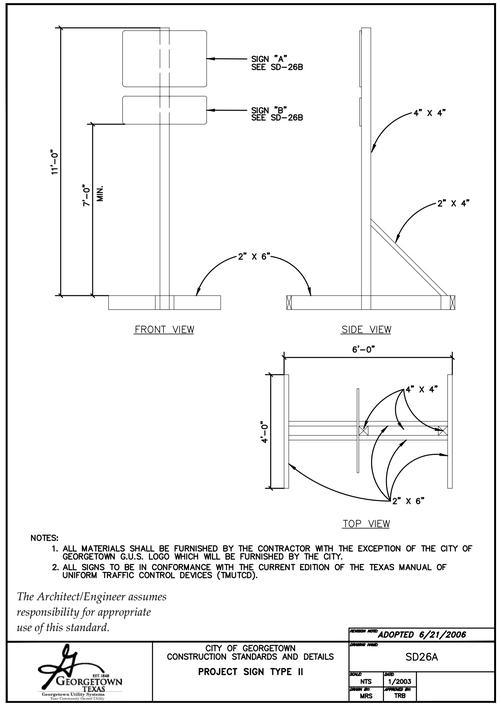


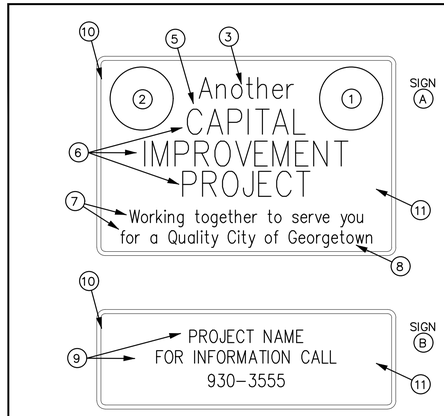
NOTES:
1. ALL MATERIALS SHALL BE FURNISHED BY THE CONTRACTOR WITH THE EXCEPTION OF THE CITY OF GEORGETOWN G.U.S. LOGO WHICH WILL BE FURNISHED BY THE CITY.
2. ALL SIGNS TO BE IN CONFORMANCE WITH THE CURRENT EDITION OF THE TEXAS MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (TMUTCD).

The Architect/Engineer assumes responsibility for appropriate use of this standard.

	CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS **PROJECT SIGN TYPE II**	REVISION DATE: ADOPTED 6/21/2006 DRAWING NAME: SD26A SCALE: NTS; DATE: 1/2003 DRAWN BY: MRS; APPROVED BY: TRB

G1 PROJECT SIGN TYPE II

CITY OF GEORGETOWN



NOTES:
1. CITY SEAL (FURNISHED BY THE CITY)
2. G.U.S. LOGO (FURNISHED BY THE CITY)
3. (1 3/4") BLUE LETTERS
4. (2 1/2") BLUE LETTERS
5. (1 1/4") SPACE
6. (3") BLUE LETTERS
7. (2") RED UPPER, (1 1/2") RED LOWER CASE LETTERS
8. (2") BLUE UPPER, (1 1/2") BLUE LOWER CASE LETTERS (City of Georgetown)
9. (10") LETTERS
10. (1 3/8") BLUE BORDER
11. REFLECTIVE SILVER SHEETING .080 ALUMINUM 2290, TRANSPARENT RED PAINT 712, BLUE PAINT 710, 3M CO. OR APPROVED EQUIVALENT.
12. REFER TO SHEET SD-26A

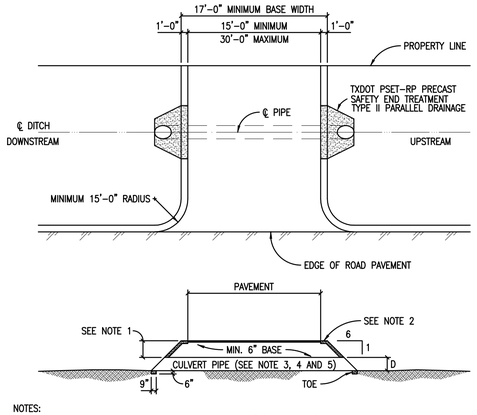
The Architect/Engineer assumes responsibility for appropriate use of this standard.

	CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS **STANDARD STREET SIGN DETAIL II**	REVISION DATE: ADOPTED 6/21/2006 DRAWING NAME: SD26B SCALE: NTS; DATE: 1/2003 DRAWN BY: MRS; APPROVED BY: TRB

G8 STANDARD STREET SIGN DETAIL II

CITY OF GEORGETOWN

CITY OF GEORGETOWN

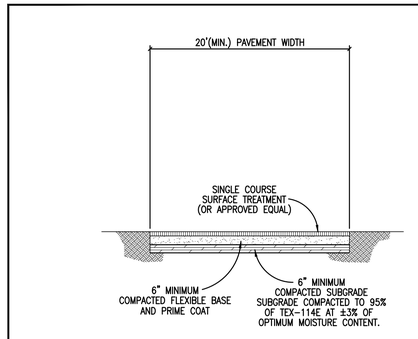


NOTES:
1. MINIMUM COVER OVER CULVERT PIPE SHALL BE 6" (SEE NOTE 5).
2. TXDOT PSET-RP PRECAST SAFETY END TREATMENT TYPE II PARALLEL DRAINING
3. CULVERT PIPE TO BE MINIMUM OF 12" DIAMETER.
4. CULVERT PIPE MATERIAL TO BE R.C.P. (CLASS IV), UNLESS PRIOR APPROVAL IS GRANTED BY THE CITY OF GEORGETOWN.
5. MINIMUM COVER OVER CULVERT PIPE SHALL PROVIDE H20 LOADING.
6. BACKFILL AROUND CULVERT PIPE SHALL BE SELECT MATERIAL TO BE PLACED AND COMPACTED TO 95% TEX-114E.
7 MINIMUM CHANNEL SIDE SLOPE SHALL BE 4:1.

A1 RURAL NON-RESIDENTIAL UNDIVIDED DRIVEWAY APPROACH WITH CULVERT PIPE

MODIFIED

CITY OF GEORGETOWN



NOTES:
1. EVERY BUILDING CONSTRUCTED SHALL BE ACCESSIBLE TO EMERGENCY APPARATUS BY WAY OF TEMPORARY ALL WEATHER DRIVING SURFACES.
2. A TEMPORARY ALL WEATHER DRIVING SURFACE SHALL EXTEND TO WITHIN 150' OF ALL EXTERIOR PORTIONS OF BUILDINGS
3. TEMPORARY ALL WEATHER DRIVING SURFACES SHALL BE CONSTRUCTED AS SHOWN ON CONSTRUCTION PLANS AND IN ACCORDANCE WITH ITEM 316 SURFACE TREATMENTS OF THE TXDOT STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREETS AND BRIDGES.
4. TEMPORARY ALL WEATHER DRIVING SURFACES SHALL BE CAPABLE OF SUPPORTING A DESIGN WHEEL LOAD OF 16,000 LB. (H-20 LOADING) IN ORDER TO SUPPORT A GROSS VEHICLE WEIGHT OF 80,000 LB. IF SUBGRADE CONDITIONS CHANGE OR ARE VERY UNSTABLE, AN ADDITIONAL GEOTECHNICAL AND/OR ENGINEERING DESIGN MAY REQUIRE A GREATER CROSS SECTION.
5. CONTRACTOR OR DEVELOPER SHALL MAINTAIN TEMPORARY ALL WEATHER DRIVING SURFACE THROUGHOUT CONSTRUCTION.
6. APPLICABLE SIGNAGE SHALL BE INSTALLED BY THE CONTRACTOR TO DISALLOW PARKING (NO PARKING – FIRE LANE).
7. TEMPORARY ALL WEATHER DRIVING SURFACES SHALL BE INSTALLED PRIOR TO THE ERECTION OF ANY STRUCTURAL FRAMING ABOVE THE FOUNDATION SLAB. CONTACT FIRE SERVICES FOR THE COORDINATION OF TEMPORARY ALL WEATHER DRIVING SURFACES FOR CONSTRUCTION.

The Architect/Engineer assumes responsibility for appropriate use of this standard.

	CITY OF GEORGETOWN CONSTRUCTION STANDARDS AND DETAILS **TEMPORARY ALL WEATHER DRIVING SURFACE**	REVISION DATE: ADOPTED 6/21/2006 DRAWING NAME: SD43 SCALE: NTS; DATE: 1/2003 DRAWN BY: MRS; APPROVED BY: TRB

A8 TEMPORARY ALL WEATHER DRIVING SURFACE

CITY OF GEORGETOWN

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

GEORGETOWN DETAILS

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D117

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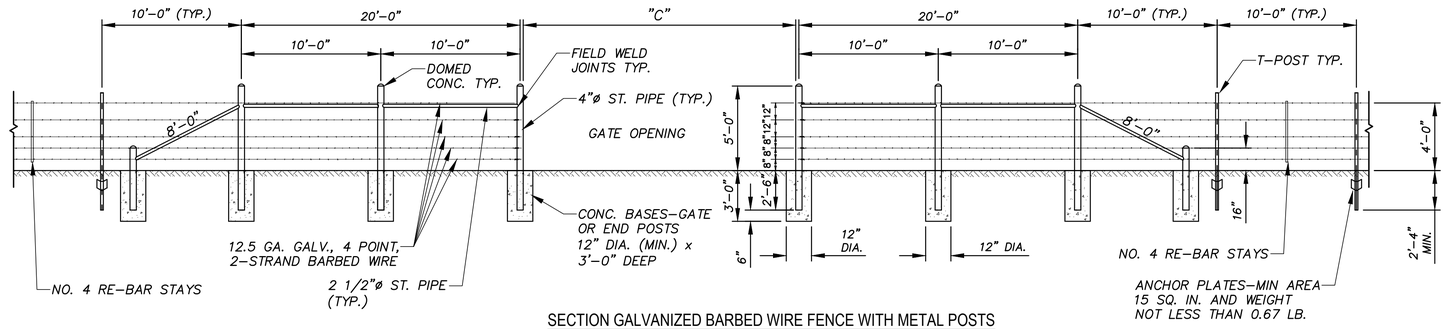
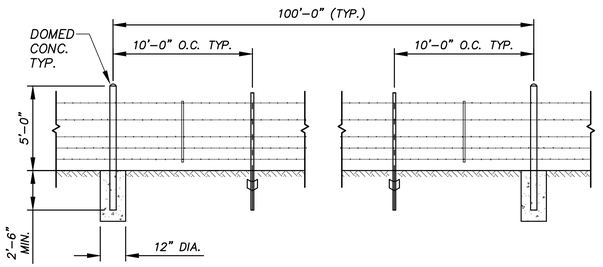


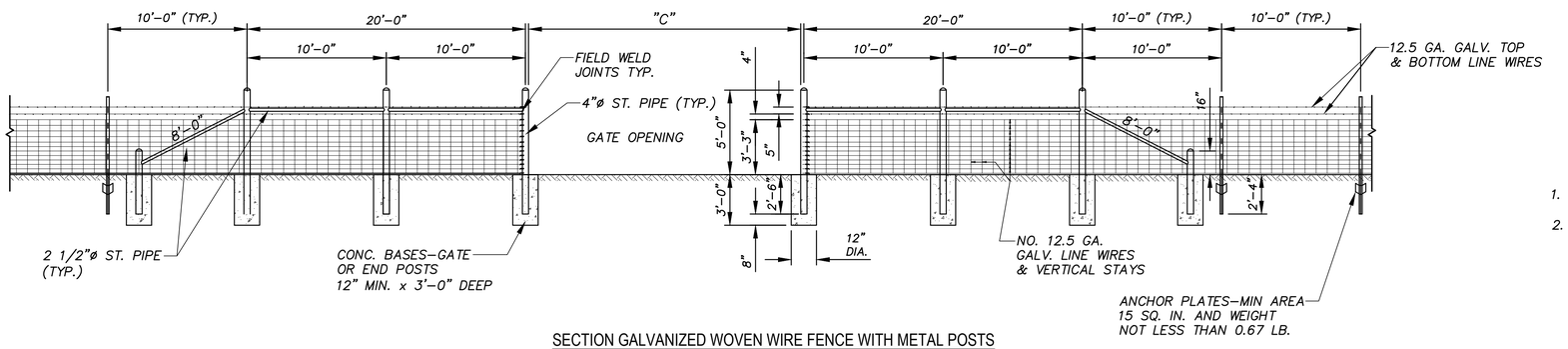
SECTION GALVANIZED BARBED WIRE FENCE WITH METAL POSTS

BRACING DETAIL USED AT ENDS AND GATES

NOTE:
FOR STEEL PIPE AND T–POST REQUIREMENTS (SEE GENERAL NOTES 6 & 7)

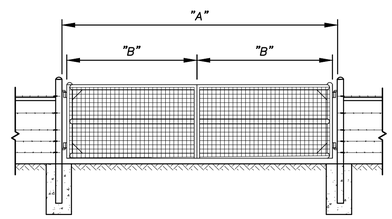


DETAIL OF LINE POST



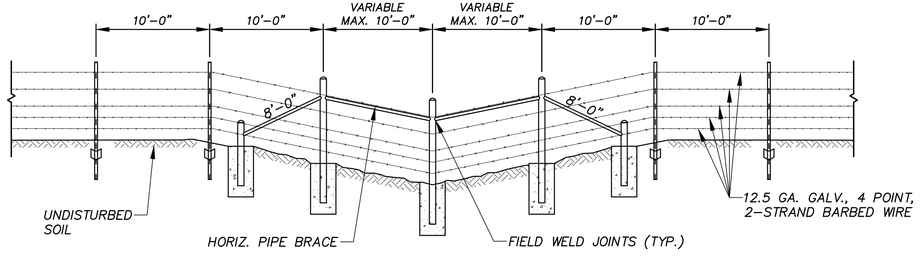
SECTION GALVANIZED WOVEN WIRE FENCE WITH METAL POSTS

BRACING DETAIL USED AT ENDS AND GATES

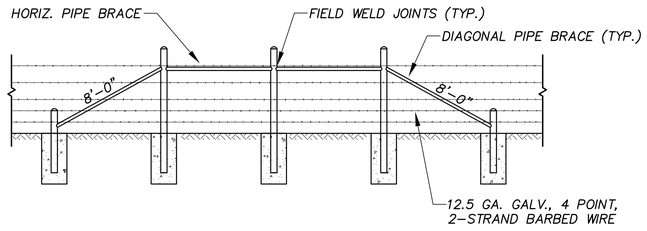


1. *GATE SHALL BE LEVEL.*
2. *CONTRACTOR SHALL FURNISH 24" OF 3/16" GALVANIZED CHAIN FOR GATES. LOCKS SHALL BE FURNISHED BY OWNER.*

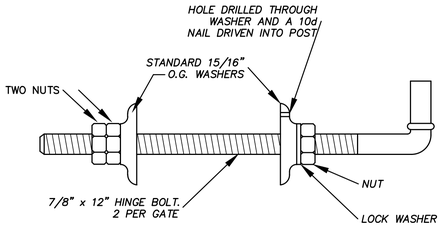
ELEVATION OF GATE



DETAIL OF FENCE SAG (SIM. FOR CREST)



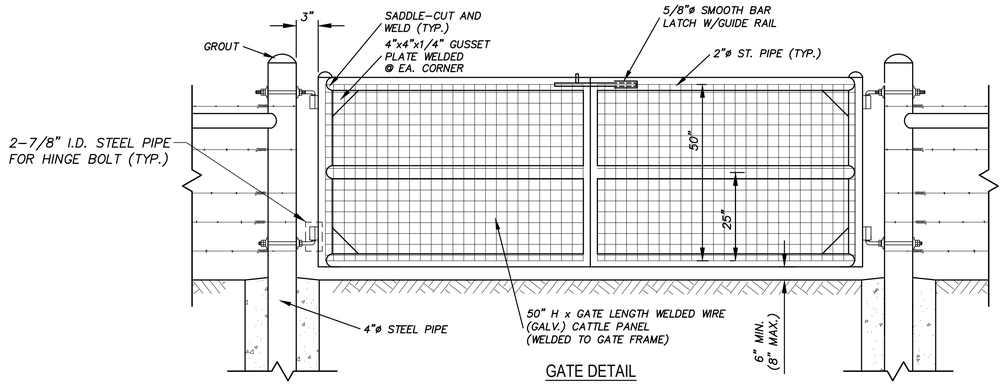
CORNER OR PULL POST ASSEMBLY



GATE HINGE BOLT ASSEMBLY

GATE WIDTH	GATE DIMENSIONS		
	A	B	C
20'–0"	20'–6"	10'–0"	20'–6"
30'–0"	30'–6"	15'–0"	30'–6"

GATE DIMENSIONS



GATE DETAIL

GENERAL NOTES

1. *ANY HIGH POINT WHICH INTERFERES WITH THE PLACING OF WIRE MESH SHALL BE EXCAVATED TO PROVIDE A 2–INCH CLEARANCE.*
2. *LATCHES FOR GATES SHALL BE GOOD COMMERCIAL QUALITY AND DESIGN LATCH OF THE SPRING FORK OR CHAIN TYPE. ALL LATCHES SHALL BE SUITABLE TO THE GATE AND SHALL BE APPROVED BY THE ENGINEER.*
3. *HINGES FOR GATES SHALL BE A COMMERCIAL DESIGN APPROVED BY THE ENGINEER SUITABLE FOR POST AND GATE.*
4. *CONCRETE SHALL BE 2000 P.S.I. (MIN) CONCRETE FOOTINGS ARE TO BE CROWNED AT THE TOP TO SHED WATER.*
5. *STEEL ANCHOR PLATES SHALL BE OF A DESIGN AND THICKNESS SUFFICIENT TO PREVENT TURNING OF THE POST IN FIRM SOIL.*
6. *STEEL PIPE END POSTS, CORNER AND PULL POSTS SHALL BE A MINIMUM OF 4" STD. PIPE (4.5" O.D., 0.237" WALL THICKNESS) WITH A 2 1/2" STD. PIPE BRACE (2.875" O.D., 0.276" WALL THICKNESS), FASTENERS FOR SECURING BARBED WIRE OR WOVEN WIRE FENCE TO METAL POSTS SHALL BE A MINIMUM OF 11 GAUGE GALVANIZED STEEL WIRE. POSTS SHALL BE FITTED WITH WATER TIGHT IRON CAPS OR DOMED GROUT.*
7. *STEEL PIPE USED FOR POSTS AND BRACES, SHALL BE STANDARD PIPE IN ACCORDANCE WITH ASTM A 53, CLASS B OR A 501. FOR T–POSTS USE STEEL THAT MEETS ASTM A 702. STEEL T–POSTS SHALL BE NOT LESS THAN 7'–0" IN LENGTH AND SHALL WEIGH NOT LESS THAN (1.33 LBS./LN. FT.).*
8. *BARBED WIRE SHALL BE 12.5 GA. AND IN ACCORDANCE WITH ASTM A 121, CLASS 1 DESIGN DESIGNATION 12–2–4–1 4R OR 12–2–5–1 4R, OR AS APPROVED BY THE ENGINEER.*
9. *WOVEN WIRE FENCE SHALL BE IN ACCORDANCE WITH ASTM A 116, CLASS 1 NO. 12.5 GRADE 60 (SEE TABLE 1 ASTM A 116) TO THE HEIGHT AND DESIGN SHOWN ON THE PLANS, OR AS APPROVED BY THE ENGINEER.*
10. *THE LOCATION OF GATES WILL BE AS INDICATED ELSEWHERE IN THESE PLANS.*

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

DOUBLE GATE & FENCE DETAIL

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D118

A1

DETAIL NO. 7081

20' GATE & FENCE DETAILS

SCALE: N.T.S.

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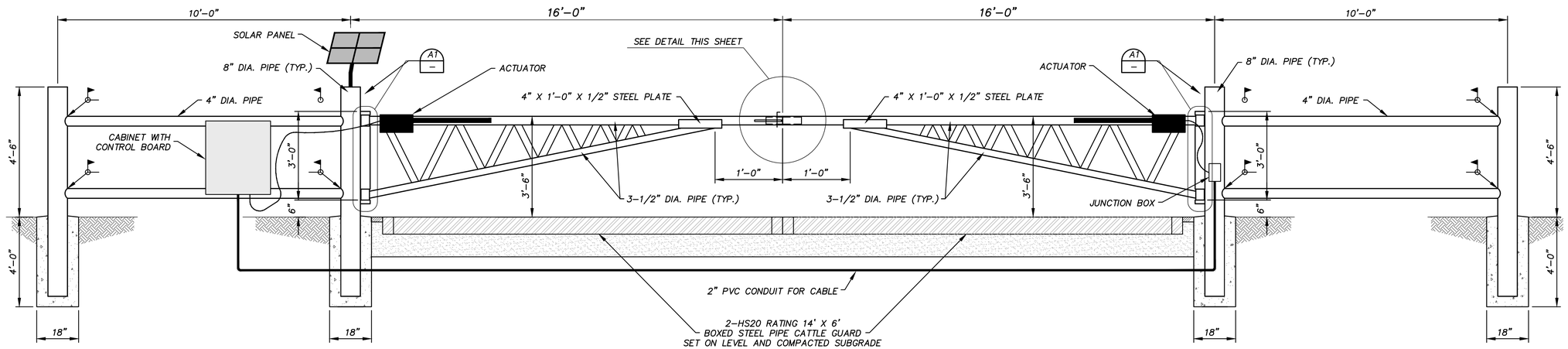
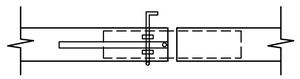


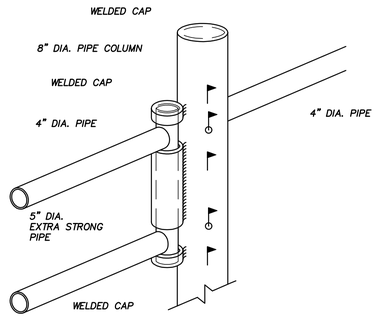


NOTE:

1. PIPE COLUMNS, HORIZONTAL PIPING AND GATE PIPING SHALL BE STANDARD STEEL PIPE (UNLESS NOTED OTHERWISE) AND SHALL BE HOT-DIPPED GALVANIZED.
2. CONTRACTOR SHALL PROVIDE AND INSTALL PATRIOT II DUAL SWING GATE OPERATOR WITH EYE (OR APPROVED EQUAL), COMPLETE-IN-PLACE.
3. GATE OPERATOR SHALL BE SOLAR CHARGED.
4. PROVIDE EIGHT (8) REMOTES: FOUR (4) FOR LANDOWNERS, TWO (2) FOR THE CITY, AND TWO (2) FOR THE CONTRACTOR.
5. CONTRACTOR SHALL RETURN REMOTES TO CITY INSPECTOR UPON REMOVAL OF THE GATE.
6. CITY INSPECTOR TO COLLECT REMOTES FROM LANDOWNERS UPON REMOVAL OF THE GATE.

G1 POWERED ENTRY GATE ELEVATION

DETAIL NO. 7120 — 1/2"=1'-0"



A1 ISOMETRIC GATE HINGE

DETAIL NO.7130 — 1"=1'-0"

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

POWERED DOUBLE GATE DETAIL

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D119

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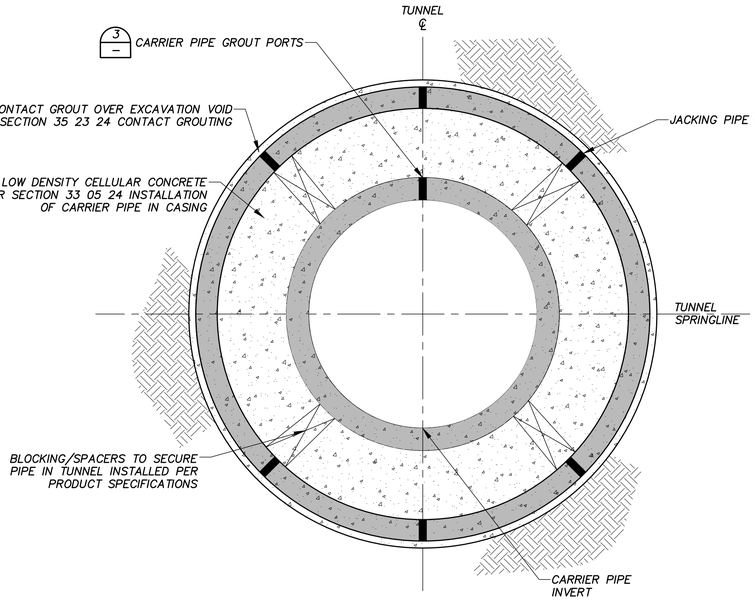

TYPICAL SECTION
TWO-PASS INSTALLATION
N.T.S.

1
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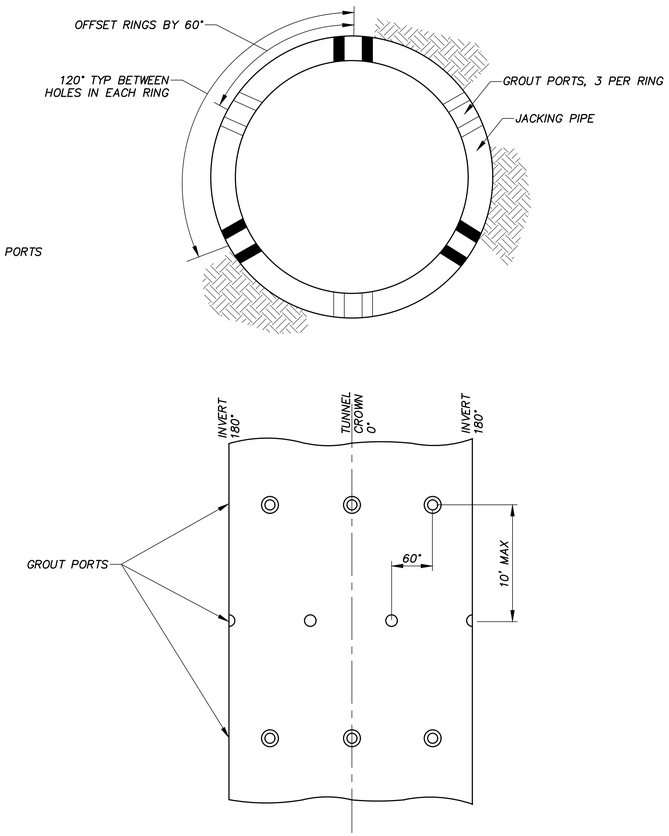

JACKING PIPE GROUT PORTS
N.T.S.

2
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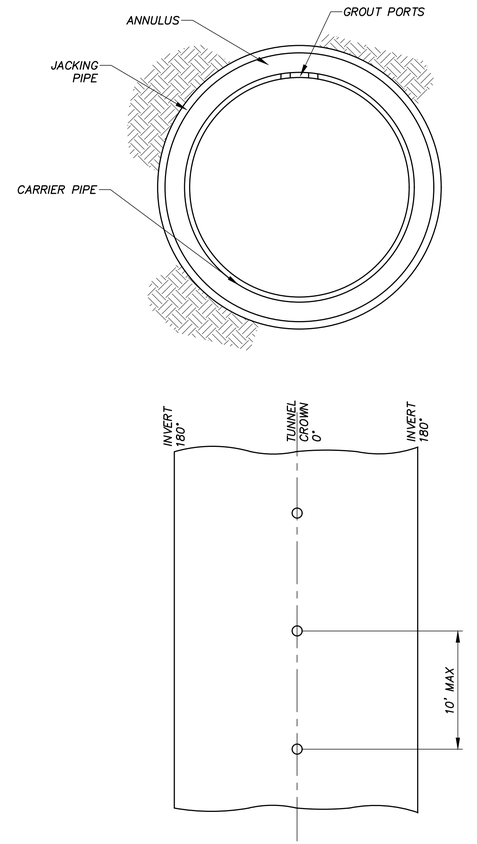

CARRIER PIPE GROUT PORTS
N.T.S.

3
–

Schnabel ENGINEERING

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 6053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TUNNEL DETAILS

03/31/2023
DATE

MATHEW KOZIOL

STATE OF TEXAS
MATHEW KOZIOL
117143
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D300

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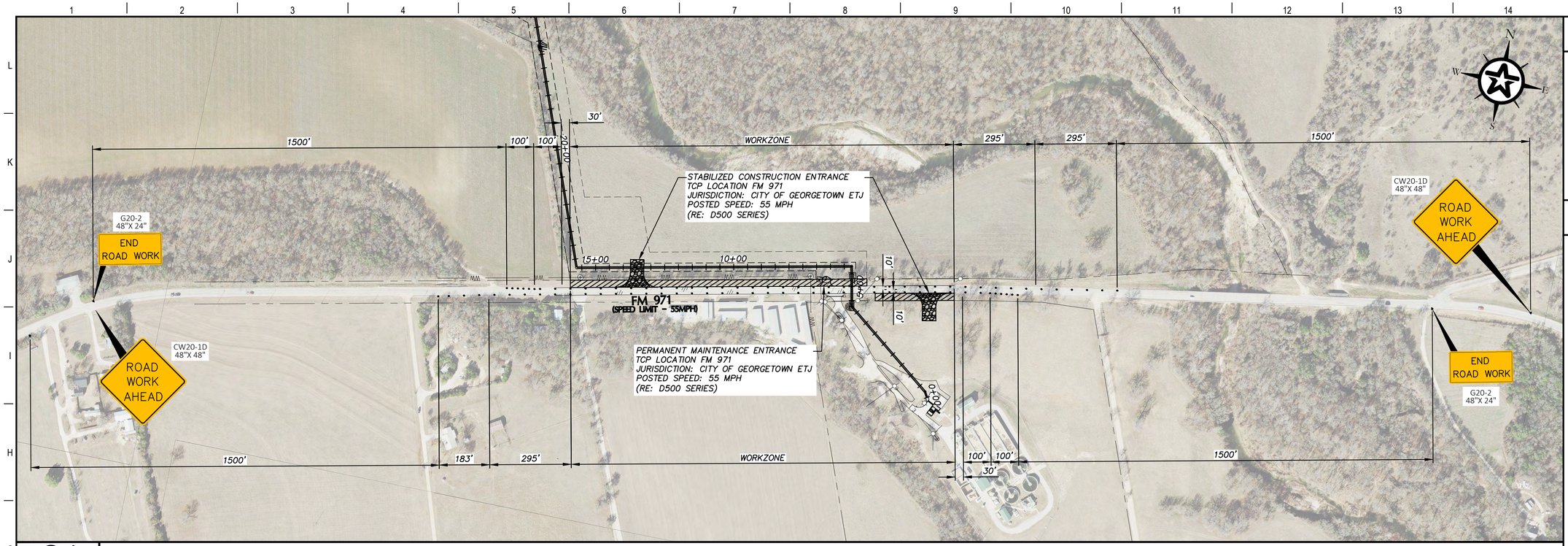

LEGEND

- BERRY CREEK INTERCEPTOR ALIGNMENT
- TEMPORARY CONSTRUCTION ENTRANCE
- TRAFFIC CONTROL BARRELS
- WORK ZONE

GENERAL NOTES

1. IN AREAS WHERE TRAFFIC IS PRESENT. TRAFFIC MUST BE HANDLED DURING CONSTRUCTION IN SUCH A MANNER AS TO CREATE THE LEAST INCONVENIENCE TO THE TRAVELING PUBLIC AND PROVIDE FOR MAXIMUM SAFETY BY MEANS OF ADEQUATE WARNING AND PROTECTION DEVICES.
2. ACCESS TO ALL PROPERTIES (BUSINESSES, RESIDENCES, ETC.) MUST BE MAINTAINED AT ALL TIMES.
3. CONTRACTOR SHALL MINIMIZE DISRUPTION TO TRAVELING PUBLIC AND SHALL MAINTAIN THROUGH ACCESS TO ALL INTERSECTIONS WITHIN THE PROJECT LIMITS AT ALL TIMES UNLESS OTHERWISE PERMITTED BY THE CONSTRUCTION OBSERVER.
4. WITHIN TXDOT R.O.W. CONTRACTOR SHALL MAINTAIN ONE LANE EACH DIRECTION AT ALL TIMES UNLESS APPROVED BY TXDOT.
5. ALL DETAILS ARE NOT SHOWN. REFER TO TXDOT STANDARDS TCP (2-1)-18 AND BC-21 FOR OPERATIONS DURING OFF PAVEMENT AND/OR OFF R.O.W. CONSTRUCTION.

G1 TRAFFIC CONTROL PLAN - FM 971

SCALE: 1"=200'

A1 NOT USED

SCALE: 1"=200'

0 100 200 400

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners
engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL PLAN 1

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
CT500

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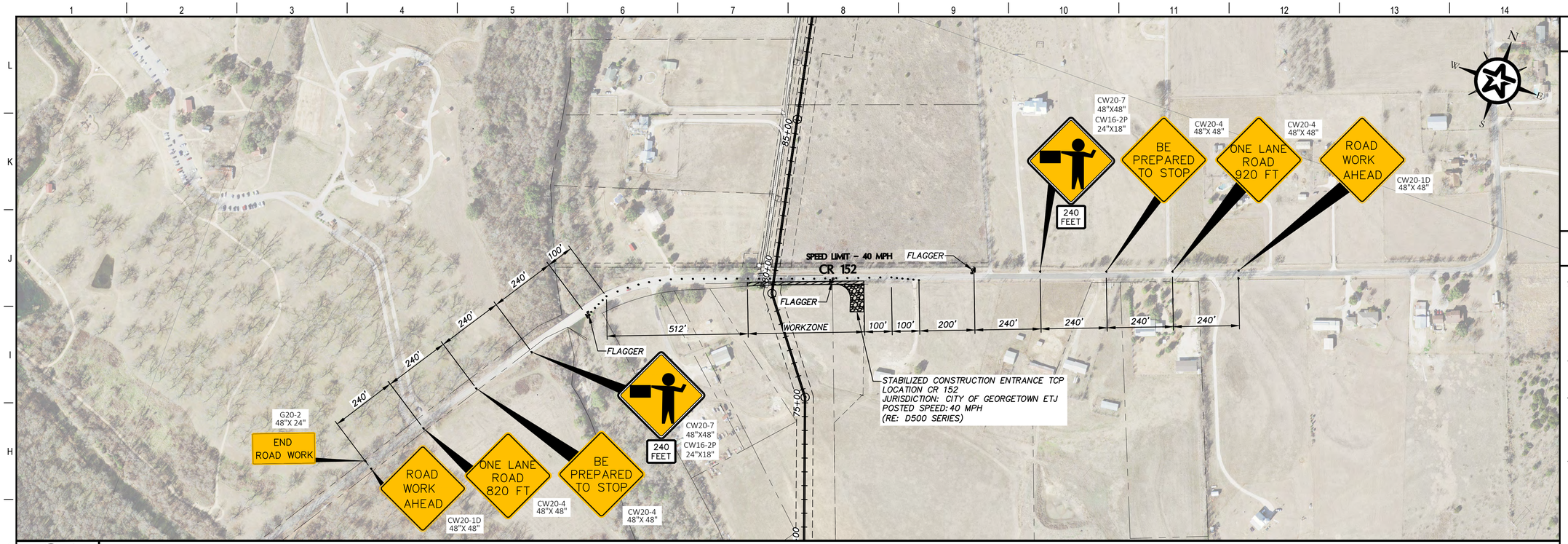
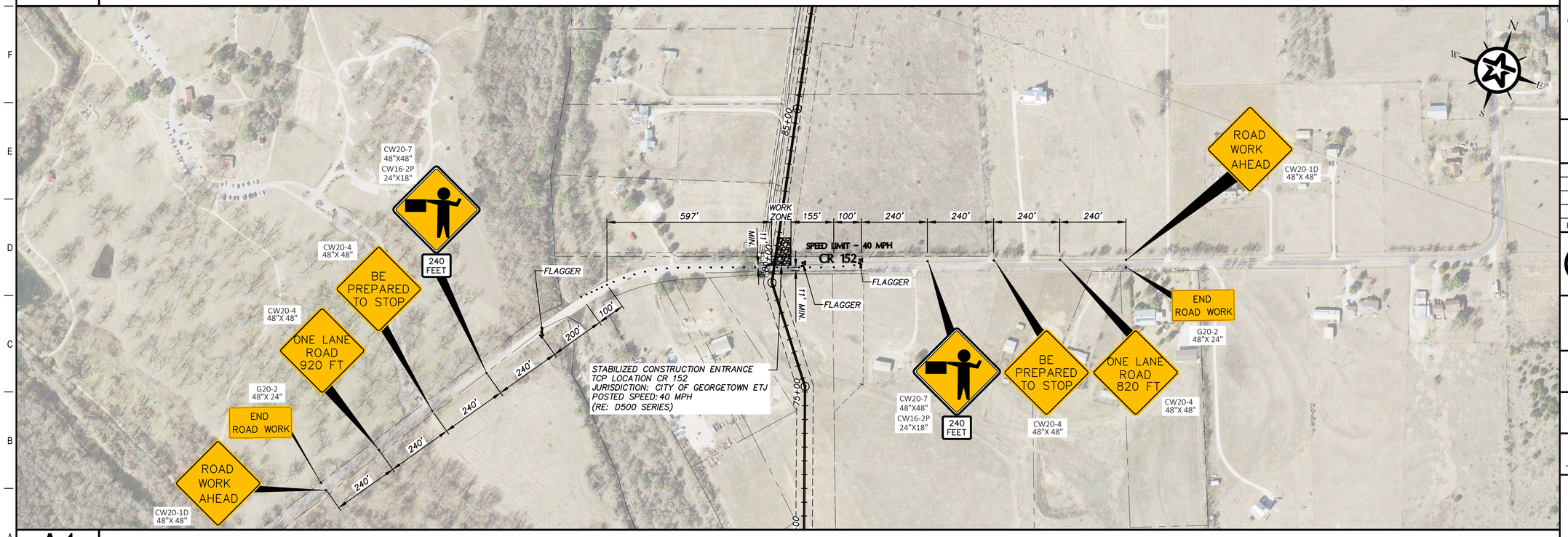


G1

TRAFFIC CONTROL PLAN - CR152 EASTBOUND STABILIZED CONSTRUCTION ENTRANCE

SCALE: 1"=200'



A1

TRAFFIC CONTROL PLAN - CR152 WESTBOUND STABILIZED CONSTRUCTION ENTRANCE

SCALE: 1"=200'

LEGEND

- BERRY CREEK INTERCEPTOR ALIGNMENT
- TEMPORARY CONSTRUCTION ENTRANCE
- TRAFFIC CONTROL BARRELS
- TRAFFIC CONTROL FLAGGER
- WORK ZONE

GENERAL NOTES

1. IN AREAS WHERE TRAFFIC IS PRESENT. TRAFFIC MUST BE HANDLED DURING CONSTRUCTION IN SUCH A MANNER AS TO CREATE THE LEAST INCONVENIENCE TO THE TRAVELING PUBLIC AND PROVIDE FOR MAXIMUM SAFETY BY MEANS OF ADEQUATE WARNING AND PROTECTION DEVICES.
2. ACCESS TO ALL PROPERTIES (BUSINESSES, RESIDENCES, ETC.) MUST BE MAINTAINED AT ALL TIMES.
3. CONTRACTOR SHALL MINIMIZE DISRUPTION TO TRAVELING PUBLIC AND SHALL MAINTAIN THROUGH ACCESS TO ALL INTERSECTIONS WITHIN THE PROJECT LIMITS AT ALL TIMES UNLESS OTHERWISE PERMITTED BY THE CONSTRUCTION OBSERVER.
4. WITHIN COUNTY R.O.W., CONTRACTOR SHALL MAINTAIN ONE LANE OF TRAFFIC AT ALL TIMES. PAVEMENT WIDTHS MAY NOT BE WIDE ENOUGH FOR ONE LANE OF TRAFFIC. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE ADDITIONAL PAVEMENT TO ACCOMMODATE ONE WAY TRAFFIC WITH FLAGGERS AT NO ADDITIONAL COST TO THE CITY.
5. ALL DETAILS ARE NOT SHOWN. REFER TO TXDOT STANDARDS TCP (2-2)-18 AND BC-21 FOR OPERATIONS DURING OFF PAVEMENT AND/OR OFF R.O.W. CONSTRUCTION.
6. PROVIDE ADDITIONAL FLAGGERS AS NEEDED TO CONTROL ACCESS FROM DRIVEWAYS.

0 100 200 400

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors

T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL PLAN 2

03/31/2023
DATE

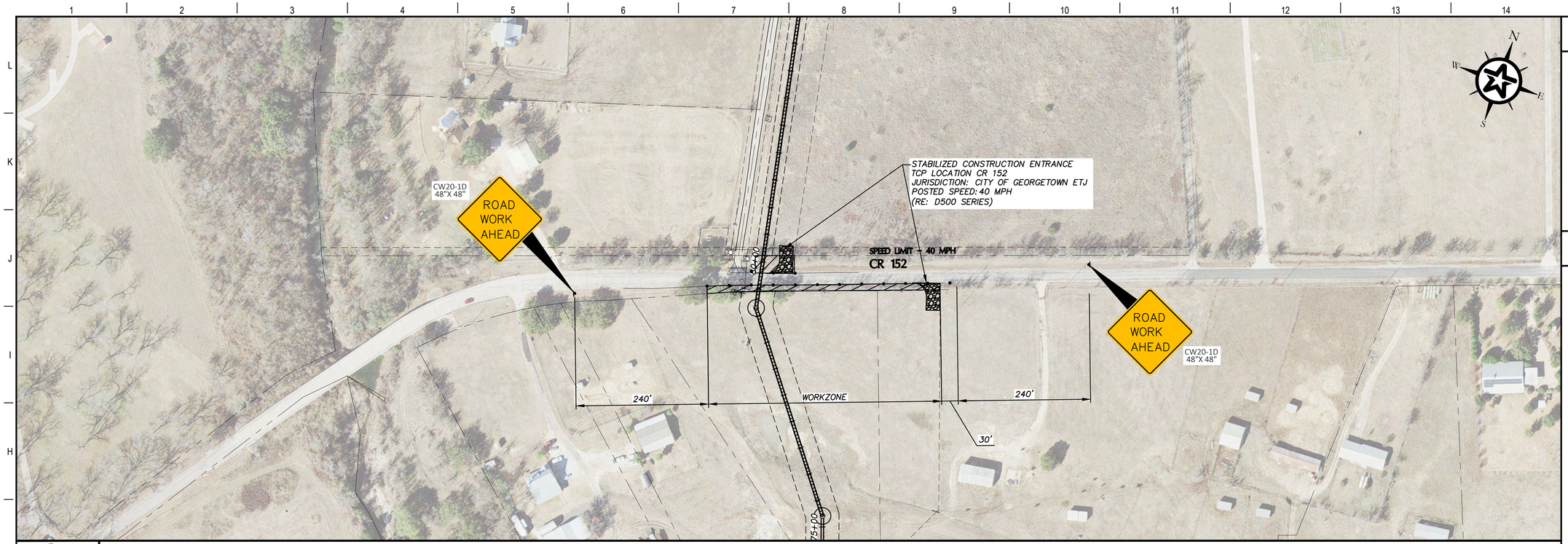
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

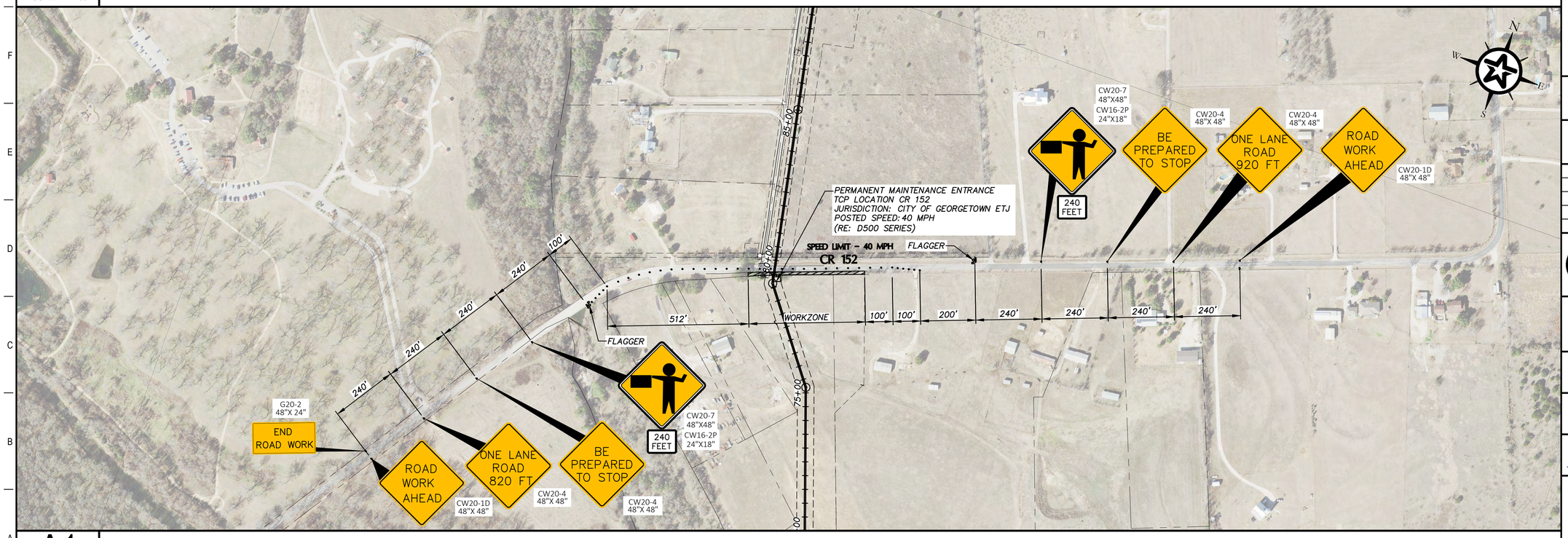
DRAWING NO.
CT501

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-TRAFFIC CONTROL PLANS.DWG, TRAFFIC CONTROL PLAN 2, 8/14/2023 2:53:41 PM, ruellar



G1 TRAFFIC CONTROL PLAN - CR152 AFTER STABILIZED CONSTRUCTION ENTRANCES ARE IN PLACE

SCALE: 1"=100'



A1 TRAFFIC CONTROL PLAN -CR152 TO CONSTRUCT PERMANENT MAINTENANCE ENTRANCE

SCALE: 1"=200'

LEGEND

- BERRY CREEK INTERCEPTOR ALIGNMENT
- TEMPORARY CONSTRUCTION ENTRANCE
- TRAFFIC CONTROL BARRELS
- TRAFFIC CONTROL FLAGGER
- WORK ZONE

GENERAL NOTES

1. IN AREAS WHERE TRAFFIC IS PRESENT. TRAFFIC MUST BE HANDLED DURING CONSTRUCTION IN SUCH A MANNER AS TO CREATE THE LEAST INCONVENIENCE TO THE TRAVELING PUBLIC AND PROVIDE FOR MAXIMUM SAFETY BY MEANS OF ADEQUATE WARNING AND PROTECTION DEVICES.
2. ACCESS TO ALL PROPERTIES (BUSINESSES, RESIDENCES, ETC.) MUST BE MAINTAINED AT ALL TIMES.
3. CONTRACTOR SHALL MINIMIZE DISRUPTION TO TRAVELING PUBLIC AND SHALL MAINTAIN THROUGH ACCESS TO ALL INTERSECTIONS WITHIN THE PROJECT LIMITS AT ALL TIMES UNLESS OTHERWISE PERMITTED BY THE CONSTRUCTION OBSERVER.
4. WITHIN COUNTY R.O.W., CONTRACTOR SHALL MAINTAIN ONE LANE OF TRAFFIC AT ALL TIMES. PAVEMENT WIDTHS MAY NOT BE WIDE ENOUGH FOR ONE LANE OF TRAFFIC. CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE ADDITIONAL PAVEMENT TO ACCOMMODATE ONE WAY TRAFFIC WITH FLAGGERS AT NO ADDITIONAL COST TO THE CITY.
5. ALL DETAILS ARE NOT SHOWN. REFER TO TXDOT STANDARDS TCP (2-1)-18, (2-2)-18, AND BC-21 FOR OPERATIONS DURING OFF PAVEMENT AND/OR OFF R.O.W. CONSTRUCTION.
6. PROVIDE ADDITIONAL FLAGGERS AS NEEDED TO CONTROL ACCESS FROM DRIVEWAYS.

0 50 100 200
GRAPHIC SCALE (FEET)

0 100 200 400
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners
engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL PLAN 3

03/31/2023
DATE

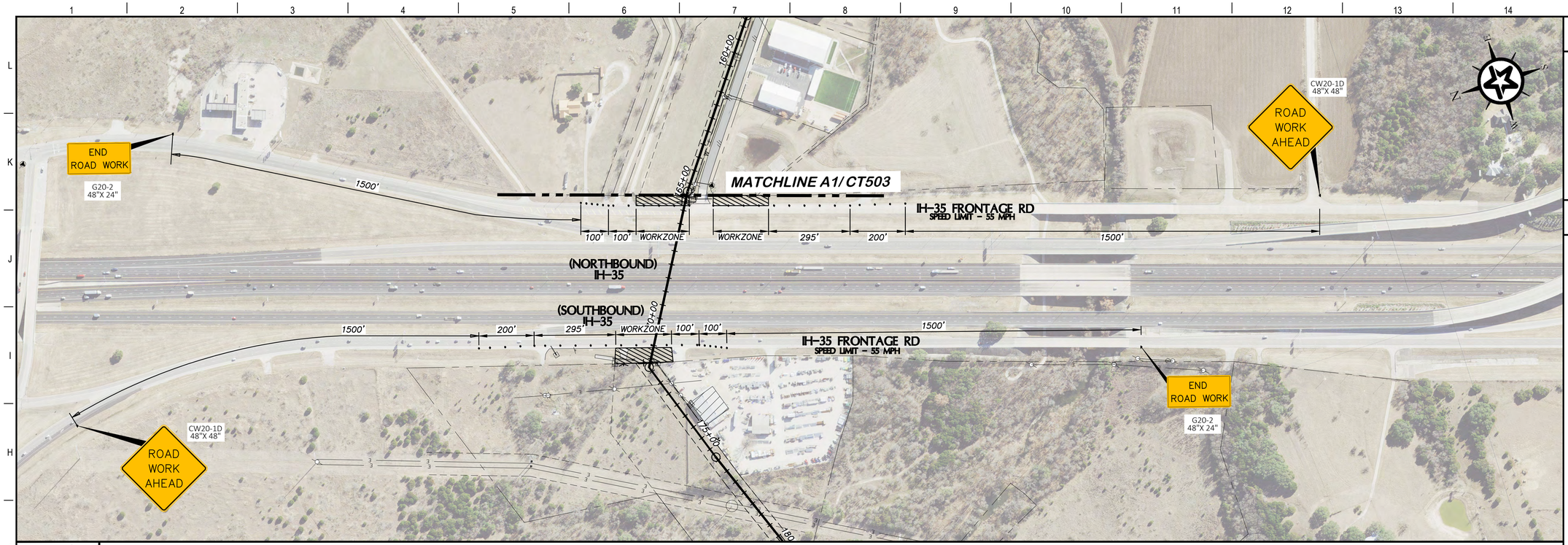
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
CT502

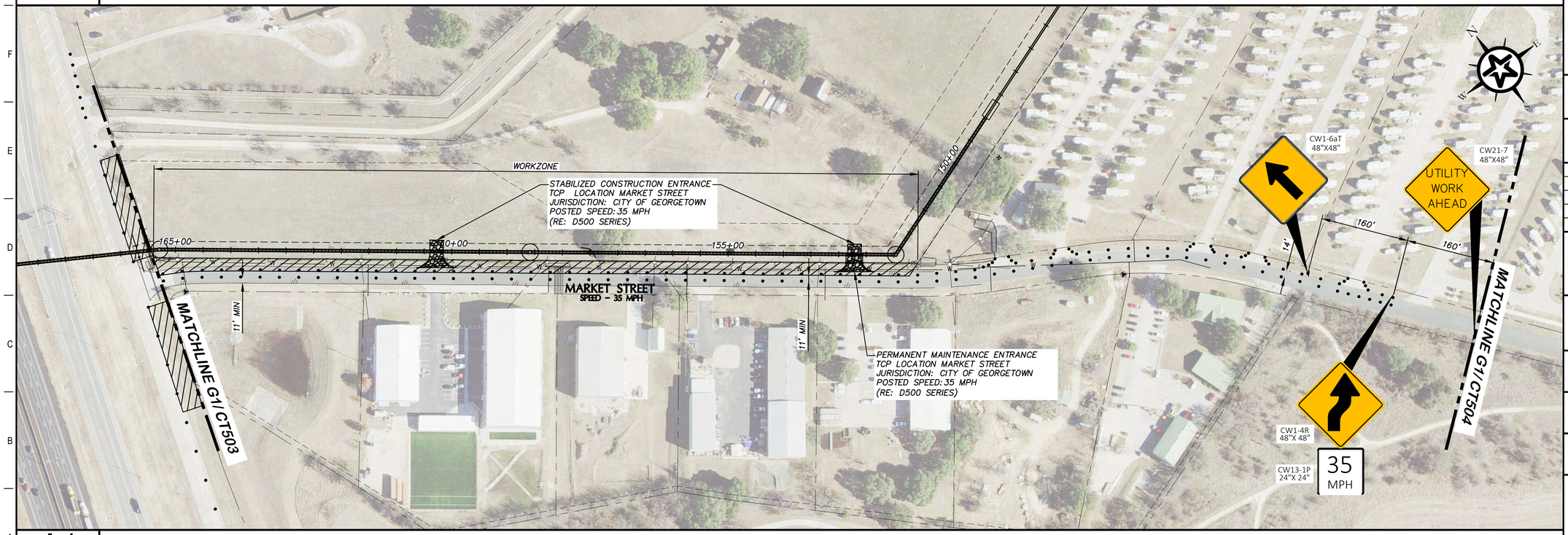
G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\3-00582-TRAFFIC CONTROL PLANS.DWG, TRAFFIC CONTROL PLAN 3, 8/14/2023 2:54:37 PM, rcuellar



A1

TRAFFIC CONTROL PLAN - MARKET STREET ~ IH-35 SOUTHBOUND & NORTHBOUND FRONTAGE ROAD

SCALE: 1"=200'



A1

TRAFFIC CONTROL PLAN - MARKET STREET WESTBOUND

SCALE: 1"=100'

LEGEND

- BERRY CREEK INTERCEPTOR ALIGNMENT
- TEMPORARY CONSTRUCTION ENTRANCE
- TRAFFIC CONTROL BARRELS
- WORK ZONE

GENERAL NOTES

1. IN AREAS WHERE TRAFFIC IS PRESENT, TRAFFIC MUST BE HANDLED DURING CONSTRUCTION IN SUCH A MANNER AS TO CREATE THE LEAST INCONVENIENCE TO THE TRAVELING PUBLIC AND PROVIDE FOR MAXIMUM SAFETY BY MEANS OF ADEQUATE WARNING AND PROTECTION DEVICES.
2. ACCESS TO ALL PROPERTIES (BUSINESSES, RESIDENCES, ETC.) MUST BE MAINTAINED AT ALL TIMES.
3. CONTRACTOR SHALL MINIMIZE DISRUPTION TO TRAVELING PUBLIC AND SHALL MAINTAIN THROUGH ACCESS TO ALL INTERSECTIONS WITHIN THE PROJECT LIMITS AT ALL TIMES UNLESS OTHERWISE PERMITTED BY THE CONSTRUCTION OBSERVER.
4. ALL DETAILS ARE NOT SHOWN. REFER TO TXDOT STANDARDS TCP (2-1)-18 AND BC-21 FOR OPERATIONS DURING OFF PAVEMENT AND/OR OFF R.O.W. CONSTRUCTION.

0 50 100 200
GRAPHIC SCALE (FEET)

0 100 200 400
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL PLAN 4

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
CT503

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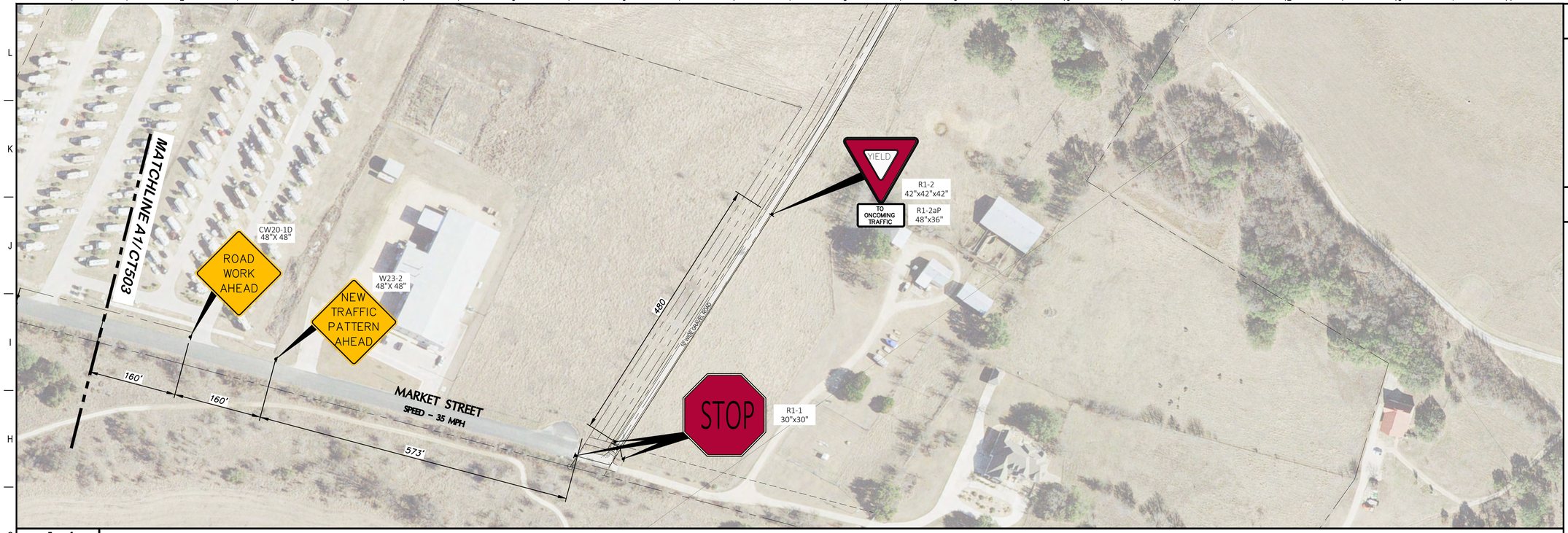

A1 TRAFFIC CONTROL PLAN - MARKET STREET

SCALE: 1"=100'

A1 NOT USED

LEGEND

- BERRY CREEK INTERCEPTOR ALIGNMENT
- TEMPORARY CONSTRUCTION ENTRANCE
- TRAFFIC CONTROL BARRELS
- WORK ZONE

GENERAL NOTES

1. IN AREAS WHERE TRAFFIC IS PRESENT. TRAFFIC MUST BE HANDLED DURING CONSTRUCTION IN SUCH A MANNER AS TO CREATE THE LEAST INCONVENIENCE TO THE TRAVELING PUBLIC AND PROVIDE FOR MAXIMUM SAFETY BY MEANS OF ADEQUATE WARNING AND PROTECTION DEVICES.
2. ACCESS TO ALL PROPERTIES (BUSINESSES, RESIDENCES, ETC.) MUST BE MAINTAINED AT ALL TIMES.
3. CONTRACTOR SHALL MINIMIZE DISRUPTION TO TRAVELING PUBLIC AND SHALL MAINTAIN THROUGH ACCESS TO ALL INTERSECTIONS WITHIN THE PROJECT LIMITS AT ALL TIMES UNLESS OTHERWISE PERMITTED BY THE CONSTRUCTION OBSERVER.
4. ALL DETAILS ARE NOT SHOWN. REFER TO TXDOT STANDARDS TCP (2-1)-18 AND BC-21 FOR OPERATIONS DURING OFF PAVEMENT AND/OR OFF R.O.W. CONSTRUCTION.
5. CONTRACTOR TO PROVIDE NON-VEHICULAR WARNING SIGNS FOR LIVESTOCK AT ALL ENTRANCES INTO A PASTURE AND AT ALL LIVESTOCK CROSSINGS.

0 50 100 200

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners
engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL PLAN 5

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
CT504

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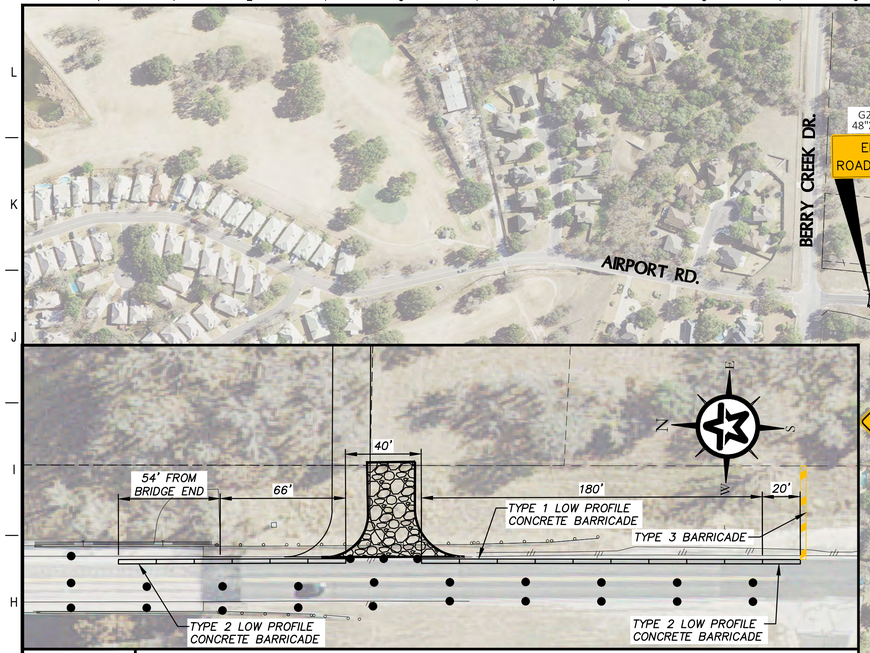
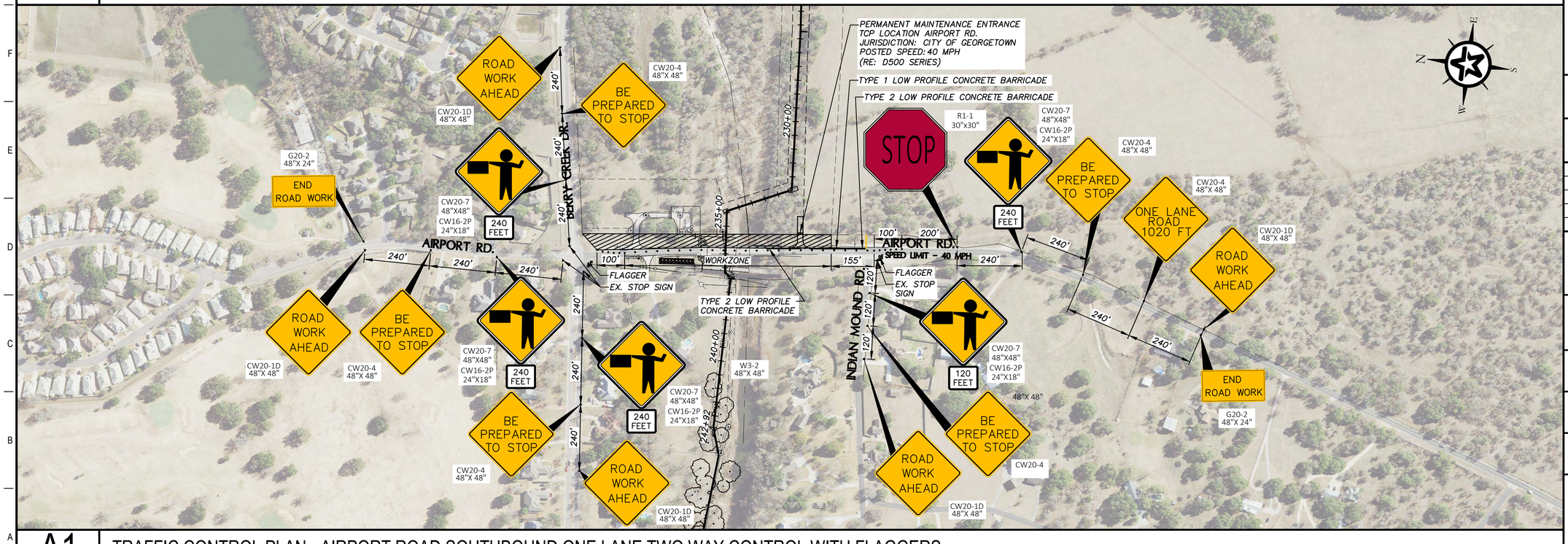


G1 — LOW PROFILE CONCRETE BARRIERS INSET

SCALE: 1"=40'

G1 — TRAFFIC CONTROL PLAN - AIRPORT ROAD PHASE 1 NORTHBOUND PLACING CONCRETE BARRIERS

SCALE: 1"=200'



A1 — TRAFFIC CONTROL PLAN - AIRPORT ROAD SOUTHBOUND ONE LANE TWO WAY CONTROL WITH FLAGGERS

SCALE: 1"=200'

LEGEND

- BERRY CREEK INTERCEPTOR ALIGNMENT
- TEMPORARY CONSTRUCTION ENTRANCE
- TRAFFIC CONTROL BARRELS
- TRAFFIC CONTROL FLAGGER
- WORK ZONE

GENERAL NOTES

1. IN AREAS WHERE TRAFFIC IS PRESENT. TRAFFIC MUST BE HANDLED DURING CONSTRUCTION IN SUCH A MANNER AS TO CREATE THE LEAST INCONVENIENCE TO THE TRAVELING PUBLIC AND PROVIDE FOR MAXIMUM SAFETY BY MEANS OF ADEQUATE WARNING AND PROTECTION DEVICES.
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3. CONTRACTOR SHALL MINIMIZE DISRUPTION TO TRAVELING PUBLIC AND SHALL MAINTAIN THROUGH ACCESS TO ALL INTERSECTIONS WITHIN THE PROJECT LIMITS AT ALL TIMES UNLESS OTHERWISE PERMITTED BY THE CONSTRUCTION OBSERVER.
4. ALL DETAILS ARE NOT SHOWN. REFER TO TXDOT STANDARDS TCP (2-1)-18, (2-2)-18, AND BC-21 FOR OPERATIONS DURING OFF PAVEMENT AND/OR OFF R.O.W. CONSTRUCTION.

0 20 40 80
GRAPHIC SCALE (FEET)

0 100 200 400
GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL PLAN 6

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS · ERIC LEE NELSON · 114449 · LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
CT505

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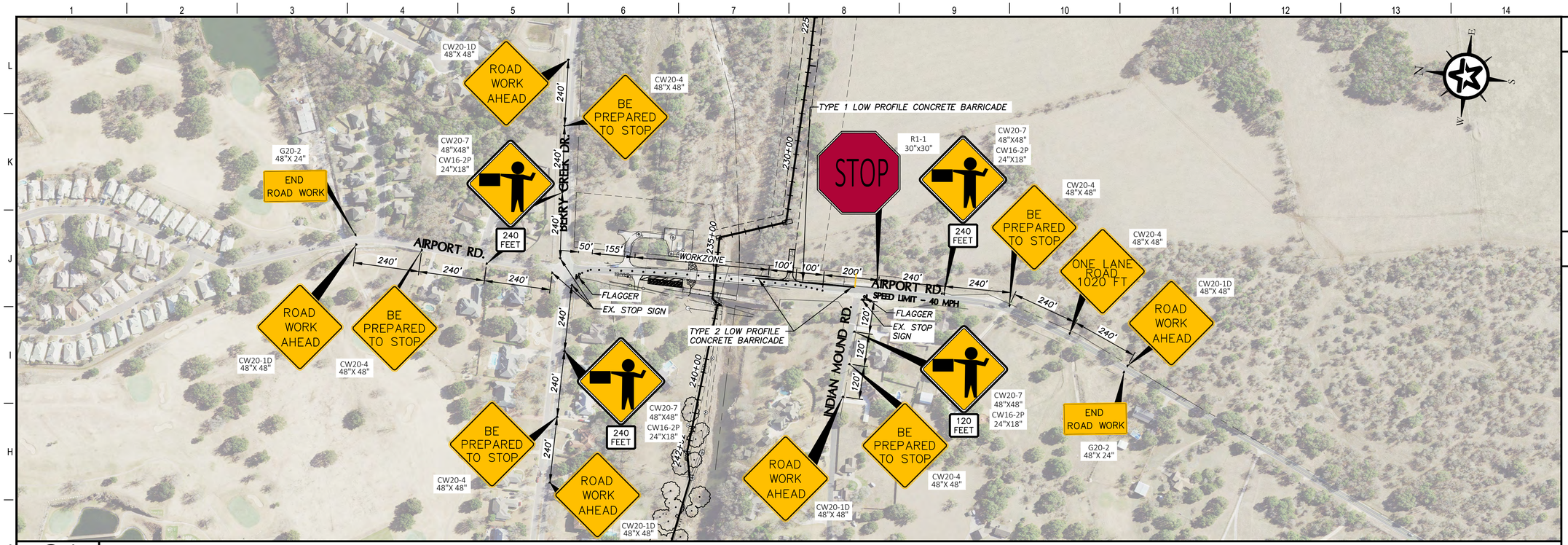

G1

TRAFFIC CONTROL PLAN - AIRPORT ROAD NORTHBOUND ONE LANE TWO-WAY CONTROL WITH FLAGGERS

SCALE: 1"=200'

A1

NOT USED

LEGEND

- BERRY CREEK INTERCEPTOR ALIGNMENT
- TEMPORARY CONSTRUCTION ENTRANCE
- TRAFFIC CONTROL BARRELS
- TRAFFIC CONTROL FLAGGER
- WORK ZONE

GENERAL NOTES

1. IN AREAS WHERE TRAFFIC IS PRESENT, TRAFFIC MUST BE HANDLED DURING CONSTRUCTION IN SUCH A MANNER AS TO CREATE THE LEAST INCONVENIENCE TO THE TRAVELING PUBLIC AND PROVIDE FOR MAXIMUM SAFETY BY MEANS OF ADEQUATE WARNING AND PROTECTION DEVICES.
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4. ALL DETAILS ARE NOT SHOWN. REFER TO TXDOT STANDARDS TCP (2-1)-18, (2-2)-18, AND BC-21 FOR OPERATIONS DURING OFF PAVEMENT AND/OR OFF R.O.W. CONSTRUCTION.

0 100 200 400

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors

T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL PLAN 7

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
CT506

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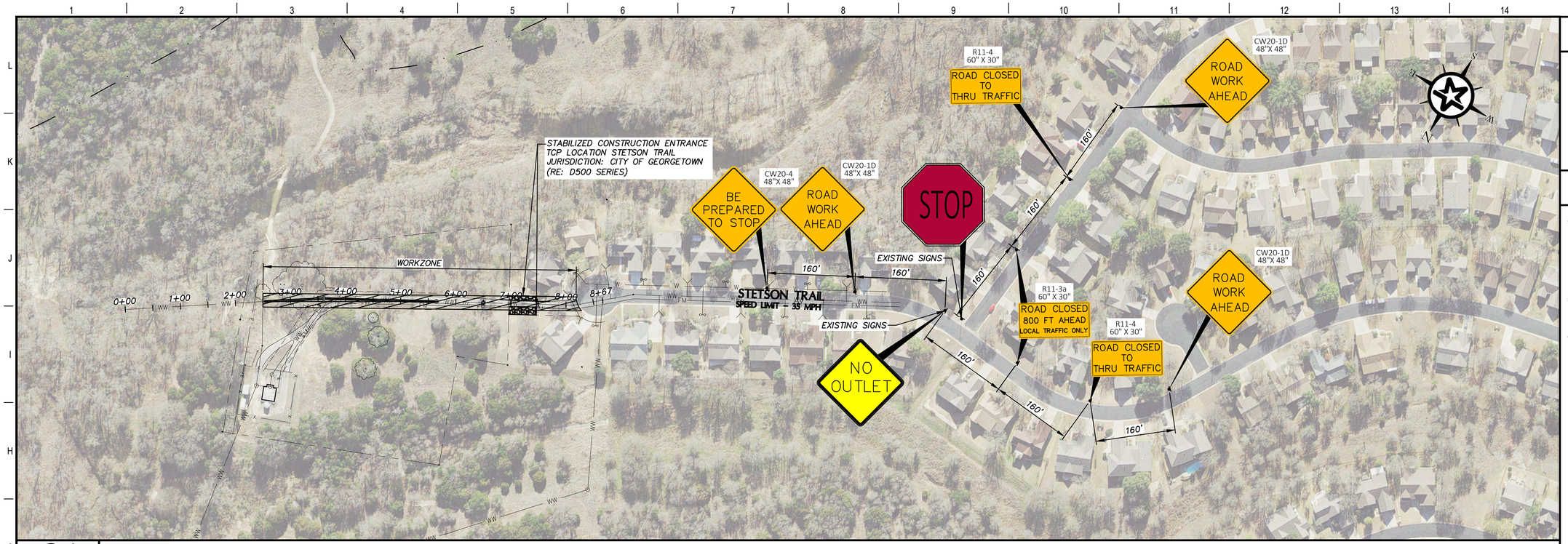

G1

TRAFFIC CONTROL PLAN - STETSON TRAIL ROADWAY CLOSED TO THRU TRAFFIC

SCALE: 1"=100'

A1

NOT USED

LEGEND

- TEMPORARY CONSTRUCTION ENTRANCE
- TRAFFIC CONTROL SIGNS
- WORK ZONE

GENERAL NOTES

1. IN AREAS WHERE TRAFFIC IS PRESENT. TRAFFIC MUST BE HANDLED DURING CONSTRUCTION IN SUCH A MANNER AS TO CREATE THE LEAST INCONVENIENCE TO THE TRAVELING PUBLIC AND PROVIDE FOR MAXIMUM SAFETY BY MEANS OF ADEQUATE WARNING AND PROTECTION DEVICES.
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0 50 100 200

GRAPHIC SCALE (FEET)

REV.	DESCRIPTION	DATE

Walker Partners
engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL PLAN OFFSITE

08/14/2023
DATE

TRISTAN A. ROBLES

STATE OF TEXAS
TRISTAN A. ROBLES
145927
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	JB
PROJECT NO.	3-00582

DRAWING NO.
CT507

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BARRICADE AND CONSTRUCTION (BC) STANDARD SHEETS GENERAL NOTES:

1. The Barricade and Construction Standard Sheets (BC sheets) are intended to show typical examples for placement of temporary traffic control devices, construction pavement markings, and typical work zone signs. The information contained in these sheets meet or exceed the requirements shown in the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD).
2. The development and design of the Traffic Control Plan (TCP)is the responsibility of the Engineer.
3. The Contractor may propose changes to the TCP that are signed and sealed by a licensed professional engineer for approval. The Engineer may develop, sign and seal Contractor proposed changes.
4. The Contractor is responsible for installing and maintaining the traffic control devices as shown in the plans. The Contractor may not move or change the approximate location of any device without the approval of the Engineer.
5. Geometric design of lane shifts and detours should, when possible, meet the applicable design criteria contained in manuals such as the American Association of State Highway and Transportation Officials (AASHTO), "A Policy on Geometric Design of Highways and Streets," the TxDOT "Roadway Design Manual" or engineering judgment.
6. When projects abut, the Engineer(s) may omit the END ROAD WORK, TRAFFIC FINES DOUBLE, and other advance warning signs if the signing would be redundant and the work areas appear continuous to the motorists. If the adjacent project is completed first, the Contractor shall erect the necessary warning signs as shown on these sheets, the TCP sheets or as directed by the Engineer. The BEGIN ROAD WORK NEXT X MILES sign shall be revised to show appropriate work zone distance.
7. The Engineer may require duplicate warning signs on the median side of divided highways where median width will permit and traffic volumes justify the signing.
8. All signs shall be constructed in accordance with the details found in the "Standard Highway Sign Designs for Texas," latest edition. Sign details not shown in this manual shall be shown in the plans or the Engineer shall provide a detail to the Contractor before the sign is manufactured.
9. The temporary traffic control devices shown in the illustrations of the BC sheets are examples. As necessary, the Engineer will determine the most appropriate traffic control devices to be used.
10. Where highway construction or maintenance work is being undertaken, other than mobile operations as defined by the Texas Manual on Uniform Traffic Control Devices, CSJ limit signs are required. CSJ limit signs are shown on BC(2). The OBEY WARNING SIGNS STATE LAW sign, STAY ALERT TALK OR TEXT LATER and the WORK ZONE TRAFFIC FINES DOUBLE sign with plaque shall be erected in advance of the CSJ limits. The BEGIN ROAD WORK NEXT X MILES, CONTRACTOR and END ROAD WORK signs shall be erected at or near the CSJ limits. For mobile operations, CSJ limit signs are not required.
11. Traffic control devices should be in place only while work is actually in progress or a definite need exists.
12. The Engineer has the final decision on the location of all traffic control devices.
13. Inactive equipment and work vehicles, including workers' private vehicles must be parked away from travel lanes. They should be as close to the right-of-way line as possible, or located behind a barrier or guardrail, or as approved by the Engineer.

WORKER SAFETY NOTES:

1. Workers on foot who are exposed to traffic or to construction equipment within the right-of-way shall wear high-visibility safety apparel meeting the requirements of ISEA "American National Standard for High-Visibility Apparel," or equivalent revisions, and labeled as ANSI 107-2004 standard performance for Class 2 or 3 risk exposure. Class 3 garments should be considered for high traffic volume work areas or night time work.
2. Except in emergency situations, flagger stations shall be illuminated when flagging is used at night.

COMPLIANT WORKZONE TRAFFIC CONTROL DEVICES

1. Only pre-qualified products shall be used. The "Compliant Work Zone Traffic Control Devices List" (CWZTCD) describes pre-qualified products and their sources.
2. Work zone traffic control devices shall be compliant with the Manual for Assessing safety Hardware (MASH).

THE DOCUMENTS BELOW CAN BE FOUND ON-LINE AT http://www.txdot.gov
COMPLIANT WORK ZONE TRAFFIC CONTROL DEVICES LIST (CWZTCD)
DEPARTMENTAL MATERIAL SPECIFICATIONS (DMS)
MATERIAL PRODUCER LIST (MPL)
ROADWAY DESIGN MANUAL - SEE "MANUALS (ONLINE MANUALS)"
STANDARD HIGHWAY SIGN DESIGNS FOR TEXAS (SHSD)
TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (TMUTCD)
TRAFFIC ENGINEERING STANDARD SHEETS

DATE:
FILE:

SHEET 1 OF 12

Texas Department of Transportation — Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION GENERAL NOTES AND REQUIREMENTS

BC(1)-21

FILE: bc-21.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
©TxDOT November 2002	CONT	SECT	JOB	HIGHWAY
REVISIONS				
4-03 7-13	DIST	COUNTY		SHEET NO.
9-07 8-14				
5-10 5-21				

95

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL DETAIL 1

03/31/2023 — DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D500

A1 — NTS — BARRICADE AND CONSTRUCTION GENERAL NOTES AND REQUIREMENTS — TXDOT

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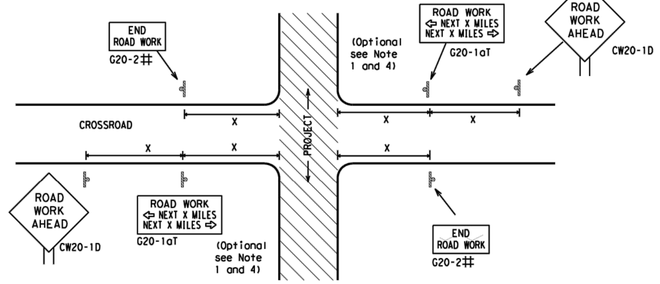
TYPICAL LOCATION OF CROSSROAD SIGNS



(Optional see Note 1 and 4)

ROAD WORK AHEAD CW20-1D

ROAD WORK ⇦ NEXT X MILES NEXT X MILES ⇨ G20-1aT

END ROAD WORK G20-2##

CROSSROAD

PROJECT

X

ROAD WORK AHEAD CW20-1D

ROAD WORK ⇦ NEXT X MILES NEXT X MILES ⇨ G20-1aT

(Optional see Note 1 and 4)

END ROAD WORK G20-2##

ROAD WORK ⇦ NEXT X MILES NEXT X MILES ⇨ G20-1aT

ROAD WORK AHEAD CW20-1D

(Optional see Note 1 and 4)

END ROAD WORK G20-2##

CROSSROAD

PROJECT

X

ROAD WORK AHEAD CW20-1D

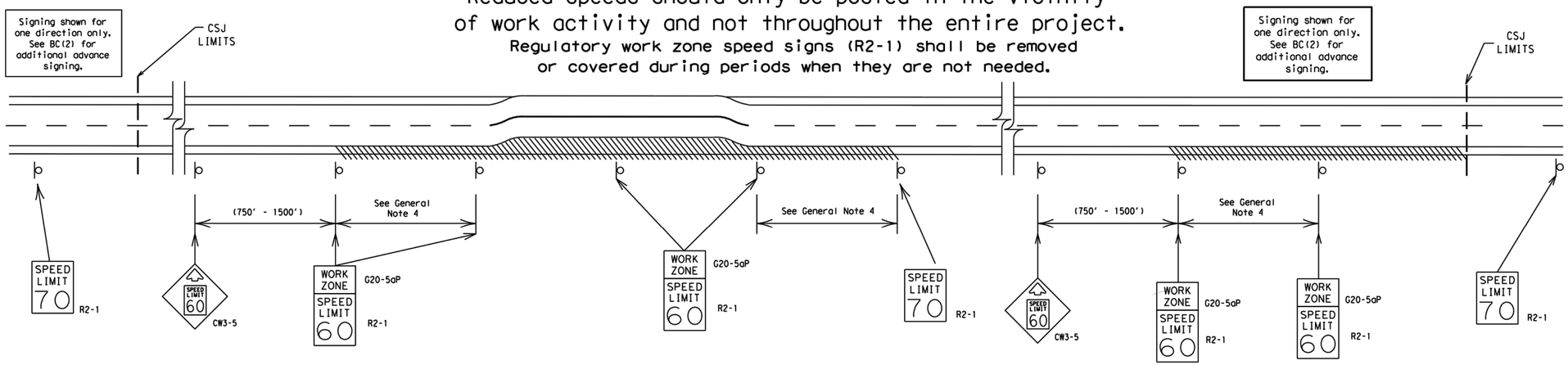
ROAD WORK ⇦ NEXT X MILES NEXT X MILES ⇨ G20-1aT

TYPICAL APPLICATION OF WORK ZONE SPEED LIMIT SIGNS

Work zone speed limits shall be regulatory, established in accordance with the "Procedures for Establishing Speed Zones," and approved by the Texas Transportation Commission, or by City Ordinance when within Incorporated City Limits.

Reduced speeds should only be posted in the vicinity of work activity and not throughout the entire project.

Regulatory work zone speed signs (R2-1) shall be removed or covered during periods when they are not needed.



GUIDANCE FOR USE:

LONG/INTERMEDIATE TERM WORK ZONE SPEED LIMITS

This type of work zone speed limit should be included on the design of the traffic control plans when restricted geometrics with a lower design speed are present in the work zone and modification of the geometrics to a higher design speed is not feasible.

Long/Intermediate Term Work Zone Speed Limit signs, when approved as described above, should be posted and visible to the motorist when work activity is present. Work activity may also be defined as a change in the roadway that requires a reduced speed for motorists to safely negotiate the work area, including:

a) rough road or damaged pavement surface
b) substantial alteration of roadway geometrics (diversions)
c) construction detours
d) grade
e) width
f) other conditions readily apparent to the driver

As long as any of these conditions exist, the work zone speed limit signs should remain in place.

SHORT TERM WORK ZONE SPEED LIMITS

This type of work zone speed limit may be included on the design of the traffic control plans when workers or equipment are not behind concrete barrier, when work activity is within 10 feet of the traveled way or actually in the traveled way.

Short Term Work Zone Speed Limit signs should be posted and visible to the motorists only when work activity is present. When work activity is not present, signs shall be removed or covered.
(See Removing or Covering on BC(4)).

GENERAL NOTES

1. Regulatory work zone speed limits should be used only for sections of construction projects where speed control is of major importance.
2. Regulatory work zone speed limit signs shall be placed on supports at a 7 foot minimum mounting height.
3. Speed zone signs are illustrated for one direction of travel and are normally posted for each direction of travel.
4. Frequency of work zone speed limit signs should be:
   40 mph and greater 0.2 to 2 miles
   35 mph and less 0.2 to 1 mile
5. Regulatory speed limit signs shall have black legend and border on a white reflective background (See "Reflective Sheeting" on BC(4)).
6. Fabrication, erection and maintenance of the"ADVANCE SPEED LIMIT"(CW3-5)sign, "WORK ZONE"(G20-5aP) plaque and the "SPEED LIMIT"(R2-1)signs shall not be paid for directly, but shall be considered subsidiary to Item 502.
7. Turning signs from view, laying signs over or down will not be allowed, unless as otherwise noted under "REMOVING OR COVERING" on BC(4).
8. Techniques that may help reduce traffic speeds include but are not limited to:
   A. Law enforcement.
   B. Flagger stationed next to sign.
   C. Portable changeable message sign (PCMS).
   D. Low-power (drone) radar transmitter.
   E. Speed monitor trailers or signs.
9. Speeds shown on details above are for illustration only. Work Zone Speed Limits should only be posted as approved for each project.
10. For more specific guidance concerning the type of work, work zone conditions and factors impacting allowable regulatory construction speed zone reduction see TxDOT form #1204 in the TxDOT e-form system.

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SHEET 3 OF 12

Texas Department of Transportation | Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION WORK ZONE SPEED LIMIT

BC(3)-21

FILE: bc-21.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
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REVISIONS 9-07 8-14 7-13 5-21	DIST	COUNTY		SHEET NO.

97

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL DETAIL 3

03/31/2023 DATE
ERIC LEE NELSON

STATE OF TEXAS ERIC LEE NELSON 114449 LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D502

A1 | BARRICADE AND CONSTRUCTION WORK ZONE SPEED LIMIT

NTS | TXDOT

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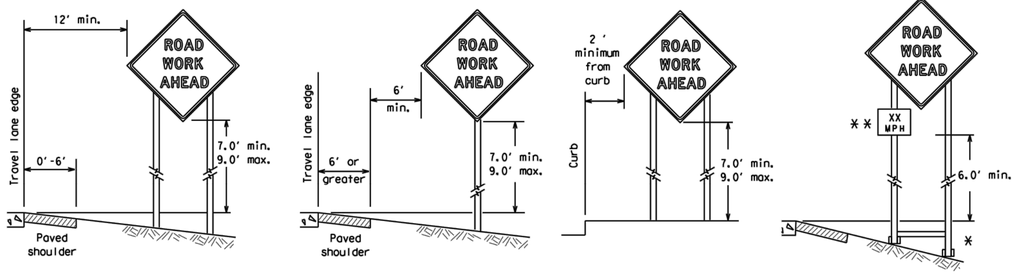
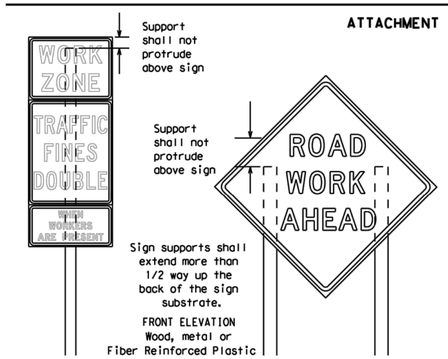
TYPICAL MINIMUM CLEARANCES FOR LONG TERM AND INTERMEDIATE TERM SIGNS



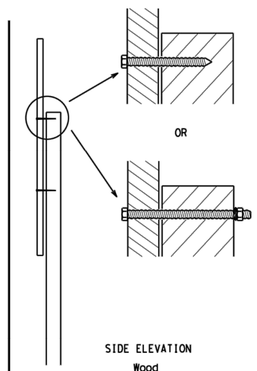
* When placing skid supports on unlevel ground, the leg post lengths must be adjusted so the sign appears straight and plumb. Objects shall NOT be placed under skids as a means of leveling.

** When plaques are placed on dual-leg supports, they should be attached to the upright nearest the travel lane. Supplemental plaques (advisory or distance) should not cover the surface of the parent sign.

ATTACHMENT FOR SIGN SUPPORTS



Splicing embedded perforated square metal tubing in order to extend post height will only be allowed when the splice is made using four bolts, two above and two below the spice point. Splice must be located entirely behind the sign substrate, not near the base of the support. Splice insert lengths should be at least 5 times nominal post size, centered on the splice and of at least the same gauge material.

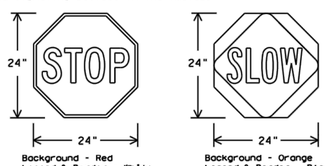


Attachment to wooden supports will be by bolts and nuts or screws. Use TxDOT's or manufacturer's recommended procedures for attaching sign substrates to other types of sign supports

Nails shall NOT be allowed. Each sign shall be attached directly to the sign support. Multiple signs shall not be joined or spliced by any means. Wood supports shall not be extended or repaired by splicing or other means.

STOP/SLOW PADDLES

1. STOP/SLOW paddles are the primary method to control traffic by flaggers. The STOP/SLOW paddle size should be 24" x 24".
2. STOP/SLOW paddles shall be retroreflectorized when used at night.
3. STOP/SLOW paddles may be attached to a staff with a minimum length of 6' to the bottom of the sign.
4. Any lights incorporated into the STOP or SLOW paddle faces shall only be as specifically described in Section 6E.03 Hand Signaling Devices in the TMUTCD.



Background - Red
Legend & Border - White

Background - Orange
Legend & Border - Black

SHEETING REQUIREMENTS (WHEN USED AT NIGHT)		
USAGE	COLOR	SIGN FACE MATERIAL
BACKGROUND	RED	TYPE B OR C SHEETING
BACKGROUND	ORANGE	TYPE B_{FL} OR C_{FL} SHEETING
LEGEND & BORDER	WHITE	TYPE B OR C SHEETING
LEGEND & BORDER	BLACK	ACRYLIC NON-REFLECTIVE FILM

CONTRACTOR REQUIREMENTS FOR MAINTAINING PERMANENT SIGNS WITHIN THE PROJECT LIMITS

1. Permanent signs are used to give notice of traffic laws or regulations, call attention to conditions that are potentially hazardous to traffic operations, show route designations, destinations, directions, distances, services, points of interest, and other geographical, recreational, specific service (LOGO), or cultural information. Drivers proceeding through a work zone need the same, if not better route guidance as normally installed on a roadway without construction.
2. When permanent regulatory or warning signs conflict with work zone conditions, remove or cover the permanent signs until the permanent sign message matches the roadway condition. For details for covering large guide signs see the TS-CD standard.
3. When existing permanent signs are moved and relocated due to construction purposes, they shall be visible to motorists at all times.
4. If existing signs are to be relocated on their original supports, they shall be installed on crashworthy bases as shown on the SMD Standard sheets. The signs shall meet the required mounting heights shown on the BC Sheets or the SMD Standards. This work should be paid for under the appropriate pay item for relocating existing signs.
5. If permanent signs are to be removed and relocated using temporary supports, the Contractor shall use crashworthy supports as shown on the BC standard sheets, TLRS standard sheets or the CWZTCD list. The signs shall meet the required mounting heights shown on the BC, or the SMD standard sheets during construction. This work should be paid for under the appropriate pay item for relocating existing signs.
6. Any sign or traffic control device that is struck or damaged by the Contractor or his/her construction equipment shall be replaced as soon as possible by the Contractor to ensure proper guidance for the motorists. This will be subsidiary to Item 502.

GENERAL NOTES FOR WORK ZONE SIGNS

1. Contractor shall install and maintain signs in a straight and plumb condition and/or as directed by the Engineer.
2. Wooden sign posts shall be painted white.
3. Barricades shall NOT be used as sign supports.
4. All signs shall be installed in accordance with the plans or as directed by the Engineer. Signs shall be used to regulate, warn, and guide the traveling public safely through the work zone.
5. The Contractor may furnish either the sign design shown in the plans or in the "Standard Highway Sign Designs for Texas" (SHSD). The Engineer/Inspector may require the Contractor to furnish other work zone signs that are shown in the TMUTCD but may have been omitted from the plans. Any variation in the plans shall be documented by written agreement between the Engineer and the Contractor's Responsible Person. All changes must be documented in writing before being implemented. This can include documenting the changes in the Inspector's TxDOT diary and having both the Inspector and Contractor initial and date the agreed upon changes.
6. The Contractor shall furnish sign supports listed in the "Compliant Work Zone Traffic Control Device List" (CWZTCD) for small roadside signs. Supports for temporary large roadside signs shall meet the requirements detailed on the Temporary Large Roadside Signs (TLRS) standard sheets. The Contractor shall install the sign support in accordance with the manufacturer's recommendations. If there is a question regarding installation procedures, the Contractor shall furnish the Engineer a copy of the manufacturer's installation recommendations so the Engineer can verify the correct procedures are being followed.
7. The Contractor is responsible for installing signs on approved supports and replacing signs with damaged or cracked substrates and/or damaged or marred reflective sheeting as directed by the Engineer/Inspector.
8. Identification markings may be shown only on the back of the sign substrate. The maximum height of letters and/or company logos used for identification shall be 1 inch.
9. The Contractor shall replace damaged wood posts. New or damaged wood sign posts shall not be spliced.

DURATION OF WORK (as defined by the "Texas Manual on Uniform Traffic Control Devices" Part 6)

1. The types of sign supports, sign mounting height, the size of signs, and the type of sign substrates can vary based on the type of work being performed. The Engineer is responsible for selecting the appropriate size sign for the type of work being performed. The Contractor is responsible for ensuring the sign support, sign mounting height and substrate meets manufacturer's recommendations in regard to crashworthiness and duration of work requirements.
   a. Long-term stationary - work that occupies a location more than 3 days.
   b. Intermediate-term stationary - work that occupies a location more than one daylight period up to 3 days, or nighttime work lasting more than one hour.
   c. Short-term stationary - daytime work that occupies a location for more than 1 hour in a single daylight period.
   d. Short, duration - work that occupies a location up to 1 hour.
   e. Mobile - work that moves continuously or intermittently (stopping for up to approximately 15 minutes.)

SIGN MOUNTING HEIGHT

1. The bottom of Long-term/Intermediate-term signs shall be at least 7 feet, but not more than 9 feet, above the paved surface, except as shown for supplemental plaques mounted below other signs.
2. The bottom of Short-term/Short Duration signs shall be a minimum of 1 foot above the pavement surface but no more than 2 feet above the ground.
3. Long-term/Intermediate-term Signs may be used in lieu of Short-term/Short Duration signing.
4. Short-term/Short Duration signs shall be used only during daylight and shall be removed at the end of the workday or raised to appropriate Long-term/Intermediate sign height.
5. Regulatory signs shall be mounted at least 7 feet, but not more than 9 feet, above the paved surface regardless of work duration.

SIZE OF SIGNS

1. The Contractor shall furnish the sign sizes shown on BC (2) unless otherwise shown in the plans or as directed by the Engineer.

SIGN SUBSTRATES

1. The Contractor shall ensure the sign substrate is installed in accordance with the manufacturer's recommendations for the type of sign support that is being used. The CWZTCD lists each substrate that can be used on the different types and models of sign supports.
2. "Mesh" type materials are NOT an approved sign substrate, regardless of the tightness of the weave.
3. All wooden individual sign panels fabricated from 2 or more pieces shall have one or more plywood cleat, 1/2" thick by 6" wide, fastened to the back of the sign and extending fully across the sign. The cleat shall be attached to the back of the sign using wood screws that do not penetrate the face of the sign panel. The screws shall be placed on both sides of the splice and spaced at 6" centers. The Engineer may approve other methods of splicing the sign face.

REFLECTIVE SHEETING

1. All signs shall be retroreflective and constructed of sheeting meeting the color and retro-reflectivity requirements of DMS-8300 for rigid signs or DMS-8310 for roll-up signs. The web address for DMS specifications is shown on BC(1).
2. White sheeting, meeting the requirements of DMS-8300 Type A, shall be used for signs with a white background.
3. Orange sheeting, meeting the requirements of DMS-8300 Type B_{FL} or Type C_{FL}, shall be used for rigid signs with orange backgrounds.

SIGN LETTERS

1. All sign letters and numbers shall be clear, and open rounded type uppercase alphabet letters as approved by the Federal Highway Administration (FHWA) and as published in the "Standard Highway Sign Design for Texas" manual. Signs, letters and numbers shall be of first class workmanship in accordance with Department Standards and Specifications.

REMOVING OR COVERING

1. When sign messages may be confusing or do not apply, the signs shall be removed or completely covered.
2. Long-term stationary or intermediate stationary signs installed on square metal tubing may be turned away from traffic 90 degrees when the sign message is not applicable. This technique may not be used for signs installed in the median of divided highways or near any intersections where the sign may be seen from approaching traffic.
3. Signs installed on wooden skids shall not be turned at 90 degree angles to the roadway. These signs should be removed or completely covered when not required.
4. When signs are covered, the material used shall be opaque, such as heavy mil black plastic, or other materials which will cover the entire sign face and maintain their opaque properties under automobile headlights at night, without damaging the sign sheeting.
5. Burlap shall NOT be used to cover signs.
6. Duct tape or other adhesive material shall NOT be affixed to a sign face.
7. Signs and anchor stubs shall be removed and holes backfilled upon completion of work.

SIGN SUPPORT WEIGHTS

1. Where sign supports require the use of weights to keep from turning over, the use of sandbags with dry, cohesionless sand should be used.
2. The sandbags will be tied shut to keep the sand from spilling and to maintain a constant weight.
3. Rock, concrete, iron, steel or other solid objects shall not be permitted for use as sign support weights.
4. Sandbags should weigh a minimum of 35 lbs and a maximum of 50 lbs.
5. Sandbags shall be made of a durable material that tears upon vehicular impact. Rubber (such as tire inner tubes) shall NOT be used.
6. Rubber ballasts designed for channelizing devices should not be used for ballast on portable sign supports. Sign supports designed and manufactured with rubber bases may be used when shown on the CWZTCD list.
7. Sandbags shall only be placed along or laid over the base supports of the traffic control device and shall not be suspended above ground level or hung with rope, wire, chains or other fasteners. Sandbags shall be placed along the length of the skids to weigh down the sign support.
8. Sandbags shall NOT be placed under the skid and shall not be used to level sign supports placed on slopes.

FLAGS ON SIGNS

1. Flags may be used to draw attention to warning signs. When used, the flag shall be 16 inches square or larger and shall be orange or fluorescent red-orange in color. Flags shall not be allowed to cover any portion of the sign face.

SHEET 4 OF 12

Texas Department of Transportation — Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION TEMPORARY SIGN NOTES

BC(4)-21

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Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL DETAIL 4

03/31/2023 — DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D503

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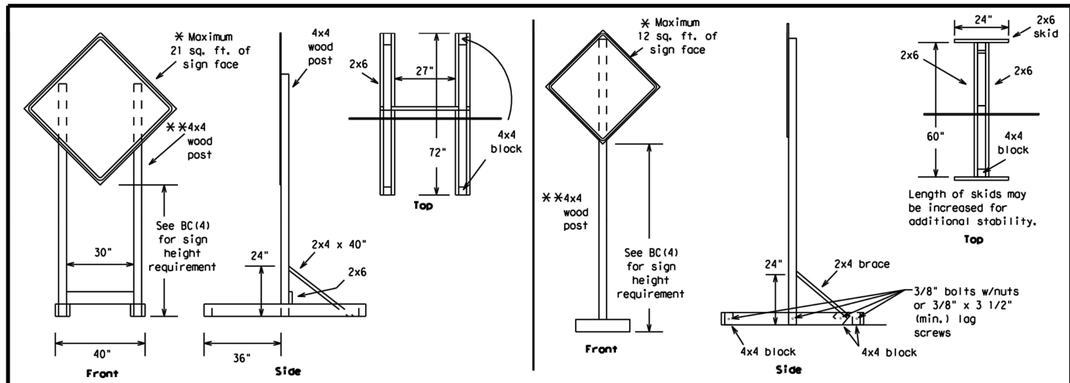
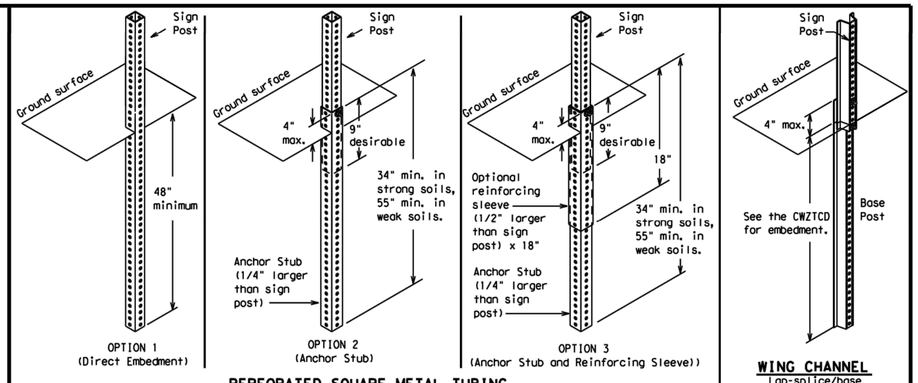


SKID MOUNTED WOOD SIGN SUPPORTS

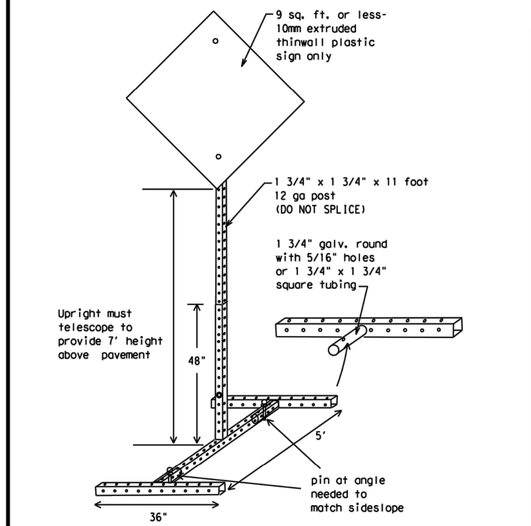
* LONG/INTERMEDIATE TERM STATIONARY - PORTABLE SKID MOUNTED SIGN SUPPORTS

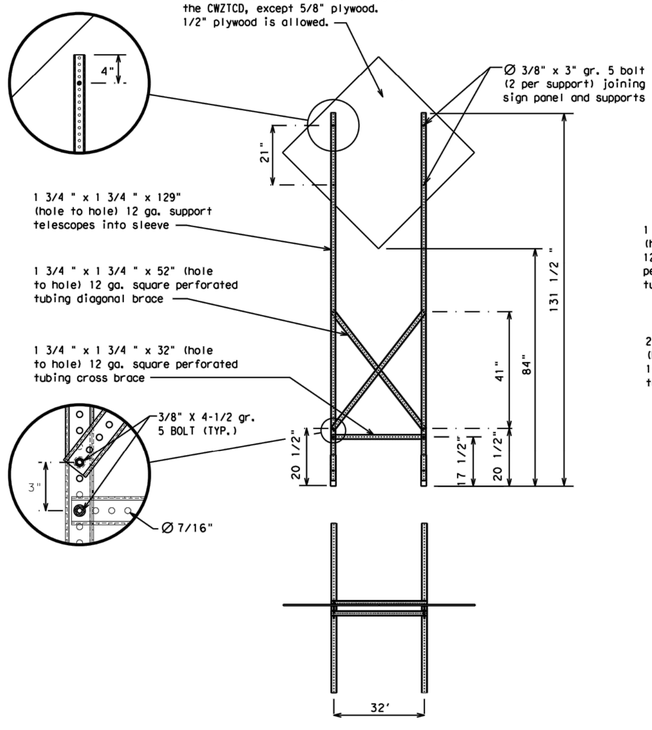


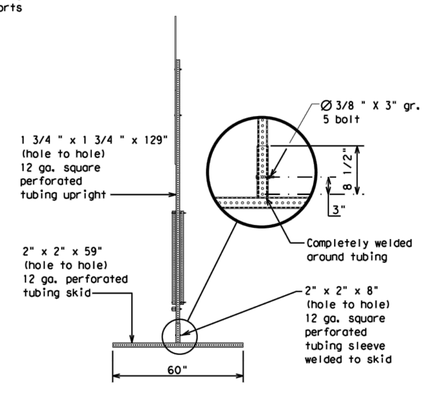
PERFORATED SQUARE METAL TUBING

GROUND MOUNTED SIGN SUPPORTS

Refer to the CWZTCD and the manufacturer's installation procedure for each type sign support.
The maximum sign square footage shall adhere to the manufacturer's recommendation.
Two post installations can be used for larger signs.







SKID MOUNTED PERFORATED SQUARE STEEL TUBING SIGN SUPPORTS

* LONG/INTERMEDIATE TERM STATIONARY - PORTABLE SKID MOUNTED SIGN SUPPORTS

DATE:
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WEDGE ANCHORS

Both steel and plastic Wedge Anchor Systems as shown on the SMD Standard Sheets may be used as temporary sign supports for signs up to 10 square feet of sign face. They may be set in concrete or in sturdy soils if approved by the Engineer. (See web address for "Traffic Engineering Standard Sheets" on BC(1)).

OTHER DESIGNS

MORE DETAILS OF APPROVED LONG/INTERMEDIATE AND SHORT TERM SUPPORTS CAN BE FOUND ON THE CWZTCD LIST. SEE BC(1) FOR WEBSITE LOCATION.

GENERAL NOTES

1. Nails may be used in the assembly of wooden sign supports, but 3/8" bolts with nuts or 3/8" x 3 1/2" lag screws must be used on every joint for final connection.
2. No more than 2 sign posts shall be placed within a 7 ft. circle, except for specific materials noted on the CWZTCD List.
3. When project is completed, all sign supports and foundations shall be removed from the project site. This will be considered subsidiary to Item 502.

* See BC(4) for definition of "Work Duration."

** Wood sign posts MUST be one piece. Splicing will NOT be allowed. Posts shall be painted white.

□ See the CWZTCD for the type of sign substrate that can be used for each approved sign support.

SHEET 5 OF 12

Texas Department of Transportation | Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION TYPICAL SIGN SUPPORT

BC(5)-21

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Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL DETAIL 5

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS · ERIC LEE NELSON · 114449 · LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D504

A1 | BARRICADE AND CONSTRUCTION TYPICAL SIGN SUPPORT
NTS | TXDOT

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WHEN NOT IN USE, REMOVE THE PCMS FROM THE RIGHT-OF-WAY OR PLACE THE PCMS BEHIND BARRIER OR GUARDRAIL WITH SIGN PANEL TURNED PARALLEL TO TRAFFIC

PORTABLE CHANGEABLE MESSAGE SIGNS

1. The Engineer/Inspector shall approve all messages used on portable changeable message signs (PCMS).
2. Messages on PCMS should contain no more than 8 words (about four to eight characters per word), not including simple words such as "TO," "FOR," "AT," etc.
3. Messages should consist of a single phase, or two phases that alternate. Three-phase messages are not allowed. Each phase of the message should convey a single thought, and must be understood by itself.
4. Use the word "EXIT" to refer to an exit ramp on a freeway; i.e., "EXIT CLOSED." Do not use the term "RAMP."
5. Always use the route or interstate designation (IH, US, SH, FM) along with the number when referring to a roadway.
6. When in use, the bottom of a stationary PCMS message panel should be a minimum 7 feet above the roadway, where possible.
7. The message term "WEEKEND" should be used only if the work is to start on Saturday morning and end by Sunday evening at midnight. Actual days and hours of work should be displayed on the PCMS if work is to begin on Friday evening and/or continue into Monday morning.
8. The Engineer/Inspector may select one of two options which are available for displaying a two-phase message on a PCMS. Each phase may be displayed for either four seconds each or for three seconds each.
9. Do not "flash" messages or words included in a message. The message should be steady burn or continuous while displayed.
10. Do not present redundant information on a two-phase message; i.e., keeping two lines of the message the same and changing the third line.
11. Do not use the word "Danger" in message.
12. Do not display the message "LANES SHIFT LEFT" or "LANES SHIFT RIGHT" on a PCMS. Drivers do not understand the message.
13. Do not display messages that scroll horizontally or vertically across the face of the sign.
14. The following table lists abbreviated words and two-word phrases that are acceptable for use on a PCMS. Both words in a phrase must be displayed together. Words or phrases not on this list should not be abbreviated, unless shown in the TMUTCD.
15. PCMS character height should be at least 18 inches for trailer mounted units. They should be visible from at least 1/2 (.5) mile and the text should be legible from at least 600 feet at night and 800 feet in daylight. Truck mounted units must have a character height of 10 inches and must be legible from at least 400 feet.
16. Each line of text should be centered on the message board rather than left or right justified.
17. If disabled, the PCMS should default to an illegible display that will not alarm motorists and will only be used to alert workers that the PCMS has malfunctioned. A pattern such as a series of horizontal solid bars is appropriate.

WORD OR PHRASE	ABBREVIATION
Access Road	ACCS RD
Alternate	ALT
Avenue	AVE
Best Route	BEST RTE
Boulevard	BLVD
Bridge	BRDG
Cannot	CANT
Center	CTR
Construction Ahead	CONST AHD
CROSSING	XING
Detour Route	DETOUR RTE
Do Not	DONT
East	E
Eastbound	(route) E
Emergency	EMER
Emergency Vehicle	EMER VEH
Entrance, Enter	ENT
Express Lane	EXP LN
Expressway	EXPWY
XXXX Feet	XXXX FT
Fog Ahead	FOG AHD
Freeway	FRWY, FWY
Freeway Blocked	FWY BLKD
Friday	FRI
Hazardous Driving	HAZ DRIVING
Hazardous Material	HAZMAT
High-Occupancy	HOV
Vehicle Highway	HWY
Hour(s)	HR, HRS
Information	INFO
It Is	ITS
Junction	JCT
Left	LFT
Left Lane	LFT LN
Lane Closed	LN CLOSED
Lower Level	LWR LEVEL
Maintenance	MAINT

WORD OR PHRASE	ABBREVIATION
Major	MAJ
Miles	MI
Miles Per Hour	MPH
Minor	MNR
Monday	MON
Normal	NORM
North	N
Northbound	(route) N
Parking	PKING
Road	RD
Right Lane	RT LN
Saturday	SAT
Service Road	SERV RD
Shoulder	SHLDR
Slippery	SLIP
South	S
Southbound	(route) S
Speed	SPD
Street	ST
Sunday	SUN
Telephone	PHONE
Temporary	TEMP
Thursday	THURS
To Downtown	TO DWNTN
Traffic	TRAF
Travelers	TRVLRS
Tuesday	TUES
Time Minutes	TIME MIN
Upper Level	UPR LEVEL
Vehicles (s)	VEH, VEHS
Warning	WARN
Wednesday	WED
Weight Limit	WT LIMIT
West	W
Westbound	(route) W
Wet Pavement	WET PVMT
Will Not	WONT

Roadway designation = IH-number, US-number, SH-FM-number

RECOMMENDED PHASES AND FORMATS FOR PCMS MESSAGES DURING ROADWORK ACTIVITIES

(The Engineer may approve other messages not specifically covered here.)

Phase 1: Condition Lists

Road/Lane/Ramp Closure List

FREEWAY CLOSED X MILE	FRONTAGE ROAD CLOSED
ROAD CLOSED AT SH XXX	SHOULDER CLOSED XXX FT
ROAD CLSD AT FM XXXX	RIGHT LN CLOSED XXX FT
RIGHT X LANES CLOSED	RIGHT X LANES OPEN
CENTER LANE CLOSED	DAYTIME LANE CLOSURES
NIGHT LANE CLOSURES	I-XX SOUTH EXIT CLOSED
VARIOUS LANES CLOSED	EXIT XXX CLOSED X MILE
EXIT CLOSED	RIGHT LN TO BE CLOSED
MALL DRIVEWAY CLOSED	X LANES CLOSED TUE - FRI
XXXXXXXX BLVD CLOSED	

Other Condition List

ROADWORK XXX FT	ROAD REPAIRS XXXX FT
FLAGGER XXXX FT	LANE NARROWS XXXX FT
RIGHT LN NARROWS XXXX FT	TWO-WAY TRAFFIC XX MILE
MERGING TRAFFIC XXXX FT	CONST TRAFFIC XXX FT
LOOSE GRAVEL XXXX FT	UNEVEN LANES XXXX FT
DETOUR X MILE	ROUGH ROAD XXXX FT
ROADWORK PAST SH XXXX	ROADWORK NEXT FRI-SUN
BUMP XXXX FT	US XXX EXIT X MILES
TRAFFIC SIGNAL XXXX FT	LANES SHIFT *

* LANES SHIFT in Phase 1 must be used with STAY IN LANE in Phase 2.

Phase 2: Possible Component Lists

Action to Take/Effect on Travel List

MERGE RIGHT	FORM X LINES RIGHT
DETOUR NEXT X EXITS	USE XXXXX RD EXIT
USE EXIT XXX	USE EXIT I-XX NORTH
STAY ON US XXX SOUTH	USE I-XX E TO I-XX N
TRUCKS USE US XXX N	WATCH FOR TRUCKS
WATCH FOR TRUCKS	EXPECT DELAYS
EXPECT DELAYS	PREPARE TO STOP
REDUCE SPEED XXX FT	END SHOULDER USE
USE OTHER ROUTES	WATCH FOR WORKERS
STAY IN LANE *	

* STAY IN LANE in Phase 2 must be used with LANES SHIFT in Phase 1.

Location List

AT FM XXXX
BEFORE RAILROAD CROSSING
NEXT X MILES
PAST US XXX EXIT
XXXXXXX TO XXXXXXX
US XXX TO FM XXXX

Warning List

SPEED LIMIT XX MPH
MAXIMUM SPEED XX MPH
MINIMUM SPEED XX MPH
ADVISORY SPEED XX MPH
RIGHT LANE EXIT
USE CAUTION
DRIVE SAFELY
DRIVE WITH CARE

** Advance Notice List

TUE-FRI XX AM- X PM
APR XX-XX X PM-X AM
BEGINS MONDAY
BEGINS MAY XX
MAY X-X XX PM - XX AM
NEXT FRI-SUN
XX AM TO XX PM
NEXT TUE AUG XX
TONIGHT XX PM- XX AM

** See Application Guidelines Note 6.

APPLICATION GUIDELINES

1. Only 1 or 2 phases are to be used on a PCMS.
2. The 1st phase (or both) should be selected from the "Road/Lane/Ramp Closure List" and the "Other Condition List".
3. A 2nd phase can be selected from the "Action to Take/Effect on Travel, Location, General Warning, or Advance Notice Phase Lists".
4. A Location Phase is necessary only if a distance or location is not included in the first phase selected.
5. If two PCMS are used in sequence, they must be separated by a minimum of 1000 ft. Each PCMS shall be limited to two phases, and should be understandable by themselves.
6. For advance notice, when the current date is within seven days of the actual work date, calendar days should be replaced with days of the week. Advance notification should typically be for no more than one week prior to the work.

WORDING ALTERNATIVES

1. The words RIGHT, LEFT and ALL can be interchanged as appropriate.
2. Roadway designations IH, US, SH, FM and LP can be interchanged as appropriate.
3. EAST, WEST, NORTH and SOUTH (or abbreviations E, W, N and S) can be interchanged as appropriate.
4. Highway names and numbers replaced as appropriate.
5. ROAD, HIGHWAY and FREEWAY can be interchanged as needed.
6. AHEAD may be used instead of distances if necessary.
7. FT and MI, MILE and MILES interchanged as appropriate.
8. AT, BEFORE and PAST interchanged as needed.
9. Distances or AHEAD can be eliminated from the message if a location phase is used.

PCMS SIGNS WITHIN THE R.O.W. SHALL BE BEHIND GUARDRAIL OR CONCRETE BARRIER OR SHALL HAVE A MINIMUM OF FOUR (4) PLASTIC DRUMS PLACED PERPENDICULAR TO TRAFFIC ON THE UPSTREAM SIDE OF THE PCMS, WHEN EXPOSED TO ONE DIRECTION OF TRAFFIC. WHEN EXPOSED TO TWO WAY TRAFFIC, THE FOUR DRUMS SHOULD BE PLACED WITH ONE DRUM AT EACH OF THE FOUR CORNERS OF THE UNIT.

FULL MATRIX PCMS SIGNS

1. When Full Matrix PCMS signs are used, the character height and legibility/visibility requirements shall be maintained as listed in Note 15 under "PORTABLE CHANGEABLE MESSAGE SIGNS" above.
2. When symbol signs, such as the "Flagger Symbol"(CW20-7) are represented graphically on the Full Matrix PCMS sign and, with the approval of the Engineer, it shall maintain the legibility/visibility requirement listed above.
3. When symbol signs are represented graphically on the Full Matrix PCMS, they shall only supplement the use of the static sign represented, and shall not substitute for, or replace that sign.
4. A full matrix PCMS may be used to simulate a flashing arrow board provided it meets the visibility, flash rate and dimming requirements on BC(7), for the same size arrow.

SHEET 6 OF 12

Texas Department of Transportation — Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION PORTABLE CHANGEABLE MESSAGE SIGN (PCMS)

BC(6)-21

FILE:	bc-21.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
©TxDOT	November 2002	CONT	SECT	JOB	HIGHWAY
REVISIONS					
9-07	8-14	DIST	COUNTY		SHEET NO.
7-13	5-21				

100

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL DETAIL 6

03/31/2023 — DATE

ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D505

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DATE:
FILE:

A1 — NTS — BARRICADE AND CONSTRUCTION PORTABLE CHANGEABLE MESSAGE SIGN (PCMS) — TXDOT

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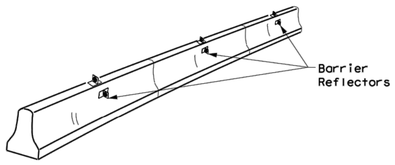
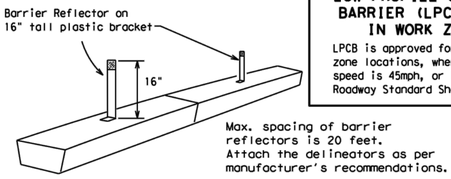
1. Barrier Reflectors shall be pre-qualified, and conform to the color and reflectivity requirements of DMS-8600. A list of prequalified Barrier Reflectors can be found at the Material Producer List web address shown on BC(1).
2. Color of Barrier Reflectors shall be as specified in the TMUTCD. The cost of the reflectors shall be considered subsidiary to Item 512.



CONCRETE TRAFFIC BARRIER (CTB)

3. Where traffic is on one side of the CTB, two (2) Barrier Reflectors shall be mounted in approximately the midsection of each section of CTB. An alternate mounting location is uniformly spaced at one end of each CTB. This will allow for attachment of a barrier grapple without damaging the reflector. The Barrier Reflector mounted on the side of the CTB shall be located directly below the reflector mounted on top of the barrier, as shown in the detail above.
4. Where CTB separates two-way traffic, three barrier reflectors shall be mounted on each section of CTB. The reflector unit on top shall have two yellow reflective faces (Bi-Directional)while the reflectors on each side of the barrier shall have one yellow reflective face, as shown in the detail above.
5. When CTB separates traffic traveling in the same direction, no barrier reflectors will be required on top of the CTB.
6. Barrier Reflector units shall be yellow or white in color to match the edgeline being supplemented.
7. Maximum spacing of Barrier Reflectors is forty (40) feet.
8. Pavement markers or temporary flexible-reflective roadway marker tabs shall NOT be used as CTB delineation.
9. Attachment of Barrier Reflectors to CTB shall be per manufacturer's recommendations.
10. Missing or damaged Barrier Reflectors shall be replaced as directed by the Engineer.
11. Single slope barriers shall be delineated as shown on the above detail.

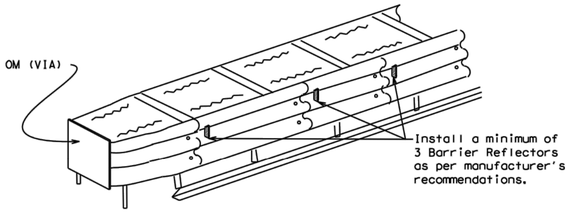


Max. spacing of barrier reflectors is 20 feet.
Attach the delineators as per manufacturer's recommendations.

LOW PROFILE CONCRETE BARRIER (LPCB)

LOW PROFILE CONCRETE BARRIER (LPCB) USED IN WORK ZONES

LPCB is approved for use in work zone locations, where the posted speed is 45mph, or less. See Roadway Standard Sheet LPCB.

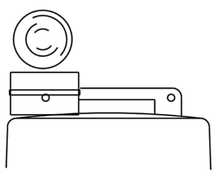


DELINEATION OF END TREATMENTS

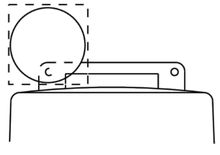
END TREATMENTS FOR CTB'S USED IN WORK ZONES

End treatments used on CTB's in work zones shall meet the apppropriate crashworthy standards as defined in the Manual for Assessing Safety Hardware (MASH). Refer to the CWZTCD List for approved end treatments and manufacturers.

BARRICADE AND CONSTRUCTION ARROW PANEL, REFLECTORS, WARNING LIGHTS & ATTENUATOR



Type C Warning Light or approved substitute mounted on a drum adjacent to the travel way.



Warning reflector may be round or square.Must have a yellow reflective surface area of at least 30 square inches

WARNING LIGHTS

1. Warning lights shall meet the requirements of the TMUTCD.
2. Warning lights shall NOT be installed on barricades.
3. Type A-Low Intensity Flashing Warning Lights are commonly used with drums. They are intended to warn of or mark a potentially hazardous area. Their use shall be as indicated on this sheet and/or other sheets of the plans by the designation "FL". The Type A Warning Lights shall not be used with signs manufactured with Type B_{FL} or C_{FL} Sheeting meeting the requirements of Departmental Material Specification DMS-8300.
4. Type-C and Type D 360 degree Steady Burn Lights are intended to be used in a series for delineation to supplement other traffic control devices. Their use shall be as indicated on this sheet and/or other sheets of the plans by the designation "SB".
5. The Engineer/Inspector or the plans shall specify the location and type of warning lights to be installed on the traffic control devices.
6. When required by the Engineer, the Contractor shall furnish a copy of the warning lights certification. The warning light manufacturer will certify the warning lights meet the requirements of the latest ITE Purchase Specifications for Flashing and Steady-Burn Warning Lights.
7. When used to delineate curves, Type-C and Type D Steady Burn Lights should only be placed on the outside of the curve, not the inside.
8. The location of warning lights and warning reflectors on drums shall be as shown elsewhere in the plans.

WARNING LIGHTS MOUNTED ON PLASTIC DRUMS

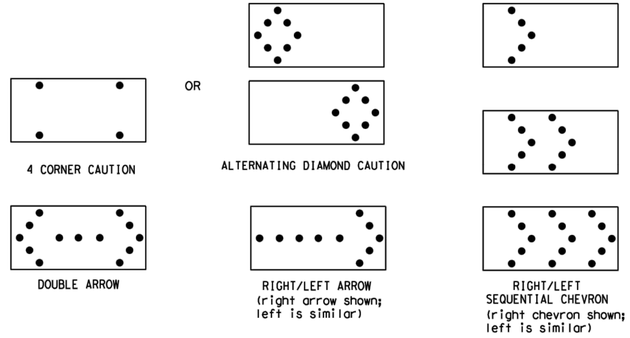
1. Type A flashing warning lights are intended to warn drivers that they are approaching or are in a potentially hazardous area.
2. Type A random flashing warning lights are not intended for delineation and shall not be used in a series.
3. A series of sequential flashing warning lights placed on channelizing devices to form a merging taper may be used for delineation. If used, the successive flashing of the sequential warning lights should occur from the beginning of the taper to the end of the merging taper in order to identify the desired vehicle path. The rate of flashing for each light shall be 65 flashes per minute, plus or minus 10 flashes.
4. Type C and D steady-burn warning lights are intended to be used in a series to delineate the edge of the travel lane on detours, on lane changes, on lane closures, and on other similar conditions.
5. Type A, Type C and Type D warning lights shall be installed at locations as detailed on other sheets in the plans.
6. Warning lights shall not be installed on a drum that has a sign, chevron or vertical panel.
7. The maximum spacing for warning lights on drums should be identical to the channelizing device spacing.

WARNING REFLECTORS MOUNTED ON PLASTIC DRUMS AS A SUBSTITUTE FOR TYPE C (STEADY BURN) WARNING LIGHTS

1. A warning reflector or approved substitute may be mounted on a plastic drum as a substitute for a Type C, steady burn warning light at the discretion of the Contractor unless otherwise noted in the plans.
2. The warning reflector shall be yellow in color and shall be manufactured using a sign substrate approved for use with plastic drums listed on the CWZTCD.
3. The warning reflector shall have a minimum retroreflective surface area (one-side) of 30 square inches.
4. Round reflectors shall be fully reflectorized, including the area where attached to the drum.
5. Square substrates must have a minimum of 30 square inches of reflectorized sheeting. They do not have to be reflectorized where it attaches to the drum.
6. The side of the warning reflector facing approaching traffic shall have sheeting meeting the color and retroreflectivity requirements for DMS 8300-Type B or Type C.
7. When used near two-way traffic, both sides of the warning reflector shall be reflectorized.
8. The warning reflector should be mounted on the side of the handle nearest approaching traffic.
9. The maximum spacing for warning reflectors should be identical to the channelizing device spacing requirements.

Arrow Boards may be located behind channelizing devices in place for a shoulder taper or merging taper, otherwise they shall be delineated with four (4) channelizing devices placed perpendicular to traffic on the upstream side of traffic.

1. The Flashing Arrow Board should be used for all lane closures on multi-lane roadways, or slow moving maintenance or construction activities on the travel lanes.
2. Flashing Arrow Boards should not be used on two-lane, two-way roadways, detours, diversions or work on shoulders unless the "CAUTION" display (see detail below) is used.
3. The Engineer/Inspector shall choose all appropriate signs, barricades and/or other traffic control devices that should be used in conjunction with the Flashing Arrow Board.
4. The Flashing Arrow Board should be able to display the following symbols:



5. The "CAUTION" display consists of four corner lamps flashing simultaneously, or the Alternating Diamond Caution mode as shown.
6. The straight line caution display is NOT ALLOWED.
7. The Flashing Arrow Board shall be capable of minimum 50 percent dimming from rated lamp voltage. The flashing rate of the lamps shall not be less than 25 nor more than 40 flashes per minute.
8. Minimum lamp "on time" shall be approximately 50 percent for the flashing arrow and equal intervals of 25 percent for each sequential phase of the flashing chevron.
9. The sequential arrow display is NOT ALLOWED.
10. The flashing arrow display is the TxDOT standard; however, the sequential chevron display may be used during daylight operations.
11. The Flashing Arrow Board shall be mounted on a vehicle, trailer or other suitable support.
12. A Flashing Arrow Board SHALL NOT BE USED to laterally shift traffic.
13. A full matrix PCMS may be used to simulate a Flashing Arrow Board provided it meets visibility, flash rate and dimming requirements on this sheet for the same size arrow.
14. Minimum mounting height of trailer mounted Arrow Boards should be 7 feet from roadway to bottom of panel.

REQUIREMENTS			
TYPE	MINIMUM SIZE	MINIMUM NUMBER OF PANEL LAMPS	MINIMUM VISIBILITY DISTANCE
B	30 x 60	13	3/4 mile
C	48 x 96	15	1 mile

ATTENTION

Flashing Arrow Boards shall be equipped with automatic dimming devices.

WHEN NOT IN USE, REMOVE THE ARROW BOARD FROM THE RIGHT-OF-WAY OR PLACE THE ARROW BOARD BEHIND CONCRETE TRAFFIC BARRIER OR GUARDRAIL.

FLASHING ARROW BOARDS

TRUCK-MOUNTED ATTENUATORS

1. Truck-mounted attenuators (TMA) used on TxDOT facilities must meet the requirements outlined in the Manual for Assessing Safety Hardware (MASH).
2. Refer to the CWZTCD for the requirements of Level 2 or Level 3 TMAs.
3. Refer to the CWZTCD for a list of approved TMAs.
4. TMAs are required on freeways unless otherwise noted in the plans.
5. A TMA should be used anytime that it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the work performance.
6. The only reason a TMA should not be required is when a work area is spread down the roadway and the work crew is an extended distance from the TMA.

SHEET 7 OF 12

Texas Department of Transportation — Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION ARROW PANEL, REFLECTORS, WARNING LIGHTS & ATTENUATOR

BC(7)-21

FILE: bc-21.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
©TxDOT November 2002	CONT	SECT	JOB	HIGHWAY
REVISIONS				
9-07 8-14	DIST	COUNTY		SHEET NO.
7-13 5-21				

TOT

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL DETAIL 7

03/31/2023 — DATE

ERIC LEE NELSON

STATE OF TEXAS · ERIC LEE NELSON · 114449 · LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D506

DATE:
FILE:

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A1 | BARRICADE AND CONSTRUCTION ARROW PANEL, REFLECTORS, WARNING LIGHTS & ATTENUATOR

NTS | TXDOT

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DATE:
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GENERAL NOTES

1. For long term stationary work zones on freeways, drums shall be used as the primary channelizing device.
2. For intermediate term stationary work zones on freeways, drums should be used as the primary channelizing device but may be replaced in tangent sections by vertical panels, or 42" two-piece cones. In tangent sections, one-piece cones may be used with the approval of the Engineer but only if personnel are present on the project at all times to maintain the cones in proper position and location.
3. For short term stationary work zones on freeways, drums are the preferred channelizing device but may be replaced in tapers, transitions and tangent sections by vertical panels, two-piece cones or one-piece cones as approved by the Engineer.
4. Drums and all related items shall comply with the requirements of the current version of the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD) and the "Compliant Work Zone Traffic Control Devices List" (CWZTCD).
5. Drums, bases, and related materials shall exhibit good workmanship and shall be free from objectionable marks or defects that would adversely affect their appearance or serviceability.
6. The Contractor shall have a maximum of 24 hours to replace any plastic drums identified for replacement by the Engineer/Inspector. The replacement device must be an approved device.

GENERAL DESIGN REQUIREMENTS

Pre-qualified plastic drums shall meet the following requirements:

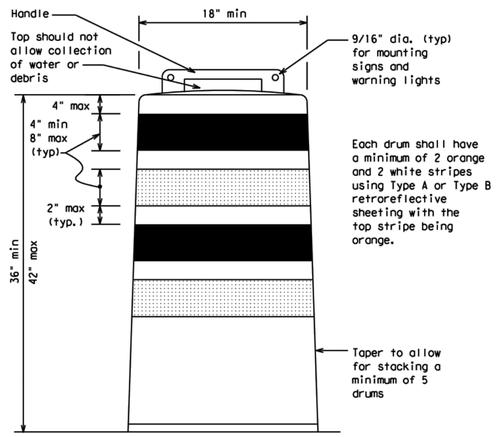
1. Plastic drums shall be a two-piece design; the "body" of the drum shall be the top portion and the "base" shall be the bottom.
2. The body and base shall lock together in such a manner that the body separates from the base when impacted by a vehicle traveling at a speed of 20 MPH or greater but prevents accidental separation due to normal handling and/or air turbulence created by passing vehicles.
3. Plastic drums shall be constructed of lightweight flexible, and deformable materials. The Contractor shall NOT use metal drums or single piece plastic drums as channelization devices or sign supports.
4. Drums shall present a profile that is a minimum of 18 inches in width at the 36 inch height when viewed from any direction. The height of drum unit (body installed on base) shall be a minimum of 36 inches and a maximum of 42 inches.
5. The top of the drum shall have a built-in handle for easy pickup and shall be designed to drain water and not collect debris. The handle shall have a minimum of two widely spaced 9/16 inch diameter holes to allow attachment of a warning light, warning reflector unit or approved compliant sign.
6. The exterior of the drum body shall have a minimum of four alternating orange and white retroreflective circumferential stripes not less than 4 inches nor greater than 8 inches in width. Any non-reflectorized space between any two adjacent stripes shall not exceed 2 inches in width.
7. Bases shall have a maximum width of 36 inches, a maximum height of 4 inches, and a minimum of two footholds of sufficient size to allow base to be held down while separating the drum body from the base.
8. Plastic drums shall be constructed of ultra-violet stabilized, orange, high-density polyethylene (HDPE) or other approved material.
9. Drum body shall have a maximum unballasted weight of 11 lbs.
10. Drum and base shall be marked with manufacturer's name and model number.

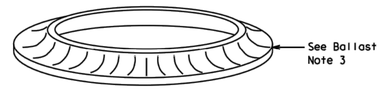
RETROREFLECTIVE SHEETING

1. The stripes used on drums shall be constructed of sheeting meeting the color and retroreflectivity requirements of Departmental Materials Specification DMS-8300, "Sign Face Materials." Type A or Type B reflective sheeting shall be supplied unless otherwise specified in the plans.
2. The sheeting shall be suitable for use on and shall adhere to the drum surface such that, upon vehicular impact, the sheeting shall remain adhered in-place and exhibit no delaminating, cracking, or loss of retroreflectivity other than that loss due to abrasion of the sheeting surface.

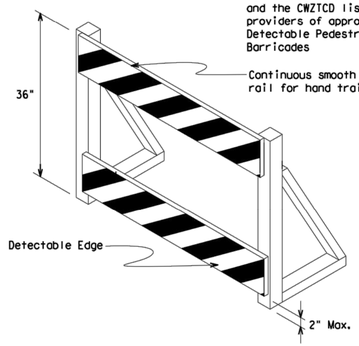
BALLAST

1. Unballasted bases shall be large enough to hold up to 50 lbs. of sand. This base, when filled with the ballast material, should weigh between 35 lbs (minimum) and 50 lbs (maximum). The ballast may be sand in one to three sandbags separate from the base, sand in a sand-filled plastic base, or other ballasting devices as approved by the Engineer. Stacking of sandbags will be allowed, however height of sandbags above pavement surface may not exceed 12 inches.
2. Bases with built-in ballast shall weigh between 40 lbs. and 50 lbs. Built-in ballast can be constructed of an integral crumb rubber base or a solid rubber base.
3. Recycled truck tire sidewalls may be used for ballast on drums approved for this type of ballast on the CWZTCD list.
4. The ballast shall not be heavy objects, water, or any material that would become hazardous to motorists, pedestrians, or workers when the drum is struck by a vehicle.
5. When used in regions susceptible to freezing, drums shall have drainage holes in the bottoms so that water will not collect and freeze becoming a hazard when struck by a vehicle.
6. Ballast shall not be placed on top of drums.
7. Adhesives may be used to secure base of drums to pavement.



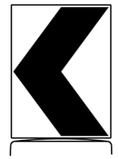


This detail is not intended for fabrication. See note 3 and the CWZTCD list for providers of approved Detectable Pedestrian Barricades

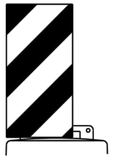


DETECTABLE PEDESTRIAN BARRICADES

1. When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and include accessibility features consistent with the features present in the existing pedestrian facility. Refer to WZ(BTS-2) for Pedestrian Control requirements for Sidewalk Diversions, Sidewalk Detours and Crosswalk Closures.
2. Where pedestrians with visual disabilities normally use the closed sidewalk, a Detectable Pedestrian Barricade shall be placed across the full width of the closed sidewalk instead of a Type 3 Barricade.
3. Detectable pedestrian barricades similar to the one pictured above, longitudinal channelizing devices, some concrete barriers, and wood or chain link fencing with a continuous detectable edging can satisfactorily delineate a pedestrian path.
4. Tape, rope, or plastic chain strung between devices are not detectable, do not comply with the design standards in the "Americans with Disabilities Act Accessibility Guidelines (ADAAG)" and should not be used as a control for pedestrian movements.
5. Warning lights shall not be attached to detectable pedestrian barricades.
6. Detectable pedestrian barricades should use 8" nominal barricade rails as shown on BC(10) provided that the top rail provides a smooth continuous rail suitable for hand trailing with no splinters, burrs, or sharp edges.



18" x 24" Sign
(Maximum Sign Dimension)
Chevron CW1-8, Opposing Traffic Lane Divider, Driveway sign D70a, Keep Right R4 series or other signs as approved by Engineer



12" x 24"
Vertical Panel
mount with diagonals sloping down towards travel way

Plywood, Aluminum or Metal sign substrates shall NOT be used on plastic drums

SIGNS, CHEVRONS, AND VERTICAL PANELS MOUNTED ON PLASTIC DRUMS

1. Signs used on plastic drums shall be manufactured using substrates listed on the CWZTCD.
2. Chevrons and other work zone signs with an orange background shall be manufactured with Type B_{FL} or Type C_{FL} Orange sheeting meeting the color and retroreflectivity requirements of DMS-8300, "Sign Face Material," unless otherwise specified in the plans.
3. Vertical Panels shall be manufactured with orange and white sheeting meeting the requirements of DMS-8300 Type A or Type B. Diagonal stripes on Vertical Panels shall slope down toward the intended traveled lane.
4. Other sign messages (text or symbolic) may be used as approved by the Engineer. Sign dimensions shall not exceed 18 inches in width or 24 inches in height, except for the R9 series signs discussed in note 8 below.
5. Signs shall be installed using a 1/2 inch bolt (nominal) and nut, two washers, and one locking washer for each connection.
6. Mounting bolts and nuts shall be fully engaged and adequately torqued. Bolts should not extend more than 1/2 inch beyond nuts.
7. Chevrons may be placed on drums on the outside of curves, on merging tapers or on shifting tapers. When used in these locations, they may be placed on every drum or spaced not more than on every third drum. A minimum of three (3) should be used at each location called for in the plans.
8. R9-9, R9-10, R9-11 and R9-11a Sidewalk Closed signs which are 24 inches wide may be mounted on plastic drums, with approval of the Engineer.

SHEET 8 OF 12

Texas Department of Transportation | Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES

BC(8)-21

FILE: bc-21.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
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Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL DETAIL 8

03/31/2023
DATE

ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
D507

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BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES

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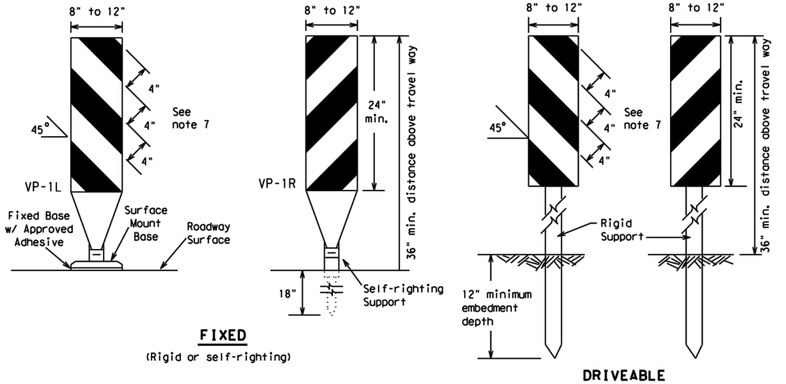
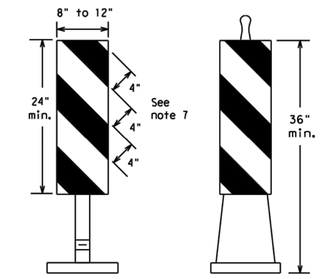


FIXED
(Rigid or self-righting)

DRIVEABLE

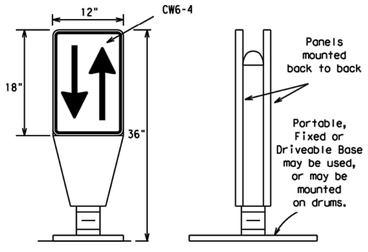


(Rigid or self-righting)

PORTABLE

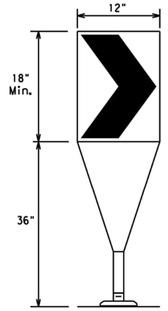
VERTICAL PANELS (VPs)

1. Vertical Panels (VP's) are normally used to channelize traffic or divide opposing lanes of traffic.
2. VP's may be used in daytime or nighttime situations. They may be used at the edge of shoulder drop-offs and other areas such as lane transitions where positive daytime and nighttime delineation is required. The Engineer/Inspector shall refer to the Roadway Design Manual for additional requirements on the use VP's for drop-offs.
3. VP's should be mounted back to back if used at the edge of cuts adjacent to two-way two lane roadways. Stripes are to be reflective orange and reflective white and should always slope downward toward the travel lane.
4. VP's used on expressways and freeways or other high speed roadways, may have more than 270 square inches of retroreflective area facing traffic.
5. Self-righting supports are available with portable base. See "Compliant Work Zone Traffic Control Devices List" (CWZTCD).
6. Sheeting for the VP's shall be retroreflective Type A or Type B conforming to Departmental Material Specification DMS-8300, unless noted otherwise.
7. Where the height of reflective material on the vertical panel is 36 inches or greater, a panel stripe of 6 inches shall be used.



1. Opposing Traffic Lane Dividers (OTLD) are delineation devices designed to convert a normal one-way roadway section to two-way operation. OTLD's are used on temporary centerlines. The upward and downward arrows on the sign's face indicate the direction of traffic on either side of the divider. The base is secured to the pavement with an adhesive or rubber weight to minimize movement caused by a vehicle impact or wind gust.
2. The OTLD may be used in combination with 42" cones or VPs.
3. Spacing between the OTLD shall not exceed 500 feet. 42" cones or VPs placed between the OTLD's should not exceed 100 foot spacing.
4. The OTLD shall be orange with a black non-reflective legend. Sheeting for the OTLD shall be retroreflective Type B_{FL} or Type C_{FL} conforming to Departmental Material Specification DMS-8300, unless noted otherwise. The legend shall meet the requirements of DMS-8300.

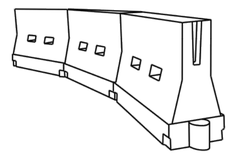
OPPOSING TRAFFIC LANE DIVIDERS (OTLD)



Fixed Base w/ Approved Adhesive (Driveable Base, or Flexible Support can be used)

1. The chevron shall be a vertical rectangle with a minimum size of 12 by 18 inches.
2. Chevrons are intended to give notice of a sharp change of alignment with the direction of travel and provide additional emphasis and guidance for vehicle operators with regard to changes in horizontal alignment of the roadway.
3. Chevrons, when used, shall be erected on the outside of a sharp curve or turn, or on the far side of an intersection. They shall be in line with and at right angles to approaching traffic. Spacing should be such that the motorist always has three in view, until the change in alignment eliminates its need.
4. To be effective, the chevron should be visible for at least 500 feet.
5. Chevrons shall be orange with a black nonreflective legend. Sheeting for the chevron shall be retroreflective Type B_{FL} or Type C_{FL} conforming to Departmental Material Specification DMS-8300, unless noted otherwise. The legend shall meet the requirements of DMS-8300.
6. For Long Term Stationary use on tapers or transitions on freeways and divided highways, self-righting chevrons may be used to supplement plastic drums but not to replace plastic drums.

CHEVRONS



LONGITUDINAL CHANNELIZING DEVICES (LCD)

1. LCDs are crashworthy, lightweight, deformable devices that are highly visible, have good target value and can be connected together. They are not designed to contain or redirect a vehicle on impact.
2. LCDs may be used instead of a line of cones or drums.
3. LCDs shall be placed in accordance to application and installation requirements specific to the device, and used only when shown on the CWZTCD list.
4. LCDs should not be used to provide positive protection for obstacles, pedestrians or workers.
5. LCDs shall be supplemented with retroreflective delineation as required for temporary barriers on BC(7) when placed roughly parallel to the travel lanes.
6. LCDs used as barricades placed perpendicular to traffic should have at least one row of reflective sheeting meeting the requirements for barricade rails as shown on BC(10). Place reflective sheeting near the top of the LCD along the full length of the device.

WATER BALLASTED SYSTEMS USED AS BARRIERS

1. Water ballasted systems used as barriers shall not be used solely to channelize road users, but also to protect the work space per the appropriate Manual for Assessing Safety Hardware (MASH) crashworthiness requirements based on roadway speed and barrier application.
2. Water ballasted systems used to channelize vehicular traffic shall be supplemented with retroreflective delineation or channelizing devices to improve daytime/nighttime visibility. They may also be supplemented with pavement markings.
3. Water ballasted systems used as barriers shall be placed in accordance to application and installation requirements specific to the device, and used only when shown on the CWZTCD list.
4. Water ballasted systems used as barriers should not be used for a merging taper except in low speed (less than 45 MPH) urban areas. When used on a taper in a low speed urban area, the taper shall be delineated and the taper length should be designed to optimize road user operations considering the available geometric conditions.
5. When water ballasted systems used as barriers have blunt ends exposed to traffic, they should be attenuated as per manufacturer recommendations or flared to a point outside the clear zone.

If used to channelize pedestrians, longitudinal channelizing devices or water ballasted systems must have a continuous detectable bottom for users of long canes and the top of the unit shall not be less than 32 inches in height.

HOLLOW OR WATER BALLASTED SYSTEMS USED AS LONGITUDINAL CHANNELIZING DEVICES OR BARRIERS

GENERAL NOTES

1. Work Zone channelizing devices illustrated on this sheet may be installed in close proximity to traffic and are suitable for use on high or low speed roadways. The Engineer/Inspector shall ensure that spacing and placement is uniform and in accordance with the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD).
2. Channelizing devices shown on this sheet may have a driveable, fixed or portable base. The requirement for self-righting channelizing devices must be specified in the General Notes or other plan sheets.
3. Channelizing devices on self-righting supports should be used in work zone areas where channelizing devices are frequently impacted by errant vehicles or vehicle related wind gusts making alignment of the channelizing devices difficult to maintain. Locations of these devices shall be detailed elsewhere in the plans. These devices shall conform to the TMUTCD and the "Compliant Work Zone Traffic Control Devices List" (CWZTCD).
4. The Contractor shall maintain devices in a clean condition and replace damaged, nonreflective, faded, or broken devices and bases as required by the Engineer/Inspector. The Contractor shall be required to maintain proper device spacing and alignment.
5. Portable bases shall be fabricated from virgin and/or recycled rubber. The portable bases shall weigh a minimum of 30 lbs.
6. Pavement surfaces shall be prepared in a manner that ensures proper bonding between the adhesives, the fixed mount bases and the pavement surface. Adhesives shall be prepared and applied according to the manufacturer's recommendations.
7. The installation and removal of channelizing devices shall not cause detrimental effects to the final pavement surfaces, including pavement surface discoloration or surface integrity. Driveable bases shall not be permitted on final pavement surfaces. The Engineer/Inspector shall approve all application and removal procedures of fixed bases.

Posted Speed	Formula	Minimum Desirable Taper Lengths ** 10' Offset	11' Offset	12' Offset	Suggested Maximum Spacing of Channelizing Devices: On a Taper	On a Tangent
30	$L=\frac{WS^2}{60}$	150'	165'	180'	30'	60'
35		205'	225'	245'	35'	70'
40		265'	295'	320'	40'	80'
45	L=WS	450'	495'	540'	45'	90'
50		500'	550'	600'	50'	100'
55		550'	605'	660'	55'	110'
60		600'	660'	720'	60'	120'
65		650'	715'	780'	65'	130'
70		700'	770'	840'	70'	140'
75		750'	825'	900'	75'	150'
80		800'	880'	960'	80'	160'

** Taper lengths have been rounded off.
L=Length of Taper (FT.) W=Width of Offset (FT.)
S=Posted Speed (MPH)

SUGGESTED MAXIMUM SPACING OF CHANNELIZING DEVICES AND MINIMUM DESIRABLE TAPER LENGTHS

SHEET 9 OF 12

Texas Department of Transportation | Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES

BC(9)-21

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REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN
BERRY CREEK W.W. INTERCEPTOR
TRAFFIC CONTROL DETAILS 9

03/31/2023 DATE
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D508

DATE:
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A1 | BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES
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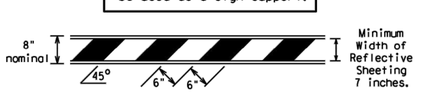
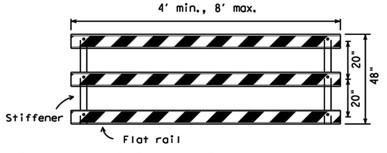
TYPE 3 BARRICADES

1. Refer to the Compliant Work Zone Traffic Control Devices List (CWZTCD) for details of the Type 3 Barricades and a list of all materials used in the construction of Type 3 Barricades.
2. Type 3 Barricades shall be used at each end of construction projects closed to all traffic.
3. Barricades extending across a roadway should have stripes that slope downward in the direction toward which traffic must turn in detouring. When both right and left turns are provided, the chevron striping may slope downward in both directions from the center of the barricade. Where no turns are provided at a closed road, striping should slope downward in both directions toward the center of roadway.
4. Striping of rails, for the right side of the roadway, should slope downward to the left. For the left side of the roadway, striping should slope downward to the right.
5. Identification markings may be shown only on the back of the barricade rails. The maximum height of letters and/or company logos used for identification shall be 1".
6. Barricades shall not be placed parallel to traffic unless an adequate clear zone is provided.
7. Warning lights shall NOT be installed on barricades.
8. Where barricades require the use of weights to keep from turning over, the use of sandbags with dry, cohesionless sand is recommended. The sandbags will be tied shut to keep the sand from spilling and to maintain a constant weight. Sand bags shall not be stacked in a manner that covers any portion of a barricade rails reflective sheeting. Rock, concrete, iron, steel or other solid objects will NOT be permitted. Sandbags should weigh a minimum of 35 lbs and a maximum of 50 lbs. Sandbags shall be made of a durable material that tears upon vehicular impact. Rubber (such as tire inner tubes) shall not be used for sandbags. Sandbags shall only be placed along or upon the base supports of the device and shall not be suspended above ground level or hung with rope, wire, chains or other fasteners.
9. Sheeting for barricades shall be retroreflective Type A or Type B conforming to Departmental Material Specification DMS-8300 unless otherwise noted.

Barricades shall NOT be used as a sign support.



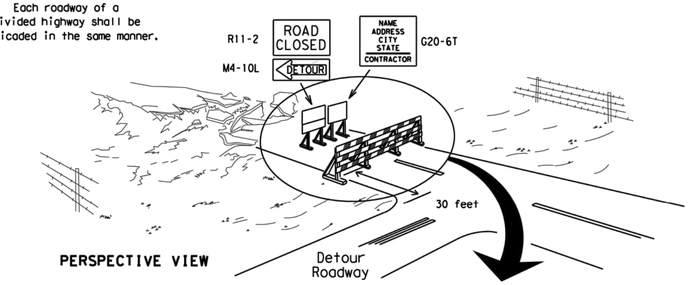
TYPICAL STRIPING DETAIL FOR BARRICADE RAIL



Stiffener may be inside or outside of support, but no more than 2 stiffeners shall be allowed on one barricade.

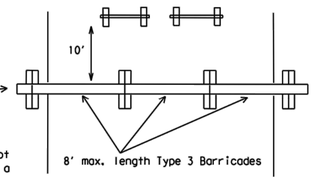
TYPICAL PANEL DETAIL FOR SKID OR POST TYPE BARRICADES

Each roadway of a divided highway shall be barricaded in the same manner.



PERSPECTIVE VIEW

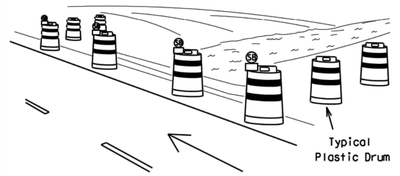
The three rails on Type 3 barricades shall be reflectorized orange and reflective white stripes on one side facing one-way traffic and both sides for two-way traffic.
Barricade striping should slant downward in the direction of detour.



PLAN VIEW

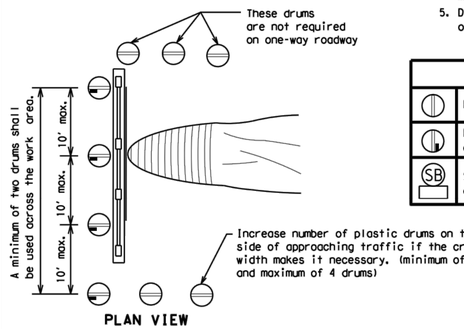
1. Signs should be mounted on independent supports at a 7 foot mounting height in center of roadway. The signs should be a minimum of 10 feet behind Type 3 Barricades.
2. Advance signing shall be as specified elsewhere in the plans.

TYPE 3 BARRICADE (POST AND SKID) TYPICAL APPLICATION



PERSPECTIVE VIEW

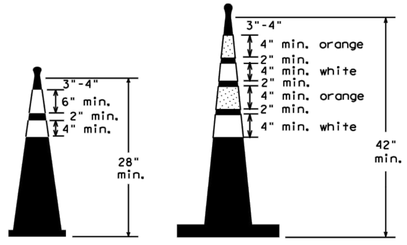
1. Where positive redirectional capability is provided, drums may be omitted.
2. Plastic construction fencing may be used with drums for safety as required in the plans.
3. Vertical Panels on flexible support may be substituted for drums when the shoulder width is less than 4 feet.
4. When the shoulder width is greater than 12 feet, steady-burn lights may be omitted if drums are used.
5. Drums must extend the length of the culvert widening.



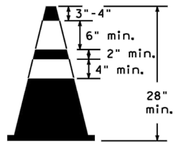
PLAN VIEW

LEGEND	
	Plastic drum
	Plastic drum with steady burn light or yellow warning reflector
SB	Steady burn warning light or yellow warning reflector

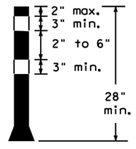
CULVERT WIDENING OR OTHER ISOLATED WORK WITHIN THE PROJECT LIMITS



Two-Piece cones



One-Piece cones

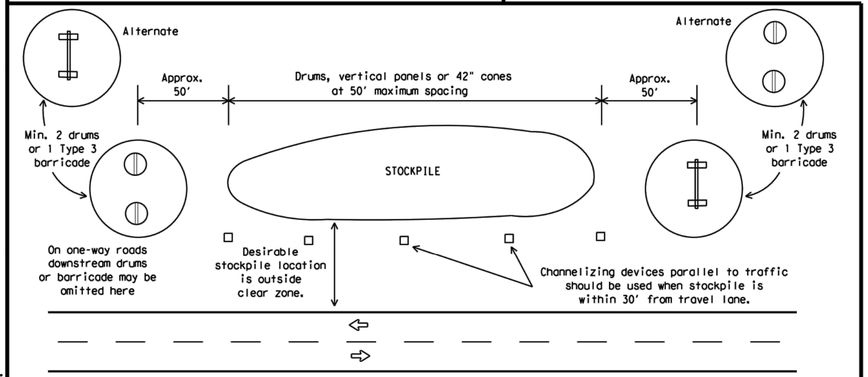


Tubular Marker

28" Cones shall have a minimum weight of 9 1/2 lbs.

42" 2-piece cones shall have a minimum weight of 30 lbs. including base.

1. Traffic cones and tubular markers shall be predominantly orange, and meet the height and weight requirements shown above.
2. One-piece cones have the body and base of the cone molded in one consolidated unit. Two-piece cones have a cone shaped body and a separate rubber base, or ballast, that is added to keep the device upright and in place.
3. Two-piece cones may have a handle or loop extending up to 8" above the minimum height shown, in order to aid in retrieving the device.
4. Cones or tubular markers shall have white or white and orange reflective bands as shown above. The reflective bands shall have a smooth, sealed outer surface and meet the requirements of Departmental Material Specification DMS-8300 Type A or Type B.
5. 28" cones and tubular markers are generally suitable for short duration and short-term stationary work as defined on BC(4). These should not be used for intermediate-term or long-term stationary work unless personnel is on-site to maintain them in their proper upright position.
6. 42" two-piece cones, vertical panels or drums are suitable for all work zone durations.
7. Cones or tubular markers used on each project should be of the same size and shape.



TRAFFIC CONTROL FOR MATERIAL STOCKPILES

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SHEET 10 OF 12

Texas Department of Transportation | Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES

BC(10)-21

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Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN
BERRY CREEK W.W. INTERCEPTOR
TRAFFIC CONTROL DETAIL 10

03/31/2023 DATE
ERIC LEE NELSON

STATE OF TEXAS
ERIC LEE NELSON
114449
LICENSED
PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D509

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WORK ZONE PAVEMENT MARKINGS

GENERAL

1. The Contractor shall be responsible for maintaining work zone and existing pavement markings, in accordance with the standard specifications and special provisions, on all roadways open to traffic within the CSJ limits unless otherwise stated in the plans.
2. Color, patterns and dimensions shall be in conformance with the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD).
3. Additional supplemental pavement marking details may be found in the plans or specifications.
4. Pavement markings shall be installed in accordance with the TMUTCD and as shown on the plans.
5. When short term markings are required on the plans, short term markings shall conform with the TMUTCD, the plans and details as shown on the Standard Plan Sheet WZ(STPM).
6. When standard pavement markings are not in place and the roadway is opened to traffic, DO NOT PASS signs shall be erected to mark the beginning of the sections where passing is prohibited and PASS WITH CARE signs at the beginning of sections where passing is permitted.
7. All work zone pavement markings shall be installed in accordance with Item 662, "Work Zone Pavement Markings."

RAISED PAVEMENT MARKERS

1. Raised pavement markers are to be placed according to the patterns on BC(12).
2. All raised pavement markers used for work zone markings shall meet the requirements of Item 672, "RAISED PAVEMENT MARKERS" and Departmental Material Specification DMS-4200 or DMS-4300.

PREFABRICATED PAVEMENT MARKINGS

1. Removable prefabricated pavement markings shall meet the requirements of DMS-8241.
2. Non-removable prefabricated pavement markings (foil back) shall meet the requirements of DMS-8240.

MAINTAINING WORK ZONE PAVEMENT MARKINGS

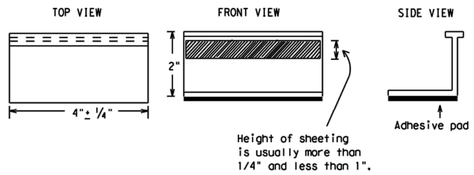
1. The Contractor will be responsible for maintaining work zone pavement markings within the work limits.
2. Work zone pavement markings shall be inspected in accordance with the frequency and reporting requirements of work zone traffic control device inspections as required by Form 599.
3. The markings should provide a visible reference for a minimum distance of 300 feet during normal daylight hours and 160 feet when illuminated by automobile low-beam headlights at night, unless sight distance is restricted by roadway geometrics.
4. Markings failing to meet this criteria within the first 30 days after placement shall be replaced at the expense of the Contractor as per Specification Item 662.

REMOVAL OF PAVEMENT MARKINGS

1. Pavement markings that are no longer applicable, could create confusion or direct a motorist toward or into the closed portion of the roadway shall be removed or obliterated before the roadway is opened to traffic.
2. The above shall not apply to detours in place for less than three days, where flaggers and/or sufficient channelizing devices are used in lieu of markings to outline the detour route.
3. Pavement markings shall be removed to the fullest extent possible, so as not to leave a discernable marking. This shall be by any method approved by TxDOT Specification Item 677 for "Eliminating Existing Pavement Markings and Markers".
4. The removal of pavement markings may require resurfacing or seal coating portions of the roadway as described in Item 677.
5. Subject to the approval of the Engineer, any method that proves to be successful on a particular type pavement may be used.
6. Blast cleaning may be used but will not be required unless specifically shown in the plans.
7. Over-painting of the markings SHALL NOT BE permitted.
8. Removal of raised pavement markers shall be as directed by the Engineer.
9. Removal of existing pavement markings and markers will be paid for directly in accordance with Item 677, "ELIMINATING EXISTING PAVEMENT MARKINGS AND MARKERS," unless otherwise stated in the plans.
10. Black-out marking tape may be used to cover conflicting existing markings for periods less than two weeks when approved by the Engineer.

DATE:
FILE:

Temporary Flexible-Reflective Roadway Marker Tabs



STAPLES OR NAILS SHALL NOT BE USED TO SECURE TEMPORARY FLEXIBLE-REFLECTIVE ROADWAY MARKER TABS TO THE PAVEMENT SURFACE

1. Temporary flexible-reflective roadway marker tabs used as guidemarks shall meet the requirements of DMS-8242.
2. Tabs detailed on this sheet are to be inspected and accepted by the Engineer or designated representative. Sampling and testing is not normally required, however at the option of the Engineer, either "A" or "B" below may be imposed to assure quality before placement on the roadway.
   A. Select five (5) or more tabs at random from each lot or shipment and submit to the Construction Division, Materials and Pavement Section to determine specification compliance.
   B. Select five (5) tabs and perform the following test. Affix five (5) tabs at 24 inch intervals on an asphaltic pavement in a straight line. Using a medium size passenger vehicle or pickup, run over the markers with the front and rear tires at a speed of 35 to 40 miles per hour, four (4) times in each direction. No more than one (1) out of the five (5) reflective surfaces shall be lost or displaced as a result of this test.
3. Small design variances may be noted between tab manufacturers.
4. See Standard Sheet WZ(STPM) for tab placement on new pavements. See Standard Sheet TCP(7-1) for tab placement on seal coat work.

RAISED PAVEMENT MARKERS USED AS GUIDEMARKS

1. Raised pavement markers used as guidemarks shall be from the approved product list, and meet the requirements of DMS-4200.
2. All temporary construction raised pavement markers provided on a project shall be of the same manufacturer.
3. Adhesive for guidemarks shall be bituminous material hot applied or butyl rubber pad for all surfaces, or thermoplastic for concrete surfaces.

Guidemarks shall be designated as:
YELLOW - (two amber reflective surfaces with yellow body).
WHITE - (one silver reflective surface with white body).

DEPARTMENTAL MATERIAL SPECIFICATIONS	
PAVEMENT MARKERS (REFLECTORIZED)	DMS-4200
TRAFFIC BUTTONS	DMS-4300
EPOXY AND ADHESIVES	DMS-6100
BITUMINOUS ADHESIVE FOR PAVEMENT MARKERS	DMS-6130
PERMANENT PREFABRICATED PAVEMENT MARKINGS	DMS-8240
TEMPORARY REMOVABLE, PREFABRICATED PAVEMENT MARKINGS	DMS-8241
TEMPORARY FLEXIBLE, REFLECTIVE ROADWAY MARKER TABS	DMS-8242

A list of prequalified reflective raised pavement markers, non-reflective traffic buttons, roadway marker tabs and other pavement markings can be found at the Material Producer List web address shown on BC(1).

SHEET 11 OF 12

Texas Department of Transportation — Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION PAVEMENT MARKINGS

BC(11)-21

FILE: bc-21.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
©TxDOT February 1998	CONT	SECT	JOB	HIGHWAY
REVISIONS 2-98 9-07 5-21				
1-02 7-13	DIST	COUNTY		SHEET NO.
11-02 8-14				

TDS

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL DETAIL 11

03/31/2023 — DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D510

A1 — NTS — BARRICADE AND CONSTRUCTION PAVEMENT MARKINGS — TXDOT

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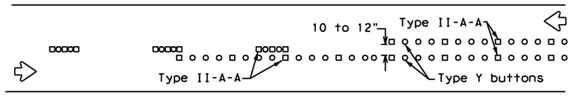
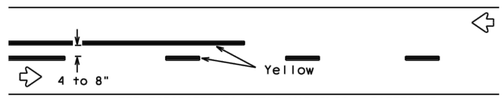
PAVEMENT MARKING PATTERNS



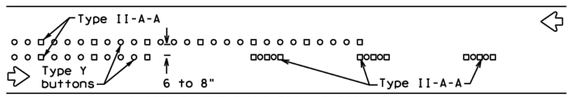
REFLECTORIZED PAVEMENT MARKINGS - PATTERN A



RAISED PAVEMENT MARKERS - PATTERN A



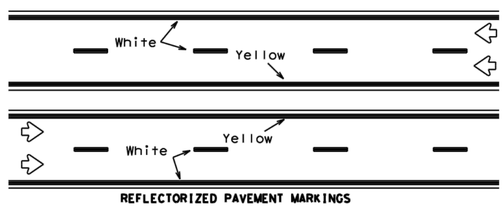
REFLECTORIZED PAVEMENT MARKINGS - PATTERN B



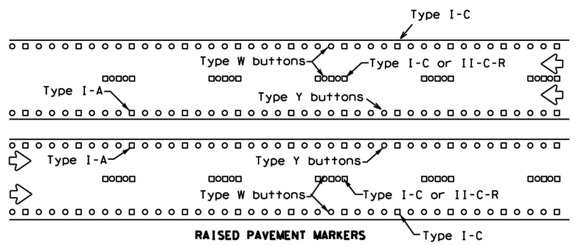
RAISED PAVEMENT MARKERS - PATTERN B

Pattern A is the TXDOT Standard, however Pattern B may be used if approved by the Engineer.
Prefabricated markings may be substituted for reflectorized pavement markings.

CENTER LINE & NO-PASSING ZONE BARRIER LINES FOR TWO-LANE, TWO-WAY HIGHWAYS



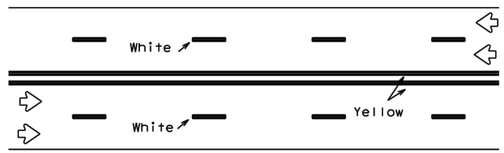
REFLECTORIZED PAVEMENT MARKINGS



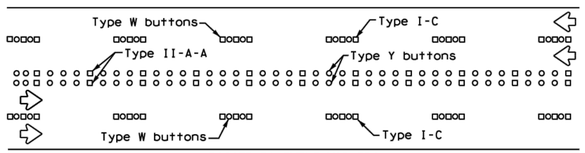
RAISED PAVEMENT MARKERS

Prefabricated markings may be substituted for reflectorized pavement markings.

EDGE & LANE LINES FOR DIVIDED HIGHWAY



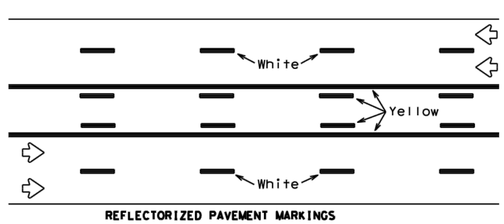
REFLECTORIZED PAVEMENT MARKINGS



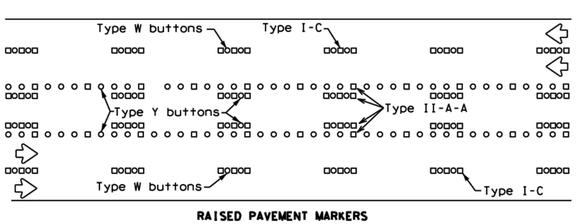
RAISED PAVEMENT MARKERS

Prefabricated markings may be substituted for reflectorized pavement markings.

LANE & CENTER LINES FOR MULTILANE UNDIVIDED HIGHWAYS



REFLECTORIZED PAVEMENT MARKINGS



RAISED PAVEMENT MARKERS

Prefabricated markings may be substituted for reflectorized pavement markings.

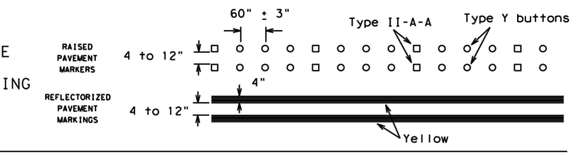
TWO-WAY LEFT TURN LANE

DATE:
FILE:

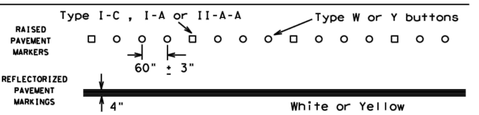
STANDARD WORK ZONE PAVEMENT MARKINGS DETAILS

SOLID LINES

DOUBLE NO-PASSING LINE

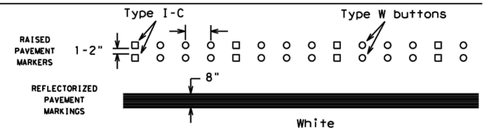


EDGE LINE OR SINGLE NO-PASSING LINE



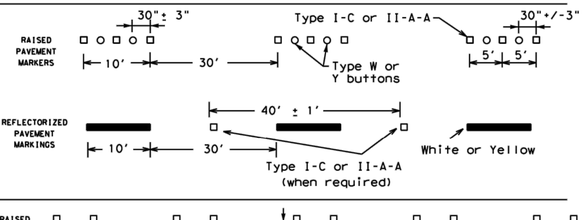
WIDE LINE

(FOR LEFT TURN CHANNELIZING LINE OR CHANNELIZING LINE USED TO DISCOURAGE LANE CHANGING.)

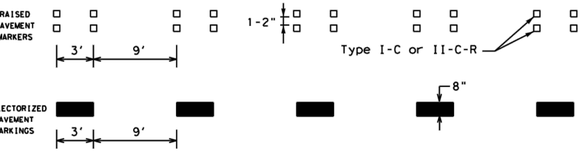


BROKEN LINES

CENTER LINE OR LANE LINE

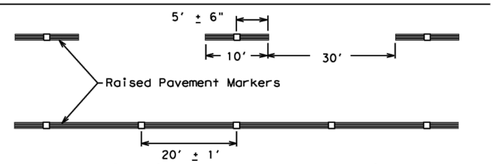


AUXILIARY OR LANEDROP LINE



REMOVABLE MARKINGS WITH RAISED PAVEMENT MARKERS

If raised pavement markers are used to supplement REMOVABLE markings, the markers shall be applied to the top of the tape at the approximate mid length of tape used for broken lines or at 20 foot spacing for solid lines. This allows an easier removal of raised pavement markers and tape.



Centerline only - not to be used on edge lines

Raised pavement markers used as standard pavement markings shall be from the approved products list and meet the requirements of Item 672 "RAISED PAVEMENT MARKERS."

SHEET 12 OF 12

Texas Department of Transportation — Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION PAVEMENT MARKING PATTERNS

BC(12)-21

FILE: bc-21.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
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REVISIONS 1-97 9-07 5-21 2-98 7-13 11-02 8-14	DIST	COUNTY		SHEET NO.
106				

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Walker Partners engineers | surveyors
T.B.P.E. Registration No. 6053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL DETAIL 12

03/31/2023
DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D511

A1
NTS
BARRICADE AND CONSTRUCTION PAVEMENT MARKING PATTERNS
TXDOT

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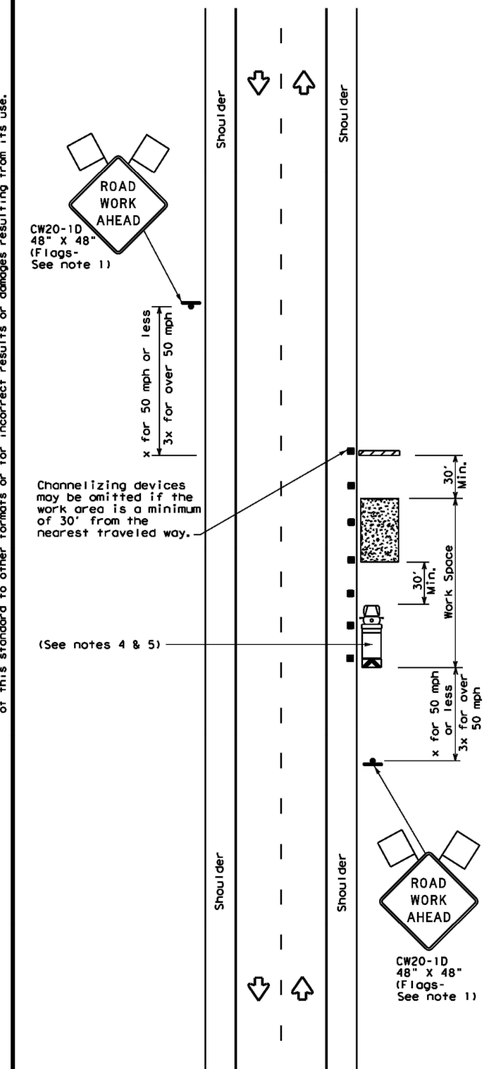
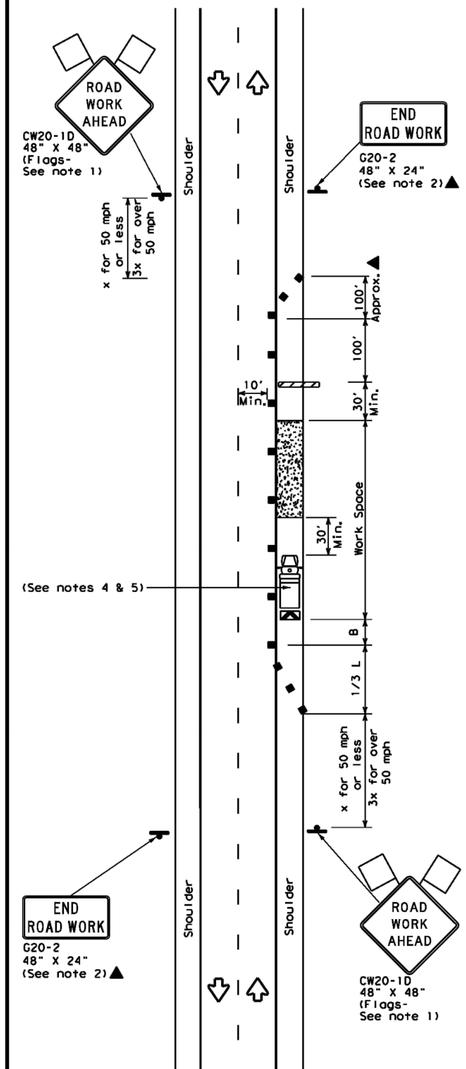


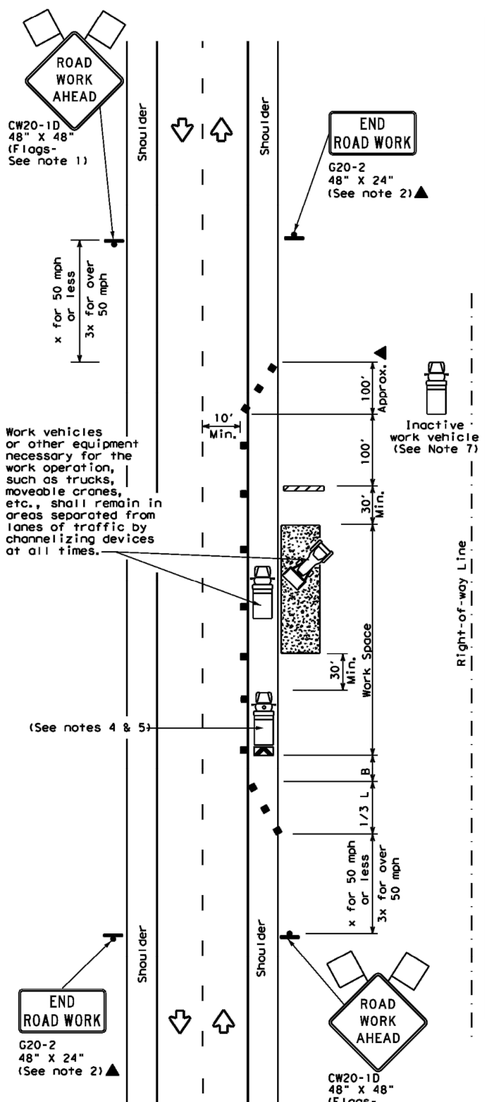
TCP (2-1a)

WORK SPACE NEAR SHOULDER
Conventional Roads



TCP (2-1b)

WORK SPACE ON SHOULDER
Conventional Roads



TCP (2-1c)

WORK VEHICLES ON SHOULDER
Conventional Roads

DATE:
FILE:

LEGEND

	Type 3 Barricade	■■	Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board	M	Portable Changeable Message Sign (PCMS)
	Sign		Traffic Flow
	Flag		Flagger

Posted Speed *	Formula	Minimum Desirable Taper Lengths ** 10' Offset	11' Offset	12' Offset	Suggested Maximum Spacing of Channelizing Devices: On a Taper	On a Tangent	Minimum Sign Spacing "X" Distance	Suggested Longitudinal Buffer Space "B"
30	$L=\frac{WS^2}{60}$	150'	165'	180'	30'	60'	120'	90'
35		205'	225'	245'	35'	70'	160'	120'
40		265'	295'	320'	40'	80'	240'	155'
45	L=WS	450'	495'	540'	45'	90'	320'	195'
50		500'	550'	600'	50'	100'	400'	240'
55		550'	605'	660'	55'	110'	500'	295'
60		600'	660'	720'	60'	120'	600'	350'
65		650'	715'	780'	65'	130'	700'	410'
70		700'	770'	840'	70'	140'	800'	475'
75		750'	825'	900'	75'	150'	900'	540'

* Conventional Roads Only

** Taper lengths have been rounded off.
L=Length of Taper(FT) W=Width of Offset(FT) S=Posted Speed(MPH)

TYPICAL USAGE

MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓	✓	✓

GENERAL NOTES

1. Flags attached to signs where shown, are REQUIRED.
2. All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated in the plans, or for routine maintenance work, when approved by the Engineer.
3. Stockpiled material should be placed a minimum of 30 feet from nearest traveled way.
4. Shadow Vehicle with TMA and high intensity rotating, flashing, oscillating or strobe lights. A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
5. Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect a wider work space.
6. See TCP(5-1) for shoulder work on divided highways, expressways and freeways.
7. Inactive work vehicles or other equipment should be parked near the right-of-way line and not parked on the paved shoulder.
8. CW21-5 "SHOULDER WORK" signs may be used in place of CW20-1D "ROAD WORK AHEAD" signs for shoulder work on conventional roadways.

Texas Department of Transportation — Traffic Operations Division Standard

TRAFFIC CONTROL PLAN CONVENTIONAL ROAD SHOULDER WORK

TCP(2-1)-18

FILE: tcp2-1-18.dgn	DN:	CK:	DW:	CK:
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REVISIONS 2-94 4-98 8-95 2-12 1-97 2-18	DIST	COUNTY		SHEET NO.

161

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN
BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL DETAIL 13

03/31/2023 DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PIC	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D512

A1 | TRAFFIC CONTROL PLAN CONVENTIONAL ROAD SHOULDER WORK
NTS | TXDOT

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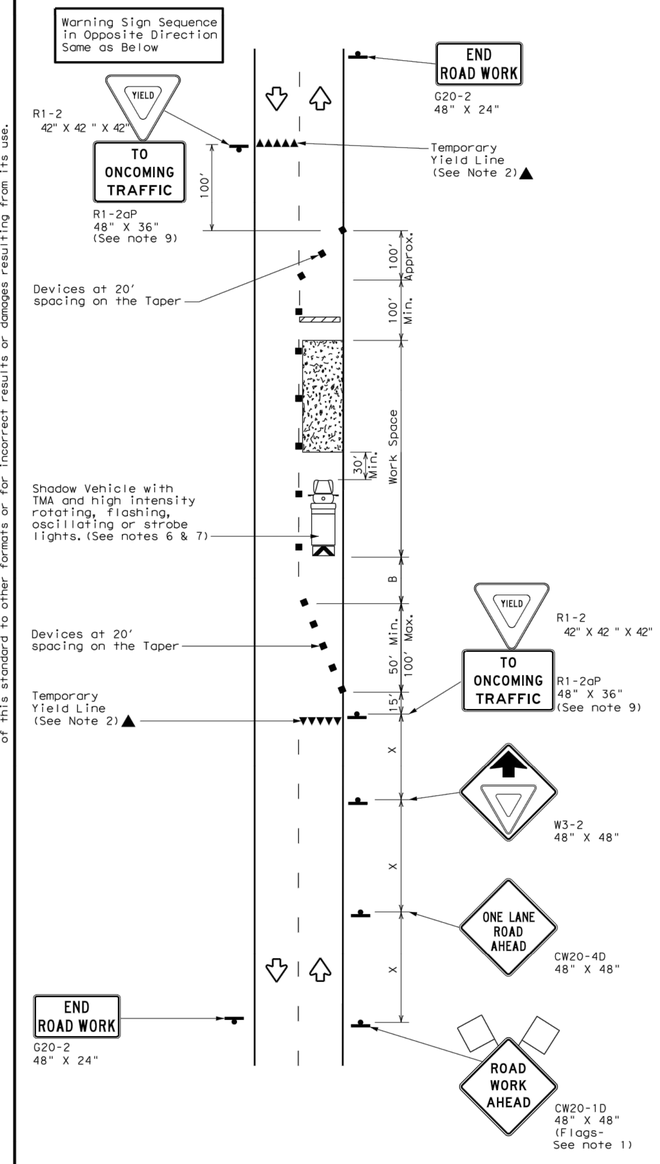


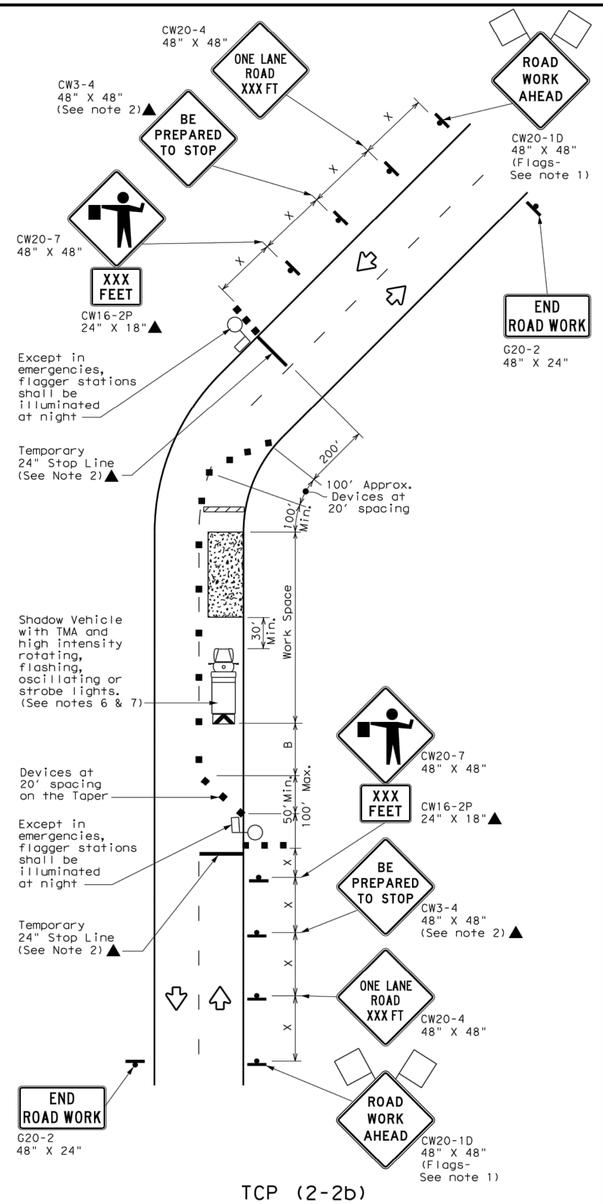
TCP (2-2a)

2-LANE ROADWAY WITHOUT PAVED SHOULDERS

ONE LANE TWO-WAY

CONTROL WITH YIELD SIGNS

(Less than 2000 ADT - See Note 9)



TCP (2-2b)

2-LANE ROADWAY WITHOUT PAVED SHOULDERS

ONE LANE TWO-WAY

CONTROL WITH FLAGGERS

LEGEND			
	Type 3 Barricade		Channelizing Devices
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)
	Trailer Mounted Flashing Arrow Board	M	Portable Changeable Message Sign (PCMS)
	Sign		Traffic Flow
	Flag		Flagger

Posted Speed *	Formula	Minimum Desirable Taper Lengths ** 10' Offset	11' Offset	12' Offset	Suggested Maximum Spacing of Channelizing Devices On a Taper	On a Tangent	Minimum Sign Spacing "X" Distance	Suggested Longitudinal Buffer Space "B"	Stopping Sight Distance
30	$L=\frac{WS^2}{60}$	150'	165'	180'	30'	60'	120'	90'	200'
35		205'	225'	245'	35'	70'	160'	120'	250'
40		265'	295'	320'	40'	80'	240'	155'	305'
45	L=WS	450'	495'	540'	45'	90'	320'	195'	360'
50		500'	550'	600'	50'	100'	400'	240'	425'
55		550'	605'	660'	55'	110'	500'	295'	495'
60		600'	660'	720'	60'	120'	600'	350'	570'
65		650'	715'	780'	65'	130'	700'	410'	645'
70		700'	770'	840'	70'	140'	800'	475'	730'
75		750'	825'	900'	75'	150'	900'	540'	820'

* Conventional Roads Only

** Taper lengths have been rounded off.

L=Length of Taper(FT) W=Width of Offset(FT) S=Posted Speed(MPH)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓	✓	

GENERAL NOTES

1. Flags attached to signs where shown, are REQUIRED.
2. All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
3. The CW3-4 "BE PREPARED TO STOP" sign may be installed after the CW20-4 "ONE LANE ROAD XXX FT" sign, but proper sign spacing shall be maintained.
4. Flaggers should use two-way radios or other methods of communication to control traffic.
5. Length of work space should be based on the ability of flaggers to communicate.
6. A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
7. Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect a wider work space.

TCP (2-2a)

8. The R1-2 "YIELD" sign traffic control may be used on projects with approaches that have adequate sight distance. For projects in urban areas, work space should be no longer than one half city block. In rural areas, roadways with less than 2000 ADT, work space should be no longer than 400 feet.
9. The R1-2aP "YIELD TO ONCOMING TRAFFIC" sign shall be placed on a support at a 7 foot minimum mounting height.

TCP (2-2b)

10. Channelizing devices on the center line may be omitted when a pilot car is leading traffic and approved by the Engineer.
11. If the work space is located near a horizontal or vertical curve, the buffer distances should be increased in order to maintain stopping sight distance to the flagger and a queue of stopped vehicles. (See table above).
12. Flaggers should use 24" STOP/SLOW paddles to control traffic. Flags should be limited to emergency situtations.

Texas Department of Transportation — Traffic Operations Division Standard

TRAFFIC CONTROL PLAN ONE-LANE TWO-WAY TRAFFIC CONTROL

TCP(2-2)-18

FILE: tcp2-2-18.dgn	DN:	CK:	DW:	CK:
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REVISIONS				
8-95 3-03	DIST	COUNTY		SHEET NO.
1-97 2-12				
4-98 2-18				

162

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors

T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL DETAIL 14

03/31/2023

DATE

ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D513

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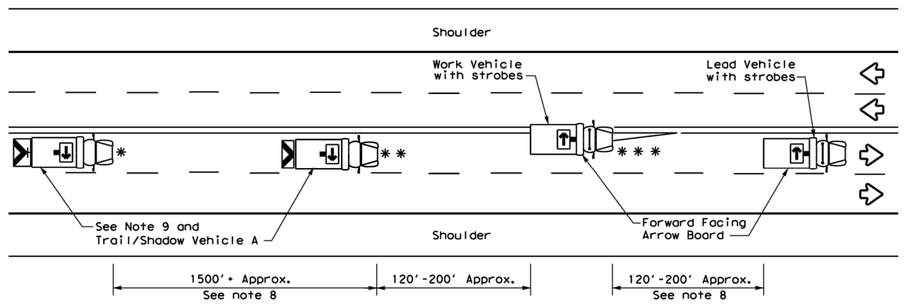
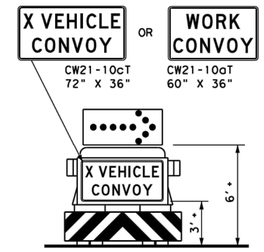


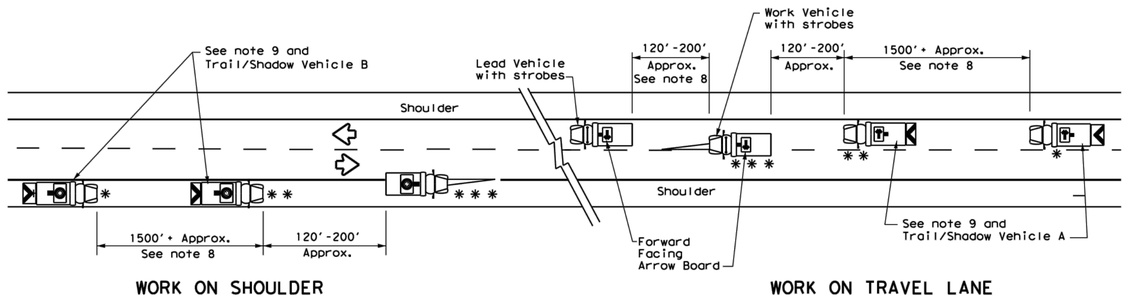
TCP (3-1a)

UNDIVIDED MULTILANE ROADWAY



TRAIL/SHADOW VEHICLE A

with RIGHT Directional display Flashing Arrow Board

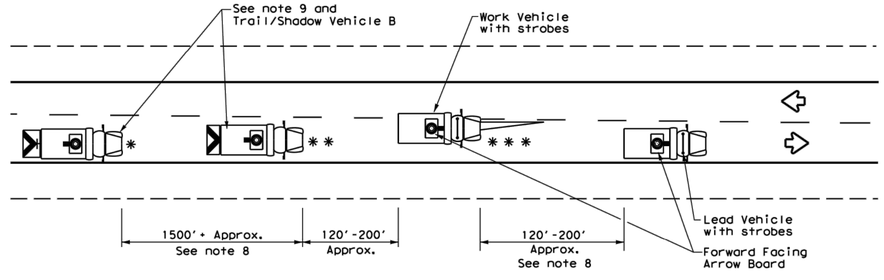


WORK ON SHOULDER

WORK ON TRAVEL LANE

TCP (3-1b)

TWO-WAY ROADWAY WITH PAVED SHOULDERS



TCP (3-1c)

TWO-WAY ROADWAY WITHOUT PAVED SHOULDERS

DATE:
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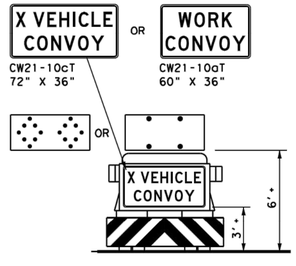


TRAIL/SHADOW VEHICLE B

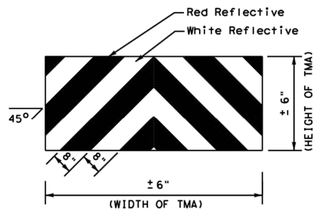
with Flashing Arrow Board in CAUTION display

LEGEND			
*	Trail Vehicle	ARROW BOARD DISPLAY	
**	Shadow Vehicle		
***	Work Vehicle		RIGHT Directional
	Heavy Work Vehicle		LEFT Directional
	Truck Mounted Attenuator (TMA)		Double Arrow
	Traffic Flow		CAUTION (Alternating Diamond or 4 Corner Flash)

TYPICAL USAGE				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
✓				

GENERAL NOTES

1. TRAIL, SHADOW, and LEAD vehicles shall be equipped with arrow boards as illustrated. When a LEAD vehicle is not used the WORK vehicle must be equipped with an arrow board. The Engineer will determine if the LEAD VEHICLE and/or TRAIL VEHICLE are required based on prevailing roadway conditions, traffic volume, and sight distance restrictions.
2. The use of amber high intensity rotating, flashing, oscillating, or strobe lights on vehicles are required. Blue high intensity rotating, flashing, oscillating or strobe lights when mounted on the driver's side of the vehicle may be operated simultaneously with the amber beacons or strobe lights.
3. The use of truck mounted attenuators (TMA) on the SHADOW VEHICLE and TRAIL VEHICLE are required.
4. Reflective sheeting on the rear of the TMA shall meet or exceed the reflectivity and color requirements of DEPARTMENTAL MATERIAL SPECIFICATION DMS 8300, Type A.
5. Flashing arrow boards shall be Type B or Type C as per the Barricade and Construction (BC) standards. The board shall be controlled from inside the vehicle.
6. Each vehicle shall have two-way radio communication capability.
7. When work convoys must change lanes, the TRAIL VEHICLE should change lanes first to shadow the other convoy vehicles.
8. Vehicle spacing between the TRAIL VEHICLE and the SHADOW VEHICLE will vary depending on sight distance restrictions. Motorists approaching the work convoy should be able to see the TRAIL VEHICLE in time to slow down and/or change lanes as they approach the TRAIL VEHICLE. Vehicle spacing between the WORK VEHICLE and SHADOW VEHICLE and vehicle spacing between WORK VEHICLE and LEAD VEHICLE may vary according to terrain, work activity and other factors.
9. "X VEHICLE CONVOY" (CW21-10cT) or "WORK CONVOY" (CW21-10aT) signs shall be used on TRAIL VEHICLES and SHADOW VEHICLES as shown. As an option 48" X 48" diamond shaped "WORK CONVOY"(CW21-10T) or "X VEHICLE CONVOY" (CW21-10bT) signs may be used where adequate mounting space exists. When used, the X VEHICLE CONVOY sign shall have the number of the convoy vehicles displayed on the sign in the number designation "X" location. The "X VEHICLE CONVOY" sign shall not be used on the SHADOW VEHICLE if a TRAIL VEHICLE is used.
10. On two-lane two-way roadways, the work and protection vehicles should pull over periodically to allow motor vehicle traffic to pass. If motorists are not allowed to pass the work convoy, a "DO NOT PASS" (R4-1) sign should be placed on the back of the rearmost protection vehicle.



STRIPING FOR TMA

Texas Department of Transportation — Traffic Operations Division Standard

TRAFFIC CONTROL PLAN MOBILE OPERATIONS UNDIVIDED HIGHWAYS

TCP(3-1)-13

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8-95 7-13				
1-97				

175

REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

TRAFFIC CONTROL DETAIL 15

03/31/2023 DATE

ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D514

A1 | TRAFFIC CONTROL PLAN MOBILE OPERATIONS UNDIVIDED HIGHWAYS

NTS | TXDOT

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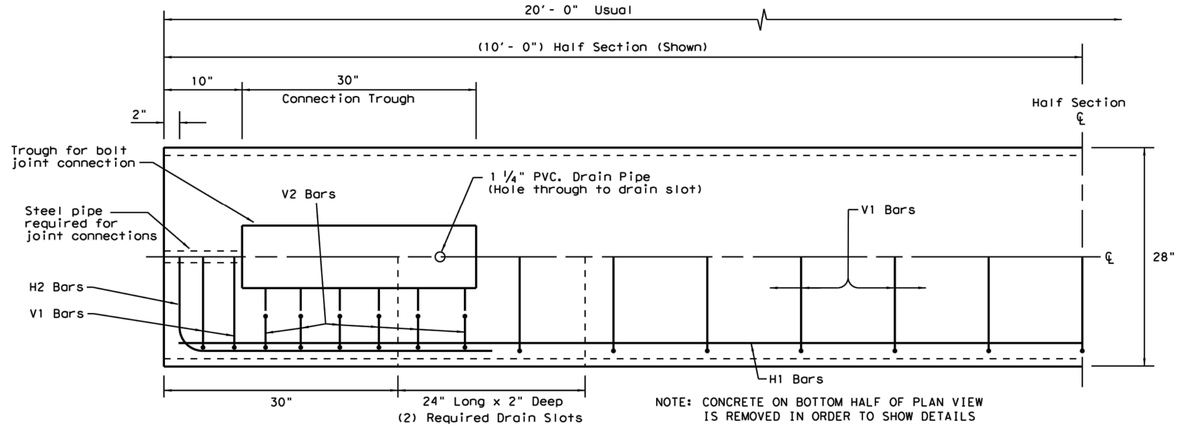
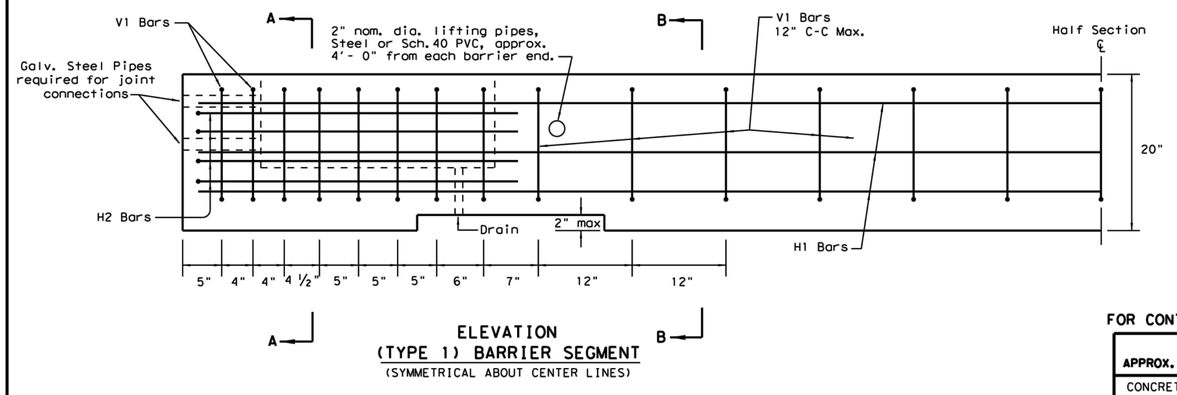
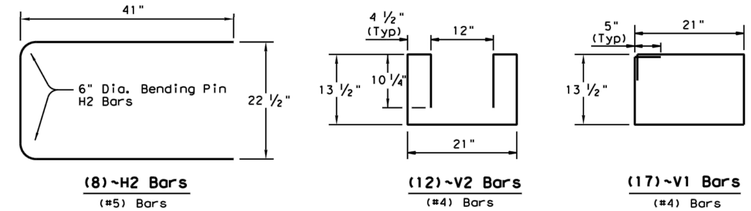


PLAN
(TYPE 1) BARRIER SEGMENT
(SYMMETRICAL ABOUT CENTER LINES)



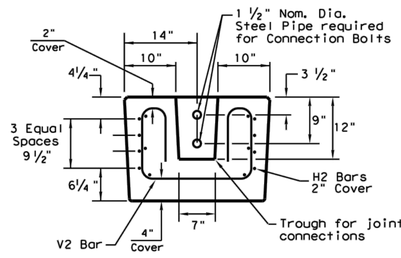
ELEVATION
(TYPE 1) BARRIER SEGMENT
(SYMMETRICAL ABOUT CENTER LINES)



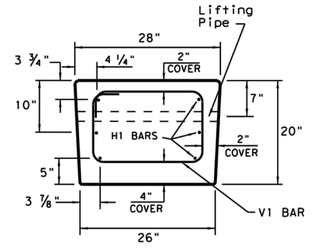
(8)~H2 Bars (#5) Bars
(12)~V2 Bars (#4) Bars
(17)~V1 Bars (#4) Bars

REINFORCING STEEL DETAILS
TYPE 1 - BARRIER SEGMENT

Note: Use 2" Dia. Bending Pin, unless otherwise shown



SECTION A-A



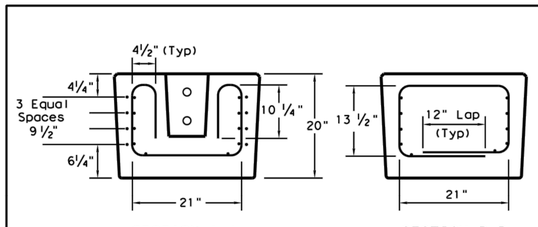
SECTION B-B

GENERAL NOTES

1. Low Profile Concrete Barrier (LPCB), is approved for use in temporary work zone locations, where the posted speed is 45 mph, or less.
2. Concrete shall be Class H for precast barrier with a minimum compressive strength of 3,600 psi.
3. Where used, rebar reinforcement shall be Grade 60 and conform to ASTM A615.
4. Precast LPCB barrier length shall be 20 ft.
5. All barrier edges shall have ¾" chamfer or a tooled radius.
6. Joint connection hardware shall be in accordance with Item 449, "Anchor Bolts." and is considered subsidiary.
7. Steel pipe required for joint connection bolts shall be galvanized in accordance with Item 445, "Galvanizing."
8. Welded wire reinforcement (WWR) may be used in lieu of conventional reinforcement for Type 1 barrier, and shall meet the requirements shown.

FOR CONTRACTORS INFORMATION ONLY

(TYPE 1) APPROX. QUANTITIES		20 FT. SECTION
CONCRETE	CY	2.6
REINFORCING STEEL	LBS	330
TOTAL BARRIER WT.	LBS	11000



SECTION A-A **SECTION B-B**

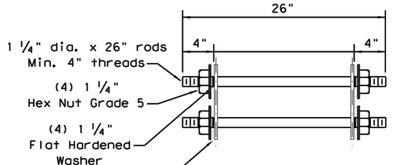
(WWR) GENERAL NOTES

1. Deformed Welded Wire Reinforcement shall conform to ASTM A497.
2. Welded wire cage may be cut or bent, if necessary, but must be approved by the Engineer.
3. Combinations of reinforcing steel and WWR are permitted, as directed by the Engineer. The dimensions from the end of the barrier section to the first wire shall not exceed 3".

REQUIRED (WWR) WIRE DESIGN

8 ~ (D31) Horizontal Wires (Equally spaced)
10 ~ (D20) Horizontal Wires (Equally spaced)
29 ~ (D20) Vertical Wires (Spaced as shown in Elevation View)

WELDED WIRE REINFORCEMENT (WWR)- OPTIONAL REINFORCING



(2) CONNECTION BOLTS
ASTM A36

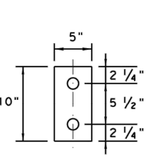


PLATE WASHER
5" x 10" x ⅜"

Note: Rods, Hex nuts and Washers shall be Galvanized.

SHEET 1 OF 2

Texas Department of Transportation — Design Division Standard

LOW PROFILE CONCRETE BARRIER
PRECAST BARRIER (TYPE 1)
LPCB-13

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CITY OF GEORGETOWN
BERRY CREEK W.W. INTERCEPTOR
TRAFFIC CONTROL DETAIL 16

03/31/2023
DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D515

A1 | LOW PROFILES CONCRETE BARRIER PRECAST BARRIER (TYPE 1)
NTS | TXDOT

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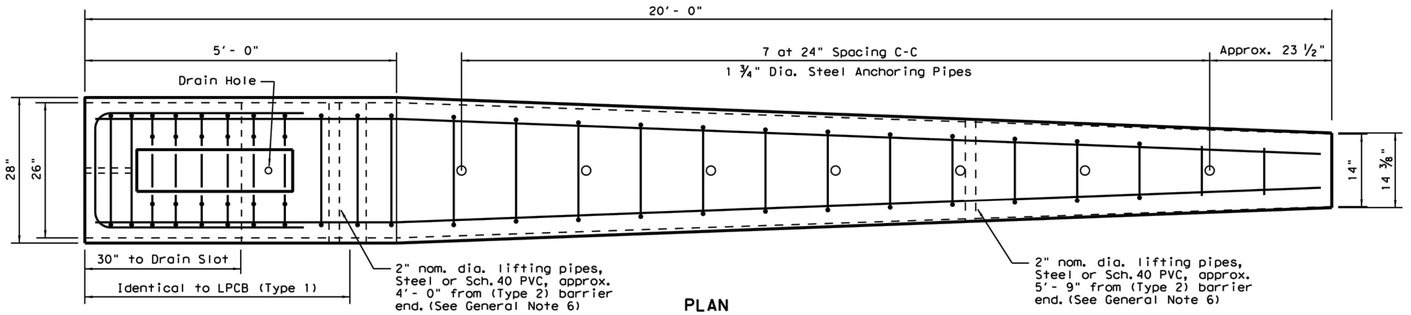
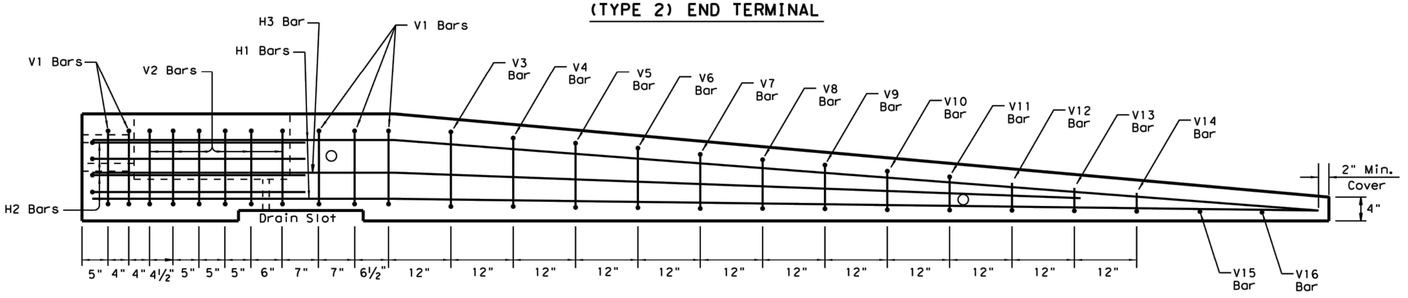
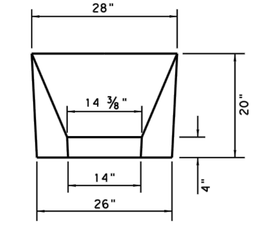


PLAN
(TYPE 2) END TERMINAL



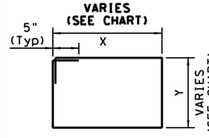
ELEVATION
(TYPE 2) END TERMINAL



APPROACH VIEW

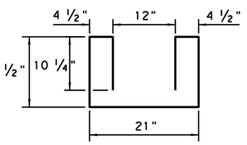
TYPE 2 - NOTES

1. Welded wire reinforcment (WWR) is "not" an option for Type 2 Barrier.
2. Type 2 Barrier shall be used as an end treatment for the Type 1 barrier segments, when applicable.
3. The end treatment can be used without the anchor pins in locations that can accommodate approximately 4 ft. of lateral displacement of the end treatment. The use of non-pinned end treatment does not affect the performance or the deflection of the Low-Profile barrier system.
4. The anchor pins are all the same length and are to be driven flush with the top of the (Type 2) barrier surface.
5. The bends in the H3 and H1 bars are slight, no formal bend is necessary.
6. The Type 2 barrier segment must be lifted from the rear first, to prevent cracking of sloped section.
7. See LPCB sheet 1 for additional information.

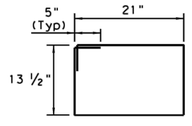


V3-V14 Bars

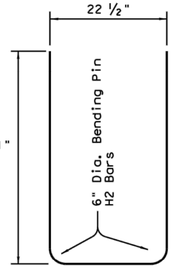
BAR (#4)	X (IN.)	Y (IN.)
V3 BAR	20 ¼	14 ½
V4 BAR	19 ½	13 ½
V5 BAR	18 ½	12 ¼
V6 BAR	17 ½	11 ¼
V7 BAR	17	10 ¼
V8 BAR	16 ¼	9
V9 BAR	15 ½	8
V10 BAR	14 ½	7
V11 BAR	13 ¾	6



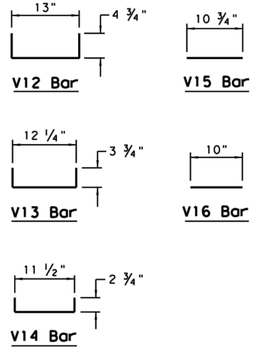
(6)~V2 Bars



(5)~V1 Bars



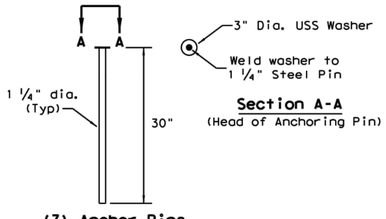
(4)~H2 Bars
(#5) Bars



REINFORCING STEEL DETAILS
TYPE 2 - END TERMINAL

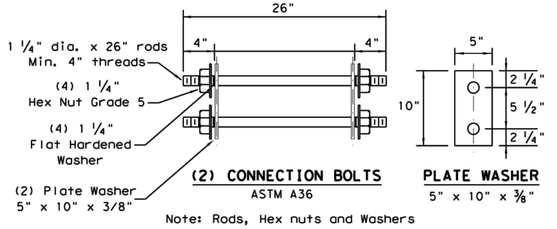
Note: All V Bars are (#4)

Note:
Anchoring pipes not shown in Elevation View



Section A-A
(Head of Anchoring Pin)

(7) Anchor Pins
ASTM A36 Steel (See Note 3)

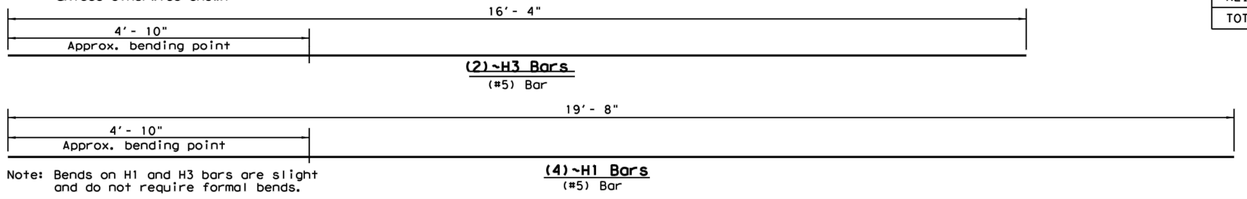


(2) CONNECTION BOLTS
ASTM A36

PLATE WASHER
5" x 10" x ⅜"

Note: Rods, Hex nuts and Washers shall be Galvanized.

Note: Use 2" Dia. Bending Pin, unless otherwise shown



Note: Bends on H1 and H3 bars are slight and do not require formal bends.

FOR CONTRACTORS INFORMATION ONLY

(TYPE 2) APPROX. QUANTITIES	20 FT. SECTION	
CONCRETE	CY	1.65
REINFORCING STEEL	LBS	240
TOTAL BARRIER WT.	LBS	7000

SHEET 2 OF 2

Texas Department of Transportation — Design Division Standard

LOW PROFILE CONCRETE BARRIER
PRECAST BARRIER (TYPE 2)
LPCB-13

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REV.	DESCRIPTION	DATE

Walker Partners engineers | surveyors
T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN
BERRY CREEK W.W. INTERCEPTOR
TRAFFIC CONTROL DETAIL 17

03/31/2023 — DATE
ERIC LEE NELSON

STATE OF TEXAS — ERIC LEE NELSON — 114449 — LICENSED PROFESSIONAL ENGINEER

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DESIGNED	HAM/TAR
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CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO. D516

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A1 — LOW PROFILE CONCRETE BARRIER PRECAST BARRIER (TYPE 2)
NTS — TXDOT

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CITY OF GEORGETOWN, TEXAS

TECHNICAL SPECIFICATIONS
FOR THE CONSTRUCTION OF

Berry Creek Wastewater Interceptor

 March 31, 2023	 March 31, 2023
Overall Project	**Tunnel Engineering**
Walker Partners engineers | surveyors	Schnabel ENGINEERING
TBPE Firm Registration No. 8053	TBPE Firm Registration No. 17846
804 Las Cimas Parkway, Bld. 1, Ste. 150, Austin, TX 78746	12301 Research Blvd., Bld. 4, Ste. 150, Austin, TX 78759

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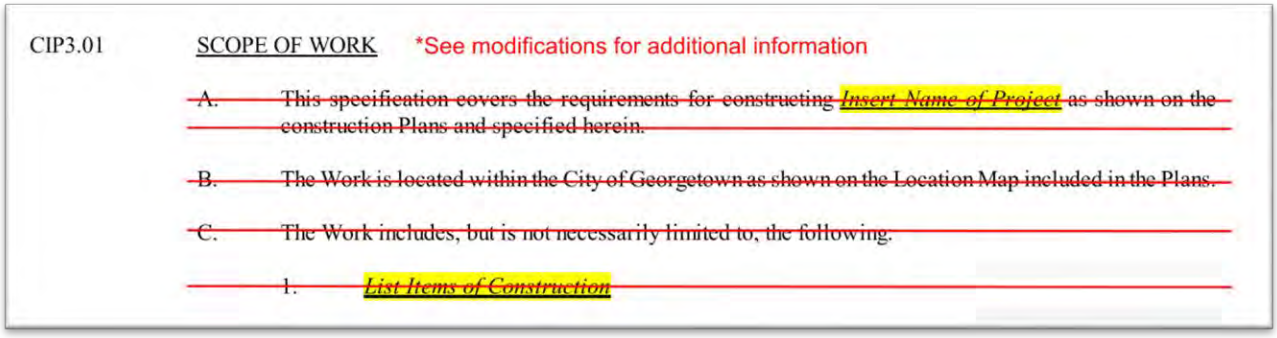
CITY OF AUSTIN SPECIFICATIONS

658S Void and Water Flow Mitigation (MODIFIED)

The City of Georgetown has allowed modifications to the Georgetown Utility Systems (GUS) Construction Specifications and Standards and the use of certain City of Austin (COA) and TXDOT Standard Specifications for the Berry Creek Wastewater Interceptor project only. The COA and TXDOT specifications have also been modified to fit the needs to the City of Georgetown.

As shown in Figure 1 below, verbiage that does not apply to the specifications has been stricken through. If additional information has been added to the specification, then there is a note that says "*See modifications for additional information." This document contains the additional information.


CIP3.01 SCOPE OF WORK *See modifications for additional information

~~A. This specification covers the requirements for constructing *Insert Name of Project* as shown on the construction Plans and specified herein.~~

~~B. The Work is located within the City of Georgetown as shown on the Location Map included in the Plans.~~

~~C. The Work includes, but is not necessarily limited to, the following.~~

~~1. *List Items of Construction*~~

Figure 1: Example of modification to GUS specification

All references to the City of Austin in the Standard Specifications shall be disregarded, as the City of Austin is not a party to this contract. Where appropriate, "City of Georgetown", can be used in place of "City of Austin".

All references to the Department in the TXDOT Standard Specifications shall be disregarded, as the TXDOT is not a party to this contract. Where appropriate, "City of Georgetown", can be used in place of "Department".

If there are any questions, errors, disputes, suggestions for improvement, or other modifications with this document, please contact the City of Georgetown Engineering Department.

CIP 3 – SUMMARY OF WORK

Delete CIP3.01 SCOPE OF WORK Paragraphs A, B and C, and replace with the following:

"A. This specification covers the requirements for constructing Berry Creek Wastewater Interceptor as shown on the construction Plans and specified herein.

B. The Work is located within the City of Georgetown as shown on the Location Map included in the Plans.

C. The Work includes, but is not necessarily limited to, the following:

1. Installation of centrifugally cast fiberglass reinforced polymer mortar (CCFRPM) pipe and fittings for municipal wastewater service, complete in place, of the sizes and to the depths shown on the plans. Installation of pipe will require a combination of both open cut and trenchless methodologies and the associated excavations and control of groundwater necessary.
2. Installation of polyvinyl chloride (PVC) pipe and fittings for municipal wastewater service connections and/or stub-outs, complete in place, of the sizes and to the depths shown on the plans.
3. Installation of precast concrete manholes (or polymer concrete manholes as an alternative) and connecting CCFRPM and PVC pipe to the manholes, complete in place, of the sizes and to the depths shown on the plans. Manhole vents shall also be installed to the heights shown and to the manholes shown on the plans.
4. Making connections to the existing wastewater system, providing by-pass systems, and plugging and abandoning certain manholes and pipes in the existing wastewater system.
5. Testing the new wastewater system and making repairs to correct for deficiencies.
6. Providing best management practices to protect streams, wetlands, trees, karsts, and other environmental resource. Coordinating with the Cit's designated representative to provide safe access to the construction site, trench, excavation, etc. to observe any anomalies, hazardous materials, environmental resources, and/or cultural resources unearthed during construction.
7. Protecting private property, especially livestock, from escaping private land, suffering any harm, and/or damaging the project.
8. Removing and replacing fences and gates and installing new gates for maintenance access.
9. Removing existing driveways and installing new driveways with culverts and safety end treatments, complete in place, of the sizes shown on the plans.
10. Removal and installation of metal beam guard fence.
11. Providing temporary barricades, signs, and traffic handling, and restoring all existing pavement markings following construction.
12. Restoring all disturbed areas after construction.
13. Providing for pre-construction and post-construction inspections of a residential building foundation.
14. Providing for water quality testing of a residential water well. Maintain a potable water supply truck on-call in the event of a water emergency, so that the landowner would be supplied potable water within 24 hours of losing use of the well, then continue to supply replacement water until such time that the well has been repaired and/or an adequate water supply has been restored."

CIP4 – SITE CONDITIONS

Delete CIP4.02 SUBSURFACE INFORMATION Paragraphs A and B, and replace with the following:

"A. The Supplementary Conditions identify:

1. Those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Bidding Documents.
2. Those drawings of physical conditions in or relating to existing surface and subsurface structures at or contiguous to the Site (except Underground Facilities) that ENGINEER has used in preparing the Bidding Documents.

B. The Bidder / Contractor shall be responsible for any additional subsurface explorations and tests deemed necessary by the Bidder/Contractor."

CIP11 – TRENCH SAFETY REQUIREMENTS

Add the following to CIP11.01 SCOPE OF WORK:

"D. Where open cut trench excavations are utilized to facilitate trenchless construction, the design requirements outlined in Section 33 73 15 – Shafts will govern the design."

Add the following to CIP11.02 SUBMITTALS:

"E. The Trench Safety Plan shall include designs for the support of excavations adjacent to the bridge elements at Airport Road, the building on the American Fence and Supply property (on the west side of IH-35 and adjacent to the Edwards property), and other structures in the vicinity of the project that may be impacted by the excavation methods proposed by the Contractor."

CIP12 – TESTING OF PIPELINES AND MANHOLES

Add the following to CIP12.02 SUBMITTALS:

"B. A testing procedure for a pipe with an inside diameter greater than 33 inches must be approved in writing by the executive director of TCEQ. The Contractor shall submit adequate information, in a timely manner, for the Engineer to submit the testing procedure proposed by the Contractor to the Texas Commission on Environmental Quality for review and approval."

Delete the row for 36-inch pipe from the table below CIP12.05, Paragraph D. Low Pressure Air Test, 2. Duration of Test and Allowable Leakage.

G1 – BARRICADES, SIGNS AND TRAFFIC HANDLING

Add the following to G1.03 CONSTRUCTION METHODS:

"C. Any existing pavement markings that must be removed or concealed during construction shall be replaced in accordance with Section SD5 Striping."

G4 – PIPE EXCAVATION, TRENCHING, EMBEDMENT, ENCASEMENT AND BACKFILLING

Add the following to G4.04 EMBEDMENT AND ENCASEMENT, Paragraph A. General:

3. "The haunching material should be placed and consolidated under the pipe while avoiding both vertical and lateral displacement of the pipe from proper grade and alignment.
4. Place and compact the embedment material in lifts to achieve the depths and a relative density greater than 70% per ASTM 4253 or 95% standard proctor density per ASTM D698. Little or no tamping of the initial backfill directly over the top of the pipe should be done to avoid disturbing the embedded pipe."

Add the following to G4.04 EMBEDMENT AND ENCASEMENT:

"D. Water Stop

1. Water stops shall consist of flowable fill in accordance with Section C9.
2. Install water stops at the locations and to the dimensions shown on the Plans.
3. Water stop shall extend above the pipe to at least 1-foot higher in elevation than the adjacent granular bedding material in the upgradient direction from the water stop.
4. The flowable fill must have "clean contact" with the trench sidewalls/bottom (bedding material shall not be located in areas between the flowable fill and trench sidewalls/bottom).
5. If groundwater collects in the excavation, it shall be pumped out prior to placement of the flowable fill water stop.

Add the following to G4.05 BACKFILLING, Paragraph C. Concrete Trench Cap:

"2. Install concrete trench caps at the locations and to the dimensions shown on the Plans."

G6 – SEDIMENTATION AND TEMPORARY EROSION CONTROL

Add the following to G6.05 MATERIALS

"J. Biodegradable Erosion Control Logs shall conform to TXDOT Item 506

1. Core Material. Furnish core material that is biodegradable or recyclable. Use compost, mulch, aspen excelsior wood fibers, chipped site vegetation, agricultural rice or wheat straw, coconut fiber, 100% recyclable fibers, or any other acceptable material unless specifically called out on the plans. Permit no more than 5% of the material to escape from the containment mesh. Funish compost meeting the requirements of item 161 , "Compost"
2. Containment Mesh. Furnish containment mesh that is 100% biodegradable, photodegradable, or recyclable such as burlap, twine, UV photodegradable plastic, polyester, or any other acceptable material. Furnish biodegradable or photodegradable plastic, polyester, or any other acceptable material. Furnish recyclable containment mesh for temporary installations.

3. Size. Furnish biodegradable erosion control logs with diameter shown on the plans or as directed. Stuff containment mesh densely so logs do not deform."

Add the following to G6.06 INSTALLATION

"J. Biodegradable Erosion Control Log

1. Install biodegradable erosion control logs near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the biodegradable erosion control logs into the erosion measures use to control sediment in areas of higher flow. Install, align, and locate the biodegradable erosion control logs as specified below, as shown on the plans, or as directed.
2. Secure biodegradable erosion control logs in a method adequate to prevent displacement as a result of normal rain events, prevent damage to the logs, and as approved, such that flow is not allowed under the logs. Temporarily removing and replacing biodegradable erosion logs as to facilitate daily works is allowed at the Contractor's expense."

Add the following to G6.07 MAINTENANCE AND INSPECTION, Paragraph B. Device Maintenance:

"10. Biodegradable Erosion Control Log

a. Remove accumulated sediment when buildup reaches six (6) inches.
b. Replace or repair any sections crushed in the course of construction activity.
c. Make other repairs as necessary to ensure that the log is filtering all runoff directed to the log."

Delete G6.09 PAYMENT, Paragraph A and replace with the following:

A. Silt fence, rock berm, and erosion control log will be paid per linear foot installed as listed in the Proposal and Bid Schedule."

SD5 – STRIPING

Delete SD5.09 MEASUREMENT AND PAYMENT Paragraph A, and replace with the following:

"A. Restoration of existing pavement marking shall be subsidiary to Section G1 BARRICADES, SIGNS AND TRAFFIC HANDLING. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof included in the appropriate items of the Proposal and Bid Schedule."

WW1 – CONCRETE MANHOLES (WASTEWATER)

Add the following to WW1.01 SCOPE OF WORK:

"B. Abandonment of existing manholes and associated piping shall be as shown on the Plans and as specified herein."

Add the following to WW1.13 PAYMENT

"C. Payment for abandonment of existing manholes shall be paid according to the unit price per each in the proper item of the Proposal and Bid Schedule. All work and materials to complete the abandonment of existing manholes and plugging existing pipes including, but not limited to, excavation, bedding, backfill, pipe plugs, manhole removal and disposal, etc. shall be subsidiary to this item."

END

CAPITAL IMPROVEMENT PROJECT REQUIREMENTS

SECTION CIP

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TECHNICAL SPECIFICATIONS

SECTION CIP1 – DEFINITION OF TERMS

CIP1.01 DEFINITIONS

A. Wherever in these specifications or in other contract documents, the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

1. CITY - The City of Georgetown, party of the First Part.

2. COUNCIL - The Georgetown City Council.

3. COUNTY - A political Subdivision of the State.

4. ENGINEER - Representative of the City.
*ENGINEER - Representative of the Contractor or the Developer.

5. INSPECTOR - The authorized representative of the City assigned to inspect any or all parts of the work and the materials to be used therein.

6. CONTRACTOR - The individual, firm or corporation or any combination thereof, Party of the Second Part, with which the contract is made by the City, Developer or Public Cooperation.

7. SUPERINTENDENT - The representative of the Contractor authorized to receive and fulfill instructions from the Engineer or representative of the City, and who shall supervise and direct the construction.

8. PAVEMENT DESIGN MANUAL - Texas Department of Transportation manual outlining procedure to be followed in the design and control of asphaltic concrete and portland cement concrete mixes for structures and pavements.

9. MANUAL OF TESTING PROCEDURES - Texas Department of Transportation Materials and Tests Division manual outlining testing methods and procedures.

10. PLANS - The drawings approved by the City, or true reproductions thereof, which show the location, character, dimensions, and details of the work and which are a part of the contract. Plans and specifications to be prepared by a Professional Engineer registered in the State of Texas.

11. SPECIFICATIONS - The directions, provisions and requirements contained herein or in the Special Provisions, supplemented by such "Special Provisions or Standards" as may be issued or made pertaining to the method and manner or performing the work or qualities of materials to be furnished. Where the phrases "or directed by the City", "ordered by the City", or "to the satisfaction of the City" occur, it is to be understood that the directions, orders, or instructions of which they relate are within the limitations of, and authorized by the contract. "Special Provisions" will cover work pertaining to a particular project included in the proposal but not covered by the specifications. Where reference is made to specifications of ASTM, AWWA, AASHTO or Bulletins and Manuals of the Texas Department of Transportation it shall be construed to mean the latest standard or tentative standard in effect on the date of the proposal.

12. RIGHT OF WAY - The land provided for a highway or street, owned by the City of Georgetown or the municipality in which the highway or street is in.

13. ROADWAY - The portion of the highway or street within the limits of construction.

14. ROADBED - The graded portion of the roadway between the intersection of top and side slopes upon which the base course, surface course, shoulders and median are constructed.

15. SUBGRADE - That portion of the roadbed upon which the subbase, base, or pavement structure is to be placed.

16. BRIDGES - Structures of over 20-foot span measured from face to face of abutments, or in case of copings, from face to face of copings, and multiple span structures of over 20-foot length, measured between inside of end walls along the centerline of the roadbed.

17. CULVERTS - All drainage structures not defined as bridges.

18. TEMPORARY STRUCTURES - All temporary bridges and structures required to maintain traffic during the construction of the work.

19. SUBSTRUCTURE - That part of the structure below the bridge seats or below the springing lines of arches. Parapets, back walls and wing walls of abutments shall be considered as parts of the substructure.

20. SUPERSTRUCTURE - The part of the structure above the bridge seats or above the springing lines of arches.

21. THE WORK - The work shall include the furnishing of all labor, materials, equipment, and other incidentals necessary or convenient to the successful completion of the project and the carrying out of all the duties and obligations imposed by the contract.

22. PROJECT - The specific section or sections of the highway or street together with all appurtenances and construction to be performed thereon under the contract.

23. ASTM - American Society for Testing Materials.

24. AASHTO - American Association of State Highway and Transportation Officials.

25. ANSI - American National Standards Institute.

26. API - American Petroleum Institute.

27. UL - Underwriters Laboratory, Inc.

28. SCREENS AND SIEVES - As defined by the ASTM.

29. HIGHWAY, STREET OR ROAD - A general term denoting a public way for purposes of vehicular travel, including the entire area within the right of way. Recommended usage in urban areas-highway or road.

30. ARTERIAL HIGHWAY OR STREET - A general term denoting a highway or street primarily for through traffic, usually on a continuous route.

31. MAJOR STREET OR MAJOR HIGHWAY - An arterial highway or street with intersections at grade and direct access to abutting property, and on which geometric design and traffic control measures are used to expedite the safe movement of through traffic.

32. THROUGH STREET OR THROUGH HIGHWAY - Every highway, street, or portion thereof at the entrance to which vehicular traffic from intersecting highways or streets is required by law to stop before entering or crossing the same and when stop signs are erected.

33. LOCAL STREET OR LOCAL ROAD - A street or road primarily for access to residence, business, or other abutting property.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP2 - ABBREVIATIONS

CIP2.01 SCOPE

A. Whenever in these Contract Documents or Specifications the following abbreviations are used, the intent and meaning shall be interpreted as follows:

1.	AA	Aluminum Association
2.	AAMA	Architectural Aluminum Manufacturers' Association
3.	AASHTO	American Association of State Highway and Transportation Officials
4.	ACI	American Concrete Institute
5.	AFBMA	Anti-Friction Bearing Manufacturers' Association
6.	AGA	American Gas Association
7.	AGMA	American Gear Manufacturers' Association
8.	AISC	American Institute of Steel Construction
9.	AISI	American Iron and Steel Institute
10.	AITC	American Institute of Timber Construction
11.	AMCA	Air Moving and Conditioning Association
12.	ANSI	American National Standards Institute
13.	APA	American Plywood Association
14.	API	American Petroleum Institute
15.	AREA	American Railway Engineering Association
16.	ASAE	American Society of Agricultural Engineers
17.	ASCE	American Society of Civil Engineers
18.	ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
19.	ASME	American Society of Mechanical Engineers
20.	ASTM	American Society of Testing and Materials
21.	AWI	Architectural Woodwork Institute
22.	AWPA	American Wood Preservers' Association
23.	AWPB	American Wood Preservers' Bureau
24.	AWS	American Welding Society
25.	AWWA	American Water Works Association
26.	BHMA	Builders' Hardware Manufacturers' Association
27.	CBMA	Certified Ballast Manufacturers' Association
28.	CDA	Copper Development Association
29.	CISPI	Cast Iron Soil Pipe Institute
30.	CMAA	Crane Manufacturers' Association of America
31.	CRSI	Concrete Reinforcing Steel Institute
32.	Fed. Spec.	Federal Specifications

33.	HI	Hydraulic Institute
34.	HMI	Hoist Manufacturers' Institute
35.	ICBO	International Conference of Building Officials
36.	IEEE	Institute of Electrical and Electronics Engineers, Inc.
37.	IPCEA	Insulated Power Cable Engineer's Association
38.	MMA	Monorail Manufacturers' Association
39.	NACE	National Association of Coatings Engineers
40.	NBMA	National Builders' Hardware Association
41.	NEC	National Electrical Code
42.	NEMA	National Electrical Manufacturers' Association
43.	NESC	National Electric Safety Code
44.	NFPA	National Fire Protection Association
45.	NLMA	National Lumber Manufacturers' Association
46.	NWMA	National Woodwork Manufacturers' Association
47.	OECI	Overhead Electrical Crane Institute
48.	OSHA	Occupational Safety and Health Act (both Federal & State)
49.	PS	Product Standards Sections - U.S. Department of Commerce
50.	RMA	Rubber Manufacturers' Association
51.	SAE	Society of Automotive Engineers
52.	SSPC	Steel Structures Painting Council
53.	TCA	Tile Council of America
54.	TxDOT	Texas Department of Transportation
55.	TEMA	Tubular Exchanger Manufacturers' Association
56.	UBC	Uniform Building Code
57.	UL	Underwriter's Laboratories, Inc.
58.	WWPA	Western Wood Products Association

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP3 – SUMMARY OF WORK
*** For Projects Contracted by the City of Georgetown for Capital Improvements ***

CIP3.01 SCOPE OF WORK *See modifications for additional information

A. This specification covers the requirements for constructing *Insert Name of Project* as shown on the construction Plans and specified herein.

B. The Work is located within the City of Georgetown as shown on the Location Map included in the Plans.

C. The Work includes, but is not necessarily limited to, the following.

1. *List Items of Construction*

CIP3.02 WORK SEQUENCE

A. Perform work in sequence as agreed upon at the pre-construction conference.

CIP3.03 PROGRESS OF THE WORK

A. The Work shall be started within 10 days following the effective date of the Notice to Proceed, and the Work shall be executed with such progress as may be required to prevent any delay to the general completion of the project. The Work shall be executed at such times and in or on such parts of the project, and with such personnel, materials, and equipment to assure completion of the Work in the time established by the Agreement.

B. If the Contractor for his convenience and at his own expense, should desire to carry on his work at night or outside regular hours, he shall submit a written approval request to the City and he shall allow ample time for satisfactory arrangements to be made for inspecting the work in progress. The Contractor shall pay the expenses for extra inspection required for work outside regular hours. Normal working hours for this purpose are Monday through Friday, 7:00 a.m. to 6:00 p.m. The Contractor shall light the different parts of the Project as required to comply with all applicable Federal and State regulations and with all applicable requirements of the City of Georgetown.

CIP3.04 CONSTRUCTION SCHEDULE

A. The Contractor shall, within 5 days after the effective date of the Notice to Proceed, provide and submit to the City for approval, the Schedule for the project.. A complete updated schedule shall be submitted with monthly pay requests. The Schedule shall account for all the work of the Contractor and his Subcontractors and suppliers. In addition to all reasonably important construction activities, the Schedule shall provide for the proper sequence of construction considering the various crafts, purchasing time, submittal approval, material delivery, equipment fabrication, and similar time consuming factors.

B. The Schedule shall include, as a minimum, the earliest starting and finish dates, and latest starting and finish dates, and the total float for each task or item. The Contractor shall update (monitor) the schedule as necessary and shall submit to the City a copy of the updated schedule (monthly) at the same time the pay estimate is prepared. The schedule shall contain all of the items of the Periodic Estimate and Pay Schedule.

While the Contractor bears full responsibility for scheduling all phases and stages of the Work to ensure its successful prosecution and completion within the time specified in accordance with all provisions of these Specifications, the Contractor is specifically required to complete fully or complete such stages of work to enable his Subcontractors and suppliers to complete their work within the respective times specified.

C. If the City determines that operations are falling behind schedule at any time during the construction period, the City may require the Contractor to add to his plant, equipment and/or construction forces,

including increases in working hours, in such quantities as are required to bring operations back on schedule. Upon receipt of written communication from the City requiring such addition, the Contractor shall furnish same at no additional cost to the City.

CIP3.05 PRECONSTRUCTION CONFERENCE

A. A pre-construction conference shall be held as soon as possible after Award of Contract and before work is started. The conference will be held at a location selected by the City. The conference will be attended by:

1. Contractor's Office Representative.

2. Contractor's General Superintendent.

3. Any subcontractors' or suppliers' representatives whom the Contractor may desire to invite or the City may request.

4. Engineer's Representatives.

5. City's Representatives.

6. Such other individuals that the City may invite.

B. A suggested format would include but not be limited to the following subjects:

1. Check of required bonds and insurance certifications.

2. Liquidated damages.

3. Shop drawing submittal and approval procedure.

4. Chain of command, direction of correspondence, and coordinating responsibility between Contractors.

5. Schedule of periodic job meetings for all involved.

6. Introduction of the key project personnel.

7. Equal opportunity requirements.

8. Laboratory testing of material requirements.

9. Inventory of material stored on site provisions.

10. Progress estimate and payment procedure.

11. Discussion of Contractor's Safety program.

12. Scheduled plan for work requiring interruption of existing operations.

13. Review of the construction Plans and Specifications.

14. Discussion of Contractor's storage facilities for the Project.

C. The City's Representative will preside at the conference, prepare the minutes of the meeting and distribute copies of same to all participants who so request by fully completing the attendance form to be circulated at the beginning of the conference.

CIP3.06 CONSTRUCTION MEETINGS

A. Periodic Construction meetings shall be held at intervals designated by the City, generally weekly to

review the progress at the project, submittals, upcoming activities, pay requests, etc. The Contractor is expected to have at least the project Superintendent present for all meetings. Attendance at the meetings shall not be directly paid for but shall be considered subsidiary to the items of the Contract.

B. In the event the Contractor is 30 minutes late or more or fails to attend a Construction meeting without 48 hours prior notice, the Contractor shall be billed the time for the Engineer(s) to represent the City at $150.00 per hour up to one (1) hour.

CIP3.07 COORDINATION WITH CITY'S OPERATIONS AND EXISTING FACILITIES

A. Several parts of the proposed Work under this Contract may connect with or into existing facilities.. The Contractor shall plan carefully the schedule of that portion of the Work which will affect the existing facilities. Such plans and schedules shall be subject to the approval of the City of Georgetown.

B. Work which requires shutdown or in any way impedes the operations of existing facilities shall be closely coordinated with the City of Georgetown. A minimum of 48 hours written notice shall be given to the City of Georgetown.

C. Immediately after the award of a Contract for this Project, the Contractor shall outline and submit a scheduled plan for installation of the work, which requires interruption of operations.

CIP3.08 CONTRACTOR'S USE OF PREMISES

A. Contractor shall limit the use of the premises for his/her work and coordinate use of the premises with the City to allow for:

1. Work by other Contractors.

2. Public use.

B. Contractor shall assume full responsibility for security of all materials and equipment stored on the site.

C. If directed by the City, move any stored items, which interfere with operations of the City, other contractors, or the public.

D. Obtain and pay for use of additional storage or work areas at no additional cost to the City if needed to perform the Work.

E. Contractor shall submit to the City for approval a plan of operations, designating proposed areas of the property to be used for his operations, material storage, equipment storage, employee's parking, offices and shops. The area shall effect minimal interference with the present operations.

F. Any damage to existing facilities, including contamination, which may be caused by Contractor's personnel, callers, visitors, materials or equipment, shall be repaired or corrected at the sole expense of the Contractor.

G. Any fence that is damaged or removed by the Contractor will be replaced at the Contractor's expense in like kind, and to the satisfaction of the City.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP4 – SITE CONDITIONS

CIP4.01 SCOPE OF WORK

A. This specification covers the requirements for investigation and verification of site conditions for the Project.

CIP4.02 SUBSURFACE INFORMATION *See modifications for additional information

~~A. No subsurface investigations have been made by the City. The Bidder / Contractor shall be responsible for any subsurface explorations and tests deemed necessary.~~

~~B. No test borings have been made by the City to indicate subsurface materials.~~

CIP4.03 SITE INVESTIGATION AND REPRESENTATION

A. The Bidder / Contractor acknowledges that he has satisfied himself as to the nature and location of the work; the general and local conditions, particularly those bearing upon availability of transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, and uncertainties of weather, river/stream stages, or similar physical conditions at the site; the conformation and conditions of the ground; the character of equipment and facilities needed preliminary to and during the prosecution of the work and all other matters which can in any way affect the work or the cost thereof under this Contract.

B. The Contractor further acknowledges that he has satisfied himself as to the character, quality, and quantity of surface and subsurface materials to be encountered from inspecting the site and from evaluating information derived from exploratory work, if any, that has been done by the City as presented in the geotechnical report, as well as from information presented herein as a part of these Contract Documents. Any failure by the Contractor to acquaint himself with all the available information will not relieve him from responsibility for properly estimating the difficulty or cost of successfully performing the work. Neither the City nor the Engineer assume responsibility for any conclusion or interpretation made by the Contractor on the basis of the information made available by the City or the Engineer.

C. Existing ground profiles shown on the Plans were plotted from field surveys.

CIP4.04 RESPONSIBILITY FOR UTILITY PROPERTIES AND SERVICE

A. Known utilities and structures adjacent to or encountered in the work are shown on the Plans. The locations shown are taken from existing records and the best information available from existing plans; however, it is expected that there may be some discrepancies and omissions in the locations and quantities of utilities and structures shown. Those shown are for the convenience of the Contractor only, and no responsibility is assumed by either the City or the Engineer for their accuracy or completeness.

B. Neither the City nor its officers or agents shall be responsible to the Contractor for damages as a result of the Contractor's failure to protect utilities encountered in the work.

C. The Contractor shall at all times provide unobstructed access to fire hydrants and structures as per Fire Code, underground conduit, manholes, and water or gas valve boxes.

D. Where the Contractor's operations could cause damage which might result in considerable expense, loss, or inconvenience when his operations are adjacent to or near railway, telegraph, telephone, television, power, oil, gas, water, sewer, irrigation, or other systems, no operations shall be commenced until the Contractor has made all arrangements necessary for the protection of these utilities and services.

E. The Contractor shall notify all utility offices that are affected by the construction operation at least 15 days in advance of commencing construction operations. The Contractor shall not expose any utility without first obtaining permission from the affected agency. Once permission has been granted, locate and, if necessary, expose and provide temporary support for all existing underground utilities in advance

of operations.

F. The Contractor shall be solely and directly responsible to the City and operators of such utility properties for any damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought because of any injuries or damage that may result from the construction operations under this Contract.

G. In the event of interruption to domestic water, sewer, storm drain, or other utility services as a result of accidental breakage due to construction operations, the Contractor shall promptly notify the proper authority and cooperate with said authority in restoration of service as promptly as possible and bear all costs of repair.

H. The Contractor shall replace, at his own expense, any and all other existing utilities or structures removed or damaged during construction, unless otherwise provided for in these Contract Documents.

I. Where existing utility lines or structures are so located as to physically conflict with permanent structures to be constructed under this Contract, the conflicting utility line or structure shall be permanently relocated.

J. The Contractor shall give immediate notice to the Engineer, the City and the owner of the utility (where applicable) when a physical conflict is determined to exist.

1. Contractor will not be charged contract time for delays caused by unanticipated conflicts.

2. Contractor shall not charge the City of Georgetown for lost time or down time for unanticipated conflicts.

K. Where existing utility lines or structures are so located as to interfere with the Contractor's prosecution of the work, but do not physically conflict with completed manholes or other permanent structures to be constructed under this Contract, any modification, alteration, or relocation of interfering utility, either permanent or temporary, shall be accomplished at the expense of the Contractor.

CIP4.05 INTERFERING STRUCTURES

A. Take necessary precautions to prevent damage to existing structures whether on the surface, aboveground, or underground. An attempt has been made to show major structures on the Plans. While the information has been compiled from the best available sources, it's completeness and accuracy cannot be guaranteed, and it is presented as a guide to avoid known possible difficulties.

B. Protect existing structures from damage, whether or not they lie within the right-of-way or the limits of the easements obtained by the City. Where existing structures must be removed to properly carry out the work, or are damaged during the work, they shall be restored at the Contractor's own expense to at least their original condition and to the satisfaction of the Engineer.

C. The Contractor may, with the approval of the Engineer and without additional compensation, remove and replace in a condition as good as or better than original, any small interfering structures such as fences and signposts that interfere with the Contractor's operations.

CIP4.06 FIELD RELOCATION

A. During the progress of the work, minor relocations of the work may be necessary. Such relocations shall be made only by direction of the Engineer or the City. If existing structures are encountered that will prevent construction as shown, notify the Engineer before continuing with the work in order that the Engineer may make such field revisions as necessary to avoid conflict with the existing structures. If the Contractor fails to notify the Engineer when an existing structure is encountered and proceeds with the work despite this interference, he shall be responsible for any damage that may occur.

CIP4.07 LAND MONUMENTS

A. The Contractor shall preserve or replace any existing Federal, State, County, City, and private land monuments encountered.

B. Any damaged or destroyed monuments shall be replaced at the sole expense of the Contractor as designated by the controlling authority of the Entity.

CIP4.08 PAYMENT

A. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP6 – CONTROL OF WORK

CIP6.01 SCOPE OF WORK

A. This specification covers the requirements for exercising control of work performed on the Project.

CIP6.02 AUTHORITY OF ENGINEER OR INSPECTOR

A. The work will be done in accordance with the Contract, Plans and Specifications. The Engineer or Inspector will decide all questions which may arise as to the quality or acceptability of materials furnished and work performed and the interpretations of the Plans and Specifications. His decisions will be final, and he will have executive authority to enforce and make effective such decisions and orders.

CIP6.03 CONFORMITY WITH PLANS, SPECIFICATIONS AND SPECIAL PROVISIONS

A. All work performed and all materials furnished shall be in reasonable close conformity with the lines, grades, cross sections, dimensions, details, gradations, physical and chemical characteristics of materials in accordance with tolerances shown on the Plans or indicated in the Specifications and Special Provisions. The limits establishing reasonable close conformity will be as defined in these items of the contract.

B. In the event the City finds that the work performed or the materials used are not within reasonable close conformity with the Plans, Specifications and Special Provisions, the affected material or product shall be removed and replaced or otherwise satisfactorily corrected by and at the expense of the Contractor.

C. Deviations from the Plans and approved working drawings as may be required will in all cases be determined by the City and authorized in writing. Before final acceptance of the project is issued by the City, the Contractor shall provide the City with a set of record drawings for the project certified by the Engineer of record.

CIP6.04 COORDINATION OF PLANS, SPECIFICATIONS AND SPECIAL PROVISIONS

A. The Specifications, the accompanying Plans, Special Provisions, and Supplemental Agreements, are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be co-operative and to describe and provide for a complete work. In cases of disagreement, figured dimensions shall govern over scaled dimensions, the Plans shall govern over Specifications, and Special Provisions shall govern over both Specifications and Plans.

CIP6.05 AUTHORITY AND DUTIES OF INSPECTORS

A. Inspectors will be authorized to inspect all work done and all materials furnished. Such inspection may extend to all or to any part of the work and to the preparation or Manufacturer of the materials to be used. Such inspection will not relieve the Contractor from any obligation to perform the work in accordance with the requirements of the Specifications. In case of any dispute arising between the Contractor and the Inspector as to materials furnished or the manner of performing the work, the Inspector will have authority to reject materials or suspend work until the question at issue can be referred to and decided by the City. The Inspector will not be authorized to revoke, alter, enlarge, or release any requirement of these Specifications, nor to approve or accept any portion of work, nor to issue instruction contrary to the Plans and Specifications. He will in no case act as foreman or perform other duties for the Contractor nor interfere with the management of the work.

CIP6.06 PLANT

A. The Contractor shall furnish plant and equipment which will be efficient, appropriate and large enough to secure a satisfactory quality of work and a rate of progress which will insure the completion of the work within the time stipulated in the Proposal. If at any time such plant appears to the Engineer to be inefficient, inappropriate or insufficient for securing the quality of work required or for producing the rate of progress aforesaid, he may order the Contractor to increase the efficiency, change the character or increase the plant and equipment, and the Contractor shall conform to such order. Failure of the Engineer to give such order shall in no way relieve the Contractor of his obligations to secure the quality of work and rate of progress required.

CIP6.07 PRIVATE LAND

A. The Contractor shall not enter or occupy private land outside of easements, except by written permission of the respective landowner.

CIP6.08 PIPE LOCATIONS

A. Pipelines shall be located substantially as indicated on the Plans, but the Engineer and the City reserve the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Plans, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required.

CIP6.09 OPEN EXCAVATIONS

A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access during construction shall be removed when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street, and requiring that the trench shall not remain open overnight. The Contractor shall take precautions, such as fences and barricades, to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles, which could be dangerous to the public, shall be well lighted at night. All trenches shall conform to the requirements of OSHA.

CIP6.10 TEST PITS

A. Test pits for the purpose of locating underground pipelines or structures in advance of the construction shall be excavated and backfilled by the Contractor at the direction of the Engineer or the City. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the Engineer and the City.

CIP6.11 MAINTENANCE OF TRAFFIC

A. Unless permission to close a street is received in writing from the proper authority, all excavated material shall be placed so that vehicular and pedestrian traffic may be maintained at all times. If the Contractor's operations cause traffic hazards, he shall repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the Engineer and the City.

B. Detours around construction will be subject to the approval of the City and the Engineer. Where detours are permitted, the Contractor shall provide all necessary barricades and signs as required to divert the flow of traffic. While traffic is detoured, the Contractor shall expedite construction operations and periods when traffic is being detoured will be strictly controlled by the City.

C. The Contractor shall take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in

progress. The Contractor shall be fully responsible for damage or injuries whether or not police protection has been provided.

CIP6.12 BLASTING

A. No blasting shall be allowed unless approved in writing by the City of Georgetown.

CIP6.13 CARE AND PROTECTION OF PROPERTY

A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition equal or better than existing before the damage was done, or he shall make good the damage in some other manner acceptable to the Engineer and the City.

CIP6.14 MAINTENANCE OF FLOW

A. The Contractor shall, at his own cost, provide for the flow of sewers, drains and water courses interrupted during the progress of the work, and shall immediately cart away and remove all offensive matter. The entire procedure of maintaining existing flow shall be fully discussed with the Engineer and the City well in advance of the interruption of any flow.

CIP6.15 COOPERATION WITHIN THIS CONTRACT

A. The Contractor shall cooperate with Subcontractors or trades, and shall assist in incorporating the work of other trades where necessary or required.

B. Cutting and patching, drilling and fitting shall be carried out where required by the Contractor and his Subcontractor having jurisdiction, unless otherwise indicated herein or directed by the Engineer or the City.

CIP6.16 CLEANUP

A. During the course of the work, the Contractor shall keep the site of his operations in as clean and neat a condition as is possible. The Contractor shall dispose of all rubbish resulting from the construction work and, at the conclusion of the work, he shall remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other refuse remaining from the construction operations, and shall leave the entire site of the work in a neat and orderly condition.

CIP6.17 FINAL INSPECTION

A. Whenever the work provided for in, and contemplated under, the contract has been satisfactorily completed, the City will make the “Final Inspection”. If the work is found to be satisfactory, the Contractor will be notified in writing of the acceptance of the same. The City will require a Certificate of Completion and Final Acceptance from the Inspector before any building, electric or plumbing permits will be issued or any City utilities provided. No such Certificate will be issued until all monuments have been set and record drawing reviewed by the Engineer of Record are provided to the City. If items are found in need of repair or completion, a final punch list will be generated and the items shall be completed by the Contractor. The City will inspect the punch list items one time following their completion. Any subsequent inspections due to inadequate repair or completion of the punch list items shall be paid for by the Contractor or Developer at $200.00 per inspection.

B. Final acceptance of the Project or Development does not relieve the Contractor or Developer of the responsibility of insuring all work shown on the Plans has been completed. If any portion of the work is found at a later date to be inferior or incomplete, the Contractor or Developer shall replace or complete the work at no expense to the City.

CIP6.18 PAYMENT

A. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP7 – CONTROL OF MATERIALS

CIP7.01 SCOPE OF WORK

A. This specification covers the requirements for exercising control of materials used on the Project.

CIP7.02 SOURCES OF SUPPLY AND QUALITY OF MATERIALS

A. The source of supply of each of the materials shall be approved by the City before any deliveries and at the option of the City, may be sampled and tested for determining compliance with the governing Specifications by the City before delivery begins. If it is found after trial that sources of supply previously approved do not produce uniform and satisfactory products, or if the product from any source proves unacceptable at any time, the Contractor shall furnish materials from other approved sources. Only materials conforming to the requirements of these Specifications and approved by the City shall be used in the work. All materials being used are subject to inspection or test at any time during their preparation or use. Any materials which have been tested and accepted at the source of supply may be subjected to a check test after delivery and all materials which, when retested, do not meet approval or have in any way become unfit for use shall not be used in the work.

B. Throughout these Specifications where reference is made to ASTM, AASHTO or bulletins of the Texas Department of Transportation for the quality of materials or sampling and testing, the most current standard, tentative standard or bulletin issued prior to the date of the proposal shall govern.

CIP7.03 SAMPLES AND TEST

A. All materials, before being incorporated in the work, shall be inspected, tested and approved by the City and any work in which materials are used without prior test and approval or written permission of the City may be ordered removed and replaced at the Contractor's expense. The Contractor shall be responsible for and pay for all charges of testing laboratories for services in conjunction with initial tests made on all imported materials to the project site including but not limited to embedment materials, fill materials, backfill materials, select material, crushed limestone base,sub-base, concrete, steel, wood forms, liquid asphalt, aggregate, water, cement, guard rail etc. Sampling and testing of all materials, on the project site will be coordinated by the Contractor and paid for by the City. The selection of the method of test shall be designated by the City. Where tests are required, other than those made in the laboratory, for the purpose of control in the manufacture of a construction item, the Contractor will be required to furnish such facilities and equipment as may be necessary to perform the tests and inspection and shall be responsible for calibration of all test equipment required. When requested, the Contractor shall furnish a complete written statement of the origin, composition, and/or manufacture of any or all materials that are to be used in the work. Testing of all materials and work shall conform to the Texas Department of Transportation "Manual of Testing Procedures" which outlines testing methods and procedures. Other Texas Department of Transportation Bulletins shall apply.

CIP7.04 PAYMENT

A. No separate payment will be made for work performed under this section of the specifications, and the cost thereof shall be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP8 – LEGAL RELATIONS AND RESPONSIBILITIES TO THE PUBLIC

CIP8.01 SCOPE OF WORK

A. This specification covers the requirements for complying with all Federal, State, and local laws, ordinances, and regulations, which in any manner affect the conduct of the work on the Project.

CIP8.02 LAWS TO BE OBSERVED

A. The Contractor shall make himself familiar with and at all times shall observe and comply with all Federal, State, and local laws, ordinances, and regulations which in any manner affect the conduct of the work and shall indemnify and save harmless the City and its representatives against any claim arising from the violation of any such law, ordinance, or regulation, whether by himself or by his employees.

CIP8.03 PERMITS, LICENSES AND TAXES

A. The Contractor shall procure all permits and licenses, pay all charges, fee and taxes, and give all notices necessary and incident to the due and lawful prosecution of the work.

CIP8.04 RESTORATION OF SURFACES OPENED BY PERMIT

A. The Contractor shall not allow any party to make an opening in the highway or street unless a duly authorized permit signed by the owner of the facility is presented. Until the acceptance of the work, the Contractor shall make all necessary repairs in the roadway where openings have been made by due authority.

CIP8.05 PUBLIC SAFETY AND CONVENIENCE

A. The safety of the public and the convenience of traffic shall be regarded as of prime importance. Unless otherwise shown on the Plans or except as herein provided, all portions of the highway and street shall be kept open to traffic. It shall be the entire responsibility of the Contractor to provide for traffic along and across the highway and streets as well as for ingress and egress to private property all as specified herein, as shown on the Plans or as directed by the City.

B. The Contractor shall plan and execute his operations in a manner that will cause the minimum interference with traffic. The Contractor shall secure the City's approval of his proposed plan of operation, sequence of work and methods of providing for the safe passage of traffic before it is placed into operation. If at any time during construction, the approved plan does not accomplish the intended purpose, due to weather or other conditions affecting the safe handling of traffic, the Contractor shall immediately make necessary changes in accordance with the latest version of the TMUTCD to correct the unsatisfactory conditions.

C. If due to rains or other reasons, the shoulders, slopes and ditches become unsatisfactory for handling traffic, construction operations shall be suspended and the base course or surface area shall be opened to traffic. Where the Specifications require that traffic be carried over or along the proposed work, construction operations shall be so prosecuted and new material so kept that placement and spreading will allow the passage of traffic in comfort and safety.

D. Where an Asphalt Surface Treatment is placed for the full width in an operation, traffic shall be carried on the shoulder slopes and ditches where appropriate. During the operation of placing asphalt and aggregate, the surface or pavement shall not be closed to traffic for a period of more than 45 minutes.

E. During construction of proposed structures, unless otherwise shown on the Plans, the Contractor shall provide and maintain detours including temporary structures or crossovers of adequate structural design as may be required for the safety and convenience of the traffic.

F. At night or otherwise, all equipment not in use shall be stored in such manner and such locations as not to interfere with the safe passage of traffic. The Contractor shall provide and maintain flagmen at such points and for such periods of time as may be required to provide for the safety and convenience of public travel and Contractor's personnel, and as directed by the City. Flagmen shall have a sense of responsibility for the safety of the public and the workers, adequate training in safe temporary traffic control practices, average intelligence, good physical condition, including sight, mobility, and hearing, mental alertness and the ability to react in an emergency, courteous but firm manner, and a neat appearance. When directing traffic, flagmen shall use the standard attire, flags and signals and follow the flagging procedure set forth in "Instructions to Flagmen" published by the Texas Department of Transportation.

CIP8.06 BARRICADES AND DANGER, WARNING AND DETOUR SIGNS

A. The Contractor shall place and maintain in good condition, standard barricades and warning signs at each end of the project and at other locations therein as called for on the Plans or as called for in the Contractor's approved plan of operation. The signs shall be of standard design as shown on the Plans and in accordance with Texas Department of Transportation Standards.

B. All barricades and signs remaining in place at night and all points of hazard to traffic shall be either retro-reflective with a material that has a smooth, sealed outer surface or illuminated by lights to show the same shape and similar color both day and night. Signs which refer to construction operations which do not apply after work has ended for the day, shall be moved to points out of the clear zone that are not visible to traffic until construction is resumed.

C. The Contractor may provide special signs not covered by the Plans to protect the traveling public against special conditions or hazards, provided however, that such signs are first approved by the City.

D. Upon completion of the work, all signs and evidences thereof shall be removed by the Contractor.

CIP8.07 PROJECT IDENTIFICATION SIGNAGE

A. Project identification signage shall be in accordance with Section CIP14- PROJECT IDENTIFICATION SIGNAGE. This does not apply to private development Projects.

CIP8.08 USE OF EXPLOSIVES

A. When the use of explosives is necessary for the prosecution of the work, the Contractor shall use the utmost care not to endanger life or property. All explosives shall be stored in a secure manner, and all storage places shall be marked clearly, "DANGEROUS - EXPLOSIVES". The method of storing and handling explosives and highly flammable materials shall conform with Federal and State laws and regulations. **The use of explosives must be approved in writing by the City prior to any use.**

B. In advance of doing any blasting work, involving the use of electric blasting caps within 200 feet of any railroad track, the Contractor shall give at least 24 hours advance notice to the nearest Roadmaster, Section Foreman, Agent, Signal Maintainer or Telegraph Operator with the request that his Superintendent be advised immediately of the pending use of explosives.

CIP8.09 PROTECTION OF ADJOINING PROPERTY

A. The Contractor shall take proper measures to protect the adjacent or adjoining property which might be damaged by any process of construction, and in case of any injury or damage resulting from any act or omission on the part of or on behalf of the Contractor, he shall restore at his own expense the damaged property to a condition equal or better than that existing before such injury or damage was done, or he shall make good such injury or damage in an acceptable manner.

CIP8.10 RESPONSIBILITY FOR DAMAGE CLAIMS

A. The Contractor shall save harmless the City from all suits, actions or claims brought on account of any injuries or damages sustained by any person or property in consequence of any neglect in safeguarding the work by the Contractor, or from any claims or amounts arising or recovered under the "Workmen's Compensation Laws" or any other laws. He shall be responsible for all damage or injury to property of any character occurring during the prosecution of the work resulting from any act, omission, neglect, or misconduct on his part in the manner or method of executing the work; or from his failure to properly execute the work; or from defective work or materials. He shall not be released from such responsibility until all claims have been settled and suitable evidence to that effect furnished the Council.

B. The Contractor's attention is directed to the fact that pipelines and other underground installations as may be shown on the Plans have been taken from the best available information. There may be other pipelines or installations. The Contractor shall save harmless the City from any and all suits or claims resulting from damage by his operations to any pipeline or underground installation.

CIP8.11 CONTRACTOR'S RESPONSIBILITY FOR WORK

A. Until the final acceptance of the work by the City as evidenced in writing, it shall be under the charge and care of the Contractor. The Contractor shall rebuild and make good at his own expense all injuries and damages to the work occurring before its completion and acceptance. In case of suspension of work for any cause, the Contractor shall be responsible for the preservation of all materials. He shall provide suitable drainage of the roadway and shall erect temporary structures where required. The Contractor shall maintain the roadway in good and passable condition until final acceptance.

B. Wherever, in the opinion of the City, any roadway or portion thereof is in suitable condition for travel, it shall be opened to traffic, as may be directed, and such opening shall not be held to be in any way the final acceptance of the roadway or any part of it or as a waiver of any of the provisions of the Contract. Where it is considered by the City to be in the public interest, any substantially completed roadway or portion thereof may be opened to traffic.

CIP8.12 PERSONAL LIABILITY OF PUBLIC OFFICIALS

A. In carrying out the provisions of the contract or in exercising any power or authority granted thereunder, there shall be no liability upon the City or its authorized assistant, either personally or otherwise, as they are agents and representatives of the City.

CIP8.13 PROSECUTION OF WORK

A. Prior to beginning construction operations, the Contractor shall submit to the City a chart or brief outlining the manner of prosecution of the work that he intends to follow in order to complete the Contract. Before any work is started on the project or development, a "Pre-Construction Conference", shall be held between the City, Contractor, Developer and any other interested parties.

CIP8.14 PAYMENT

A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP9 – ENVIRONMENTAL PROTECTION PROCEDURES

CIP9.01 SCOPE OF WORK

A. This specification covers the requirements for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operations under this Contract. For the purpose of this specification, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.

B. The control of environmental pollution requires consideration of air, water and land, and involves management of noise and solid waste, as well as other pollutants.

C. Schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the work. Provide erosion control measures such as diversion channels, sedimentation or filtration systems, berms, seeding, mulching or other special surface treatments as are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc. All erosion control measures shall be in place in an area prior to any construction activity in that area. Specific requirements are specified in Section G6-SEDIMENTATION AND TEMPORARY EROSION CONTROL.

D. These Specifications are intended to ensure that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.

E. All phases of sedimentation and erosion control shall comply with and be subject to the approval of the Texas Commission on Environmental Quality, and U.S. EPA.

CIP9.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including descriptions of any special operations required, temporary roads and embankments, and all other pertinent data to illustrate conformance to the specification found within.

CIP9.03 APPLICABLE REGULATIONS

A. Comply with all applicable Federal, State and local laws and regulations concerning environmental pollution control and abatement.

CIP9.04 NOTIFICATIONS

A. The Engineer and/or City will notify the Contractor in writing of any non-compliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements shall notify the Contractor in writing, through the Engineer, of any non-compliance with State or local requirements. The Contractor shall, after receipt of such notice from the Engineer or from the regulatory agency through the Engineer, immediately take corrective action. Such notice, when delivered to the Contractor or his/her authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the City may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

CIP9.05 IMPLEMENTATION

A. Prior to commencement of the work, the Contractor shall meet with the City to develop mutual understandings relative to compliance with this provision and administration of the environmental pollution control program. All environmental and pollution control features shall be in place prior to any construction.

B. Remove temporary environmental control features, when approved by the Engineer, and incorporate permanent control features into the Project at the earliest practical time.

CIP9.06 PROTECTION OF WATERWAYS

A. The Contractor shall observe the rules and regulations of the State of Texas and agencies of the U.S. Government prohibiting the pollution of any lake, stream, river, or wetland by the dumping of any refuse, rubbish, dredge material, or debris therein.

B. Contractors are specifically cautioned that disposal of materials into any waters of the State must conform with the requirements of the Texas Commission on Environmental Quality, and an applicable permit from the U.S. Army Corps of Engineers.

C. The Contractor shall be responsible for providing holding ponds or an approved method which will handle, carry through, or divert around his work all flows, including storm flows and flows created by construction activity, so as to prevent silting of waterways or flooding damage to the property or adjacent properties.

D. The Contractor is responsible for researching the need for a U.S. EPA NPDES permit for the construction site. If one is required, the Contractor is responsible for obtaining the permit and for monitoring the site per the permit requirements until final completion.

CIP9.07 DISPOSAL OF EXCESS EXCAVATION AND OTHER WASTE MATERIALS

A. Excess excavated material not required or suitable for backfill and other waste material must be disposed of at sites approved by the City and Engineer.

B. Unacceptable disposal sites, include, but are not limited to, sites within a wetland or critical habitat and sites where disposal will have a detrimental effect on surface water or groundwater quality.

C. The Contractor may make his own arrangements for disposal subject to submission of proof to the Engineer that the Owner(s) of the proposed site(s) has a valid fill permit issued by the appropriate governmental agency and submission of a haul route plan including a map of the proposed route(s).

D. The Contractor shall provide watertight conveyance of any liquid, semi-liquid, or saturated solids which tend to bleed or leak during transport. No liquid loss from transported materials will be permitted whether being delivered to the construction site or being hauled away for disposal. Fluid materials hauled for disposal must be specifically acceptable at the selected disposal site.

CIP9.08 USE OF CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture or any other applicable regulatory agency. Use of all such chemicals and disposal of residues shall be in conformance with the Manufacturer's instructions.

B. Any oil or other hydrocarbon spilled or dumped during construction must be excavated and completely removed from the site prior to final acceptance. Soil contaminated by the Contractor's operations shall become the property of the Contractor, who will bear all costs of testing and disposal.

C. Before a Contractor commences work, the following steps shall be completed.

1. The City will inform the Contractor of his rights under the Texas Hazards Communication Act.

2. The City will provide a copy of the Chemical List giving the hazardous chemicals to which the Contractor, his employees and agents may be exposed to on the Project site.

3. The City will provide copies of all Material Safety Data Sheets (MSDS) to the Contractor for the hazardous chemicals, which he may be exposed to on the Project site.

4. The City will inform the Contractor of his obligation to inform his employees and agents of each of the above requirements.

5. The Contractor shall provide MSDS for all hazardous chemicals he may bring onto the project site that the City's employees may be exposed to.

6. The Contractor shall sign a Contractor Acknowledgement certifying that he/she has received the information provided by the City on hazardous chemicals and maintain the Acknowledgement with the original Contract.

CIP9.09 EROSION CONTROL

A. Provide positive means of erosion control such as shallow ditches around construction to carry off surface water. Erosion control measures, such as siltation basins, silt fences, rock berms, hay check dams, mulching, jute netting and other equivalent techniques, shall be used as appropriate. Flow of surface water into excavated areas shall be prevented. Ditches around the construction area shall also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches shall be backfilled and the ground surface restored to original condition.

CIP9.10 PROTECTION OF STREAMS

A. Care shall be taken to prevent, or reduce to a minimum, any damage to any stream from pollution by debris, sediment or other material, or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or processing, or that contains oils or sediments that will reduce the quality of the water in the stream, shall not be directly returned to the stream. Such waters will be diverted through a settling basin or filter before being directed into the streams.

B. The Contractor shall not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels.

C. All preventative measures shall be taken to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a Contingency Action Plan approved by the Texas Commission on Environmental Quality. Contractor shall submit two (2) copies of approved contingency plans to the Engineer.

D. Water being flushed from structures or pipelines after disinfection, with a Cl_2 residue of 2 mg/l or greater, shall be treated with a dechlorination solution, in a method approved by the Engineer, prior to discharge.

CIP9.11 PROTECTION OF LAND RESOURCES

A. Land resources within the project boundaries and outside the limits of permanent work shall be restored to a condition, after completion of construction, that will appear to be natural and not detract from the appearance of the Project. Confine all construction activities to the appropriate areas shown on the Plans.

B. Outside of areas requiring earthwork for the construction of the new facilities, the Contractor shall not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.

C. Where trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment, dumping or other operations, protect such trees by placing boards, planks, or poles around them in accordance with Section S6- SEDIMENTATION AND TEMPORARY EROSION CONTROL. Monuments and markers shall be protected similarly before beginning operations near them.

D. Any trees or other landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition. The Engineer or the City will decide what method of restoration shall be used and whether damaged trees shall be treated and healed or removed and disposed of.

All scars made on trees by equipment, construction operations, or by the removal of limbs larger than one (1) inch in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.

Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Engineer or the City, shall be immediately removed and replaced.

E. The locations of the Contractor's storage, and other construction buildings, required temporarily in the performance of the work, shall be cleared portions of the job site or areas to be cleared as shown on the Plans and shall require written approval of the Engineer and shall not be within wetlands or floodplains. The preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Plans showing storage facilities shall be submitted for approval of the Engineer or the City.

F. If the Contractor proposes to construct temporary roads or embankments and excavations for plant and/or work areas, he/she shall submit the following for approval at least 10 days prior to scheduled start of such temporary work.

1. A layout of all temporary roads, excavations and embankments to be constructed within the work area.

2. Details of temporary road construction.

3. Plans and cross sections of proposed embankments and their foundations, including a description of proposed materials.

4. A landscaping drawing showing the proposed restoration of the area. Removal of any trees and shrubs outside the limits of existing clearing area shall be indicated. The drawing shall also indicate location of required guard posts or barriers required to control vehicular traffic passing close to trees and shrubs to be maintained undamaged. The drawing shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of the Contractor's approved drawings shall be made only with the written approval of the Engineer. No unauthorized road construction, excavation or embankment construction including disposal areas will be permitted.

G. Remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess waste materials, or any other vestiges of construction as directed by the Engineer or the City. It is anticipated that excavation, filling and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The disturbed areas shall be prepared and seeded as described in Section G7-LOAMING, HYDROSEEDING AND PERMANENT EROSION CONTROL, or as approved by the Engineer or the City.

H. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

CIP9.12 PROTECTION OF AIR QUALITY

A. Burning. The use of burning at the project site for the disposal of refuse and debris will not be permitted.

B. Dust Control. The Contractor will be required to maintain all excavations, embankment, subgrade, road bed, base course stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas within or outside the project boundaries free from dust which could cause the standards for air pollution to be exceeded, and which would cause a hazard or nuisance to others.

C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is prohibited. The use of chlorides may be permitted with approval from the Engineer or the City.

D. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Engineer or the City.

CIP9.13 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

A. During the life of this Contract, the Contractor shall maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

CIP9.14 NOISE CONTROL

A. The Contractor shall make every effort to minimize noises caused by his/her operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with State and Federal regulations.

CIP9.15 PAYMENT

A. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP10 - SUBMITTALS

CIP10.01 SCOPE OF WORK

A. This specification covers the requirements for submissions applicable to the following work-related submittals: Shop Drawings, Product Data, Samples, Mock Ups, Construction Photographs, and Construction or Submittal Schedules. Detailed submittal requirements will be specified in the technical specification sections.

B. All submittals shall be clearly identified by reference to Specification Section, Paragraph, Drawing No. or Detail as applicable. Submittals shall be clear and legible and of sufficient size for sufficient presentation of data.

CIP10.02 SHOP DRAWINGS, PRODUCT DATA, SAMPLES

A. Shop Drawings

1. Shop drawings as specified in individual work Sections include, but are not necessarily limited to, custom-prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shopwork manufacturing instructions, custom templates, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certifications, as applicable to the Work.

2. All shop drawings submitted by subcontractors for approval shall be sent directly to the Contractor for checking. The Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of materials.

3. The Contractor shall check all subcontractor's shop drawings regarding measurements, size of members, materials, and details to satisfy himself that they conform to the intent of the Plans and Specifications. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractors for correction before submission thereof.

4. All details on shop drawings submitted for approval shall show clearly the relation of the various parts to the main members and lines of the structure, and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the Plans before being submitted for approval.

B. Product Data

1. Product data as specified in individual Sections, include, but are not necessarily limited to, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the Manufacturer's product specification and installation instructions, availability of colors and patterns, Manufacturer's printed statements of compliance’s and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational-range diagrams, production or quality control inspection and test reports and certifications, mill reports, product operating and maintenance instructions and recommended spare-parts listing and printed product warranties, as applicable to the work.

C. Samples

1. Samples specified in individual Sections, include, but are not necessarily limited to, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols and units of work to be used by the Engineer or the City for independent inspection and testing, as applicable to the work.

CIP10.03 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall review shop drawings, product data and samples, including those by subcontractors, prior to submission to determine and verify the following:

1. Field measurements

2. Field construction criteria

3. Catalog numbers and similar data

4. Conformance with the Specifications

B. Each shop drawing, sample and product data submitted by the Contractor shall have affixed to it the following Certification Statement including the Contractor's Company name and signed by the Contractor: "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements." Shop drawings and product data sheets eleven by seventeen (11" x 17") and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The cover sheet shall fully describe the packaged data and include a listing of all items within the package. Provide to the Resident Project Representative a copy of each submittal transmittal sheet for shop drawings, product data and samples at the time of submittal of said drawings, product data and samples to the Engineer or the City.

C. The Contractor shall utilize a 10 character submittal identification numbering system in the following manner:

1. The first character shall be a D, S, P, M, or R, which represents Shop/Working Drawing and other Product Data (D), Sample (S), Preliminary Submittal (P), Operating/Maintenance Manual (M), or Request for Information (R).

2. The next sequence shall be the applicable Specification Section Number.

3. The next three (3) digits shall be the numbers 001 - 999 to sequentially number each initial separate item or drawing submitted under each specific Section number.

4. The last character shall be a letter, A-Z, indicating the submission, or resubmission of the same Drawing (i.e. A=1st submission, B=2nd submission, C=3d submission, etc.). A typical submittal number would be as follows:

D-C2-008-B

D = Shop Drawing

C2 = Specification Section for Concrete for Structures C2

008 = The eighth initial submittal under this specification section

B = The second submission (first resubmission) of that particular shop drawing

D. Notify the Engineer or the City in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.

E. The review and approval of shop drawings, samples or product data by the Engineer or the City shall not relieve the Contractor from his/her responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer or the City will have no responsibility therefore.

F. No portion of the work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to

approved shop drawings and data shall be at the Contractor's risk. The City will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

G. Project work, materials, fabrication, and installation shall conform with approved shop drawings, applicable samples, and product data.

CIP10.04 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other Contractor.

B. Each submittal, appropriately coded, will be returned within 30 working days following receipt of submittal by the Engineer or the City.

C. Number of submittals required:

1. Shop Drawings as defined in Paragraph G10.02 A: Six (6) copies.

2. Product Data as defined in Paragraph G10.02 B: Six (6) copies.

3. Samples: Submit the number stated in the respective Specification Sections.

D. Submittals shall contain:

1. The date of submission and the dates of any previous submissions.

2. The Project title and number.

3. Contractor identification.

4. The names of:

   a. Contractor
   b. Supplier
   c. Manufacturer

5. Identification of the product, with the specification section number, page and paragraph(s).

6. Field dimensions, clearly identified as such.

7. Relation to adjacent or critical features of the Work or materials.

8. Applicable standards, such as ASTM or Federal Specification numbers.

9. Identification of deviations from Contract Documents.

10. Identification of revisions on re-submittals.

11. Two (2) five-inch by three-inch (5”x3”) blank space for Contractor and Engineer stamps.

CIP10.05 REVIEW OF SHOP DRAWINGS, PRODUCT DATA, WORKING DRAWINGS AND SAMPLES

A. The review of shop drawings, data, and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed as:

1. Permitting any departure from the Contract requirements;

2. Relieving the Contractor of responsibility for any errors, including details, dimensions, and materials; and/or

3. Approving departures from details furnished by the Engineer or the City, except as otherwise

provided herein.

B. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

C. If the shop drawings, data or samples as submitted describe variations and show a departure from the Contract requirements which the Engineer finds to be in the interest of the City and to be so minor as not to involve a change in Contract Price or time for performance, the Engineer may return the reviewed drawings without noting an exception.

D. Submittals will be returned to the Contractor under one of the following codes.

Code 1 "REVIEWED" is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.

Code 2 "PROVIDE AS NOTED". This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.

Code 3 "PROVIDE AS NOTED/CONFIRM". This combination of codes is assigned when a confirmation of the notations and comments IS required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.

Code 4 "PROVIDE AS NOTED/RESUBMIT". This combination of codes is assigned when notations and comments are extensive enough to require a re-submittal of the package. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This re-submittal is to address all comments, omissions and non-conforming items that were noted. Re-submittal is to be received by the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the re-submittal.

Code 5 "NOT APPROVED" is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.

Code 6 "COMMENTS ATTACHED" is assigned where there are comments attached to the returned submittal which provide additional data to aid the Contractor.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data.

E. Re-submittals will be handled in the same manner as first submittals. On re-submittals the Contractor shall direct specific attention, in writing on the letter of transmittal and on resubmitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the Engineer, on previous submissions. Any such revisions which are not clearly identified shall be made at the risk of the Contractor. The Contractor shall make corrections to any work done because of this type revision that is not in accordance to the Contract Documents as may be required by the Engineer.

F. Partial submittals may not be reviewed. The Engineer will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor, and will be considered "Not Approved" until resubmitted. The Engineer may at his/her option provide a list or mark the submittal directing the Contractor to the areas that are incomplete.

G. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the Contractor shall give written notice thereof to the Engineer at least seven (7) working days prior to release for manufacture.

H. When the shop drawings have been completed to the satisfaction of the Engineer, the Contractor shall

carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.

CIP10.06 DISTRIBUTION

A. Distribute reproductions of approved shop drawings and copies of approved product data and samples, where required, to the job site file and elsewhere as directed by the Engineer. Number of copies shall be as directed by the Engineer but shall not exceed six (6).

CIP10.07 MOCK UPS

A. Mock Up units as specified in individual Sections include, but are not necessarily limited to, complete units of the standard of acceptance for that type of work to be used on the Project. Remove at the completion of the Work or when directed.

CIP10.08 GENERAL PROCEDURES FOR SUBMITTALS

A. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work sections, of the Specifications, so that the installation will not be delayed by processing times including disapproval and re-submittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit submittals sufficiently in advance of the Work.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP11 – TRENCH SAFETY REQUIREMENTS

CIP11.01 SCOPE OF WORK *See modifications for additional information

A. This specification covers the requirements to plan, design, construct, install, maintain, monitor, modify as necessary, and remove upon completion, a Trench Safety System as specified herein.

B. The requirements of this Section apply to all trenches which equal or exceed a depth of five (5) feet, measured from the ground surface at the highest side of the trench to the trench bottom.

C. All applicable and non-conflicting portions of Section G4- TRENCHING, BACKFILLING AND COMPACTION apply as appropriate.

CIP11.02 SUBMITTALS *See modifications for additional information

A. Within 30 days after the Notice to Proceed, but not less than 10 calendar days prior to execution of any trench excavation operations, the Contractor shall submit a site specific Trench Safety System Conformance Affidavit stating that operations will be conducted in full conformance with the OSHA Standards.

1. The Conformance Letter shall also describe the Trench Safety System techniques proposed to be used on the Project.

2. Specific references to the applicable OSHA Standards sections shall be included for each technique to be used.

B. The Trench Safety System Plan shall be in writing, site specific and sufficiently detailed and clear to be understandable and usable by all personnel who will be executing, supervising and witnessing the trenching operations. A copy of the Trench Safety System Plan shall be available at the site of trenching operations at all times.

C. If borings and/or detailed geotechnical analyses are required to develop the Trench Safety System Plan, they shall be executed by the Contractor at his cost.

D. For trenches having depths greater than the various limits given in the OSHA Standards (8, 12 or 20 feet, depending on the techniques used), a site specific protective system shall be designed by a Registered Professional Engineer, registered in the State of Texas experienced in soil mechanics and structural design. The design shall be signed, sealed and dated by the Professional Engineer, and it shall identify those specific locations where the design is applicable.

CIP11.03 GENERAL

A. All materials and products incorporated into the Trench Safety System shall be suitable for their intended uses; shall meet all design criteria and parameters used by the Trench Safety System designer; and shall meet all applicable requirements of OSHA Standards.

CIP11.04 METHODS OF PROVIDING FOR TRENCH SAFETY

A. Protective systems referenced in this Section shall be as defined and described in 29 CFR 1962.652, "Requirements for Protective Systems."

B. It is the duty, responsibility and prerogative of the Contractor to determine the specific applicability of a proposed Trench Safety System for each field condition encountered on the Project. Contractor specifically holds the City, Engineer, and any of their designated representatives harmless in any actions resulting from the failure or inadequacy of the Trench Safety System used to complete the Project.

C. Unless otherwise noted on the drawings or excluded below, Sloping/Benching, Trench Shielding with trench boxes, and/or Sheeting/Shoring/Bracing protective systems may be used on this Project.

D. Restrictions on the use of the various protective systems for this Project are as follows:

1. Sloping or Benching. Allowed with prior approval from the City.

2. Trench Shields/Boxes. No restrictions.

3. Sheeting/Shoring/Bracing. No restrictions.

CIP11.05 INSPECTION DUTIES OF CONTRACTOR

A. Provide a Competent Person, as defined in the OSHA Standards, to make frequent inspections of the trenching operations and the Trench Safety System in full conformance with the OSHA Standards.

B. If evidence of a possible cave-in or landslide is apparent, all work in the trench shall immediately cease and not be resumed until all necessary precautions have been taken to safeguard personnel entering the trench.

C. In an emergency situation, which may threaten or affect the safety or welfare of any persons or properties, the Contractor shall act at his discretion to prevent possible damage, injury or loss. Any additional compensation or time extension claimed for such actions shall be considered in view of the cause of the emergency and in accordance with the General Conditions.

CIP11.06 MEASUREMENT AND PAYMENT

A. Payment for the Trench Safety Plan shall be on a Lump Sum price basis, the Lump Sum price being as given in the Bid Proposal.

B. Payment for the Trench Safety Plan Implementation shall be on a unit price basis, the unit price being as given in the Bid Proposal, and the unit of measure being linear feet of trench and/or square foot of bore pit or structure, without regard to whether specific trench safety precautions are required or used for the trench reach being measured.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP12 – TESTING OF PIPELINES AND MANHOLES

CIP12.01 SCOPE OF WORK

A. This specification covers the requirements to perform ex-filtration testing and deflection testing of gravity pipelines and to perform pressure and leakage testing of pressure pipelines.

CIP12.02 SUBMITTALS *See modifications for additional information

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including a description of the deflection test procedure for flexible pipe greater than 27-inches in diameter, video inspection of gravity wastewater lines, and all other pertinent data to illustrate conformance to the specification found within.

CIP12.03 GENERAL

A. The entire length of the installed gravity line and the force main shall be field tested for water tightness. Gravity wastewater lines shall be video taped by camera.

B. Hydrostatic pressure and leakage tests shall be made on all pressure pipelines carrying wastewater or water.

C. All labor and equipment, including, but not limited to test pump with regulated by-pass meters and gauges required for conducting pipeline tests, shall be furnished by the Contractor. The Contractor shall furnish equipment and necessary piping as required to transport water used in testing from source to test location.

D. Time and sequence of testing shall be scheduled by the Contractor, subject to observation and approval by the City. The Contractor shall provide adequate labor, tools and equipment to operate valves and to locate and repair any leaks discovered during the initial filling of the pipeline prior to actual testing or during the course of the tests.

CIP12.04 CLEANING

A. At the conclusion of the work, thoroughly clean all pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered the pipes during the construction period. Debris cleaned from the lines shall be removed from the low end of the pipeline. If after this cleaning, obstructions remain, they shall be removed. After the pipelines are cleaned and if the groundwater level is above the pipe or following a heavy rain, the Engineer will examine the pipes for leaks. If any defective pipes or joints are discovered, they shall be repaired, and/or replaced by the Contractor at his expense.

CIP12.05 TEST PROCEDURES FOR GRAVITY PIPELINES, FORCE MAINS AND MANHOLES

A. Scope: After sewers and manholes have been installed and backfilled, subject newly laid gravity lines and manholes to a leakage test. Contractor to furnish all labor, materials, tools and equipment to test lines. Take such precautions as required to prevent damage to lines and appurtenances being tested. Repair any damage resulting from test at Contractor's expense. Conduct test in presence of Engineer or designated City Representative.

B. Test Procedures for Leakage Test of Gravity Sewer: Contractor, at his option, may test lines by hydrostatic or low pressure air test as specified below. However, the Engineer may direct a specific test be performed in specified areas of the Project.

C. Infiltration or Exfiltration Test (for Gravity Sewer)

1. Preparation: Seal ends of line section being tested with water tight plugs, equipped with pipe riser inserted and braced in the inlet of the manholes. Fill section with water 24-hours prior to start of test. Fill slowly from downstream manhole in test section so that no air is trapped in the line. Leave outlets of stacks and service lines exposed and unplugged until after exfiltration test has been made. Outlets terminating below level of test water surface to be temporarily extended upward by installing additional lengths of pipe. After completion of satisfactory test, remove lengths of pipe added for test.

2. Duration of Test: Test for 24-hours. Minimum head of either two (2) feet measured above the crown, inside pipe at upper end of section or four (4) feet measured above trench water table, whichever is higher, so that a net positive of two (2) feet TCEQ is used for testing.

3. Allowable Leakage: Allowable leakage or exfiltration in any individual section under construction shall not exceed 10 gallons per inch of inside diameter per mile of pipe per 24 hours.

D. Low Pressure Air Test

1. Preparation: Clean pipe to be tested by propelling snug fitting inflated rubber ball through the pipe with water or by use of water jet cleaning equipment. After manhole to manhole reach of pipe has been backfilled and cleaned, pneumatic plugs shall be placed in the line at each manhole and inflated to 25 psig. Add air slowly to the section under test until the internal pressure of 4.0 psig is obtained. Allow at least two (2) minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.

2. Duration of Test and Allowable Leakage

Decrease pressure to 3.5 psig and start stopwatch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. Minimum permissible pressure holding times are indicated in seconds and shall be computed by the following equation:

$T = (0.085 \times D \times K)/Q$

T = time for pressure to drop 1.0 pound per square inch gauge in seconds
K = 0.000419xDxL, but not less than 1.0
D = average inside diameter in inches
L = length of line of same pipe size being tested, in feet
Q = rate of loss assume 0.0015 cubic feet per minute per square foot internal surface shall be used

Since K value of less than 1.0 shall not be used, there are minimum times for each pipe diameter as outlined below:

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
(inches)	(seconds)	(feet)	(seconds)
6	340	398	0.855(L)
8	454	298	1.520(L)
10	567	239	2.374(L)
12	680	199	3.419(L)
15	850	159	5.342(L)
18	1020	133	7.693(L)
21	1190	114	10.471(L)
24	1360	100	13.676(L)

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
27	1530	88	17.309(L)
30	1700	80	21.369(L)
33	1870	72	25.856(L)
36	2040	66	30.771(L)

The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration as outlined above or until failure. Lines with a 27-inch average inside diameter and larger may be air tested at each joint. If the joint test is used, a visual inspection of the joint shall be performed immediately after testing. The pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 psi gauge to 2.5 psi gauge shall be 10 seconds.

E. Test Procedures for Hydrostatic Test for Manholes

1. Manholes shall be tested for leakage separately and independently of the wastewater lines by hydrostatic exfiltration testing, or other methods acceptable to the City. If a manhole fails a leakage test, the manhole must be made water tight and retested. The maximum leakage for hydrostatic testing shall be 0.025 gallon per vertical foot per hour. Alternative test methods must ensure compliance with the above allowable leakage. Hydrostatic exfiltration testing shall be performed as follows: all wastewater lines coming into the manhole shall be sealed with an internal pipe plug, then the manhole shall be filled with water and maintained full for at least one (1) hour. For concrete manholes a wetting period of 24-hours may be used prior to testing in order to allow saturation of the concrete.

F. Test Procedures for Vacuum Testing Manholes

1 In lieu of the hydrostatic exfiltration test, manholes may be tested by vacuum. Manholes tested by vacuum shall be performed by the Contractor in compliance with these specifications.

2. Manholes shall be tested after installation of all connections (existing and/or proposed) in place. All lift holes shall be plugged with an approved non-shrink grout and all drop connections and gas sealing connections shall be installed prior to testing. The lines entering the manhole shall be temporarily plugged with the plugs braced to prevent them from being drawn into the manhole. The plugs shall be installed in the lines beyond the drop-connections, gas sealing connections, etc. The test head shall be placed inside the frame at the top of the manhole and inflated in accordance with the manufacturer's recommendations. A vacuum of 10-inches of mercury shall be drawn, and the vacuum pump shall be turned off. With the valve closed, the level of vacuum shall be read after the required test time as shown in the following table. If the drop in the level is less than one (1) inch of mercury (final vacuum of nine (9) inches of mercury), the manhole will have passed the vacuum test. The required test time shall be 120-seconds.

3. Manholes which have a final vacuum of nine (9) inches of mercury after the time indicated will be accepted. Any manhole which fails the vacuum test as described above shall be repaired with an approved non-shrink grout or other material acceptable to the Engineer and the City based on the material from which the manhole is constructed. The manhole shall be retested as described above until a successful test is made.

G. Exfiltration Test

1. Preparation: Seal ends of manhole being tested with watertight plugs. Fill manhole 24-hours prior to start of test. Manholes to be filled to top of manhole cone section.

2. Duration of Test: The test shall be performed for a 24-hour duration.

3. Allowable Leakage: No leakage is allowed. The water elevation shall be the same at beginning and end of test period.

H. Deflection Testing

1. Deflection tests shall be performed on all flexible pipes. For pipes with inside diameters less than 27-inches, a rigid mandrel shall be used to measure deflection. For pipelines with an inside diameter of 27-inches and greater, the Contractor shall submit to the Engineer the proposed method, with which shall provide a precision of ± two tenths of one percent (0.2%) deflection, for review and approval by the Texas Commission on Environmental Quality. The test shall be conducted after final backfill has been in place at least 30 days in the presence of a representative of the City's Utilities Department. No pipe shall exceed a deflection of five percent (5%). If a pipe should fail to pass the deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place an additional 30 days. Test shall be performed without mechanical pulling devices.

2. Mandrel Sizing: The rigid mandrel shall have an outside diameter (O.D.) equal to 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter of the pipe minus two minimum wall thickness for O.D. controlled pipe and the average inside diameter for the I.D. Controlled pipe, all dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

3. Mandrel Design: The rigid mandrel shall be constructed of a metal or rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.

4. Method Options: Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test. A deflectometer may be approved provided the Contractor notifies the Engineer in a timely manner and submits adequate information for the Engineer to submit to the Texas Commission on Environmental Quality for review and approval. Mandrels with removable legs or runners may also be approved provided the Contractor notifies the Engineer in a timely manner and submits adequate information for the Engineer to submit to the Texas Commission on Environmental Quality for review and approval.

I. Repairs of Lines: Remove and replace or make approved corrective repairs to any section of line or manhole which has leakage that exceeds above amounts. Repair any individual leaks that may appear whether or not overall section meets leakage requirements. Individual leaks will ordinarily be revealed by looking through sewer with a light while groundwater level is over sewer, during water tamping operations or immediately after water leakage is emptied from sewer.

J. Retest: Sewers and/or manholes failing to meet requirements of leakage test will, after repair by Contractor, be tested again for leakage. No sewer or manhole will be accepted until leakage is less than allowable amount.

K. Video Inspection

1. The use of a television camera for inspection prior to placing the sewer in service will be required. Video inspection is at the cost of the Contractor, and copies of the DVD will be presented to the City prior to final acceptance. One (1) copy of the DVD shall be submitted to the City.

2. Post construction video of the gravity wastewater lines will be evaluated on a case-by-case basis for acceptance. Preparation for video taping of wastewater line shall be as follows:

   a. Flush and clean the gravity wastewater line prior to video taping.

   b. The videotape shall display the station, in accordance with the Plans and Standards, and counter on the screen. Manhole numbers and stations shall correspond to the contract documents.

   c. If debris is evident in the line during the video, the line will be flushed and cleaned to allow a clean video.

   d. All manholes will be identified at the beginning and end of the video corresponding to contract documents with upstream and downstream ends identified.

   e. Additional video inspections shall be performed prior to completion of one-year warranty period and submitted on DVD.

L. Force Main

1. Force Main shall be pressure tested one and one-half (1 1/2) times the maximum output of the pumps. The allowable hydrostaic leakage rate shall be based on CIP 12.06 Table 6A.

CIP12.06 TEST PROCEDURES FOR PRESSURE PIPELINES

A. General

1. After the pipe has been laid and backfilled and the backfill has been otherwise consolidated, all newly laid pipe, or any valved section thereof, shall be subjected to the hydrostatic pressure specified below for that particular type of pipe. The duration of the hydrostatic test shall be at least two (2) hours. Unless otherwise specified or noted on the Plans. All meters, fixtures, devices or appliances which are connected to the pipeline system and which might be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped during the testing procedures.

2. Each valved (capped or plugged) section of pipe shall be filled slowly with water and all air shall be expelled. If permanent air vents are not located at all high points, the Contractor shall install, at his own expense, corporation or blow-off cocks at such points so that air can be expelled as filling takes place. After verification that all air has been expelled, the cocks shall be closed and the pipe kept filled until tested. All exposed pipe, fittings, valves, hydrants and joints shall be examined while under test pressure and all visible leaks shall be stopped. Any cracked or defective pipe, fittings, valves or hydrants discovered during testing shall be removed and replaced by the Contractor. Replacement shall be with sound material and the test shall be repeated until satisfactory to the City.

B. Special Requirements: Where any section of pipeline is provided with concrete reaction blocking, the hydrostatic pressure shall not be made until at least five (5) days have elapsed after installation of the blocking. However, if high-early-strength cement is used in the concrete, two (2) days shall have elapsed prior to testing.

C. Leakage Test: A Leakage Test will be conducted on each valved section over the entire Project. The leakage test shall be at 150 psi for at least four (4) hours. Fire lines shall be tested at 200 psi for two (2)

hours with 0 loss.

D. Allowable Leakage

1. The allowable hydrostatic leakage rate shall be based on the following formula:

Fire lines 0 loss
$L = \frac{SD\sqrt{P}}{133,200}$
L = testing allowance in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of the pipe in inches
P = average test pressure during the hydrostatic test in pounds per square inch (gauge)

Table 6A
Hydrostatic testing allowance per 1,000 ft of pipeline* - *gph*†

Avg. Test Pressure *psi*	Nominal Pipe Diameter – in.																	
	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54	60	64
450	.48	.64	.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60	9.56	10.19
400	.45	.60	.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11	9.01	9.61
350	.42	.56	.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58	8.43	8.99
300	.39	.52	.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02	7.80	8.32
275	.37	.50	.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72	7.47	7.97
250	.36	.47	.71	.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41	7.12	7.60
225	.34	.45	.68	.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03	6.76	7.21
200	.32	.43	.64	.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73	6.37	6.80
175	.30	.40	.59	.80	.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36	5.96	6.36
150	.28	.37	.55	.74	.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97	5.52	5.88
125	.25	.34	.50	.67	.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53	5.04	5.37
100	.23	.30	.45	.60	.75	.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05	4.50	4.80

* If the pipeline under test contains sections of various diameters, the testing allowance will be the sum of the testing allowance for each size.
† Calculated on the basis of Eq. 1.

a. These formulas are based on a testing allowance of 11.65 gpd/mi/in. (1.079 L/d/km/mm) of nominal diameter at a pressure of 150 psi (1,034 kPa).

b. 5.2.1.6.1 Testing allowance at various pressures is shown in Tables 6A and 6B.

c. 5.2.1.6.2 When testing against closed metal-seated valves, an additional testing allowance per closed valve of 0.0078 gal/h/in. (1.2 mL/h/mm) of nominal valve size shall be allowed.

d. 5.2.1.6.3 When hydrants are in the test section, the test shall be made against the main valve in the hydrant.

e. 5.2.1.7 Acceptance of installation. Acceptance shall be determined on the basis of testing allowance. If any test of laid pipe discloses a testing allowance grater than that specified in Sec. 5.2.1.6, repairs or replacements shall be accomplished inaccordance with the specifications.

f. 5.2.1.7.1 All visible leaks are to be repaired regardless of the allowance used for

testing.

2. If such testing discloses leakage in excess of this specified allowable, the Contractor, at his expense, shall locate and correct all defects in the pipeline until the leakage is within the specified allowance. All known leaks, irregardless of this test, shall be repaired.

E. Pressure Test: After satisfactorily completing the leakage test, each valved section over the entire project, shall be tested at 200 psi for a sufficient period (approximately 10 min) to discover all leaking or defective materials and/or workmanship.

F. Disinfecting Water Mains: The Contractor shall disinfect all water mains before the new facilities are placed into service. Disinfection must be performed in accordance with AWWA C651, latest revision and water samples must be submitted to a laboratory approved by the Texas Department of Health. Sample must be collected by the Contractor or his representative in the presence of the City or his representative. The Contractor shall be responsible for delivering the samples to an approved laboratory for testing. Sample results must indicate the facility is free of microbiological contamination before it is placed into service. It shall be the Contractor's responsibility to obtain a current copy of AWWA C651 to determine the correct forms of chlorine for disinfection, the basic disinfection procedure, preventive and corrective measures during construction, methods of chlorination, final flushing procedures, procedures for bacteriological tests, procedures for redisinfection and disinfection procedures when cutting into existing mains. The Contractor, at its expense, will supply the concentrated chlorine disinfecting material, the City's personnel will supervise and direct the overall sterilization procedure. The Contractor, at his own expense, shall provide all other equipment, supplies and necessary labor to perform the sterilization under general supervision by the City.

G. General

1. All valves shall be arranged to prevent the strong disinfecting dosage from flowing back into the existing water supply piping. The new pipeline shall then be completely filled with disinfecting solution by feeding the concentrated chlorine and approved water from the existing system uniformly into the new piping in such proportions that every part of the line has a minimum concentration of chlorine as prescribed in AWWA C651.

2. Unless otherwise identified, all quantities called for herein refer to measurements by the testing procedures in the current edition of "Standard Methods of Examination of Water and Wastewater". The chlorine concentration of each step in the sterilization procedure shall be verified by chlorine residual determinations. This disinfecting solution shall be retained in the piping for at least twenty-four (24) hours, and all valves, hydrants, etc., shall be operated to disinfect all their parts. After this retention period, the water shall contain no less than the chlorine residual prescribed in AWWA C651 throughout the treated section of the pipeline.

3. This heavily chlorinated water shall then be carefully flushed from the line until the chlorine concentration is not higher than the residual generally prevailing in the existing distribution system, or approximately 1.0 parts per million. Proper planning and appropriate preparations to handle, dilute and dispose of this strong chlorine solution without causing injury or damage to the public, the water system, the environment must be approved by the City before flushing of the line may begin, and the flushing shall be witnessed by an authorized representative of the City.

H. Bacteriological Testing

1. After final flushing of the strong disinfecting solution, water samples from the line shall be tested for bacteriological quality, at the Contractor's expense, and must be found free of coliform organisms before the pipeline may be placed in service. One (1) test sample shall be drawn from the end of the main and additional samples collected at intervals of not more than one-thousand (1,000) feet along the pipeline. A minimum of three (3) samples must be collected.

2. The Contractor, at his own expense, shall install sufficient sampling taps at proper locations along the pipeline. Each sampling tap shall consist of a standard corporation cock installed in

the line and extended with a copper tubing gooseneck assembly. After samples have been collected, the gooseneck assembly shall be removed and retained for future use.

3. Samples for bacteriological analysis shall be collected only from suitable taps, in sterile bottles. Collection of the test samples shall be made in the presence of City personnel. If the initial disinfection fails to produce acceptable sample tests, the disinfection procedure shall be repeated (without extra compensation) until satisfactory test results have been obtained, before the piping may be placed in service.

CIP12.07 FINAL ACCEPTANCE

A. No pipe installation will be accepted until all known leaks have been repaired whether or not leakage is within allowable limits. Locating and repairing of leaks shall be performed by the Contractor at no additional cost to the City.

B. The City will certify that all required pressure and leakage tests have been successfully completed before the pipeline is accepted.

CIP12.08 PAYMENT

A. No separate payment will be made for work completed in accordance with this specification, and the cost thereof will be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP13 – SUMMARY OF TESTING (MISCELLANEOUS)

CIP13.01 SCOPE OF WORK

A. This specification covers the requirements to perform testing of various work items for this Project.

CIP13.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature and all other pertinent data to illustrate conformance to the specification found within.

CIP13.03 TESTING FOR ROADS

Testing for roads shall be in accordance with Table 13-1.

Table 13-1

Item	Test Method	Passing Criteria	Comments
Hot Mix Asphaltic Concrete (HMAC)	Tex-200-F	See SD1.06 A	Sieve Analysis of Fine and Coarse Aggregate
	Tex-207-F	94.5%-97.5%Lab Density; 91.0%-96.0%In-PlaceField Density	Determining Density of Compacted Bituminous Mixtures
	Tex-210-F	See SD 1.06 B	Determining Asphalt Content of Bituminous Mixtures by Extraction
	Tex-227-F		Max. Specific Gravity of Bituminous Mixtures
	Tex-208-F	Max 35	Stability
Trench Backfill	Applicable Tex Testing Method	See Section G4.05	Minimum of one test every 250 linear feet of trench length for each lift.
Embankment	Tex-114-E		Test every 2,000 SY of roadbed surface
Flexible Base	Tex-107-E, Part II	2% shrinkage	Bar Linear Shrinkage
	Tex-411-A		Magnesium Soundness
	Tex-110-E		Sieve Analysis
	Tex-113-E	100% Density	Moisture Density
	Tex-115-E		Roadway Density
	Tex-116-E	40 Max.	Wet Ball Mill
	Tex-117-E	45 psi @ 0 psi lateral & 175 psi @ 15 psi lateral Max. increase ≤ 20	Triaxial Test (Part I or II)
	Tex-460-A	Plasticity Index ≤ 10	Particle Count (Part I)
	Tex-106-E	Liquid Limit ≤35	Plasticity Index
	Tex-104-E	±2% Optimum	Liquid Limit
	Tex-103-E		Moisture Content

Table 13-1, cont.

Item	Test Method	Passing Criteria	Comments
Striping	Tex-828-B Tex-854-B	10 or more stripes visible (day) 6 or more stripes visible (night) 0.060-inches minimum thickness for edgeline markings 0.090-inches minimum thickness for stop bars, legends, symbols, gore and centerline/no passing barrier line markings 0.180-inches maximum thickness for all markings	Glass Beads: If criteria is not met, check Tex-828-B for scheduling replacement of striping. The average of the readings across each sample must be equal to or above the specified minimum thickness. No reading should be more than 10-mils below the specified minimum thickness.

CIP13.04 TESTING FOR WATER/WASTEWATER

Testing for water/wastewater shall be in accordance with Table 13-2.

Table 13-2

Item	Test Method	Passing Criteria	Comments
Valves, Hydrants and Appurtenances	Manufacturer's Recommendations	Manufacturer's Recommendations	Functional field test of each valve, including actuators and valve control equipment.
Water and Wastewater Lines			As described in Section CIP 12: Testing of Pipelines

CIP13.05 TESTING FOR CONCRETE

Testing for concrete shall be in accordance with Table 13-3.

Table 13-3

Item	Test Method	Passing Criteria	Comments
Asphalt Board	Tex-524-C	Deflection from horizontal <1:3[1/],	
Concrete Slump			See Table 13-4 for Slump
Coarse Aggregate	Tex-413-A Tex-410-A Tex-411-A	0.25% by weight clay lumps 1.00% by weight shale 5.00% by weight laminated and/or friable particles 40% wear 12% loss Sodium Sulfate 18% loss Magnesium Sulfate	See Table 13-5 for Gradation Soundness Test

Table 13-3, cont.

Fine Aggregate	Tex-612-J Tex-408-A	60% by weight acid insoluble residue subject to direct traffic. Color shall not be darker than Organic Color No. 3 (Gardner No. 11)	 Color Test

	Tex-401-F Tex-203-F Tex-402-A	 Not less than 80 Between 2.3 & 3.1 for Non-Class K Between 2.6 & 2.8 for Class K	See Table 13-6 for Gradation Sand Equivalent Fineness Modulus
Membrane Curing	Tex-219-F	2% loss for 24-hour test 4% loss for 72-hour test	Water Retention Test

Table 13-4

Concrete Designation	Slump	Maximum Slump
1. All drill shaft	6	7
2. Uncased drill shafts, thin walled sections (<9") and pre-stressed concrete members	4	5
3. Slabs, caps, columns, piers, wall sections over 9", etc.	3	4
4. Underwater or seal concrete	6	7
5. Riprap, curb, gutter and other miscellaneous concrete.	As specified by City.	

Table 13-5

Aggregate Grade No.	Nominal Size (in)	Amount Retained (%)								
		2 1/2 in	2 in	1 1/2 in	1 in	¾ in	½ in	3/8 in	No 4	No 8
1	2	0	0-20	15-50		60-80			95-100	
2 (467)*	1 1/2			0-5		30-65		70-90	95-100	
3	1 1/2			0-5		10-40	40-75		95-100	
4 (57)*	1				0-5		40-75		90-100	95-100
5 (67)*	¼					0-10		45-80	90-100	95-100
6 (7)*	½							30-60	85-100	95-100
7	3/8							5-30	75-100	
8	3/8							0-5	35-80	90-100

Table 13-6

Aggregate Grade No.	Amount Retained (%)							
	3/8 in	No 4	No 8	No 16	No 30	No 50	No 100	No 200
1	0	0-5	0-20	15-50	35-75	65-90	90-100	97-100

CIP13.06 PAYMENT

A. No separate payment will be made for work completed in accordance with this specification, and the cost thereof will be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP14 – PROJECT CLOSEOUT

CIP14.01 SCOPE OF WORK

A. This specification covers the administrative and procedural requirements for Project closeout, including but not limited to:

1. Closeout procedures.
2. Final cleaning.
3. Adjusting.
4. Project record documents.
5. Spare parts and maintenance materials.

CIP14.02 RECORD DOCUMENTS

A. Maintain on site, one (1) set of the following documents; actual revisions to the Work shall be recorded in these documents:

1. Contract Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other Modifications to the Contract.
5. Reviewed shop drawings, product data, and samples.

B. Store Record Documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and Modifications.

E. Contract Drawings and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured depths of foundations in relation to finish floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract Drawings.

F. Submit documents to City with claim for final Application or Payment. Retention monies will not be released until complete record documents have been submitted.

CIP14.03 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's and/or City's inspection.

B. Provide submittals to the City that are required by governing or other authorities.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

CIP14.04 FINAL CLEANING

A. At the completion of work and immediately prior to final inspection, cleaning of the entire project shall be accomplished according to the following provisions:

1. The Contractor shall thoroughly clean, sweep, wash, and polish all work and equipment provided under the Contract, including finishes. The cleaning shall leave the structures and site in a complete and finished condition to the satisfaction of the City.

2. All Subcontractors shall similarly perform, at the same time, an equivalent thorough cleaning of all work and equipment provided under their contracts.

3. The Contractor shall remove all temporary structures and all debris, including all dirt, sand, gravel, rubbish and waste material.

4. Should the Contractor not remove rubbish or debris, or not clean the buildings and site as specified above, the City reserves the right to have the cleaning done at the expense of the Contractor.

B. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

C. Use cleaning materials only on surfaces recommended by cleaning material manufacturers.

D. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.

E. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces. Polish surfaces so designated to shine finish.

F. Repair, patch, and touch up marred surfaces to specified finish, to match adjacent surfaces.

G. Replace air-handling filters if units were operated during construction.

H. Vacuum clean all interior spaces, including inside cabinets. Broom clean paved surfaces, mow any areas planted with grass which are in excess of two (2) inches high, and rake clean other surfaces of grounds.

I. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.

J. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly-painted surfaces.

CIP14.05 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

CIP14.06 FINAL INSPECTION

A. After final cleaning and restoration and upon written notice from the Contractor that the work is completed, the Engineer and/or City will make a preliminary inspection, with the Contractor present. Upon completion of this preliminary inspection, the Engineer and/or City will notify the Contractor, in writing, of any particulars in which this inspection reveals that the work is defective or incomplete.

B. Upon receiving written notice from the Engineer and/or City, the Contractor shall immediately undertake the work required to remedy deficiencies and complete the work to the satisfaction of the City.

C. When the Contractor has corrected or completed the items as listed in the Engineer's/ City's written notice, he/she shall inform the City in writing, that the required work has been completed. Upon receipt of this notice, the Engineer and/or City and the Contractor, will make the final inspection of the Project.

D. Should the Engineer and/or City find all work satisfactory at the time of his inspection, the Contractor will be allowed to make application for final payment in accordance with the provisions of the Standard Form of Agreement. Should the Engineer and/or City still find deficiencies in the work, the Engineer and/or City will inform the Contractor of the deficiencies and will deny the Contractor's request for final payment until such time as the Contractor has satisfactorily completed the required work. Additional inspections of deficiencies shall be paid for by the Contractor at $200.00 per inspection.

CIP14.07 ACCESSORY ITEMS

A. The Contractor shall provide to the City, upon acceptance of the equipment, all special accessories required to place each item of equipment in full operation. These special accessory items include, but are not limited to, the specified spare parts, adequate oil and grease as required for the first lubrication of the equipment, initial fill-up of all chemical tanks and fuel tanks, light bulbs, fuses, hydrant wrenches, valve wrenches, valve keys, handwheels, and other expendable items as required for initial start-up and operation of all equipment.

CIP14.08 GUARANTEES, BONDS, AND AFFIDAVITS

A. No application for final payment will be accepted until all guarantees, bonds, certificates, licenses, and affidavits required for work or equipment as specified are satisfactorily filed with the Engineer.

CIP14.09 RELEASE OF LIENS OR CLAIMS

A. No application for final payment will be accepted until satisfactory evidence of release of liens has been submitted to the City as required by the Standard Form of Agreement.

CIP14.10 FINAL PAYMENT

A. Final payment will be made to the Contractor in accordance with Item 47- “Payment Procedures”, Standard Form of Agreement. Final payment and release of retention monies will not be made until the Contractor has submitted one (1) set of as-built plans to the City for the Project.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP15 – PROJECT IDENTIFICATION SIGNAGE

CIP15.01 SCOPE OF WORK

A. This specification covers the requirements for furnishing, fabricating and erecting Project Signs on Capital Improvement Projects (C.I.P.) and for project identification at other construction sites, when required on the Plans or by the City.

CIP15.02 MATERIALS

A. Sign Face: The sign face shall be manufactured on standard exterior waterproof plywood sheets or other suitable material approved by the Engineer or the City. Unless indicated otherwise on the Plans, the thickness of the plywood sheet shall be a minimum of $^{3}/_{4}$-inches.

B. Posts: Plastic post, of the size indicated on the Plans, shall be pressure treated with pentachlorophenol.

C. Paint: Exterior oil base paint shall be used and colors shall be as indicated on the Plans.

D. Signs for Capital Improvements Projects: City seals shall be provided by the City.

CIP15.03 INSTALLATION

A. The signs shall be erected at each major entrance to the project for maximum public identification and exposure. At locations where construction is confined to an adequate area defined by the City, the installed sign size shall be four-feet by eight-feet (4'x8'). At locations where roadway construction is in progress, such as a street paving or construction of a sidewalk, the sign shall be two-feet by three-feet (2'x3'). The signs shall be posted on portable wood frames or stanchions and will be located in the proximity of the work area as construction progresses. All lumber shall be painted with two (2) coats of paint as indicated on the Plans.

B. In special cases, the size of the sign may be changed to meet special requirements, but general proportions shall be maintained.

C. It shall be the responsibility of the Contractor to maintain and relocate signs, if necessary, during the progression of the project. Care shall be exercised to assure that placement of the signs does not interfere with or cause sight obstruction to vehicular and pedestrian traffic.

D. The Contractor may install, at his own expense, company signs to identify the Contractor, Developer, etc. Signs are to be securely attached to the posts at locations indicated on the Plans and shall not be larger than 18-inches by 36-inches.

CIP15.04 PAYMENT

A. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP16 – WARRANTY

CIP16.01 SCOPE OF WORK

A. This specification covers the requirements of the Contractor's or Developer's one (1) year warranty period for all work performed on the Project.

CIP16.01 WARRANTY

A. Upon final acceptance by the City of Georgetown, the Contractor warrants for a period of one (1) year, the construction of the Project according to Plans and Specifications as they may be modified in accordance with the Contract Documents, and further warrants the proper operation of mechanical, electrical, and other devices or other equipment, if any, included in the project for a period of one (1) year. The Contractor or Developer warrants to the City that all materials and equipment furnished under this Contract shall be new unless otherwise approved by the City's Representative and that all work will be of good quality, free from faults and defects, and in conformance to these requirements, including substitutions not properly approved and authorized, may be considered defective.

B. This warranty is in addition to any rights or warranties expressed or implied by law and consumer protection claims arising from misrepresentations by the Contractor or Developer. This warranty obligation shall be covered by any performance or payment bonds tendered in compliance with the Contract Provisions.

C. If within one (1) year after the date of substantial completion of the work or designated portion thereof, or within one (1) year after acceptance by the City of the designated Project, or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents, any of the work is found or determined to be defective, including obvious defects, or otherwise not in accordance with the Contract Documents, the Contractor or Developer shall correct it promptly.

D. If within 10 days after the City has notified the Contractor or Developer of a defect, failure, or abnormality in the work, the Contractor or Developer has not started to make the necessary repairs or adjustments, the City is hereby authorized to make the repairs or adjustments, or to order the work to be done by a third party. The cost of the work shall be paid by the Contractor or Developer. The cost of all materials, parts labor, transportation, supervision, special tools, and supplies required for the replacement or repair of parts and for correction of defects, shall be paid by the Contractor, Developer or by the surety. This guarantee shall be extended to cover all repairs and replacements furnished under the guarantee, and the period of the guarantee for each repair or replacement shall be one (1) year after the installation or completion. The one (1) year warranty shall cover all work equipment, and materials that are part of this project, whether or not a warranty is specified in the individual section prescribing that particular aspect of the work. Where more than a one (1) year warranty is specified in the individual section, that warranty shall govern.

E. After receipt of written notice from the City to begin corrective work, the Contractor or Developer shall promptly begin the corrective work, unless the City's Representative has previously given the Contractor a written acceptance of such condition. This obligation shall survive the termination of the Contract. This guarantee shall not constitute the exclusive remedy of the City, nor shall other remedies be limited to either the warranty or guarantee period.

CIP16.03 PAYMENT

A. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP17 – INSPECTION OF PROJECTS

CIP17.01 INSPECTION

A. All Projects, whether by a private development or the City of Georgetown shall be inspected by the City or a designated representative of the City.

B. The time that the City of Georgetown or its designated representative will be available for inspection is from 8:00 AM to Noon and 1:00 PM to 5:00 PM on working days. Working days shall be defined as Monday through Friday excluding all holidays observed by the City of Georgetown. All inspections shall be scheduled with the City a minimum of two (2) working days prior to the inspection.

C. If the Contractor, for his convenience and at his own expense, should desire to carry on his work at night or outside regular hours, he shall submit a written approval request to the City and he shall allow ample time for satisfactory arrangements to be made for inspecting the Work in progress. The Contractor shall pay the expenses for extra inspection required for work outside regular hours at a rate of $50.00/hour. Normal working hours for this purpose are Monday through Friday, 7:00 a.m. to 6:00 p.m. The Contractor shall light the different parts of the Project as required to comply with all applicable Federal and State regulations and with all applicable requirements of the City of Georgetown.

CIP17.02 AUTHORITY AND DUTIES OF INSPECTORS

A. Inspectors will be authorized to inspect all work done and all materials furnished. Such inspection may extend to all or to any part of the Work and to the preparation or Manufacturer of the materials to be used. Such inspection will not relieve the Contractor from any obligation to perform the Work in accordance with the requirements of the Specifications. In case of any dispute arising between the Contractor and the Inspector as to materials furnished or the manner of performing the Work, the Inspector will have authority to reject materials or suspend work until the question at issue can be referred to and decided by the City. The Inspector will not be authorized to revoke, alter, enlarge, or release any requirement of these Specifications, nor to approve or accept any portion of the Work, nor to issue instruction contrary to the Plans and Specifications. He will in no case act as foreman or perform other duties for the Contractor nor interfere with the management of the Work.

END OF SECTION

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GENERAL SPECIFICATIONS

SECTION G

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TECHNICAL SPECIFICATIONS

SECTION G1 – BARRICADES, SIGNS AND TRAFFIC HANDLING

G1.01 SCOPE OF WORK

A. This specification covers the requirements to provide, install, move, replace, maintain, clean and remove temporary or permanent street closure barricades, signs or other devices required to handle the traffic in conformance with the current edition of the Texas Manual of Uniform Traffic Control Devices for Streets and Highways (TMUTCD)and as indicated by the Engineer or the City.

G1.02 SUBMITTALS

A. Within 10 days after the Notice to Proceed, the Contractor shall submit to the Engineer a site-specific Traffic Control Plan. The Traffic Control Plan shall be sealed by a Professional Engineer Registered in the State of Texas as required by the Project Specifications, City, or Engineer.

G1.03 CONSTRUCTION METHODS *See modifications for additional information

A. Prior to commencing the construction, suitable "Barricades, Signs and Traffic Handling" devices shall be installed to protect the workers and the public. A traffic control plan specific to the Project shall be designed and submitted to the City prior to the start of construction. If indicated by the Plans or requested by the City the plan shall be designed by a qualified traffic engineer who is a Registered Professional Engineer in the State of Texas.

B. The Contractor shall be responsible for installing all markers, signs and barricades conforming to the Texas Manual on Uniform Traffic Control Devices and/or as indicated. If, in the opinion of the Engineer, additional markers, signs or barricades are needed in the interest of safety, the Contractor will install such as are required or as directed by the Engineer.

G1.04 MAINTENANCE

A. It shall be the Contractor's responsibility to maintain, clean, move and replace if necessary, barricades, signs and traffic handling devices during the time required for construction of the Project. When no longer needed all temporary barricades, signs and traffic handling devices shall be removed and the area restored to its original condition or as directed by the Engineer.

G1.05 PAYMENT

A. Payment shall be made for the work performed in accordance with this specification and the appropriate bid items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION G2 – SITE PREPARATION

G2.01 SCOPE OF WORK

A. This specification covers the requirements for performing all clearing, grubbing and stripping of topsoil complete as shown on the Plans and as specified herein.

G2.02 SUBMITTALS

A. None required unless specifically called for in the Plans, Standards or requested by the City or the Engineer.

G2.03 CLEARING AND GRUBBING

A. Except as otherwise directed, cut, grub, remove and dispose of all trees, stumps, brush, shrubs, roots and any other objectionable material within the limits defined on the Plans.

B. All trees, stumps, brush, shrubs, roots and other objectionable material shall be cut, grubbed, removed and disposed of from areas to be occupied by buildings, structures, roads, pipelines and any other areas to be stripped. Trees and brush shall be removed to a depth at least three (3) feet below the finished grade.

C. In addition, heavy growths of weeds or other plants shall be stripped from the surface in order to provide clear access to the work site and to prevent their inclusion in stockpiled soil which is to be reused later. Trees, stumps, surface plants and all debris removed from the site shall be disposed of off-site by the Contractor at his own expense.

D. Before the start of construction, protect trees or groups of trees, designated by the Engineer to remain, from damage by all construction operations by erecting suitable barriers, or by other approved means. Clearing operations shall be conducted in a manner to prevent falling trees from damaging trees designated to remain.

E. Areas outside the limits of clearing shall be protected from damage and no equipment or materials shall be stored in these areas.

F. No stumps, trees, limbs, or brush shall be buried in any fills or embankments.

G2.04 STRIPPING

A. Strip topsoil from all areas to be occupied by buildings, structures, roadways and all areas to be excavated or filled. Avoid mixing topsoil with subsoil and stockpile topsoil in areas on the site as approved by the Engineer. Topsoil shall be free from brush, trash, large stones and other extraneous material and protected until it is placed as specified under Section G7- LOAMING, HYDROSEEDING AND PERMANENT EROSION CONTROL. Dispose of any remaining topsoil as directed by the City. All excess topsoil shall remain property of the City at its option, and Contractor shall place extra materials at a site designated by the City.

G2.05 DISPOSAL OF MATERIALS

A. All tree trunks, limbs, roots, stumps, brush, foliage, other vegetation and objectionable material shall be removed from the site and disposed of in a permitted disposal site in a manner satisfactory to the Engineer.

B. Burning of cleared and grubbed materials will not be permitted.

C. Disposal of Excavated Materials

1. Suitable excavated materials may be stockpiled to be used for backfilling. Excess excavated

materials and unsuitable backfill materials shall be disposed of by the Contractor in the following manner:

a. Clays, sands and gravel in excess of project requirements shall be disposed of by the Contractor at such locations and under consideration arranged by the Contractor at his expense.

b. Limestone and other rock excavation shall be disposed of by the Contractor at such locations and under consideration arranged by the Contractor at his expense.

2. The classification of clays, sands, gravel, limestone and rock shall be made in accordance with the Unified Soil Classification System, U.S. Army Corps of Engineers, T.M. 3-357.

3. Desirable topsoil, sod, or area fill shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such a manner as to cause a minimum of inconvenience to the City's operations, and to permit safe and convenient access to private and public property adjacent to the work

G2.06 UNAUTHORIZED EXCAVATION

A. Whenever the excavation is carried beyond or below the lines and grades as shown on the plans, except as specified above, all such excavated space shall be refilled with such material and in such a manner, as may be directed by the City, so as to insure the stability of the affected structure. Beneath all structures, space excavated without authority shall be refilled by the Contractor, at his own expense, with Class "C" concrete, crushed stone or selected fill materials, as directed by the City.

G2.07 PAYMENT

A. Payment will be made for work performed in accordance with this specification by the unit quantity for the item for right-of-way preparation in the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION G3 – SITE CLEARING

G3.01 SCOPE OF WORK

A. This specification covers the requirements for site clearing operations for this Project.

G3.02 SUBMITTALS

A. None required unless specifically called for in the Plans, Standards, or requested by the City or the Engineer.

G3.03 TRAFFIC

A. Conduct site-clearing operations to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

G3.04 PROTECTION

A. Provide temporary fences, barricades, coverings, or other protection to preserve existing items indicated to remain and to prevent injury or damage to persons or property. Provide protection for adjacent properties as required.

B. Restore damaged work to condition existing prior to start of work.

C. Protect existing trees and vegetation that are indicated to remain from physical damage. Do not store materials or equipment within tree drip line. Replace damaged trees that cannot be restored to full growth, as determined by arborist, unless otherwise acceptable to the Engineer or the City.

D. Protect existing property and easement corners and pins. In the event that property or easement corners or pins are moved disturbed or destroyed the Contractor shall replace them at his own expense. They shall be replaced by a Registered Professional Land Surveyor registered in the State of Texas.

G3.05 EXISTING SERVICES

A. Locations indicated are approximate; determine exact location before commencing work. Coordinate with local utility service requirements and comply with their instructions.

G3.06 SITE CLEARING

A. Remove trees, shrubs, grass and other vegetation, improvements, or obstructions as indicated or that interfere with new construction. Removal includes digging out stumps and roots, together with subsequent off-site disposal.

B. Strip and stockpile topsoil that will be reused in the Work.

C. Remove existing improvements, both above-grade and below-grade, to extent indicated or as otherwise required to permit new construction.

G3.07 SALVAGEABLE ITEMS

A. Carefully remove items indicated to be salvaged and store on the City's premises where indicated or directed.

G3.08 AIR POLLUTION

A. Control air pollution caused by dust and dirt; comply with governing regulations.

G3.09 REGRADING

A. Fill depressions and voids resulting from site-clearing operations. Using satisfactory soil materials, place in maximum six (6) inch deep horizontal layers and compact each layer to density of surrounding original ground.

B. Grade ground surface to conform to required contours and to provide surface drainage.

G3.10 DISPOSAL OF MATERIAL

A. Dispose of waste materials including trash, debris and excess topsoil. No waste material shall remain on the City's property.

B. Burning waste materials on site is not permitted.

G3.11 PAYMENT

A. No separate payment will be made for work performed in accordance with this specification, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION G4 - PIPE EXCAVATION, TRENCHING, EMBEDMENT, ENCASEMENT AND BACKFILLING

G4.01 SCOPE OF WORK

A. This specification covers the requirements for furnishing all labor, equipment and material and performing all work necessary, in connection with excavation, trenching, embedment, encasement, and backfilling, for the installation of water lines, storm sewer lines, wastewater lines, etc. in this Project.

G4.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including a Trench Safety Plan (which shall be sealed by a Professional Engineer registered in the State of Texas, if required) embedment material (source, gradation and type), backfill material (source, gradation and type), encasement material (if required), equipment and all other pertinent data to illustrate conformance to the specification found within.

G4.03 EXCAVATION

A. General

1. Excavation shall include the removal of any trees, stumps, brush, debris, or other obstacles that may obstruct the line of work, and the excavation and removal of all earth, rock or other materials to the extent necessary to install the pipe and appurtenances in conformance with the line and grades shown in the Plans, or as specified.

B. Maximum and Minimum Width of Trenches

1. The sides of all trenches shall be cut as nearly vertical as possible. Unless otherwise specified on the Plans, the minimum width of trench in which the pipe may be installed shall not be less than 12-inches plus the outside diameter of the pipe, and the maximum width shall not be more than 24-inches plus the outside diameter of the pipe, measured at an elevation in the trench which is 12-inches above the top of the pipe when it is laid to grade.

2. Wherever the prescribed maximum trench width is exceeded, the Contractor shall use the class embedment or encasement required by the Engineer to provide the load carrying capacity for the trench width as actually cut, and the additional cost incurred will be borne by the Contractor.

C. Sheeting and Shoring

1. Where required in the Contractor's Trench Safety System, or where required for other reasons in caving ground, or in wet, saturated or flowing materials, the sides of all trenches and excavations shall be adequately sheeted and braced so as to maintain the excavation free from slides or cave-ins.

2. Sheeting and shoring shall not be left in place unless its removal is impractical.

D. Dewatering Excavations

1. There shall be sufficient pumping equipment, in good working order, available at all times to remove any water that accumulates in excavations. Where the pipeline crosses natural drainage channels, the work shall be conducted in such a manner that unnecessary damage or delays in the prosecution of the work will be prevented. Provisions shall be made for the

satisfactory disposal of surface water pumped so as to prevent damage to public or private property. The Contractor shall be responsible for maintaining safe working conditions and suitable construction techniques.

E. Disposal of Excavated Materials

1. Suitable excavated materials may be piled adjacent to the work to be used for backfilling. Excavated materials unsuitable for backfilling, or in excess of that required for backfilling, shall be disposed of by the Contractor. Desirable topsoil, sod, etc. shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such a manner as to cause a minimum of inconvenience to public travel. Suitable selected bedding or backfill material shall be provided at no additional cost to the City.

F. Trench Depth

1. Excavation for the pipeline shall be removed to a depth below the pipe barrel and pipe bell as shown in the Plans for the type of embedment specified, and the bottom of the trench brought to true subgrade with the embedment or encasement shown in the Plans.

G. Soft Subgrade

1. Where soft or spongy material is encountered in the excavation at subgrade level, it shall be removed to such a depth that a stable foundation is achieved by replacing the unsuitable material with tamped gravel, brought to the level of the bottom of bedding.

2. Gravel used shall be washed gravel or crushed stone and may fit any gradation of size up to three (3) inches. The particular gradation shall take into consideration the actual field conditions.

H. Excavated Materials

1. Excavated materials shall be piled adjacent to the work to be used for backfilling as required. After the trench has been refilled, topsoil shall be replaced to the extent that rock excavated from the trench will be completely covered and the area is returned to its original condition.

2. Where required on the Plans or when otherwise specified, desirable topsoil shall be piled separately in a careful manner and replaced in its original position.

3. Where a trench is required to cross a paved area, the asphalt or concrete shall be saw cut and removed for a total width that is two (2) feet greater than the trench width. The Contractor shall dispose of all excavated concrete, asphalt and subgrade material that is unsuitable for backfilling or in excess of that required for backfilling.

I. Damage to Existing Utilities

1. Where existing utilities are damaged, they shall be replaced immediately with material equal to or better than the existing material. Such work shall be at the entire expense of the Contractor.

G4.04 EMBEDMENT AND ENCASEMENT *See modifications for additional information

A. General

1. Embedment shall be as required in the Plans or Standards. All embedment materials shall be free of grass, roots, vegetation, and other deleterious materials. Embedment Standards are shown on the Plans or Standards.

2. When the pipe has been checked for line and grade, the trench shall be backfilled with enough granular material or concrete on both sides to hold the pipe firmly in position. When placing granular material or concrete around the pipe, care shall be taken to fill all voids around the pipe. The pipe shall not be floated. The embedment or encasement material shall be carefully tamped to assure uniform pipe support and density.

B. Embedment Materials

1. Material for embedment shall conform to the following sieve analysis:

Sieve Size	⅜" F % Retained	½" D % Retained
½"	0	0
⅜"	0-2	5-25
4m	40-85	80-100
10m	95-100	96-100

C. Concrete Embedment and Encasement

1. Concrete embedment and encasement and cap shall have a minimum compressive strength of 2,000 pounds per square inch at 28 days.

2. Dry mix will not be permitted. The concrete cushion portion of the embedment or encasement will be mixed moist or damp to give a slump of not more than one (1) inch. Concrete for the sides and top, if specified, shall be mixed to obtain a slump of not less than one (1) inch or more than three (3) inches.

3. After pipe joints are completed, the voids at the joints in the embedment section shall be filled with concrete, and the embedment shall be brought up to proper grade. Where concrete is placed over or along the pipe, it shall be placed in such a manner as not to damage or injure the joints or displace the pipe. Care shall be taken in the placement of concrete to assure that a uniform pad, free of voids and of specified thickness, is constructed under the entire pipe section.

4. A cleavage line between the base concrete and the side embedment concrete will not be allowed. Backfilling shall be done in a careful manner and at such time, after concrete embedment or encasement has been placed, as not to damage the concrete in any way.

G4.05 BACKFILLING

A. General

1. Backfilling shall include the refilling and consolidating of the fill in trenches and excavations up to the surrounding ground surface or road grade at crossings. No backfill shall be placed until the Engineer, the City or his authorized Inspector has inspected the trench and pipe in place and has authorized the placing of backfill.

2. Backfilling shall be done with select material or concrete backfill as described hereafter and shown on the Plans. No material of a perishable, spongy or otherwise unsuitable nature shall be used in backfilling.

B. Select Backfill Material

1. Unless otherwise shown on the Plans, or approved by the Engineer, the select material backfill shall be Specification Section SD4 Flexible Base, Type A Grade 1.

2. If approved by the Engineer, good, sound earth may be used as select material for backfill over the pipe. Good, sound earth as defined as gravel, sandy loam or loam, free from excessive clay. Select material shall not have rocks with an average dimension larger than one (1) inch, and no dimension greater than two (2) inches.

3. An alternative to the flexible base as select backfill will be on-site or imported select material so long as it is properly moisture-conditioned, placed and compacted.

4. It shall be the full responsibility of the Contractor to explore the project and subsurface materials to determine if the trench excavation will be suitable for use as select materials and to follow as closely as possible this Specification to insure a good, sound pipeline when completed.

C. Concrete Trench Cap

1. Where 36-inch minimum cover cannot be obtained or due to potential surface loading, the City may require a cap to be installed.

D. Concrete Backfill

1. Where shown on the Plans, concrete backfill shall consist of selected rock material or granular sand material mixed with a minimum of three sacks of cement per cubic yard. All material shall be mixed in a concrete mixer or transit mixed unless otherwise approved by the City.

E. Backfilling Operation

1. Backfilling operation outside of pavement shall be compacted to the required density without damaging the pipe or bedding. Backfill under non paved areas, two feet outside of any structure or utilities and excluding lines within a floodplain, streams and watercourses shall be compacted to 90% of the maximum dry density in accordance Tex-114-E. Areas within two feet of structures or existing utilities and areas within a floodplain, streams and water courses shall be compacted to 95% in accordance with Tex-114-E. Prior to any compaction, moisture shall be within $\pm$3% of the optimum moisture content.

2. All trenches under proposed or existing concrete roadways, driveways and sidewalks, paved waterways, brick roadways, asphaltic roadways with concrete base, gravel roadways, and roadways with gravel base and asphalt surface, shall be backfilled to the required density in six (6) inch maximum lifts without damaging the pipe or bedding except the first lift over the pipe bedding will be twelve (12) inches in depth. Swelling soils (soils with a plasticity index of 20 or more) shall be sprinkled as required to provide not less than optimum moisture nor more than 3% over the optimum moisture content to the extent necessary to provide not less than 95% nor more than 102% of the maximum dry density as determined in accordance with Tex-114-E. Non-swelling soils (soils with a plasticity index less than 20) shall be sprinkled as required and compacted to the extent necessary to provide not less than 95% of the optimum dry density with the moisture within $\pm$3% of the optimum moisture content in accordance with Tex-114-E. Jetting with water will not be permitted. Flexible base used as select backfill shall be compacted to 95% of Tex-113E at $\pm$3% of the optimum moisture content.

3. After the trench has been refilled, topsoil shall be replaced to the extent that rock excavated from the trench will be completely covered or removed and the area is returned to its original condition, except that in cultivated areas a minimum of six (6) inches of topsoil shall be replaced.

G4.06 PAYMENT

A. No separate payment will be made for work performed under this Specification for excavating, trenching, embedment, and backfilling. All costs incurred shall be included in the contract price for the appropriate items in the Proposal and Bid Schedule.

B. No separate payment will be made for the bedding used in embedment. All costs incurred shall be included in the contract price for the appropriate bid item.

C. Separate payment, if authorized by the City, will be made for crushed stone or washed gravel as described in these specifications under Section G4.02(G), SOFT SUBGRADE, at the contract unit price per cubic yard as provided in the Proposal and Bid Schedule under "Extra Gravel for Embedment."

D. Separate payment will be made for 2,000 psi Concrete Encasement or Backfill at the contract unit price per cubic yard or linear foot as provided in the Proposal and Bid Schedule under 2,000 psi Concrete Encasement. Concrete and three (3) sack granular sand or rock material mix backfill will be measured in cubic yards or linear feet actually placed based on actual trench width not to exceed the specified maximum trench width and will be paid for at the contract price per cubic yard or linear foot as provided in the Proposal and Bid Schedule.

E. Where authorized by the Engineer, gravel used to replace unsuitable material will be paid for at the unit bid price for Extra Gravel for embedment.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION G5 – GRANULAR FILL MATERIALS

G5.01 SCOPE OF WORK

A. This specification covers the requirements for the use of granular fill materials for this Project.

G5.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to Engineer or the City for approval, technical product literature including the source of the material, gradation, type of material, and all other pertinent data to illustrate conformance to the specification found within.

G5.03 GENERAL

A. Granular fill materials are specified in this Section, but their use for bedding pipe, pavement base, are specified in detail in sections G4 TRENCHING, BACKFILLING AND COMPACTION and SD4 FLEXIBLE BASE. The Engineer may respectively order the use of fill materials for purposes other than those specified in other Sections if, in his/her opinion, such use is advisable.

G5.04 MATERIALS

A. Common fill shall consist of mineral soil, substantially free of clay, organic material, loam, wood, trash, and other objectionable material which may be compressible, or which cannot be compacted properly. Common fill shall not contain stones larger than six (6) inches in any dimension, broken concrete, masonry, rubble, asphalt pavement, or other similar materials. It shall have physical properties, as approved by the Engineer, such that it can be readily spread and compacted.

B. Select common fill shall be as specified above for common fill except that the material shall contain no stones larger than two (2) inches in its largest dimension.

C. Crushed Stone Backfill shall consist of hard, durable, particles of proper size and gradation, free from sand, loam, clay, excess fines and deleterious materials. The size of the particles shall be uniformly graded such that the following bedding specifications are met:

Sieve Size	$^{3}/_{8}$" F % Retained	½" D % Retained	Washed Gravel % Retained
½"	0	0	0
$^{3}/_{8}$"	0-2	5-25	---
4m	40-85	80-100	---
10m	95-100	96-100	---
¾"	---	---	100

D. Crushed Stone Base shall consist of sound, durable stone, free of any foreign material, angular in shape, free from structural defects and comparatively free of chemical decay. This material shall comply with Texas Department of Transportation Item 248, Type "A", Grade 1 unless otherwise shown on the Plans or Standards. The stone shall have a maximum size of $^{7}/_{8}$-inch.

E. Cement Stabilization Sand Backfill shall consist of a mixture of ASTM C33 fine aggregate and Type I cement. The mix shall be proportioned of two (2) sacks of cement per cubic yard.

G5.05 PAYMENT

A. No separate payment will be made for work performed in accordance with this specification, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION G6 – SEDIMENTATION AND TEMPORARY EROSION CONTROL

G6.01 SCOPE OF WORK

A. This specification covers the requirements necessary to perform all installation, maintenance, removal and area cleanup related to sedimentation control work as shown on the Plans and as specified herein.

G6.02 SUBMITTALS

A. Within 10 days after Notice to Proceed, the Contractor shall submit to the Engineer for approval, technical product literature for all commercial products to be used for sedimentation and erosion control.

G6.03 GENERAL

A. The work shall include, but not necessarily be limited to: triangular filter dike, rock berm, silt fence, curb inlet protection, stabilized construction entrance, tree protection, excelsior matting, and temporary mulching, sediment removal and disposal, device maintenance, removal of temporary devices, temporary mulching, excelsior matting installation and final cleanup. All sedimentation and erosion control shall be installed prior to the start of any construction activities.

G6.04 QUALITY ASSURANCE

A. The Contractor shall be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the construction site to off site areas or into the stream system via surface runoff or underground drainage systems. Measures in addition to those shown on the Plans necessary to prevent the movement of sediment off site shall be installed, maintained, removed, and cleaned up at the expense of the Contractor. No additional charges to the City will be considered.

B. Sedimentation and erosion control measures shall conform to the requirements outlined in the Texas Natural Resources Conservation Commission, Chapter 213.

G6.05 MATERIALS *See modifications for additional information

A. Triangular Filter Dike

1. Triangular filter dike sections shall be either 10-feet or 20-feet in length.
2. Geotextile fabric shall extend to 12-inches upstream of triangular filter dike structure.
3. Triangular filter dike structure shall be 18-inches in length on all three (3) faces.
4. Three (3) inch to five (5) inch open graded rock shall be placed over skirt to anchor it on the upstream side.
5. Structure shall be formed by six (6) gauge six inch by six inch (6”x6”) welded wire mesh.
6. Geotextile fabric shall be non-woven, 4.5 oz. minimum and 36-inches wide.

B. Rock Berm

1. Woven wire sheathing shall be 20-gauge with one (1) inch openings.
2. Rock shall be three inches to five inches (3”-5”) open graded.

C. Silt Fence

1. Steel posts shall be a minimum of four (4) feet in length, heavy weight T-Post.

2. Welded wire fabric shall be two-inch by four-inch (2"x4") mesh of 12-gauge by 12-gauge galvanized wire mesh.

3. Silt fence fabric shall be a 4.5 oz minimum non-woven geotextile filter fabric 36-inches wide.

4. Tie wires for securing silt fence fabric to wire mesh shall be light gauge metal clips (hog rings), or $^{1}/_{32}$-inch diameter soft aluminum wire.

5. Prefabricated commercial silt fence may be substituted for built-in-field fence. Prefabricated silt fence shall be "Envirofence" as manufactured by Mirafi Inc., Charlotte, NC or equal.

D. Curb Inlet Protection

1. 4.5 oz. minimum non-woven geotextile filter fabric shall be used.

2. Sand bags shall be used to hold the filter fabric in place.

E. Stabilized Construction Entrance

1. Stabilized construction entrance shall have a minimum width of 12-feet and a minimum length of 50-feet.

2. An eight (8) inch high diversion ridge shall be constructed 15-feet from the edge of the existing roadway.

3. Stabilized construction entrance shall be graded to drain towards the existing roadway at a two-percent (2%) slope.

4. Rock shall be four-inches to eight-inches (4"-8") coarse aggregate.

5. Rock shall be placed to a depth of at least eight (8) inches.

F. Tree Protection – Chain Link Fence

1. Chain link fence shall be five (5) feet in height.

2. Fence shall be installed around the driplines of the trees to be protected.

G. Tree Protection – Wood Slats

1. Where any exceptions result in a fence being closer than four (4) feet to a tree trunk, protect the trunk with strapped-on-planking two inches by four inches (2"x4") wood slats to a height of eight (8) feet, or to the limits of lower branching in addition to the reduced fencing provided.

2. Trees most heavily impacted by construction activities should be watered deeply once a week during periods of hot, dry weather. Tree crowns should be sprayed with water periodically to reduce dust accumulation on the leaves.

3. Any trenching required for the installation of landscape irrigation shall be placed as far from existing tree trunks as possible.

4. No landscape topsoil dressing greater than four (4) inches shall be permitted within the dripline of a tree. No soil is permitted on the root flare of any tree.

5. No vehicles or equipment shall be allowed to park within the dripline of an existing tree.

H. Soil Retention Blankets

1. Soil retention blankets shall be installed in all seeded drainage swales and ditches as shown on the Plans or as directed by the Engineer. Only soil retention blankets included on TxDOT's Approved Products List will be considered acceptable for use on this Project.

I. Temporary Mulch

1. Temporary mulch shall be applied to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days of the completion of rough grading.

G6.06 INSTALLATION *See modifications for additional information

A. Triangular Filter Dike

1. Layout the filter dike following as closely as possible to the contour.

2. Clear the ground of debris, rocks, and plants that will interfere with installation.

3. Place the filter dike sections one (1) at a time, with the skirt on the uphill side towards the direction of flow anchoring each section to the ground before the next section is placed.

4. Anchors should be placed on two (2) foot centers alternating from front to back so that there is actually only one (1) foot in between anchors.

5. Securely fasten the skirt from one (1) section of filter dike to the next.

6. Filter dikes must maintain continuous contact with the ground.

7. After the site is completely stabilized, the dikes and any remaining silt should be removed. Silt should be disposed of in a manner that will not contribute to additional siltation.

B. Rock Berm Installation

1. Layout the rock berm following as closely as possible to the contour.

2. Clear the ground of debris, rocks or plants that will interfere with installation.

3. Place woven wire fabric on the ground along the proposed installation with enough overlap to completely encircle the finished size of the berm.

4. Place the rock along the center of the wire to the designated height.

5. Wrap the structure with the previously placed wire mesh secure enough so that when walked across, the structure retains its shape.

6. Secure with tie wire.

7. The ends of the berm should be tied into existing upslope grade and the berm should be buried in a trench approximately four (4) inches deep to prevent failure of the control.

8. The rock berm should be left in place until all upstream areas are stabilized and accumulated silt removed.

C. Silt Fence Installation

1. Layout the silt fence following as closely as possible to the contour.

2. Clear the ground of debris, rocks, and plants (including grasses taller than two (2) inches) to provide a smooth flow approach surface. Excavate four-inches deep by four-inches wide (4"x4") trench on upstream side of face per Plans.

3. Drive the heavy duty T-post at least 12-inches into the ground and at a slight angle towards the flow.

4. Attach the two-inches by four-inches (2"x4") 12-gauge welded wire mesh to the T-post with $11^{1}/_{2}$-gauge galvanized T-post clips. The top of the wire to be 24-inches above ground level. The welded wire mesh to be overlapped six (6) inches and tied at least six (6) times with hog rings.

5. The silt fence to be installed with a skirt a minimum of 11-inches wide placed on the uphill side of the fence inside excavated trench. The fabric to overlap the top of the wire by one (1) inch.

6. Anchor the silt fence by backfilling with excavated dirt and rocks.

7. Geotextile splices should be a minimum of 18-inches wide attached in at least six (6) places.

D. Curb Inlet Protection Installation

1. Clear the pavement of debris, rocks, etc. to provide a smooth surface for installation.

2. Place the filter fabric over the inlet and extend to five (5) feet beyond inlet opening, upstreamof inlet. Terminate fabric in street gutter with sand bags placed in gutter flowline.

3. Place sandbags on top of filter fabric around the perimeter of the protected area to secure the filter fabric.

4. Care shall be taken insure that the inlet protection will remain in place during periods of heavy runoff and that severe ponding will not occur in the street.

E. Stabilized Construction Entrance Installation

1. Clear the area of debris, rocks or plants that will interfere with installation.

2. Grade the area for the entrance to flow back on to the construction site. Runoff from the stabilized construction entrance onto a public street will not be allowed except for the first 15 feet connecting to the public street.

3. Place geotextile fabric if required.

4. Place rock as required.

F. Tree Protection – Chain Link Fence

1. Tree protection fences shall be installed prior to the commencement of any site preparationwork (clearing, grubbing or grading).

2. Fences shall completely surround the tree, or clusters of trees; will be located at the outermost limit of the tree branches (dripline), and will be maintained throughout the construction project in order to prevent the following:

   a. Soil compaction in the root zone area resulting from vehicular traffic, or storage of equipment or materials.

   b. Root zone disturbances due to grade changes greater than six (6) inches cut or fill or trenching not reviewed and authorized by the City.

   c. Wounds to exposed roots, trunks or limbs by mechanical equipment.

   d. Other activities detrimental to trees, such as chemical storage, cement truck cleaning and fire.

3. Exceptions to installing fences at tree driplines may be permitted in the following cases:

a. Where permeable paving is to be installed, erect the fence at the outer limits of the permeable paving area.

b. Where trees are close to a proposed building, erect the fence no closer than six (6) feet to building.

G. Tree Protection – Wood Slats

1. Any roots exposed by construction activity shall be pruned flush with the soil. Backfill root areas with good quality top soil as soon as possible. If exposed root areas are not backfilled within two (2) days, cover them with organic material in a manner which reduces soil temperature, and minimizes water loss due to evaporation.

2. Prior to excavation or grade cutting within tree dripline, make a clean cut between the disturbed and undisturbed root zones with a rock saw or similar equipment, to minimize damage to remaining roots.

3. Pruning to provide clearance for structures, vehicular traffic and equipment shall take place before construction starts.

H. Excelsior Matting

1. The area to be covered shall be properly prepared, fertilized and seeded with permanent vegetation before the blanket is applied.

2. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area.

3. The blankets shall be applied in the direction of water flow, and stapled. Blankets shall be placed a minimum of three (3) rows, of four (4) foot wide (total approx. 12-foot width) within the drainage swale/ditch and stapled together in accordance with Manufacturer's instructions.

4. Side overlaps shall be four (4) inch minimum. The staples shall be made of wire, 0.091-inch in diameter or greater, "U" shaped with legs 10-inches in length and a $1^{1}/_{2}$-inch crown. The staples shall be driven vertically into the ground, spaced approximately two (2) linear feet apart, on each side, and one (1) row in the center alternately spaced between each size.

5. Upper and lower ends of the matting shall be buried to a depth of four (4) inches in a trench.

6. Erosion stops shall be created every 25-feet by making a fold in the fabric and carrying the fold into a silt trench across the full width of the blanket. The bottom of the fold shall be four (4) inches below the ground surface. Staple on both sides of fold.

7. Where the matting must be cut or more than one (1) roll length is required in the swale, turn down upper end of downstream roll into a slit trench to a depth of four (4) inches. Overlap lower end of upstream roll four (4) inches past edge of downstream roll and staple.

8. To ensure full contact with soil surface, roll matting with a roller weighing 100-pounds per foot of width perpendicular to flow direction after seeding, placing matting and stapling.

9. Thoroughly inspect channel after completion. Correct any areas where matting does not present a smooth surface in full contact with the soil below.

I. Temporary Mulching

1. Straw mulch shall be applied at rate of 100 lbs/1,000 ft^2 and tackified with latex acrylic copolymer at a rate of 1 gal/1,000 ft^2 diluted in a ratio of 30 parts water to one (1) part latex acrylic copolymer mix.

G6.07 MAINTENANCE AND INSPECTIONS *See modifications for additional information

A. Inspections

1. Contractor shall make a visual inspection of all sedimentation control devices once per week and promptly after every rain event exceeding ¼-inch. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas or into the vent trench, Contractor shall promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly.

B. Device Maintenance

1. Triangular Filter Dikes

   a. Realign berms as needed to prevent gaps between the sections.

   b. Accumulated silt should be removed after each rainfall event, and disposed of in a manner which shall not cause additional siltation.

2. Rock Berm

   a. Remove sediment and other debris when buildup reaches six (6) inches and dispose of the accumulated silt in an approved manner.

   b. Repair any loose wire sheathing.

   c. Reshape as needed.

   d. Replace berm when the structure ceases to function as intended due to silt accumulation among the rocks, washout, construction traffic damage, etc.

3. Silt Fences

   a. Remove accumulated sediment when buildup reaches six (6) inches.

   b. Replace damaged fabric, or patch with a two (2) foot minimum overlap.

   c. Replace or repair any sections crushed or collapsed in the course of construction activity.

   d. Make other repairs as necessary to ensure that the fence is filtering all runoff directed to the fence.

4. Curb Inlet Protection

   a. Repair any damaged fabric, or patch with a two (2) foot minimum overlap.

   b. Replace any damaged sandbags.

   c. Remove accumulated sediment.

5. Stabilized Construction Entrance

   a. Periodic top dressing with additional stone may be required as conditions demand to prevent tracking or flowing of sediment onto public rights-of-way.

   c. Cleanout any measures used to trap sediment as needed.

   d. All sediment spilled, dropped, washed or tracked on to public rights-of-way should be removed immediately by the Contractor.

   e. When necessary, wheels should be cleaned to remove sediment prior to entrance onto public rights-of-way.

f. When washing is required, it should be done on an area stabilized with crushed stone that drains into an approved sediment trap or sediment basin.

g. All sediment should be prevented from entering any storm drain, ditch or water course by using approved methods.

6. Tree Protection – Chain Link Fence

a. Repair or replace any chain link fence damaged by construction activities.

7. Tree Protection – Wood Slats

a. Repair or replace any wood slats damaged by construction activities.

8. Excelsior Matting

a. Replace matting as needed to prevent erosion from occurring.

9. Temporary Mulch

a. Replace mulch as needed to prevent erosion from occurring.

G6.08 REMOVAL AND FINAL CLEANUP

A. Once the site has been fully stabilized against erosion, remove sediment control devices and all accumulated silt. Dispose of silt and waste materials in proper manner. Re-grade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated on the Plans.

G6.09 PAYMENT *See modifications for additional information

A. Silt fence and rock berm will be paid per linear foot installed as listed in the Proposal and Bid Schedule.

B. Stabilized Construction Entrance will be paid per each installed as listed in the Proposal and Bid Schedule.

C. Tree protection will be paid per each installed as listed in the Proposal and Bid Schedule.

D. Erosion Control Blankets will be paid per square yard as listed in the Proposal and Bid Schedule.

E. Triangular Filter Dikes will be paid per linear foot as listed in the Proposal and Bid Schedule.

F. No separate payment will be made for all other work performed in accordance with this specification, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION G7 – LOAMING, HYDROSEEDING AND PERMANENT EROSION CONTROL

G7.01 SCOPE OF WORK

A. This specification covers the requirements to provide erosion control and place topsoil, finish grade, apply fertilizer, hydraulically apply seed and mulch and maintain all seeded areas as shown on the Plans and as specified herein, including all areas disturbed by the Contractor.

G7.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, samples of all materials to be used and all other pertinent data to illustrate conformance to the specification found within.

G7.03 TOPSOIL

A. Topsoil shall be fertile, friable, natural topsoil typical of topsoil of the locality and shall be obtained from a well drained site that is free of flooding. It shall be without admixture of subsoil or slag and free of stones, lumps, plants or their roots, sticks, clay, peat and other extraneous matter and shall not be delivered to the site or used while in a frozen or muddy condition. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0 and shall contain not less than three (3) percent organic matter as determined by loss of ignition of moisture-free samples dried at 100 degrees Celsius. The topsoil shall meet the following mechanical analysis:

	Percentage Passing
1-inch screen opening	100
No. 10 mesh	95 - 100
No. 270 mesh	35 - 75
0.002 mm*	5 - 25

* Clay size fraction determined by pipette or hydrometer analysis.

B. At least 10 days prior to anticipated start of topsoiling operations, a one (1) pint sample of topsoil material shall be delivered by the Contractor to a laboratory for testing and approval. All testing shall be at the sole expense of the Contractor. Based on tests performed by the laboratory, the topsoil shall be identified as acceptable, acceptable with certain fertilizer and limestone applications or unacceptable. If the topsoil is found acceptable the fertilizer and lime requirements will be as specified or as recommended by the laboratory. If the topsoil is found unacceptable, the Contractor shall be responsible for identifying another source of topsoil and shall incur all expenses associated with testing additional samples. All topsoil incorporated into the site work shall match the sample provided to the laboratory for testing. Topsoil stockpiled under other Sections of these Specifications may be used subject to the testing and approval outlined above. Contractor will be responsible for screening stockpiled topsoil and providing additional topsoil as required at his/her own expense.

C. Lime shall be ground limestone containing not less than 85-percent calcium and magnesium carbonates and be ground to such fineness that at least 50-percent shall pass a 100-mesh sieve and at least 90-percent shall pass a 20-mesh sieve.

D. All planting shall be done between May 1 and September 15 except as specifically authorized in writing. If planting is authorized to be done outside the dates specified, the seed shall be planted with the addition of winter fescue (Kentucky 31) at a rate of 100 lbs. per acre.

E. The seed shall be furnished and delivered premixed in the proportions specified within. A Manufacturer's Certificate of Compliance to the specified mixes shall be submitted by the Manufacturers for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates.

F. Seed shall be delivered in sealed containers bearing the dealer's guaranteed analysis.

G. Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air-dry weight content and not contain in excess of 10-percent moisture.

H. Excelsior matting blanket installed in all drainage swales and ditches shall be in accordance with Section G6- SEDIMENTATION AND TEMPORARY EROSION CONTROL.

G7.04 APPLICATION OF TOPSOIL

A. Unless otherwise shown on the plans, topsoil shall be placed to a minimum compacted depth of six (6) inches on all parts of the site not covered with structures, pavement, or existing woodland.

B. For all areas to be seeded:

1. Fertilizer (10-20-10) shall be applied at the rate of 30-lbs. per 1,000-sq. ft. or as determined by the soil test.

2. Seed shall be applied at the rate of five (5) lbs. per 1,000-sq. ft.

3. Fiber mulch shall be applied at the rate of 40-lbs. per 1,000-sq. ft.

C. After the topsoil is placed and before it is raked to true lines and rolled, limestone shall be spread evenly over the loam surface and thoroughly incorporated by heavy raking to at least one half the depth of topsoil.

D. The application of fertilizer may be performed hydraulically in one (1) operation with hydroseeding and fiber mulching. The Contractor is responsible for cleaning all structures and paved areas of unwanted deposits of the hydroseeded mixture.

G7.05 INSTALLATION OF TOPSOIL

A. Previously established grades, as shown on plans shall be maintained in a true and even condition.

B. Subgrade shall be prepared by tilling prior to placement of topsoil to obtain a more satisfactory bond between the two layers. Tillage operations shall be across the slope. Tillage shall not take place on slopes steeper than two (2) horizontal to one (1) vertical or where tillage equipment cannot be operated. Tillage shall be accomplished by disking or harrowing to a depth of nine (9) inches parallel to contours. Tillage shall not be performed when the subgrade is frozen, excessively wet, extremely dry or in other conditions which would not permit tillage. The subgrade shall be raked and all rubbish, sticks, roots and stones larger than two (2) inches shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with loam.

C. Topsoil shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades and elevations indicated. No loam shall be spread in water or while frozen or muddy.

D. After topsoil has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All stiff clods, lumps, roots, litter and other foreign material shall be removed from the loamed area and disposed of by the Contractor. The areas shall also be free of smaller stones, in excessive quantities, as

determined by the Engineer or the City. The whole surface shall then be rolled with a hand roller weighing not more than 100-lbs per foot of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be regraded and rolled until a smooth and even finished grade is created.

E. Seeding shall be done within 10 days following soil preparation. Seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the grass seed and mulch shall be equal in quantity to the specified rates. Prior to the start of work, the Contractor shall furnish the Engineer with a certified statement as to the number of pounds of materials to be used per 100-gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the Contractor's hydroseeder. Upon completion of seeding operations, the Contractor shall furnish the Engineer and the City with a certified statement on the actual quantity of solution applied.

F. In order to prevent unnecessary erosion of newly topsoiled and graded slopes and unnecessary siltation of drainageways, the Contractor shall carry out seeding and mulching as soon as he/she has satisfactorily completed a unit or portion of the project. A unit or portion of the project shall be determined by the City or Engineer. When protection of newly loamed and graded areas is necessary at a time which is outside of the normal seeding season, the Contractor shall protect those areas by what ever means necessary as approved by the Engineer and the City and shall be responsible for prevention of siltation in the areas beyond the limit of work.

G. When newly graded subgrade areas cannot be topsoiled and seeded because of season or weather conditions and will remain exposed for more than 30 days, the Contractor shall protect those areas against erosion and washouts in accordance with Section G6- SEDIMENTATION AND TEMPORARY EROSION CONTROL, or by other measures as approved by the Engineer and the City. Prior to application of topsoil, any such materials applied for erosion control shall be removed or thoroughly incorporated into the subgrade by disking. Fertilizer shall be applied prior to spreading of topsoil.

H. On slopes, the Contractor shall provide against washouts by a method approved by the Engineer and the City. Any washout which occurs shall be regraded and reseeded at the Contractor's expense until a good sod is established.

G7.06 HYDROMULCHING

A. Fertilizer: 18-18-5, (Nitrogen, Phosphoric Acid, Potash) show release granular at a rate of 25-lbs per 1,000-sq. ft.

B. Water: The Contractor shall provide water necessary for grass planting and maintenance until acceptance by the City.

C. Planting Seasons: Grass planting by sodding, sprigging, or hydromulching shall normally be done between May 1 and September 15.

D. Hydromulching General

1. Submit Manufacturer’s product specifications and guaranteed purity analysis for fertilizer.

2. Product Delivery, Storage and Handling

a. Deliver fertilizer to site in original unopened containers bearing Manufacturer’s guaranteed chemical analysis, name, trademark and conformance to State Law.

b. Store fertilizer in a dry location and protect from weather.

3. Guaranty and Replacement

a. Provide guaranty for a period of one (1) year after final completion and acceptance of project, that the installed grass areas be at least the quality and condition as during acceptance.

b. Rehydromulch unacceptable areas during the guaranty period. Guaranty shall not include damage or loss of lawn due to acts of God, acts of vandalism or negligence on the part of the City.

E. Native Grass Hydromulching-Products

1. Grass Seed: Common Bermuda grass, hulled, minimum 82% pure live seed. All grass seed shall be free from noxious weed, grade "A" recent crop, recleaned and treated with appropriate fungicide at time of mixing. Seed shall be furnished in sealed, standard containers with dealer's guaranteed analysis.

2. Mulch: Conwed regular wood fiber mulch or approved equal.

3. Fertilizer: 18-18-5, water-soluble or an approved equal.

4. Topsoil: Supply high quality imported topsoil of loamy character to the limits shown on the Plans, high in humus and organic content from local agriculture source. Topsoil to be free from clay, lumps, coarse sands, stones, roots and other foreign matter. There shall be no toxic amounts of acid or alkaline elements. Soil to be used for on-site mixing of backfill.

F. Native Grass Hydromulching-Execution

1. Preparation: Fine grade to final elevation removing any debris and insuring the seedbed is smooth.

2. Installation: Use a hydromulcher (sprayer) and apply the mixture at the following rate. (Mix in accordance with Manufacturer's recommendations.)

a. Hydromulch mixture shall contain 2.5-lbs. of common Bermuda grass seed per 1,000-sq. ft. hydromulch applied.

b. Mulch – 60-lbs. per 1,000-sq. ft.

c. Fertilizer – 25-lbs (18-18-5) per 1,000-sq. ft.

3. General Maintenance

a Water the completed installation as necessary to insure germination of grass.

b. Maintain grass areas until complete germination and establishment of all areas.

c. Correct defective work as soon as apparent. Maintenance shall include, but not be limited to, weeding and fertilizing.

d. Clean up: Remove trash and debris from the site.

e. Acceptance: Substantial completion inspection to determine acceptance of grass areas will be made by the City after complete germination and coverage has been attained.

G7.07 MAINTENANCE OF DEVELOPING GRASS

A. The Contractor shall water and maintain all grassed areas until final acceptance. He shall also re-fertilize at the rate of one (1) pound of nitrogen and one (1) pound of phosphorous per 1,000-sq. ft. every 60 days until the grass is accepted.

B. Areas which, due to settling or improper leveling, do not have positive drainage shall be re-leveled with topsoil and replanted with grass.

C. Areas damaged by erosion, vehicle ruts and similar damage shall be re-leveled with topsoil and replanted. Finished ground surface shall be sufficiently smooth and level to facilitate mowing.

G7.08 ACCEPTANCE

A. Work under this section shall be considered acceptable when finish graded surfaces are level and well-drained, when there are no bare spots larger than three (3) square feet, when no more than 10 percent of the total area has bare spots larger than one (1) square foot, when not more than 15 bare spots larger than six (6) inches square and the grass is at least two (2) inches high, and when other requirements listed herein are met.

B. Acceptance of work normally coincides with final acceptance of the entire project. However, seasonal factors may be cause for delay in grass planting, development, and acceptance.

C. The City will accept responsibility for normal maintenance when grass is accepted. However, the Contractor shall remain responsible for any subsequent grass damage that he causes and for warranty of materials and workmanship for a period of not less than one (1) year from the time of acceptance.

D. The Contractor shall furnish full and complete written instruction for maintenance of the seeded areas to the City at the time of acceptance.

G7.09 PAYMENT

A. No separate payment will be made for finish grading, placement of topsoil or grass planting and fertilizing. All related costs shall be included in the proper item of the Proposal and Bid Schedule.

END OF SECTION

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SECTION G8 – MISCELLANEOUS WORK AND CLEANUP

G8.01 SCOPE OF WORK

A. This specification covers the requirements to do the miscellaneous work not specified in other sections but obviously necessary for the proper completion of the work as shown on the Plans.

G8.02 SUBMITTALS

A. Within 10 days after the Notice to Proceed, the Contractor shall submit to the Engineer, in triplicate, a breakdown of any lump sum included in the Proposal and Bid Form. This breakdown shall be subject to approval by the Engineer and when so approved shall become the basis for determining progress payments and for negotiation of change orders, if required. In some contracts a lump sum item shall not be provided in the Proposal and Bid Form and shall be subsidiary to the other work items.

G8.03 GENERAL

A. When applicable, the Contractor will perform the work in accordance with other sections of this Specification. When no applicable specification exists the Contractor shall perform the work in accordance with the best modern practice and/or as directed by the Engineer.

B. The work of this Section includes, but is not limited to, the following:

1. Crossing and Relocating Existing Utilities
2. Restoring Driveways, Fences and Curbing
3. Cleaning Up
4. Incidental Work
5. Restoring Easements and Rights-of-Way

G8.04 CROSSING AND RELOCATING EXISTING UTILITIES

A. This item includes any extra work required in crossing culverts, water courses including streams and drainage ditches, drains, gas mains, water mains and water services and other utilities. This work shall include but is not limited to the following: bracing, hand excavation and backfill (except screened gravel) and any other work required for crossing the utility or obstruction not included for payment in other items of this specification. Notification of Utility Companies shall be the Contractor's responsibility.

B. In locations where existing utilities cannot be crossed without interfering with the construction of the work as shown on the Plans, the Contractor shall remove and relocate the utility as directed by the Engineer or Representative of the City or cooperate with the Utility Companies concerned if they relocate their own utility.

C. At pipe crossings and where designated by the Plans, the Contractor shall furnish and place crushed stone bedding so that the existing utility or pipe is firmly supported for its entire exposed length. The bedding shall extend to the mid-diameter of the pipe crossed.

G8.05 RESTORING OF DRIVEWAYS AND FENCES

A. Existing public and private driveways disturbed by the construction shall be replaced. Paved drives shall be repaved to the limits and thicknesses existing prior to construction. Gravel dirt roads and drives shall be replaced and regraded.

B. Fences in the vicinity of the work shall be protected from damage. If damaged, fences shall be replaced in condition equal to that prior to being damaged and the work shall be satisfactory to the City.

G8.06 CLEANING UP

A. The Contractor shall remove all construction material, excess excavation, buildings, equipment and other debris remaining on the job as a result of construction operations and shall restore the site of the work to a neat and orderly condition. All stored materials shall be kept in a neat manner, secured and protected from the public.

G8.07 INCIDENTAL WORK

A. Do all incidental work not otherwise specified, but obviously necessary to the proper completion of the Contract as specified and as shown on the Plans.

G8.08 RESTORING THE EASEMENTS AND RIGHTS-OF-WAY

A. Portions of the work may be within easements through private property. The Contractor shall be responsible for all damage to private property due to his/her operations. The Contractor shall protect from injury all walls, fences, cultivated shrubbery and vegetables, fruit trees, pavement, underground facilities, such as water pipes, or other utilities which may be encountered along the easement. If removal and replacement are required, it shall be done in a workmanlike manner so that replacement is equivalent to that which existed prior to construction.

B. Existing lawn and sod surfaces damaged by construction in easements shall be replaced. The Contractor may cut and replace the lawn and sod, or may restore the areas with an equivalent depth and quality of loam, seeded and fertilized as specified in Section G7- LOAMING, HYDROSEEDING AND PERMANENT EROSION CONTROL if acceptable to the owner of the private property and the City. These areas shall be maintained and re-seeded or re-sodded at the option of the owner of the private property and the City, if necessary, until all work under this Contract has been completed and accepted. Any additional work required to restore easements to their original condition shall be performed by the Contractor.

G8.09 PAYMENT

A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATION

SECTION G9-STRUCTURAL EXCAVATION

G9.01 SCOPE OF WORK

A. This specification covers the requirements for excavation for the placing of structures, except pipe, for the disposal of such excavated material, and for the backfilling around completed structures to the level of the original ground.

G9.02 SUBMITTALS

A. None required unless specifically called for in the Plans, Standards or requested by the Engineer or the City.

G9.03 CONSTRUCTION METHODS

A. Excavation shall be done in accordance with the lines and depths indicated on the Plans or as established by the City. Unless otherwise specified on the Plans or permitted by the City no excavation shall be made outside a vertical plane three (3) feet from the footing lines and parallel thereto. When caissons are provided, no excavation will be permitted outside the outer faces of the caissons.

B. To permit the City to judge the adequacy of a proposed foundation, the Contractor, if requested, shall make soundings or take cores to determine the character of the subgrade materials. The maximum depth of soundings or cores will in general, not exceed five (5) feet below the proposed footing grade. It is the intent of this provision that soundings shall be made at the time the excavation in each foundation is approximately complete.

C. Excavations shall conform to elevations shown on the Plans, or raised or lowered by written order of the City, when such alterations are judged proper. When deemed necessary to increase or decrease the plan depth of footings, the alterations in the details of the structure shall be as directed by the City. The City shall have the right to substitute revised details resulting from consideration of changes in the design conditions.

D. When a structure is to be placed on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final excavation to grade shall not be performed until just before the footing is placed.

E. Excavated material required to be used for backfill may be deposited by the Contractor in storage piles at points convenient for its rehandling during the backfilling operations and with the approval of the City.

F. For all single and multiple box culverts, pipe culverts, pipe arch culverts, and box sewers of all types, where the soil encountered at established footing grade is a quicksand, muck, or similar unstable material, the following procedure shall be used unless other methods are called for on the Plans:

1. The depth to which unstable material is removed will be determined by the City. The depth will not exceed two (2) feet below the footing of culverts that are two (2) feet or more in height, and will not exceed the height of culverts of those less than two (2) feet high. Excavation shall be carried at least one (1) foot horizontally beyond the limits of the structure on all sides. All unstable soil removed shall be replaced with suitable stable material, in uniform layers of suitable depth for compaction as directed by the City. Each layer shall be wetted; if necessary, and compacted by rolling or tamping as required to provide a stable foundation for the structure. Soil which has sufficient stability to properly sustain the adjacent sections of the roadway embankment will be considered a suitable foundation material.

2. When in the opinion of the City, it is not feasible to construct a stable footing as outlined above, the Contractor shall construct it by the use of special materials, such as flexible

base, cement stabilized base, cement stabilized backfill or other material, as directed by the City.

G. When the material encountered at footing grade of a culvert is found to be partially rock, or incompressible material, and partially a compressible soil which is satisfactory for the foundation, the incompressible material shall be removed for a depth of six (6) inches below the footing grade and backfilled with a compressible material similar to that used for the rest of the structure.

G9.04 BACKFILLING

A. General: As soon as practicable, all portions of excavation not occupied by the permanent structure shall be backfilled. Back-fill material shall be free from large or frozen lumps, wood or other extraneous material.

1. That portion of backfill which will not support any portion of completed roadbed or embankment shall be placed in layers not more than 10-inches in depth (loose measurement) and shall be compacted to a density comparable with the adjacent, undisturbed material.

2. That portion of the backfill which will support any portion of the roadbed or embankment or is within two (2) feet of the roadbed or embankment shall be placed in uniform layers not to exceed six (6) inches in depth (loose measurement) and each layer compacted to the density specified for the appropriate material. Each layer of backfill material, if dry, shall be wetted uniformly to the moisture content required to obtain the specified density and shall be compacted to that density by means of mechanical tamps, except that the use of rolling equipment of the type generally used in compacting embankments will be permitted on portions which are accessible to such equipment. All portions of embankment too close to any portion of a structure to permit compaction by the use of the blading and rolling equipment used on adjoining sections of embankment, shall be placed and compacted in the same manner as specified above for backfill material. These provisions require the mechanical compaction, by means of either rolling equipment or mechanical tamps, of all backfill and embankment adjoining the exterior walls and wingwalls of culverts. Unless otherwise provided by the Plans or Special Conditions, hand tamping will not be accepted as an alternate for mechanical compaction. As a general rule, material used in filling or backfilling the portions described in this paragraph shall be an earth free of any appreciable amount of gravel or stone particles more than four (4) inches in greatest dimension and of a gradation that permits thorough compaction. The percentage of fines shall be sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density. When required by the Plans or by written order of the City, cement stabilized material shall be used for backfilling.

3. All portions of fill and backfill described in the preceding paragraph shall be compacted to the same density requirements specified for the adjoining sections of embankment in accordance with the governing specifications therefore.

4. Where no embankment is involved on the Project and no specifications therefor are included in the Contract, all backfill shall be compacted to a density comparable with the adjacent undisturbed material.

5. Care shall be taken to prevent any wedging action of backfill against the structure, and the slopes bounding the excavation shall be stepped or serrated to prevent such action.

6. Backfilling shall not proceed prior to inspection and approval of the inspector.

G9.05 PIPE CULVERTS

A. The following requirements shall apply to the backfilling of pipe culverts in addition to the pertinent portions of the general requirements given in the preceding and in pipe bedding Standards.

1. Backfilling shall be continued in this manner to the elevation of the top of the pipe. Special care shall be taken to secure thorough compaction of the material placed under the haunches of the pipe. In the case of pipe in trenches, that portion of the backfill above the top of the pipe which supports embankment or the roadbed or is within two (2) feet of the roadbed or embankment shall receive mechanical compacting as specified, and the portion which will not support any portion of embankment or roadbed shall be placed in layers not more than ten (10) inches in depth (loose measurement) and shall be compacted by whatever means the Contractor chooses, to a density comparable with the adjacent, undisturbed material.

G9.06 PAYMENT

A. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END SECTION

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STREETS AND DRAINAGE

SECTION SD

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TECHNICAL SPECIFICATIONS

SECTION SD1 - HOT MIX ASPHALTIC CONCRETE PAVEMENT

SD1.01 SCOPE OF WORK

A. This specification covers the requirements for furnishing and installing hot mix asphaltic concrete as shown in the Plans and specified within. Construction shall include a base course, a level-up course, a surface course or any combination of these courses as shown on the Plans, each course being composed of a compacted mixture of aggregate and asphalt mixed hot in a mixing plant, in accordance with the details shown on the Plans and the requirements herein.

SD1.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer for approval, technical product literature including mix design, aggregate source, aggregate gradation, aggregate type, and all other pertinent data to illustrate conformance to the specification found within.

SD1.03 MATERIALS

A. The mineral aggregate shall be composed of a course aggregate, a fine aggregate, and if required, a mineral filler. Coarse aggregate shall be that part of the aggregate retained on the No. 10 sieve and shall be stone, crushed slag, crushed gravel, or gravel. Fine aggregate shall be that part passing the No. 10 sieve and shall consist of sand or screenings. Mineral filler shall consist of dry stone dust, Portland cement, or fly ash. Mineral aggregate shall meet the requirements of Item 340, Texas Department of Transportation, Standard Specifications for Construction of Highways, Streets and Bridges. The plasticity index of fine aggregate portion passing the No. 40 sieve shall not be more than six (6).

SD1.04 ASPHALTIC MATERIAL

A. Asphalt for the paving mixture shall meet the requirements of Texas Department of Transportation, Item 300 of the Standard Specifications for Construction of Highways, Streets and Bridges. The grade of asphalt used shall be designated by the Engineer or the City after design tests have been made using the mineral aggregate to be used in the job.

SD1.05 TACK COAT

A. Tack coat shall be in accordance with Texas Department of Transportation, Item 300 of the Standard Specifications for Construction of Highways, Streets and Bridges. Asphaltic material shall be approved by the Engineer or the City.

SD1.06 TYPES OF ASPHALTIC CONCRETE

A. The mixture shall be designed and tested in accordance with the current Texas Department of Transportation, Standard Specifications for Construction of Highways, Streets and Bridges, Item 340, Type D, and will have a laboratory density of not less than 94.5% nor more than 97.5%, and a stability of not less than 35.

B. The asphaltic material shall form from four to eight (4–8) percent of the mixture by weight or from nine to nineteen (9-19) percent of the mixture by volume.

SD1.07 EQUIPMENT

A Spreading and Finishing Machine

1. The spreading and finishing machine shall be a type approved by the Engineer, shall be capable of producing a surface that will meet the requirements of the typical cross section and the surface test, when required, and when the mixture is dumped directly into the finishing machine, shall have adequate power to propel the delivery vehicles in a satisfactory manner. The finishing machine shall be equipped with a flexible spring and/or hydraulic-type hitch sufficient in design and capacity to maintain contact between the rear wheels of the hauling equipment and the pusher rollers of the finishing machine while the mixture is being unloaded.

2. The use of any vehicle which requires dumping directly into the finishing machine and which the finishing machine cannot push or propel in such a manner as to obtain the desired lines and grades without resorting to hand-finishing will not be allowed. Unless otherwise permitted by the Plans, vehicles of the semi-trailer type are specifically prohibited from dumping directly into the finishing machine while in contact with the finishing machine. Vehicles dumping directly or indirectly into the finishing machine shall be so designed and equipped that unloading into the finishing machine can be mechanically and/or automatically operated in such a manner that overloading the finishing machine being used cannot occur and the required lines and grades will be obtained without resorting to hand-finishing.

3. Dumping of the asphaltic mixture in a windrow and then placing the mixture in the finishing machine with loading equipment will be permitted, provided that the loading equipment is constructed and operated in such manner that substantially all of the mixture deposited on the roadbed is picked up and loaded in the finishing machine without contamination of foreign material of the mixture, and excessive temperature loss is not encountered. The loading equipment will be so designed and operated that the finishing machine being loaded will obtain the required line, grade, and surface without resorting to hand-finishing. Any operation of the loading equipment resulting in the accumulation and subsequent shedding of this accumulated material into the asphaltic mixture will not be permitted.

B. Rolling Equipment

1. Rolling equipment shall consist of pneumatic tire rollers, two-axle tandem roller weighing not less than eight (8) tons, three-wheel roller weighing not less than 10-tons, three-axle tandem roller weighing not less than 10-tons, and trench rollers having a 20-inch wheeldrive and producing 325 pounds per linear inch of roller width at a speed of 1.8 miles per hour in low gear.

C. Straight Edges and Templates

1. The Contractor shall provide an acceptable 10-foot straight edge for surface testing.

SD1.08 CONSTRUCTION METHODS

A. The prime coat, tack coat or the asphaltic mixture, when placed with a spreading and finishing machine, shall not be placed when the air temperature is below 50 degrees F and is falling, but it may be placed when the air temperature is above 40 degrees F and is rising. The air temperature shall be taken in the shade away from artificial heat. It is further provided that the prime coat, tack coat or asphaltic mixture shall be placed only when the humidity, general weather conditions and temperature and moisture condition of the base, in the opinion of the Engineer or the City, are suitable.

B. Prime Coat

1. A prime coat is required, and shall be applied at the rate determined by the Engineer but not less than 0.2-gallons per square yard of MC-1 asphalt. The asphaltic concrete shall not be applied on a previously primed flexible base until the primed base has completely cured to the satisfaction of the Engineer and the City.

C. Transporting Asphaltic Concrete

1. The asphaltic mixture, prepared as directed above, shall be hauled to the work site in tight vehicles previously cleaned of all foreign material. The dispatching of the vehicles shall be arranged so that all material delivered may be placed, and all rolling shall be completed during daylight hours. In cool weather, or for long hauls, canvas covers and insulating of the truck bodies may be required. The inside of the truck body may be given a light coating of oil, lime slurry or other material satisfactory to the Engineer and the City, if necessary, to prevent mixture from adhering to the body.

D. Placing

1. Generally, the asphaltic mixture shall be dumped and spread on the approved prepared surface with the specified spreading and finishing machine, in such manner that when properly compacted, the finished pavement will be smooth, of uniform density, and will meet the requirements of the typical cross-sections and the surface tests. During the application of asphaltic material, care shall be taken to prevent splattering of adjacent pavement, curb and gutter, and structures. When the asphaltic mixture is placed in a narrow strip along the edge of an existing pavement, or used to level up small areas of an existing pavement, or placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated when authorized by the Engineer or the City, provided a satisfactory surface can be obtained by other approved methods.

E. Compacting

1. Rolling: The pavement shall be compressed thoroughly and uniformly with the specified roller and/or other approved rollers. Rolling with the three-wheel and tandem rollers shall start longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the rear wheel. Alternate trips of the roller shall be slightly different in length. Rolling with pneumatic-tire roller shall be done as directed by the Engineer. Rolling shall be continued until no further compression can be obtained and all roller marks are eliminated. One (1) tandem roller, one (1) pneumatic-tire roller, and at least one (1) three-wheel roller, as specified above, shall be provided for each job. If the Contractor elects, he may substitute the three-axle tandem roller for the two-axle tandem roller and/or the three-wheel roller; but in no case shall less than three rollers be in use on each job. Additional rollers shall be provided if needed. The motion of the roller shall be slow enough at all times to avoid displacement of the mixture. If any displacement occurs, it shall be corrected at once by the use of rakes and of fresh mixtures where required. The roller shall not be allowed to stand on pavement which has not been fully compacted. To prevent adhesion of the surface mixture to the roller, the wheels shall be kept thoroughly moistened with water, but an excess of water will not be permitted. All rollers must be in good mechanical condition. Necessary precautions shall be taken to prevent the dropping of gasoline, oil, grease, or other foreign matter on the pavement, either when the rollers are in operation or when standing. Regardless of the method used for compaction, all rolling to achieve specified density shall cease when the Hot Mix Asphaltic Mixture drops below 175°F (80°C).

2. In-Place Density: The Hot Mix Asphaltic mixture shall be tested daily at the project site for conformance to specification requirements. Unless directed otherwise by the Engineer or designated representative, a bag sample and a core or section will be obtained for each 2000 square yards or portion of paving each day, with a minimum of three bag samples and three cores for each day's paving.

Bag samples shall be taken during lay-down operations. The primary sampling point for the bag samples shall be from the windrow if a windrow elevator is used. If a windrow elevator is not used, the sample shall be taken from the middle of the paving machine hopper. Gradation, asphalt content and stability value of the hot mix asphaltic mixture shall be reported for each of the bag samples. The stability value reported for each of the bag samples shall be the average of three (3) tests per bag.

Pavement thickness and in-place density shall be determined from the field cores or sections. The average of all hot mix asphaltic concrete pavement core or section thicknesses shall meet the minimum thickness of 2.0". No individual core or section thickness deficiency may be greater than 0.2 inches. Pavement that does not meet the thickness specification shall be removed and replaced as outlined below. The in-place density tests are intended for compaction-control tests and will be tested according to Test Method Tex-207-F. The core or section densities shall average from 91.0% to 96.0% of the maximum theoretical density except that the minimum acceptable density of an individual sample is 89.0% or the maximum acceptable density of an individual sample is 97.0%. There will be no two consecutive core or section densities below 91.0% or above 96.0%. Asphalt pavement represented by a density less than 89.0%, more than 97.0% or two consecutive densities less than 91.0% shall be removed and replaced.

Any pavement to be removed and replaced will be removed and replaced from curb to curb or edge of asphalt to edge of asphalt at the contractor's expense. Additional density tests shall be used to delineate the limits of the in-place hot mix asphaltic pavement that does not meet the density specification and the results of the tests shall not be used in the calculation of the overall average density. Protocol to assess the area of asphalt pavement removal and replacement shall start between the failing density or two consecutive densities that are less than 91.0% and the next passing density to either side of the failing pavement. Additional cores or sections will be required to quantify the area of replacement back to an in-place density of 91.0%. Backscattering (nuclear densities) shall not be used to determine the actual density of asphaltic pavement.

Pavements with low-density results may be retested; but the pavement shall not receive any additional compactive effort.

Final acceptance of the pavements shall be the responsibility of the Engineer.

3. Hand-Tamping: The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller or in such position as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.

F. Surface Tests

1. The surface of the pavement, after compaction, shall be smooth and true to the established line, grade, and cross-section, and when tested with a 10-foot straightedge placed parallel to the centerline of the roadway or tested by other equivalent and acceptable means, except as provided herein, the maximum deviation shall not exceed 1/4-inch in 10-feet, and any point in the surface not meeting this requirement shall be corrected.

SD1.09 ROADS DAMAGED BY CONSTRUCTION

A. The Contractor shall reconstruct existing asphalt paved roads which are damaged as a result of construction of this project at no additional cost to the City. Reconstruction shall consist of reconstructing the road to an "as new condition" to the existing pavement cross section. The Contractor may use existing base material, adding new base material as needed. Contractor shall compact and reshape road subgrade to existing grade. The subbase and base shall be compacted in accordance with these specifications. The Contractor shall install at least two (2) inches of hot-mix asphalt pavement in accordance with these specifications.

SD1.10 MEASUREMENT AND PAYMENT

A. Payment for furnished and installed hot mix asphaltic concrete pavement shall be paid according to the unit price per square yard in the proper item of the Proposal and Bid Schedule.

B. All work and materials to complete the hot mix asphaltic concrete shall be subsidiary to this item.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION SD2 – ROADWAY EXCAVATION

SD2.01 SCOPE OF WORK

A. This specification covers the requirements for shaping and finishing of all earthwork on the entire length of roadway, and approaches to same, in conformity with the required lines, grades and typical cross sections and in accordance with specification requirements herein outlined. Compaction shall conform to the method of "Density Control" and/or "Ordinary Compaction" as shown on the Plans and Specifications.

SD2.02 SUBMITTALS

A. None required unless specifically called for in the Plans, Standards, or requested by the City or Engineer.

SD2.03 CONSTRUCTION METHODS

A. All roadway excavation and corresponding embankment construction shall be performed as specified herein and in Section S3- EMBANKMENT, and the completed roadway shall conform to the established alignment, grades and cross sections.

B. All suitable excavated materials shall be utilized, insofar as practicable, in constructing the required roadway sections. Unsuitable roadway excavation and roadway excavation in excess of that needed for the construction of the roadway shall be disposed of outside the limits of the right-of-way. Unsuitable material encountered below subgrade elevation in roadway cuts, shall be removed and replaced, as directed by the Representative of the City with material from the roadway excavation or with other suitable material.

C. During construction, the roadbed and ditches shall be maintained in such condition as to insure proper drainage at all times and ditches and channels shall be so constructed and maintained as to avoid damage to the roadway section. Soils with plasticity index (PI) of 20 or more shall be stabilized with an amount of lime adequate to reduce the PI to less than 20. Type A Grade 1 base material may be used with a minimum ratio of 1 to 1, in lieu of lime. If using lime treatment refer to Item 260 in the Texas Department of Transportation's "Standard Specifications for Construction of Highways, Streets and Bridges".

NOTE: **ALL UNDERGROUND UTILITIES SHALL BE INSTALLED PRIOR TO ANY LIME TREATMENT OR FLEXIBLE BASE PLACEMENT.**

NOTE: Blue-tops will be set on the center and crown of the streets or roads at every 50-foot station. These grade stakes will be to finished grade and visible for inspection before flexible base is applied.

SD2.04 PAYMENT

A. No separate payment will be made for work performed in accordance with this specification. Select back fill shall be paid for according to the unit price per cubic yard according to the appropriate item, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION SD3 – EMBANKMENT AND SUBGRADE

SD3.01 SCOPE OF WORK

A. This specification covers the requirements for the placement and compaction of all materials obtained from roadway, borrow, channel and structural excavation for utilization in the construction of roadway embankments, subgrade, levees and dikes (berms).

SD3.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including the source of the material, equipment and all other pertinent data to illustrate conformance to the specification found within.

SD3.03 CONSTRUCTION METHODS

A. Prior to placing any embankment, all "Preparing Right of Way" operations shall have been completed on the excavation sources and areas over which the embankment is to be placed. Stump holes or other small excavations in the limits of the embankments shall be backfilled with suitable materials and thoroughly tamped by approved methods before commencing embankment construction. The surface of the ground, including plowed loosened ground or surface roughened by small washes or otherwise shall be restored to approximately its original slope by blading or other methods. Where indicated on the Plans, the ground surface thus prepared shall be compacted by sprinkling and rolling.

B. The surface of the ground of all unpaved and proposed paved areas, which are to receive embankment, shall be loosened by scarifying or plowing to a depth of not less than six (6) inches. The loosened material shall be recompacted with the new embankment as hereinafter specified.

C. Where directed the surface of hillsides to receive embankment shall be loosened by scarifying or plowing to a depth of not less than six (6) inches, or cut into steps before embankment materials are placed. The embankment shall then be placed in layers, as hereinafter specified, beginning at the low side in part width layers and increasing the widths as the embankment is raised. The material, which has been loosened, shall be recompacted simultaneously with the embankment material placed at the same elevation.

D. Where embankments are to be placed adjacent to or over existing roadbeds, the roadbed slopes shall be plowed or scarified to a depth of not less than six (6) inches and the embankment built up in successive layers, as hereinafter specified, to the level of the old roadbed before its height is increased. Then, if directed, the top of the old roadbed shall be scarified and recompacted with the next layer of the new embankment. The total depth of the scarified and added material shall not exceed the permissible depth of layer.

E. Trees, shrubs, roots, vegetation or other unsuitable materials shall not be placed in embankment.

F. Except as otherwise required by the plans, all embankment shall be constructed in layers approximately parallel to the finished grade of the roadbed and unless otherwise specified, each layer shall be so constructed as to provide a uniform slope of ¼-inch per foot from the center line of the roadbed to the outside, except that on superelevated curves each layer shall be constructed to conform to the superelevation required by the governing standard.

G. Embankments shall be constructed to the grade established by the Engineer or the City and completed embankments shall correspond to the general shape of the typical sections shown on the plans and each section of the embankment shall correspond to the detailed section or slopes established by the Engineer. After completion of the roadway, it shall be continuously maintained to its finished section and grade until the project is accepted.

SD3.04 EARTH EMBANKMENTS

A. Earth embankments shall be defined as those composed principally of material other than rock, and shall

be constructed of accepted material from approved sources.

B. Except as otherwise specified, earth embankments shall be constructed in successive layers for the full width of the individual roadway cross section and in such lengths as are best suited to the sprinkling and compaction methods utilized.

C. Layers of embankment may be formed by utilizing equipment (which will spread the material as it is dumped, or formed by being spread by blading or other acceptable methods from piles or windrows dumped from excavating or hauling equipment in such amounts that material is evenly distributed.)

D. Minor quantities of rock encountered in constructing earth embankment shall be incorporated in the specified embankment layers, or may be placed in accordance with the requirements for the construction of rock embankments in the deeper fills within the limits of haul shown on the Plans, provided such placement of rock is not immediately adjacent to structures. Also, rock may be placed in the portions of embankments outside the limits of the completed roadbed width where the size of the rock prohibits their incorporation in the normal embankment layers.

E. Each layer of embankment shall be uniform as to material, density and moisture content before beginning compaction. Where layers of unlike materials abut each other, each layer shall be feather edged for at least 100-feet or the material shall be so mixed as to prevent abrupt changes in the soil. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position, but all such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken and the embankment material mixed by blading, harrowing, disking or similar methods to the end that a uniform material of uniform density is secured in each layer.

F. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be evenly applied and it shall be the responsibility of the Contractor to secure a uniform moisture content throughout the layer by such methods as may be necessary.

G. In order to facilitate uniform wetting of the embankment material, the Contractor may apply water at the material source if the sequence and methods used are such as not to cause an undue waste of water. Such procedure shall be subject to the approval of the Representative of the City.

H. All earth cuts, full width or part width cuts in side hill, which are not required to be excavated below subgrade elevation for base and backfilled, shall be scarified to a uniform depth of at least six (6) inches below grade, and the material shall be mixed and reshaped by blading and then sprinkled and rolled in accordance with the requirements outlined above for earth embankments and to the same density as that required for the adjacent embankment.

I. Compaction of embankments shall be obtained by the method hereinafter described as "Ordinary Compaction" or the method hereinafter described as the "Density Control" method.

SD3.05 ORDINARY COMPACTION (outside of Roadway Pavement)

A. When the "Ordinary Compaction" method is specified, the following provisions shall govern: Each layer shall not exceed eight (8) inches of loose depth, and shall be compacted until there is no evidence of further compaction. Prior to and in conjunction with the rolling operation, each layer shall be brought to the moisture content ordered by the Representative of the City, and shall be kept leveled with suitable equipment to insure uniform compaction over the entire layer.

SD3.06 DENSITY CONTROL

A. When the "Density Control" method compaction is specified, each layer shall be compacted to the required density by any method, type and size of equipment which will give the required compaction. The depth of layers, prior to compaction, shall depend upon the type of sprinkling and compacting equipment used. However, maximum depth 16-inches loose and 12-inches compacted shall not be exceeded unless approved by a representative of the City. Prior to and in conjunction with the rolling operation, each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept leveled with suitable equipment to insure uniform compaction over the entire layer.

B. For each layer of earth embankment and select material, it is the intent of this specification to provide the density as required herein, unless otherwise shown on the Plans. Swelling soils (soils with plasticity index (PI) of 20 or more) shall have a density of not less than 95% nor more than 102 % of density as determined by Tex-114-E, with moisture content not less than optimum. Non-swelling soils (soils with plasticity index (PI) less than 20) shall have a density of not less than 95% of density as determined by Tex-114-E at ±3% of the optimum moisture content. Determination of the plasticity index shall be the responsibility of the Contractor or Developer. Field density determinations (Tex-114-E) will be taken every 2000 square yards of roadbed surface at the Contractor's expense.

C. After each layer of earth embankment or select material is complete, tests will be required. If the material fails to meet the density specified, the course shall be reworked as necessary to obtain specified density. Such procedure shall be determined by, and subject to, the approval of the Representative of the City.

D. The subgrade shall be tested by proof rolling in conformity with Texas Department of Transportation, Item 216, "Rolling (Proof)" in the Standard Specifications for Construction of Highways, Streets and Bridges prior to placement of the first course of flexible base material.

E. Should the subgrade, due to any reason or cause, lose the required stability, density or finish before the pavement structure is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent layer or granular material. Excessive loss of moisture shall be construed to exist when the subgrade soil moisture content is more than three (3) percent below the optimum for compaction ratio density.

SD3.07 ROCK EMBANKMENTS

A. Rock Embankments shall be defined as those composed principally of rock, and shall be constructed of accepted material from approved sources.

B. Except as otherwise specified, rock embankments normally shall be constructed in successive layers for the full width of the individual roadway cross section and of 18-inches or less in depth.

C. The maximum dimension of any rock used in embankment shall be less than the depth of the embankment layer. All oversized rock which is otherwise suitable for construction shall be broken to the required dimensions and utilized in embankment construction where proposed by Plans.

D. Unless otherwise provided, the upper or final layer of the embankment shall contain no stones larger than four (4) inches in their greatest dimension, and, insofar as such is available by selection from the excavation, shall be composed of material so graded that the density and uniformity of the surface layer may be secured by the methods and requirements as set forth for "Ordinary Compaction" or "Density Control" method.

E. When the "Ordinary Compaction" method of compaction is specified, each embankment layer shall be rolled as directed, and where the embankment materials require, shall be sprinkled when and to the extent directed by the Representative of the City.

F. When the "Density Control" method of compaction is specified, each layer shall be compacted to the required density as outlined for "Earth Embankment", except in those layers where rock will make density testing difficult, the Representative of the City may require the layer to be proof rolled to insure proper compaction.

SD3.08 AT CULVERTS AND BRIDGES

A. Embankments adjacent to culverts and bridges which cannot be compacted by use of the blading and rolling equipment used in compacting and adjoining sections of embankment shall be compacted in the manner prescribed under Specification Section G9- STRUCTURAL EXCAVATION and Specification Section G4- PIPE EXCAVATION, TRENCHING, EMBEDMENT, ENCASEMENT AND BACKFILLING.

B. Embankments placed around spill-through type abutments, shall be constructed in six (6)-inch loose layers of uniform suitable material placed in such manner as to maintain approximately the same elevation on

each side of the abutment, and all materials shall be mixed, wetted and compacted as specified above.

C. As a general rule, embankment material placed adjacent to any portion of any structure and in the first two (2) layers above the top of any culvert or similar structure shall be an earth, free of any appreciable amount of gravel or stone particles more than four (4) inches in greatest dimension and of such gradation as to permit thorough compaction. When, in the opinion of the Representative of the City, such material is not readily available, the use of rock or gravel mixed with earth will be permitted, in which case no particles larger than 12-inches in greatest dimension and six (6) inches in least dimension may be used and the percentage of fines shall be sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density.

SD3.09 SELECTION OF MATERIALS

A. In addition to the requirements in the excavation items of the specifications covering the general selections and utilization of materials to improve the roadbed, embankments shall be constructed in proper sequence to receive the select material layers shown on the plans, with such modifications as may be directed by the Representative of the City. The layer of embankment immediately preceding the upper layer of select material shall be constructed to the proper section and grade within a tolerance of not more than 0.10 foot from the established section and grade when properly compacted and finished to receive the select material layer.

NOTE: ALL UNDERGROUND UTILITIES SHALL BE INSTALLED PRIOR TO ANY LIME TREATMENT OR FLEXIBLE BASE PLACEMENT.

NOTE: Bluetops will be set on the center, crown, and back of curb of the streets or roads every 50-foot station. These grade stakes will be to finished grade and visible for inspection before flexible base is applied.

SD3.10 PAYMENT

A. No separate payment will be made for work performed in accordance with this specification, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION SD4 – FLEXIBLE BASE
(Crushed Stone)

SD4.01 SCOPE OF WORK

A. This specification covers the requirements for the use of "Flexible Base (Crushed Stone)" for this project.

SD4.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer for approval, technical product literature including binding material, additives, aggregate source, aggregate type, aggregate gradation and all other pertinent data to illustrate conformance to the specification found within.

SD4.03 GENERAL

A. "Flexible Base (Crushed Stone)"shall consist of a foundation course for surface course or for other base courses; shall be composed of crusher-run broken stone; and shall be constructed as herein specified in one or more courses in conformity with the typical sections shown on Plans and to the lines and grades as established by the Plans.

SD4.04 MATERIAL

A. The material shall be crushed and shall consist of durable particles of stone mixed with approved binding material. The material source shall be approved by the Representative of the City, and conform to the requirements as follows:

B. When properly slaked and tested by standard Texas Department of Transportation laboratory methods, the flexible base material shall meet the following requirements:

C. Physical requirements

a. General. All types shall meet the physical requirements for the specified grade(s) as set forth in Table 1.

Additives, such as, but not limited to, lime, cement or fly ash, shall not be used to alter the soil constants or strengths shown in Table 1, unless otherwise shown on the Plans.

Unless otherwise shown on the Plans, the base material shall have a minimum Bar Linear Shrinkage of two (2) percent as determined by Test Method Tex-107-E, Part II.

b. The flexible base shall be:

1. Type A. Type A material shall be crushed stone produced from oversized quarried aggregate, sized by crushing and produced from a naturally occurring single source. Crushed gravel or uncrushed gravel shall not be acceptable for Type A material. No blending of sources and/or additive materials will be allowed in Type A material.

TABLE 1
PHYSICAL REQUIREMENTS

Grade 1	
Triaxial Class 1: Min. compressive strength, psi: 45 at 0 psi lateral pressure and 175 at 15 psi lateral pressure	
Master Grading	
1-3/4"	0
7/8"	10-35
3/8"	30-50
No. 4	45-65
No. 40	70-85

Grade 1	
Max LL	35
Max PI	10
Wet Ball Mill	
Max	40
Max increase in passing	
No. 40	20

1. Gradation requirements are percent retained on square sieves.

2. When a magnesium soundness value is shown on the Plans the material will be tested in accordance with Test Method Tex-411-A.

Sieve Analysis	Tex-110-E
Moisture-Density Determination	Tex-113-E
Roadway Density	Tex-115-E
Wet Ball Mill	Tex-116-E
Triaxial Tests (Part I or II as selected by the Engineer)	Tex-117-E
Particle Count	Tex-460-A, Part I

Samples for testing the base material for triaxial class, soil constants, gradation and wet ball mill will be taken prior to the compaction operations.

SD4.05 TOLERANCES

A. The limits establishing reasonably close conformity with the specified gradation and plasticity index are defined by the following:

B. The City may accept the material, providing not more than two (2) out of 10 consecutive gradation tests performed are outside the specified limit on any individual or combination of sieves by no more than five (5) percent and where no two (2) consecutive tests are outside the specified limit.

C. The City may accept the material providing not more than 2 out of 10 consecutive plasticity index samples tested are outside the specified limit by no more than two (2) points and where no two (2) consecutive tests are outside the specified limit.

SD4.06 CONSTRUCTION METHODS

A. Preparation of Subgrade

1. The roadbed shall be excavated and shaped in conformity with the typical sections, lines and grades as shown on the Plans. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with approved material. All holes, ruts and depressions shall be filled with approved material, and if required, the subgrade shall be thoroughly wetted with water and reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the base material. The surface of the subgrade

shall be finished to line and grade as established and in conformity with the typical section shown on the Plans, and any deviation in excess of ½-inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling. Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of work.

B. First Course

1. Immediately before placing the base material, the subgrade shall be checked as to conformity with grade and section.

2. The material shall be delivered in approved vehicles of a uniform capacity and it shall be the charge of the Contractor that the required amount of specified material shall be delivered in each 100-foot station. Material deposited upon the subgrade shall be spread and shaped the same day unless otherwise directed by the City in writing. In the event inclement weather or other unforeseen circumstances render impractical the spreading of the material during the first 24-hour period, the material shall be scarified and spread as directed by the City. The material shall be sprinkled, if directed, and shall then be bladed, dragged and shaped to conform to typical sections as shown on the Plans. The base layer shall be constructed in lifts not exceeding six (6) inches compacted thickness with each course being of equal thickness. All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well graded material, as directed by the City.

3. The course shall be compacted by the method of compaction hereinafter specified as the "Density Control" method of compaction.

   a. The course shall be sprinkled as required and compacted to the extent necessary to provide not less than the percent density as hereinafter specified under "Density". In addition to the requirements specified for density, the full depth of flexible base shown on the Plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section of flexible base is completed, density tests shall be taken every 750 square yards of roadbed surface or every 250 linear feet, whichever is the least. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical section shown on the Plans and to the established lines and grades. In that area on which pavement is to be placed, any deviation in excess of ¼-inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling. Should the base course, due to any reason or cause, lose the required stability, density and finish before the surfacing is complete, it shall be recompacted and refinished at the sole expense of the Contractor. The base material shall be placed at the optimum moisture contents to ± 3%.

C. Succeeding Courses

1. Construction methods shall be the same as prescribed for the first course.

D. Density

1. When the "Density Control" method of compaction is used, each course of flexible base shall be compacted to the percent density indicated below. The testing will be as outlined in TEX 113E. It is the intent of this specification to provide in that part of the base included in the flexbase section as shown on the Plans immediately below the finished surface of the roadway, not less that 100 percent of the density as determined by the compaction ratio method. Field density determination shall be made in accordance with approved methods.

SD4.07 NOTES

A. Invoices showing total amount of flexible base delivered to each street or road shall be furnished to the City before asphalt is applied.

B. Bluetops will be set on the center, crown and back of curb of the streets or roads every 50-foot station or sufficient to maintain line and grade. These grade stakes will be to finished grade and visible for inspection before asphalt is applied.

SD4.08 PAYMENT

A. Payment for furnished and installed flexible base shall be paid according to the unit price per square yard in the proper item of the Proposal and Bid Schedule.

B. All work and materials to complete the installation of flexible base shall be subsidiary to this item.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION SD5 - STRIPING

SD5.01 SCOPE OF WORK

A. This specification covers the requirements for furnishing and installing pavement markings as shown on the Plans and specified within.

SD5.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including material type, test data, and all other pertinent data to illustrate conformance to the specification found within.

SD5.03 MATERIALS

A. All pavement markings shall be thermoplastic type materials that require heating to elevated temperatures for application. They shall conform to Texas Department of Transportation Materials Specification D-9-8220. Each container of thermoplastic material shall be clearly marked to indicate the color, weight, type of material, Manufacturer's name and the lot/batch number.

SD5.04 STREET SIGNS

A. All signage sheeting shall be high intensity or better. All signage posts shall be 2.375" OD x .095" thin wall steel tubing. All signs shall have breakaway foundations. All signage shall meet the current edition of TMUTCD.

SD5.05 EQUIPMENT

A. All equipment used to place pavement markings shall be maintained in a satisfactory condition. The equipment shall be able to place markings at a rate that will produce a uniform product meeting all the requirements set within item 666 of the standard specifications for Construction of Highways, Streets and Bridges. It shall be capable of placing linear markings up to eight (8) inches in width in a single pass and able to place a center line and no passing barrier line configuration of one (1) broken line with two (2) solid lines at the same time to the alignment and spacing shown on the Plans. Equipment shall be capable of placing lines with clean edges of a uniform cross section within a tolerance of $^{1}/_{8}$ of an inch per four (4) inches width of marking. It shall have an automatic cut-off device with manual operating capabilities to provide clean, reasonably square marking ends to the satisfaction of the Engineer or the City and provide a method of applying broken line in an approximate stripe-to-gap ratio of 10 to 30. The length of the stripe shall not be less than 10-feet or more than 10.5-feet. The total length of any stripe-gap cycle shall not be less than 39.5-feet or more than 40.5-feet. It shall provide a continuous mixing and agitation of the pavement marking material. The use of pans, aprons or similar appliances will not be permitted for longitudinal striping applications. Beads shall be applied by an automatic bead dispenser that is attached to the pavement marking equipment in such a manner that the beads are dispensed uniformly and almost instantly as the marking is placed on the pavement surface. The bead dispenser shall have an automatic cut-off control, synchronized with the cut-off of the pavement marking equipment. A hand held thermometer shall be kept on the project during the placement of pavement markings capable of measuring the temperature of the pavement marking material.

SD5.06 CONSTRUCTION METHODS

A. Pavement marking shall be applied with an approximate stripe-to-gap ratio of 10 to 30 when the application is broken line striping. The length of the broken stripe shall not be less than 10-feet nor more than 10.50-feet. The total length of any stripe-gap cycle shall not be less than 39.50-feet nor more than 40.50-feet.

B. With prior approval from the City of Georgetown, pavement markings may be placed on roadways open to traffic. When markings are to be placed under traffic, a minimum of interference to the operation of the traffic flow shall be maintained. Traffic control shall be maintained as shown on the

approved Traffic Control Plan. All markings placed under open-traffic conditions shall be protected from traffic damage and disfigurement.

C. The deviation rate in pavement marking alignment shall not exceed one (1) inch per 200-feet of roadway and the maximum deviation shall not exceed two (2) inches nor shall any abrupt deviations be acceptable.

D. Markings shall have a uniform cross section. The density and quality of the markings shall be uniform throughout their thickness. The applied markings shall have no more than five (5) percent, by area, of holes or voids and shall be free of blisters.

E. Markings shall be reflectorized both internally and externally. Glass beads shall be applied to the materials at a uniform rate sufficient to achieve uniform and distinctive retroflective characteristics when observed in accordance with Test Method Tex-828-B.

F. Pavement markings that are not in alignment or sequence, as shown on the Plans or Standards, shall be removed and replaced at the sole expense of the Contractor.

SD5.07 SURFACE PREPARATION

A. New Portland cement concrete surfaces shall be cleaned to remove curing membrane, dirt, grease, loose and/or flaking existing construction markings and other forms of contamination.

B. Older Portland cement concrete surfaces and asphalt surfaces that exhibit loose and/or flaking existing markings shall be cleaned to remove all loose and flaking markings.

C. All pavement on which pavement markings are to be placed shall be completely dry.

SD5.08 APPLICATION

A. Unless otherwise shown on the Plans, Portland cement concrete surfaces and asphaltic surfaces that are three (3) years old or older shall be sealed by the use of paint type striping. The paint type markings shall be placed a minimum of two (2) and a maximum of 30 calendar days in advance of placing the thermoplastic type pavement markings. If the paint type markings become dirty for any reason prior to placing the thermoplastic type markings, they shall be cleaned by washing, brushing, compressed air or other means approved. The pavement and paint type marking shall both be thoroughly dry before any thermoplastic type markings are placed. The color of the paint type markings shall be the same as the thermoplastic type markings.

B. Pavement markings shall not be applied when the temperature and moisture limitations are beyond the Manufacturer's recommendation. The minimum thickness for thermoplastic markings shall be 0.060-inches (60-mil) for edgeline markings and 0.090-inches (90-mil) for stop bars, legends, symbols, gore and centerline/no passing barrier line markings, when measured in accordance with Test Method Tex-854-B. The maximum thickness of all thermoplastic type markings shall be 0.180-inches (180 mil).

C. All markings which do not meet the specifications found within or are not satisfactory to the striping plan, installation of the markings, or do not meet the requirements of the project, shall be removed and replaced at the sole expense of the Contractor. In the event that damage is done to the pavement surface in the replacement operation, the damage shall be corrected to the satisfaction of the City at the sole expense of the Contractor.

SD5.09 MEASUREMENT AND PAYMENT *See modifications for additional information

~~A. Payment for furnished and installed pavement markings shall be paid according to the unit price per linear foot in the proper item of the Proposal and Bid Schedule.~~

B. All work and materials to complete the pavement markings shall be subsidiary to this item.

END OF SECTION

WASTEWATER SPECIFICATIONS

SECTION WW

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TECHNICAL SPECIFICATIONS

SECTION WW1 – CONCRETE MANHOLES (WASTEWATER)

WW1.01 SCOPE OF WORK *See modifications for additional information

A. This specification covers the requirements to install precast concrete manholes, frames and covers, and appurtenances as shown on the Plans and as specified herein.

WW1.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, shop drawings, product data, materials of construction, and details of installation shall be submitted in accordance with Section CIP10- SUBMITTALS. Submittals shall include the following: base sections, riser sections, eccentric conical top sections, flat slab tops, grade rings with notarized certificate indicating compliance with ASTM C478, pipe connection to manhole, manhole frame and cover with notarized certificate indicating compliance with ASTM A48, Class 30, method of repair for minor damage to precast concrete sections, manhole lining system.

B. Design Data

1. Precast concrete structures:

a. Six (6) copies of sectional plan(s) and elevations showing dimensions and reinforcing steel placement.

b. Six (6) copies of concrete design mix.

C. Test Reports

1. Precast concrete structures:

a. Six (6) copies of concrete test cylinder reports from an approved testing laboratory certifying conformance with specifications.

WW1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A48 - Specification for Gray Iron Castings.

2. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

3. ASTM C33 - Specification for Concrete Aggregates.

4. ASTM C150 - Standard Specification for Portland Cement.

5. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.

6. ASTM D4101 - Specification for Propylene Plastic Injection and Extrusion Materials.

B. American Concrete Institute (ACI)

1. ACI 318 - Building Code Requirements for Reinforced Concrete.

2. ACI 350R - Concrete Sanitary Engineering Structures.

C. American Association of State Highway and Transportation Officials (AASHTO)

1. Standard Specifications for Highway, Streets and Bridges.

D. Occupational Safety and Health Administration (OSHA)

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

WW1.04 QUALITY ASSURANCE

A. All material shall be new and unused.

B. Materials' quality, manufacturing process and finished sections are subject to inspection and approval by Engineer or other City representative. Inspection may be made at place of Manufacture, at work site following delivery, or both.

C. Materials will be examined for compliance with ASTM specifications, these Specifications and approved Manufacturer's drawings. Additional inspection criteria shall include: appearance, dimensions(s), blisters, cracks and soundness.

D. Materials shall be rejected for failure to meet any Specification requirement. Rejection may occur at place of manufacture, at work site, or following installation. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no cost to City.

E. Repair minor damage to precast concrete sections by approved method, if repair is authorized by Engineer or the City.

WW1.05 PRODUCTS

A. Reference to a Manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Like items of materials/equipment shall be the end products of one Manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and Manufacturer's service.

C. Provide lifting lugs or holes in each precast section for proper handling.

WW1.06 PRECAST CONCRETE MANHOLE SECTIONS

A. Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478 and meet the following requirements:

1. Bottom slab thickness shall be 12-inches.

2. Top section shall be flat slab with a minimum clear opening of 32 $^{7}/_{8}$-inches diameter.

3. Base, riser and transition top sections shall have tongue and groove joints.

4. Sections shall be cured by an approved method.

5. Precast concrete sections shall be shipped after concrete has attained 3,000 psi compressive strength.

6. Design precast concrete base, riser, transition top, flat slab top and grade ring for a minimum HS-20 loading plus earth load. Calculate earth load with a unit weight of 130 pounds per cubic foot.

7. Mark date of manufacture, name and trademark of Manufacturer on the inside of each precast section.

8. Construct and install precast concrete base as shown on the Plans.

9. Provide integrally cast knock-out panels in precast concrete manhole sections at locations, and with sizes shown on Plans. Knock-out panels shall have no steel reinforcing.

B. Manhole diameter shall be as shown on the Plans, but not less than the diameter of the largest connecting pipe plus two (2) feet.

C. Pipe Sections

Pipe sections shall conform to current specifications for Precast Reinforced Manhole Sections, ASTM Designation C478, with the following additions:

1. Pipe shall be machine made by a process which will provide for uniform placement of zero slump concrete in the form and compaction by mechanical devices which will assure a dense concrete in the finished product.

2. Aggregates for the concrete shall consist of limestone aggregates in the proportion of at least 75% by weight of the total aggregates.

3. Minimum wall thickness for the manhole risers shall be as listed under Wall "B" in the "Class Tables" of ASTM C76 for Class III pipe.

D. Joints

1. Joints shall conform to the joint specifications in ASTM C478, C76, and ASTM C443. All manhole sections, including the bottom section, shall be furnished with "O-ring" type rubber gasket joints. The joints shall be furnished and installed with the bell down to resist groundwater infiltration. All joints shall be sealed with mortar or an approved non-shrink grout on the inside and the outside of the manhole. Grade rings shall be mortared to each other and on the inside and outside to provide a waterproof seal.

E. Manhole Steps

1. Unless specifically approved by the City, manhole steps shall not be provided.

WW1.07 MANHOLE FRAME AND COVER

A. Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30.

B. Manhole covers shall have a diamond pattern, pickholes and the word SEWER as appropriate cast in three (3) inch letters. Manhole frame and covers shall be Neenah Foundry, Western Iron Works, Vulcan Foundry, or equal. Model numbers refer to Western Iron works products:

1. Manhole Frame and cover - WRM-36.

WW1.08 JOINTING PRECAST MANHOLE SECTIONS

A. Seal tongue and groove joints of precast manhole sections with rubber "O"-ring gasket. O-ring gasket shall conform to ASTM C443.

B. Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

WW1.09 PIPE CONNECTIONS TO MANHOLE

A. Connect pipe to manhole in the following ways:

1. Flexible sleeve - Integrally cast sleeve in precast manhole section or install sleeve in a formed or cored opening. Fasten pipe in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous material to protect from corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve; Kor-N-Seal connector; PSX Press-Seal Gasket or equal.

2. Compression gasket - Integrally cast compression gasket in precast manhole section. Insert pipe into compression gasket. Compression gasket shall be A-Lok, or equal.

WW1.10 INSTALLATION

A. Manhole Installation

1. Manholes shall be constructed to the dimensions shown on the Plans and as specified herein. Protect all work against flooding and flotation.

2. Place manhole base on a bed of screened gravel eight (8) inches in depth as shown on the Plans. Set manhole base so that a maximum grade adjustment of eight (8) inches is required to bring the manhole frame and cover to final grade.

Use precast concrete grade rings to adjust manhole frame and cover to final grade.

3. Set precast concrete barrel sections plumb with a $^{1}/_{4}$-inch maximum out of plumb tolerance allowed. Seal joints of precast barrel sections with either a rubber "O" ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finished flush with the adjoining surfaces. Caulk the inside of any leaking barrel section joint with non-shrink grout to the satisfaction of the Engineer and the City.

4. Allow joints to set for 14 hours before backfilling unless a shorter period is specifically approved by the Engineer or the City.

5. Plug holes in the concrete barrel sections required for handling with a non-shrinking grout or non-shrinking grout in combination with concrete plugs. Finish flush on the inside.

6. Core holes in precast sections to accommodate pipes prior to setting manhole sections in place to prevent jarring which may loosen the mortar joints.

7. Backfill carefully and evenly around manhole sections.

B. Manhole Pipe Connections

1. Construct manhole pipe connections, including pipe stubs, as specified above. Close or seal pipe stubs for future connections with a gasketed watertight plug.

C. Setting Manhole Frame and Cover

1. Set manhole covers and frames in a full mortar bed. Utilize precast concrete grade rings, for a maximum adjustment of twelve (12) inches, to assure frame and cover are set to the finished grade. Set manhole frame and cover to final grade prior to placement of permanent paving.

WW1.11 TESTS

A. Test each manhole in accordance with Section CIP12- TESTING OF PIPELINES AND MANHOLES. Engineer or the City's representative shall observe each test.

WW1.12 CLEANING

A. Thoroughly clean all new manholes of all silt, debris and foreign matter of any kind, prior to final inspections.

WW1.13 PAYMENT *See modifications for additional information

A. Payment for furnished and installed manholes shall be paid according to the unit price per each in the proper item of the Proposal and Bid Schedule.

B. All work and materials to complete the reinforced concrete pipe including but not limited to excavation, bedding, backfill, connection to pipe, etc. shall be subsidiary to this item.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION WW2 – POLYVINYL CHLORIDE (PVC) PIPE-WASTEWATER

WW2.01 SCOPE OF WORK

A. This specification covers the requirements to install and test polyvinyl chloride (PVC) pipe and fittings, including excavation, sheeting, storing, dewatering, pipe laying, jointing, testing, backfilling, and any other work that is required or necessary to complete the installation as shown in the Plans as specified herein, complete as shown on the Plans and as specified herein.

WW2.02 SUBMITTALS

A. Within 30 days of the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including the names of the pipe and fittings suppliers, a list of materials to be furnished, shop drawings on required pipes and fittings, certified test reports that the pipe for this Contract was manufactured and tested in accordance with the ASTM Standards specified herein, and all other pertinent data to illustrate conformance to the specification found within.

WW2.03 QUALITY ASSURANCE

A. All PVC pipe and fittings shall be from a single Manufacturer. The Supplier shall be responsible for the provisions of all test requirements specified in ASTM D3034 or ASTM F789 as applicable. In addition, all PVC pipe to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the City. The Contractor shall require the Manufacturer's cooperation in these inspections. The cost of plant inspection of all pipe approved for this Contract, plus the cost of inspection of disapproved pipe, will be borne by the Contractor.

B. Inspections of the pipe may also be made by the Engineer or other representatives of the City after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.

WW2.04 POLYVINYL CHLORIDE (PVC) WASTEWATER PIPE AND FITTINGS

A. Pipe and fittings shall be Type PSM, PVC SDR 26 with full diameter dimensions and shall conform to ASTM D3034, or Type PS-46 PVC conforming to ASTM F789, for sizes 4 through 15-inch and shall conform to ASTM F679 for sizes 18 through 27-inch. Straight pipe shall be furnished in lengths of not more than 13-feet and wyes shall be furnished in lengths of not more than three (3) feet. Saddle wyes will not be allowed.

B. PVC pipe and fittings shall have bell and spigot push-on joints. The bell shall consist of an integral wall section with a solid cross-section elastomeric gasket securely locked in place to prevent displacement during assembly. Elastomeric gaskets shall conform to ASTM F477.

C. All fittings and accessories shall have bell and/or spigot configurations compatible with the pipe.

D. For Force Main, all pipe shall be C-900, DR-18 pipe or epoxy coated ductile iron encased with brown 8 mil. polyethylene film.

WW2.05 HANDLING AND CUTTING PIPE

A. Pipe and fittings are slightly brittle. Care shall be taken in shipping, handling and laying to avoid damaging the pipe and fittings. Extra care will be necessary during cold weather construction.

B. Any pipe or fitting showing a crack or which has received a blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.

C. All pipe ends shall be square after cutting.

D. While stored, pipe shall be adequately supported from below at not more than three (3) foot intervals to prevent deformation. Pipe shall not be stacked higher than six (6) feet. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures and out of direct sunlight. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings which allows temperature buildup when exposed to direct sunlight will not be permitted.

WW2.06 JOINTING POLYVINYL CHLORIDE (PVC) WASTEWATER PIPE AND FITTINGS

A. PVC wastewater pipe and fittings shall be jointed in accordance with the recommendations of the latest ASTM Standards and detailed instructions of the Manufacturer.

B. All manhole connections shall be as shown on the Plans.

WW2.07 INSTALLING POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than $^{1}/_{16}$-inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the Manufacturer shall be explicitly followed.

B. Any pipe or fittings discovered to be defective after laying shall be removed and replaced with a sound piece.

C. The Engineer or the City may examine each bell and spigot end to determine whether any preformed joint has been damaged prior to installation. Any pipe having defective joint surfaces shall be rejected, marked as such, and immediately removed from the job site.

D. All pipe shall be sound and clean before laying. When laying is not in progress, including lunch time, the open ends of the pipe shall be closed by watertight plugs or other approved means.

E. Pipe and fittings shall be installed in accordance with the instructions of the Manufacturer, ASTM D2321 and as specified herein. As soon as the excavation is complete to normal grade of the bottom of the trench, bedding shall be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. The pipe shall be laid accurately to the lines and grades indicated on the Plans. The specified embedment shall be accurately shaped and trimmed to receive the pipe barrel and each pipe section, when in place, shall have a uniform bearing on the subgrade for the full length of the pipe barrel. Pipe shall not be laid unless the subgrade is free of water and in a satisfactory condition. Adjustments of the pipe to line and grade shall be made by scraping away or filling in with granular material, and not by wedging or blocking up the bell. Blocking under the pipe will not be permitted. The bedding as shown in the details of the Plans, shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to force the bedding under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe. The bedding shall then be placed to 12-inches above the top of the pipe. The initial three (3) feet of backfill above the bedding backfill shall be placed in eight (8) inch layers and carefully compacted. Generally, the compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting the initial three (3) feet of backfill shall be approved by the pipe Manufacturer's representative prior to use.

F. Joints shall not be "pulled" or "cramped". Each joint of pipe shall be completed in compliance with Manufacturer’s recommendations.

G. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.

H. Precautions shall be taken to prevent flotation of the pipe in the trench.

I. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, screened material shall be placed to fill any voids created and the screened material and backfill shall be re-compacted to provide uniform side support for the pipe.

J. Pipe stubs for manhole connections shall not exceed 3.25-feet in length unless directed otherwise by the Engineer or the City. Install caps where required. When connecting to an existing manhole, the opening for the connection of the wastewater pipe and the manhole shall be cored using an approved coring machine to the dimensions and size required to install the flexible "SEAL BOOT" resilient connector that meets the requirements of ASTM C-923. The connection shall be watertight when complete and meet the requirements of Section WW1- CONCRETE MANHOLES.

K. Wastewater mains shall be installed in straight trenches from manhole to manhole or manhole to cleanout. There will be no curvilinear installations of wastewater mains.

WW2.08 TESTING

A. Testing and cleaning of pipe shall be as specified in Specification Section CIP12- TESTING OF PIPELINES AND MANHOLES.

WW2.09 PAYMENT

A. The wastewater line, complete in place, will be measured for payment in linear feet along the centerline of the pipe actually installed. Measurement shall be through all manholes and no deduction in length will be made for such appurtenances. Installation of the wastewater line will be paid for at the unit contract price per linear foot as provided in the Proposal and Bid Schedule.

B. Payment of the unit contract price for the items of work performed shall be the total compensation for furnishing all labor, materials, tools, testing equipment and incidentals and performing all work that is necessary for the installation of the pipe, fittings, embedment or encasement, and all other appurtenances in accordance with the Plans and the provisions of these specifications.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION WW3 – CONNECTIONS TO AND WORK ON THE EXISTING WASTEWATER SYSTEM

WW3.01 SCOPE OF WORK

A. This specification covers the requirements to maintain flow in existing sewers, handle existing wastewater flow, construct and maintain all temporary connections and diversions and construct the permanent connections to the new system as shown on the Plans and as directed by the Engineer.

WW3.02 SUBMITTALS

A. None required unless specifically called for in the Plans, details, or requested by the Engineer.

WW3.03 GENERAL

A. The Contractor shall supply all materials, equipment and labor required for plugging existing wastewater lines, all work on existing manholes (including all work and materials required to reshape existing manhole inverts with concrete and connecting new wastewater lines to existing manholes) and all additional work required.

B. Should damage of any kind occur to the existing wastewater line, the Contractor shall at his/her own expense, as part of the work under this Section, make repairs to the satisfaction of the Engineer.

C. The Contractor shall notify the Engineer immediately of any discrepancies in elevations of existing wastewater lines and manholes between those shown on the Plans and those established during construction in order that the Engineer can make the necessary modifications.

D. All new wastewater pipe for connection shall conform to the pipe specifications in Section WW2-POLYVINYL CHLORIDE (PVC) PIPE - WASTEWATER.

WW3.04 HANDLING WASTEWATER FLOWS

A. The Contractor shall provide all labor, equipment and materials necessary to maintain existing flows, including temporary diversions and all pumping of sewage that may be required to prevent backing up of wastewater lines and shall immediately remove all offensive matter at his/her own expense.

B. The Contractor shall not be permitted to overflow, bypass, pump or by any other means convey sewage to any stream, or other water course.

C. All procedures for maintaining flows must meet the approval of the Engineer and the Contractor shall be required to submit to the Engineer, for approval, a detailed written plan of all methods of flow maintenance 10 days in advance of flow interruption.

WW3.05 PAYMENT

A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

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CONCRETE SPECIFICATIONS

SECTION C

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TECHNICAL SPECIFICATIONS

SECTION C1 – CONCRETE STRUCTURES

C1.01 SCOPE OF WORK

A. This specification covers the requirements for the construction of all types of structures involving the use of structural concrete, except where the requirements are waived or revised by other governing specifications.

B. All concrete structures shall be constructed in accordance with the design requirements and details shown on the Plans; in conformity with the pertinent provisions of the items contracted for; the incidental items referred to; and in conformity with the requirements herein.

C1.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including the type of concrete, concrete mix design, concrete type and Manufacturer of precast structures, a description of curing methods used, and all other pertinent data to illustrate conformance to the specification found within.

C1.03 MATERIALS

A. Concrete

1. All concrete shall conform to the provisions of Section C2, CONCRETE FOR STRUCTURES. The class of concrete for each type of structure or unit shall be as specified on the Plans, or by pertinent governing specifications.

B. Expansion Joint Material

1. Preformed Fiber Material - Preformed fiber expansion joint material shall be one-half (½) inch or as shown on the Plans. At the Contractor's option, the material shall be one of the following types, unless otherwise noted on the Plans:

   a. "Preformed Bituminous Fiber Material" shall meet the requirements of the Standard Specifications for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM Designation: D1751.

   b. "Preformed Non-Bituminous Fiber Material": shall meet the requirements of the Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction ASTM Designation: D1751, except that the requirements pertaining to bitumen content, density and water absorption shall be voided.

2. Joint Sealing Material - Unless otherwise noted on the Plans, the sealer shall be synthetic polymer Sikaflex – ICSL or equivalent.

3. Asphalt Board - Asphalt Board shall consist of two liners of 0.016 inches asphalt impregnated paper, filler with a mastic mixture of asphalt and vegetable fiber and/or mineral filler. Boards shall be smooth, flat and sufficiently rigid to permit installation. When tested in accordance with Test Method Tex-524-C, the asphalt board shall not deflect from the horizontal more than one (1) inch in three and one half (3 ½) inches.

4. Rebonded Neoprene Filler - Rebonded neoprene filler shall consist of ground closed-cell neoprene particles, rebonded and molded into sheets of uniform thickness of the dimensions shown on Plans.

   Filler material shall meet the requirements of ASTM Designations: D1752 Type 1 where applicable.

C. Expansion Joints - Joints and devices to provide for expansion and contraction shall be constructed as indicated herein or on the Plans.

D. Placing Reinforcements - Reinforcement in concrete structures shall be placed carefully and accurately and rigidly supported as provided in the Section C7 – REINFORCING STEEL.

E. Placing Concrete-General - The minimum temperature of all concrete at the time of placement shall not be less than 50°F.

F. The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. When conditions are such that additional moisture is needed for finishing, the required water shall be applied to the surface by Fog Spray Only, and shall be held to a minimum amount. Fog spray for this purpose may be applied with hand operated fogging equipment.

G. The maximum time interval between the addition of cement to the batch, and the placing of concrete in the forms shall not exceed the following:

Air or Concrete Temperature	Maximum Time (Without Retarding Agent)	Maximum Time (With Retarding Agent)
Non-Agitated Concrete		
Up to 80° F	30 Minutes	45 Minutes
Over 80° F	15 Minutes	30 Minutes
Agitated Concrete		
90° F or above	45 Minutes	75 Minutes
Above 75° F to 89° F	60 Minutes	90 Minutes
75° F and below	90 Minutes	120 Minutes

H. Upon completion of the final finish, interim curing will be required for slab concrete in bridge decks and top slabs of direct traffic culverts as follows:

1. Unless otherwise shown on the Plans, Type 1 membrane curing compound (Resin Base Only) shall be applied to the slab surface.

I. Required water curing shall begin as soon as it can be done without damaging the concrete finish.

J. The Contractor shall notify the City two (2) days in advance before placing concrete in any unit of the structure to permit the inspection of forms, reinforcing steel placement, and other preparations. Concrete shall not be placed in any unit prior to the completion of form work and placement of reinforcement therein.

K. Concrete mixing, placing and finishing shall be done in daylight, hours, unless adequate provisions are made to light the entire site of all operations.

L. Concrete placement will not be permitted when impending weather conditions will impair the quality of the finished work. If rainfall should occur after placing operations are started, the Contractor shall provide ample coverage to protect the work. In case of drop in temperature, the provisions set forth in Section C1.04- PLACING CONCRETE IN COLD WEATHER shall apply.

M. The sequence of placing concrete shall be as provided on the Plans or as required herein. The placing shall be regulated so the pressures caused by the plastic concrete shall not exceed the loads used in the form design. Form design shall be the sole responsibly of the Contractor.

N. The method of handling, placing, and consolidation of concrete shall minimize segregation and displacement of the reinforcement, and produce a uniformly dense and compact mass. Concrete shall not have a free fall of more than 5 feet, except in the case of thin walls such as in culverts. Any hardened concrete splatter ahead of the plastic concrete shall be removed.

O. The method and equipment used to transport concrete to the forms shall be capable of maintaining the rate of placement approved by the City. Concrete may be transported by bucket, chutes, buggies, belt conveyors, pumps or other acceptable methods.

P. Each part of the forms shall be filled by depositing concrete as near its final position as possible. The coarse aggregate shall be worked back from the face and the concrete forced under and around the reinforcement bars without displacing them. Depositing large quantities at one point and running or working it along the forms will not be allowed.

Q. Concrete shall be deposited in the forms in layers of suitable depth but not more than 36-inches in thickness, unless otherwise directed by the City.

R. The sequence of successive layers or adjacent portions of concrete shall be such that they can be vibrated into a homogeneous mass with the previously placed concrete without a cold joint. Not more than one hour shall elapse between adjacent or successive placements of concrete. Unauthorized construction joints shall be avoided by placing all concrete between the authorized joints in one continuous operation.

S. An approved retarding agent shall be used to control stress cracks, and/or unauthorized cold joints in mass placements where differential settlement and/or setting time may induce stress cracking, such as on false work, in deep girder stems, etc.

T. Openings in forms shall be provided, if needed, for the removal of laitance or foreign matter of any kind.

U. All forms shall be wetted thoroughly before the concrete is placed therein.

V. All concrete shall be well consolidated and the mortar flushed to the form surfaces by continuous working with immersion type vibrators. Vibrators which operate by attachment to forms or reinforcement will not be permitted, except on steel forms.

W. The concrete shall be vibrated immediately after deposit. Prior to the beginning of work, a systematic spacing of the points of vibrations shall be established to insure complete consolidation and thorough working of the concrete around the reinforcement, embedded fixtures, and into the corners and angles of the forms. Immersion type vibrators shall be inserted vertically, at points 18 to 30-inches apart, and slowly withdrawn. The vibrator may be inserted in a sloping or horizontal position in shallow slabs. The entire depth of each lift shall be vibrated, allowing the vibrator to penetrate several inches into the preceding lift. Concrete along construction joints shall be thoroughly consolidated by operating the vibrator along and close to but not against the joint surface. The vibration shall continue until thorough consolidation, and complete embedment of reinforcement and fixtures is produced, but not long enough to cause segregation. Vibration may be supplemented by hand spading or rodding, if necessary, to insure the flushing of mortar to the surface of all forms.

C1.04 PLACING CONCRETE IN COLD WEATHER

A. Cast-in-Place Concrete - Concrete may be placed when the atmospheric temperature is not less than 35° F. Concrete shall not be placed in contact with any material coated with frost or having a temperature less than 32° F.

B. Aggregates shall be free from ice, frost and frozen lumps. When required, in order to produce the minimum specified concrete temperature, the aggregate and/or the water shall be heated uniformly, in accordance with the following:

The water temperature shall not exceed 180° F nor shall the aggregate temperature exceed 150° F. The heating apparatus shall heat the mass of aggregate uniformly. The temperature of the mixture of aggregates and water shall be between 50° F and 85° F before introduction of the cement.

C. All concrete shall be effectively protected as follows:

1. The temperature of slab concrete of all unformed surfaces shall be maintained at 50° F or above for a period of 72 hours from time of placement and above 40° F for an additional 72 hours.

2. The temperature at the surface of all concrete in bents, piers, culvert walls, retaining walls, parapets, wingwalls, bottom of slabs, and other similar formed concrete shall be maintained at 40° F or above for a period of 72 hours from time of placement.

3. The temperature of all concrete, including the bottom slabs of culverts placed on or in the ground, shall be maintained above 32° F for a period of 72 hours from time of placement.

D. Protection shall consist of providing additional covering, insulated forms or other means, and if necessary, supplementing such covering with artificial heating. Curing as specified under Section C1.10-CURING CONCRETE, shall be provided during this period until all requirements for curing have been satisfied.

E. When impending weather conditions indicate the possibility of the need for such temperature protection, all necessary heating and covering material shall be on hand ready for use before permission is granted to begin placement.

C1.05 PLACING CONCRETE IN HOT WEATHER

A. When the temperature of the air is above 85° F, an approved retarding agent will be required in all concrete used in superstructures, top slabs of direct traffic culverts, and will be required in all cased drilled shafts regardless of temperature. No concrete will be placed any time the temperature of the concrete at placement, exceeds 90° F. Ice will be used to decrease the temperature of concrete. The general formula will be, five (5) pounds of ice per yard of concrete per degree of temperature drop.

C1.06 PLACING CONCRETE IN WATER

A. Concrete shall be deposited in water only when specified on the Plans or with written permission of the City. The forms, cofferdams or caissons shall be sufficiently tight to prevent any water current passing through the space in which the concrete is being deposited. Pumping will not be permitted during concrete placing, nor until it has set for at least 36 hours.

B. The concrete shall be placed with a tremie, closed bottom-dump bucket, or other approved method, and shall not be permitted to fall freely through the water nor shall it be disturbed after it has been placed. Its surface shall be kept approximately level during placement

C. The tremie shall consist of a water-tight tube 14-inches or less in diameter. It shall be constructed so that the bottom can be sealed and opened after it is in place and fully charged with concrete. It shall be supported so that it can be easily moved horizontally to cover all the work area and vertically to control the concrete flow.

D. The placing operations shall be continuous until the work is complete.

C1.07 PLACING CONCRETE IN BOX CULVERTS

A. In general, construction joints will be permitted only where shown on the Plans.

B. Where the top slab and walls are placed monolithically in culverts more than four (4) feet in clear height, an interval of not less than one (1) nor more than two (2) hours shall elapse before placing the top slab to allow for shrinkage in the wall concrete.

C. The base slab shall be finished accurately at the proper time to provide a smooth uniform surface. Top slabs which carry direct traffic shall be finished as specified under Item 360 “Concrete Pavement” of the Standard Specifications for the Construction of Highways Streets and Bridges of Texas Department of Transportation, latest addition. Top slab of fill type culverts shall be given a reasonable smooth float finish.

C1.08 PLACING CONCRETE IN FOUNDATIONS AND SUBSTRUCTURE

A. Concrete shall not be placed in footings until the depth and character of the foundation has been inspected by the City and permission has been given to proceed.

B. Placing of concrete footings upon seal courses will be permitted after the caissons of cofferdams are free from water and the seal course cleaned. Any necessary pumping or bailing during the concrete operation shall be done from a suitable pump located outside the forms.

C. All temporary walls or braces inside cofferdams or caissons shall be constructed or adjusted as the work proceeds to prevent unauthorized construction joints in footings or shafts.

D. When footings can be placed in a dry excavation without the use of cofferdams or caissons, forms may be omitted, if desired by the Contractor and approved by the City, and the entire excavation filled with concrete to the elevation of the top of footing.

C1.09 TREATMENT AND FINISHING OF HORIZONTAL SURFACES

A. All unformed upper surfaces shall be struck off to grade and finished. The use of mortar topping for surfaces under this classification will not be permitted.

C1.10 CURING CONCRETE

A. The Contractor shall inform the City fully of the methods and procedures proposed for curing; shall provide the proper equipment and material in adequate amounts, and shall have the proposed method, equipment and material approved prior to placing concrete.

B. Inadequate curing and/or facilities therefore shall be cause for the City to stop all construction on the job until remedial action is taken.

C. All concrete shall be cured for a period of four (4) curing days except as noted herein.

C1.11 EXCEPTIONS TO 4-DAY CURING

A. When the air temperature is expected to drop below 35° F, the water curing mats shall be covered with polyethylene sheeting, burlap-polyethylene blankets or other material to provide the protection required by Section C1.04- PLACING CONCRETE IN COLD WEATHER.

B. A curing day is defined as a calendar day when the temperature, taken in the shade away from artificial heat, is above 50° F for at least 19 hours, (or colder days are satisfactory if provisions are made to maintain the temperature at all surfaces of the concrete above 40° F for the entire 24 hours). The required curing period shall begin when all concrete therein has attained its initial set.

C. The following methods are permitted for curing concrete subject to the restrictions and the following requirements for each method of curing.

1. Form Curing - When forms are left in contact with the concrete, other curing methods will not be required except for cold weather protection.

a. Wet Mat - Cotton mats shall be used for this curing method. They shall be placed as soon as possible after the surface has sufficiently hardened to prevent damage to the concrete. Damp burlap blankets made from nine (9) ounce stock may be placed on the damp concrete surface for temporary protection prior to the application of the cotton mats which may be placed dry and wetted down after placement.

The mats shall be weighted down adequately to provide continuous contact with all concrete surfaces where possible. The surfaces of the concrete shall be kept wet for the required curing time. Surfaces which cannot be cured by contact shall be enclosed with mats, anchored positively to the forms, or to the ground, so that outside air cannot enter the enclosure. Sufficient moisture shall be provided inside the enclosure to keep all surfaces of the concrete wet.

b. Water Spray - This method shall consist of overlapping sprays or sprinklers that keep all unformed surfaces continuously wet.

c. Ponding - This method required the covering of the surfaces with a minimum of two (2) inches of clean granular material, kept wet at all times, or a minimum of one (1) inch depth of water. Satisfactory provisions shall be made to provide a dam to retain the water or saturated sand.

2. Membrane Curing - Unless otherwise provided herein or shown on the Plans, either Type 1 or Type 2 membrane curing compound may be used where permitted.

a. For substructure concrete, only one (1) type of curing compound will be permitted on any one (1) structure. (Material requirements and construction methods shall be as required by Section C6 – MEMBRANE CURING except as changed herein.) Membrane shall be applied in a single, uniform coating at the rate of coverage recommended by the Manufacturer and as approved by the City, but not less than one (1) gallon per 180 square feet of area. Tests for acceptance shall be at this specified rate.

b. Membrane curing shall not be applied to dry surfaces, but shall be applied just after free moisture has disappeared. Formed surfaces and surfaces which have been given a first rub shall be dampened and shall be moist at the time of applications of the membrane.

c. When membrane is used for complete curing, the film shall remain unbroken for the minimum curing period specified. Membrane which is damaged shall be corrected immediately by reapplication of membrane. Unless otherwise noted herein or on the Plans, the choice of membrane type shall be at the option of the Contractor, except that the City may require the same curing method for like portions of a single structure.

C1.12 REMOVAL OF FORMS AND FALSEWORK

A. Except as herein provided, forms for vertical surfaces may be removed when the concrete has aged not less than one (1) day when Type I or Type II cement is used, and not less than one-half ($^1/_2$) day when Type III cement is used, provided it can be done without damage to the concrete.

C1.13 DEFECTIVE WORK

A. Any defective work discovered after the forms have been removed shall be repaired as soon as possible in accordance with Section C1.14- FINISHING EXPOSED SURFACES.

B. If the surface of the concrete is bulged, uneven or shows excess honeycombing or form marks, which in the opinion of the City, cannot be repaired satisfactorily, the entire section shall be removed and replaced at the expense of the Contractor.

C1.14 FINISHING EXPOSED SURFACES

A. Ordinary Surface Finish - An Ordinary Surface Finish shall be applied to all concrete surfaces either as a final finish or preparatory to a higher grade or class of finish. Higher grades and classes of finish shall be in accordance with the Plans, Standards or Special Conditions. Where neither a grade nor class of finish is specified, and Ordinary Surface Finish, only, will be required.

B. Ordinary Surface Finish shall be provided as follows:

1. After form removal, all porous or honeycombed areas and spalled areas shall be corrected by chipping away all loose or broken material to sound concrete.

2. Featheredges shall be eliminated by cutting a face perpendicular to the surface. Shallow cavities shall be repaired using adhesive grout or epoxy grout. If judged repairable by the Engineer or the City, large defective areas shall be corrected using concrete or other material approved by the City.

3. Holes and spalls caused by removal of metal ties, etc., shall be cleaned and filled with adhesive grout or epoxy grout. Exposed parts of metal chairs on surfaces to be finished by rubbing, shall be chipped out to a depth of one-half ($^1/_2$) inch and the surface repaired.

4. All fins, runs, dips or mortar shall be removed from surfaces which remain exposed. Form marks and chamfer edges shall be smoothed by grinding and/or dry rubbing.

C1.15 PAYMENT

A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION C2 – CONCRETE FOR STRUCTURES

C2.01 SCOPE OF WORK

A. This specification covers the requirements for concrete related materials used for the storing and handling of concrete related materials; and for the proportioning and mixing of concrete for bridges, culverts, pre-stressed concrete, and incidental concrete construction.

C2.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including the type of concrete, concrete mix design, concrete type and Manufacturer of precast structures, a description of curing methods used, and all other pertinent data to illustrate conformance to the specification found within.

C2.03 GENERAL

A. The concrete shall be composed of Portland cement, aggregates (fine and coarse), admixtures if desired or required, and water, proportioned and mixed as hereinafter provided.

1. Cement - The cement shall be either Type, I, II, or III Portland Cement conforming to ASTM Designation : C150

2. Mortar (Grout) - Mortar for repair of concrete, shall consist of 1 part cement, two (2) parts finely graded sand, and enough water to make the mixture plastic. When required to prevent color difference, white cement shall be added to produce the color required. When required by the City, latex adhesive shall be added to the mortar.

3. Admixtures - Calcium Chloride will not be permitted. Unless otherwise noted, Air-entraining, retarding and water reducing admixtures may be used in all concrete and shall conform to the requirements of the Standard Specification for Construction of Highways, Streets, and Bridges of the Texas Department of Transportation, latest edition.

C2.04 CLASSIFICATION AND MIX DESIGN

A. It shall be the responsibility of the Contractor to furnish the mix design, using a Coarse Aggregate Factor acceptable to the City, for the class (es) of concrete specified. The mix shall be designed by a qualified concrete technician to conform with the requirements contained herein and in accordance with current Texas Department of Transportation standards. The Contractor shall perform, at his own expense, the work required to substantiate the design. Complete concrete design data shall be submitted to the City for approval.

B. It shall also be the responsibility of the Contractor to determine and measure the batch quantity of each ingredient, including all water, so that the mix conforms to these specifications and any other requirements shown on the Plans.

C. In lieu of the above mix design responsibility, the Contractor may accept a design furnished by the City, however, this will not relieve him of providing concrete meeting the requirements of these specifications.

C2.05 QUALITY OF CONCRETE, GENERAL

A. The concrete shall be uniform and workable. The cement content, maximum allowable water cement ratio, the desired and maximum slump and the strength requirements of the various classes of concrete shall conform to the requirements of Tables 1 - 4 and as required herein.

Table 1

Concrete Designation	Desired Slump	Max. Slump
Structural Concrete		
(1) All Drill Shaft	6	7
(2) Uncased Drilled Shafts, Thin-Walled Sections (9" or less), and Prestressed Concrete Members	4	5
(3) Slabs, Caps, Columns, Piers, Wall Sections Over 9", etc.	3	4
Underwater or Seal Concrete	6	7
Riprap, Curb, Gutter and Other Miscellaneous Concrete	As specified by City	

NOTE: NO CONCRETE WILL BE PERMITTED WITH SLUMP IN EXCESS OF THE MAXIMUMS SHOWN.

B. Coarse Aggregate

Coarse aggregate shall be washed and shall consist of durable particles of gravel, crushed blast furnace slag, crushed stone, or combinations thereof and shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter, or other objectionable material either free or as an adherent coating. When white portland cement is specified, the coarse aggregates used in the concrete shall be light colored. Quality shall be reasonably uniform throughout. Coarse aggregate shall not contain more than 0.25 percent by weight of clay lumps, or more than one (1) percent by weight of shale, or more than five (5) percent by weight of laminated and/or friable particles when tested in accordance with Test Method Tex-413-A. Coarse aggregate from each source shall have a wear of not more than 40 percent when tested in accordance with Test Method Tex-410-A.

Unless otherwise shown on the Plans, coarse aggregate from each source will be subjected to five (5) cycles of both the sodium sulfate and the magnesium sulfate soundness test in accordance with Test Method
Tex-411-A. When the loss is greater than 12-percent with sodium sulfate and/or 18 percent with magnesium sulfate, further testing will be required prior to acceptance or rejection of the material. A satisfactory record under similar conditions of service and exposure will be considered in the evaluation of material failing to meet these requirements.

When tested in accordance with Test Method Tex-401-A, the coarse aggregate, including combinations of aggregates when used, shall conform to the gradation requirements shown in Table 2.

Table 2
COARSE AGGREGATE GRADATION CHART

Percent Retained on Each Sieve										
Aggregate Grade No.	Nominal Size in.	2-1/2 in.	2 in.	1-1/2 in.	1 in.	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 8
1	2	0	0-20	15-50		60-80			95-100	
2 (467)*	1-1/2		0	0-5		30-65		70-90	95-100	
3	1-1/2		0	0-5		10-40	40-75		95-100	
4 (57)*	1			0	0-5		40-75		90-100	95-100
5 (67)*	1/4				0	0-10		45-80	90-100	95-100
6 (7)*	1/2					0	0-10	30-60	85-100	95-100
7	3/8						0	5-30	75-100	
8	3/8						0	0-5	35-80	90-100

* Numbers in parenthesis indicate that these gradations conform to corresponding ASTM gradation in ASTM C33.

C. Fine Aggregate

Fine Aggregate shall be washed and consist of clean, hard, durable and uncoated particles of natural or Manufactured sand or a combination thereof, with or without a mineral filler. When white Portland cement is specified the fine aggregate used in the concrete shall be light colored. It shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material and it shall not contain more than 0.5-percent by weight of clay lumps. When the aggregate is subjected to the color test for organic impurities in accordance with Test Method Tex-408-A, the test result shall not show a color darker than standard.

Unless otherwise shown on the Plans, the acid insoluble residue of fine aggregate used in concrete subject to direct traffic shall be not less than 60 percent by weight when tested in accordance with Test Method Tex-612-J.

When tested in accordance with Test Method Tex-401-A, the fine aggregate or combinations of aggregates, including mineral filler shall conform to the gradation requirements shown in Table 3.

Table 3
FINE AGGREGATE GRADATION CHART

Percent Retained on Each Sieve								
Aggregate Grade No.	3/8 in.	No. 4	No. 8	No. 16	No. 30	No.50	No. 100	No. 200
1	0	0-5	0-20	15-50	35-75	65-90	90-100	97-100

1. Where manufactured sand is used in lieu of natural sand, the percent retained on the No. 200 sieve shall be 94 to 100.

2. Where the sand equivalent value is greater than 85, the retainage on the No. 50 sieve may be 65 to 94 percent.

3. Fine aggregate will be subjected to the Sand Equivalent Test (Test Method Tex-203-F). The sand equivalent shall not be less than 80 unless otherwise shown on the Plans.

4. For all classes of concrete, except class K, the fineness modulus shall be between 2.30 and 3.10 as determined by Test Method Tex-402-A. The fineness modulus for class K shall be 2.6 to 2.8 unless otherwise shown on the Plans.

Table 4

SLUMP REQUIREMENTS

Class of Conc.	Sacks of Cement per C.Y.	Min. Comp Strength 28 (f'c) 28 Day psi	Min Beam Strength 7 Day	Max. Water Cement Ratio gal/sack	Coarse Aggr. No.
A	5.0	3000	425 390 (3)	6.5	1-2-3-4-8 (1) (4)
B	4.5	2500	300	8.0	2-3-4-5-6-7
C	6.0	3600	510	6.0	1-2-3-4-5-
D	3.0	1500	215	11.0	2-3-4-5-6-7
E	6.0	3000	425	6.0	2-3-4-5
S	6.5	4000	570 525 (3)	5.0	2-3-4-5
P	5.0	NA	555 (2)	6.25	2-3
DC	8.75	5500	720	3.6	6
CO	7.0	4600	640	4.5	6
SS	7.0	3600	510	5.5	3-4-5

1. Grade 8 aggregate for use in extended course, unless a larger size is approved by the Engineer or City.

2. Minimum running average of concrete pavement.

3. When Type II or Type I / II is cement is used.

4. Unless otherwise permitted by the Engineer, Grade I coarse aggregate may only be used in massive foundations with four (4) inch minimum clear spacing between reinforcing steel bars. Grade I aggregate may not be used in Drill Shafts.

CLASS OF CONCRETE	TYPICAL USAGE
A	Drill Shafts, Culverts, (except top of slab of Direct Traffic Culverts), Inlets, Manholes, Headwalls, Approach Slabs, Curb, Gutter, Curb and Gutter, Concrete Retards, Sidewalks, Driveways, Concrete Pavement, Back-up Walls and Anchors.
B	Rip Rap, Small Roadside Signs, and Anchors
C	Drilled Shafts, Bridge Substructures, Bridge Railing, Culverts (except top of slab of Direct Traffic Culverts), Wing Walls, Approach Slabs, Concrete Traffic Barriers
D	Rip Rap
E	Seal Concrete
S	Bridge Slab, Top Slab of Direct Traffic Culvert, Bridge Sub-structure
P	Concrete Pavement
DC	Dense Concrete Overlay
CO	Concrete Overlay
SS	Slurry Displacement Shafts, Underwater Drill Shafts

C2.06 MIXING CONDITIONS

A. The concrete shall be mixed in quantities required for immediate use. Retempering of concrete will not be permitted.

B. In threatening weather, which may result in conditions that will adversely affect quality of the concrete to be placed, the City may order postponement of the work. Where work has been started and changes in weather conditions require protective measures, the Contractor shall furnish adequate shelter to protect the concrete against damage from rainfall, or freezing temperatures. If necessary to continue operations during rainfall, the Contractor shall also provide protective coverings for the material stock piles. Aggregate stock piles need to be covered only to the extent necessary to control the moisture conditions in the aggregates to adequately control the consistency of the concrete.

C2.07 PLACING, CURING AND FINISHING

A. The placing of concrete, including construction of forms and falsework, curing and finishing, shall be in accordance with Section C1- CONCRETE STRUCTURES, and Section C1.14- FINISHING EXPOSED SURFACES.

C2.08 PAYMENT

A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION C6 – MEMBRANE CURING

C6.01 SCOPE OF WORK

A. This specification covers the requirements for curing concrete pavement, concrete pavement (base), curbs, curb and gutters, retards, sidewalks, driveways, medians, islands, concrete riprap, cement stabilized riprap, concrete structures and other concrete as indicated on the plans by impervious membrane method.

C6.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including the type of membrane curing, the Manufacturer of the method used, a description of the water retention test to be used, and all other pertinent data to illustrate conformance to the specification found within.

C6.03 MATERIALS

A. The membrane curing compound shall comply with the "Standard Specification for Liquid Membrane-forming Compounds for Curing Concrete", ASTM Designation: C 309, Type 1 clear or translucent, or Type 2 white pigmented. The material shall have a minimum flash point of 80° F when tested by the "Pensky-Martin Closed Cup Method".

B. It shall be of such consistency that it can be satisfactorily applied as a fine mist through an atomizing nozzle by means of approved pressure spraying equipment at atmospheric temperatures above 40° F.

C. It shall be of such nature that it will not produce permanent discoloration of concrete surfaces nor react deleteriously with the concrete or its components. Type 1 compound shall contain a fugitive dye that will be distinctly visible for not less than four (4) hours or more than seven (7) days after application.

D. The compound shall produce a firm, continuous, uniform moisture impermeable film free from pinholes and shall adhere satisfactorily to the surfaces of damp concrete. It shall, when applied to the damp concrete surface at the rate of coverage specified herein, dry to touch in not more than four (4) hours and shall adhere in a tenacious film without running off or appreciably sagging. It shall not disintegrate, check, peel or crack during the required curing period.

E. The compound shall not peel or pick up under traffic and shall disappear from the surface of the concrete by gradual disintegration.

F. The compound shall be delivered to the job only in the Manufacturer's original containers, which shall be clearly labeled with the Manufacturer's name, the trade name of the material, and a batch number or symbol with which test samples may be correlated.

G. The water retention test shall be in accordance with Test Method Tex-219-F. Percentage loss shall be defined as the water lost after the application of the curing material was applied. The permissible percentage moisture loss (at the rate of coverage specified herein) shall not exceed the following:

24 hours after application.....2 percent
72 hours after application.....4 percent

C6.04 CONSTRUCTION METHODS

A. The membrane curing compound shall be applied after the surface finishing has been completed, and immediately after the free surface moisture has disappeared. The surface shall be sealed with a single uniform coating of the specified type of curing compound applied at the rate of coverage recommended by the Manufacturer and directed by the City, but not less than one (1) gallon per 180 square feet of area. The Contractor shall provide satisfactory means and facilities to properly control and check the rate of applications of the compound.

B. The compound shall be thoroughly agitated during its use and shall be applied by means of approved mechanical power pressure sprayers. The sprayers used to apply the membrane to concrete pavement or concrete pavement (base) shall travel at uniform speed along the forms and be mechanically driven. The equipment shall be of such design that it will insure uniform and even application of the membrane material. The sprayers shall be equipped with satisfactory atomizing nozzles. Only on small miscellaneous items will the Contractor be permitted to use hand powered spray equipment. For all spraying equipment, the Contractor shall provide facilities to prevent the loss of the compound between the nozzle and the concrete surface during the spraying operations.

C. The compounds shall not be applied to a dry surface and if the surface of the concrete has become dry, it shall be thoroughly moistened prior to application of membrane by fogging or mist application. Sprinkling or coarse spraying will not be allowed.

D. At locations where the coating shows discontinuities, pinholes, or other defects; or if rain falls on the newly-coated surface before the film has dried sufficiently to resist damage, an additional coat of the compound shall be applied immediately at the same rate of coverage specified herein.

E. To insure proper coverage, the City shall inspect all treated areas after application of the compound for the period of time designated in the governing specification for curing, either of membrane curing or for other methods. Dry areas are identifiable because of the lighter color of dry concrete as compared to damp concrete. All suspected areas shall be tested by placing a few drops of water on the suspected areas. If the water stands in rounded beads or small pools which can be blown along the surface of the concrete without wetting the surface, the water-impervious film is present. If the water wets the surface of the concrete as determined by obvious darkening of the surface, or by visible soaking into the surface, no water-impervious film is present. Should the foregoing test indicate that any area during the curing period is not protected by the required water-impervious film, additional coat or coats of the compound shall be applied immediately, and the rate of application of the membrane compound shall be increased until all areas are uniformly covered by the required water-impervious film.

F. When temperatures are such as to warrant protection against freezing, curing by this method shall be supplemented with an approved insulating material capable of protecting the concrete for the specified curing period.

G. If at any time there is reason to believe that this method of curing is unsatisfactory or is detrimental to the work, the Contractor, when notified, shall immediately cease the use of this method and shall change to curing by one (1) of the other methods specified under this contract.

C6.05 PAYMENT

A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATION

SECTION C8 - REINFORCED CONCRETE PIPE

C8.01 SCOPE OF WORK

A. This specification covers the requirements for the placing of reinforced concrete pipe and for the material and incidental construction requirements for reinforced concrete pipe sewers. The culvert pipe shall be installed in accordance with the requirements of these specifications to the lines and grades shown on the Plans, and shall be of the classes, sizes and dimensions shown thereon. The installation of pipe shall include all joints or connections to new or existing pipe, headwalls, etc., as may be required to complete the work. The locations of private driveway and side road pipe may be varied as deemed necessary by the Engineer or the City.

C8.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including pipe Manufacturer, joint material, bedding material, fittings, geotextile fabric, and all pertinent data to illustrate conformance to the specification found within.

C8.03 MATERIALS

A. The pipe shall be of the Class specified on the Plans. The shell thickness, the amount of circumferential reinforcement and the strength of the pipe shall conform to the specified Class as summarized in ASTM Designation: C76 for Circular Pipe: C506 for Arch Pipe or C507 for Horizontal Elliptical Pipe.

1. All precast concrete pipe shall be machine made or cast by a process which will provide for uniform placement of the concrete in the form and compaction by mechanical devices which will assure a dense concrete. Concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed concrete will not be acceptable for use in precast pipe.

2. Unless otherwise approved by the City, not more than two (2) holes may be placed in the top section of precast pipe for lifting and placing. The holes may be cast, cut, or drilled in the wall of the pipe. The holes shall not exceed three (3) inches in diameter at the inside of surface of the pipe wall. Not more than one (1) longitudinal wire or two (2) circumferential wires may be cut per layer of reinforcing steel when locating lift holes in the pipe wall. After the pipe is in place, lift holes shall be filled with concrete or mortar or precast concrete plugs to the satisfaction of the Engineer.

3. The Contractor has the option of using portland cement or portland cement plus fly ash. When fly ash is used, then “cement” shall also be defined as “cement plus fly ash”. “Cement plus fly ash” shall be composed of portland cement of the type specified and 20 to 35 percent fly as by absolute volume. Type B fly ash shall not be used when Type II cement is shown on the plans. When portland cement is partially replaced, blended or otherwise modified by a pozzolan, the pozzolan is defined and limited to fly ash conforming to TxDOT Department Materials Specification D-9-8900, “Fly Ash”.

B. Jointing Materials

1. Cold Applied, Plastic Asphalt Sewer Joint Compound shall be suitable for jointing concrete pipe. It shall consist essentially of natural and/or processed asphalt base, suitable volatile solvents, and inert filler. The consistency is to be such that the ends of the pipe can be coated with a layer of the compound up to one-half ($^1/_2$) inch thick by means of a trowel. It shall cure to a firm, stiff plastic condition after application. The material shall be of a uniform mixture and any small separation occurring in the container before use must by readily stirred back to form a uniform mix.

2. Mortar for joints shall consist of one (1) part cement, two (2) parts sand and sufficient water to make a plastic mix. The sealing of joints with mortar shall be in accordance with TxDOT Item 464 of the Standard Specifications for Construction of Highways, Streets and Bridges.

3. Rubber gaskets shall conform to ASTM C361 or C443. The design of the joints and permissible variations in dimensions shall be in accordance with ASTM C443. The Contractor shall furnish the Engineer the Manufacturer's Certificate of Analysis. Rubber gaskets shall be installed according to the recommendations of the Manufacturer. Water tight joints will be required when using rubber gaskets. Backfilling may begin when approved by the City.

4. Cold applied preformed plastic gaskets shall be suitable for sealing joints of tongue and groove concrete pipe in accordance with TxDOT Item 464 of the Standard Specifications for Construction of Highways, Streets and Bridges.

C. Rubber Gaskets shall conform to ASTM Designation: C361 or C443, with the provision that the Contractor shall furnish the City the Manufacturer's Certificate of Analysis.

D. Cold Applied Preformed Plastic Gaskets shall be suitable for sealing joints of tongue and groove concrete pipe. The gasket sealing the joint shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes or obnoxious odors. The gasket joint sealer shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength, and shall be supplied in extruded rope-form of suitable cross-section. The size of the plastic gasket joint sealer shall be in accordance with the Manufacturer's recommendations and sufficient to obtain the squeeze-out as described under "Jointing", The gasket joint sealer shall be protected by a suitable removable two-piece wrapper. The two-piece wrapper shall be so designed that one-half may be removed longitudinally without disturbing the other half.

E. All fittings and wyes shall be manufactured and not constructed on the project unless prior approval is granted by the City.

F. All joints that are not sealed with a watertight connection shall be wrapped with MARFI-140-N geotextile fabric or equivalent. The joint shall be wrapped with 18-inch wide fabric splitting the joint (nine (9) inches on each side).

C8.04 CONSTRUCTION METHODS

A. Excavation. All excavation shall be in accordance with the requirements of Section G9-STRUCTURAL EXCAVATION. Before pipe is laid in a trench, the completed and shaped trench to receive the pipe shall be of sufficient width to provide free working space for satisfactory bedding and jointing and thorough tamping of the backfill and bedding material under and around the pipe. The Contractor shall make such temporary provisions as may be necessary to insure adequate drainage of the trench and bedding during the construction operation.

B. Bedding. The pipe shall be bedded in accordance with the details shown on the Plans. Where the soil encountered at the established grade is quicksand, muck, or similar unstable material, unless special construction methods are called for on the Plans or in the special provisions, such unstable soil shall be removed and replaced in accordance with the requirements of Section G9-STRUCTURAL EXCAVATION.

C. Laying Pipe. Unless otherwise authorized by the City, the laying of pipe on the prepared foundation shall be started at the outlet end with the spigot or tongue end pointing downstream and shall proceed toward the inlet. Where bell and spigot pipe are used, cross trenches shall be cut in the foundation to allow the barrel of the pipe to rest firmly upon the prepared bed. These cross trenches shall be not more than two (2) inches larger than the bell ends of the pipe. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trench without disturbing the prepared foundation and the trench. The ends of the pipe shall be carefully cleaned before the pipe is placed. As each length of pipe is laid, the mouth of the pipe shall be protected to prevent the entrance of earth or bedding material. The pipe shall be fitted and matched so that when laid in the bed shall form a smoother, uniform conduit. When elliptical pipe with circular reinforcing or

circular pipe with elliptical reinforcing is used, the pipe shall be laid in the trench in such position that the markings "Top" or "Bottom", shall not be more than five (5) degrees form the vertical plane through the longitudinal axis of the pipe.

Multiple installations of reinforced concrete pipe shall be laid with the centerlines of individual barrels parallel. When not otherwise indicated on the Plans, the following clear distances between outer surfaces of adjacent pipe shall be used.

Diameter of Pipe	18"	24"	30"	36"	42"	48"	54"	60" - 84"
Clear Distance Between Pipes	0' –9"	0' –11"	1' –1"	1' –3"	1' –5"	1' –7"	1' –11"	2' –0"

D. Jointing. All piping, if specified by the Plans, Details, or the City,

1. Joints sealed with Portland cement mortar shall be made as follows: mortar, composed of one (1) part portland cement and two (2) parts sand, so placed as to form a durable water-tight joint. The ends of the pipe shall be cleaned thoroughly and wetted before making the joint. After any section of pipe is laid and before any succeeding section is laid the lower half of the bell or groove of the pipe last laid shall be plastered thoroughly by troweling on an even layer of mortar. Next, mortar shall be applied to the upper portion of the tongue or spigot of the pipe section being laid.

   The spigot or tongue end of the next section of pipe shall then be inserted and the joint pulled up tight, taking care that the inner surfaces of the abutting pipe section are flush and even. After the section is laid and uniformly matched and the sections have been fitted as close as the construction of the pipe will permit, the lower half of the inner circumference of the joints of pipe over 18-inches in diameter shall be sealed and packed with mortar and finished smooth and even with the adjacent section of pipe. Before this mortar has attained initial set, additional mortar then shall be applied from the outside and forced into the unfilled portion of the bell or grooved to fill completely the annular space around the spigot or tongue. For bell and spigot pipe, a bead shall be formed on the outside by troweling on mortar downward at an angle of 45 degrees from the outer edge of the bell to the spigot of the last laid section. For tongue and groove pipe, a bead shall be formed extending at least one (1) inch on either side of the joint and of approximately semicircular cross-section or triangular cross-section. If the triangular cross-section is used, it shall be formed by placing the mortar approximately 45 degrees outward form the extreme edges of the bead. For pipe too small to permit finishing of the inside surface of the joint, a tight stopper of burlap or other equivalent materials shall be dragged through the pipe past the new joint to remove any fins of mortar. Special care shall be exercised in placing adjacent pipe sections to avoid movement of the pipe in place and the breaking of the mortar bond at completed joints. After the initial set, the mortar on the outside shall be protected form air and sun with a thoroughly wetted earth or burlap cover or acceptable equivalent which shall be kept wet for a minimum of 48 hours or until the backfill has been completed. No jointing shall be done when the atmospheric temperature is at or below 40° F, and when necessary, because of a sudden drop in temperature, joints shall be protected against freezing for at least 24 hours. After placing, any pipe which is not in true alignment or which shows any undue settlement after laying or is damaged, shall be taken up and relayed or replace without extra compensation.

   At the Contractor's option, and with the approval of the City for pipes which are large enough for a man to enter and perform the required work efficiently, pipe may be furnished with the groove not less than one-half ($^1/_2$) of an inch and not more than three-fourths ($^3/_4$) of an inch longer than the tongue. Such pipe may be laid without mortar joints and backfilled. Care shall be exercised to avoid displacing the joints during the backfilling operations. After the backfilling has been completed, the space between the end of the tongue and the groove shall be cleaned of all foreign material, thoroughly wetted and filled with mortar around the entire circumference of the pipe. Mortar for this use shall be of such consistency that it can be packed in the joint completely filling the space between adjacent pipes. The City will inspect this process to ascertain that the joints are being

completely filled. If the City finds that this is not being accomplished, he may void this process and require that for the remainder of the project the pipe be jointed and backfilled in accordance with the provisions of the first paragraph of this section.

The Contractor shall make available for the use of the City an appropriate rolling device similar to an automobile mechanic's "Creeper" for conveyance through the small size pipe structures.

No mortar banding on the outside of pipe will be required for side drain culverts. No joint material will be required for temporary culverts.

Mortar joints will be required for irrigation wells, vents and similar vertical structures.

2. Joints using Cold Applied, Plastic Asphalt Sewer joint compound shall be made as follows: Both ends of the pipes shall be clean and dry and shall be coated with a suitable primer of the type recommended by the Manufacturer where they will be in contact with the joint material. Under no circumstance shall this type of joint be attempted on wet pipe. After the pipe has been set to proper line and grade in the trench, a one-half ($^1/_2$) of an inch thick layer of the compound shall be troweled or otherwise placed on the groove end of the pipe covering not less than two-thirds ($^2/_3$) of the joint face around the entire circumference. Next the tongue end of the next pipe shall be shoved home with sufficient pressure to make a tight joint. After the joint is made, any excess mastic projecting into may proceed as soon as the joint has been inspected and approved by the City. Special precautions shall be taken in placing and compacting backfill to avoid damage to the joints.

3. Joints using rubber gaskets shall be made as follows: Where rubber gasket pipe joints are required by the Plans, the joint assembly shall be made according to the recommendations of the gasket Manufacturer. Watertight joints will be required when using rubber gaskets.

4. Joints using cold applied preformed plastic gaskets shall be made as follows: A suitable primer of the type recommended by the Manufacturer of the gasket joint sealer shall be brush applied to the tongue and groove joint surfaces and the end surfaces and allowed to dry and harden. No primer shall be applied over mud, sand or dirt or sharp cement protrusions. The surface to be primed must be cleaned and dry when primer is applied.

   Before laying the pipe in the trench, the plastic gasket sealer shall be attached around the tapered tongue or tapered groove near the shoulder or hub of each pipe joint. The paper wrapper shall be removed from one (1) side only of the two (2) piece wrapper on the gasket and pressed firmly to the clean, dry pipe joint surface. The outside wrapper shall not be removed until immediately before pushing the pipe into its final position.

   When the tongue is correctly aligned with the flare of the groove, the outside wrapper on the gasket shall be removed and the pipe shall be set with sufficient force and power, (Back hoe shovel, chain hoist, ratchet hoist or winch), to cause the evidence of squeeze-out of the gasket material on the inside or outside around the complete pipe that would tend to obstruct the flow shall be removed. (Pipe shall be set in a straight line with all parts of the pipe on line and grade at all times). Backfilling of pipe laid with plastic gasket joints may proceed as soon as the joint has been inspected and approved by the City. Special precautions shall be taken in placing and compacting backfill to avoid damage to the points.

   When the atmospheric temperature is below 60° F, plastic joint seal gaskets shall either be stored in an area warmed to above 70° F, or artificially warmed to this temperature in a manner satisfactory to the City. Gaskets shall then be applied to pipe joints immediately prior to placing pipe in trench, followed by connection to previously laid pipe.

E. Backfilling. After the pipe has been placed, bedded and jointed as specified, filling and/or backfilling shall be done in accordance with the applicable requirements of Section G9-STRUCTURAL EXCAVATION. When mortar joints are specified, no fill or backfill shall be placed until the jointing material has been cured for at least six (6) hours. Special precautions shall be taken in placing and compacting the backfill to avoid any movement of the pipe or damage to the joints. Joints consisting of material other than mortar may be backfilled immediately.

F. Protection of Pipe. Unless otherwise shown on the Plans or permitted in writing by the City, no heavy earth moving equipment will be permitted to haul over the structure until a minimum of four (4) feet of permanent or temporary, compacted fill has been placed thereon. Pipe damaged by the Contractor's equipment shall be removed and replaced by the Contractor at no additional cost.

C8.05 PAYMENT

A. Payment for furnished and installed reinforced concrete pipe shall be paid according to the unit price per linear foot in the proper item of the Proposal and Bid Schedule. All work and materials to complete the reinforced concrete pipe including, but not limited to, excavation, bedding, backfill, connection to structures, etc., shall be subsidiary to this item.

END SECTION

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TECHNICAL SPECIFICATIONS

SECTION C9 – FLOWABLE BACKFILL

C9.01 SCOPE OF WORK

A. This specification covers the requirements for the furnishing and placing of flowable backfill as indicated on the Plans.

C9.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including flowable backfill mix design, curing method, and all other pertinent data to illustrate conformance to the specification found within.

C9.03 CONSTRUCTION METHODS

A. All trenches to be backfilled shall be properly prepared according to the Plans and Specifications prior to placement of flowable backfill.

C9.04 FLOWABLE BACKFILL

A. Flowable backfill shall be placed in accordance with the details and to the dimensions shown on the Plans or as established by the City.

B. The mixture shall consist of 188 pounds of Type III Portland cement, 94 pounds of fly ash and 3,000 pounds of sand per cubic yard of flowable backfill.

C. The minimum allowable slump for flowable backfill is 6-inches.

D. Immediately following the placement of flowable backfill, it shall be cured in accordance with Section C1- CONCRETE STRUCTURES.

C9.05 PAYMENT

A. Payment for flowable backfill shall be subsidiary to the appropriate bid items of the Proposal and Bid Schedule.

END OF SECTION

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SPECIAL SPECIFICATIONS

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SECTION 33 05 22
JACKING PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Minimum requirements for manufacturing, furnishing, and transporting Steel Jacking Pipe, Concrete Jacking Pipe, or Centrifugally Cast Fiberglass Reinforced Polymer Mortar (CCFRPM) Jacking Pipe to be installed by trenchless methods at the locations shown on the Drawings.

B. Related Specification Sections include, but are not necessarily limited to:
   1. Section 33 05 24 – Installation of Carrier Pipe in Casing
   2. Section 33 30 02 – Trenchless Excavation by Tunnel Boring Machine
   3. Section 33 30 03 – Trenchless Excavation by Microtunnel Boring Machine
   4. Section 33 30 04 – Trenchless Excavation by Hand Tunneling
   5. Section 35 23 24 – Contact Grouting
   6. Section 33 05 37.03 - Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe (CCFRPM) for Jacking Installation

C. Related Documents:
   1. Geotechnical Engineering Report, Revision 2 (GER); Berry Creek Offsite Wastewater Main – North Alternative; Georgetown, Texas; prepared for Walker Partners by Terracon Consultants, Inc.; March 8, 2023.
   2. Hydrologic Report for the Berry Creek Wastewater Interceptor Project (Hydrologic Report); Williamson County, Texas; prepared for Walker Partners by SWCA Environmental Consultants; October 2022.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. Measurement
      a. No separate measurement will be made for this item.
   2. Payment
      a. The work performed and materials furnished in accordance with this Item are subsidiary to the lump sum cost bid for the reach in which Jacking Pipe is installed, complete in place, and no other compensation will be allowed.

1.3 REFERENCES

A. Reference Standards
   1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
   2. American Society of Civil Engineers (ASCE):
      a. CI 27-17, Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction

3. ASTM International (ASTM):
   a. A36, Standard Specification for Carbon Structural Steel
   b. A139, Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS Sizes 4 and Over).
   c. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
   d. C1417 Specification for Manufacture of Reinforced Concrete Sewer, Storm Drain, and Culvert Pipe for Direct Design
4. American Water Works Association (AWWA):
   a. C200, Steel Water Pipe, 6-IN and Larger
   b. M11 Steel Pipe: A Guide for Design and Installation

1.4 DEFINITIONS

A. Jacking Pipe: Steel pipe, reinforced concrete pipe, or Centrifugally Cast Fiberglass Reinforced Polymer Mortar (CCFRPM) Pipe utilized to thrust the tunnel boring machine, microtunnel boring machine, or hand tunneling shield to perform the trenchless excavations.

B. Microtunnel Boring Machine (MTBM): See Section 33 30 03 – Trenchless Excavation by Microtunnel Boring Machine.

C. Tunnel Boring Machine (TBM): See Section 33 30 02 – Trenchless Excavation by Tunnel Boring Machine.

D. Hand Tunneling Shield: See Section 33 30 04 – Trenchless Excavation by Hand Tunneling.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section CIP10

B. The Contractor shall submit shop drawings including the following:
   1. Pipe stulling plan.
   2. Details for Jacking Pipe outlining the following:
      a. Grout and lubrication ports
      b. Joint details
      c. Other miscellaneous items for furnishing and fabricating pipe

C. The Contractor shall submit calculations in a neat, legible format that are sealed by a Licensed Professional Engineer in Texas, consistent with the information provided in the GER, and includes:
   1. Calculations of the anticipated jacking loads considering the anticipated geologic conditions and drive length for each drive.
   2. Calculations confirming that Jacking Pipe capacity is adequate to resist the anticipated jacking loads with the minimum required factor of safety.
   3. Calculations confirming that Jacking Pipe capacity is adequate to safely support all other anticipated loads, including earth and groundwater pressures, surcharge loads, and handling loads.
   4. Calculations confirming that jointing method will support all loading conditions.

D. The Contractor shall submit certificates and test reports prior to shipment of the pipe including a Certificate of Adequacy of Design stating that the pipe to be furnished complies with the requirements in article 2.1 of this Section for the chosen pipe type.

1.6 QUALITY ASSURANCE [NOT USED]

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery, Handling, and Storage
   1. Prior to delivery of the pipe, end/internal bracing shall be furnished and installed, as recommended by the manufacturer, for protection during shipping and storage.
   2. Deliver, handle and store pipe in accordance with the Manufacturer's recommendations to protect coating systems.

PART 2 - PRODUCTS

2.1 MATERIALS

A. For trenchless installation, provide grout/lubricant ports along the pipe at intervals of 10 feet or less.
   1. Ports and fittings shall be attached to the pipe in a manner that will not materially affect the strength of the pipe nor interfere with installation of carrier pipe.
   2. Plugs for sealing the fittings shall be provided by the Contractor and shall be capable of withstanding all external and internal pressures and loads without leaking.

B. Steel Jacking Pipe:
   1. Shall have a minimum ½ inch wall thickness.
   2. Shall be new, smooth-wall, carbon steel pipe conforming to ASTM A36; ASTM A139, Grade B; or ASTM A572, Grade 42.
   3. All materials, design, fabrication, handling, and testing of steel Jacking Pipe shall conform to the requirements of ASTM A139, AWWA C200, AWWA Manual 11
   4. All materials, design, fabrication, handling, and testing of Permalok steel Jacking Pipe shall conform to the requirements of ASTM A36, ASTM A572, Grade 42.
   5. Steel Jacking Pipe shall be fabricated with longitudinal weld seams.
   6. All girth weld seams shall be ground flush.
   7. When steel pipe ends have to be beveled for welding, the ends shall be beveled on the outside to an angle of 35 degrees with a tolerance of ± 2½ degrees and with a width of root face 1/16 inch ± 1/32 inch.
   8. Shall meet the requirements of TxDOT for installation beneath TxDOT right-of-way.

C. Concrete Jacking Pipe:
   1. shall be new reinforced concrete pipe designed and manufactured for jacking applications conforming to ASCE CI 27-17.
   2. All materials, design, fabrication, handling, and testing of concrete Jacking Pipe shall conform to the requirements of ASCE CI 27-17, ASTM C1417.

D. CCFRPM Jacking Pipe:
   1. Shall be specifically designed and manufactured for jacking applications.
   2. Refer to Section 33 05 37.03 – Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe for Jacking Installation.

E. Dimensional Tolerances

1. Furnish and install Jacking Pipe with dimensional tolerances that are compatible with performance requirements and proposed installation methods that meet or exceed the specific requirements below:
   a. Minimum wall thickness at any point shall be at least 95 percent of the nominal wall thickness.
   b. Outside circumference within 1.0 percent or 3/4 inch of the nominal circumference, whichever is less.
   c. Roundness such that the difference between the major and minor outside diameters shall not exceed 0.5 percent of the specified nominal outside diameter or 1/4 inch, whichever is less.
   d. Maximum allowable straightness deviation of 1/8 inch in any 10-foot length.
2. All Jacking Pipe shall have square ends.
   a. The ends of pipe sections shall not vary by more than 1/8 inch at any point from a true plane perpendicular to the axis of the pipe and passing through the center of the pipe at the end.

PART 3 - EXECUTION

3.1 DESIGN

A. The Contractor is fully responsible for the design of Jacking Pipe that meets or exceeds the design requirements of this Specification and that is specifically designed for installation by the planned trenchless method.

B. Design of the Jacking Pipe shall account for all installation and service loads including:
   1. Jacking loads with the minimum factor of safety (FS):
      a. Steel jacking pipe FS=2.0 minimum
      b. Reinforced concrete jacking pipe FS=2.0 minimum
      c. CCFRPM jacking pipe FS=3.0 minimum
   2. External groundwater and earth loads.
   3. Traffic loads including HS-20 as applicable.
   4. Practical consideration for handling, shipping, and other construction operations.
   5. Any other live or dead loads reasonably anticipated.

C. Design shall be sealed and signed by a registered Professional Engineer licensed in the State of Texas.

3.2 INSTALLATION

A. Install Jacking Pipe for trenchless installation in accordance with Section 33 30 02 – Trenchless Excavation by Tunnel Boring Machine, Section 33 30 03 – Trenchless Excavation by Microtunnel Boring Machine, and Section 33 30 04 – Trenchless Excavation by Hand Tunneling as applicable.

B. Joints
   1. Steel
      a. Welded steel joints shall include full penetration field butt welding.
      b. Integral machine press-fit connection shall be in accordance with manufacturer recommendation such as Permalok, Northwest Pipe Company, Inc., or approved equal.
   2. Reinforced Concrete

a. Adjacent pipe sections shall be separated by a cushioning material to facilitate a uniform transfer of stress between contact surfaces and to minimize radial splitting pressures associated with high bearing pressures. The cushioning material shall be held back from the edge of bearing surfaces to minimize edge distress.

3. CCFRPM
   a. Pipe joints shall comply with Section 33 05 37.03 – Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe for Jacking Installation

C. In a two-pass installation, Jacking Pipe shall be provided with inside diameter sufficient to efficiently install the required carrier pipe with casing spacers and to allow installation of the carrier pipe within the line and grade tolerance as required in Section 33 05 24 – Installation of Carrier Pipe in Casing. If installed directly, the CCFRPM Jacking Pipe shall be provided with an inside diameter equal to or slightly larger than the inside diameter of the CCFRPM carrier pipe that would be provided in a two-pass installation.

D. Random segments of pipe will not be permitted for straight runs of Jacking Pipe. Closing piece segments, however, shall be acceptable.

E. Contact grouting of the annulus outside the Jacking Pipe shall be performed in accordance with Section 35 23 24 – Contact Grouting.

END OF SECTION

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SECTION 33 05 24
INSTALLATION OF CARRIER PIPE IN CASING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for the installation of Centrifugally Cast Fiber Reinforced Polymer Mortar Pipe (CCFRPM) carrier pipe into oversized jacking pipe or casing at locations shown on the Drawings and where a two-pass trenchless installation method is utilized.

B. Related Specification Sections include, but are not necessarily limited to:
   1. Section 33 05 22 – Jacking Pipe
   2. Section 33 30 02 – Trenchless Excavation by Tunnel Boring Machine
   3. Section 33 30 03 – Trenchless Excavation by Microtunnel Boring Machine
   4. Section 33 30 04 – Trenchless Excavation by Hand Tunneling

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. Installation of Carrier Pipe in Casing
      a. Measurement
         1) No separate measurement shall be made for this item.
      b. Payment
         The work performed and materials furnished in accordance with this item are subsidiary to the lump sum cost bid for the reach in which carrier pipe is installed in casing, complete in place, and no other compensation will be allowed.

1.3 REFERENCES

A. Reference Standards
   1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
   2. American Society of Testing and Materials (ASTM)
      a. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      b. C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or [50 mm] Cube Specimens).
   3. Occupational Safety and Health Administration (OSHA)
      a. OSHA Regulations and Standards for Underground Construction, 29 CFR Part 1926, Subpart S, Underground Construction and Subpart P, Excavation.

1.4 DEFINITIONS

A. Annular space: The void between the outside of the carrier pipe and the inside of the casing to be filled with Low Density Cementitious Material (LDCM).

B. Carrier Pipe: Permanent pipe for operational use that is used to convey flows.

C. Casing: An oversized steel or reinforced concrete pipe installed by a two-pass trenchless method that supports the ground and provides a stable underground excavation for installation of the carrier pipe within.

D. Casing spacers: Spacers or blocking material designed to support the carrier pipe during installation within the casing and to support the carrier pipe during LDCM placement to prevent movement and provide resistance to buoyant forces. The casing spacers shall be of a material and installed in a configuration recommended by the carrier pipe manufacturer.

E. Low Density Cementitious Material (LDCM): A lightweight cementitious material that contains stable air or gas cells uniformly distributed throughout the mixture of a volume percentage greater than 20 percent.

1.5 SUBMITTALS

A. Submittals shall be in accordance with CIP10.

B. The Contractor shall submit information demonstrating adherence with the qualification requirements outlined in Section 1.6 minimum 30 days prior to the start of work.

1. Submit project name, date, location, description (diameter and length) of tunnel(s), description of procedures, and names and contact information of references with individual knowledge of the work on each project.

C. Work Plans

1. Carrier pipe installation equipment, materials, and construction methods to be employed.
2. Carrier pipe support and casing spacer plan, including:
   a. Detail drawings and carrier pipe manufacturer's information for the casing spacers that will be used.
   b. Calculations, sealed by a Professional Engineer, demonstrating that spacers and spacer arraignment and spacing is suitable to support the weight of pipe and resist buoyancy forces during installation and grouting without deformation of or damage to the carrier pipe.
3. End seal or bulkhead designs.
4. Annular Space Grouting Work Plan and Methods, including:
   a. Grouting methods and equipment
   b. Grouting procedures and sequences including:
      1) Injection methods and grout port locations.
      2) Injection pressures confirming accordance with the carrier pipe manufacturer's recommendations
      3) Monitoring and recording equipment
      4) Pressure gauge calibration data
   c. LDCM grout mix details including:
      1) Proportions
      2) Proposed grout densities, viscosity, and set time.
      3) Laboratory test results of trial batches verifying the strength, density, set time, and viscosity.
      4) Admixtures with manufacturer's literature

D. Daily logs of annulus grouting operations.

E. Grout strength test results.

1.6 QUALITY ASSURANCE

A. Qualifications
   1. Carrier pipe placement and annulus grouting work shall be performed by an experienced subcontractor or Contractor who has at least 5 years of experience in performing similar work and has completed at least three projects of similar nature.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Low Density Cementitious Material (LDCM)
   1. The LDCM shall be Portland cement-based grout mix with the addition of a foaming agent designed for this application.
   2. Compressive Strength: minimum strength of 10 psi in 24 hours, 300 psi in 28 days
   3. Provide less than 1 percent shrinkage by volume.
   4. Design grout mix with the proper density and use proper methods to prevent floating of the carrier pipe.
   5. Proportion grout to flow and to completely fill the annular space.

B. Casing Spacers shall be new and produced by a reputable manufacturer of casing spacers of similar size and/or meet the specific recommendations of the carrier pipe manufacturer specifically for the use in this application.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General
   1. Carrier pipe installation shall not begin until the following tasks have been completed:
      a. All required submittals have been provided, reviewed, and accepted.
      b. All contact grouting of casing is complete.
      c. Remove all loose soil, debris, and standing water from casing.
      d. Grind smooth all rough welds at casing joints.
      e. Final casing alignment data and record drawings have been submitted and accepted by Engineer.
      f. Site safety representative has prepared a code of safe practices and an emergency plan in accordance with applicable requirements.

B. Carrier Pipe Line and Grade tolerances
   1. Lay pipe to slope gradients noted on drawings.
   2. Perform survey checks of line-and-grade of carrier pipe during installation operations.
   3. The Contractor is fully responsible for the accuracy of the installation and the correction of it, as required. Where the carrier pipe installation does not satisfy the specified tolerances, correct the installation, including if necessary, redesign of the pipe or structures at no additional cost to Owner.

C. Installation of Carrier Pipe
   1. Installation of Casing Spacers
      a. Provide casing spacers or other approved devices to prevent flotation, movement, and/or damage to the pipe during installation and LDCM backfill placement.
      b. Casing spacers shall be designed and installed in accordance with manufacturer's recommendations and approved submittals.
      c. Casing spacers and their spacing shall be designed by a licensed professional engineer.
   2. Carrier pipe shall be installed without sliding or dragging it on the ground or in the casing in a manner that could damage the pipe or coatings.
   3. Submit line and grade survey data for approval demonstrating carrier pipe installation is within line and grade tolerances prior to installation of end seals and placement LDCM grout in the annulus.
   4. Transitions from CCFRPM jacking pipe to carrier pipe installed in two-pass tunneling or jacking pipe to direct bury pipe shall only be allowed at manholes. The contractor shall not connect jacking pipe to two-pass carrier pipe nor connect jacking pipe to direct bury pipe.

D. Installation of End Seals
   1. Provide end seals at each end of the casing to contain the LDCM during placement.
   2. Design end seals to withstand the planned grouting pressure and be watertight to prevent groundwater from entering the casing.
   3. End seals shall be designed by a licensed professional engineer.

E. Annular Space Grouting
   1. Annular space shall be filled with LDCM in all locations.
   2. Equipment:
      a. Mix material in equipment of sufficient size to provide the desired amount of grout material for each stage in a single operation. The equipment shall be capable of mixing the grout at the required densities for the approved procedure and shall be capable of changing the densities as required by field conditions.
      b. Pumping equipment shall be of a size sufficient to inject grout at a volume, velocity and pressure compatible with the size/volume of the annular space.
      c. Use grout pipes, or other appropriate materials, to avoid damage to carrier pipe during grouting.
   3. LDCM Placement
      a. Prior to filling of the annular space, test the carrier pipe in accordance with Section 33 05 37.02 CCFRPM for Tunnel Carrier Installation.
      b. Verify the maximum allowable pressure with the carrier pipe manufacturer, outlined in the approved submittal, and/or with the design engineer and do not exceed this pressure.
      c. Maximum injection pressure shall be 5 psi.
      d. Begin placing LDCM grout through the port at the lowest elevation in the pipe or in the end seal.
      e. Once grouting operations begin, grouting shall proceed uninterrupted, unless grouting procedures require multiple stages.

f. Grout placements shall be terminated when grout flows from the upper most port or when other means of confirming the complete filling of the annular space have been achieved.

3.2 FIELD QUALITY CONTROL

A. Reports and Records required for pipe installations
   1. Maintain and submit daily logs of grouting operations.
      a. Include:
         1) Grouting locations
         2) Pressures
         3) Volumes
         4) Grout mix pumped
         5) Time of pumping
   2. Note any problems or unusual observations on logs.

B. Grout Strength Tests
   1. Contractor shall perform testing for 24-hour and 28-day compressive strength tests for the cylinder molds or grout cubes obtained during grouting operations.
   2. Contractor shall perform field sampling during annular space grouting.
      a. Contractor shall collect at least 1 set of 4 cylinder molds or grout cubes for each 100 cubic yards of grout injected but not less than 1 set for each grouting shift.
      b. Contractor shall perform 24-hour and 28-day compressive strength tests per ASTM C39 (cylindrical specimens) or ASTM C109 (cube specimens).
      c. Remaining samples shall be tested as directed by Owner or Engineer.

3.3 CLEANING

A. During pipe installation, the carrier pipe interior shall remain free of debris.

B. Immediately upon completion LDCM grouting the carrier pipe shall be cleaned of all grout and debris and in accordance with Section CIP12

3.4 SAFETY

A. The Contractor is responsible for safety on the job site.
   1. Perform all Work in accordance with the current applicable regulations of the Federal, State and local agencies.
   2. In the event of conflict, comply with the more restrictive applicable requirement.

B. No gasoline powered equipment shall be permitted in jacking shafts and receiving shafts/pits.
   1. Diesel, electrical, hydraulic and air powered equipment is acceptable, subject to applicable local, State and Federal regulations.

C. Methods of construction shall be such as to ensure the safety of the Work, Contractor's and other employees on site and the public.

D. Furnish and operate a temporary ventilation system in accordance with applicable safety requirements when personnel are underground.
   1. Perform all required air and gas monitoring.
   2. Ventilation system shall provide a sufficient supply of fresh air and maintain an atmosphere free of toxic or flammable gasses in all underground work areas.

E. Perform all Work in accordance with all current applicable regulations and safety requirements of the federal, state and local agencies.
   1. Comply with all applicable provisions of OSHA 29 CFR Part 1926, Subpart S, Underground Construction and Subpart P, Excavations.
   2. In the event of conflict, comply with the more stringent requirements.

F. If personnel will enter the pipe during construction, the Contractor shall develop an emergency response plan for rescuing personnel trapped underground in a shaft excavation or pipe.
   1. Keep on-site all equipment required for emergency response in accordance with the agency having jurisdiction

END OF SECTION

SECTION 33 05 37.01

CENTRIFUGALLY CAST FIBERGLASS REINFORCED POLYMER MORTAR PIPE (CCFRPM) FOR DIRECT BURY

PART 1 GENERAL

1.1 SUMMARY

A. Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe (CCFRPM).

1.2 REFERENCES

A. ASTM D3262 – Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.

B. ASTM D4161 – Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.

C. ASTM D2412 – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

D. ASTM D3681 – Standard Test Method for Chemical Resistance of "Fiber glass" Pipe in a Deflected Condition.

E. ASTM D638 – Test Method for Tensile Properties of Plastics.

F. Texas Commission of Environmental Quality (TCEQ) Chapter 217 Design Criteria for Domestic Wastewater Systems

G. American Water Works Association (AWWA)

H. AWWA M45 Fiberglass Pipe Design

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Pipe and Fittings:
   1. Basis of Measurement: By the linear foot. Trench depths shall be paid as follows: (all depths).
   2. Basis of Payment: Includes materials, labor, tools, equipment, excavation, bedding, embedment, backfill, pipe, fittings and accommodations for localized loadings, to indicated depth, connection to existing sewer and new manholes, all testing and for all other incidentals necessary to complete the pipe installation as indicated.

1.4 SUBMITTALS

A. Product Data: Certified Test Reports from the manufacturer's testing facility of centrifugally cast fiberglass reinforced polymer mortar pipe certifying that pipe has been tested in

accordance with and exceeds the minimum requirements of ASTM D3262, ASTM D2412, and ASTM D3681

B. Shop Drawings:
Must Show:
1. Critical dimensions (Wall thickness, Pipe length, class, diameter), joint details and connections, fasteners, gaskets details, anchors, and specials.
2. Materials of construction.

C. Manufacturer's instructions for handling, transporting, loading, storage, and installation of pipe.
1. Instructions shall include trench preparation, pipe layout, and/or other methods for accommodating localized loadings where differential settlement can be expected (i.e., connections to rigid structures, change in foundation soil stiffness, inactive fault zones, etc.).
2. Contractor and pipe manufacturer shall review the technical data and be prepared to accommodate localized loadings in such a manner that delays in the prosecution of the work will be prevented.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Pipe delivery, storage, and handling shall be in accordance with manufacturer's recommendations.

B. The Owner or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing. Material found to be defective due to manufacture or damage in shipment shall be rejected and removed from the job site.

C. Manufacturer's Notification to Customer: Should the Owner request to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the Owner with adequate advance notice of when and where the production of those pipes will take place.

PART 2 PRODUCTS

2.1 MATERIALS

A. Resin System: The manufacturer shall use only polyester resin systems with a proven history of performance in wastewater systems. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product. Internal resin shall be resistant to exposure to sulfuric acid as produced by biological activity from hydrogen sulfide gases.

B. Glass Reinforcements: The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.

C. Silica Sand: Sand shall be a minimum 98% silica with a maximum moisture content of 0.2%.

D. Additives: Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the product.

E. Elastomeric Gaskets: Gaskets shall meet ASTM F477 and be supplied by qualified gasket manufacturers and be suitable for the service intended.

2.2 MANUFACTURE AND CONSTRUCTION

A. Pipes: Manufacture pipe by the centrifugal casting process to result in a dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes exposed to sewer flow shall provide crack resistance and abrasion resistance. The exterior surface of the pipes shall be comprised of a sand and resin layer which provides UV protection to the exterior.

B. Joints: Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D4161. Joints at tie-ins, when needed, may utilize gasket-sealed closure couplings.

C. Fittings: Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays.

D. Markings: Each length of pipe shall be marked in at least one location using large, easily legible, permanent letters indicating the manufacturer name, manufacturer number (identifies factory, location, date manufactured, shift and sequence), nominal diameter, laying lengths, pipe stiffness, ASTM Designation.

E. Acceptable Manufacturer: HOBAS Pipe USA.

2.3 DIMENSIONS

A. Diameters: The actual outside and inside diameter of the pipes shall be in accordance with ASTM D3262 and per manufacturer's literature.

B. Lengths: Pipe shall be supplied in nominal lengths of 20 feet. Actual laying length shall be nominal +1, -4 inches.

C. Special Pipe Sections: Special pipe sections, less than nominal length of 20 feet, may only be installed where it is necessary to complete the pipe installation.

D. Wall Thickness: The minimum wall thickness shall be the stated design thickness.

E. Pressure Class: Shall not be less than PN-25

F. Stiffness Class: The stiffness class of the pipe shall meet all project requirements including the ability to withstand all external loads, construction loads and not be less than SN 72.

G. End Squareness: Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8".

H. Roundness: The pipe shall be round within 0.1% of the outside diameter.

2.4 TESTING

A. Pipes: Pipes shall be manufactured and tested in accordance with ASTM D3262.

B. Joints: Coupling joints shall meet the requirements of ASTM D4161.

C. Stiffness: Minimum pipe stiffness when tested in accordance with ASTM D2412 shall be 72 psi.

PART 3 EXECUTION

3.1 INSTALLATION

A. Burial: The bedding and burial of pipe and fittings shall be in accordance with the project drawings and specifications and the manufacturer's requirements.

B. Pipe Handling: Use textile slings, other suitable materials or a forklift. Use of chains or cables is not recommended.

C. Jointing:
1. Clean ends of pipe and coupling components.
2. Apply joint lubricant to pipe ends and elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
3. Use suitable equipment and end protection to push or pull the pipes together.
4. Do not exceed forces recommended by the manufacturer for coupling pipe.
5. Join pipes in straight alignment. Pipe deflection is not permitted.

D. Verify trench excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2 PREPARATION

A. Correct over excavation with coarse aggregate.

B. Remove large stones or other hard matter capable of damaging pipe or impeding consistent backfilling or compaction.

C. Protect and support existing sewer lines, utilities and appurtenances.

D. Maintain profiles of utilities. Coordinate with other utilities to eliminate interference. Notify Engineer where crossing conflicts occur.

3.3 BEDDING

A. Excavate pipe trench in accordance with Drawings.

B. Excavate to lines and grades shown on Drawings.

C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.

D. Provide sheeting and shoring in accordance with Contractor's Trench Safety Plan.

E. Bedding shall be required to bring the trench bottom up to grade and shall be the same material as the embedment. The bedding shall be contoured at each belled joint to permit proper joint assembly while maintaining uniform pipe support.

F. Place bedding to a compacted depth as indicated on the Drawings and/or per manufacturer's instructions to accommodate localized loadings where differential settlement can be expected.

G. Maintain optimum moisture content of bedding material to attain the required compaction density as shown on the Drawings and in accordance with the manufacturer's requirements.

3.4 INSTALLATION - PIPE

A. Lay pipe to slope gradients noted on Drawings.

B. Assemble and handle pipe in accordance with manufacturer's instructions.

C. Keep pipe and fittings clean until work is completed and accepted. Cap open ends during periods of work stoppage.

D. Lay bell and spigot pipe with bells upstream.

E. Connect pipe to existing sewer system at existing manhole as indicated on Drawings.

3.5 EMBEDMENT

A. Place embedment by methods that will not disturb or damage the pipe.

B. Work in and compact the haunching material in the area between the bedding and the underside of the pipe before placing and compacting the remainder of the pipe zone embedment.

C. Place embedment around sides and above the top of pipe in accordance with the Drawings.

D. Maintain optimum moisture content of embedment material to attain required compaction density.

3.6 BACKFILL

A. Place backfill above embedment material in accordance with the Drawings and Section G4 – Pipe Excavation, Trenching, Embedment, Encasement and Backfilling.

3.7 FIELD QUALITY CONTROL

A. Request inspection prior to and immediately after placing embedment.

B. Compaction Testing for Bedding, Embedment, and Backfill: In accordance with the Section G4 – Pipe Excavation, Trenching, Embedment, Encasement and Backfilling.

C. When tests indicate Work does not meet specified requirements, remove work, replace and retest.

D. Frequency of Compaction Tests: Per CIP 13 – Summary of Testing (Miscellaneous).

3.8 PROTECTION OF FINISHED WORK

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is complete.

3.9 SEWER TESTING

A. Examination:
   1. Verify piping is ready for testing and that trenches are backfilled.

B. Piping Preparation:
   1. Lamping:
      a. Lamp gravity piping after flushing and cleaning.
      b. Perform lamping operation by shining light at one end of each pipe section between manholes; observe light at other end; reject pipe not installed with uniform line and grade; remove and reinstall rejected pipe sections; re-clean and lamp until pipe section achieves uniform line and grade.

C. Testing Gravity Sewer Piping:
   1. All field testing shall be in accordance with City of Georgetown Standard Specifications and TCEQ Sewage Collection System General Construction Notes.
   2. Individual Joint Testing: Wastewater collection system pipes with a 27-inch or larger average inside diameter must be air tested at each joint.

END OF SECTION

SECTION 33 05 37.02

CENTRIFUGALLY CAST FIBERGLASS REINFORCED POLYMER MORTAR PIPE (CCFRPM) FOR TUNNEL CARRIER INSTALLATION

PART 1 GENERAL

1.1 SUMMARY

A. Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe (CCFRPM) as carrier pipe for a two-pass tunneling installation.

1.2 REFERENCES

A. ASTM D3262 – Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.

B. ASTM D4161 – Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.

C. ASTM D2412 – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

D. ASTM D3681 – Standard Test Method for Chemical Resistance of "Fiber glass" Pipe in a Deflected Condition.

E. ASTM D638 – Test Method for Tensile Properties of Plastics.

F. Texas Commission of Environmental Quality (TCEQ) Chapter 217 Design Criteria for Domestic Wastewater Systems

G. American Water Works Association (AWWA)

H. AWWA M45 Fiberglass Pipe Design

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Pipe and Fittings:
   1. Basis of Measurement: No separate measurement shall be made for this item.
   2. Basis of Payment: No separate measurement shall be made for this item, but shall be included in the lump sum cost bid for the reach in which this pipe is installed complete in place.

1.4 SUBMITTALS

A. Product Data: Certified Test Reports from the manufacturer's testing facility of centrifugally cast fiberglass reinforced polymer mortar pipe certifying that pipe has been tested in accordance with and exceeds the minimum requirements of ASTM D3262, ASTM D2412, and ASTM D3681

B. Shop Drawings:
Must Show:
1. Critical dimensions (Wall thickness, Pipe length, class, diameter), joint details and connections, fasteners, gaskets details, anchors, and specials.
2. Materials of construction.

C. Manufacturer's instructions for handling, transporting, loading, storage, and installation of pipe.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Pipe delivery, storage, and handling shall be in accordance with manufacturer's recommendations.

B. The Owner or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing. Material found to be defective due to manufacture or damage in shipment shall be rejected and removed from the job site.

C. Manufacturer's Notification to Customer: Should the Owner request to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the Owner with adequate advance notice of when and where the production of those pipes will take place.

PART 2 PRODUCTS

2.1 MATERIALS

A. Resin System: The manufacturer shall use only polyester resin systems with a proven history of performance in wastewater systems. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product. Internal resin shall be resistant to exposure to sulfuric acid as produced by biological activity from hydrogen sulfide gases.

B. Glass Reinforcements: The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.

C. Silica Sand: Sand shall be a minimum 98% silica with a maximum moisture content of 0.2%.

D. Additives: Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the product.

E. Elastomeric Gaskets: Gaskets shall meet ASTM F477 and be supplied by qualified gasket manufacturers and be suitable for the service intended.

2.2 MANUFACTURE AND CONSTRUCTION

A. Pipes: Manufacture pipe by the centrifugal casting process to result in a dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes exposed to

sewer flow shall provide crack resistance and abrasion resistance. The exterior surface of the pipes shall be comprised of a sand and resin layer which provides UV protection to the exterior.

B. Joints: Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings or bell-spigot joints that utilize elastomeric sealing gaskets as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D4161. Joints at tie-ins, when needed, may utilize gasket-sealed closure couplings.

C. Fittings: Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays.

D. Markings: Each length of pipe shall be marked in at least one location using large, easily legible, permanent letters indicating the manufacturer name, manufacturer number (identifies factory, location, date manufactured, shift and sequence), nominal diameter, laying lengths, pipe stiffness, ASTM Designation.

E. Acceptable Manufacturer: HOBAS Pipe USA.

2.3 DIMENSIONS

A. Diameters: The actual outside and inside diameter of the pipes shall be in accordance with ASTM D3262 and per manufacturer's literature.

B. Lengths: Pipe shall be supplied in nominal lengths of 20 feet. Actual laying length shall be nominal +1, -4 inches. When required by pit size, or other limitations, restrict the pipe to shorter lengths, nominal sections of 10 feet or other even divisions of 20 feet shall be used.

C. Wall Thickness: The minimum wall thickness shall be the stated design thickness.

D. Pressure Class: Shall not be less than PN-25

E. Stiffness Class: The stiffness class of the pipe shall meet all project requirements including the ability to withstand all external loads, construction loads and not be less than SN 72.

F. End Squareness: Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8".

G. Roundness: The pipe shall be round within 0.1% of the outside diameter.

2.4 TESTING

A. Pipes: Pipes shall be manufactured and tested in accordance with ASTM D3262.

B. Joints: Joints shall meet the requirements of ASTM D4161.

C. Stiffness: Minimum pipe stiffness when tested in accordance with ASTM D2412 shall normally be 72 psi.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation: Pipe and fittings shall be in accordance with the project drawings and specifications and the manufacturer's requirements. See Specification 33 05 24 – Installation of Carrier Pipe in Casing.

B. Pipe Grouting: Annular space grouting shall not damage the pipe and be in accordance with the project drawings and specifications and the manufacturer's requirements. See Specification 33 05 24 – Installation of Carrier Pipe in Casing.

C. Pipe Handling: Use textile slings, other suitable materials or a forklift. Use of chains or cables is not recommended.

D. Jointing:
   1. Clean ends of pipe and coupling components.
   2. Apply joint lubricant to pipe ends or bell interior surfaces and elastomeric seals. Use only lubricants approved by the pipe manufacturer.
   3. Use suitable equipment and end protection to push or pull the pipes together.
   4. Do not exceed forces recommended by the manufacturer for joining or pushing pipe.
   5. Join pipes in straight alignment. Pipe deflection is not permitted.

3.2 FIELD QUALITY CONTROL

A. Field quality control shall be in accordance with Specification Section 33 05 24 – Installation of Carrier Pipe in Casing

3.3 PROTECTION OF FINISHED WORK

A. Protect pipe from damage or displacement until tunneling operation is complete.

3.4 SEWER TESTING

A. Examination:
   1. Verify piping is ready for testing.

B. Piping Preparation:
   1. Lamping:
      a. Lamp gravity piping after flushing and cleaning.
      b. Perform lamping operation by shining light at one end of each pipe section installed in tunnel; observe light at other end; reject pipe not installed with uniform line and grade; remove and reinstall rejected pipe sections; re-clean and lamp until pipe section achieves uniform line and grade.

C. Testing Gravity Sewer Piping:
   1. All field testing shall be in accordance with City of Georgetown Standard Specifications and TCEQ Sewage Collection System General Construction Notes.

2. Individual Joint Testing: Wastewater collection system pipes with a 27-inch or larger average inside diameter must be air tested at each joint.

END OF SECTION

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SECTION 33 05 37.03

CENTRIFUGALLY CAST FIBERGLASS REINFORCED POLYMER MORTAR PIPE (CCFRPM) FOR JACKING INSTALLATION

PART 1 GENERAL

1.1 SUMMARY

A. Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe (CCFRPM) for jacking installation in single-pass tunneling.

1.2 REFERENCES

A. ASTM D3262 – Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.

B. ASTM D4161 – Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.

C. ASTM D2412 – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

D. ASTM D3681 – Standard Test Method for Chemical Resistance of "Fiber glass" Pipe in a Deflected Condition.

E. ASTM D638 – Test Method for Tensile Properties of Plastics.

F. Texas Commission of Environmental Quality (TCEQ) Chapter 217 Design Criteria for Domestic Wastewater Systems

G. American Water Works Association (AWWA)

H. AWWA M45 Fiberglass Pipe Design

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Pipe and Fittings:
   1. Basis of Measurement: No separate measurement shall be made for this item.
   2. Basis of Payment: No separate measurement shall be made for this item, but shall be included in the lump sum cost bid for the reach in which this pipe is installed complete in place.

1.4 SUBMITTALS

A. Product Data: Certified Test Reports from the manufacturer's testing facility of centrifugally cast fiberglass reinforced polymer mortar pipe certifying that pipe has been tested in accordance with and exceeds the minimum requirements of ASTM D3262, ASTM D2412, and ASTM D3681

B. Shop Drawings:
Must Show:
1. Critical dimensions (Wall thickness, Pipe length, class, diameter), joint details and connections, fasteners, gaskets details, anchors, and specials.
2. Materials of construction.

C. Manufacturer's instructions for handling, transporting, loading, storage, and installation of pipe.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Pipe delivery, storage, and handling shall be in accordance with manufacturer's recommendations.

B. The Owner or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing. Material found to be defective due to manufacture or damage in shipment shall be rejected and removed from the job site.

C. Manufacturer's Notification to Customer: Should the Owner request to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the Owner with adequate advance notice of when and where the production of those pipes will take place.

PART 2 PRODUCTS

2.1 MATERIALS

A. Resin System: The manufacturer shall use only polyester resin systems with a proven history of performance in wastewater systems. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product. Internal resin shall be resistant to exposure to sulfuric acid as produced by biological activity from hydrogen sulfide gases.

B. Glass Reinforcements: The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.

C. Silica Sand: Sand shall be a minimum 98% silica with a maximum moisture content of 0.2%.

D. Additives: Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the product.

E. Elastomeric Gaskets: Gaskets shall meet ASTM F477 and be supplied by qualified gasket manufacturers and be suitable for the service intended.

2.2 MANUFACTURE AND CONSTRUCTION

A. Pipes: Manufacture pipe by the centrifugal casting process to result in a dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes exposed to

sewer flow shall provide crack resistance and abrasion resistance. The exterior surface of the pipes shall be comprised of a sand and resin layer which provides UV protection to the exterior.

B. Joints: Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings or bell-spigot joints that utilize elastomeric sealing gaskets as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D4161. The joints shall have approximately the same O.D. as the pipe, so when the pipes are assembled, the joints are essentially flush with the pipe outside surface. Joints at tie-ins, when needed, may utilize gasket-sealed closure couplings.

C. Fittings: Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays.

D. Markings: Each length of pipe shall be marked in at least one location using large, easily legible, permanent letters indicating the manufacturer name, manufacturer number (identifies factory, location, date manufactured, shift and sequence), nominal diameter, laying lengths, pipe stiffness, ASTM Designation.

E. Acceptable Manufacturer: HOBAS Pipe USA.

2.3 DIMENSIONS

A. Diameters: The actual outside and inside diameter of the pipes shall be in accordance with ASTM D3262 and per manufacturer's literature. For the nominal diameter shown on the plans, the inside diameter of CCFRPM jacking pipe must be equal to or greater than the inside diameter of CCFRPM pipe installed as carrier pipe or direct bury.

B. Lengths: Pipe shall be supplied in nominal lengths of 10 or 20 feet. Actual laying length shall be nominal +1, -4 inches.

C. Wall Thickness: The minimum wall thickness, measured at the bottom of the spigot gasket groove where the wall cross-section has been reduced, is determined from the maximum jacking load. Refer to Section 33 05 22 – Jacking Pipe for design requirements.

D. Stiffness Class: The stiffness class of the pipe shall meet all project requirements including the ability to withstand all external loads, construction loads and not be less than SN 72. Refer to Section 33 05 22 – Jacking Pipe for design requirements.

E. End Squareness: Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/16".

F. Roundness: The pipe shall be round within 0.1% of the outside diameter.

2.4 TESTING

A. Pipes: Pipes shall be manufactured and tested in accordance with ASTM D3262.

B. Joints: Coupling joints shall meet the requirements of ASTM D4161.

C. Stiffness: Minimum pipe stiffness when tested in accordance with ASTM D2412 shall meet the requirements of the designated stiffness class.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation: Install Jacking Pipe for trenchless installation in accordance with Section 33 30 02 – Trenchless Excavation by Tunnel Boring Machine and Section 33 30 03 – Trenchless Excavation by Microtunnel Boring Machine.

B. Contact Grouting: Contact grouting shall not damage the pipe and be in accordance with the project drawings and specifications and the manufacturer's requirements. See Specification 35 23 24 Contact Grouting.

C. Pipe Handling: Use textile slings, other suitable materials or a forklift. Use of chains or cables is not recommended.

D. Jointing:
1. Clean ends of pipe and coupling components.
2. Apply joint lubricant to pipe ends and elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
3. Use suitable equipment and end protection to push or pull the pipes together.
4. Do not exceed forces recommended by the manufacturer for joining or pushing pipe.
5. Join pipes in straight alignment. Pipe deflection is not permitted.

3.2 PROTECTION OF FINISHED WORK

A. Protect pipe from damage or displacement until tunneling operation is complete.

3.3 SEWER TESTING

A. Examination:
1. Verify piping is ready for testing.

B. Piping Preparation:
1. Lamping:
   a. Lamp gravity piping after flushing and cleaning.
   b. Perform lamping operation by shining light at one end of each pipe section installed in tunnel and observe light at other end.

C. Testing Gravity Sewer Piping:
1. All field testing shall be in accordance with City of Georgetown Standard Specifications and TCEQ Sewage Collection System General Construction Notes.
2. Individual Joint Testing: Wastewater collection system pipes with a 27-inch or larger average inside diameter must be air tested at each joint.

END OF SECTION

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SECTION 33 30 02

Trenchless Excavation by Tunnel Boring Machine

PART 1 - GENERAL

1.1 SUMMARY

A. Scope of Work:

1. Furnish all labor, design, materials, and equipment required to perform the trenchless excavation through the geologic conditions interpreted from the Geotechnical Engineering Report (GER) and hydrologic conditions interpreted from the Hydrologic Report to the minimum dimensions shown on the Drawings and as required to perform the work utilizing a Tunnel Boring Machine (TBM) propelled by jacking pipe. This shall include the excavation, handling, removal, and disposal of all materials encountered in the tunnel excavation; installation of jacking pipe, installation and maintenance of tunnel temporary utilities, drainage, ventilation, lighting, power, and communications; tunnel safety; timely maintenance and repair of TBM equipment; and all appurtenant work necessary to complete the Work in accordance with the Contract Documents.
2. Where noted, contractor may elect to install the carrier pipe directly utilizing Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe (CCFRPM) jacking pipe or by a two-pass system utilizing oversized steel casing or concrete jacking pipe functioning as casing within which the CCFRPM carrier pipe is installed. Requirements for the jacking pipe are outlined in Section 33 05 22 – Jacking Pipe.
3. Transitions from CCFRPM jacking pipe to carrier pipe installed in two-pass tunneling or jacking pipe to direct bury pipe shall only be allowed at manholes. The contractor shall not connect jacking pipe to two-pass carrier pipe nor connect jacking pipe to direct bury pipe.
4. This is one alternative to perform the trenchless excavation along the reaches indicated on the Drawings. The excavation may also be performed utilizing a slurry microtunnel boring machine. The requirements of Section 33 30 03 – Tunnel Excavation by Microtunnel Boring Machine will govern if that method is selected by the Contractor. Reach 1 may be excavated by hand tunneling and the requirements of Section 33 30 03 – Tunnel Excavation by Hand Tunneling will govern if that method is selected by the Contractor.

B. Related Specification Sections include, but are not necessarily limited to:

1. Section 33 05 22 – Jacking Pipe
2. Section 33 05 24 – Installation of Carrier Pipe in Casing
3. Section 33 30 03 – Trenchless Excavation by Microtunnel Boring Machine
4. Section 33 30 04 – Trenchless Excavation by Hand Tunneling
5. Section 33 73 15 – Shafts
6. Section 33 73 80 – Groundwater Control for Shafts and Tunnels
7. Section 35 23 24 – Contact Grouting
8. Section 33 05 37.02 – Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe for Tunnel Carrier Installation

9. Section 33 05 37.03 – Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe for Jacking Installation

C. Related documents:
   1. Geotechnical Engineering Report, Revision 2 (GER); Berry Creek Offsite Wastewater Main – North Alternative; Georgetown, Texas; prepared for Walker Partners by Terracon Consultants, Inc.; March 8, 2023.
   2. Hydrologic Report for the Berry Creek Wastewater Interceptor Project (Hydrologic Report); Williamson County, Texas; prepared for Walker Partners by SWCA Environmental Consultants; October 2022.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. Measurement
      a. No separate measurement shall be made for this item.
   2. Payment
      a. The work performed and materials furnished in accordance with this item are subsidiary to the lump sum cost bid for the reach which trenchless excavation by tunnel boring machine is successfully completed, and no other compensation will be allowed.

1.3 REFERENCES

A. Reference Standards
   1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
   2. Occupational Safety and Health Administration (OSHA)
      a. OSHA Regulations and Standards for Underground Construction, 29 CFR Part 1926, Subpart S, Underground Construction and Subpart P, Excavation.

1.4 DEFINITIONS

A. Tunnel Boring Machine (TBM): A TBM with a full-face motorized rotating cutterhead with enough power and equipped with the appropriate cutting tools to excavate the anticipated geologic materials interpreted from the GER at the planned drive lengths. This may be a traditional manned open-face TBM, auger bore machine, a remote operated machine or small boring unit, or other machine capable of performing the work in accordance with these specifications.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section CIP10.

B. The Contractor shall submit a list of all equipment to be used and product data demonstrating equipment is sufficient to perform the work.

C. The Contractor shall submit information demonstrating adherence with the qualification requirements outlined in Section 1.6 minimum 30 days prior to the start of work.
   1. Submit project name, date, location, description (diameter and length) of tunnel(s), ground and groundwater conditions, trenchless methods utilized, and names and contact information of references with individual knowledge of the work on each project.

D. Contractor shall submit a TBM excavation work plan 30 days prior to start of work describing the equipment and procedures to be employed. Acceptance by the Engineer of the required designs does not relieve the Contractor of the full responsibility for the adequacy of the designs.
   1. Provide manufacturer's literature describing system in detail including machine type, any design modifications, spoil removal system, jacking system, and method for maintaining line and grade.
   2. Provide plan of single pass or two-pass installation and type and size of jacking pipe to be utilized. Coordinate with design and submittal requirements outlined in Section 33 05 22 – Jacking Pipe.
   3. Provide a layout of each tunnel work area including shafts/pits, pipe storage, material handling, and jacking arrangement.
   4. Include ground water control measures during tunneling in accordance with Section 33 73 80 – Groundwater Control for Shafts and Tunnels.
   5. Provide a schedule for all trenchless excavation work identifying each of the trenchless reaches and all major construction activities as independent items.
   6. Identify tunnel lighting, communications, and other utility systems.
   7. Provide a description of the alignment control and steering systems. Provide manufacturer’s literature, drawings showing setup and support provisions, and other details for the laser. Submit a description of surveying methods to set laser positions and a description of procedures to check laser and reset or realign laser during construction. Confirm that these systems can achieve the required pipeline line and grade within the specified tolerances.
   8. Submit name and resume of surveyor licensed in the State of Texas who shall be responsible for setting survey control and laser for pipe installation.
   9. Identify the capacity, number, and arrangement of jacks. Provide details of thrust ring, jacking controls, and pressure gages. Provide an estimate of maximum jacking force expected to be required to complete each drive, and planned location of intermediate jacking stations (IJS) if used.
   10. Provide thrust block and jacking frame design and details. Submit sealed calculations prepared by the Design Engineer demonstrating that the thrust block can transfer the maximum planned forces developed by the main jacks to the ground without excessive movements.
   11. Provide details of the IJS and IJS pipe lead and tail pipe design, including manufacturer’s literature.
   12. Provide details of pipe lubrication injection system and pipe lubricants to be used, including manufacturer’s literature.
   13. Submit written documentation from the accepted disposal site(s) indicating that they will accept the spoil and are in compliance with all City, County, State, and Federal regulations.
   14. Provide a general plan, procedures, and details for constructing recovery shafts and other methods to remove obstructions that may be encountered during tunneling.
   15. Provide a safety plan for the tunneling operations including provisions for ventilation, and electrical system safeguards. Submit name of Contractor’s site safety representative responsible for implementing safety program.
   16. Provide emergency response plan for rescuing personnel trapped underground in a shaft excavation or pipe if personnel will enter the pipe during construction.

E. Contractor shall submit daily shift records including:
   1. Starting and ending stations for each shift.
   2. Crew size and allocations for each shift.
   3. Time of beginning and end of each pipe section installed.
   4. Record of soil or rock type and groundwater inflow rates.
   5. Records of any unusual occurrences including unstable ground, ground water problems, equipment malfunction, power outages, damage to jacking pipe. Include the location and time of each such occurrence.

1.6 QUALITY ASSURANCE

A. Qualifications
   1. Contractor:
      a. All trenchless boring work shall be performed by an experienced subcontractor or Contractor who has at least 5 years of experience in performing tunneling work and has completed at least 5 boring projects of similar diameter, in similar ground conditions, and utilizing similar trenchless construction methods.
         1) At least 1 of the projects shall have an individual boring of similar diameter and of length equal to or greater in length than the longest drive planned on this project.
      b. The project superintendent shall have at least 5 years of experience supervising boring construction and have experience supervising at least 2 boring projects of similar diameter, in similar ground conditions, and utilizing similar trenchless construction methods.
      c. Design Engineer: Licensed Professional Engineer in the State of Texas with a minimum of ten (10) years of experience in jacking pipe and jacking frame design.
      d. The site safety representative and personnel responsible for air quality monitoring shall be experienced in tunnel construction and shall have current certification by OSHA.
      e. Surveyor: Licensed Surveyor in the State of Texas with experience on similar projects.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Casing or jacking pipe shall be in accordance with Section 33 05 22 – Jacking Pipe.

B. Carrier pipe shall be in accordance with Section 33 05 37.02 – Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe for Tunnel Carrier Installation

C. Contact Grout shall be in accordance with Section 35 23 24 – Contact Grouting

PART 3 - EXECUTION

3.1 PREPARATION

A. Trenchless excavation by TBM shall not begin until the following have been completed:

1. Review of available utility drawings and location of conduits and underground utilities in all areas where excavation is to be performed. Notify the applicable one-call system prior to any excavation to avoid interference with the existing conduits and utilities in accordance with Section CIP4 & CIP6.
2. Contractor shall notify the Texas One Call system (800-245-4545) to request marking of utilities by utility owners / operators that subscribe to One Call and shall individually notify all other known or suspected utilities to request marking of these utilities.
   a. Confirm that all requested locates are made prior to commencing boring operations.
   b. Visually confirm and stake necessary existing lines, cables, or other underground facilities including exposing necessary crossing utilities and utilities within 10 feet laterally of the designed tunnel.
3. Follow notification requirements of permit or easement provider where applicable.
4. Complete shaft or pit excavations and support systems for each drive in accordance with Section 33 73 15 – Shafts and approved design submittal.

3.2 DESIGN CRITERIA

A. The alignment of each of the trenchless sections will pass through various geologic formations, ground water conditions, and rock of varying quality and strength. Design excavation methods and spoil conveyance system of each section for the ground and groundwater conditions anticipated in that section, as interpreted from the GER and the Hydrologic Report.

B. See Section 33 73 80 – Groundwater Control for Shafts and Tunnels for special considerations related to groundwater inflows.

C. The TBM shall have adequate thrust, torque, and cutterhead rotational speed to excavate the geologic material as interpreted from the GER.

D. The Drawings show minimum casing diameters for two-pass installations. Subject to review and acceptance by the Engineer, the Contractor may select such dimensions as may be required to conduct the work, consistent with his planned equipment, means, and methods.
   1. Trenchless Reaches shown with steel encasement must utilize two-pass installation and must utilize steel casing.
   2. Trenchless Reaches shown with unspecified encasement must utilize two-pass installation and may utilize steel or reinforced concrete pipe (RCP) as casing.

E. In a single-pass installation, the inside diameter of the carrier pipe as indicated on the Drawings must be maintained.

F. Use methods and equipment that control surface settlement and heave above the pipeline to prevent damage to existing utilities, facilities, and improvements.
   1. Limit any ground movements (settlement/heave) to values that shall not cause damage to adjacent utilities or surface features (i.e. pavement, structures, railroad tracks, etc.)
   2. Repair damage to existing utilities or other infrastructure resulting from excavation at no additional cost to the Owner.

G. Maximum radial over cut shall be 1.0 inch (2.0 inches on the diameter).

3.3 INSTALLATION

A. General

1. As necessary to control or minimize the inflow of groundwater into the tunnel, the Contractor shall install, operate, and maintain a tunnel groundwater control system in accordance with Section 33 73 80 – Groundwater Control for Shafts and Tunnels.
2. Properly manage and dispose of groundwater inflows to the shafts or pits in accordance with requirements of Section 33 73 80 – Groundwater Control for Shafts and Tunnels and all permit conditions.
3. The project superintendent shall be on site at all times during trenchless excavation work.
4. Immediately notify the Engineer if any problems are encountered with equipment or materials or if the Contractor believes the conditions encountered are materially and significantly different than those represented by the Contract Documents.
5. Where pipe is required to be installed under railroad embankments or under highways, streets, or other facilities, construction shall be performed in such a manner so as to not interfere with the operation of the railroad, street, highway, or other facility, and so as not to weaken or damage any embankment or structure. Any damage shall be immediately repaired to original or better condition and to the satisfaction of the Engineer or permit grantor at no additional cost to the Owner.
6. During construction operations, furnish and maintain barricades and lights to safeguard traffic and pedestrians until such time as the backfill has been completed and then remove from the site.
7. Furnish all necessary equipment, power, water, and utilities for tunneling, spoil removal and disposal, grouting and other associated work required for the methods of construction.
8. Maintain clean working conditions at all times inside the tunnel and shafts. All muck, slush, grout spills, ponded water, and any other material not required for tunneling shall be removed from the excavations in a timely manner.
9. Whenever there is a condition that is likely to endanger the stability of the excavation or adjacent structures, operate with a full crew, 24 hours a day, including weekends and holidays, without interruption, until those conditions no longer jeopardize the stability of the Work.

B. Shafts and Pits:

1. Suitable shafts, pits, or trenches shall be excavated for the purpose of conducting the trenchless operations in accordance with Section 33 73 15 – Shafts.
2. The shafts, pits, or trenches excavated to facilitate these operations shall be backfilled in accordance with Section 33 73 15 – Shafts immediately after the carrier pipe and associated manhole installation has been completed.

C. Jacking System

1. The main jacking equipment installed shall have a jacking capacity that is at least 150% of the maximum calculated allowable jacking load required to install the pipe and shall be designed by the Design Engineer.

2. The main jacks shall be mounted in a jacking frame and located in the jacking shaft. The TBM shall be moved forward by the jacks advancing a successive string of connected pipes toward a receiving shaft. The jacking system shall develop a uniform distribution of jacking forces on the end of the pipe by the use of thruster rings and cushioning material.
3. A thrust block or reaction frame is required to transfer jacking loads to the ground behind the jacking shaft. The thrust block shall be constructed perpendicular to the proposed pipe alignment and shall be designed by the Design Engineer to withstand the maximum jacking pressure to be used, with a safety factor of at least 2.0 without excessive deflection or displacement.
4. Operate the jacks so as not to exceed 80 percent of their rated capacity. At no time shall the jacks be operated so as to exceed the axial capacity of the jacked pipe, including all safety factors, as determined by the Design Engineer per the requirements of Section 33 05 22 – Jacking Pipe. Provide additional jacking capacity, such as intermediate jacking stations, if the jacking requirements shall otherwise exceed 80 percent of their rated capacity.
5. When intermediate jacking stations are utilized, the maximum jacking force shall not exceed the maximum allowable jacking load of the casing as determined by the Design Engineer per the requirements of Section 33 05 22 – Jacking Pipe.
6. The jacking system shall be capable of continuously monitoring the jacking pressure and advance rate.

D. Boring:
1. Install jacking pipe by boring hole with an approved TBM and simultaneously jacking pipe into place.
2. Blasting is not allowed.
3. Excavated material may be removed from the tunnel via muck cars, conveyor, auger, or other approved methods. Place excavated material near the top of the working pit and dispose of as required. If no room is available, immediate haul off is required.
4. The use of water or other fluids in connection with the boring operation will be permitted only to the extent required to lubricate cuttings. Jetting or sluicing will not be permitted.
5. The Contractor shall be fully responsible for ensuring the methods used are adequate for the protection of workers, pipe, property, and the public and to provide a finished product as required.

E. Contact Grouting:
1. Contact grout the annulus space between the installed jacking pipe and the ground and any voids caused by or encountered during the boring in accordance with Specification Section 35 23 24 – Contact Grouting.

F. Control of Line and Grade:
1. The benchmarks and other primary survey control have been established and are shown on the Plans. The Contractor shall verify the accuracy of these benchmarks at the beginning of construction and report any errors or discrepancies to the Engineer.

2. When satisfied that all benchmarks are correct, use these benchmarks to furnish and maintain all reference lines-and-grades for microtunneling. For tunneling, use these lines-and-grades to establish the location of the casing using laser guidance system. Surveying shall be performed by a surveyor licensed in the State of Texas. The Contractor shall be fully responsible for the accuracy of the work and the correction of defective work, as required.
3. Laser shall be mounted independently from the thrust block and jacking frame to maintain the alignment of the laser. Stop tunneling operations and reset laser if laser alignment shifts or is moved off of design alignment and grade for any reason. Laser shall only be reset by qualified surveying personnel in accordance with accepted procedures.
4. Monitor line-and-grade continuously during tunneling operations. Record deviation with respect to design line-and-grade at least once per jacking cycle and submit records to the Engineer as requested. Control line-and-grade of the casing to within the specified tolerances.
5. If the jacking pipe installation exceeds the specified tolerances for deviations, return to the theoretical tunneling line and/or grade at a rate of not more than one (1) inch per twenty-five (25) feet. If the tunnel deviates sufficiently off plan line and/or grade to require a redesign of the carrier pipe or appurtenances, the Contractor shall have the system redesigned at no cost to the Owner. All corrective work shall be performed as accepted by the Engineer, at no additional cost to the Owner.

3.4 CLEANUP AND RESTORATION

A. After completion of the boring, all construction debris, spoils, oil, grease, and other materials shall be removed from the pipe, pits, and all work areas.

B. Restoration shall follow construction as the work progresses and shall be completed as soon as reasonably possible.
   1. Restore and repair any damage resulting from surface settlement caused by shaft excavation or boring.
   2. Any property damaged or destroyed shall be restored to a condition equal to or better than existing prior to construction.
   3. Restoration shall be completed no later than 30 days after boring is complete, or earlier if required as part of a permit or easement agreement.
   4. This provision for restoration shall include all property affected by the construction operations.

3.5 SITE QUALITY CONTROL

A. Field Tests and Inspections
   1. Allow access and furnish necessary assistance and cooperation to aid in the observations, measurements, data, and sample collection, including, but not limited to the following:
      a. The Engineer shall have access to the boring system prior to, during, and following all boring operations.
      b. The Engineer shall have access to the trenchless shafts or pits prior to, during, and following all boring operations.
         1) This shall include, but not be limited to, visual inspection of installed pipe and verification of line and grade.

2) The Contractor shall provide safe access in accordance with all safety regulations.

c. The Engineer shall have access to spoils removed from the boring excavation prior to, during, and following all boring operations.

3.6 SAFETY

A. The work has been classified as potentially-gassy in accordance with the Code of Federal Regulations, 29 CFR 1926 Safety and Health Regulations for Construction (OSHA).

B. The Contractor is responsible for safety on the Site.
   1. Perform all Work in accordance with the current applicable regulations of the Federal, State, and local agencies.
   2. In the event of conflict, comply with the more restrictive applicable requirement.

C. No gasoline powered equipment shall be permitted in receiving shafts/pits.
   1. Diesel, electrical, hydraulic, and air powered equipment are acceptable, subject to applicable local, State, and Federal regulations.

D. Furnish and operate a temporary ventilation system in accordance with applicable safety requirements when personnel are underground.
   1. Perform all required air and gas monitoring.
   2. Ventilation system shall provide a sufficient supply of fresh air and maintain an atmosphere free of toxic or flammable gasses in all underground work areas.

E. Perform all work in accordance with all current applicable regulations and safety requirements of the Federal, State, and Local agencies.

F. Comply with all applicable provisions of OSHA 29 CFR Part 1926, Subpart S, Underground Construction and Subpart P, Excavations.
   1. In the event of conflict, comply with the more stringent requirements.

G. If personnel will enter the pipe during construction, the Contractor shall develop an emergency response plan for rescuing personnel trapped underground in a shaft excavation or pipe.
   1. Keep on-site all equipment required for emergency response in accordance with the agency having jurisdiction.

END OF SECTION

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SECTION 33 30 03

Trenchless Excavation by Microtunnel Boring Machine

PART 1 - GENERAL

1.1 SUMMARY

A. Scope of Work:

1. Furnish all labor, design, materials, and equipment required to perform the trenchless excavation through the geologic conditions interpreted from the Geotechnical Engineering Report (GER) and hydrologic conditions interpreted from the Hydrologic Report to the minimum dimensions shown on the Drawings and as required to perform the work utilizing a Microtunnel Boring Machine (MTBM). This shall include the excavation and disposal of all materials encountered in the tunnel excavation; installation of jacking pipe, installation and maintenance of tunnel temporary utilities, drainage, ventilation, lighting, power, and communications; tunnel safety; timely maintenance and repair of MTBM equipment; and all appurtenant work necessary to complete the Work in accordance with the Contract Documents.
2. Where noted, contractor may elect to install the carrier pipe directly utilizing centrifugally cast fiberglass reinforced polymer mortar (CCFRPM) jacking pipe or by a two-pass system utilizing oversized steel casing or concrete jacking pipe functioning as casing within which the CCFRPM carrier pipe is installed. Requirements for the jacking pipe are outlined in Section 33 05 22 – Jacking Pipe.
3. Transitions from CCFRPM jacking pipe to carrier pipe installed in two-pass tunneling or jacking pipe to direct bury pipe shall only be allowed at manholes. The contractor shall not connect jacking pipe to two-pass carrier pipe nor connect jacking pipe to direct bury pipe.
4. This is one alternative to perform the trenchless excavation along the reaches indicated on the Drawings. The excavation may also be performed utilizing an open-face tunnel boring machine (TBM). The requirements of Section 33 30 02 – Tunnel Excavation by Tunnel Boring Machine will govern if that method is selected by the Contractor. Reach 1 may be excavated by hand tunneling and the requirements of Section 33 30 03 – Tunnel Excavation by Hand Tunneling will govern if that method is selected by the Contractor.

B. Related Specification Sections include, but are not necessarily limited to:

1. Section 33 05 22 – Jacking Pipe
2. Section 33 05 24 – Installation of Carrier Pipe in Casing
3. Section 33 30 02 – Trenchless Excavation by Tunnel Boring Machine
4. Section 33 30 04 – Trenchless Excavation by Hand Tunneling
5. Section 33 73 15 – Shafts
6. Section 33 73 80 – Groundwater Control for Shafts and Tunnels
7. Section 35 23 24 – Contact Grouting
8. Section 33 05 37.02 – Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe for Tunnel Carrier Installation

9. Section 33 05 37.03 – Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe for Jacking Installation

C. Related documents:
   1. Geotechnical Engineering Report, Revision 2 (GER); Berry Creek Offsite Wastewater Main – North Alternative; Georgetown, Texas; prepared for Walker Partners by Terracon Consultants, Inc.; March 8, 2023.
   2. Hydrologic Report for the Berry Creek Wastewater Interceptor Project (Hydrologic Report); Williamson County, Texas; prepared for Walker Partners by SWCA Environmental Consultants; October 2022.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. Measurement
      a. No separate measurement will be made for this item.
   2. Payment
      a. The work performed and materials furnished in accordance with this item are subsidiary to the lump sum cost bid for the reach which tunnel excavation by microtunnel boring machine is successfully completed, and no other compensation will be allowed.

1.3 REFERENCES

A. Reference Standards
   1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
   2. Occupational Safety and Health Administration (OSHA)
      a. OSHA Regulations and Standards for Underground Construction, 29 CFR Part 1926, Subpart S, Underground Construction and Subpart P, Excavation.

1.4 DEFINITIONS

A. Microtunnel Boring Machine (MTBM): A remotely controlled, steer able, laser- guided microtunnel boring machine consisting of an articulated boring machine shield and a rotating cutting head that uses a slurry to provide continuous pressurized face support during excavation and lubrication of the pipe string.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section CIP10.

B. The Contractor shall submit a list of all equipment to be used and product data demonstrating equipment is sufficient to perform the work.

C. The Contractor shall submit information demonstrating adherence with the qualification requirements outlined in Section 1.6 minimum 30 days prior to the start of work.
   1. Submit project name, date, location, description (diameter and length) of tunnel(s), ground and groundwater conditions, trenchless methods utilized, and names and contact information of references with individual knowledge of the work on each project.

D. Contractor shall submit an MTBM excavation work plan at least 30 days prior to start of work describing the equipment and procedures to be employed. Acceptance by the Engineer of the required designs does not relieve the Contractor of the full responsibility for the adequacy of the designs.
   1. Provide manufacturer's literature describing system in detail including machine type, any design modifications, spoil removal system, slurry separation system, jacking system, method for maintaining line and grade, and procedures and provisions for injecting pipe lubricants.
   2. Provide plan of single pass or two-pass installation and type and size of jacking pipe to be utilized. Coordinate with design and submittal requirements outlined in Section 33 05 22 – Jacking Pipe.
   3. Provide a layout of each microtunnel work area including shafts/pits, pipe storage, material handling, jacking arrangement, and slurry handling system.
   4. Identify ground water control measures during tunneling in accordance with Section 33 73 80 – Groundwater Control for Shafts and Tunnels.
   5. Provide a schedule for all trenchless excavation work identifying each of the trenchless reaches and all major construction activities as independent items.
   6. Describe tunnel lighting, communications, and other utility systems.
   7. Provide a description of the alignment control and steering systems. Provide manufacturer’s literature, drawings showing setup and support provisions, and other details for the laser. Submit a description of surveying methods to set laser positions and a description of procedures to check laser and reset or realign laser during construction. Confirm that these systems can achieve the required pipeline line and grade within the specified tolerances.
   8. Submit name and resume of surveyor licensed in the State of Texas who shall be responsible for setting survey control and laser for pipe installation.
   9. Identify the capacity, number, and arrangement of main jacks. Provide details of thrust ring, jacking controls and pressure gages. Provide an estimate of maximum jacking force expected to be required to complete each drive, and approximate location of intermediate jacking stations (IJS) if used.
   10. Provide thrust block and jacking frame design and details. Submit sealed calculations prepared by the Design Engineer demonstrating that the thrust block can transfer the maximum planned forces developed by the main jacks to the ground without excessive movements.
   11. Provide details of the IJS system and the IJS pipe lead and tail pipe design, including manufacturer’s literature.
   12. Provide details of pipe lubrication injection system and pipe lubricants to be used during microtunneling, including manufacturer’s literature.
   13. Provide spoil and/or slurry handling, separation, transport, and disposal equipment and procedures indicating details of the slurry additives, slurry separation plant, and the location of slurry and spoil disposal sites for microtunneling.
   14. Provide a plan to deal with microtunnel slurry accidentally released to the surface.
   15. Submit written documentation from the accepted disposal site(s) indicating that they will accept the spoil and are in compliance with all City, County, State, and Federal regulations.

16. Provide a general plan, procedures, and details for constructing recovery shafts and other methods to remove obstructions that may be encountered during microtunneling.
17. Provide a safety plan for the microtunneling operations including provisions for ventilation, and electrical system safeguards. Submit name of Contractor's site safety representative responsible for implementing safety program.
18. Provide emergency response plan for rescuing personnel trapped underground in a shaft excavation or pipe if personnel will enter the pipe during construction.

E. Contractor shall submit daily shift records including:
   1. Starting and ending stations for each shift.
   2. Crew size and allocations for each shift.
   3. Time of beginning and end of each pipe section installed.
   4. Record of soil or rock type.
   5. A digital copy of records from the control cabin in a format able to be imported to Microsoft Excel, indicating thrust force, cutterhead torque, rate of advance, line and grade deviation, roll, inclination, laser position, steering altitude, slurry face pressure and other pertinent information from the data logger, recorded at 10-minute intervals, or less. The distance wheel shall be operated at all times and the records correlated to the jacked stations.
   6. Records of any unusual occurrences including unstable ground, ground water problems, equipment malfunction, power outages, damage to jacking pipe. Include the location and time of each such occurrence.

1.6 QUALITY ASSURANCE

A. Qualifications
   1. Contractor:
      a. All trenchless microtunnel boring work shall be performed by an experienced subcontractor or Contractor who has at least 5 years of experience in performing microtunneling work and has completed at least 5 microtunnel boring projects of similar diameter and in similar ground conditions.
         1) At least 1 of the projects shall have an individual boring of similar diameter and of length equal to or greater in length than the longest drive planned on this project.
      b. The project superintendent shall have at least 5 years of experience supervising microtunnel boring construction and have experience supervising at least 2 microtunnel boring projects of similar diameter and in similar ground conditions.
      c. Microtunnel Design Engineer: Licensed Professional Engineer in the State of Texas with a minimum of ten (10) years of experience in the design of casing pipe, jacking frames, thrust blocks, jacking systems, and other related design work for microtunnel applications.
      d. MTBM Operator: Minimum five (5) years of experience in the operation of the equipment planned to be utilized.
      e. Surveyor: Licensed Surveyor in the State of Texas with experience on similar projects.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Casing or jacking pipe shall be in accordance with Section 33 05 22 – Jacking Pipe.

B. Carrier pipe shall be in accordance with Section 33 05 37.02 – Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe for Tunnel Carrier Installation

C. Contact Grout shall be in accordance with Section 35 23 24 – Contact Grouting

PART 3 - EXECUTION

3.1 PREPARATION

A. Trenchless excavation by MTBM shall not begin until the following have been completed:
   1. Review of available utility drawings and location of conduits and underground utilities in all areas where excavation is to be performed. Notify the applicable one-call system prior to any excavation to avoid interference with the existing conduits and utilities in accordance with Section CIP4 & CIP6.
   2. Contractor shall notify the Texas One Call system (800-245-4545) to request marking of utilities by utility owners / operators that subscribe to One Call and shall individually notify all other known or suspected utilities to request marking of these utilities.
      a. Confirm that all requested locates are made prior to commencing boring operations.
      b. Visually confirm and stake necessary existing lines, cables, or other underground facilities including exposing necessary crossing utilities and utilities within 10 feet laterally of the designed tunnel.
   3. Follow notification requirements of permit or easement provider where applicable.
   4. Complete shaft or pit excavations and support systems for each drive in accordance with Section 33 73 15 – Shafts and approved design submittal.

3.2 DESIGN CRITERIA

A. The alignment of each of the trenchless sections will pass through various geologic formations, groundwater conditions, and rock of varying quality and strength. Design excavation methods, spoil conveyance system, and slurry separation system of each section for the ground and groundwater conditions anticipated in that section. The MTBM shall have seals capable of withstanding the hydrostatic head associated with the groundwater conditions.

B. See Section 33 73 80 – Groundwater Control for Shafts and Tunnels for special considerations related to groundwater inflows.

C. Design launching and receiving seals to prevent loss of ground, groundwater, and lubricants at shafts designed by the Microtunnel Design Engineer.

D. The Drawings show minimum casing diameters for two-pass installations. Subject to review and acceptance by the Engineer, the Contractor may select such dimensions as may be required to conduct the work, consistent with his planned equipment, means, and methods.

1. Trenchless Reaches shown with steel encasement must utilize two-pass installation and must utilize steel casing.
2. Trenchless Reaches shown with unspecified encasement may utilize steel or reinforced concrete pipe (RCP) as casing.

E. In a single-pass installation, the inside diameter of the carrier pipe as indicated on the Drawings must be maintained.

F. Use methods and equipment that control ground movements (settlement and heave) to prevent damage to existing adjacent utilities, facilities, and surface features (i.e. pavement, structures, railroad tracks, etc.).
   1. Repair damage to existing utilities or other infrastructure resulting from the work at no additional cost to the Owner.

G. Maximum radial over cut shall be 1.0 inch (2.0 inch on the diameter).

3.3 INSTALLATION

A. General
   1. As necessary to control or minimize the inflow of groundwater into the tunnel, the Contractor shall install, operate, and maintain a tunnel groundwater control system in accordance with Section 33 73 80 – Groundwater Control for Shafts and Tunnels.
   2. Properly manage and dispose of groundwater inflows to the shafts or pits in accordance with requirements of Section 33 73 80 – Groundwater Control for Shafts and Tunnels and all permit conditions.
   3. The project superintendent shall be on site at all times during trenchless excavation work.
   4. Immediately notify the Engineer if any problems are encountered with equipment or materials or if the Contractor believes the conditions encountered are materially and significantly different than those represented by the Contract Documents.
   5. Where pipe is required to be installed under railroad embankments or under highways, streets, or other facilities, construction shall be performed in such a manner so as to not interfere with the operation of the railroad, street, highway, or other facility, and so as not to weaken or damage any embankment or structure. Any damage shall be immediately repaired to original or better condition and to the satisfaction of the Engineer or permit grantor at no additional cost to the Owner.
   6. During construction operations, furnish and maintain barricades and lights to safeguard traffic and pedestrians until such time as the backfill has been completed, then remove barricades and lights from the site.
   7. Furnish all necessary equipment, power, water, and utilities for tunneling, spoil removal and disposal, grouting and other associated work required for the methods of construction.
   8. Maintain clean working conditions at all times inside the tunnel and shafts. All muck, slush, grout spills, ponded water, and any other material not required for tunneling shall be removed from the excavations in a timely manner.
   9. Whenever there is a condition that is likely to endanger the stability of the excavation or adjacent structures, operate with a full crew, 24 hours a day, including weekends and holidays, without interruption, until those conditions no longer jeopardize the stability of the Work.

B. Microtunnel Boring Machine (MTBM)

1. The MTBM shall be a closed full-face machine designed and built or rebuilt for the ground conditions on this project by a recognized MTBM manufacturer with at least 5 years' experience in the design and manufacture of MTBMs of this type. The manufacturer must still be in the business of designing and manufacturing MTBMs. All of the various components and systems, which make up the MTBM shall be new or reconditioned so that the machine is ready to operate upon installation at the site. It shall have excess capacity to handle the range of geological conditions indicated in GER and Hydrologic Report.
2. The machine shall be capable of fully supporting the face during both excavation and shutdown periods, and shall have the capability of exerting a controllable, measurable, continuous, stabilizing pressure at the face as required to prevent loss of ground. The system shall be capable of adjustments required to balance the soil pressures at the tunnel face to an accuracy of one foot of equivalent hydrostatic pressure. The machine shall utilize a synchronized slurry transportation system with machine advance rate to avoid over excavation or loss of ground.
3. The slurry pressure at the excavation face shall be controlled by use of slurry pumps. The Contractor shall carefully control slurry pressures applied at the tunnel face to prevent loss of ground and to prevent fracturing of the ground and discharge of slurry to the ground surface or into waterways.
4. Provide a slurry separation plant that is appropriate for the spoils generated from the soils and rock being excavated, and compatible with the anticipated excavation rate, effective in removing the spoil from the slurry, and is acceptable in terms of the available construction staging areas. Use settlement tanks, shakers, vibrating screens, hydro-cyclones and centrifuges as required for effective spoil removal.
5. Monitor the composition of the slurry to maintain the slurry density and viscosity limits as accepted in the submittals.
6. Properly transport and dispose of all excavated materials and slurry in accordance with all applicable City, County, State, and Federal regulations.
7. The MTBM shall be configured or equipped to permit access into the slurry chamber to allow changing of cutterhead tooling.
8. The machine shall be remotely operated, laser guided, and monitored continuously by the operator. A display showing the position of the machine in relation to design line-and-grade shall be provided at the operation console to allow the operator to monitor face pressure, roll, inclination, laser position, steering attitude, slurry face pressure, rate of advance, installed length, thrust force and cutterhead torque. The machine shall have a data logger that records all of the above at 10-minute intervals, or less, to a portable digital storage device in a format that can be imported into Microsoft Excel. The Contractor shall download this data, and include it in the daily report in both the form of raw data and plotted graphically to show the machine parameters as the excavation progresses.
9. The machine shall have a laser guidance system with a light sensitive or electronic target appropriate for the drive lengths required and capable of achieving the line-and-grade control requirements for the project.
10. The machine shall have an articulated shield that is steerable in both vertical and horizontal directions to maintain line-and-grade within the specified tolerances. The cutterhead shall have a reversible drive system so that it can rotate and cut in either direction to minimize rotation or roll of the pipe during installation.

11. A pipe lubrication injection system shall be provided to inject pipe lubricants as required to minimize jacking force. The pipe lubrication system pressure shall be continuously monitored, recorded, and controlled to prevent pipe buckling and/or ground heave.
12. The machine shall be capable of installing the selected jacking pipe at the diameters indicated on the Drawings while limiting overcut below the allowable maximum.
13. Overcut shall not exceed 1 inch measured from the outside diameter of the jacking pipe being installed. The annular space created by any overcut shall be filled with a lubricant material that shall reduce the friction drag of the soil on the pipe and eliminate voids around the pipe. At completion of tunneling, the annular space created by any overcut shall be filled with neat cement grout by means of contact grouting per Section 35 23 24 – Contact Grouting.

C. Jacking System
1. The main jacking equipment installed shall have a jacking capacity that is at least 150% of the maximum calculated allowable jacking load required to install the pipe and shall be designed by the Microtunnel Design Engineer.
2. The main jacks shall be mounted in a jacking frame located in the jacking shaft. The MTBM shall be moved forward by the jacks advancing a successive string of connected pipes toward a receiving shaft. The jacking system shall develop a uniform distribution of jacking forces on the end of the pipe by the use of thruster rings and cushioning material.
3. A thrust block or reaction frame is required to transfer jacking loads to the soil behind the jacking shaft. The thrust block shall be constructed perpendicular to the proposed pipe alignment and shall be designed by the Microtunnel Design Engineer to withstand the maximum jacking pressure to be used, with a safety factor of at least 2.0 without excessive deflection or displacement.
4. Operate the jacks so as not to exceed 80 percent of their rated capacity. At no time shall the jacks be operated so as to exceed the axial capacity of the jacked pipe, including all safety factors, as determined by the Design Engineer per the requirements of Section 33 05 22 – Jacking Pipe. Provide additional jacking capacity, such as intermediate jacking stations, if the jacking requirements shall otherwise exceed 80 percent of their rated capacity.
5. When intermediate jacking stations are utilized, the maximum jacking force shall not exceed the maximum allowable jacking load of the casing as determined by the Design Engineer per the requirements of Section 33 05 22 – Jacking Pipe.
6. The jacking system shall be capable of continuously monitoring the jacking pressure and advance rate.

D. Shafts and Pits:
1. Suitable shafts, pits, or trenches shall be excavated for the purpose of conducting the trenchless operations in accordance with Section 33 73 15 – Shafts.
2. Provide launching and receiving seals to prevent loss of ground, groundwater, and loss of lubricants at jacking shaft deigned by the Microtunnel Design Engineer.
3. The shafts, pits, or trenches excavated to facilitate these operations shall be backfilled immediately after the carrier pipe and associated manhole installation has been completed in accordance with Section 33 73 15 – Shafts.

E. Boring:

1. Install jacking pipe by boring with an approved MTBM and simultaneously jacking pipe into place.
2. The use of water or other fluids in connection with the boring operation will be permitted only to the extent required to maintain face pressure and to lubricate the pipe string. Jetting or sluicing will not be permitted.
3. The Contractor shall be fully responsible for ensuring the methods used are adequate for the protection of workers, pipe, property, and the public; and to provide a finished product as required.

F. Contact Grouting:
1. Contact grout the annulus space between the installed jacking pipe and the ground and any voids caused by or encountered during the boring in accordance with Specification Section 35 23 24 – Contact Grouting.

G. Control of Line and Grade:
1. The benchmarks and other primary survey control have been established and are shown on the Plans. The Contractor shall verify the accuracy of these benchmarks at the beginning of construction and report any errors or discrepancies to the Engineer.
2. When satisfied that all benchmarks are correct, use these benchmarks to furnish and maintain all reference lines-and-grades for microtunneling. For microtunneling, use these lines-and-grades to establish the location of the casing using laser guidance system. Surveying shall be performed by a surveyor licensed in the State of Texas. The Contractor shall be fully responsible for the accuracy of the work and the correction of defective work, as required.
3. Laser shall be mounted independently from the thrust block and jacking frame to maintain the alignment of the laser. Stop microtunneling operations and reset laser if laser alignment shifts or is moved off of design alignment and grade for any reason. Laser shall only be reset by qualified surveying personnel in accordance with accepted procedures.
4. Monitor line-and-grade continuously during microtunneling operations. Record deviation with respect to design line-and-grade at least once per jacking cycleand submit records to the Engineer as requested. Control line-and-grade of the casing to within the specified tolerances.
5. If the jacking pipe installation exceeds the specified tolerances for deviations, return to the theoretical microtunneling line and/or grade at a rate of not more than one (1) inch per twenty-five (25) feet. If the tunnel deviates sufficiently off plan line and/or grade to require a redesign of the carrier pipe or appurtenances, the Contractor shall have the system redesigned at no cost to the Owner. All corrective work shall be performed as accepted by the Engineer, at no additional cost to the Owner.

3.4 CLEANUP AND RESTORATION

A. After completion of the boring, all construction debris, spoils, oil, grease, and other materials shall be removed from the pipe, pits, and all work areas.

B. Restoration shall follow construction as the work progresses and shall be completed as soon as reasonably possible.
1. Restore and repair any damage resulting from surface settlement or heave caused by shaft excavation or boring.

2. Any property damaged or destroyed shall be restored to a condition equal to or better than existing prior to construction.
3. Restoration shall be completed no later than 30 days after boring is complete, or earlier if required as part of a permit or easement agreement.
4. This provision for restoration shall include all property affected by the construction operations.

3.5 SITE QUALITY CONTROL

A. Field Tests and Inspections
   1. Allow access and furnish necessary assistance and cooperation to aid in the observations, measurements, data, and sample collection, including, but not limited to the following:
      a. The Engineer shall have access to the boring system prior to, during, and following all boring operations.
      b. The Engineer shall have access to the trenchless shafts or pits prior to, during, and following all boring operations.
         1) This shall include, but not be limited to, visual inspection of installed pipe and verification of line and grade.
         2) The Contractor shall provide safe access in accordance with all safety regulations.
      c. The Engineer shall have access to spoils removed from the boring excavation prior to, during, and following all boring operations.

3.6 SAFETY

A. The work has been classified as potentially-gassy in accordance with the Code of Federal Regulations, 29 CFR 1926 Safety and Health Regulations for Construction (OSHA).

B. The Contractor is responsible for safety on the Site.
   1. Perform all Work in accordance with the current applicable regulations of the Federal, State, and local agencies.
   2. In the event of conflict, comply with the more restrictive applicable requirement.

C. No gasoline powered equipment shall be permitted in shafts/pits.
   1. Diesel, electrical, hydraulic, and air powered equipment are acceptable, subject to applicable local, State, and Federal regulations.

D. Furnish and operate a temporary ventilation system in accordance with applicable safety requirements when personnel are underground.
   1. Perform all required air and gas monitoring.
   2. Ventilation system shall provide a sufficient supply of fresh air and maintain an atmosphere free of toxic or flammable gasses in all underground work areas.

E. Perform all work in accordance with all current applicable regulations and safety requirements of the Federal, State, and Local agencies.

F. Comply with all applicable provisions of OSHA 29 CFR Part 1926, Subpart S, Underground Construction and Subpart P, Excavations.
   1. In the event of conflict, comply with the more stringent requirements.

G. If personnel will enter the pipe during construction, the Contractor shall develop an emergency response plan for rescuing personnel trapped underground in a shaft excavation or pipe.
   1. Keep on-site all equipment required for emergency response in accordance with the agency having jurisdiction.

END OF SECTION

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SECTION 33 30 04

Trenchless Excavation by Hand Tunneling

PART 1 - GENERAL

1.1 SUMMARY

A. Scope of Work:

1. Furnish all labor, design, materials, and equipment required to perform the trenchless excavation for Reach 1 through the geologic conditions interpreted from the Geotechnical Engineering Report (GER) and hydrologic conditions interpreted from the Hydrologic Report to the minimum dimensions shown on the Drawings and as required to perform the work utilizing a hand tunneling with a shield propelled by jacking pipe. This shall include the excavation, handling, removal, and disposal of all materials encountered in the tunnel excavation; installation of jacking pipe, installation and maintenance of tunnel temporary utilities, drainage, ventilation, lighting, power, and communications; tunnel safety; and all appurtenant work necessary to complete the Work in accordance with the Contract Documents.
2. For Reach 1, install jacking pipe or by a two-pass system utilizing oversized steel casing within which the CCFRPM carrier pipe is installed. Requirements for the jacking pipe are outlined in Section 33 05 22 – Jacking Pipe.
3. This is one alternative to perform the trenchless excavation of Reach 1 indicated on the Drawings. The excavation may also be performed utilizing a tunnel boring machine or slurry microtunnel boring machine. The requirements of Section 33 30 02 – Trenchless Excavation by Tunnel Boring Machine or Section 33 30 03 – Tunnel Excavation by Microtunnel Boring Machine will govern for the method selected by the Contractor.

B. Related Specification Sections include, but are not necessarily limited to:

1. Section 33 05 22 – Jacking Pipe
2. Section 33 05 24 – Installation of Carrier Pipe in Casing
3. Section 33 30 02 – Trenchless Excavation by Tunnel Boring Machine
4. Section 33 30 03 – Trenchless Excavation by Microtunnel Boring Machine
5. Section 33 73 15 – Shafts
6. Section 33 73 80 – Groundwater Control for Shafts and Tunnels
7. Section 35 23 24 – Contact Grouting
8. Section 33 05 37.02 – Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe for Tunnel Carrier Installation
9. Section 33 05 37.03 – Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe for Jacking Installation

C. Related documents:

1. Geotechnical Engineering Report, Revision 2 (GER); Berry Creek Offsite Wastewater Main – North Alternative; Georgetown, Texas; prepared for Walker Partners by Terracon Consultants, Inc.; March 8, 2023.

2. Hydrologic Report for the Berry Creek Wastewater Interceptor Project (Hydrologic Report); Williamson County, Texas; prepared for Walker Partners by SWCA Environmental Consultants; October 2022.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. Measurement
      a. No separate measurement shall be made for this item.
   2. Payment
      a. The work performed and materials furnished in accordance with this item are subsidiary to the lump sum cost bid for the reach which trenchless excavation by tunnel boring machine is successfully completed, and no other compensation will be allowed.

1.3 REFERENCES

A. Reference Standards
   1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
   2. Occupational Safety and Health Administration (OSHA)
      a. OSHA Regulations and Standards for Underground Construction, 29 CFR Part 1926, Subpart S, Underground Construction and Subpart P, Excavation.

1.4 DEFINITIONS

A. Hand Tunneling Shield: The leading section of jacked steel casing or approved tunneling shield used to support the tunneled ground from which hand tunneling operations can safely excavate the ground and perform the work in accordance with the specifications.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section CIP10.

B. The Contractor shall submit a list of all equipment to be used and product data demonstrating equipment is sufficient to perform the work.

C. The Contractor shall submit information demonstrating adherence with the qualification requirements outlined in Section 1.6 minimum 30 days prior to the start of work.
   1. Submit project name, date, location, description (diameter and length) of tunnel(s), ground and groundwater conditions, trenchless methods utilized, and names and contact information of references with individual knowledge of the work on each project.

D. Contractor shall submit a hand tunneling excavation work plan 30 days prior to start of work describing the equipment and procedures to be employed. Acceptance by the Engineer of the required designs does not relieve the Contractor of the full responsibility for the adequacy of the designs.
   1. Provide manufacturer's literature describing system in detail including shield type, any design modifications, spoil removal system, jacking system, and method for maintaining line and grade.

2. Provide plan of two-pass installation and type and size of jacking pipe to be utilized. Coordinate with design and submittal requirements outlined in Section 33 05 22 – Jacking Pipe.
3. Provide a layout of each tunnel work area including shafts/pits, pipe storage, material handling, and jacking arrangement.
4. Identify ground water control measures during tunneling in accordance with Section 33 73 80 – Groundwater Control for Shafts and Tunnels.
5. Provide a schedule for all trenchless excavation work identifying each of the trenchless reaches and all major construction activities as independent items.
6. Identify tunnel lighting, communications, and other utility systems.
7. Provide a description of the alignment control. Provide manufacturer's literature, drawings showing setup and support provisions, and other details. Confirm that these systems can achieve the required pipeline line and grade within the specified tolerances.
8. Submit name and resume of surveyor licensed in the State of Texas who shall be responsible for setting survey control for pipe installation.
9. Capacity, number, and arrangement of jacks. Provide details of thrust ring, jacking controls, and pressure gages. Provide an estimate of maximum jacking force expected to be required to complete each drive, and planned location of intermediate jacking stations (IJS) if used.
10. Provide thrust block and jacking frame design and details. Submit sealed calculations prepared by the Design Engineer demonstrating that the thrust block can transfer the maximum planned forces developed by the main jacks to the ground without excessive movements.
11. Provide details of the IJS and IJS pipe lead and tail pipe design, including manufacturer's literature.
12. Provide details of pipe lubrication injection system and pipe lubricants to be used, including manufacturer's literature.
13. Submit written documentation from the accepted disposal site(s) indicating that they will accept the spoil and are in compliance with all City, County, State, and Federal regulations.
14. Provide a general plan, procedures, and details for methods to remove obstructions that may be encountered during hand tunneling.
15. Provide a plan to control the face during mining and when not actively mining.
16. Provide a safety plan for the hand tunneling operations including provisions for ventilation, and electrical system safeguards. Submit name of Contractor's site safety representative responsible for implementing safety program.
17. Provide emergency response plan for rescuing personnel trapped underground in a shaft excavation or pipe if personnel will enter the pipe during construction.

E. Contractor shall submit daily shift records including:
   1. Starting and ending stations for each shift.
   2. Crew size and allocations for each shift.
   3. Time of beginning and end of each pipe section installed.
   4. Record of soil or rock type and groundwater inflow rates.

5. Records of any unusual occurrences including unstable ground, ground water problems, equipment malfunction, power outages, damage to jacking pipe. Include the location and time of each such occurrence.

1.6 QUALITY ASSURANCE

A. Qualifications

1. Contractor:
   a. All hand tunneling work shall be performed by an experienced subcontractor or Contractor who has at least 5 years of experience in performing hand tunneling work and has completed at least 5 projects of similar diameter, in similar ground conditions, and utilizing similar construction methods.
      1) At least 1 of the projects shall have an individual tunnel of similar diameter and of length equal to or greater in length than the longest hand tunneling drive planned on this project.
   b. The project superintendent shall have at least 5 years of experience supervising hand tunneling construction and have experience supervising at least 2 projects of similar diameter, in similar ground conditions, and utilizing similar trenchless construction methods.
   c. Design Engineer: Licensed Professional Engineer in the State of Texas with a minimum of ten (10) years of experience in jacking pipe and jacking frame design.
   d. The site safety representative and personnel responsible for air quality monitoring shall be experienced in tunnel construction and shall have current certification by OSHA.
   e. Surveyor: Licensed Surveyor in the State of Texas with experience on similar projects.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Casing or jacking pipe shall be in accordance with Section 33 05 22 – Jacking Pipe.

B. Carrier pipe shall be in accordance with Section 33 05 37.02 – Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe for Tunnel Carrier Installation

C. Contact Grout shall be in accordance with Section 35 23 24 – Contact Grouting

PART 3 - EXECUTION

3.1 PREPARATION

A. Trenchless excavation by hand tunneling shall not begin until the following have been completed:

1. Review of available utility drawings and location of conduits and underground utilities in all areas where excavation is to be performed. Notify the applicable one-call system prior to any excavation to avoid interference with the existing conduits and utilities in accordance with Section CIP4 & CIP6.

2. Contractor shall notify the Texas One Call system (800-245-4545) to request marking of utilities by utility owners / operators that subscribe to One Call and shall individually notify all other known or suspected utilities to request marking of these utilities.
   a. Confirm that all requested locates are made prior to commencing boring operations.
   b. Visually confirm and stake necessary existing lines, cables, or other underground facilities including exposing necessary crossing utilities and utilities within 10 feet laterally of the designed tunnel.
3. Follow notification requirements of permit or easement provider where applicable.
4. Complete shaft or pit excavations and support systems for each drive in accordance with Section 33 73 15 – Shafts and approved design submittal.

3.2 DESIGN CRITERIA

A. The alignment of each of the trenchless sections will pass through various geologic formations, ground water conditions, and rock of varying quality and strength. Design excavation methods and spoil conveyance system of each section for the ground and groundwater conditions anticipated in that section, as interpreted from the GER and the Hydrologic Report.

B. See Section 33 73 80 – Groundwater Control for Shafts and Tunnels for special considerations related to groundwater inflows.

C. The hand tunneling equipment shall have sufficient cutting power to excavate the geologic material as interpreted from the GER.

D. The Drawings show minimum casing diameters for two-pass installations. Subject to review and acceptance by the Engineer, the Contractor may select such dimensions as may be required to conduct the work, consistent with his planned equipment, means, and methods.
   1. Trenchless Reaches shown with steel encasement must utilize two-pass installation and must utilize steel casing.
   2. Trenchless Reaches shown with unspecified encasement must utilize two-pass installation and may utilize steel or reinforced concrete pipe (RCP) as casing.

E. Use methods and equipment that control surface settlement and heave above the pipeline to prevent damage to existing utilities, facilities, and improvements.
   1. Limit any ground movements (settlement/heave) to values that shall not cause damage to adjacent utilities or surface features (i.e. pavement, structures, railroad tracks, etc.)
   2. Repair damage to existing utilities or other infrastructure resulting from excavation at no additional cost to the Owner.

F. Use methods and equipment that allow control of the face during mining and when not actively mining.

G. Maximum radial over cut shall be 1 inch (2.0 inch on the diameter).

3.3 INSTALLATION

A. General

1. As necessary to control or minimize the inflow of groundwater into the tunnel, the Contractor shall install, operate, and maintain a tunnel groundwater control system in accordance with Section 33 73 80 – Groundwater Control for Shafts and Tunnels.
2. Properly manage and dispose of groundwater inflows to the shafts or pits in accordance with requirements of Section 33 73 80 – Groundwater Control for Shafts and Tunnels and all permit conditions.
3. The project superintendent shall be on site at all times during trenchless excavation work.
4. Immediately notify the Engineer if any problems are encountered with equipment or materials or if the Contractor believes the conditions encountered are materially and significantly different than those represented by the Contract Documents.
5. Where pipe is required to be installed under railroad embankments or under highways, streets, or other facilities, construction shall be performed in such a manner so as to not interfere with the operation of the railroad, street, highway, or other facility, and so as not to weaken or damage any embankment or structure. Any damage shall be immediately repaired to original or better condition and to the satisfaction of the Engineer or permit grantor at no additional cost to the Owner.
6. During construction operations, furnish and maintain barricades and lights to safeguard traffic and pedestrians until such time as the backfill has been completed and then remove from the site.
7. Furnish all necessary equipment, power, water, and utilities for tunneling, spoil removal and disposal, grouting and other associated work required for the methods of construction.
8. Maintain clean working conditions at all times inside the tunnel and shafts. All muck, slush, grout spills, ponded water, and any other material not required for tunneling shall be removed from the excavations in a timely manner.
9. Whenever there is a condition that is likely to endanger the stability of the excavation or adjacent structures, operate with a full crew, 24 hours a day, including weekends and holidays, without interruption, until those conditions no longer jeopardize the stability of the Work.

B. Shafts and Pits:
   1. Suitable shafts, pits, or trenches shall be excavated for the purpose of conducting the trenchless operations in accordance with Section 33 73 15 – Shafts.
   2. The shafts, pits, or trenches excavated to facilitate these operations shall be backfilled in accordance with Section 33 73 15 – Shafts immediately after the carrier pipe and associated manhole installation has been completed.

C. Jacking System
   1. The main jacking equipment installed shall have a jacking capacity that is at least 150% of the maximum calculated allowable jacking load required to install the pipe and shall be designed by the Design Engineer.
   2. The main jacks shall be mounted in a jacking frame and located in the jacking shaft. The hand tunneling shield shall be moved forward by the jacks advancing a successive string of connected pipes toward a receiving shaft. The jacking system shall develop a uniform distribution of jacking forces on the end of the pipe by the use of thruster rings and cushioning material.

3. A thrust block or reaction frame is required to transfer jacking loads to the soil behind the jacking shaft. The thrust block shall be constructed perpendicular to the proposed pipe alignment and shall be designed by the Design Engineer to withstand the maximum jacking pressure to be used, with a safety factor of at least 2.0 without excessive deflection or displacement.
4. Operate the jacks so as not to exceed 80 percent of their rated capacity. At no time shall the jacks be operated so as to exceed the axial capacity of the jacked pipe, including all safety factors, as determined by the Design Engineer per the requirements of Section 33 05 22 – Jacking Pipe. Provide additional jacking capacity, such as intermediate jacking stations, if the jacking requirements shall otherwise exceed 80 percent of their rated capacity.
5. When intermediate jacking stations are utilized, the maximum jacking force shall not exceed the maximum allowable jacking load of the casing as determined by the Design Engineer per the requirements of Section 33 05 22 – Jacking Pipe.
6. The jacking system shall be capable of continuously monitoring the jacking pressure and advance rate.

D. Mining:
1. Install jacking pipe by advancing an approved tunneling shield and simultaneously jacking pipe into place.
2. Blasting is not allowed.
3. Excavated material may be removed from the tunnel via muck cars, conveyor, auger, or other approved methods. Place excavated material near the top of the working pit and dispose of as required. If no room is available, immediate haul off is required.
4. The use of water or other fluids in connection with the boring operation will be permitted only to the extent required to lubricate cuttings. Jetting or sluicing will not be permitted.
5. The excavated tunnel face shall not extend more than 2 feet beyond the end of the casing pipe. Decrease this distance as required by the character or stability of the material being excavated.
6. The Contractor shall be fully responsible for ensuring the methods used are adequate for the protection of workers, pipe, property, and the public and to provide a finished product as required.
7. The Contractor shall provide satisfactory support of the excavated face.

E. Contact Grouting:
1. Contact grout the annulus space between the installed jacking pipe and the ground and any voids caused by or encountered during the boring in accordance with Specification Section 35 23 24 – Contact Grouting.

F. Control of Line and Grade:
1. Maximum deviation from line or grade shall be 3 inches at any point along the drive.
2. Provide means to monitor line and grade continuously during boring operations.
3. Verify line and grade every 50-feet by means of survey by a licensed surveyor or other approved method.

4. If the pipe installation does not meet the specified tolerances, correct the installation, including any necessary redesign of the pipeline or structures and acquisition of necessary easements.

3.4 CLEANUP AND RESTORATION

A. After completion of the hand tunneling, all construction debris, spoils, oil, grease, and other materials shall be removed from the pipe, pits, and all work areas.

B. Restoration shall follow construction as the work progresses and shall be completed as soon as reasonably possible.
   1. Restore and repair any damage resulting from surface settlement caused by shaft excavation or boring.
   2. Any property damaged or destroyed shall be restored to a condition equal to or better than existing prior to construction.
   3. Restoration shall be completed no later than 30 days after boring is complete, or earlier if required as part of a permit or easement agreement.
   4. This provision for restoration shall include all property affected by the construction operations.

3.5 SITE QUALITY CONTROL

A. Field Tests and Inspections
   1. Allow access and furnish necessary assistance and cooperation to aid in the observations, measurements, data, and sample collection, including, but not limited to the following:
      a. The Engineer shall have access to the tunneling system prior to, during, and following all tunneling operations.
      b. The Engineer shall have access to the trenchless shafts or pits prior to, during, and following all boring operations.
         1) This shall include, but not be limited to, visual inspection of installed pipe and verification of line and grade.
         2) The Contractor shall provide safe access in accordance with all safety regulations.
      c. The Engineer shall have access to spoils removed from the boring excavation prior to, during, and following all tunneling operations.

3.6 SAFETY

A. The work has been classified as potentially-gassy in accordance with the Code of Federal Regulations, 29 CFR 1926 Safety and Health Regulations for Construction (OSHA).

B. The Contractor is responsible for safety on the Site.
   1. Perform all Work in accordance with the current applicable regulations of the Federal, State, and local agencies.
   2. In the event of conflict, comply with the more restrictive applicable requirement.

C. No gasoline powered equipment shall be permitted in receiving shafts/pits.
   1. Diesel, electrical, hydraulic, and air powered equipment are acceptable, subject to applicable local, State, and Federal regulations.

D. Furnish and operate a temporary ventilation system in accordance with applicable safety requirements when personnel are underground.
   1. Perform all required air and gas monitoring.
   2. Ventilation system shall provide a sufficient supply of fresh air and maintain an atmosphere free of toxic or flammable gasses in all underground work areas.

E. Perform all work in accordance with all current applicable regulations and safety requirements of the Federal, State, and Local agencies.

F. Comply with all applicable provisions of OSHA 29 CFR Part 1926, Subpart S, Underground Construction and Subpart P, Excavations.
   1. In the event of conflict, comply with the more stringent requirements.

G. If personnel will enter the pipe during construction, the Contractor shall develop an emergency response plan for rescuing personnel trapped underground in a shaft excavation or pipe.
   1. Keep on-site all equipment required for emergency response in accordance with the agency having jurisdiction.

END OF SECTION

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SECTION 33 73 15
SHAFTS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope of Work:
   1. This Section includes all labor, equipment, and materials necessary to construct shafts to the lines, grades, and limits shown on the Drawings, or as approved by the Engineer, through the geologic conditions interpreted from the Geotechnical Engineering Report (GER) and Hydrologic conditions interpreted from the Hydrologic Report.
   2. Work shall include, but not be limited to excavation, support of excavation (SOE) system, installation of invert slab, constructing shaft-tunnel connections, placing grout, removal of SOE elements, and backfilling as shown on the Drawings.
   3. The Contractor shall have the sole responsibility for the design, construction, maintenance, and backfilling of all shafts.
   4. The Contractor shall have the sole responsibility for maintenance and protection of existing utilities, structures, and facilities within the zone impacted by the shaft. The zone of impact shall include the zone of ground movement in the vicinity of this work.
   5. The Contractor shall have the sole responsibility for sizing the shaft within the limits specified and shown on the Drawings. The size of the excavations shall be adequate to construct all required permanent structures and to gain access to tunneling operations for all materials, equipment, and personnel.
   6. The Contractor shall allow the Engineer and the Owner's representative access to the shafts, and to use the shafts to access tunnel operations.

B. Related Specification Sections include, but are not necessarily limited to:
   1. Section C2 – Concrete for Structures
   2. Section C9 – Flowable Backfill
   3. Section CIP11 Trench Safety Requirements
   4. Section G4 - Trenching, Backfilling, and Compaction.
   5. Section WW1 Precast Concrete Manholes
   6. Section 33 30 02 – Trenchless Excavation by Tunnel Boring Machine
   7. Section 33 30 03 – Trenchless Excavation by Microtunnel Boring Machine
   8. Section 33 30 03 – Trenchless Excavation by Hand Tunneling
   9. Section 35 23 24 – Contact Grouting
   10. Section 33 73 80 – Groundwater Control for Shafts and Tunnel

C. Related documents:
   1. Geotechnical Engineering Report, Revision 2 (GER); Berry Creek Offsite Wastewater Main – North Alternative; Georgetown, Texas; prepared for Walker Partners by Terracon Consultants, Inc.; March 8, 2023.

2. Hydrologic Report for the Berry Creek Wastewater Interceptor Project (Hydrologic Report); Williamson County, Texas; prepared for Walker Partners by SWCA Environmental Consultants; October 2022.

1.2 PRICE AND PAYMENT PROCEDURES [NOT USED]

A. Measurement and Payment
   1. Measurement
      a. No separate measurement will be made for this item.
   2. Payment
      a. The work performed and materials furnished in accordance with this Item are subsidiary to the lump sum cost bid for the reach(es) in which shafts are utilized to complete the work, and no other compensation will be allowed.

1.3 REFERENCES

A. Standards
   1. ASTM A36 – Standard Specification for Carbon Structural Steel.
   2. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
   3. ASTM A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   4. ASTM A1064 – Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

1.4 DEFINITIONS

1. Shaft: Excavation supported by SOE of any shape or dimension as needed to facilitate trenchless construction. This includes a trench or open-cut section where trenchless construction would break into or out of.
2. Support of Excavation (SOE): temporary earth-retaining system to control the soil or rock to facilitate constructing a safe and efficient shaft.
3. Groundwater inflow: Groundwater which enters anywhere within a partially or fully excavated shaft, as cumulatively measured by pumping from dewatering well(s) and flow meters, as individually measured at individual point sources, as measured in total via sump pump discharge flow meters or as measured by other CMI approved measurement methods.
4. Shaft Designer: Responsible for the design of the shafts and associated SOE.
5. Tunnel-to-Shaft Connection Designer: Responsible for design of soft eyes, entry and exit seals, and ground improvement zones to accommodate construction of shafts, tunnel, and associated connections.

1.5 SUBMITTALS

A. General:
   1. Submittals shall be in accordance with Section CIP10.

B. The Contractor shall submit a list of all equipment to be used and product data demonstrating equipment is sufficient to perform the work.

C. The Contractor shall submit information demonstrating adherence with the qualification requirements outlined in Section 1.6 minimum 30 days prior to the start of work.

a. For each position - submit project name, date, location, description (size and depth) ground and groundwater conditions, SOE systems utilized, and names and contact information of references with individual knowledge of the work on each project.

D. Submit the following to the Engineer at least 60 days prior to the start of shaft construction at each shaft site. Acceptance by the Engineer of the shaft and associated SOE designs does not relieve the Contractor of the full responsibility for the adequacy of the design.

1. Shop Drawings:
   a. Shop Drawings for each shaft to be constructed. Shop Drawings shall include but not be limited to: shaft location and dimensions; proposed SOE and details for both soil and rock; flood protection system demonstrating protection to the FEMA 100-year floodplain elevations indicated on the drawings; backfill; and surface restoration.
2. Submit a break-in/break-out plan for each shaft that includes the following:
   a. Location of all SOE elements and clearance distance from each to the outside dimension of the Tunnel Boring Machine (TBM) or Microtunnel Boring Machine (MTBM);
   b. Location and dimensions of ground improvement zones to be used to stabilize the ground and/or control groundwater flow, as needed;
   c. Means and methods to mitigate hazardous gases entering into the shafts, tunnel, TBM, or MTBM;
   d. Means and method to maintain tunnel line and grade;
   e. Means and methods to protect the invert and prevent instability of shaft SOE or tunnel segments.
   f. Means and methods to prevent loss of slurry for MTBM launching and receiving.
3. Calculations:
   a. Submit calculations for all the details of each shaft and associated SOE. Calculations shall be signed and sealed by the Shaft Designer.
   b. Submit calculations for all the details of connections used in each tunnel to shaft transition. Calculations shall be signed and sealed by the Tunnel-to-Shaft Connection Designer.
4. Procedures and Methods:
   a. Submit procedures for excavating shafts, installing SOE, installing product pipe and final structures, and backfilling.
   b. Submit methods for controlling groundwater and removing and disposing of water. See requirements outlined in Section 33 73 80 – Groundwater Control for Shafts and Tunnel.
5. Product Data:
   a. Submit manufacturer’s product data for all materials incorporated into the final shaft structure.

1.6 QUALITY ASSURANCE

A. Qualifications

1. Contractor and Shaft Personnel Qualifications:
   a. Shaft Designer and Tunnel-to-Shaft Connection Designer:
      i. Professional Engineer licensed in the State of Texas, with demonstrated competence in the design of shaft SOE.

ii. Minimum of 10 years of experience and 3 shaft SOE projects of similar scope and complexity.

b. Superintendent:
   i. Minimum of 5 years of experience and 3 projects of similar scope and complexity.
   ii. The superintendent shall be on site full time during the construction of the shafts.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Provide and maintain an adequate supply of SOE materials at the site while shaft excavation is in progress consistent with requirements of the schedule.

1.8 FIELD [SITE] CONDITIONS

A. Refer to the Contract Documents, including the Geotechnical Engineering Report (GER) and the Hydrologic Report, for anticipated subsurface conditions. Subsurface conditions may require interpretation by the Contractor and the Shaft Designer and Tunnel-to-Shaft Connection Designer.

B. Multiple portions of the project with anticipated shafts are located in the FEMA 100-year flood plain. At a minimum, design the construction methods and groundwater and surface water control methods to allow the shaft, contractor's equipment, and the tunnel to be effectively protected to the elevation of the "1% Annual Chance Flood" (FEMA 100-year flood). The FEMA 100-year floodplain is shown on the Contract Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Materials:
   1. Material conforming to Flowable Backfill per Section C9 – Flowable Backfill; or
   2. Material conforming to Select Backfill Material per Section G4 Pipe Excavation, Trenching, Embedment, Encasement and Backfilling.

B. Concrete: Conform to Section C2 Concrete for Structures.

C. Lean Concrete: Lean concrete shall have a low strength (in the range of 500-1,000 psi) and small aggregate such that it is easily and evenly chipped away for lagging installation.

D. Shotcrete: Shall be designed by the Contractor to safely resist design ground loads with an appropriate safety factor and shall be compatible with the anticipated subsurface conditions.

E. Structural Steel: Steel ribs, fabricated connections and accessories, other steel W shapes, plate steel, and other structural steel shall conform to the requirements of ASTM A572 or ASTM A36, unless otherwise accepted.

F. Lagging:
   1. Lagging between soldier piles or ring beams shall be timber, steel plate, or reinforced concrete.

2. Lagging shall be designed by the Contractor to safely resist design ground loads with an appropriate safety factor. As a minimum, design shall demonstrate adequate resistance to bending forces imposed on the lagging.
3. Liner Plate: Shall meet the requirements of ASTM A1011 manufactured by Dywidag Systems International, Inc., Contech Construction Products, Inc., or approved equal.

G. Rock Bolts: Shall be designed by the Contractor to safely resist design ground loads with an appropriate safety factor and shall be compatible with the anticipated subsurface conditions.

H. Welded Wire Mesh:
1. Welded Wire Mesh shall conform to ASTM A1064.

I. The Shaft Designer and Tunnel-to-Shaft Connection Designer shall be ultimately responsible for determining the specific material requirements for the work.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shaft excavation shall not begin until the following have been completed:
1. Review of available utility drawings and location of conduits and underground utilities in all areas where excavation is to be performed. Notify the applicable one-call system prior to any excavation to avoid interference with the existing conduits and utilities in accordance with Section CIP4 & CIP6.
2. Contractor shall notify the Texas One Call system (800-245-4545) to request marking of utilities by utility owners / operators that subscribe to One Call and shall individually notify all other known or suspected utilities to request marking of these utilities.
   a. Confirm that all requested locates are made prior to commencing boring operations.
   b. Visually confirm and stake necessary existing lines, cables, or other underground facilities including exposing necessary crossing utilities and utilities within 10 feet laterally of the designed tunnel.
3. Follow notification requirements of permit or easement provider where applicable.

3.2 DESIGN

A. Shaft Designer and Tunnel-to-Shaft Connection Designer shall:
1. Design shafts and associated SOE to withstand earth pressures, equipment loads, applicable traffic and construction loads, and other surcharge loads to allow the safe construction of the tunnel without excessive movement or settlement of the ground, and to prevent damage to adjacent structures, streets, and utilities.
2. Where shafts connect to open-cut sections or where open cut sections are utilized as launch or receiving pits, coordinate the design with the requirements of Section CIP11 – Trench Safety Requirements and Section G4 – Trenching, Backfilling and Compaction.
3. Design a shaft flood protection system to protect the shaft (and connected underground works) from flooding in the event a flood causes water levels to reach the FEMA 100-year floodplain elevations indicated on the drawings.

4. Design shaft SOE elements to be compatible with the ground and groundwater conditions interpreted from the GER and the Hydrologic Report. Hydrostatic pressures should be calculated from the FEMA 100-year floodplain elevations indicated on the drawings.
5. Design shaft to consider any uplift forces that may act on the bottom of the shaft and whether ground improvement or other means of water cutoff are required.
6. Design a concrete base slab which is required in the shaft from which the tunnel boring machine or microtunnel boring machine will be launched and operated.

3.3 INSTALLATION

A. General:

1. Construct the shafts to accommodate the installation of the pipe, manholes, TBM or MTBM, and jacking equipment. The Contractor is responsible for the shaft locations and dimensions.
2. Locate existing utilities in the vicinity of the proposed construction sites prior to shaft location layouts and prior to material purchases for shaft construction. Determine if conflicts exist prior to any excavation for the proposed work.
3. Conduct layout work for each shaft to the lines and levels required before installation of facilities.
4. Provide safety railing and barricades at all excavations at all times.
5. Provide, operate, and maintain for the duration of the Work a temporary ventilation system that conforms to specified safety requirements and the requirements of jurisdictional authorities.
6. No gasoline powered equipment shall be permitted in the shafts. Diesel, electrical, hydraulic, and air powered equipment is acceptable, subject to applicable City, County, State, and Federal regulations.

B. Excavation:

1. Excavate soil and rock through conditions interpreted from the GER.
2. Excavations shall be to the dimensions as necessary to accomplish the work but in no case outside of the construction limits as shown on the drawings without specific acceptance by the Engineer. Do not excavate more than six inches deeper than the elevations shown or accepted. Excavations carried more than six inches deeper than the elevations shown or accepted shall be backfilled with accepted compacted material or lean concrete at no cost to the Owner. Methods used in making excavations shall not loosen ground beyond the limits of excavation.
3. The height of unsupported shaft sidewall span shall not exceed three feet in soil and five feet in rock. No unsupported sidewall spans will be allowed to exist for longer than 8 hours.
4. Handle and control groundwater in conformance with Section 33 73 80 – Groundwater Controls for Shafts and Tunnel.
5. Excavated material shall be handled and disposed of in accordance with Section G4 Pipe Excavation, Trenching, Embedment, Encasement and Backfilling.

C. Shaft SOE Installation:

1. Install SOE in accordance with Contractor's approved design and in accordance and compatible with Section 33 30 02 – Trenchless Excavation by Tunnel Boring Machine and Section 33 30 03 – Trenchless Excavation by Microtunnel Boring Machine as applicable.
2. Ring Beam and Lagging:
   a. Applications: Ring beams and lagging may be used as SOE in a circular shaft.
   b. Fabrication and Installation: Ring beams shall be pre-rolled to an appropriate curvature to match the intended excavated diameter of the shaft, and may be composed of several component pieces, with properly designed structural connections, to facilitate easy installation. Ring beams shall be expanded against the excavation wall or blocked at a spacing determined by the Contractor's design.
   c. Lagging: Provide timber, steel plate, or pre-cast concrete lagging of sufficient strength to withstand lateral earth pressures. Install lagging with no gap between adjacent boards or panels. As installation progresses, backfill the voids between the excavation face and the lagging with grout, sand, or pea gravel packed into place.
3. Rock Bolts:
   a. Applications: Rock bolts may be used as part of an SOE system in rock in conjunction with welded wire mesh and/or shotcrete.
   b. Install in accordance with approved design submittal.
4. Secant Piles
   a. Applications: Secant piles may be used as SOE in soil or rock in conjunction with other SOE elements as needed per the Contractor's approved design.
   b. Install in accordance with approved design submittal.

D. Shaft-to-Tunnel Connection
1. Perform the connection in a manner that will not damage the tunnel excavation and lining. Provide any supplemental support necessary to prevent damage to the shaft and tunnel lining during break-in and break-out of the tunnel into or out of the shaft.
2. Supplemental support shall not adversely affect the final structure. Remove supplemental support that would degrade or decay over time that would result in damage to the structure or nearby facilities.
3. Supplemental support within the tunnel or shaft shall remain in place as long as necessary.
4. The supplemental support shall be in place and at full strength prior to tunnel break-in or break-out.
5. Complete the connection of the tunnel to the shaft without discharging excessive slurry fluid or groundwater into the tunnel or shaft in order to maintain natural groundwater levels, preclude loss of ground, and to protect the local groundwater regime.

3.4 CLEANUP AND RESTORATION

A. Restore work areas to original condition or as shown on the Drawings.

B. Removal:

1. Remove all SOE and flood protection elements within five (5) feet of the ground surface, including (but not limited to) secant piles, slurry walls, soldier piles, wales, struts, lagging, and liner plates. SOE elements greater than five (5) feet below the ground surface shall be removed if practical, or if degradation or decay over time would result in damage to nearby facilities. Removal of the SOE system shall be performed in a manner that will not disturb or harm adjacent construction or facilities and only after shaft backfill has been placed. All voids created by the removal of the SOE elements shall be immediately filled with controlled density fill, lean concrete, or cement grout, as accepted by the Engineer. The SOE elements removed from the excavation shall remain the property of the Contractor and shall be removed from the site.

C. Backfill:
   1. Backfill shafts with flowable backfill a minimum of 6 inches above the crown of the tunnel in accordance with Section C9 – Flowable Backfill. Furnish, place and compact remaining backfill in the shafts, pits, and other excavations in accordance with the Drawings, Section C9 – Flowable Backfill, and Section G4 Section G4 - Pipe Excavation, Trenching, Embedment, Encasement, and Backfilling. Flowable backfill may be used as an alternative for the trench backfill specified on the shaft excavation support details (in the Drawings) at no additional cost to Owner.
   2. Coordinate backfilling with the installation of final carrier pipe, manholes, and other system appurtenances.

3.5 SITE QUALITY CONTROL

A. Field Tests and Inspections
   1. Allow access and furnish necessary assistance and cooperation to aid in the observations, measurements, data, and sample collection, including, but not limited to the following:
      a. The Engineer shall have access to the trenchless shafts or pits prior to, during, and following all boring operations.
         1) This shall include, but not be limited to, visual inspection of installed pipe and verification of line and grade.
         2) The Contractor shall provide safe access in accordance with all safety regulations.
      b. The Engineer shall have access to spoils removed from the boring excavation prior to, during, and following all boring operations.

3.6 SAFETY

A. The work has been classified as potentially-gassy in accordance with the Code of Federal Regulations, 29 CFR 1926 Safety and Health Regulations for Construction (OSHA).

B. The Contractor is responsible for safety on the Site.
   1. Perform all Work in accordance with the current applicable regulations of the Federal, State, and local agencies.
   2. In the event of conflict, comply with the more restrictive applicable requirement.

C. No gasoline powered equipment shall be permitted in shafts/pits.
   1. Diesel, electrical, hydraulic, and air powered equipment are acceptable, subject to applicable local, State, and Federal regulations.

D. Furnish and operate a temporary ventilation system in accordance with applicable safety requirements when personnel are underground.
   1. Perform all required air and gas monitoring.
   2. Ventilation system shall provide a sufficient supply of fresh air and maintain an atmosphere free of toxic or flammable gasses in all underground work areas.

E. Perform all work in accordance with all current applicable regulations and safety requirements of the Federal, State, and Local agencies.

F. Comply with all applicable provisions of OSHA 29 CFR Part 1926, Subpart S, Underground Construction and Subpart P, Excavations.
   1. In the event of conflict, comply with the more stringent requirements.

G. If personnel will enter the pipe during construction, the Contractor shall develop an emergency response plan for rescuing personnel trapped underground in a shaft excavation or pipe.
   1. Keep on-site all equipment required for emergency response in accordance with the agency having jurisdiction.

END OF SECTION

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SECTION 33 73 80
GROUNDWATER CONTROL FOR SHAFTS AND TUNNELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnishing all material and labor to install and maintain pumps, piping, drains and other facilities for the control, measurement, collection, and disposal of groundwater from inside all tunnel and shaft excavations. Water collected in the tunnel shall be directed to the shafts or otherwise to the surface for disposal. Work performed under this specification is applicable only to control of ground and construction water in shafts and tunnels.
2. Design tunnel and shaft groundwater control facilities as necessary and as required. Maintain the excavation free from seepage and standing water at all times during excavation and construction. Remove all components of the tunnel and shaft groundwater control system when no longer required, as accepted by the Engineer.
3. All work specified is the responsibility of the Contractor, subject to the approval of the Engineer. All applicable rules, laws, and regulations shall be followed. No part of this specification shall be construed as a relaxation of any of these rules, laws, and regulations.

B. Related Specification Sections include, but are not necessarily limited to:

1. Section 33 05 22 – Jacking Pipe
2. Section 33 05 24 – Installation of Carrier Pipe in Steel Casing
3. Section 33 30 02 – Trenchless Excavation by Tunnel Boring Machine
4. Section 33 30 03 – Trenchless Excavation by Microtunnel Boring Machine
5. Section 33 73 15 – Shafts
6. Section 35 23 24 – Contact Grouting

C. Related documents:

1. Geotechnical Engineering Report, Revision 2 (GER); Berry Creek Offsite Wastewater Main – North Alternative; Georgetown, Texas; prepared for Walker Partners by Terracon Consultants, Inc.; March 8, 2023.
2. Hydrogeologic Report for the Berry Creek Wastewater Interceptor Project, dated October 2022.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Measurement
   a. Groundwater inflows into the tunnels and shafts shall be measured in gallons per minute (GPM). Measurement of groundwater flow for consideration of payment shall only consider the groundwater inflow from one tunnel reach or drive and one shaft.
2. Payment

a. Flows less than 125 GPM from a single tunnel reach or drive shall be considered incidental to the work and are not subject to compensation. Sustained flows greater than 125 GPM from a single tunnel reach or drive shall qualify the Contactor for additional compensation and a performance period extension by way of a change order. The flow must be substantiated by a calibrated flow devise as required herein. The change order shall need to demonstrate the fair and equitable additional cost incurred and the time delayed by the groundwater flows exceeding 125 gpm. The change order shall be paid for out of the groundwater inflow allowance item.

1.3 REFERENCES [NOT USED]

1.4 DEFINITIONS [NOT USED]

1.5 SUBMITTALS

A. For submittal procedures refer to Section CIP10.

A. The Contractor shall submit a list of all equipment to be used and product data demonstrating equipment is sufficient to perform the work.

B. The Contractor shall submit information demonstrating adherence with the qualification requirements outlined in Section 1.6 minimum 30 days prior to the start of work.
   a. Submit project name, date, location, description (size and depth) ground and groundwater conditions, SOE systems utilized, and names and contact information of references with individual knowledge of the work on each project.

C. The Contractor shall submit a shaft and tunnel groundwater control plan to the Engineer for review and approval at least 30 calendar days prior to the start of shaft-sinking activities. The plan shall be prepared by a qualified individual experienced in design, installation, and operation of groundwater control systems in similar conditions. Acceptance by the Engineer of the tunnel and shaft groundwater control system proposed by the Contractor will only be with respect to the basic principles the Contractor intends to employ. Acceptance by the Engineer does not relieve the Contractor of the full responsibility for the adequacy of the groundwater control system. The plan shall include:
   1. Names and descriptions of proposed groundwater control facilities, equipment suppliers, and Subcontractors.
   2. Design calculations demonstrating the adequacy of the proposed groundwater control system for the intended application.
   3. Installation details, descriptions and drawings of the proposed groundwater control system showing locations, dimensions, depth, installation requirements, power supply, and operation and maintenance procedures.
   4. Description of the proposed monitoring, sampling, testing, reporting, and control system.
   5. Methods and locations for treatment, discharge, or disposal or removed water.
   6. Description, sizes, and capacities of the proposed pumps, filters, sediment trapping devices and other treatment equipment.
   7. Water quality sampling and testing frequencies for discharge water.
   8. Field monitoring equipment including calibration method and frequency.
   9. Means of measuring inflow to excavations.

D. The engineer responsible for the groundwater control plan shall the qualification requirements outlined in Section 1.6. The plan, working drawings, and calculations, including any revisions, shall be signed and sealed by the responsible engineer.

E. Maintain and submit daily shift records of water disposal and records of unusual groundwater problems and observations.

F. The Contractor shall obtain and submit written permits from authorities where water will be disposed. Permits shall absolve the Owner from responsibility in connection with disposal of water.

1.6 QUALITY ASSURANCE

A. Qualifications

1. The engineer responsible for development of the groundwater control plan shall be a professional engineer licensed in the state of Texas and shall have a minimum of 10 years of experience in the development of similar groundwater control plans for similar tunnel or shaft projects.

1.7 DELIVERY, STORAGE, AND HANDLING [NOT USED]

1.8 FIELD [SITE] CONDITIONS

A. While geotechnical borings at shaft and tunnel locations generally suggest dry conditions, water flows can occur from the Edwards Aquifer located beneath the Georgetown Limestone. Faults known to exist in this formation and other possible features can allow water to flow to the piezometric elevations located above the tunnel due to artesian conditions described in the referenced Hydrogeologic Report for the Berry Creek Wastewater Interceptor Project, dated October 2022.

B. Groundwater inflows of 125 gpm may occur in a single given tunnel reach and launch shaft. Refer to Section 1.2 for Measurement and Payment provisions.

C. Perched groundwater at the soil and rock interface and precipitation events may result in flush flows into the shafts. Flush flows that dissipate within 48 hours shall not warrant additional compensation or performance time increase to the Contractor.

D. Water inflows at creek crossing locations resulting from a direct hydraulic connection to the creek will not warrant additional compensation or performance time increase to the Contractor.

PART 2 - PRODUCTS [NOT USED]

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. The Contractor shall review the available subsurface and hydrogeologic data for the project site. It shall be the Contractor’s responsibility to evaluate the subsurface conditions at the project site with respect to all required groundwater control.

2. For any groundwater control system, the Contractor is responsible for any additional geotechnical and hydrogeologic site investigations, field testing, and laboratory testing necessary to allow the design to be completed to the current standard of practice.
3. The Contractor shall, at all times during construction, provide ample means and devices to promptly remove and properly dispose of all water entering the tunnel or shaft excavation and keep the excavations firm and free of standing water. The operations shall be carried out in such a manner that no disturbance to or softening of the excavated surface of the tunnel or bottom of the shaft will result.
4. Provide calibrated flow measuring equipment to continuously measure instantaneous groundwater inflow rate of water originating from each tunnel reach or drive capable of measuring flow to the nearest 10 GPM.
5. Discharged water from the tunnel shall be directed to the shaft or otherwise to the surface for removal and disposal.
6. All groundwater shall be disposed of in accordance with all applicable local, state, federal laws and regulations (see Section 3.3).

B. Groundwater Control System:

1. The location of all elements of the groundwater control system shall be such that interference with tunnel or shaft excavation and construction activity is minimized.
2. Unless otherwise accepted by the Engineer in writing, the groundwater control system shall be operated continuously 24 hours per day, 7 days per week until all facilities and structures affected by the water inflows have been satisfactorily constructed, including placement of fill materials.
3. Backup pumps, piping, hoses, and power supply must be present and good working order at all times during dewatering activities.
4. In the event the tunnel and shaft groundwater control system does not meet the specified requirements, and as a consequence damages the excavation, in the opinion of the Engineer, the Contractor shall supply all materials, labor, and equipment to perform all work required for restoration of the excavation to the satisfaction of the Engineer, at no cost to the Owner.

C. Filters:

1. The system shall be designed to prevent migration of soil fines material from outside the tunnel or shaft walls. The contractor shall use properly designed well filters, filter fabrics, or other materials as required to meet this requirement.

3.2 CLEANUP AND RESTORATION

A. All elements of the tunnel and shaft construction groundwater control system shall be removed from the site at the completion of the construction work unless otherwise approved by the Owner.

3.3 SITE QUALITY CONTROL

A. Pollution Control

1. Development and implementation of the groundwater control plan shall be in accordance with the project Stormwater Pollution and Prevention Plan (SWPPP) and other pollution control documents and permits.

END OF SECTION

SECTION 35 23 24
CONTACT GROUTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for contact grout mix designs and furnishing and injecting contact grout within the space between the excavated surface and jacking pipe utilized in trenchless construction. The jacking pipe may be steel casing or concrete pipe when a two-pass trenchless installation method is utilized or may be the Centrifugally Cast Fiberglass Reinforced Polymer Mortar (CCFRPM) carrier pipe in a single-pass system.

B. Related Specification Sections include, but are not necessarily limited to:
   1. Section 33 05 22 – Jacking Pipe
   2. Section 33 30 02 – Trenchless Excavation by Tunnel Boring Machine
   3. Section 33 30 03 – Trenchless Excavation by Microtunnel Boring Machine
   4. Section 33 30 04 – Trenchless Excavation by Hand Tunneling
   5. Section 33 73 80 – Groundwater Control for Shafts and Tunnels

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment
   1. Measurement
      a. No separate measurement will be made for this item.
   2. Payment
      a. The work performed and materials furnished in accordance with this Item are subsidiary to the lump sum cost bid for the reach(es) in which contact grouting is utilized to complete the work, and no other compensation will be allowed.

1.3 REFERENCES

A. Reference Standards
   1. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
   2. ASTM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens)
   3. ASTM C144 – Standard Specification for Aggregate for Masonry Mortar
   4. ASTM C150 – Standard Specification of Portland Cement
   5. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete
   6. ASTM C937 – Standard Specification for Grout Fluidifier for Preplaced Aggregate Concrete

1.4 DEFINITIONS

A. Contact Grouting: The systematic injection of grout, at low pressures, to achieve continuous contact between the jacking pipe and the surrounding ground, including overbreak areas.

B. Jacking Pipe: Steel, concrete, CCFRPM, or otherwise pipe utilized to thrust the tunnel boring machine, microtunnel boring machine, or hand tunneling shield to perform the trenchless excavations.

C. Refusal: When grout is no longer injected, i.e., 0 cubic feet per minute, into the grout port over a continuous 1-minute period at the applicable maximum specified injection pressure.

1.5 SUBMITTALS

A. Product Data:
   1. Manufacturer's product data sheets showing:
      a. Mixing, handling, storage and waste disposal requirements.
      b. Safety Data Sheets (SDS) for all materials submitted or brought on site.
   2. Source of supply for each grout ingredient.
   3. For each type and source of material:
      a. Cement: Standard physical and chemical analysis.
      b. Admixtures: Documentation showing that the proposed admixtures have a history of demonstrable satisfactory performance.
   4. Source of potable water.
   5. Shop drawing of one-way valve assembly, grout injection header including shut-off valve, pressure gauges and bypass/recirculation system.

B. Working Drawings and Methods Statements:
   1. Layout and description of grouting equipment and facilities for performing work, including:
      a. Provide a Grouting Plan describing grouting operations, including sequence of work operations including starting location, ending location, criteria for completion of contact grouting at any port, grout mixing and pumping equipment location, access port one-way grout valve configuration and operation, and grout header configuration and operation. Describe provisions to protect the jacking pipe from over pressurization leading to structural damage.
      b. Locations of manufactured grout ports in the jacking pipe
      c. Agitators or holding tanks.
      d. Mixers, pumps, and grout delivery piping and manifolds.
      e. Hookup details including valves, packers and gauges.
      f. Proportioning and mixing grout.
      g. Measuring grout pressure and injection rate.
      h. Maintaining grout pressure not to exceed specified limits.
      i. Sequencing grouting and establishing basis and threshold values for modifying mixes.
      j. Direct communication method between grout mixer operator and injection worker.

C. Mix Designs:
   1. Details of grout mix, proportions and admixtures.

2. Laboratory test data verifying the strength and set time of the proposed grout mix.

D. Quality Control:
   1. Qualifications:
      a. Test laboratory used for calibrating and testing accuracy of gauges and meters to be used in grouting operations.
      b. Test laboratory performing quality assurance and testing for all grout materials, test mixes and field testing.
   2. Certifications:
      a. Certificates of compliance for materials specified herein.
      b. Calibration certificates for gauges and meters to be used in grouting operations.
   3. Quality Control Plans:
      a. Methods for assuring uninterrupted contact grouting at pressures that do not exceed the maximum specified.
      b. Methods for demonstrating that grout mixes meet design criteria.
   4. Recordkeeping:
      a. Cumulative Records of strength tests on grout samples within 2 working days of performing tests.
      b. Shift report for each grout crew and for each shift, regardless of actual progress, and submitted no later than the beginning of the following working day. Include:
         1) Crew size, employee name, classification, and work assignment.
         2) Number and type of equipment used.
         3) List of idle or inoperative equipment and reason for downtime.
         4) Daily grout injection records for each grout port:
            i. Location and orientation.
            ii. Mix design used and any alterations.
            iii. Time of original mix and time when injected or wasted.
            iv. Grouting time spent on each grout port broken down by quantity injected, injection pressure, total volume and pumping rate.
            v. Grout communication to other grout ports.
   5. Notifications:
      a. Written notification within 1 workday of any proposed addition, deletion or change to the scheduling of shift work, or mix design.
      b. Written notification within 1 workday of performing gauge and meter tests.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED PRODUCTS [NOT USED]

2.2 MATERIALS

A. Grout
   1. Minimum 24-hour compressive strength of 300 psi, 7-day compressive strength of 900 psi and 28-day compressive strength of 1,500 psi.
   2. Use a neat cement grout mix.
   3. Grout shall consist of ASTM C150 Portland Type II cement, not more than 2 percent bentonite by weight of cement, fluidifier as necessary, and water in the proportions specified herein or as acceptable to the Engineer.

4. Sand may be added to the grout mix only in instances of very high grout takes as approved by the Engineer. The addition of sand may require the addition of fluidifier to the grout mix.
5. Fluidifiers shall hold the solid constituents of the grout in colloidal suspension, be compatible with the cement and water used in the grouting work, contain an expansive shrinkage compensator and comply with the requirements of ASTM C937.
6. Grout mix (water/cement) ratios shall be expressed in cubic feet of water per cubic foot of cement (94-pound bag). The range of water-cement ratios shall be between 0.75:1 and 1.5:1 by volume.
7. Grout not placed within 2 hours of mixing shall be wasted and disposed of in accordance with all local, state, and federal regulations.

B. Admixtures:
   1. Admixtures may be used in the cement grout. Admixtures shall conform to ASTM C494 and shall not contain chlorides. The Engineer shall be advised of type and amount of admixture.

C. Cement
   1. Conforming to ASTM C150, Type II Portland cement.

D. Bentonite:
   1. Bentonite shall be a high yielding sodium montmorillonite.
   2. Mix in accordance with manufacturer's written recommendations.

E. Sand:
   1. Sand to conform to ASTM C144, except:
      a. Fineness modulus is between 1.50 and 2.00; and
      b. Gradation shall meet the following grading requirements:

Table 1. Sand Gradation

Sieve Sizes	Percentage Passing by Weight
No.8	100
No. 16	95–100
No. 30	60–85
No. 50	20–50
No. 100	10–30
No. 200	0–5

F. Fluidifiers shall be as approved by the Engineer.

G. Water shall be from a potable source.

2.3 EQUIPMENT

A. Grouting Equipment
   1. Mixer:
      a. Use an appropriate system capable of delivering proposed homogenized grout mix to the mixer and pump in the tunnel where grouting is to be performed.

b. Size to ensure an uninterrupted supply of grout to the pump.
c. Provide a means of accurately measuring and metering grout ingredients, including modifying the water/cement ratio.

2. Agitator:
   a. Provide a separate agitator serving as a holding tank between the mixer and the pump equipped with baffles to induce turbulence and rotating paddles to assure thorough mixing of the grout prior to and during injection.
3. Pumps:
   a. Shall produce uniform flow without pulsation for pumping immediately behind the jacking pipe.
   b. Equip with a pressure gauge and volumetric meter as specified herein.
   c. Equip with pressure limiting device as necessary to assure that maximum injection pressure specified is not exceeded.
4. Appurtenances:
   a. Packers: Capable of sealing grout ports without leakage when grouting at the maximum specified pressure and being removed after the grout has set. Packers shall be provided with shut-off valves.
   b. Piping between pump and grout ports: Provide a manifold comprising a system of valves and pressure gauge in the line at the collar of the grout port to permit accurate control and monitoring of grouting pressure, bleeding and regulation of flow.
   c. The grouting equipment shall be provided with a meter at the point of placement. The meter shall be calibrated in cubic feet to the nearest 0.1 of a cubic foot.
   d. The grouting equipment shall be provided with a pressure gauge at the point of placement. The pressure gauge shall be accurate to ±1 psi over allowable grouting pressure range.
   e. Equip with a return/recirculation line from grout injection valve to the agitator or mixer tank.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to cleaning or flushing grout delivery lines, disconnect injection valve from grout port to avoid pressure surges.

3.2 INSTALLATION

A. Perform grouting in a progressive, logical manner:
   1. Grouting shall progress sequentially in a constant up-gradient direction from one grout port to the next adjacent grout port in the sequence indicated in the approved submittals.
   2. At any time during the grouting operations, sufficient contact grouting ports ahead of the grouting shall be cleaned and opened. Valves or other suitable devices shall be attached and placed in the fully open position on all ungrouted ports within the maximum grout communication distance, as determined by the Contractor and accepted by the Engineer.
   3. Grout progressively along the jacking pipe by beginning from the lowest point of the tunnel both longitudinally and circumferentially.

4. Maximum Injection Pressure: 5 psi above hydrostatic pressure at the grout injection port unless otherwise approved of in the submittal.
5. Do not pump grout into more than one grout port at any time.
6. Operator of grout mixer and grout injection valves shall be in direct, constant, and continuous communication during grout injection operation.

B. Grout shall be continuously recirculated after mixing and during grouting operations.

C. Perform contact grouting through a valve affixed to a grout connection fabricated with the jacking pipe per Contractor's approved workplan.

D. Leave grout ports adjacent to a grout hookup open during grouting operations to facilitate the escape of air and water from pockets in the space surrounding the jacking pipe. When grout is found to flow from adjacent grout connections at a consistency equal to that being injected, cap such adjacent connections or install valves for bleed, until later use as a grout connection.

E. Do not close any valved, open, ungrouted grout port until grout of the same consistency as that being injected issues forth.

F. After the grouting is finished, the valve shall be closed before the grout header is removed. Grout port valve shall remain closed until grout has attained 24-hour set strength.

G. Control groundwater in accordance with Section 33 73 80 – Groundwater Control for Shafts and Tunnels during the full duration of the contact grouting and until a minimum 24-hour compressive strength has been achieved in accordance with ASTM C39 or ASTM C109.

3.3 SITE QUALITY CONTROL

A. Strength Tests:
1. The Contractor shall take one set of 4 test specimens at the greater frequency of every 250 cubic feet of grout mixed or each batch mixed.
2. Grout for the test samples shall be taken from the nozzle of the grout injection line.
3. The Contractor shall test cylinders or cubes in accordance with ASTM C39 or ASTM C109, respectively.

B. Master Gauges and Meters:
1. Perform testing of all field gauges and meters weekly using master gauges and meters.
2. Perform field tests in the presence of the Engineer.
3. Verify accuracy of master gauges and meters using a test laboratory no less than every 2 months.

C. Acceptance Criteria:
1. Grout samples shall be acceptable if all production 28-day samples meet minimum 28-day strength or if the average of all production 28-day samples meet minimum 28-day strength and the weakest sample is within 10 percent of the minimum 28-day strength.

3.4 CLEANING

A. Perform the following concurrently and at the end of each shift with grouting operations:

1. Cleaning the inside surface of the jacking pipe.
2. Maintaining the tunnel invert free of debris.

B. Install plugs in grout ports after grout has attained 7-day strength.

C. Promptly remove and dispose of any leakage or wastage of drill cuttings, grout, or other objectionable materials. If such materials bond to the surface of the jacking pipe, remove by chipping, bush hammering, grinding or other acceptable means approved by the Engineer.

END OF SECTION

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CITY OF AUSTIN SPECIFICATIONS

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TEM NO. 658 VOID AND WATER FLOW MITIGATION

(MODIFIED CITY OF AUSTIN STANDARD SPECIFICATION)

658.1 Description

This item governs notification requirements, as well as the furnishing and installing mitigation measures, specified by the Engineer or the designated Representative, for voids and water flow features discovered in bedrock during excavation activities of a project. This item does not apply to excavations that occur below the water table or in unconsolidated earth material. It is intended to address features observed upon initial excavation or discrete discharge points that are discovered when trench backfill material is removed. The purpose of the mitigation is to preserve voids and water flow features while maintaining utility integrity and preventing pollution.

Notification is required for a void that: (a) is at least one square foot in total area; or (b) blows air from within the substrate; (c) consistently receives water during any rain event; and/or (d) potentially transmits groundwater. Construction must stop until mitigation measures are reviewed and approved by the City of Georgetown.

658.2 Submittals

A. Submittals requirements of this specification include:

1. 3×5 hard rock: Source, type and gradation of rock.
2. Flowable Backfill: Mix design for flowable backfill and other submittals shall be as required by Section C9.
3. Low Slump Concrete: The mix design for Class A Concrete (3,000 psi) and other submittals shall be as required by City of Georgetown Section C2. The concrete shall have a maximum 3 inch slump. Concrete mixtures allowed or required by the Texas Commission on Environmental Quality (TCEQ) will be accepted as an alternate on a case-by-case basis.
4. Filter Fabric: Submittals as required by City of Georgetown Section G6. The material to be used for this application shall be noted.
5. Permanent Turf Reinforcement Mat (PTRM): Non-degradable turf reinforcement mat that meets the specification requirements of the U.S. Department of Transportation, Federal Highway Administration (FHWA) FP-03, Section 713.18. The mat shall be made of nylon or other inert plastic and not be coated with chemical, substance or film. Maximum mesh opening shall be no greater than 2.5 mm (0.1 inch).
6. Corrugated polyethylene plastic tubing: product data.

658.3 Materials

A. 3×5 hard rock: Rocks shall be sound with a minimum of 3 inches in smallest dimension and 5 inches in largest dimension. Open-graded rock of the size indicated on Details and fines removed, shall be used.

B. Flowable Backfill: This material shall meet the requirements for flowable backfill as specified in City of Georgetown Section C9.

C. Filter Fabric: This material shall meet the requirements for filter fabric as specified in City of Georgetown Section G6.

D. Low Slump Concrete: This concrete shall meet the requirements for Class A Concrete as specified in City of Georgetown Section C2. The concrete shall have a maximum 3-inch slump. Concrete mixtures allowed or required by the TCEQ will be accepted as an alternate on a case-by-case basis.

E. Polypropylene Bags filled with pea gravel. Pea gravel shall be clean washed material, hard and insoluble in water, free of mud, clay, silt, vegetation or other debris. Stone quality shall meet ASTM C 33. Size gradation shall be as follows:

SIEVE SIZE	% RETAINED BY WEIGHT
¾″	0
½″	0—25
¼″	90—100

F. Pipe Bedding Stone: Pipe bedding stone shall be clean gravel, crushed gravel or crushed limestone, free of mud, clay, vegetation or other debris, conforming to ASTM C 33 for stone quality. Size gradation shall conform to ASTM C-33 No. 57 or No. 67 or the following Table:

SIEVE SIZE	% RETAINED BY WEIGHT
1½″	0
1″	0—10
½′	40—85
#4	90—100
#8	95—100

G. Permanent Turf Reinforcement Mat (PTRM): Non-degradable turf reinforcement mat shall meet the specification requirements of the U.S. Department of Transportation, Federal Highway Administration (FHWA) FP-03, Section 713.18. The mat shall be made of nylon or other inert plastic and not be coated with chemical, substance or film. Maximum mesh opening shall be no greater than 0.1 inch.

H. Corrugated polyethylene plastic tubing conforming to AASHTO M 252.

658.4 Procedures

A. Contractor shall be responsible for notifying the City Inspector and the designated Geologist or Geologist representative when voids and water flow features are discovered in bedrock during excavation activities. Contractor shall be responsible for ensuring that the Geologist or Geologist representative has the opportunity to observe voids and water flow features prior to any initial temporary back fill operations and following back fill removal for bedding, final back fill, pipe or manhole installation.

B. Each underground void or water flow feature shall be mitigated in accordance with one or more of the following procedures and methods:

1. The Geologist or designated Geologist representative will observe the trench wall for any voids larger than 1 cubic foot or any flowing water anomalies. The Geologist or the Owner shall call the Construction Inspector as necessary, for additional observation of the anomaly. The location of the anomaly shall be recorded in the Construction Inspector's daily progress report. The owner must also notify the Texas Commission on Environmental Quality (TCEQ) for projects located within the jurisdictional boundaries of the Edwards Aquifer Recharge Zone or Contributing Zone, as defined in Chapter 213 of Title 30 of the Texas Administrative Code.

2. Initial observation of the anomaly shall be made from the top of the trench. The Contractor shall submit an Excavation Safety System Plan (Section CIP11) for review and shall install all necessary safety

equipment to allow direct observation of the anomaly. The Contractor shall also have a vac-truck on site before the Geologist arrives and be prepared to clean up and prepare rock for the Geologist to minimize the amount of time needed for the Geologist to observe the anomaly. Vac-truck shall be subsidiary to the bid items in this specification.

3. The Contractor must stop all excavation or trenching activities within 50 feet of the outer edge of the void's interior extent.

4. In certain cases, the Geologist or designated Geologist representative may determine that the void requires protection prior to any further backfill operations. Protection preventing the backfill from entering the void may consist of plywood planking or other barricade necessary to block the backfill. Areas of flowing water may require temporary mitigation measures, as well. The Contractor shall implement all appropriate mitigation measures established by the Geologist or designated Geologist representative.

5. If a void is located at the bottom of a trench, temporary void protection per Class I Detail, shall be provided at all times that trench excavation is halted and until Owner's geologic and biologic inspection has occurred and Contractor has been given instructions on how to proceed.

6. A second void or water flow feature inspection may be required following final excavation operations. The Contractor shall stabilize the trench to allow for observation of the anomaly from within the trench. The Contractor shall provide an Excavation Safety System Plan (Section CIP11) and shall install all necessary safety equipment to allow direct observation of the void or water flow feature. The Contractor shall assist in the investigation by providing access to the anomaly (e.g., ladders, harness and rigging, scaffolding, etc.) and confined space safety equipment. Contractor shall install all necessary shoring and trench protection.

7. The Contractor shall provide the safety plan for allowing trench entry for anomaly inspection. The Contractor's designated safety supervisor shall ensure that all OSHA requirements are met during anomaly observation. The Contractor shall not place pipe, pipe bedding, and backfill within 50 feet of the anomaly prior to final inspection.

8. The Geologist shall submit and obtain approval of an anomaly mitigation plan to the City. The Contractor shall not proceed with construction of the mitigation measures, excavating, pipe placement or installing pipe bedding or backfill within 50 feet of the anomaly(ies) until an approved anomaly mitigation plan is acquired.

9. Voids that are less than 18 cubic feet, are dry, have no airflow and are located at least 1 foot above the top of a utility pipe do not require an anomaly mitigation plan approval prior to mitigation. Mitigation may occur after the City Inspector concurs with the Geologist's description and the Engineer's proposed mitigation. The mitigation must be documented in the record drawings prior to the completion of the project. TCEQ approval requirements must still be followed, if the site is located within the TCEQ-defined Edwards Aquifer Recharge Zone.

10. The Contractor shall construct the void and/or water flow mitigation measure(s) in accordance with the approved anomaly mitigation plan. Anticipated measures shall be documented within the Contract Documents and pay items. The Contractor and Construction Inspector shall record material quantities of all completed mitigation measures in accordance with the pay items in the Construction Inspector's daily progress report for each day that a specific mitigation event is undertaken. The Contractor shall notify the Geologist 48 hours in advance of mitigation installation.

11. Upon completion of each void and/or water flow mitigation measure, a Geologist or designated Geologist representative shall inspect the work before the Contractor resumes construction activities within 50 feet of the anomaly. The owner's Geologist or Geologist representative must observe and photograph the phases of the installation of the mitigation measures and submit an electronic report to the City Inspector.

658.5 Execution

A. GENERAL

The Engineer and Geologist, or designated representative, shall establish the appropriate permanent void and water flow mitigation measures. Void and/or water flow mitigation measures shall be constructed as herein depicted and specified for most anomalies encountered. If the Geologist or designated Geologist representative observes unusually large voids or unforeseen circumstances, other measures may be prescribed by the Engineer and Geologist, or designated representative, once the anomaly is observed.

B. VOID AND WATER FLOW MITIGATION MEASURES

1. Class I temporary void mitigation measures for a void at the bottom of a trench or along a sidewall of a trench, generally consist of:

    a. Temporary protection of the void shall be provided by covering the void opening with filter fabric with minimum of 3 foot distance from edge of void to edge of filter fabric. This action will be taken prior to covering the trench or temporary backfilling operations.

    b. The void opening shall be covered with plywood planking with a minimum of 1 foot distance from edge of the void to the edge of the planking. Planking is to be placed to prevent backfill from entering void. Rock (minimum weight of 5 pounds) or concrete block shall be placed over planking.

2. Class II permanent void mitigation measures generally consist of:

    a. Permanent protection of the void by hand packing with 3- to 5-inch rock to provide stable bearing support and covering the rock at the opening with filter fabric. Low slump concrete (Class A, 3000 psi) shall be placed to cover the opening area and to seal the void at the limits of excavation. Concrete shall be a minimum of 18 inches thick within the void opening and shall extend a minimum of 6 inches beyond the edge of the void. Void openings that are less than 30 inches deep shall be sealed entirely with concrete. A form shall be used to ensure proper placement of a low slump concrete-seal over the void opening. After the void is covered, the controlled low-strength bedding and backfill material shall be placed. The controlled low-strength fill material shall extend a minimum of 5 feet beyond the edge of all voids in all directions.

    b. For Grade 2 voids, additional measures may be specified by the Engineer or designated representative (e.g., increase thickness of concrete and placement of rebar reinforcement in the concrete, placement of a steel plate over void opening, etc.).

3. Class III void mitigation measures generally consist of:

    a. Permanent protection of the void by hand packing large areas with pea gravel-filled polypropylene bags to provide stable bearing support in order to protect a void from infiltration of backfill material. If a void is greater than 100 cubic feet or is located within a rock strata that is structurally unstable, then 3- to 5-inch rock may be utilized behind the gravel-filled polypropylene bags to prevent ground collapse. A connector pipe may be required to maintain air or water flow within a void bisected by the trench. After a void is filled, low slump concrete (Class A, 3000 psi) shall be placed to seal the void opening. If needed, place a form to ensure a minimum thickness of concrete that extends at least 18 inches into the void.

    b. Secondary containment of wastewater and storm sewer lines by outer carrier pipe or low slump concrete (Class A, 3000 psi) or flowable backfill encasement is required. Low slump concrete or flowable backfill encasement shall be a minimum of 6 inches thickness on all sides of the pipe and shall extend a minimum of 5 feet beyond the edge of any voids. Stabilizing collars and other supports, as needed, must be provided.

4. Class IV void mitigation measures shall be as indicated in the drawings or as approved by the Engineer and Geologist, or designated representative.

5. Class V void mitigation measures generally consist of:

    a. Placement of flowable backfill bedding material along the length of pipe as directed by the Engineer or designated representative.

    b. Placement of gravel backfill material wrapped in PTRM one foot beyond limits of void in all directions. PTRM shall be placed along areas between the gravel material and trench walls/earth backfill and shall overlap at top. A connector pipe may be required to maintain air or water flow within a void bisected by the trench, and pea gravel-filled polypropylene bags may be required when connector pipe is used.

    c. A minimum of 3 feet of flowable backfill shall be placed along the length of pipe on either side of the gravel backfill material and shall extend a minimum of 1 foot above the gravel backfill material. Forms shall be used to control the placement of flowable backfill material.

6. For very large voids, the Geologist or designated representative shall conduct a cave stability analysis and define specific mitigation measures. The Contractor will implement specific mitigation measures per the direction of the Engineer and Geologist, or designated representative, after the anomaly mitigation plan is approved by the City of Georgetown.

C. REPORTING

1. The Contractor shall provide written documentation to the Engineer, the Geologist, and the City of Georgetown or designated representative describing the void and water flow mitigation measures taken on the Project. The information shall be included in the Construction Inspector's daily progress report. The report shall include, as a minimum, the following information:

    a. Location (line stationing, distance from permanent structure, depth in trench from adjacent surface grade, geologic strata, etc.).

    b. Physical dimensions of void and/or description of water flow recorded on the Contractor Void Description and Documentation Log Sheet (provided as Attachment A).

    c. Photographs, field notes, maps, sketches, and measurements.

    d. Mitigation action taken and status. Include a copy of the plan sheet showing the location of the void and details for mitigation measures.

    e. Actual agreed-upon quantities of materials used by Contractor in execution of mitigation shall be included in the Construction Inspector's daily progress report.

    f. Signature from the Contractor and Construction Inspector indicating agreement with the documented quantities and any delays associated with downtime for observation of the void.

658.6 Measurement

A. Measurement for void and water flow mitigation measures shall be made as follows:

1. Measurement of temporary void protection (filter fabric, plywood planking, etc.) shall be per each occurrence.

2. Measurement of flowable backfill shall be by the cubic yard of material in place.

3. Measurement of pea gravel-filled polypropylene bags shall be by each. Minimum size is 1 cubic foot.

4. Measurement of 3- to 5-inch rock shall be by the cubic yard of rock placed.

5. Measurement of filter fabric shall be by the square yard of filter fabric as needed to maintain specified clearance from edge of void.
6. Measurement of permanent turf reinforcement mat shall be by the square yard of material in place.
7. Measurement of low slump concrete material shall be by the cubic yard of material in place.
8. Measurement for provision of Special Trench Safety shall be per Linear Foot.
9. Measurement for Downtime Associated with Observation of Voids and/or Flowing Water shall be per Day. This pay item shall only apply in circumstances where the Contractor's operations have been halted and Contractor cannot continue work in another area of the project. Delay time will not be allocated for time that work on a void mitigation measure is in progress, only for time associated with observation and determination of mitigation measures to be taken. Contractor must notify the City's Inspector within one hour of the beginning of the delay and document the time and cause of delay. Documentation shall also include explanation of why work could not continue. Work stoppage for one hour or less shall not be cause for delay and will not be measured, but shall be included in the unit price bid in the pipe pay items. Partial day delays shall be measured as fractions of a day calculated by half days. Delays over one hour and up to 4 hours will be counted at 0.5 DAY.
10. Measurement for corrugated polyethylene tubing shall be per Linear Foot.

658.7 Payment

The work performed for "Temporary Void Protection (Plywood Planking)" and "Pea Gravel-Filled Polypropylene Bags for Void Mitigation" will be paid for at the unit price bid per each occurrence. The unit price bid items shall include full compensation for all materials and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

The work performed for "Flowable Backfill," "Low Slump Concrete," and "3 To 5 Inch Rock for Void Mitigation" will be paid for at the unit price bid per cubic yard. These unit bid price items shall include full compensation for all concrete, rock, curing, finishing, and for all labor, tools, materials, equipment and incidentals necessary to complete the work.

The work performed for "Filter Fabric for Void Mitigation" and for "Permanent Turf Reinforcement Mat" will be paid for at the unit price bid per square yard. These unit bid price items shall include full compensation for all materials and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

The work performed for "Special Trench Safety Associated with Observation of Voids and/or Flowing Water" and “Corrugated Polyethylene Plastic Tubing for Void Mitigation” will be paid for at the unit price bid per linear foot. These unit bid price items shall include full compensation for all materials, supervision, mobilization, de-mobilization, and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

The work performed for "Downtime Associated with Observation of Voids and/or Flowing Water" will be paid for at the unit price bid per day. This unit bid price item shall include full compensation for all materials, supervision, mobilization, de-mobilization, and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment for will be made using the following bid items:

Temporary Void Protection (Plywood Planking)	Per Each
Controlled Low Strength Material for Mitigation	Per Cubic Yard
Pea Gravel-Filled Polypropylene Bags for Void Mitigation	Per Each
3 To 5 Inch Rock for Void Mitigation	Per Cubic Yard

Filter Fabric for Void Mitigation	Per Square Yard
Permanent Turf Reinforcement Mat for Void Mitigation	Per Square Yard
Low Slump Concrete	Per Cubic Yard
Special Trench Safety Associated with Observation of Voids and/or Flowing Water	Per Linear Foot
Corrugated Polyethylene Plastic Tubing for Void Mitigation	Per Linear Foot
Downtime Associated with Observation of Voids and/or Flowing Water	Per Day

END

ATTACHMENT A

CONTRACTOR VOID DESCRIPTION AND DOCUMENTATION LOG SHEET

TCEQ EAPP ID No: _____ Feature ID: _____
Inspection Date: _____ Time: _____
Latitude: _____ OR Easting: _____
Longitude: _____ Northing: _____
Datum: _____ Datum: _____
Coordinate System & Units: _____ Coordinate System & Units _____
Trench Station ID: _____ Depth Below Surface: _____

Intercepted by: ____ Backhoe _____ Trencher _____ Dozer ___ Drill _____ Other ___
Shape (Circle One): Spherical Keyhole Dome Irregular Other
Vertical Fracture Trend Horizontal Fracture
Size: _____ft Length _____ ft. Width _____ ft. Height _____ ft³ Volume
Extends into Rock: ____ ft

Water Flow (Y/N): □ Rate: _____ Note: _____
Air Flow (Y/N): □ Rate: _____ Note: _____

Closest CEF or Recharge Feature: _____ Type: _____ Distance: _____

Size Category:	Grade 1	□ (1 ft³ < V <18 ft³)
	Grade 2	□ (18 ft³ ≤ V <160 ft³)
	Grade 3	□ (≥ 160 ft³)
Water Flow Category:	Type A	□ (Dry)
	Type B	□ (<1 gpm or evidence of previous flow)
	Type C	□ (≥1 gpm from discrete discharge point or bedrock horizon)
Biological Category:	Level 1	□ (No evidence of marcofauna)
	Level 2	□ (Evidence of macrofauna)
Suggested Mitigation:	Class 1	□ (**Temporary** measure only; Grade 1 and 2 voids)
	Class II	□ (Grade 1 and 2 voids; floor of trench)
	Class III	□ (Grade 1/Type A and Grade 2/Type A voids on trench sidewalls)
	Class V	□ (Grade 1 or Grade 2 with water flow features/voids on sidewalls above bedding)
	Custom	□ (Site Specific Measure)

Geologist/Inspector: _____ Phone No.: _____
Construction Supervisor: _____ Phone No.: _____
Project Engineer: _____ Phone No.: _____

ADDITIONAL NOTES AND SKETCHES

Organized Sewage Collection System Application

Texas Commission on Environmental Quality

For Regulated Activities on the Edwards Aquifer Recharge Zone and Relating to 30 TAC §213.5(c), Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Regulated Entity Name: Berry Creek Wastewater Interceptor

1. ☒ **Attachment A – SCS Engineering Design Report**. This Engineering Design Report is provided to fulfill the requirements of 30 TAC Chapter 217, including 217.10 of Subchapter A, §§217.51 – 217.70 of Subchapter C, and Subchapter D as applicable, and is required to be submitted with this SCS Application Form.

Customer Information

2. The entity and contact person responsible for providing the required engineering certification of testing for this sewage collection system upon completion (including private service connections) and every five years thereafter to the appropriate TCEQ region office pursuant to 30 TAC §213.5(c) is:

   Contact Person: Chris Pousson
   Entity: City of Georgetown
   Mailing Address: PO Box 409
   City, State: Georgetown, Tx Zip: 78627
   Telephone: 512-930-6576 Fax: 512-930-3559
   Email Address: chris.pousson@georgetown.org
   The appropriate regional office must be informed of any changes in this information within 30 days of the change.

3. The engineer responsible for the design of this sewage collection system is:

   Contact Person: Eric Lee Nelson, P.E.
   Texas Licensed Professional Engineer's Number: 114449
   Entity: Walker Partners, LLC
   Mailing Address: 6504 Bridge Point Parkway, Suite 200
   City, State: Austin, Tx Zip: 78730
   Telephone:512-382-0021 Fax:n/a
   Email Address:enelson@walkerpartners.com

Project Information

4. Anticipated type of development to be served (estimated future population to be served, plus adequate allowance for institutional and commercial flows):

☐ Residential: Number of single-family lots:
☐ Multi-family: Number of residential units:
☐ Commercial
☐ Industrial
☐ Off-site system (not associated with any development)
☒ Other: Anticipated types of developments and populations are described in the 2023 Wastewater Master Plan attached as Exhibit 3

5. The character and volume of wastewater is shown below:

87% Domestic	34.29 million gallons/day
13% Industrial	5.12 million gallons/day
_____% Commingled	_____gallons/day

Total gallons/day: 39.41

6. Existing and anticipated infiltration/inflow is 4.75 million gallons/day. This will be addressed by: This will be a new interceptor and no significant infiltration/inflow is expected. This value was included based on the City's estimates used for sizing the collection system.

7. A Water Pollution Abatement Plan (WPAP) is required for construction of any associated commercial, industrial or residential project located on the Recharge Zone.

☐ The WPAP application for this development was approved by letter dated_____. A copy of the approval letter is attached.
☐ The WPAP application for this development was submitted to the TCEQ on_____, but has not been approved.
☐ A WPAP application is required for an associated project, but it has not been submitted.
☒ There is no associated project requiring a WPAP application.

8. Pipe description:

Table 1 - Pipe Description

Pipe Diameter(Inches)	*Linear Feet (1)*	*Pipe Material (2)*	*Specifications (3)*
30	305	CCFRPM	ASTM D3262 - SN 72

Total Linear Feet: 305

(1) Linear feet - Include stub-outs and double service connections. Do not include private service laterals.

(2) Pipe Material - If PVC, state SDR value.
(3) Specifications - ASTM / ANSI / AWWA specification and class numbers should be included.

9. The sewage collection system will convey the wastewater to the Pecan Branch Wastewater (name) Treatment Plant. The treatment facility is:

☒ Existing
☐ Proposed

10. All components of this sewage collection system will comply with:

☒ The City of Georgetown standard specifications.
☐ Other. Specifications are attached.

11. ☒ No force main(s) and/or lift station(s) are associated with this sewage collection system.

☐ A force main(s) and/or lift station(s) is associated with this sewage collection system and the **Lift Station/Force Main System Application** form (TCEQ-0624) is included with this application.

Alignment

12. ☒ There are no deviations from uniform grade in this sewage collection system without manholes and with open cut construction.

13. ☒ There are no deviations from straight alignment in this sewage collection system without manholes.

☒ **Attachment B - Justification and Calculations for Deviation in Straight Alignment without Manholes**. A justification for deviations from straight alignment in this sewage collection system without manholes with documentation from pipe manufacturer allowing pipe curvature is attached.

☐ For curved sewer lines, all curved sewer line notes (TCEQ-0596) are included on the construction plans for the wastewater collection system.

Manholes and Cleanouts

14. ☒ Manholes or clean-outs exist at the end of each sewer line(s). These locations are listed below: (Please attach additional sheet if necessary)

Table 2 - Manholes and Cleanouts

Line	*Shown on Sheet*	*Station*	*Manhole or Clean-out?*
OFF-SITE WASTEWATER INTERCEPTOR CONNECTION	C125	3+60.83	PR-BCI-MH-1

Line	*Shown on Sheet*	*Station*	*Manhole or Clean-out?*
OFF-SITE WASTEWATER INTERCEPTOR CONNECTION	C125	5+64.76	PR-BCI-MH-2
OFF-SITE WASTEWATER INTERCEPTOR CONNECTION	C125	6+50.00	PR-BCI-MH-3

15. ☒ Manholes are installed at all Points of Curvature and Points of Termination of a sewer line.

16. ☒ The maximum spacing between manholes on this project for each pipe diameter is no greater than:

Pipe Diameter (inches)	**Max. Manhole Spacing (feet)**
6 - 15	500
16 - 30	800
36 - 48	1000
≥54	2000

☒ **Attachment C – Justification for Variance from Maximum Manhole Spacing**. The maximum spacing between manholes on this project (for each pipe diameter used) is greater than listed in the table above. A justification for any variance from the maximum spacing is attached, and must include a letter from the entity which will operate and maintain the system stating that it has the capability to maintain lines with manhole spacing greater than the allowed spacing.

17. ☐ All manholes will be monolithic, cast-in-place concrete.

☒ The use of pre-cast manholes is requested for this project. The manufacturer's specifications and construction drawings, showing the method of sealing the joints, are attached.

Site Plan Requirements

Items 18 - 25 must be included on the Site Plan.

18. ☒ The Site Plan must have a minimum scale of 1" = 400'.
Site Plan Scale: 1" = 40'.

19. ☒ The Site Plan must include the sewage collection system general layout, including manholes with station numbers, and sewer pipe stub outs (if any). Site plan must be overlain by topographic contour lines, using a contour interval of not greater than ten feet and showing the area within both the five-year floodplain and the 100-year floodplain of any drainage way.

20. Lateral stub-outs:

☐ The location of all lateral stub-outs are shown and labeled.
☒ No lateral stub-outs will be installed during the construction of this sewer collection system.

21. Location of existing and proposed water lines:

☒ The entire water distribution system for this project is shown and labeled.
☐ If not shown on the Site Plan, a Utility Plan is provided showing the entire water and sewer systems.
☐ There will be no water lines associated with this project.

22. 100-year floodplain:

☒ After construction is complete, no part of this project will be in or cross a 100-year floodplain, either naturally occurring or manmade. (Do not include streets or concrete-lined channels constructed above of sewer lines.)
☐ After construction is complete, all sections located within the 100-year floodplain will have water-tight manholes. These locations are listed in the table below and are shown and labeled on the Site Plan. (Do not include streets or concrete-lined channels constructed above sewer lines.)

Table 3 - 100-Year Floodplain

Line	*Sheet*	*Station*
N/A	N/A of N/A	N/A to N/A

23. 5-year floodplain:

☒ After construction is complete, no part of this project will be in or cross a 5-year floodplain, either naturally occurring or man-made. (Do not include streets or concrete-lined channels constructed above sewer lines.)
☐ After construction is complete, all sections located within the 5-year floodplain will be encased in concrete or capped with concrete. These locations are listed in the table below and are shown and labeled on the Site Plan. (Do not include streets or concrete-lined channels constructed above sewer lines.)

Table 4 - 5-Year Floodplain

Line	*Sheet*	*Station*
N/A	N/A of N/A	N/A to N/A

24. ☒ Legal boundaries of the site are shown.

25. ☒ The ***final plans and technical specifications*** are submitted for the TCEQ's review. Each sheet of the construction plans and specifications are dated, signed, and sealed by the Texas Licensed Professional Engineer responsible for the design on each sheet.

Items 26 - 33 must be included on the Plan and Profile sheets.

26. ☒ All existing or proposed water line crossings and any parallel water lines within 9 feet of sewer lines are listed in the table below. These lines must have the type of pressure

rated pipe to be installed shown on the plan and profile sheets. Any request for a variance from the required pressure rated piping at crossings must include a variance approval from 30 TAC Chapter 290.

☒ There will be no water line crossings.
☐ There will be no water lines within 9 feet of proposed sewer lines.

Table 5 - Water Line Crossings

Line	*Station or Closest Point*	*Crossing or Parallel*	*Horizontal Separation Distance*	*Vertical Separation Distance*
N/A	N/A	N/A	N/A	N/A

27. Vented Manholes:

☒ **No part** of this sewer line is within the 100-year floodplain and vented manholes are not required by 30 TAC Chapter 217.
☐ **A portion** of this sewer line is within the 100-year floodplain and vented manholes will be provided at less than 1500 foot intervals. These water-tight manholes are listed in the table below and labeled on the appropriate profile sheets.
☐ **A portion** of this sewer line is within the 100-year floodplain and an alternative means of venting shall be provided at less than 1500 feet intervals. A description of the alternative means is described on the following page.
☐ **A portion** of this sewer line is within the 100-year floodplain; however, there is no interval longer than 1500 feet located within. No vented manholes will be used.

Table 6 - Vented Manholes

Line	*Manhole*	*Station*	*Sheet*
N/A	N/A	N/A	N/A

28. Drop manholes:

☒ There are no drop manholes associated with this project.
☐ Sewer lines which enter new or existing manholes or "manhole structures" higher than 24 inches above the manhole invert are listed in the table below and labeled on the appropriate profile sheets. These lines meet the requirements of 30 TAC §217.55(l)(2)(H).

Table 7 - Drop Manholes

Line	*Manhole*	*Station*	*Sheet*
N/A	N/A	N/A	N/A

29. Sewer line stub-outs (For proposed extensions):

☒ The placement and markings of all sewer line stub-outs are shown and labeled.
☐ No sewer line stub-outs are to be installed during the construction of this sewage collection system.

30. Lateral stub-outs (For proposed private service connections):

☐ The placement and markings of all lateral stub-outs are shown and labeled.
☒ No lateral stub-outs are to be installed during the construction of this sewage collection system.

31. Minimum flow velocity (From Appendix A)

☒ Assuming pipes are flowing full; all slopes are designed to produce flows equal to or greater than 2.0 feet per second for this system/line.

32. Maximum flow velocity/slopes (From Appendix A)

☐ Assuming pipes are flowing full, all slopes are designed to produce maximum flows of less than or equal to 10 feet per second for this system/line.

☒ **Attachment D – Calculations for Slopes for Flows Greater Than 10.0 Feet per Second.** Assuming pipes are flowing full, some slopes produce flows which are greater than 10 feet per second. These locations are listed in the table below. Calculations are attached.

Table 8 - Flows Greater Than 10 Feet per Second

Line	*Profile Sheet*	*Station to Station*	*FPS*	*% Slope*	*Erosion/Shock Protection*
OFF-SITE WASTEWATER INTERCEPTOR CONNECTION	C125	2+49.99 TO 3+60.83	13.40	2.50	Concrete Encasement
OFF-SITE WASTEWATER INTERCEPTOR CONNECTION	C125	3+60.83 TO 5+64.76	13.40	2.50	Concrete Encasement

33. Assuming pipes are flowing full, where flows are ≥ 10 feet per second, the provisions noted below have been made to protect against pipe displacement by erosion and/or shock under 30 TAC §217.53(l)(2)(B).

☒ Concrete encasement shown on appropriate Plan and Profile sheets for the locations listed in the table above.
☐ Steel-reinforced, anchored concrete baffles/retards placed every 50 feet shown on appropriate Plan and Profile sheets for the locations listed in the table above.
☐ N/A

Administrative Information

34. ☒ The final plans and technical specifications are submitted for TCEQ review. Each sheet of the construction plans and specifications are dated, signed, and sealed by the Texas Licensed Professional Engineer responsible for the design on each sheet.

35. ☒ Standard details are shown on the detail sheets, which are dated, signed, and sealed by the Texas Licensed Professional Engineer, as listed in the table below:

Table 9 - Standard Details

Standard Details	***Shown on Sheet***
Lateral stub-out marking **[Required]**	N/A
Manhole, showing inverts comply with 30 TAC §217.55(l)(2) **[Required]**	D105 & D107
Alternate method of joining lateral to existing SCS line for potential future connections **[Required]**	N/A
Typical trench cross-sections **[Required]**	D108
Bolted manholes **[Required]**	D106
Sewer Service lateral standard details **[Required]**	N/A
Clean-out at end of line **[Required, if used]**	N/A
Baffles or concrete encasement for shock/erosion protection **[Required, if flow velocity of any section of pipe >10 fps]**	D107
Detail showing Wastewater Line/Water Line Crossing **[Required, if crossings are proposed]**	D108
Mandrel detail or specifications showing compliance with 30 TAC §217.57(b) and (c) **[Required, if Flexible Pipe is used]**	C005 Notes & Section CIP12.05.H
Drop manholes **[Required, if a pipe entering a manhole is more than 24 inches above manhole invert]**	D105 &D107

36. ☒ All organized sewage collection system general construction notes (TCEQ-0596) are included on the construction plans for this sewage collection system.

37. ☒ All proposed sewer lines will be sufficiently surveyed/staked to allow an assessment prior to TCEQ executive director approval. If the alignments of the proposed sewer lines are not walkable on that date, the application will be deemed incomplete and returned.

    ☒ Survey staking was completed on this date: 8/21/23

38. ☒ Submit one (1) original and one (1) copy of the application, plus additional copies as needed for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ will distribute the additional copies to these jurisdictions. The copies must be submitted to the appropriate regional office.

39. ☒ Any modification of this SCS application will require TCEQ approval, prior to construction, and may require submission of a revised application, with appropriate fees.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. This **Organized Sewage Collection System Application** is hereby submitted for TCEQ review and executive director approval. The system was designed in accordance with the requirements of 30 TAC §213.5(c) and 30 TAC §217 and prepared by:

Print Name of Licensed Professional Engineer: Eric Lee Nelson, P.E.

Date: 8/16/2023

Place engineer's seal here:



Signature of Licensed Professional Engineer:

Appendix A-Flow Velocity Table

Flow Velocity (Flowing Full) All gravity sewer lines on the Edwards Aquifer Recharge Zone shall be designed and constructed with hydraulic slopes sufficient to give a velocity when flowing full of not less than 2.0 feet per second, and not greater than 10 feet per second. The grades shown in the following table are based on Manning's formula and an n factor of 0.013 and shall be the minimum and maximum acceptable slopes unless provisions are made otherwise.

Table 10 - Slope Velocity

Pipe Diameter(Inches)	*% Slope required for minimum flow velocity of 2.0 fps*	*% Slope which produces flow velocity of 10.0 fps*
6	0.50	12.35
8	0.33	8.40
10	0.25	6.23
12	0.20	4.88
15	0.15	3.62
18	0.11	2.83
21	0.09	2.30
24	0.08	1.93
27	0.06	1.65
30	0.055	1.43
33	0.05	1.26
36	0.045	1.12
39	0.04	1.01
>39	*	*

**For lines larger than 39 inches in diameter, the slope may be determined by Manning's formula (as shown below) to maintain a minimum velocity greater than 2.0 feet per second when flowing full and a maximum velocity less than 10 feet per second when flowing full.*

$$v = \frac{1.49}{n} \times R_h^{0.67} \times \sqrt{S}$$

Figure 1 - Manning's Formula

Where:

v = velocity (ft/sec)
n = Manning's roughness coefficient (0.013)

Rh = hydraulic radius (ft)
S = slope (ft/ft)

ATTACHMENT A

CITY OF GEORGETOWN BERRY CREEK INTERCEPTOR ENGINEERING REPORT – DECOMMISSIONING OF THE SUN CITY LIFT STATION

Prepared by:

Walker Partners
engineers | surveyors

6504 Bridge Point Parkway, Suite 200
Austin, Texas, 78730

July 2023

Walker Partners
engineers | surveyors

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Design

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Exhibit 1: Road Map

Exhibit 2: Calculations pertinent to the design:

- ✓ Wastewater Model Profile with Design Flow Values
- ✓ Capacity Calculations
- ✓ Flexible Pipe Calculations

Exhibit 3: 2023 Wastewater Master Plan by CDM Smith

Exhibit 4: Georgetown – San Gabriel River Flood Protection Planning Study

PROJECT SUMMARY

This report is a revision to the TCEQ approved Berry Creek Wastewater Interceptor (Project) from Stetson Trail to Airport Road. Georgetown will be decommissioning the Sun City Lift Station (LS) in the Sun City neighborhood located in Georgetown, Texas. This project will connect the existing 27" wastewater line feeding the LS to the existing 30" Berry Creek Interceptor that was constructed in 2019. This modification will allow the City of Georgetown to have a gravity collection system from the LS generally following Berry Creek until Airport Road where the proposed 2023 Berry Creek Interceptor will begin and eventually terminate at the Pecan Branch Wastewater Treatment Plant (PB WWTP).

DESIGN

Capacity Design

CDM Smith prepared the 2023 Wastewater Master Plan for the City of Georgetown. The wastewater design flows, estimated by CDM Smith in the 2023 WWMP, were used in conjunction with the wastewater system design criteria outlined in the 2023 WWMP and the criteria required by the Texas Commission of Environmental Quality (TCEQ). ***Exhibit 2*** includes the wastewater design flows from the 2023 WWMP and the capacity calculations for this Project. The wastewater design flows are listed on the row that is labeled "US flow (MGD)" towards the bottom of the pipe profile. This profile was exported from the CDM Smith wastewater model. The 2023 WWMP is included as ***Exhibit 3***.

The following criteria were used for sizing the wastewater gravity lines.

- ✓ Pipe must be designed to prevent a surcharge;
- ✓ Minimum velocity of 2 ft/sec when flowing full;
- ✓ Maximum velocity of 10 ft/sec (otherwise pipe protection is required); and,
- ✓ Minimum acceptable Manning's n of 0.013.

The proposed 30" interceptor will ultimately allow for the City of Georgetown to decommission the Sun City Lift Station by connecting to the Project.

Structural Analysis

The pipe materials for the collection system will consist of centrifugally cast fiberglass reinforced polymer mortar (CCFRPM), as noted in Table 1 on F-0582. The flexible pipe calculations required by TCEQ are also included in Exhibit 2. Please note that CCFRPM is specified for the 30" diameter pipe, but we are also including calculations for PVC in case there is a supply chain issue in the future and PVC must be substituted to complete the project. The calculations for PVC follow the procedure outlined in TCEQ-10243 (10/01/04), and the calculations for CCFRPM follow the procedure outlined in AWWA M45 Fiberglass Pipe Design. The fiberglass pipe material properties that were provided by the manufacturer are noted on the calculations.

Floodplains

The boundaries of the FEMA 100-year floodplain were graphically plotted to show the current floodplain boundaries. However, the City of Georgetown provided the San Gabriel Flood Protection Planning Study (see ***Exhibit 4***), and supporting models, that included future floodplain boundaries and water surface elevations. The future floodplains were more conservative, so they were used for the design of this Project. The future 5-year floodplain and FEMA 100-year floodplain was graphically plotted. This pipeline alignment does not cross through the future 100-year or 5-year floodplain no concrete trench cap or venting will be installed on the proposed pipeline or manholes.

Variances

No variances are requested from Chapter 217 – Design Criteria for Domestic Wastewater Systems. The plans and specifications are in substantial compliance with all requirements of Chapter 217.

EXHIBIT 1

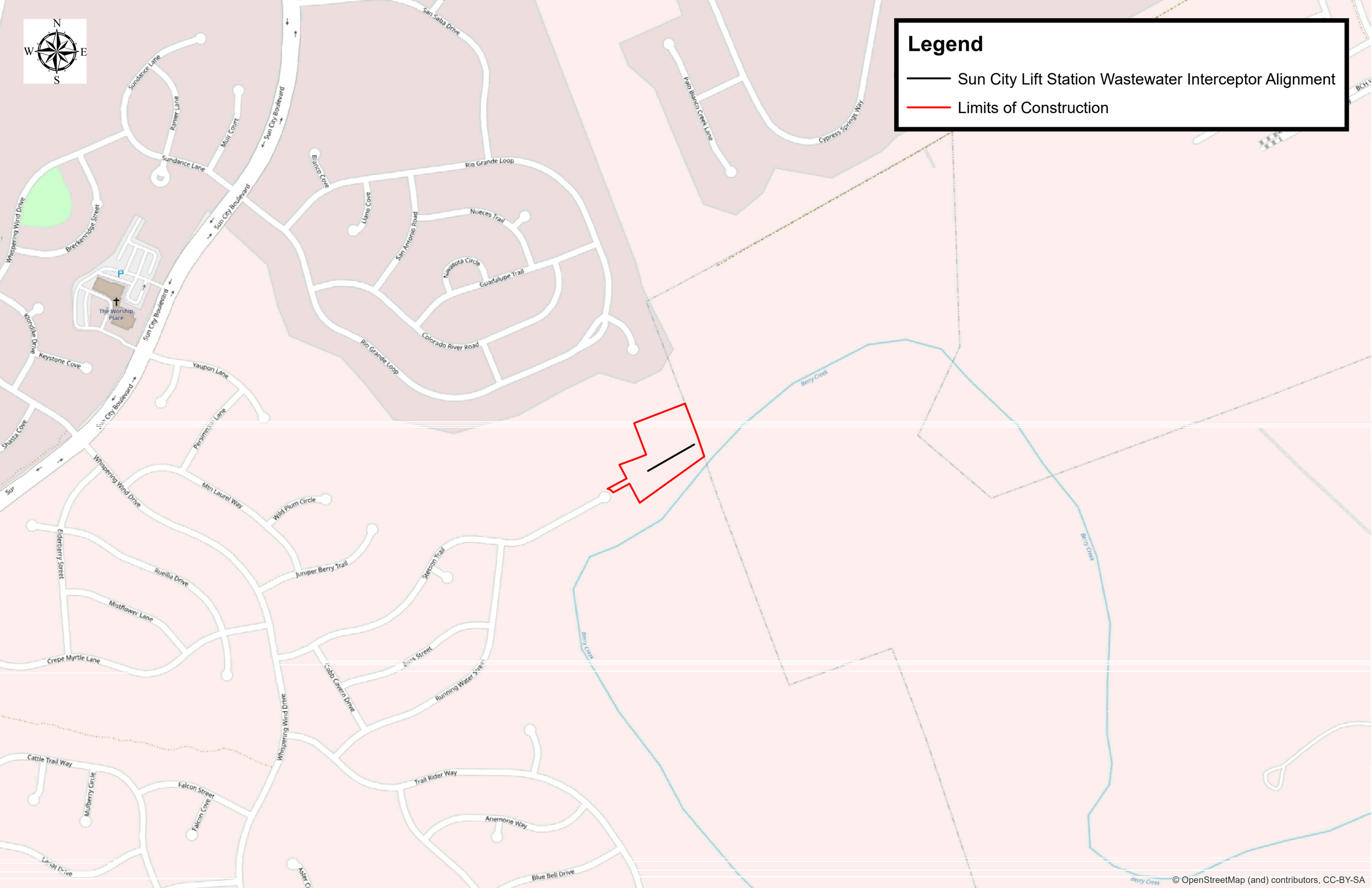
N
W
E
S
Legend
Sun City Lift Station Wastewater Interceptor Alignment
Limits of Construction
San Saba Drive
Sundance Lane
Ranier Lane
Musi Court
Sun City Boulevard
Rio Grande Loop
Bianco Cove
Llano Cove
San Antonio Road
Nueces Trail
Nawasota Circle
Guadalupe Trail
Colorado River Road
Palo Blanco Creek Lane
Cypress Springs Way
Whispering Wind Drive
Breckenridge Street
The Worship Place
Klondike Drive
Keystone Cove
Yaupon Lane
Persimmon Lane
Shasta Cove
Min Laurel Way
Wild Plum Circle
Elderberry Street
Ruellia Drive
Juniper Berry Trail
Stetson Trail
Mistflower Lane
Crepe Myrtle Lane
Cobb Cavern Drive
Running Water Street
Cattle Trail Way
Mulberry Circle
Falcon Street
Falcon Cove
Trail Rider Way
Anemone Way
Blue Bell Drive
Berry Creek
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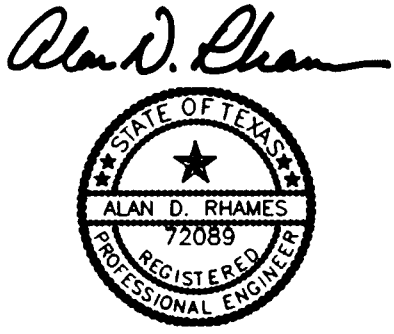
EXHIBIT 2

ENGINEER'S DESIGN REPORT

FOR THE

BERRY CREEK WASTEWATER INTERCEPTOR



April 16, 2019

Prepared For:

EST. 1848
GEORGETOWN
TEXAS

City of Georgetown, Texas

Prepared By:

CDM Smith

CDM Smith
9430 Research Boulevard, Suite 1-200
Austin, Texas 78759
(512) 346-1100
TBPE Firm No. F-3043

April 2019

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1.0 Introduction

The purpose of this report is to demonstrate that the proposed City of Georgetown – Berry Creek Wastewater Interceptor project complies with the Texas Commission on Environmental Quality (TCEQ) 30 TAC §217 – Design Criteria for Domestic Wastewater Systems. The project includes the construction of around 15,600 linear feet of wastewater gravity main and manholes from the existing Sun City Lift Station to a point just upstream of the Berry Creek Lift Station in Georgetown, Texas. This permit consists of Phase 2 (Phase 4B on Exhibit 1) of this wastewater line, which consists of the placement of the upstream portion of the wastewater line (8,009 LF) between the existing Sun City Lift Station and Shell Road. The alignment of the interceptor generally follows Berry Creek. The flow from the interceptor will be treated at the Berry Creek Wastewater Treatment Plant (WWTP) on an interim basis and will ultimately be processed at the existing Pecan Branch WWTP. Phase 2 (Phase 4B on Exhibit 1) will be connected to Phase 1 (Phase 4A on Exhibit 1) before being put into service.

All improvements proposed are consistent with the *Georgetown Utility Systems 2018 Water Services Master Plan (Water & Wastewater)* completed by CDM Smith in October 2018. The *Master Plan* details sequential improvements to wastewater collection, transfer and treatment facilities necessary to meet Georgetown's anticipated growth over the next several decades. In the event a wider view of how the proposed Berry Creek Interceptor fits into the city's long-term infrastructure plan is needed, a copy of the *Master Plan* is available for review upon request.

Although the pipe specifications could be either PVC or fiberglass, the owner chose to install PVC pipe, and these values are reflected in our calculations.

2.0 Service Areas

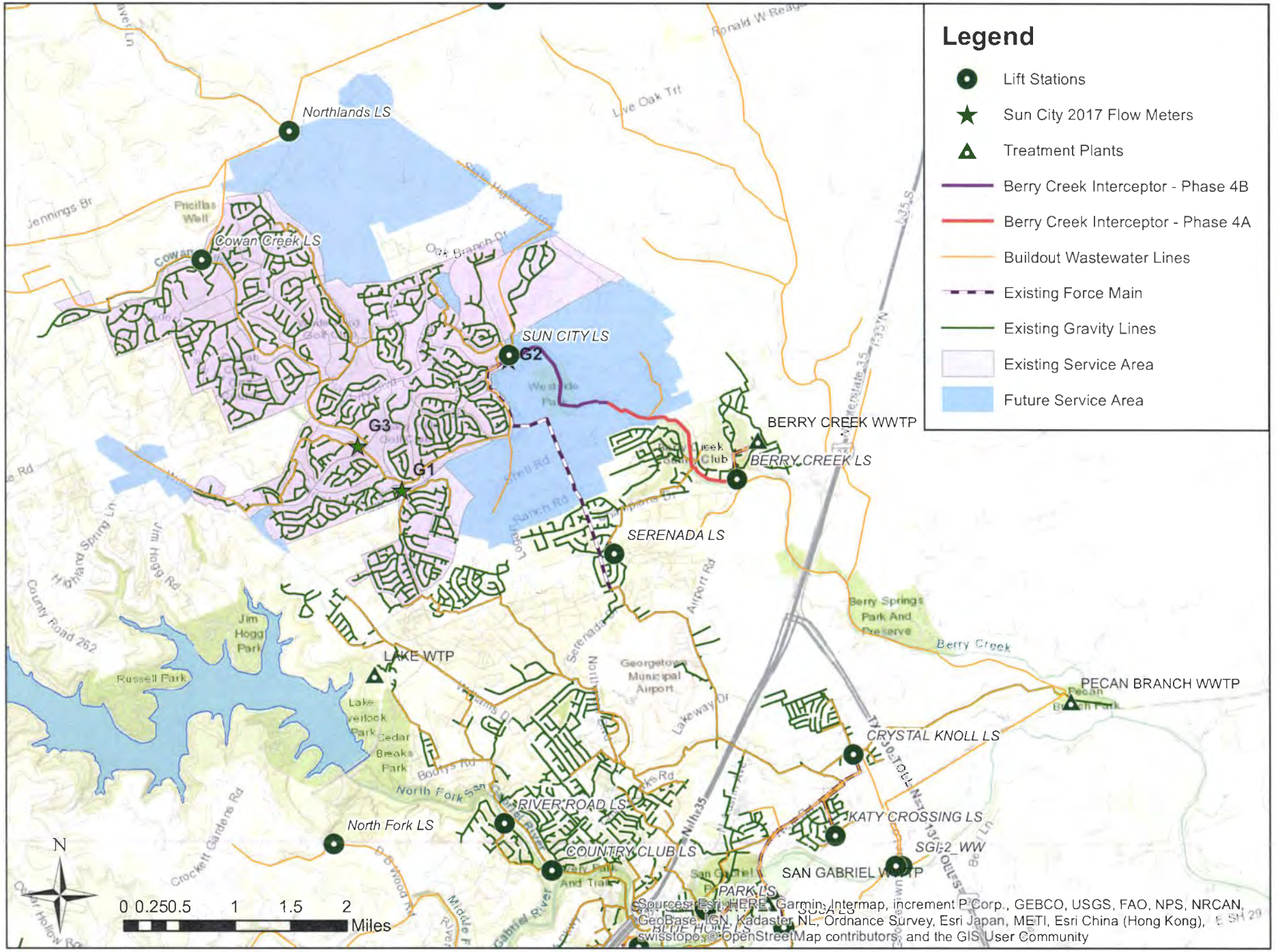
2.1 Overall Service Configuration

Exhibit 1 shows the current and proposed service areas of the Berry Creek Wastewater Interceptor. Ultimate buildout estimates were prepared in the *Georgetown Utility Systems 2018 Water Services Master Plan (Water & Wastewater)* based on the most recent planning documents available from the City of Georgetown. The service area is projected to ultimately contain about 4,400 single family homes and 19,900 multi-family residential units, generating a total projected population of about 49,000 people within the 6,600-acre drainage basin. The service area is also projected to include a small amount of commercial property primarily composed of local retail and local office uses.

This permit consists of placing the upstream portion of the Berry Creek Wastewater Line (Phase 4B on Exhibit 1). Phase 1 (Phase 4A on Exhibit 1) is already being constructed and Phase 2 will connect to this line. No flow will go through the wastewater line that is reflected in this permit until both phases of the project are complete.

The general direction of wastewater flow is from northwest to southeast. The proposed project is intended to capture all flow entering the existing Sun City lift station which currently serves areas to the north, south and west and conveys it via force main and gravity line to the existing Serenada lift station. The proposed interceptor initially will provide relief of peak flows to the Sun City Lift Station and force main system by taking peak flows in excess of the lift station capacity to the Berry Creek Waste Water Treatment Plant (WWTP). Ultimately, the proposed interceptor will be extended to the Pecan Branch WWTP and allow decommissioning the Sun City lift station. All flows from the Sun City Lift Station are currently treated at the

Pecan Branch WWTP. The Berry Creek WWTP has capacity to accept flows from the interceptor on an interim basis until downstream improvements are completed.


Legend
Lift Stations
Sun City 2017 Flow Meters
Treatment Plants
Berry Creek Interceptor - Phase 4B
Berry Creek Interceptor - Phase 4A
Buildout Wastewater Lines
Existing Force Main
Existing Gravity Lines
Existing Service Area
Future Service Area
Northlands LS
Cowan Creek LS
SUN CITY LS
G2
G3
G1
BERRY CREEK WWTP
BERRY CREEK LS
SERENADA LS
LAKE WTP
PECAN BRANCH WWTP
CRYSTAL KNOLL LS
RIVER ROAD LS
North Fork LS
KATY CROSSING LS
COUNTRY CLUB LS
SGI-2 WW
SAN GABRIEL WWTP
PARK LS
N
0 0.250.5 1 1.5 2
Miles
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

2.2 *Extension of Service into Areas Not Currently Served*

The Berry Creek Interceptor is sized to accept and convey all projected flow generated within the drainage basin at full buildout based on the most current planning projections. The depth of the interceptor is sufficient to serve the vast majority of future development tracts by gravity, assuming reasonable development patterns. The extension of future gravity wastewater service will be accomplished through the construction of wastewater lines funded by private development and/or by executed development agreements. Although the initial goal of the interceptor is to retire the existing Sun City Lift Station, stubs from proposed manholes for the extension of gravity wastewater lines into four future development tracts have been provided.

3.0 Pipe Design Criteria

3.1 *Capacity/Flow Design*

As detailed previously, all improvements proposed are consistent with the *Georgetown Utility Systems 2018 Water Services Master Plan.* The *Master Plan* includes an *Infoworks ICM* model of the city's wastewater collection system. The model is integrated with long-term planning data and has been calibrated using flow monitoring of both dry weather and wet weather conditions. The wastewater flow estimates used for design of the Berry Creek Interceptor were generated by the *Infoworks ICM* model. Because a review of the entire Georgetown wastewater system is well beyond the scope of this report, supplemental flow calculations are presented below which use a flow estimation approach typical for central Texas municipalities. These calculations are intended to demonstrate that the flow estimates generated by *Infoworks ICM* are reasonable and appropriate without requiring a separate review of the *Master Plan* itself. Note that the calculated depth of flow (see Section 4) at estimated maximum flows is less than half full for every pipe segment proposed. The actual capacity of each pipe segment is therefore at least twice the design flow specified.

3.2 *Average Dry Weather Flow (DWF or Q_{AVG})*

The total service area of the Berry Creek Wastewater Interceptor is approximately 6,600 acres. Projected land use within each contributing area was divided into three different land use types including single-family units, multi-family units and commercial property. A living unit equivalent (LUE) conversion was applied to each land use to arrive at a total LUE estimate for each basin. An LUE is considered to be a use that generates wastewater at a rate equal to a typical single-family home. Typical LUE and population estimates assume average dry weather flow to be about 70 gallons per person per day, equating, assuming 3.5 people per single family home, to about 245 gallons per LUE per day. A significant amount of the area within the Berry Creek drainage basin contains age-restricted development (typically 55 and older). These homes generally contain fewer people per residence and also generate less wastewater per person. Based on flow monitoring conducted by the City of Georgetown average wastewater generation per LUE within the Berry Creek basin is anticipated to be on the order of 200 gallons per LUE per day. the average dry weather wastewater flow (in gpm) can then calculated according to the following equation:

$$Q_{AVG} = [\text{ LUEs x 200 gal/day }] / [24 \text{ hrs} * 60 \text{ min/day}] \quad (1)$$

For example, the average dry weather flow for a 500-acre basin containing 1,500 LUEs would be:

$$Q_{AVG} = [\text{ 1500 LUEs x 200 gal/day }] / [24 \text{ hrs} * 60 \text{ min/day}] = 208.3 \text{ gpm} = 0.30 \text{ GPM}$$

3.3 *Peak Dry Weather Flow (DWF or Q_{PDW})*

Peak dry weather flow is calculated by applying a peaking factor to the average dry weather flow value calculated above. The peaking factor and peak dry weather flow can be calculated according to the following equations:

$$P.F. = [\ 18+ (0.0206 \times Q_{AVG})^{1/2}\ ] / [\ 4 + (0.0206 \times Q_{AVG})^{1/2}\ ] \quad (2)$$

$$Q_{PDW} = P.F. \times Q_{AVG} \quad (3)$$

The peaking factor and peak dry weather flow for the example 500-acre basin containing 1,500 LUEs would be:

$$P.F. = [\ 18+ (0.0206 \times 208.3)^{1/2}\ ] / [\ 4 + (0.0206 \times 208.3)^{1/2}\ ] = 3.306$$

$$Q_{PDW} = 3.306 \times 208.3 = 688.8 \text{ gpm} = 0.99 \text{ MGD}$$

3.4 *Peak Wet Weather Flow (WWF or Q_{PWW})*

During rainfall events, storm water enters the wastewater collection system through defects which develop over time in the pipe, manholes and private connections. Peak wet weather flow represents the combination of peak dry weather flow plus external groundwater and surface water which enter the system during and after rainfall events. Typical infiltration and inflow rates used by central Texas municipalities are 750 gallons per acre per day. Peak wet weather flow is calculated according to the following formula:

$$Q_{PWW} = ([\ \text{Acres} \times 750 \text{ gal/day}\ ] / [24 \text{ hrs} * 60 \text{ min/day}]) + Q_{PDW} \quad (4)$$

The peak wet weather flow for the example 500-acre basin containing 1,500 LUEs would be:

$$Q_{PWW} = ([\ 500 \times 750 \text{ gal/day}\ ] / [24 \text{ hrs} * 60 \text{ min/day}]) + 688.8 = 949.3 \text{ gpm} = 1.37 \text{ MGD}$$

Exhibit 2 indicates the estimated Q_{AVG}, Q_{PDW} and Q_{PWW} flows for each segment of the proposed interceptor using the flow estimation approach detailed above. Exhibit 2-1 shows flows for full buildout at 50 years, while Exhibit 2-2 shows initial flows through the interceptor after construction completion. Exhibit 2 also presents the Q_{AVG} and Q_{PWW} flows for each segment of the Berry Creek Interceptor generated by the *Infoworks ICM* model. Inflow and infiltration has been monitored by flow meters throughout Georgetown and specifically Sun City. The parameters from the flow monitoring are factored into the flow calculations used in the *Infoworks ICM* model. Comparison of the flow estimates reveals that the results of the calculation approach presented above and the *Infoworks ICM* model compare well. Note that the *Infoworks ICM* model includes some of the estimated groundwater infiltration in the average day flow. Q_{AVG} flows from the *Infoworks ICM* are therefore generally larger than those calculated using the alternate methodology presented herein. As discussed in Section 3.1, all proposed pipe segments have at least twice the capacity required to carry the Q_{PWW}. This permit only reflects pipeline places between Station 83+47 and 156+08, and no flow will go through these pipes until both phases of the interceptor have been constructed.

EXHIBIT 2-1

BERRY CREEK WASTEWATER INTERCEPTOR
PIPE SEGMENT FLOW CALCULATIONS FOR FULL BUILDOUT (50 YEARS)

Start Station	End Station	Pipe Diameter (Inches)	Average Dry Weather Flow (MGD) *InfoWorks*	Peak Wet Weather Flow (MGD) *Infoworks*	Average Dry Weather Depth (ft)	Peak Wet Weather Depth (ft)	Average Dry Weather Velocity (fps)	Peak Wet Weather Velocity (fps)	Cumulative Contributing Acres	Cumulative Contributing LUEs	Peaking Factor	Infiltration and Inflow (gpad)	Average Dry Weather Flow (MGD) *Calculated*	Peak Wet Weather Flow (MGD) *Calculated*
30" AND 36" WASTEWATER INTERCEPTOR														
1+00	6+48	36	6.11	12.31	1.41	2.23	2.9	3.4	6613	19539	2.2	750	3.91	13.63
6+48	7+52	36	6.11	12.31	1.41	2.23	2.9	3.4	6613	19539	2.2	750	3.91	13.63
7+52	13+13	36	6.11	12.31	1.41	2.23	2.9	3.4	6613	19539	2.2	750	3.91	13.63
13+13	17+71	36	6.12	12.31	1.41	2.23	2.9	3.4	6613	19539	2.2	750	3.91	13.63
17+71	19+81	36	6.12	12.31	1.41	2.23	2.9	3.4	6613	19539	2.2	750	3.91	13.63
19+81	22+32	36	6.12	12.31	1.41	2.23	2.9	3.4	6613	19539	2.2	750	3.91	13.63
22+32	23+49	36	6.12	12.31	1.41	2.23	2.9	3.4	6613	19539	2.2	750	3.91	13.63
23+49	26+31	36	6.12	12.31	1.41	2.23	2.9	3.4	6613	19539	2.2	750	3.91	13.63
26+31	27+43	36	6.12	12.31	1.44	2.23	2.9	3.3	6613	19539	2.2	750	3.91	13.63
27+43	32+50	30	6.12	12.31	1.10	1.71	4.5	5.3	6613	19539	2.2	750	3.91	13.63
32+50	37+42	30	6.12	12.31	1.11	1.71	4.5	5.3	6613	19539	2.2	750	3.91	13.63
37+42	40+03	30	6.12	12.31	1.10	1.71	4.5	5.3	6613	19539	2.2	750	3.91	13.63
40+03	44+20	30	6.12	12.31	1.10	1.71	4.5	5.3	6613	19539	2.2	750	3.91	13.63
44+20	48+51	30	6.12	12.31	1.10	1.71	4.5	5.3	6613	19539	2.2	750	3.91	13.63
44+20	48+51	30	6.12	12.31	1.10	1.71	4.5	5.3	6613	19539	2.2	750	3.91	13.63
48+51	52+72	30	6.12	12.31	1.10	1.71	4.5	5.3	6613	19539	2.2	750	3.91	13.63
52+72	54+14	30	6.12	12.31	1.10	1.71	4.5	5.3	6613	19539	2.2	750	3.91	13.63
54+14	56+80	30	6.12	12.31	1.10	1.71	4.5	5.3	6613	19539	2.2	750	3.91	13.63
56+80	62+56	30	6.12	12.31	1.10	1.71	4.5	5.3	6244	18042	2.3	750	3.61	12.81
62+56	67+56	30	5.61	11.32	0.92	1.37	5.3	6.4	6244	18042	2.3	750	3.61	12.81
67+56	74+97	30	5.62	11.32	1.05	1.61	4.4	5.3	6170	17731	2.3	750	3.55	12.64
74+97	76+62	30	5.52	11.12	1.04	1.59	4.4	5.2	6031	17252	2.3	750	3.45	12.35
76+62	78+50	30	5.38	10.82	1.00	1.51	4.5	5.4	6031	17252	2.3	750	3.45	12.35
78+50	80+85	30	5.38	10.82	0.97	1.44	4.8	5.7	6031	17252	2.3	750	3.45	12.35
80+85	83+44	30	5.38	10.82	0.97	1.44	4.8	5.7	6031	17252	2.3	750	3.45	12.35

EXHIBIT 2-1

BERRY CREEK WASTEWATER INTERCEPTOR
PIPE SEGMENT FLOW CALCULATIONS FOR FULL BUILDOUT (50 YEARS)

Start Station	End Station	Pipe Diameter (Inches)	Average Dry Weather Flow (MGD) *InfoWorks*	Peak Wet Weather Flow (MGD) *Infoworks*	Average Dry Weather Depth (ft)	Peak Wet Weather Depth (ft)	Average Dry Weather Velocity (fps)	Peak Wet Weather Velocity (fps)	Cumulative Contributing Acres	Cumulative Contributing LUEs	Peaking Factor	Infiltration and Inflow (gpad)	Average Dry Weather Flow (MGD) *Calculated*	Peak Wet Weather Flow (MGD) *Calculated*
30" AND 36" WASTEWATER INTERCEPTOR (CONTINUED)														
83+44	85+41	30	5.38	10.82	0.97	1.46	4.8	5.7	6031	17252	2.3	750	3.45	12.35
85+41	89+07	30	5.38	10.82	0.97	1.44	4.8	5.7	6031	17252	2.3	750	3.45	12.35
89+07	90+57	30	5.38	10.82	1.02	1.54	4.4	5.8	5964	16955	2.3	750	3.39	12.19
90+57	97+83	30	5.29	10.63	0.94	1.40	4.9	5.9	5964	16955	2.3	750	3.39	12.19
97+83	100+22	30	5.29	10.63	0.96	1.43	4.8	5.7	5964	16955	2.3	750	3.39	12.19
100+22	104+41	30	5.27	10.63	0.94	1.41	4.9	5.8	5964	16955	2.3	750	3.39	12.19
104+41	108+53	30	5.29	10.63	0.95	1.42	4.8	5.7	5964	16955	2.3	750	3.39	12.19
108+53	110+29	30	5.29	10.63	1.02	1.54	4.4	5.2	5803	16359	2.3	750	3.27	11.85
110+29	118+29	30	5.13	10.28	1.00	1.51	4.3	5.2	5746	16097	2.3	750	3.22	11.71
118+29	120+74	30	5.04	10.11	0.99	1.49	4.3	5.1	5746	16097	2.3	750	3.22	11.71
120+74	127+88	30	5.02	10.11	1.02	1.54	4.2	4.9	5746	16097	2.3	750	3.22	11.71
127+88	132+89	30	5.02	10.11	1.02	1.54	4.2	4.9	5746	16097	2.3	750	3.22	11.71
132+89	138+54	30	5.02	10.11	1.04	1.57	4.1	4.8	5557	15420	2.3	750	3.08	11.31
138+54	141+89	30	4.79	9.64	1.01	1.52	4.0	4.8	5509	15254	2.3	750	3.05	11.21
141+89	146+13	30	4.75	9.54	1.04	1.57	4.1	4.8	5509	15254	2.3	750	3.05	11.21
146+13	149+66	30	4.75	9.54	1.02	1.55	3.9	4.6	5509	15254	2.3	750	3.05	11.21
149+66	151+65	30	4.75	9.54	1.02	1.55	3.9	4.6	4425	12315	2.4	750	2.46	9.25
151+65	155+31	30	4.75	9.54	0.66	7.10	0.9	8.7	4425	12315	2.4	750	2.46	9.25
155+31	156+08	30	4.75	9.54	0.66	7.10	0.9	8.7	4425	12315	2.4	750	2.46	9.25
156+08	156+88	15	0.98	2.20	0.26	0.39	5.4	6.7	913	2541	3.1	750	0.51	2.26
27" WASTEWATER INTERCEPTOR														
1+00	6+48	27	3.70	7.30	0.64	0.91	7.1	8.6	3512	9774	2.5	750	1.95	7.54
8" WASTEWATER LINE 'C'														
0+00	2+18	8	0.005	0.024	0.11	0.23	0.9	1.4	9	18	4.3	750	0.004	0.022
2+18	5+36	8	0.005	0.025	0.09	0.18	1.3	2.0	10	19	4.3	750	0.004	0.024
5+36	6+71	8	0.006	0.026	0.07	0.14	1.8	2.9	12	20	4.3	750	0.004	0.026

EXHIBIT 2-2

BERRY CREEK WASTEWATER INTERCEPTOR
PIPE SEGMENT FLOW CALCULATIONS FOR INITIAL FLOWS

Start Station	End Station	Pipe Diameter (Inches)	Average Dry Weather Flow (MGD) *InfoWorks*	Peak Wet Weather Flow (MGD) *Infoworks*	Average Dry Weather Depth (ft)	Peak Wet Weather Depth (ft)	Average Dry Weather Velocity (fps)	Peak Wet Weather Velocity (fps)	Cumulative Contributing Acres	Cumulative Contributing LUEs	Peaking Factor	Infiltration and Inflow (gpad)	Average Dry Weather Flow (MGD) *Calculated*	Peak Wet Weather Flow (MGD) *Calculated*
30" AND 36" WASTEWATER INTERCEPTOR														
1+00	6+48	36	0.05	0.24	0.13	0.25	0.7	1.1	85	230	3.9	750	0.05	0.24
6+48	7+52	36	0.05	0.24	0.13	0.25	0.7	1.1	85	230	3.9	750	0.05	0.24
7+52	13+13	36	0.05	0.24	0.13	0.25	0.7	1.1	85	230	3.9	750	0.05	0.24
13+13	17+71	36	0.05	0.24	0.13	0.25	0.7	1.1	85	230	3.9	750	0.05	0.24
17+71	19+81	36	0.05	0.24	0.12	0.25	0.7	1.1	85	230	3.9	750	0.05	0.24
19+81	22+32	36	0.05	0.24	0.13	0.25	0.7	1.1	85	230	3.9	750	0.05	0.24
22+32	23+49	36	0.05	0.24	0.13	0.25	0.7	1.1	85	230	3.9	750	0.05	0.24
23+49	26+31	36	0.05	0.24	0.13	0.25	0.7	1.1	85	230	3.9	750	0.05	0.24
26+31	27+43	36	0.05	0.24	0.13	0.25	0.7	1.1	85	230	3.9	750	0.05	0.24
27+43	32+50	30	0.05	0.24	0.10	0.20	1.1	1.7	85	230	3.9	750	0.05	0.24
32+50	37+42	30	0.05	0.24	0.10	0.20	1.1	1.7	85	230	3.9	750	0.05	0.24
37+42	40+03	30	0.05	0.24	0.10	0.20	1.1	1.7	85	230	3.9	750	0.05	0.24
40+03	44+20	30	0.05	0.24	0.10	0.20	1.1	1.7	85	230	3.9	750	0.05	0.24
44+20	48+51	30	0.05	0.24	0.10	0.20	1.1	1.7	85	230	3.9	750	0.05	0.24
44+20	48+51	30	0.05	0.24	0.10	0.20	1.1	1.7	85	230	3.9	750	0.05	0.24
48+51	52+72	30	0.05	0.24	0.10	0.20	1.1	1.7	85	230	3.9	750	0.05	0.24
52+72	54+14	30	0.05	0.24	0.10	0.20	1.1	1.7	85	230	3.9	750	0.05	0.24
54+14	56+80	30	0.05	0.24	0.10	0.20	1.1	1.7	82	228	3.9	750	0.05	0.24
56+80	62+56	30	0.05	0.24	0.10	0.20	1.1	1.7	82	228	3.9	750	0.05	0.24
62+56	67+56	30	0.05	0.24	0.09	0.18	1.3	2.0	82	228	3.9	750	0.05	0.24
67+56	74+97	30	0.05	0.24	0.10	0.20	1.1	1.7	82	228	3.9	750	0.05	0.24
74+97	76+62	30	0.05	0.24	0.10	0.20	1.1	1.7	82	228	3.9	750	0.05	0.24
76+62	78+50	30	0.05	0.24	0.10	0.20	1.1	1.8	82	228	3.9	750	0.05	0.24
78+50	80+85	30	0.05	0.24	0.10	0.20	1.1	1.8	82	228	3.9	750	0.05	0.24
80+85	83+44	30	0.05	0.24	0.09	0.19	1.2	1.9	82	228	3.9	750	0.05	0.24

EXHIBIT 2-2

BERRY CREEK WASTEWATER INTERCEPTOR
PIPE SEGMENT FLOW CALCULATIONS FOR INITIAL FLOWS

Start Station	End Station	Pipe Diameter (Inches)	Average Dry Weather Flow (MGD) *InfoWorks*	Peak Wet Weather Flow (MGD) *Infoworks*	Average Dry Weather Depth (ft)	Peak Wet Weather Depth (ft)	Average Dry Weather Velocity (fps)	Peak Wet Weather Velocity (fps)	Cumulative Contributing Acres	Cumulative Contributing LUEs	Peaking Factor	Infiltration and Inflow (gpad)	Average Dry Weather Flow (MGD) *Calculated*	Peak Wet Weather Flow (MGD) *Calculated*
30" AND 36" WASTEWATER INTERCEPTOR (CONTINUED)														
83+44	85+41	30	0.05	0.24	0.09	0.19	1.1	1.9	82	228	3.9	750	0.05	0.24
85+41	89+07	30	0.05	0.24	0.09	0.19	1.2	1.9	82	228	3.9	750	0.05	0.24
89+07	90+57	30	0.05	0.24	0.10	0.20	1.1	1.7	82	228	3.9	750	0.05	0.24
90+57	97+83	30	0.05	0.24	0.09	0.19	1.2	1.9	82	228	3.9	750	0.05	0.24
97+83	100+22	30	0.05	0.24	0.09	0.19	1.2	1.9	82	228	3.9	750	0.05	0.24
100+22	104+41	30	0.05	0.24	0.09	0.19	1.2	1.9	82	228	3.9	750	0.05	0.24
104+41	108+53	30	0.05	0.24	0.09	0.19	1.1	1.8	82	228	3.9	750	0.05	0.24
108+53	110+29	30	0.05	0.24	0.10	0.20	1.1	1.7	82	228	3.9	750	0.05	0.24
110+29	118+29	30	0.05	0.24	0.10	0.20	1.1	1.7	82	228	3.9	750	0.05	0.24
118+29	120+74	30	0.05	0.24	0.10	0.20	1.1	1.7	82	228	3.9	750	0.05	0.24
120+74	127+88	30	0.05	0.24	0.10	0.20	1.0	1.6	82	228	3.9	750	0.05	0.24
127+88	132+89	30	0.05	0.24	0.10	0.20	1.0	1.6	82	228	3.9	750	0.05	0.24
132+89	138+54	30	0.05	0.24	0.10	0.21	1.0	1.6	82	228	3.9	750	0.05	0.24
138+54	141+89	30	0.05	0.24	0.10	0.21	1.0	1.6	82	228	3.9	750	0.05	0.24
141+89	146+13	30	0.05	0.24	0.10	0.21	1.0	1.6	82	228	3.9	750	0.05	0.24
146+13	149+66	30	0.05	0.24	0.10	0.21	1.0	1.6	82	228	3.9	750	0.05	0.24
149+66	151+65	30	0.05	0.24	0.10	0.21	1.0	1.6	82	228	3.9	750	0.05	0.24
151+65	155+31	30	0.05	0.24	0.07	0.15	1.7	2.9	82	228	3.9	750	0.05	0.24
155+31	156+08	30	0.05	0.24	0.07	0.15	1.7	2.9	82	228	3.9	750	0.05	0.24
156+08	156+88	15	0.01	0.03	0.03	0.06	1.5	2.2	11	28	4.3	750	0.01	0.03
27" WASTEWATER INTERCEPTOR														
1+00	6+48	27	0.04	0.21	0.06	0.14	1.8	2.9	71	200	3.9	750	0.04	0.21
8" WASTEWATER LINE 'C'														
0+00	2+18	8	0.00	0.004	0.00	0.03	0.0	0.9	3	2	4.4	750	0.00	0.004
2+18	5+36	8	0.00	0.004	0.00	0.03	0.0	1.4	3	2	4.4	750	0.00	0.004
5+36	6+71	8	0.00	0.004	0.00	0.02	0.0	1.8	3	2	4.4	750	0.00	0.004

3.5 *Water line Crossings*

There are multiple potable water line crossings perpendicular to the proposed wastewater interceptor. The subject crossings are either contained within ASTM A139 Grade 2 (35,000 psi) steel casing or will be leak protected through the use of flowable fill or a joint of pressure pipe centered on the water line. Note that the pressure rating for a 48" steel casing pipe with a ½-inch wall is 438 psi and the pressure rating for a 42" steel casing pipe with a 1/2-inch wall is 500 psi. Neoprene end seals manufactured by CCI Pipeline Systems will be used to seal the casing ends. For water line crossings not in casing, the pipe will be encased in flowable fill or a pressure rated pipe will be provided (at the contractor's option). Pressure rated pipe for 30- and 36-inch pipe will be AWWA C900 DR25 (165 psi) PVC (note that ASTM F679 pipe with these sizes is cast iron OD). Pressure wastewater pipe in the 8-inch size will conform with ASTM D2241 DR26 (165 psi) PVC requirements.

4.0 Line Size, Grades, and Velocities

4.1 *Flow Depth and Velocity Calculations*

The required size of the interceptor is dependent on the design flow, design criteria, pipe slope and pipe roughness. Consistent with TAC Chapter 217, Manning's formula was used to calculate hydraulic flow characteristics in each pipe segment assuming a roughness coefficient of 0.013 and the formula shown below.

$$v = \frac{1.49}{n} \times R_h^{0.67} \times \sqrt{S} \qquad (5)$$

where v = velocity (ft/sec)
n = Manning's roughness coefficient (0.013)
Rh = hydraulic radius (ft)
S = slope (ft/ft)

The calculated flow, depth and velocity for each line segment is included in Exhibit 2 and on the plan and profile sheets for both average day and peak wet weather conditions. Flow depths for the estimated peak wet weather flow in each segment are below the half-full pipe full condition; each segment therefore contains significant additional capacity beyond the projected peak wet weather flow at full buildout. Since the City of Georgetown has complied an *Infoworks ICM* model calibrated specifically to the system, the flow estimates generated by the model were used for the hydraulic flow calculations.

Based on the flow calculations, the proposed interceptor was sized as a 36-inch pipe for the bottom 2,650 linear feet of interceptor and as 30-inch pipe for the remainder of the line. The project also contains two short connecting segments of pipe at the extreme upper end of the project. These lines (15-inch and 27-inch) were sized to match the existing pipes (which currently discharge to the Sun City lift station) to which they are connecting. Finally, a short segment of 8-inch wastewater line is also included in the project. This line will serve about twenty homes off of Saint Andrews Drive.

The minimum grade for the Interceptor is 0.10 percent for the end of the 36" PVC pipe (Manhole 1) and the maximum slope for each pipe size varies with the diameter of the line being considered.

4.2 Manholes

The majority of the project alignment lies within the 100-year floodplain. All proposed manholes will be bolted and gasketed. Manhole vents will be extended to an elevation above the 100-year floodplain and augmented with an entry check valve to prevent water entry in the event a rainfall event significantly exceeding a 100-year event occurs. Specific check valve elevations for each individual vent were specified on the vent detail.

Both pre-cast and cast-in-place concrete manholes will be used for the project. Specifications and construction drawings, showing the method of sealing the joints, is provided along with this report.

4.3 Corrosion Potential and Odor Control

PVC pipe conforming with ASTM D3034 and ASTM F679 or equivalent fiberglass pipe manufactured under ASTM D3262 will be used for this interceptor. Neither PVC nor fiberglass material is subject to corrosion by sulfuric acid which may form on the walls if hydrogen sulfide is produced by the interceptor. All manhole interiors will be coated with 80 mils of Raven 405 to protect concrete and grout from corrosion.

Air intake vents (at manholes) have been specified at a maximum spacing of 1,500 feet, generally every third manhole. The vents will allow oxygenated air to enter the interceptor system and diffuse into the flow stream through the water surface. All proposed pipe segments are anticipated to flow at less than half full, providing meaningful water surface area within the pipe through which to transfer oxygen. In addition, all proposed pipe segments except for 8-inch Line "C", contain a minimum average dry weather flow velocity of 2.8 feet per second, preventing the accumulation of odor-producing solids within the pipe. The slopes on 8-inch Line "C" also exceed the minimum allowable under TAC 217. The line is relatively short and will serve a limited number of homes, as such, residence time in the pipe will be limited, minimizing odor concerns.

5.0 Structural Analysis

5.1 Flexible Pipe Calculations

There are multiple parameters that go into determining the structural integrity of flexible pipe. The first parameter to consider is dead load and live load, which determine the loading (or pressure) exerted on buried pipe. Dead load (or vertical load) is determined using the prism load. This is shown in equation 6.

$$W_c = \gamma D \qquad (6)$$

where W_c = density of the backfill soil (lb/ft^3);
D = Depth of Cover on Pipe (ft);
W_c = load on pipe (lb/ft).

A typical value of 120 psf is used for the density of the backfill soil. In some cases, a load coefficient variable of Cd is used, but based on the ratio of the trench width and the width of the pipe, the value was assumed to be 1.

Live load is important for shallow pipe installations. It is determined based on the depth of pipe and the type of moving vehicle weight across the surface. In this case, trucks and cars will contribute to the live load. For PVC, which is used in this project, standard H-20 live load values were used.

Another important parameter for structural integrity is allowable buckling pressure. Pipe buckling is a localized failure of the pipe wall structure which results from insufficient pipe stiffness for an application. There are two types of buckling pressure, unconfined and confined.

Unconfined buckling pressure is determined by equation 7.

$$P_{cr} = \frac{0.447PS}{(1-v^2)} \quad (7)$$

Where: P_{cr} = Unconfined buckling pressure (lb/in^2)
PS = Pipe stiffness (lb/in^2)
V = Poisson's Ratio (0.38, for PVC/Fiberglass)

There are two different pipe stiffness (PS) values considered for this design – 72 and 115. Unconfined buckling pressure for this application is calculated as 37.6 lb/in^2 for 72 PS pipe and 60.1 lb/in^2 for 115 PS pipe.

The maximum grouting pressure applies a factor of safety (FS) to the unconfined buckling pressure. A FS of 2 was used and the maximum grouting pressure was determined as 18.8 lb/in^2 for 72 PS pipe and 30.1 lb/in^2 for 115 PS pipe.

Confined buckling pressure accounts for soil pressure and adds a Modulus of Soil Reaction (E') as a factor to the unconfined buckling pressure, shown in Equation 8. The soil modulus was calculated based on bedding material of coarse-grain soils with moderate compaction using the table "Soil Reaction for Buried Flexible Pipe" by Amster K. Howard, U.S. Bureau of Reclamation, Denver, CO. The soil modulus based on these parameters was determined to be 2,000 psi.

$$P_b = 1.15\sqrt{P_{cr} * E'} \quad (8)$$

Where: P_b = Confined buckling pressure (lb/in^2)
E' = Soil Modulus (lb/in^2)

For the two different pipe stiffnesses the confined buckling pressure was found to be 315.4 psi for 72 PS pipe and 398.7 psi for 115 PS pipe.

This confined buckling pressure can be used to find the maximum height cover based on the formula:

$$H = 144\frac{P_b}{\gamma} \quad (9)$$

Where: H = Height over cover
ɣ = Soil Unity Weight (psf)

The maximum height of cover for both 72 and 115 PS pipe is 378.4 and 478.4 ft, respectively. The design depth is significantly less than this maximum height, so the design depth for buckling is okay.

Another important parameter is the trench width, which is 12" plus the pipe outside diameter. This is determined by the standard detail and specifications for this project.

5.2 Pipe Deflection Calculations

The pipe materials proposed for construction of the interceptor is flexible. Per TCEQ regulations, a maximum of 5% pipe deflection is allowed over the Edwards Aquifer Recharge Zone. Pipe deflection calculations were performed to determine the maximum deflection expected at various depths of cover. Deflection was calculated according to the following formula:

$$\Delta x = \frac{D_e K W_c}{0.149 PS + 0.061 E'} \quad (10)$$

where Δx = deflection in pipe (in);
D_e = deflection lag factor;
K = bedding constant;
W_c = vertical load (lb/in);
PS = pipe stiffness; and
E' = modulus of soil reaction.

The deflection lag factor is assumed to be 1.0. The bedding constant is 0.083 based on a bedding angle of 180 degrees. (bedding will actually be extended above the top of the pipe). The minimum pipe stiffness will be 72 psi (regardless of whether PVC or fiberglass is used) and the modulus of soil reaction is 2,000 was used although crushed stone bedding will likely be used, allowing a soil modulus of up to 3,000 psi. specified.

The vertical load on the pipe is computed using Equation 6, shown in Section 5.1.

Pipe deflection calculations were performed for one foot less than the minimum cover and for one foot more than the maximum cover for each pipe diameter proposed based on the plans provided. The results of the calculations are shown in Exhibit 3. None of the calculated pipe deflections is more than two percent.

Long-term deflection is represented in table 6 of the "Deflection: The Pipe/Soil Mechanism" technical report by Uni-Bell.[1] This table shows that for the bedding material, degree of compaction, and depth of cover for this project the maximum deflection achievable would be 4.3%. The long-term deflection is less than 5% and okay for this application.

5.3 Pipe Crushing Calculations

Pipe crushing is the physical crushing of a pipe wall under load. Crushing rarely governs pipe installations as deflection is far more common. Pipe crushing calculations were performed to determine the maximum stress on the pipe wall for the shallowest and deepest pipe installations. Note that a few locations have a shallower depth than is indicated on the table, however, the pipe will be inside a stall sleeve in these areas and will therefore not be exposed to external stress. The results of the calculations are shown in Exhibit 4. Deflection was calculated according to the following formula:

[1] Uni-Bell PVC Pipe Association. "Deflection: The Pipe/Soil Mechanism". Uni-Bell Technical Report. https://www.uni-bell.org/portals/0/ResourceFile/deflectionnew.pdf

$$Sc = T / A \quad (11)$$

where T = Wall Thrust (lb/in)
A = Area of Pipe Wall (sq.in/in)
Sc = Compressive Stress (psi)

and $$T = Py \times Do / 2 \quad (12)$$

where Py = $Wc = \gamma D$ (psi)
Do = Outside Diameter of Pipe (in)

5.4 Pipe Strain Calculations

Strain on a buried pipe is used to determine the long-term capabilities of the pipe material. Total strain on the pipe is caused by two actions: (1) flexure of the pipe as it deforms and (2) hoop stress in the pipe wall. Hoop strain is determined from Equation 13.

$$\varepsilon_h = \frac{PD}{2tE} \quad (13)$$

where ε_h = maximum strain in the pipe wall due to hoop stress (in/in)
P= Pressure on the pipe (psi)
E = Modulus of elasticity of pipe material (psi) = 400,000 psi
t = Pipe wall thickness (in)
D = Pipe diameter (in)

Flexure stain is determined by Equation 14.

$$\varepsilon_f = \frac{t}{D}\left[\frac{3\Delta Y/D}{1-2\Delta Y/D}\right] = \frac{1}{DR}\left[\frac{3\Delta Y}{D-2\Delta Y}\right] \quad (14)$$

where ε_f = maximum strain in the pipe wall due to hoop stress (in/in)
ΔY = Vertical decrease in diameter [Deflection] (in)
t = Pipe wall thickness (in)
DR = Dimension ratio
D = Pipe diameter (in)

The total strain in the sum of both the hoop strain and the flexure strain. The results of the strain calculations are shown in Exhibit 5. The maximum strains are between 0.03% and 0.09%, which is small and below excessive failure strains of 5%.

Exhibit 3

BERRY CREEK WASTEWATER INTERCEPTOR
PIPE DEFLECTION CALCULATIONS

Pipe Diameter (In)	Pipe Stiffness (psi)	Depth of Cover (ft)	Dead Load @120 pcf (psi)	H-20 Live Load (psi)	Total Pressure Py (psi)	Soil Modulus (psi) (1)	Deflection Lag Factor	Bedding Constant	Total Wall Crushing Stress (lb/sq.in)	Calculated Deflection (%)	Pipe Wall Strength Status
8" SDR 26 D3034 PVC (PS115)											
8	115	4	3.33	2.78	6.1	2000	1.0	0.1	0.0	0.44	OK
8	115	18	15.00	0.00	15.0	2000	1.0	0.1	0.0	1.08	OK
15" SDR 26 D3034 PVC (PS115)											
15	115	14	11.67	0.00	11.7	2000	1.0	0.1	0.0	0.84	OK
15	115	17	14.17	0.00	14.2	2000	1.0	0.1	0.0	1.02	OK
27" F679 PVC (PS72)											
27	72	10	8.33	0.00	8.3	2000	1.0	0.1	0.0	0.63	OK
27	72	13	10.83	0.00	10.8	2000	1.0	0.1	0.0	0.82	OK
30" F679 PVC (PS72)											
30	72	4	3.33	2.78	6.1	2000	1.0	0.1	0.0	0.46	OK
30	72	24	20.00	0.78	20.8	2000	1.0	0.1	0.0	1.57	OK
36" F679 PVC (PS72)											
36	72	5	4.17	1.74	5.9	2000	1.0	0.1	0.0	0.45	OK
36	72	19	15.83	0.00	15.8	2000	1.0	0.1	0.0	1.19	OK

(1) Installed soil modulus will be 3000 psi (crushed stone); 2000 psi was used as a conservative value

Exhibit 4

BERRY CREEK WASTEWATER INTERCEPTOR
PIPE WALL CRUSHING CALCULATIONS

Pipe Diameter (In)	Pipe Class	Pipe Outside Diameter (In)	Pipe Wall Thickness (In)	Depth of Cover (ft)	Dead Load @120 pcf (psi)	H-20 Live Load (psi)	Total Pressure Py (psi)	Total Wall Thrust T (lb/in)	Total Wall Crushing Stress (lb/sq.in)	Allowable PVC Wall Crushing Stress (psi)	Pipe Wall Strength Status
8" SDR 26 D3034 PVC (PS115)											
8	PS 115	8.4	0.32	4	3.33	2.78	6.1	25.7	80.2	2900	OK
8	PS 115	8.4	0.32	18	15.00	0.00	15.0	63.0	196.9	2900	OK
15" SDR 26 D3034 PVC (PS115)											
15	PS 115	15.3	0.59	14	11.67	0.00	11.7	89.3	151.3	2900	OK
15	PS 115	15.3	0.59	17	14.17	0.00	14.2	108.4	183.7	2900	OK
27" F679 PVC (PS72)											
27	PS 72	28.0	0.84	10	8.33	0.00	8.3	116.7	138.9	2900	OK
27	PS 72	28.0	0.84	13	10.83	0.00	10.8	151.7	180.6	2900	OK
30" F679 PVC (PS72)											
30	PS 72	32.0	0.96	4	3.33	2.78	6.1	97.8	101.9	2900	OK
30	PS 72	32.0	0.96	24	20.00	0.78	20.8	332.5	346.3	2900	OK
36" F679 PVC (PS72)											
36	PS 72	38.3	1.15	5	4.17	1.74	5.9	113.1	98.4	2900	OK
36	PS 72	38.3	1.15	19	15.83	0.00	15.8	303.2	263.7	2900	OK

EXHIBIT 5

BERRY CREEK WASTEWATER INTERCEPTOR
PIPE STRAIN CALCULATIONS

Pipe Diameter (in)	Pressure on Pipe (psi)	Modulus of Elasticity (psi)	Pipe Wall Thickness (in)	Vertical Decrease in diameter (in)	Dimension Ratio	Hoop Strain (in/in)	Flexure Strain (in/in)	Maximum Total Strain (in/in)
8" SDR 26 D3034 PVC (PS115)								
8	6.11	400,000	0.32	0.004	26	0.0002	0.00	0.0003
8	15.00	400,000	0.32	0.011	26	0.0005	0.00	0.0006
15" SDR 26 D3034 PVC (PS115)								
15	11.67	400,000	0.59	0.008	26	0.0004	0.00	0.0004
15	14.17	400,000	0.59	0.010	26	0.0005	0.00	0.0005
27" F679 PVC (PS72)								
27	8.33	400,000	0.84	0.006	N/A	0.0003	0.00	0.0004
27	10.83	400,000	0.84	0.008	N/A	0.0004	0.00	0.0005
30" F679 PVC (PS72)								
30	6.11	400,000	0.96	0.005	N/A	0.0002	0.00	0.0003
30	20.78	400,000	0.96	0.016	N/A	0.0008	0.00	0.0009
36" F679 PVC (PS72)								
36	5.91	400,000	1.15	0.004	N/A	0.0002	0.00	0.0002
36	15.83	400,000	1.15	0.012	N/A	0.0006	0.00	0.0007

5.5 Road and Creek Bores

The project contains multiple road and creek crossings. Each of these will be installed in a drilled bore advanced for an excavated pit on either side of the bore section. The vast majority of bore sections will occur on rock and it is anticipated that the bore holes should be dimensionally stable in the short term. Most bores will be cased in a steel encasement pipe one foot larger in diameter than the carrier pipe. Steel casing will have one-half inch thick walls. Prior to the installation of the encasement pipe, the annular space outside of the encasement will be completed grouted. The carrier pipe will be supported on casing spacers installed at an interval of ten feet or at a spacing which will prevent deflection of the carrier pipe, whichever is less. Some shorter bores (such as one under a tee box at Station 28+00) may be installed without casing. In this case, the annular space on the exterior of the carrier pipe will be grouted.

6.0 Lift Station and Wastewater Treatment Plant Capacity

As detailed in Section 1.0, all improvements proposed are consistent with the *Georgetown Utility Systems 2018 Water Services Master Plan (Water & Wastewater)*. The *Master Plan* details sequential improvements to wastewater collection, transfer and treatment facilities necessary to meet Georgetown's anticipated growth over the next several decades. The flow in the proposed interceptor will discharge to the Berry Creek Lift Station on an interim basis. This interim condition provides peak flow relief to the Sun City Lift Station and flow main system. Under this interim condition, peak flows in excess of the Sun City Lift Station capacity will be treated at the Berry Creek Wastewater Treatment Plant. The lift station contains three pumps rated at 0.5 MGD each. The treatment plant has a capacity of 0.5 MGD Average and 1.5 MGD Peak. All flows from the Sun City Lift Station are currently treated at the Pecan Branch WWTP.

For this permit, only the upstream section of the Berry Creek Wastewater Interceptor will be constructed between the Sun City Lift Station and Shell Road. The rest of the interceptor down to Airport Road is already under construction. No flows will be carried through the line until both phases of the interceptor have been constructed.

Longer term, the Berry Creek Interceptor will be extended an additional four miles to the southeast to the Pecan Branch Wastewater Treatment Plant and most flow from the Berry Creek interceptor to the Berry Creek WWTP will be discontinued. Pecan Branch WWTP is currently undergoing expansion and is planned for an expansion every permit cycle as system flows warrant. The current expansion will increase capacity to 1.7 MGD Average and 5.3 MGD Peak. The next phase of improvements (anticipated to commence design in 2019) will further expand the plant capacity to 3.0 MGD Average and 9.0 MGD Peak.

Inflow and infiltration flow hydraulic effects have been factored into the proposed and existing systems. The inflow and infiltration has been monitored by flow meters and the parameters from the flow monitoring are factored into the flow calculations used to size the interceptor and evaluate the capacity of the Sun City Lift Station.

The Berry Creek WWTP has capacity to accept flows from the interceptor on an interim basis until downstream improvements are completed which will convey flow to Pecan Branch WWTP. Additional details on both the interim and planned long-term capacity of the interceptor and downstream infrastructure is available in the *Georgetown Utility Systems 2018 Water Services Master Plan (Water & Wastewater)* (See Section 6 of *Master Plan)* included with the permit submittal.

7.0 Safety Considerations

Testing will be conducted in accordance with all City of Georgetown and TCEQ requirements. The *TCEQ Organization Sewage Collection System General Construction Notes* are included on the design drawings. Because the proposed interceptor is being installed to relieve an existing lift station, the entire project can be installed, tested and placed into operation prior to the permanent diversion of flow into the new pipes. This approach will allow concerns related to gas buildup in manholes (which must be entered to apply coating) to be minimized. All OSHA safety regulations related to confined space entry will be observed. Excavation safety systems will be utilized for all pipe and manhole installations.

8.0 Testing Requirements and Safety

8.1 Installation of Gravity Collection System Pipes and Manholes

Testing will be conducted in accordance with all City of Georgetown and TCEQ requirements. The *TCEQ Organization Sewage Collection System General Construction Notes* are included on the design drawings. All improvements will be certified to be in compliance with Chapter 217 prior to being placed into service. Project plans and specifications are configured to ensure that the pipe installation will adhere to minimum separation distances specified in 30 TAC §217. All crossing of potable water lines occur at a near perpendicular configuration with the wastewater line being lower than the water line. A joint of pressure pipe will be centered below the water line where required by Chapter 217.

The language in the plans or specifications shall ensure the separation distance between any unknown water line which are discovered during the installation phase of the project and the gravity sewer pipe which will be installed. All known potable water line crossings are shown on the drawings and a least two feet of vertical separation is provided.

8.2 Occupational Safety, Public Health and Environmental Protection

Trench protection will be provided for all trenches equal or greater than five (5) feet deep. The Contractor will be required to provide a Trench Safety System Plan designed by a Texas Licensed Professional Engineer that conforms with local, state and OSHA Standards. Regular inspections of the pipe installation will take place during construction and the contractor will be instructed to correct any deviations from the approved trench safety plan or correct any unsafe conditions discovered prior to resuming work.

Because the proposed interceptor is being installed to relieve an existing lift station, the entire project can be installed, tested and placed into operation prior to the permanent diversion of flow into the new pipes. This approach will allow concerns related to gas buildup in manholes (which must be entered to apply coating) to be minimized. All OSHA safety regulations related to confined space entry will be observed.

8.3 Environmental Safety

All improvements will be protected by temporary erosion control measures installed and maintained along the project alignment. The drawings indicate the location and type of each proposed temporary control and provide details for the installation and maintenance of such controls. Temporary controls will be maintained until the area served by the controls has been revegetated. The specifications require the treatment of sediment laden groundwater prior to release. The contractor will also be required to file a detailed TPDES plan prior to commencing construction.

9.0 Proposed Code Exceptions

All improvements will be installed in compliance with Chapter 217 with the exception that one waiver is proposed. TAC Chapter 213.5(c)(3)(H) requires a justification for the placement of a wastewater line within the 5-year floodplain and also requires concrete encasement and/or capping for higher velocity areas. The project alignment selected generally parallels Berry Creek for most of the project extents. This alignment was selected to allow the interceptor to serve properties within the drainage basin which lie on both sides of the creek. Placing the interceptor low enough to service both sides of the creek by gravity but outside of the 5-year floodplain would require a prohibitively deep excavation or a lengthy tunnel, rendering the project economically inviable. In addition, the presence of existing platted property along several sections of the interceptor significantly constrained alignment options.

Exhibit 5 attached represents a summary table for the recently updated HEC-RAS hydraulic model of Berry Creek. With the exception of crossings (which will be cased in steel pipe), the alignment lies in floodplain overbank areas. The model results show 100-year flow velocities in the two to five feet-per-second range, below the six feet-per-second threshold generally considered an erosion concern. In addition, the vast majority of the proposed line has a minimum of eight feet of cover and over fifty percent of the line within the floodplain has a least fourteen feet of cover. Given the depth of cover, local geology (erosion resistant rock) and the low overbank flow velocities, concerns regarding exposure of the interceptor due to long-term erosion are minimal. An exception is therefore requested to install the proposed pipe within the five-year floodplain without encasement. The drawings and bid quantities will include provisions for the installation of up to 2,500 linear feet of six-inch thick concrete trench cap to be installed in the event erosion susceptible areas are encountered during construction.

EXHIBIT 5

BERRY CREEK WASTEWATER INTERCEPTOR
OVERBANK VELOCITIES FROM HEC-RAS MODEL PREPARED BY DUNCET AND CHAN

HEC-RAS Creek Cross Section	Approximate Interceptor Station	Flood Event	Left Overbank Velocity (ft/s)	Channel Velocity (ft/s)	Right Overbank Velocity (ft/s)
Airport Rd Bridge (26586)	1+00	100 Year	4.3	13.9	3.6
27897	11+11	100 Year	2.4	12.0	1.6
28840	20+11	100 Year	2.9	12.4	1.6
Champions Drive Bridge (29117)	21+25	100 Year	3.4	13.9	2.5
Oak Tree Drive Bridge (29483)	26+55	100 Year	3.4	13.0	3.4
30713	37+25	100 Year	2.1	13.7	2.8
31657	44+00	100 Year	4.8	18.5	4.7
32604	58+00	100 Year	3.0	12.8	3.5
33544	67+00	100 Year	3.3	13.9	2.3
34491	75+00	100 Year	3.1	14.0	2.6
Shell Road Bridge (35102)	81+80	100 Year	3.2	16.0	4.9
35429	85+25	100 Year	2.2	10.3	3.1
36857	99+00	100 Year	3.9	12.9	3.4
37773	106+50	100 Year	2.0	7.1	2.0
38734	117+50	100 Year	2.2	13.4	2.9
39686	126+50	100 Year	3.1	15.0	3.5
40655	133+50	100 Year	2.8	14.6	2.7
41572	142+25	100 Year	3.9	12.9	2.8
Stetson Trail (43012)	156+00	100 Year	4.0	13.3	2.1

EXHIBIT 5

BERRY CREEK WASTEWATER INTERCEPTOR
OVERBANK VELOCITIES FROM HEC-RAS MODEL PREPARED BY DUNCET AND CHAN

HEC-RAS Creek Cross Section	Approximate Interceptor Station	Flood Event	Left Overbank Velocity (ft/s)	Channel Velocity (ft/s)	Right Overbank Velocity (ft/s)
Airport Rd Bridge (26586)	1+00	5 Year	2.1	8.7	1.7
27897	11+11	5 Year	1.2	7.5	0.6
28840	20+11	5 Year	1.3	8.8	0.8
Champions Drive Bridge (29117)	21+25	5 Year	2.1	10.2	0.9
Oak Tree Drive Bridge (29483)	26+55	5 Year	2.1	11.4	2.4
30713	37+25	5 Year	1.1	9.7	1.4
31657	44+00	5 Year	2.6	13.3	2.8
32604	58+00	5 Year	2.6	11.0	2.2
33544	67+00	5 Year	1.6	11.8	1.6
34491	75+00	5 Year	1.5	8.3	1.1
Shell Road Bridge (35102)	81+80	5 Year	1.8	10.0	2.5
35429	85+25	5 Year	1.6	8.4	1.9
36857	99+00	5 Year	2.7	9.4	2.1
37773	106+50	5 Year	1.3	6.0	1.2
38734	117+50	5 Year	0.9	7.6	1.5
39686	126+50	5 Year	1.5	9.5	2.1
40655	133+50	5 Year	1.3	8.5	1.7
41572	142+25	5 Year	2.4	9.7	2.0
Stetson Trail (43012)	156+00	5 Year	2.3	8.3	1.5

Project No.: 3-00582
Project: Berry Creek WW Interceptor
Calc. Desc.: Gravity Design Flow

Date: 5/30/2023
Released by: E. Nelson

Design Flow: 7.3 mgd

Criteria *[source]*:
1) Peak WWF (design flow) is not to exceed 80% of the capacity of the pipe flowing full *[2014 WWMP]*
2) Minimum slope to maintain a velocity greater than 2 fps when flowing full *[TCEQ]*
3) Maximum slope to maintain a velocity less than 10 fps when flowing full *[TCEQ]*
4) Minimum acceptable Manning's n of 0.013 *[TCEQ]*

30" HOBAS PROPOSED	Full Pipe Flow - Min. Velocity	Full Pipe Flow - Min. Slope	Full Pipe Flow - Max. Velocity	Partial Pipe Flow - Min. Slope	Partial Pipe Flow - Min. Slope	Critical Depth
Nominal Diameter (in) =	30	30	30	30	30	30
Average Outside Diameter, D (in) =	32	32	32	32	32	32
Min. Wall Thickness, t (in) =	0.69	0.69	0.69	0.69	0.69	0.69
Inside Diameter, D (in) =	30.62	30.62	30.62	30.62	30.62	30.62
Inside Diameter, D (ft) =	2.55	2.55	2.55	2.55	2.55	2.55
Manning's n =	0.013	0.013	0.013	0.013	0.013	0.013
Slope (ft/ft) =	0.056%	2.501%	1.394%	2.501%	2.501%	2.501%
g (fps^2)=	32.2	32.2	32.2	32.2	32.2	32.2
Depth, y (ft) =	2.55	2.55	2.55	0.50	0.70	1.12
Central Angle, θ = 2 arccos (1-2y/D) =	6.28	6.28	6.28	1.83	2.21	2.89
Area, A (sqft) = D^2 (θ - sin θ)/8 =	5.11	5.11	5.11	0.70	1.14	2.16
Wetted Perimeter, P (ft) = θ D/2 =	8.02	8.02	8.02	2.34	2.81	3.69
Hydraulic Radius, R (ft) = A/P =	0.64	0.64	0.64	0.30	0.41	0.58
Top Width, B (ft) = D sin (θ/2) =	0.00	0.00	0.00	2.02	2.28	2.53
Hydraulic Depth (ft) = A/B =				0.35	0.50	0.85
Q (mgd) =	6.61	44.28	33.06	3.70	7.30	7.30
Q (cfs) =	10.23	68.51	51.14	5.72	11.29	11.29
Max Flow (mgd) = 80% Q =	5.29	35.43	26.44			
v (fps) =	2.00	13.40	10.00	8.13	9.90	5.24
Is 2 ≤ v ≤ 10 ?				yes	yes	
$Fr^2 = TQ^2/gA^3$ =				5.89	6.08	1.00

*Solve for value in green box by adjusting variable in orange box.

Project No.: 3-00582
Project: Berry Creek WW Interceptor
Calc. Desc.: Gravity Design Flow

Date: 5/30/2023
Released by: E. Nelson

Design Flow: 7.3 mgd

Criteria *[source]*:
1) Peak WWF (design flow) is not to exceed 80% of the capacity of the pipe flowing full *[2014 WWMP]*
2) Minimum slope to maintain a velocity greater than 2 fps when flowing full *[TCEQ]*
3) Maximum slope to maintain a velocity less than 10 fps when flowing full *[TCEQ]*
4) Minimum acceptable Manning's n of 0.013 *[TCEQ]*

30" PVC PROPOSED	Full Pipe Flow - Min. Velocity	Full Pipe Flow - Min. Slope	Full Pipe Flow - Max. Velocity	Partial Pipe Flow - Min. Slope	Partial Pipe Flow - Min. Slope	Critical Depth
Nominal Diameter (in) =	30	30	30	30	30	30
Average Outside Diameter, D (in) =	32	32	32	32	32	32
Min. Wall Thickness, t (in) =	1	1	1	1	1	1
Inside Diameter, D (in) =	30	30	30	30	30	30
Inside Diameter, D (ft) =	2.50	2.50	2.50	2.50	2.50	2.50
Manning's n =	0.013	0.013	0.013	0.013	0.013	0.013
Slope (ft/ft) =	0.057%	2.501%	1.432%	2.501%	2.501%	2.501%
g (fps^2)=	32.2	32.2	32.2	32.2	32.2	32.2
Depth, y (ft) =	2.50	2.50	2.50	0.50	0.71	0.79
Central Angle, θ = 2 arccos (1-2y/D) =	6.28	6.28	6.28	1.86	2.24	2.39
Area, A (sqft) = D^2 (θ - sin θ)/8 =	4.91	4.91	4.91	0.70	1.14	1.33
Wetted Perimeter, P (ft) = θ D/2 =	7.85	7.85	7.85	2.32	2.80	2.99
Hydraulic Radius, R (ft) = A/P =	0.63	0.63	0.63	0.30	0.41	0.45
Top Width, B (ft) = D sin (θ/2) =	0.00	0.00	0.00	2.00	2.25	2.33
Hydraulic Depth (ft) = A/B =				0.35	0.51	0.57
Q (mgd) =	6.35	41.93	31.73	3.70	7.30	3.70
Q (cfs) =	9.82	64.87	49.09	5.72	11.29	5.72
Max Flow (mgd) = 80% Q =	5.08	33.55	25.38			
v (fps) =	2.00	13.22	10.00	8.15	9.92	4.30
Is 2 ≤ v ≤ 10 ?				yes	yes	
$Fr^2 = TQ^2/gA^3$ =				5.87	6.04	1.00

*Solve for value in green box by adjusting variable in orange box.

HOBAS Pipe Design Analysis
3-00582 Berry Creek WW Interceptor Project
Georgetown , TX

		Line A Stations	3+63	3+63
Pipe Properties	**Abbrev.**	**Formula**	**30" (Cover=18', Quaternary Terrace and Alluvial Deposits)**	**30" (Cover=18', Limestone)**
Nominal Pipe Diameter (in.)	Dn		30	30
Outer Pipe Diameter (in.)	OD		32	32
Outer Diameter of Coupling (in.)	OD2		33.9	33.9
Min. Pipe Stiffness (psi)	PS		72	72
Min. Total Wall Thickness (in.)	Tt		0.7	0.7
Min. Liner Thickness (in.)	Tl		0.04	0.04
Ult. Comp Strength (psi)	Sac		10500	10500
Hoop Flexural Modulus of Pipe (psi)	Ehf		1900000	1900000
Soil Weight (lbs/ft^3)	Ws		130	130
Max Depth of Burial for Section (ft.)	Hs		15	15
Max Depth of Burial for Section (in.)	Hs		180	180
Water Weight (lbs/ft^3)	Ww		62.4	62.4
Depth of Water Table Above Pipe (ft)	Hw	Worst Case Scenario = At-Grade	15	15
Multiple Presence Factor	Mp		1.2	1.2
Live Load Distribution Factor	LLDF	1.15 if Class I or II	1.15	1.15
Length of Tire Footprint (ft)	tl		10	10
Width of Tire Footprint (ft)	tw		20	20
Parallel Load	L1	$tl + LLDF * h$	217	217
Depth at Which Wheel Loads Interact	hint	$\frac{72 - tw}{LLDF}$ $when\ Hs > hint\ \ \frac{tw + 72 + LLDF * h}{2}$ $when\ Hs \leq hint\ \ tw + LLDF * h$	45.22	45.22
Perpendicular Load	L2		149.50	149.50
Impact Factor	If	$1 + 0.33(\frac{96 - h}{96}) \geq 1.0$	1	1
Wheel Load (lbs)	P	AASHTO HS-20	16000	16000
Live Load (psi)	Ll	$\frac{Mp * P * If}{L1 * L2}$	0.59	0.59
Embedment Material		Compaction: SPD 95	CRUSHED ROCK (CLASS I)	CRUSHED ROCK (CLASS I)
Composite Constrained Soil Modulus (psi)	Ms	Sc X Msb	7095	6128
Native Soil Constrained Modulus (psi)	Msn	M45 Table 5-6	1500	50000
Embedment Material Constrained Modulus (psi)	Msb	M45 Table 5-4	3225	3225
Trench Width @ Pipe Springline (in)	Bd	HOBAS Figure 11 (Min. 8" clearance)	50	50
AWWA M45 Table 5-5		$\frac{Bd}{OD}$	1.6	1.6
AWWA M45 Table 5-5		$\frac{Msn}{Msb}$	0.47	15.50
Soil Support Combining Factor	Sc	AWWA M45 Table 5-5	2.2	1.9
Bedding Coefficient	Kx	Open Trench= 0.1	0.1	0.1
Pipe Shape Factor	Df	AWWA M45 Table 5-1	3.8	3.8
Deflection lag factor	Dl		1	1
Max Recommended Deflection (%)			5%	5%
Min Wall Crushing Safety Factor			5	5
Min Ring Bending Strain Safety Factor			1.5	1.5
Min Pushing Capacity Safety Factor			3	3
Min Constrained Buckling Safety Factor			2.5	2.5

Mean Diameter	Dm	$OD - Tstr$	31.34	31.34
Mean Radius	Rm	$\frac{Dm}{2}$	15.67	15.67
Total Wall Thickness	Tt		0.7	0.7
Liner Thickness	Tl		0.04	0.04
Structural Wall Thickness	Tstr	$Tt - Tl$	0.66	0.66
Nominal Interior Diameter	ID		30.64	30.64
Hoop Flexural Modulus of Pipe (psi)	Ehf		1900000	1900000
Structural Thickness	Tstr		0.66	0.66
Mean Radius	Rm		15.67	15.67
Pipe Stiffness (psi)	**PS**	$\frac{Ehf * Tstr^3}{0.149 * (1.025 * Rm)^3 * 12}$	**74**	**74**
Soil Weight	Ws		130	130
Water Weight	Ww		62.4	62.4
Soil Cover Height	Hs		15	15
Water Table Height	Hw		15	15
Soil Load	Ls	$\frac{Ws * Hs}{144}$	13.54	13.54
Water Load	Lw	$\frac{Ww * Hw}{144}$	6.50	6.50
Live Load	Ll		0.59	0.59
Water Buoyancy Factor	Rw	$1 - \frac{0.33 * Hw}{Hs}$	0.67	0.67
Total Load (psi)	**Qt**	$Ls * Rw + Lw + Ll$	**16.16**	**16.16**
Compressive Strength	Sac		10500	10500
Structural Thickness	Tstr		0.66	0.66
Outside Diameter	OD		32	32
Total Load	Tl		16.16	16.16
Capacity	C	$Sac * Tstr$	6930	6930
Load	L	$\frac{OD}{2} * Ltot$	258.64	258.64
Wall Crushing, safety factor		$\frac{C}{L}$	**26.79**	**26.79**
Check			**Acceptable**	**Acceptable**
Deflection Lag Factor	Dl		1	1
Bedding Coefficient	Kx		0.1	0.1
Minimum Pipe Stiffness	PS		73.73	73.73
Soil Cover Height	Hs		15	15
Soil Weight	Ws		130	130
Soil Load	Ls	$\frac{Ws * Hs}{144}$	13.54	13.54
Live Load	Ll		0.59	0.59
Composite Constrained Soil Modulus	Ms		7095	6127.5
Deflection	**Δ**	$Kx * \frac{Dl * Ls + Ll}{0.149 * PS + 0.061 * Ms}$	**0.32%**	**0.37%**
Check			**Acceptable**	**Acceptable**
Pipe Shape Factor	Df		3.8	3.8
Total Thickness	Tt		0.7	0.7
Mean Diameter	Dm		31.34	31.34
Calculated Deflection	Δ		0.0032	0.0037
Bending Strain	**eb**	$Df * \Delta * \frac{Tt}{Dm}$	**0.03%**	**0.03%**
Check			**Acceptable**	**Acceptable**

Pipe Shape Factor	Df		3.8	3.8
Total Thickness	Tt		0.7	0.7
Mean Diameter	Dm		31.34	31.34
Max Recommended Deflection	Δ		0.05	0.05
Bending Strain	**eb**	$Df * \Delta * \frac{Tt}{Dm}$	**0.42%**	**0.42%**
Check			**Acceptable**	**Acceptable**
Composite Constrained Soil Modulus	Ms		7095	6127.5
Min Pipe Stiffness	PS		72.00	72.00
Mean Diameter	Dm		62.4	62.4
Soil Cover Height	Hs		15	15
	Rh	$\frac{11.4}{11 + (\frac{Dm}{Hs * 12})}$	1.005	1.005
Critical Buckling	Qcr	$0.267 * PS^{0.33} * Ms^{0.67} * Rh$	418.41	379.27
Total Buckling	Qt	$Rw * Ls + Lw + Ll$	16.16	16.16
Constrained Buckling, safety factor		$\frac{Qcr}{Qt}$	**25.88**	**23.46**
Check			**Acceptable**	**Acceptable**

TCEQ Exfiltration Test Pressure					
Pressure Class	PN	psi		25	25
Pressure Class	PN	feet of water		57.75	57.75
Hydrostatic Head Test	Htest	2' plus groundwater elevation		17	17
Check		**PN > Htest**	**Acceptable**	**Acceptable**	

TCEQ-10243 (10/01/04)						
PVC Pipe						
	Station		**3+63.00**	**3+63.00**		
Live Load Determination						
						Reference
						Plans
$L_i = \frac{PI_f}{144L_1L_2}$	**Size**		**30-inch**	**30-inch**		Plans
	Soil		**Quaternary Terrace and Alluvial Deposits**	**Rock**		Geologic Assessment
Li = live load (psi)	Li	=	0.37	0.37	psi	AWWA M23 PVC Pipe
P = HS-20 wheel load (16,000 lbs)	P	=	16,000.00	16,000.00	lbs	AWWA M23 PVC Pipe
If = impact factor (1.1 for 2 ft < H < 3 ft, or 1.0 for H≥ 3 ft)	If	=	1.00	1.00		AWWA M23 PVC Pipe
$L_1 = 0.83+1.75H$						
L1 = load width parallel to direction of travel (ft)	L1	=	32.33	32.33	feet	Calculated
t1 = length of tire footprint (HS20 = 10 inches or 0.83 feet)	t1	=	0.83	0.83	feet	AWWA M23 PVC Pipe
H = the height of ground surface above the top of pipe (ft)	H	=	18.00	18.00	feet	Maximum from Plans
$L_2 = 1.67+1.75H$, where 2 '< H < 2.48'						
$L_2 = (43.67+1.75H)/8$, where H >= 2.48'						
L2 = load width perpendicular to direction of travel (ft)	L2	=	9.40	9.40	feet	Calculated
t2 = width of tire footprint (HS20 = 20 inches or 1.67 feet)	t2	=	1.67	1.67	feet	AWWA M23 PVC Pipe
Allowable Buckling Pressure Determinations						
Qa = allowable buckling pressure (psi)	Qa	=	80.13	80.13	psi	TCEQ-10243 Equation 1
$Q_a = 0.4\sqrt{(32R_w)(B')(E_b)\left(\frac{EI}{D^3}\right)}$						
Rw = water buoyancy factor (dimensionless)	Rw	=	0.67	0.67		TCEQ-10243 Equation 2
B' = empirical coefficient of elastic support (dimensionless)	B'	=	0.45	0.45		TCEQ-10243 Equation 3
Eb = modulus of soil reaction, pipe bedding material (psi)	Eb	=	3,000.00	3,000.00	psi	AWWA M23 Table 4-5 (Crushed Stone Per Section G4 = SC1 - Slight to High Compaction) (ASTM D-2321 Type IA)
E = modulus of elasticity of pipe material (psi)	E	=	500,000.00	500,000.00	psi	ASTM F679 PS75 / ASTM D3034 SDR26
I = moment of inertia of the pipe wall cross section (in4/in)	I	=	0.0833	0.0833	in^4 / in	TCEQ-10243 Equation 4
D=mean pipe diameter (in)	D	=	31.00	31.00	inches	ASTM F679 PS75 / ASTM D3034 SDR26
Do=outside pipe diameter (in)	Do	=	32	32	inches	ASTM F679 PS75 / ASTM D3034 SDR26
Rw = water buoyancy factor	Rw	=	0.67	0.67		TCEQ-10243 Equation 2
$R_w = 1 - 0.33\left(\frac{h_w}{h}\right)$						
H = the height of ground surface above the top of pipe (ft)	H	=	18.00	18.00	feet	Maximum from Plans
h = the height of ground surface above the top of pipe (in)	h	=	216.00	216.00	inches	Calculated
Hw= height of water surface above top of pipe (ft)	Hw	=	18.00	18.00	feet	Set Equal to Soil Height to be Conservative
hw= height of water surface above top of pipe (in.)	hw	=	216.00	216.00	inches	Calculated
B' = empirical coefficient of elastic support (dimensionless)	B'	=	0.45	0.45		TCEQ-10243 Equation 3

TCEQ-10243 (10/01/04)						
PVC Pipe						
	Station		**3+63.00**	**3+63.00**		
$B' = \frac{1}{1 + 4e^{(-.065H)}}$						
I = moment of inertia of the pipe wall cross section (in4/in)	I	=	0.0833	0.0833	in^4 / in	TCEQ-10243 Equation 4
$I = \frac{t^3}{12}$						
t = pipe wall thickness (in)	t	=	1.000	1.000	in	ASTM F679 PS75 / ASTM D3034 SDR26
Prism Load Calculations						
Qp = pressure applied to pipe under installed conditions (psi)	Qp	=	19.40	19.40	psi	TCEQ-10243 Equation 5
$Q_p = (\gamma_w)(h_w) + [R_w(W_c/D)] + L_i$						
γw = specific weight of water 0.0361 (pci)	γw	=	0.0361	0.0361	pci	
hw= height of water surface above top of pipe (in.)	hw	=	216.00	216.00	inches	
Rw = water buoyancy factor (dimensionless)	Rw	=	0.67	0.67		TCEQ-10243 Equation 2
Wc = vertical soil load on the pipe per unit length in pounds per linear inch (lb/in)	Wc	=	520.00	520.00	lb/in	TCEQ-10243 Equation 6
D=mean pipe diameter (in)	D	=	31.00	31.00	inches	ASTM F679 PS75 / ASTM D3034 SDR26
Li = live load	Li	=	0.37	0.37	psi	
Wc = vertical soil load on the pipe per unit length in pounds per linear inch (lb/in)	Wc	=	520.00	520.00	lb/in	TCEQ-10243 Equation 6
$Wc = \gamma_s H(D + t)/144$						
γs = specific weight of soil (pcf)	γs	=	130.00	130.00	pcf	Geotechnical Report
** If Qa is greater or equal to Qp, specified pipe is acceptable for the proposed installation.	Qa/Qp	=	4.13	4.13		Calculated

TCEQ-10243 (10/01/04)						
PVC Pipe						
	Station		**3+63.00**	**3+63.00**		
Wall Crushing Calculations						
$H = \frac{24 \times P_c \times A}{\gamma_s \times D_o}$						
H = max depth of burial from ground surface to crown of pipe (ft)	H	=	276.92	276.92	ft	TCEQ-10243 Equation 7
Do=outside pipe diameter (in)	Do	=	32	32	inches	ASTM F679 PS75 / ASTM D3034 SDR26
Pc=compressive stress or hydrostatic design basis (HDB) (psi)	Pc	=	4,000.00	4,000.00	psi	For typical PVC pipe assume 4,000 psi. HDB must be supplied by pipe manufacturer for other materials.
A=surface area of the pipe wall (or unit length x t for solid-wall pipe, in2/ft)	A	=	12.00	12.00	in2/ft	Calculated
γs = specific weight of soil (pcf)	γs	=	130.00	130.00	pcf	Geotechnical Report
24=conversions and coefficients						
Strain Prediction Calculations						
$\varepsilon = \varepsilon_h + \varepsilon_f$						Handbook of PVC Pipe
$\varepsilon_h = \frac{Q_p D}{2tE}$						Handbook of PVC Pipe
$\varepsilon_f = \frac{t}{D}\left[\frac{3\Delta Y/D}{1-2\Delta Y/D}\right]$						Handbook of PVC Pipe
ε = total strain (in/in)	εh	=	0.00060	0.00060		Calculated
εh = strain from hoop stress (in/in)	εf	=	0.00155	0.00093		Calculated
εf = strain from ring deflection (in/in)	ε	=	0.00216	0.00153		Calculated
**Strain is not a performance-limiting factor in this situation.						
Deflection Analysis						
Eb = modulus of soil reaction, pipe bedding material (psi)	Eb	=	3,000.00	3,000.00	psi	AWWA M23 Table 4-5 (Crushed Stone Per Section G4 = SC1 - Slight to High Compaction) (ASTM D-2321 Type IA)
E'n = modulus of soil reaction, in situ material (psi)	E'n	=	1,500.00	50,000.00	psi	AWWA M23 Table 4-7 (Geotechnical Report Data)
Is Eb/E'n greater than 1.25?	Eb/E'n	=	Yes	No		
If Yes, then calculate zeta factor.						
If No, then assume zeta = 1						
$Zeta = 1.44/(f + (1.44 - f)E_b/E'_n$	zeta	=	0.58	1.00		TCEQ-10243 Equation 8

TCEQ-10243 (10/01/04)						
PVC Pipe						
	Station		**3+63.00**	**3+63.00**		
$f = \frac{\left(\frac{b}{D_o}\right) - 1}{(1.154 + (0.444\left(\frac{b}{D_o}\right) - 1)}$						
	f	=	0.40	0.40		TCEQ-10243 Equation 9
	b	=	50.00	50.00	inches	OD + 18-inches
f = the trench width coefficient						
b = trench width (in)						
$P_s = \frac{EI}{0.149r^3}$						
Ps = Pipe stiffness (psi)	Ps	=	75	75	psi	TCEQ-10243 Equation 10
E = modulus of elasticity of pipe material (psi)	E	=	500,000.00	500,000.00	psi	ASTM F679 PS75 / ASTM D3034 SDR26
I = moment of inertia of the pipe wall cross section (in4/in)	I	=	0.0833	0.0833	in^4 / in	TCEQ-10243 Equation 4
r = mean radius (in)	r	=	15.50	15.50	in	Calculated
$\frac{P_s}{SSF} = \frac{P_s}{0.061 \times zeta \times Eb} \geq 0.15$	Ps/SSF	=	0.71	0.41		TCEQ-10243 Equation 12
SSF = soil stiffness factor						
Long-term Pipe Deflection						
$\frac{\Delta Y}{D} = \frac{(K)(L_p + L_i)(100)}{0.149P_s + (0.061)(zeta)(E_b)}$	ΔY/D	=	0.94	0.94	%	TCEQ-10243 Equation 13 (zeta assumed to be 1)
ΔY/D = predicted percent vertical deflection under load (%)	ΔY/D	=	1.56	0.94	%	TCEQ-10243 Equation 13 (zeta calculated)
K = bedding angle constant, assumed to be 0.110 unless otherwise justified	K	=	0.11	0.11		
**Maximum deflection allowed 5%			✓	✓		N/A if not applicable or Confirm Pipe is Approved with ✓
**If zeta assumed to be 1 and 4%<deflection<5%, then calculate zeta and maximum deflection allowed is 5%			N/A	N/A		N/A if not applicable or Confirm Pipe is Approved with ✓
**If zeta assumed to be 1 and deflection≤4%, then pipe is approved			✓	✓		N/A if not applicable or Confirm Pipe is Approved with ✓
**If 4%<deflection<5% and zeta calculated, then pipe is approved			N/A	N/A		N/A if not applicable or Confirm Pipe is Approved with ✓
$L_p = \frac{\gamma_s H}{144}$	Lp	=	16.25	16.25	psi	TCEQ-10243 Equation 14
Lp = prism load (psi)						

EXHIBIT 3



FINAL REPORT



City of Georgetown

Wastewater System Master Plan

January 2023





CDM Smith

Ryan Tordella

STATE OF TEXAS

RYAN TORDELLA

140621

LICENSED PROFESSIONAL ENGINEER

2/2/2023

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Section 1
Introduction

As the City of Georgetown, Texas and surrounding areas continue to experience high levels of residential and commercial growth, the City of Georgetown (City) must be able to anticipate wastewater service needs. Recent growth trends have exceeded the expectations of the previous master plan; therefore, this updated master plan is critical to help the City plan for future wastewater infrastructure.

The City developed a wastewater master plan (WWMP) in 2005 and has been consistently updating and maintaining the master plan since then. The 2005 WWMP outlined necessary upgrades and expansions for the existing wastewater collection and treatment systems based on expected growth. The 2008 WWMP then re-evaluated the system under existing and future conditions based on an updated wastewater collection system model and a new development plan, which included a future land use plan and growth framework. An updated 10-year capital improvement plan (CIP) was developed with estimated costs for each recommended project. The 2014 WWMP considered further changes in expected growth to develop an updated CIP. In the 2018 WWMP, growth and demand projections were updated, and the planned wastewater service area was expanded in the northern part of the system. Additionally, the model was updated to include recent projects and account for the expanded future service area.

This master plan update is referred to as the 2022 WWMP. As part of this update, growth and demand projections have been updated, and the planned wastewater service area has been expanded in the north and southeast parts of the system as well as into existing areas served by septic tanks. Additionally, the model has been calibrated with 15 flow monitors and updated to include recent projects and account for the expanded future service area.

1.1 Overview of the Wastewater Collection System

The City's wastewater collection and treatment system consists of approximately 440 miles of gravity pipe, 28 miles of force main, 44 lift stations, and 5 wastewater treatment plants (WWTPs). The total average daily treatment capacity of the system based on the summed capacity of all five WWTPs is 8.5 million gallons per day (mgd). The existing service area covers approximately 17 square miles (10,710 acres). A map of the system and service area is shown in **Figure 1-1**. Specific areas of significance that are referred to in this report are also noted in **Figure 1-1**.

The wastewater collection system model is mostly an interceptor model and includes gravity pipes 10 inches and larger and any other pipes deemed important for analysis or connectivity. The existing conditions model includes all existing lift stations and force mains necessary for analysis of the system. Note that Southwestern lift station is referred to as the SG3A lift station in subsequent reports and the model; therefore, this report will continue with that nomenclature.

Lift stations and force mains not included in the model are small or private lift stations that are not directly connected to the modeled system or significant for evaluation. They include Airport Road, Blue Hole, Cimmaron Hills 1 and 2, Gateway, Gatlin Creek Condo, Georgetown Meadows,

Highlands, Hillwood, Hogg, Indian Creek, Lakeside 1 and 2, Oaks at San Gabriel, Pleasant Valley, River Road #2, and Sunny Trails. Mayfield Ranch and Highlands lift stations are owned by Parkside and are not included in the model as well.

1.2 Scope of Work

The 2022 WWMP involved the following tasks:

- Update growth projections and spatial distributions for existing and future conditions wastewater flows.
- Expand the future service area to include new areas to the north and southeast.
- Update the existing wastewater collection system hydraulic model to include updated information and recently completed projects.
- Recalibrate wastewater flows based on recent flow monitoring data collected throughout the system.
- Perform capacity analyses on the wastewater collection system for existing and future conditions.
- Prepare a 10-year CIP based on the evaluation of the hydraulic model and discussions with the City.

Section 2 of this report covers the service area characteristics used to develop the wastewater flows in the model. This includes a discussion of population projections and distribution. **Section 3** reviews the wastewater flow parameters that have been developed as part of previous studies. **Section 4** discusses the update and validation of the hydraulic model. The collection system was evaluated using the updated hydraulic model for existing and future conditions. The evaluation criteria and results of the evaluation are discussed in **Section 5**. The CIP projects, with cost estimates, are listed in tables at the end of **Section 6**. An exhibit, contained in a pocket at the end of this report, identifies the location of each CIP and buildout conditions project. **Appendix A** describes the methodology used to project future growth within the City's ETJ. **Appendix B** describes the calibration process for the existing model given the flow data collected from the 15 flow monitors.

1.3 Limitations of Study

The findings and recommendations contained in this study are valid as of the date of this report and based on the information referenced herein. Changes in the amount or patterns of growth within the study area, changes in water use patterns, implementation of more detailed investigations, or changes in regulations may affect the conclusions and recommendations presented in this report. Master plans such as this report should be thoroughly reviewed every three to five years to determine if the assumptions and recommendations are still valid.

OPOSSUM CREEK
195
2338
COWAN CREEK
SUN CITY LS
BERRY CREEK WWTP
BERRY CREEK
BERRY CREEK LS
972
3405
SERENADA LS
NORTH FORK SAN GABRIEL RIVER
GATLIN CREEK LS
LAKESIDE LS
LAKESIDE LS 2
PECAN BRANCH WWTP
SAN GABRIEL RIVER
130
CRYSTAL KNOLL LS
971
NORTH FORK SAN GABRIEL RIVER
RIVER ROAD LS #1
RIVER ROAD LS #2
35
KATY CROSSING LS
SAN GABRIEL WWTP
COUNTRY CLUB LS
SAN GABRIEL RIVER
MIDDLE FORK SAN GABRIEL RIVER
CIMARRON HILLS LS #2
CIMARRON HILLS WWTP
OAKS AT SAN GABE LS
CIMARRON HILLS LS #1
RIVER VISTA LS
PARK LS
SOUTHWESTERN LS
INTERCEPTOR LS
BLUE HOLE LS
HILLWOOD LS
STONEHENGE LS
DOVE SPRINGS WWTP
SCENIC LS
INDIAN CREEK LS
SMITH BRANCH LS
RAIL ROAD LS
29
WOLF RANCH LS
SOUTH FORK SAN GABRIEL RIVER
PLEASANT VALLEY LS
AMBER OAK LS
1460
2243
KASPER LS
GATEWAY LS
SUNNY TRAIL LS
MAYFIELD RANCH LS
WESTINGHOUSE LS
MIDWAY LS
WESTINGHOUSE LS 2
HIGHLANDS LS
1431
BLOCK HOUSE CREEK
1431
BRUSHY CREEK
175
3406
79
734

LEGEND

- LIFT STATION
- TREATMENT PLANT
- Major Streets
- Existing Service Area

Wastewater Lines

- 6-8"
- 10-14"
- 15-19"
- 20-24"
- 27-30"
- 33-36"
- 42-48"
- 51-60"

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N W E S

Georgetown Utility Systems
Water and Wastewater Master Plan - 2022

Figure 1-1 Wastewater Collection and Treatment System

0 0.325 0.65 1.3 Miles

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Section 2
Wastewater Service Area

The current and ultimate wastewater service areas represent the boundaries of the wastewater collection system hydraulic model for existing and future conditions, respectively. These service areas were divided into subservice areas referred to as sewersheds. Parameters attributed to each of the sewersheds are used to derive the wastewater flows simulated in the model. These sewershed parameters include population, nonresidential flow, and contributing area. This section describes the service areas and data available, the sewershed delineation process, and the methodology used to develop the sewershed characteristics.

2.1 Service Area Description

The existing service area and information available to develop the existing conditions wastewater flow parameters are shown in **Figure 2-1**. This includes water billing accounts by type and a delineation between areas currently served by the wastewater collection system and unsewered areas. Spatially distributed water billing accounts were used to determine population and nonresidential flows needed for the wastewater collection system model. As such, accounts located in unsewered areas were not included in determining the wastewater service area population. Population in the service area was determined from the number of residential accounts while winter water billing data were used to develop the portion of wastewater flow that is produced by all other customers not represented by the residential population. These nonresidential customers include commercial, industrial, professional, and institutional (schools, hospitals, etc.) customers. The locations of these customers are depicted in **Figure 2-1** using the water billing categories.

Existing and future wastewater flows, including magnitude and location of flow, were developed using detailed flow parameters, including water billing data and planned developments for the entire City service area. Additional data available to develop future wastewater flow parameters include a modified future land use plan and growth framework originally developed for Georgetown's extraterritorial jurisdiction (ETJ). Using these sources of development information and other applicable data, wastewater flow parameters were derived for the planning horizons of 2022, 2032, and ultimate buildout. Details regarding the development of the wastewater flow parameters and the information used are provided in the technical memorandum *Wastewater Flow Projections Modeling Methodology* available in **Appendix A**.

The ultimate wastewater service area boundary is shown in **Figure 2-2**.

2.2 Sewershed Delineation

A sewershed is a defined area for which wastewater flows are tributary to a single point along an interceptor (i.e., all the flow from one sewershed should drain to a single point). Based on this definition and additional information as discussed in this subsection, sewersheds were delineated for the ultimate wastewater service area, which includes existing and future development areas. Some sewersheds are specifically delineated to represent large, proposed development areas. In

other cases, sewersheds were further divided to improve resolution in the model where detailed information was available.

The relative size of the sewersheds defines the "flow resolution" of the collection system model. Smaller sewersheds result in a larger number of sewersheds, which increases the number of wastewater flow inputs to the model. The flow resolution is often dictated by the size of the flow monitoring basins because the distribution of flow upstream of the flow meters must be assumed. Subdividing the flow monitoring basins into too many smaller units may result in a misrepresentation of the flow upstream of the meter location. Flow monitoring was completed for large basins to capture as much flow as possible to get a more complete understanding of the total flows, but this limits the understanding of the flows upstream. On the other hand, knowledge from previous and recent flow monitoring efforts was used to make reasonable assumptions about the upstream flows, which allowed for smaller sewersheds.

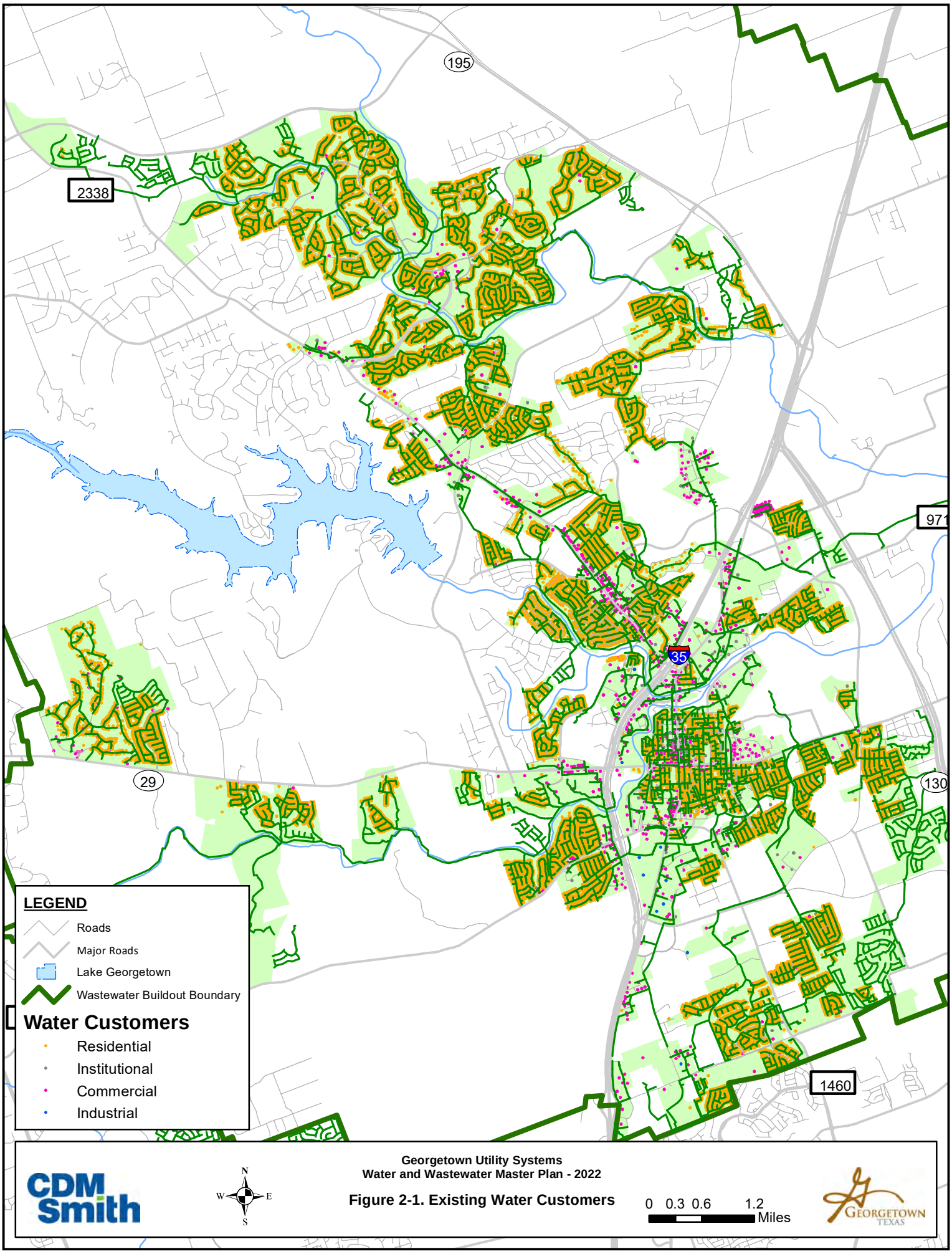
In addition to size, the following information was considered when delineating the sewersheds (in order of significance): pipe layout, topography, and parcels. Pipe layout for existing development areas is the best determination of how wastewater flow is routed to a single point. For future development areas, topography best represents how gravity pipes will likely be aligned. Parcel information is used in addition to topography for future development areas because it is assumed, in some cases, that a parcel will be developed such that the flow will be conveyed to a single point inside the parcel.

2.3 Development of Sewershed Parameters

The sewershed parameters consist of population, nonresidential flow, and contributing area. Population and nonresidential flow were used to derive the portion of wastewater flow that comes from everyday uses. The contributing area plays a role in simulating the amount of rainfall that enters the collection system during storm events. The components of wastewater flow are discussed further in Section 3. This section describes how the sewershed parameters were developed from the data available for existing and future conditions.

For existing and future conditions, the same methodology was used for determining the contributing area for each sewershed. The contributing area is considered an area that could potentially collect and route rainfall-dependent inflow and infiltration (RDII) that enters into the wastewater collection system. Areas that were not considered as contributing include neighborhoods served by on-site sewage treatment systems, large areas of currently undeveloped land, open space, recreation space (e.g., golf courses), major highways, waterways, airport runways, mining areas, and floodplains. In some cases, the areas are not included in the overall service area boundary. For other areas that were not considered contributing, the area was subtracted from the total area value in the model.

The next two sections discuss the methodologies used to develop populations and nonresidential flows for existing and future conditions.



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Water and Wastewater Master Plan - 2022

Figure 2-1. Existing Water Customers

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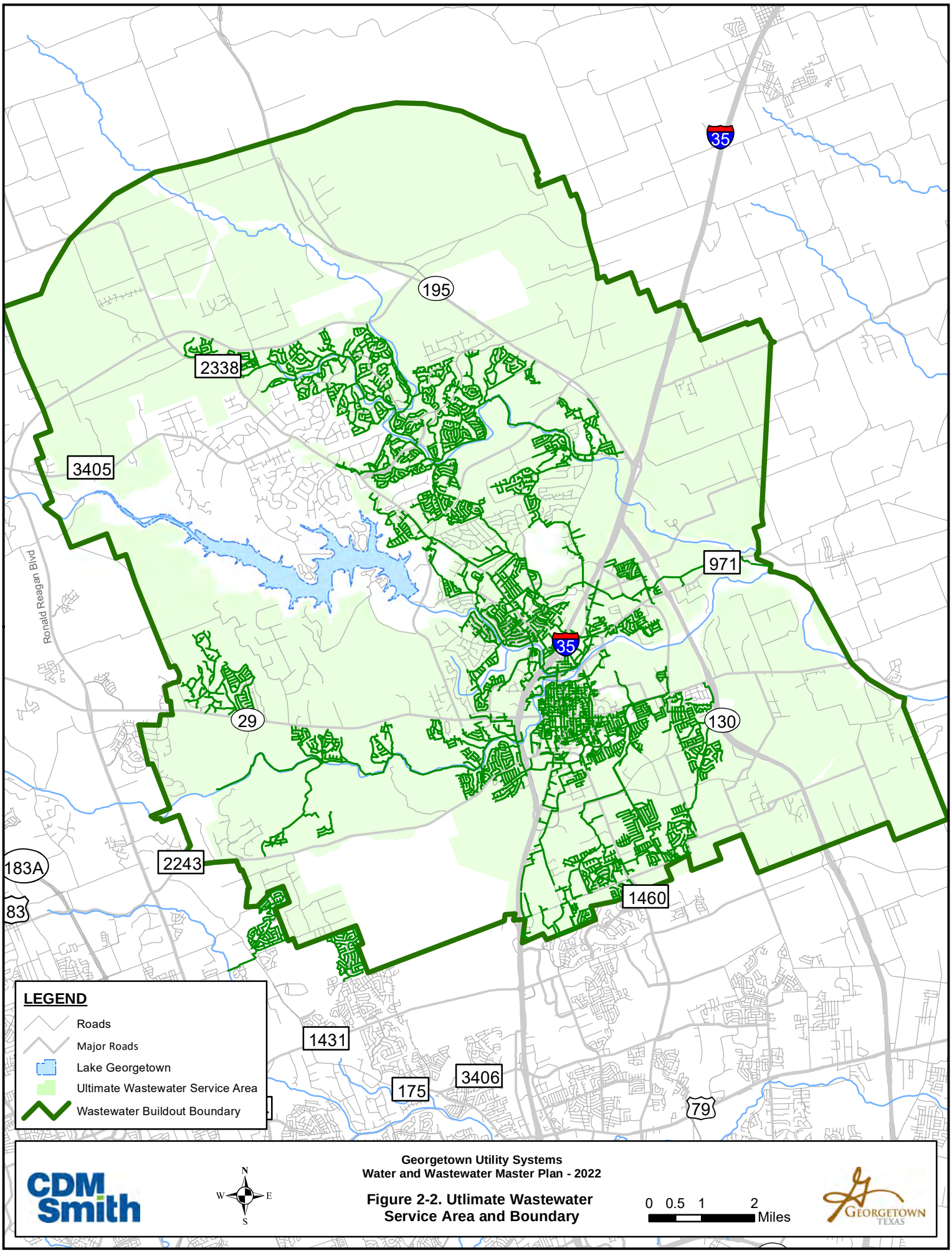

Georgetown Utility Systems
Water and Wastewater Master Plan - 2022

Figure 2-2. Utlimate Wastewater Service Area and Boundary

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2.3.1 Existing Conditions

The water billing records for 2021 were used to develop the existing conditions population. The geo-located billing records were intersected with the sewersheds to distribute population throughout the collection system. The residential water billing accounts were used to determine the existing conditions population assuming the following:

- Single-family unit (SFU or SF) = 2.5 people
- Multifamily unit (MFU or MF) = 1.9 people
- Age-restricted unit (ARU or AR) = 1.75 people (existing conditions only)

Nonresidential wastewater flow was derived from winter water billing records. Winter water use for nonresidential accounts was used to estimate nonresidential average day wastewater flows for each sewershed in the wastewater model. Winter water use is the best estimate of wastewater flow for these customers as outdoor water usage is at a minimum during the winter, resulting in most of the water used returning to the wastewater system. The data was distributed in the model by intersecting the geo-located billing records for nonresidential account holders with the sewersheds.

2.3.2 Future Conditions

For future conditions, the wastewater flow parameters of population and nonresidential flow were developed using the information summarized below, in order of priority:

- Planned developments information: The development and growth of several areas have been specifically described by developers or estimated by the City through their tracking of growth via their "Developments Pipeline" database. These areas are referred to as "planned developments" for the master plan. This database is the best information available regarding the magnitude and location of future wastewater flows. **Appendix A** includes a table and map of all planned developments considered. These developments represent 100 percent of the additional population expected in the City service area by 2032.
- Redevelopment plans: Specific redevelopment areas considered include Williams Drive and the downtown area.
- Areas of limited water and wastewater service: There are areas within the wastewater service area that are not currently served or will not be served in the future by the wastewater system. Specifically, these are areas defined as mining, parks and open space, and other as described in **Appendix A**. There are also existing and future septic system areas that are defined as having wastewater service or no service in the future.
- Updated future land use plan and land use density information: City had previously developed a future land use plan and land use densities for Georgetown's ETJ, which was used in the 2008, 2014, and 2018 WWMPs. For this 2022 WWMP, this information has been modified to represent more recent trends in the type of growth expected for Georgetown. The future land use plan includes a land use layer showing the distribution of the future land use types and a table of future land use densities that describe the number and type of

residential units per acre and unit nonresidential wastewater flows. Shown and described further in Appendix A, the updated land use densities are also shown here in **Table 2-1**. The future land use plan is used to project wastewater parameters for future conditions planning horizons in areas where there is planned redevelopment, no existing development, or no planned development. In other words, this information fills in the gaps of where the details of future development are not well known.

- Updated growth framework: Similar to the future land use plan, the City had also developed a growth framework that has been used in the previous master plans. The original growth framework assisted in assigning the spatially distributed wastewater flow parameters to each planning horizon. The growth framework has been modified according to recent growth trends and the original categories have been modified to align with the specific planning horizons for this 2022 master plan update.

The information above and methods used to develop the future wastewater parameters in the model are described in detail in **Appendix A**.

For the nonresidential flow, winter water billing records were studied previously to determine appropriate unit flows in gallons per day per acre (gpd/ac) for each category. The 2014 WWMP described how the nonresidential unit flows were originally derived; the values were used in the 2018 WWMP and have also been carried into the 2022 WWMP.

Table 2-1 Future Land Use Densities

Future Land Use Category	Residential		Nonresidential	
	Percent of Area	Dwelling Units per Acre[1]	Percent of Area	Average Day Flow (gpd/ac)
Agricultural/Rural Residential	100%	0.2 SFU		
Neighborhood/Mixed-density Neighborhood	100%	3.5 SFUs		
Community Center	10%	10 MFUs	90%	1,200
Regional Center	10%	10 MFUs	90%	1,500
Institutional Use			100%	950
Mixed-Use Neighborhood Center	25%	7 SFUs and 7 MFUs	75%	1,200
Employment Center	10%	10 MFUs	90%	900

1. A dwelling unit is defined as single family (SFU) or multifamily (MFU). A residential living unit equivalent (LUE) is equal to 1 SFU or 0.75 MFU. One MFU is equal to 1.9 people. One age-restricted unit (ARU) is equal to 1.75 people for existing conditions and 1.9 people in future conditions. One LUE is equal to 2.5 unless the area is defined as age-restricted.

2.4 Modeled Wastewater Parameters Summary

The sewershed parameters are used to calculate the wastewater flows contributed by each delineated sewershed in the existing and future system models. Section 3 describes the development of the wastewater flow parameters that were applied to the sewershed parameters to simulate wastewater flow. **Table 2-2** summarizes the overall parameters within the wastewater service area for each planning horizon including a comparison to the existing

conditions parameters used in 2008, 2014, and 2018. The 2022 planning horizon is based on existing conditions, while the 2032 and buildout planning horizons represent future conditions.

Table 2-2 Summary of Parameters Characterized by Planning Horizon

Sewershed Parameters	Total Value in Wastewater Service Area					
	2008	2014	2018	2022	2032	Buildout
Contributing Area (acres)	10,470	12,173	13,676	18,498	33,992	92,901
Population	46,475	50,042	56,519	83,749	199,274	638,531
Nonresidential flow (mgd)	1.206	1.31	1.32	0.65	2.08	9.71

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Section 3
Wastewater Flows

Wastewater collection system flow consists of two components: dry weather flow (DWF) and rainfall derived inflow and infiltration (RDII). Flow monitoring data is used to develop the parameters that are used to simulate the components of wastewater flow in a hydraulic model. For this 2022 WWMP, model calibration was based on flow monitoring data collected in 2022 and supplemented with recent flow monitoring data collected in 2018 for areas in Sun City. In addition to describing the wastewater components, this section discusses the 2022 flow monitoring effort and how the collected data were used to update some of the wastewater flow parameters.

3.1 Wastewater Flow Components

Figure 3-1 illustrates the components that make up wet weather wastewater flow as a stacked area graph. DWF consists of groundwater infiltration (GWI) and base wastewater flow (BWF). GWI is groundwater that leaks into the system through cracks in pipes, joints, and other structural defects. GWI is distinct from wet-weather induced flows in that GWI occurs even under dry weather conditions. GWI is typically a relatively constant flow throughout the day, but it may vary seasonally. BWF consists of residential and nonresidential sanitary wastewater flows that enter the wastewater collection system from everyday water uses. Unlike GWI, BWF usually follows a diurnal pattern.

RDII is more complex than DWF. RDII is the result of rainfall and rainfall runoff entering the wastewater collection system. As the name suggests, RDII is made up of inflow and infiltration. Rainfall-dependent inflow is rainfall runoff that directly enters the collection system through illicit stormwater connections and manhole defects. The flow response to inflow is usually relatively rapid, with flows following rainfall patterns closely. Rainfall-dependent infiltration occurs when groundwater in saturated soils leaks into the collection system through cracks in pipes, leaky joints, and similar defects. Rainfall derived infiltration usually occurs more slowly, peaking after peak rainfall and taking hours or days to recede.

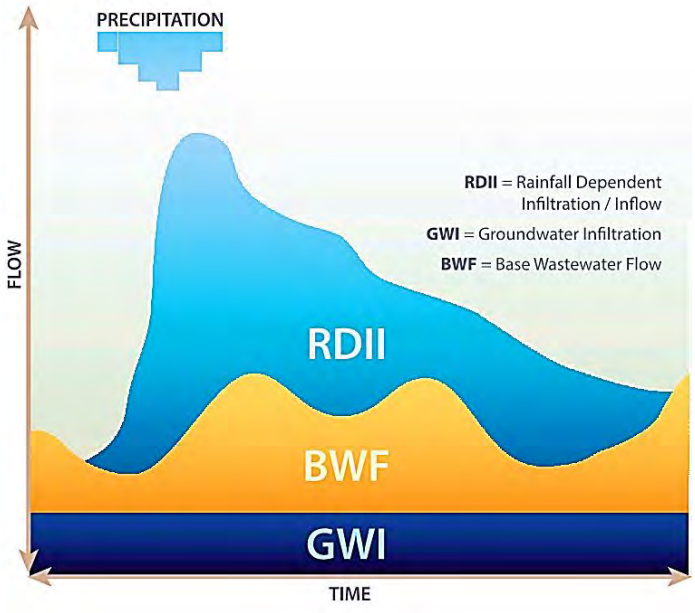


Figure 3-1
Components of Wastewater Flow

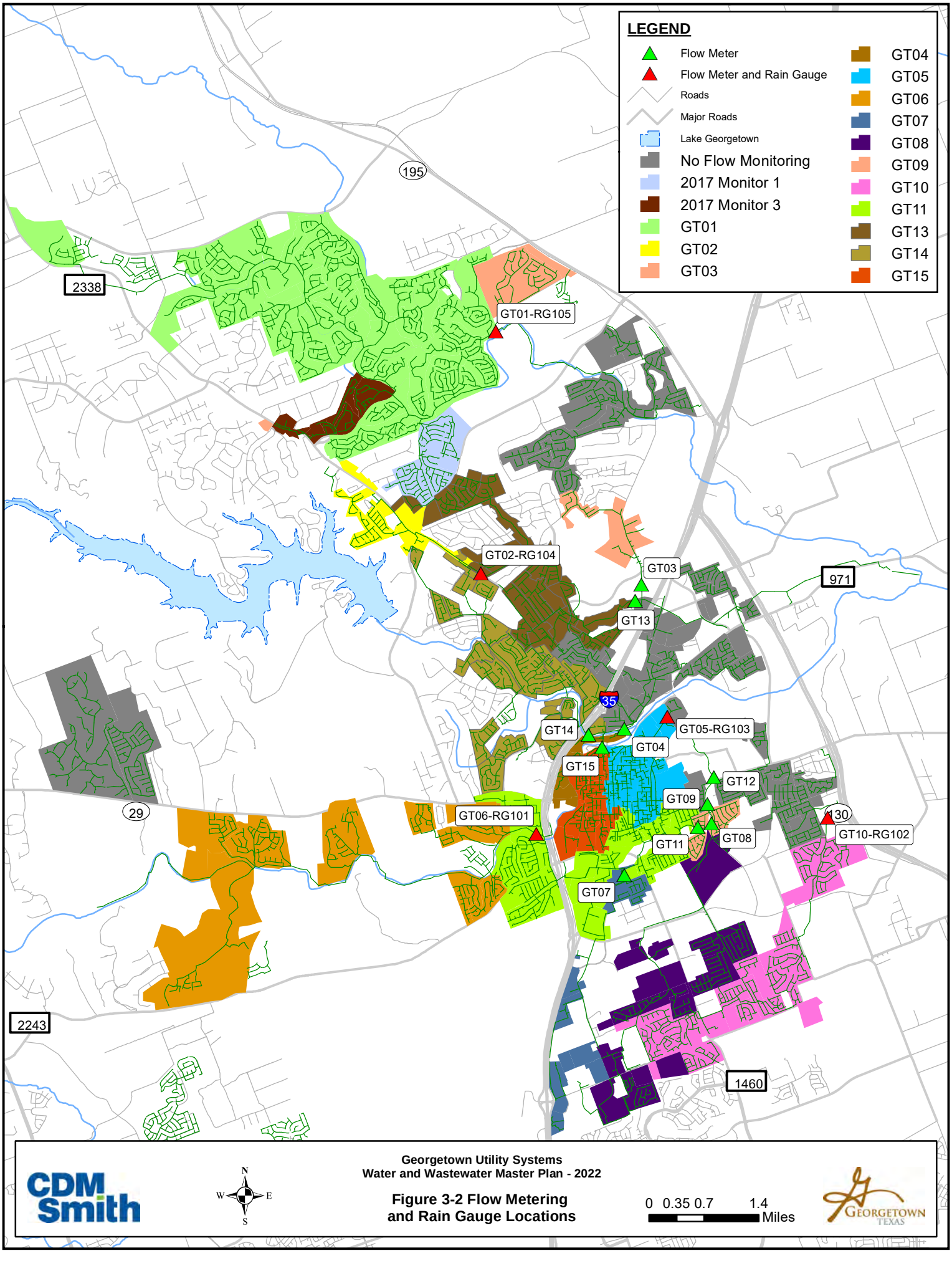
Factors that affect the characteristics of RDII can include:

- Age, material, and construction quality of the sewer pipes
- Local soil properties
- Permeability of ground cover (land use)

The sum of DWF and RDII is referred to as wet weather flow. Peak wet weather flow, typically referred to as the peak flow or design flow, is the peak of the combined DWF and RDII.

3.2 Flow Monitoring and Wastewater Flow Processing

Wastewater flow monitoring was conducted in 15 areas as shown in **Figure 3-2**. Level, velocity, and flow data was collected from November 20, 2021 to May 6, 2022. The data collected was quality data with no issues. Rainfall data was directly collected by Interra Hydro in five locations. A significant rainfall event is defined as being equal to or greater than 1 inch in total depth over a 24-hour period at least at one rain gauge. Three significant rainfall events were observed during the flow monitoring as shown in **Table 3-1**. **Figure 3-3** compares the monitored rainfall with Georgetown's design event.



Georgetown Utility Systems
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Figure 3-2 Flow Metering and Rain Gauge Locations

0 0.35 0.7 1.4 Miles

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Table 3-1. Rain Events

Rain Gauges	Event 1 (March 21, 2022)	Event 2 (April 25, 2022)	Event 3 (May 5, 2022)
	Rainfall Depth by Storm Event (inches)		
RG 101 – Wolf Ranch LS	1.63	1.76	1.35
RG 102 – Saddle Creek LS	1.33	1.21	0.91
RG 103 – San Gabriel WWTP	1.62	1.25	1.54
RG 104 – Williams Drive	0.13	0.44	1.6
RG 105 – Sun City LS	0.49	0.39	1.04

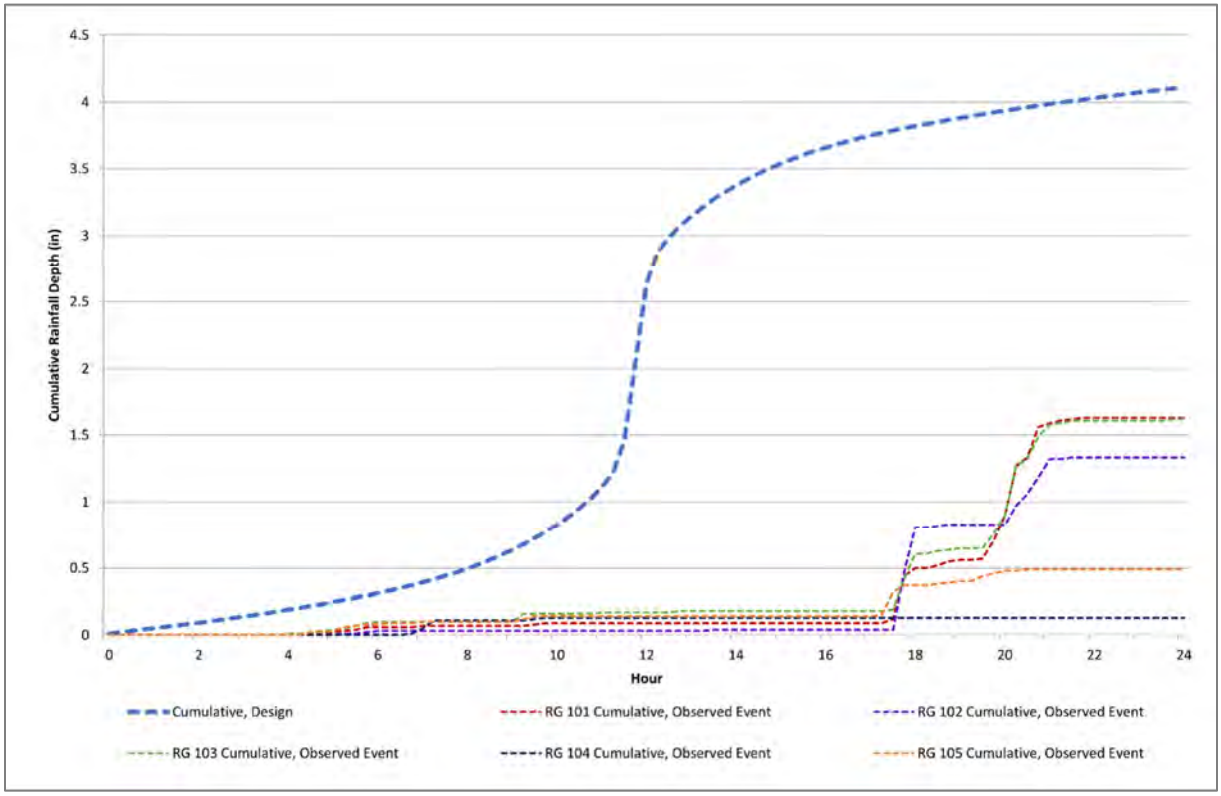

Figure 3-3. Design Rainfall Event Compared to the Observed March 2022 Rainfall Event

The rain event graphed above in **Figure 3-3** (March 2022) is the event that was used for wet weather calibration. This event was less than a 1-year storm in terms of peak hour intensity and total volume. Please note that the northern portion of Georgetown did not see much rainfall during this event. The May 5th rainfall event was used for wet weather calibration in those areas.

3.2.1 Dry Weather Flow Processing

The general DWF processing methodology used for analyzing flow monitoring data for this and previous WWMPs is described in **Table 3-2**. This processing resulted in the development of DWF parameters for various areas of the wastewater system.

Table 3-2 Dry Weather Flow Processing Methodology

Processing Step	Description of Procedure
Determine Dry Weather Days	The rainfall of record is examined. Dry-weather days include days during which no rainfall was recorded. Also, 2 days following a rainfall event are excluded as dry-weather days.
Determine DWF Statistics	The dry-weather days are statistically analyzed to determine average daily, average maximum, and average minimum flows for each meter. Days with missing data and having a standard deviation greater than 1.0 are removed from this analysis.
Estimate GWI	GWI is estimated as a percentage of the average minimum nighttime flow (varied by meter).
Determine BWF	BWF consists of residential flows and nonresidential flows. BWF is determined by subtracting GWI from the average daily DWF.
Estimate Residential and Nonresidential Flows	Water billing records are used to determine the amount of nonresidential flow upstream of each flowmeter. The remaining flow is assumed to be residential.
Determine Diurnal Patterns at Meter Location	The sanitary flow is statistically analyzed to determine the residential diurnal pattern for each metered area. A pattern for nonresidential flow is assumed.

The diurnal patterns determined in the final processing step in **Table 3-2** represent an attenuated diurnal pattern, which means they show less variation and a lag in the peak compared to what would occur further upstream in the system. Because the wastewater flows are entered into to the hydraulic model at the upstream end, the diurnal patterns developed from the observed data had to be transposed and adjusted to represent the pattern that would occur at that upstream point. This is best described in **Figure 3-4**. The dotted blue line represents the wastewater flow entering at the upstream end of the hydraulic model, which is based on the adjusted diurnal pattern. The solid blue line is the simulated flow in the hydraulic model at the location of the flowmeter. The peak and trough of the graph are attenuated by the time it takes for the flow to reach the meter location. Additionally, there is a lag in the peak flow of about 2 hours. The final result is that the simulated flow compares well to the observed flow (solid red line) at the flowmeter location.

Appendix B provides dry weather calibration results.

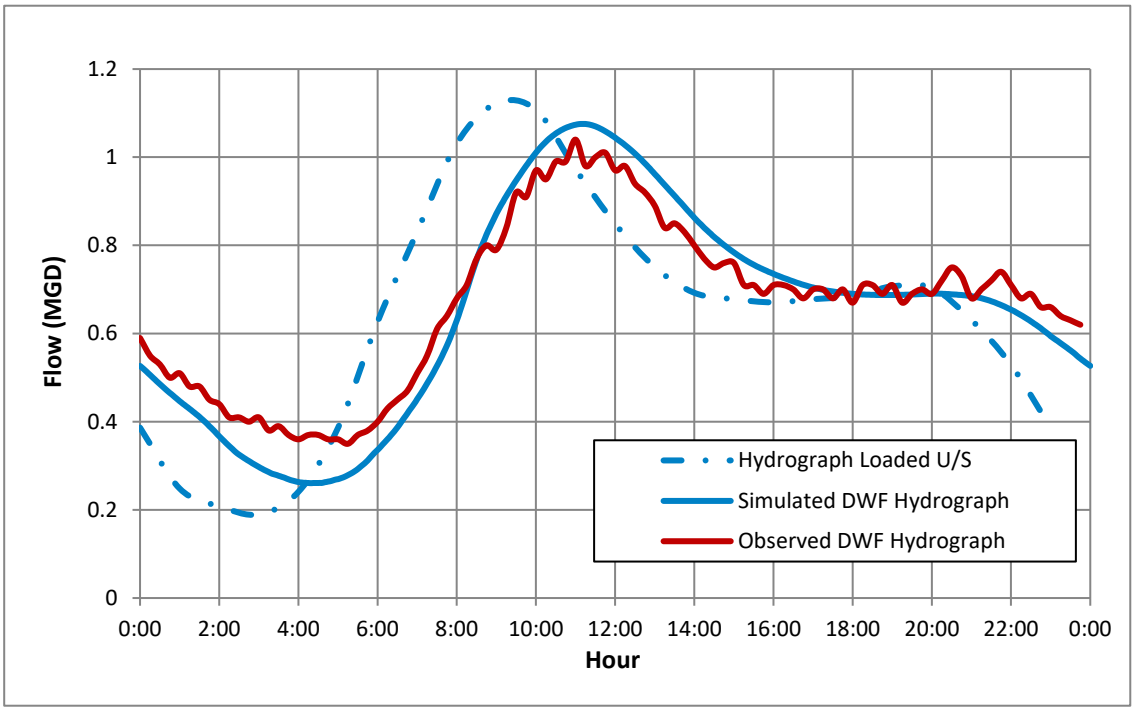

Figure 3-4 Diurnal Pattern Adjustment Example

3.2.2 Rainfall-Dependent Inflow and Infiltration

RDII makes up the remaining observed flow once the DWF is subtracted from the total observed flow. RDII parameters were developed for each meter during the significant rainfall events. A significant rainfall event is defined as being equal to or greater than 1 inch in total depth over a 24-hour period. Three significant rainfall events were observed during the flow monitoring. The rainfall data was distributed over the flow monitored areas using Thiessen polygons, and a weighted average was used to determine the rainfall associated with each flowmeter for wastewater flow processing. **Appendix B** provides wet weather calibration results.

Wet-Weather Peaking Factor

To prioritize the sewersheds in terms of their I/I contribution, the peak wet-weather to average dry-weather flow ratio (i.e. the peaking factor) was calculated. Even if the infiltration volume is low, inflow could be producing high peaks that lead to overflows and surcharging.

The wet-weather peaking factor can help guide sanitary sewer evaluation survey prioritization, like the Edwards Aquifer Recharge Zone (EARZ) work the City performs annually. To calculate the peaking factors, the peak hour wet weather flow for a given event was divided by the basins ADF.

The maximum peaking factor for each sewershed is categorized in **Table 3-3**. Based on industry standards and CDM Smith's experience analyzing I/I for utilities, a peaking factor of less than 2.5 represents a low RDII response (Level 1). A peaking factor of less than 4.0 may indicate investigation is required (Level 2), and peaking factors over 4.0 are areas that are high priority for investigation into RDII responses (Level 3). The TCEQ 217 design requirements for sanitary systems requires a peaking factor of 4.0 when actual data is not available. Actual peaking factors in excess of 4.0 would exceed the design basis of the City's collection system.

systems requires a peaking factor of 4.0 when actual data is not available. Actual peaking factors in excess of 4.0 would exceed the design basis of the City's collection system.

Table 3-3 Wet-Weather Peaking Factor Level Summary

Wet-Weather Peaking Factor	Flow Monitors	Number of Monitors in Level (#)
Less than 2.5	GT01, GT02, GT03, GT04, GT10, GT13, GT14	7
2.5 to 4.0	GT05, GT06, GT09, GT11, GT15	5
Greater than 4.0	GT07, GT08	2

The calculated wet-weather peaking factors and peak wet-weather wastewater flows measured during all events for each sewershed are presented in **Table 3-4**. Each peaking factor is color-coded based on the categories described above. Level 1 peaking factors, indicating sewers are in good condition, are shaded in green. Level 2 peaking factors, indicating sewers may require investigation, are shaded in blue. Peaking factors with a Level of 3, indicating the sewers are in fair to poor condition, are shaded red.

Table 3-4 Wet –Weather Peaking Factor

Monitor	Upstream Monitor	Wet-Weather Peaking Factor			Peak Hour WWF (mgd)			ADF (mgd)
		March 21, 2022	April 25, 2022	May 5, 2022	March 21, 2022	April 25, 2022	May 5, 2022	
GT01	None	1.56	1.51	1.48	1.59	1.54	1.51	1.02
GT02	None	1.56	1.67	1.84	0.21	0.22	0.25	0.13
GT03	GT01	1.85	1.47	N/A	1.89	1.50	N/A	1.02
GT04	GT14, GT15	2.23	1.92	2.11	1.57	1.36	1.49	0.71
GT05	None	3.13	1.80	2.08	1.19	0.68	0.79	0.38
GT06	None	2.77	2.29	2.45	1.03	0.85	0.91	0.37
GT07	None	22.77	2.26	2.65	2.21	0.22	0.26	0.10
GT08	None	4.13	1.71	1.65	1.66	0.69	0.67	0.40
GT09	GT06, GT07, GT11, GT08	2.94	1.36	1.65	4.49	2.08	2.52	1.53
GT10	None	2.36	1.96	1.68	0.94	0.78	0.67	0.40
GT11	GT06, GT07	3.58	1.68	1.89	3.12	1.47	1.65	0.87
GT13	GT02	1.77	1.58	1.63	1.15	1.02	1.05	0.65
GT14	None	1.15	0.98	N/A	0.74	0.63	N/A	0.65
GT15	None	3.04	1.19	1.17	1.07	0.42	0.41	0.35

(1) Peaking Factor for GT12 is not applicable because of the varying nature of the user settings at the Smith Branch LS diversion structure.

A peak wet-weather flow greater than or equal to 4 times the average indicates higher than typical system I/I. Overall, peaking factors ranged from 1 to 22.77. Of the 14 flow monitors, 7 recorded high peaking factors, the majority of which occurred during the March 21, 2022 event.

It should be noted flow monitors did not consistently record high peaking factors during all three storm events. Texas is currently in a drought and the antecedent moisture conditions before the

second and third rain events were extremely dry. Additionally, the rainfall across the city varied significantly during each rainfall event with the northern area receiving little to no rain during the March 2022 event.

As shown in **Table 3-4**, the meter with the largest RDII peaking factor is GT07. The service area for this meter is the area surrounding the Westinghouse and Midway lift stations just east of I-35. It is recommended that the City investigate and try to eliminate sources of RDII in this area.

For the GT15 service area, CDM Smith recommends investigating for possible RDII reduction. As discussed in Section 5 of the 2022 WWMP, this area is largely affected by the design storm and is predicted to nearly overflow. Any reduction in RDII response may postpone the need for the future infrastructure project recommended for that area.

Overall, the City of Georgetown's system is largely resistant to RDII. The effort the City puts into maintenance and RDII reduction is clearly shown by the results in **Table 3-4**.

3.3 Wastewater Flow Parameters

Based on processing of the most recent flow monitoring data, calibration, and discussions with the City, the final wastewater flow parameters used to develop the hydraulic models are summarized in this section. The flow parameters include those for DWF and RDII.

Different characteristics were used based on the type of evaluation (existing system or future system) and whether an area is an existing or future development. The parameters for the existing or calibrated conditions represent the parameters developed to calibrate the model and best represent the existing flows of the system. The future or planning conditions parameters are increased in some cases to be consistent with design criteria that has been previously developed. Also, the design criteria were developed to be conservative for developing future predicted flows as future conditions are not well known.

The DWF parameters are summarized in **Table 3-5**. This includes GWI, BWF, and peaking factors for BWF. The BWF peaking factors represent the peak in the diurnal pattern used to vary the average BWF throughout the day and is calculated using the following equation:

$$Peaking\ Factor = \frac{Maximum\ BWF}{Average\ BWF}$$

Residential diurnal patterns were developed for each flow monitored area based on the flow data. For those areas not included in any of flow monitoring studies, a typical residential diurnal pattern was developed based on the Sun City meter data, because that meter best represents residential flow only. For nonresidential flow, a diurnal pattern was assumed based on a typical workday schedule.

It is important to note that these peaking factors are only applicable for the collection system hydraulic model, and they do not represent what is required for design. The modeling peaking factors are applied to the sewersheds, which are large areas compared to a small development area. This is similar to why the diurnal curve developed from the flow monitoring was adjusted as demonstrated in **Figure 3-4**. When predicting wastewater flows, developers should use the

recommended design criteria. **Appendix C** provides the recommended planning and design criteria for the City's water and wastewater systems. Note that the criteria were divided into the categories of planning and design because such criteria are not always the same.

Based on the 2018 WWMP, it was decided between the City and CDM Smith that RDII for future development areas would be assumed at 750 gallons per acre per day (gpad). For the 2022 WWMP, CDM Smith recommends keeping this assumption. As a point of reference, the City of Austin uses 750 gpad peak RDII for their design parameter. Overall, it was decided that 750 gpad for peak RDII flow was more reasonable for planning for buildout of the entire service area. This value is used for modeling and service area planning, but the design criterion to be used by developers for specific areas will remain at 1,000 gpad as specified in the design criteria portion of Appendix C.

Table 3-5 Wastewater Flow Criteria for Future Development Areas

Wastewater Flow Category	Criteria
Ground Water Infiltration (GWI)	
Residential	30 gallons per capita/day (gpcd)
Nonresidential	25% of average nonresidential BWF
Base Wastewater Flow (BWF)	
Typical Residential	70 gpcd
Age Restricted Planned Unit Development	55 gpcd
Nonresidential	Based on future land use densities or information provided by developer
BWF Peaking Factors	
Residential	2.1
Nonresidential	1.5
Rainfall Dependent Inflow and Infiltration (RDII)	
Peak RDII	750 gal/ac/day

Note: gpcd is gallons per capita per day

Section 4
Hydraulic Model

The City's wastewater collection system hydraulic model uses InfoWorks ICM by Innovyze. The model was originally developed for the 2005 WWMP and has been continually updated since then. The sewersheds, sewershed parameters, and wastewater flow parameters were updated for this 2022 WWMP as described in previous sections and applied to the model. Some infrastructure information in the model was updated based on information provided by the City as discussed in this section. The model has been calibrated over time using the flow monitoring data available with the most recent data collected in 2022. More on the flow monitoring effort can be found in **Appendix B**. The overall model was validated for this 2022 WWMP by comparing simulated average daily flows at the wastewater treatment plants with observed values.

4.1 Modeled Infrastructure

The model includes gravity pipe 10 inches in diameter and greater and significant lift stations and force mains. Several smaller diameter gravity pipes that are important to the system model are included as well. For lift stations, privately owned or small lift stations are not included in the model. A summary of the modeled infrastructure is presented in **Table 4-1**. A map of the modeled infrastructure is presented as **Figure 4-1**.

As part of this master plan update, the infrastructure components of the model were updated to include new construction and any additional information provided by the City as shown on record drawings to replace assumed values. The overall infrastructure updates for this 2022 WWMP have been incorporated into the model and are summarized below:

- Gravity sewer for Sun City Neighborhoods 68, 70, and 84, which connect to the Sun City Interceptor.
- Barton tributary interceptor connecting to the SGI.
- Wolf Ranch interceptor connecting to the SGI.
- Teravista Sections 321, 322B, and 323 interceptors that convey flow to the McNutt lift station.
- A few manholes and pipe segments in the downtown area, which were added to the model including areas such as Holly Street, Scenic Drive, the softball field, and Interstate 35 at San Gabriel River.
- Updates from the SEWWMP which was a separate study in between the 2018 and 2022 WWMP were also included in the 2022 WWMP model. The major update from the SEWWMP to the model was the inclusion of the Saddle Creek Lift Station and upstream gravity sewer.

Table 4-1 Modeled Infrastructure Summary

Gravity Pipe		
Diameter (inches)	**Length (feet)**	**Percent of Pipe in Model**
6	4,416	1%
8	56,450	12%
10	73,098	16%
12	75,020	17%
15	24,052	5%
18	77,688	17%
21	53,717	12%
24	21,992	5%
27	13,964	3%
30	17,057	4%
33	2,703	1%
36	29,239	6%
42	2,280	1%
48	1,350	0%
TOTAL	453,027	

Force Mains		
Diameter (inches)	**Length (feet)**	**Percent of Pipe in Model**
4	1,824	2%
6	9,709	13%
8	2,861	4%
10	12,779	17%
12	9,109	12%
16	34,066	45%
20	3,772	5%
21	373	0%
36	404	1%
TOTAL	74,896	

Lift Stations				
Name	**Number of Pumps**	**FM Diameter (inches)**	**Firm Capacity (gpm[3])**	**Firm Capacity (mgd[3])**
Berry Creek	3	8	625	0.9
Country Club	2	10	920	1.32
Crystal Knoll	2	10	800	1.15
Interceptor	2	12	750	1.08
Katy	2	10	750	1.08
Midway	2	6	221	0.32
Park	3	20	3,800	5.47
Rail Road	2	4	250	0.36
River Road	2	4	180	0.26
Saddle Creek	2	12	2,083	3.00
Scenic	2	4	380	0.55
Serenada	2	4	120	0.17
SG3A[1]	3	12	2,083	3.00
Smith Branch	3	16	3,400	4.90
South Regional[2]	3	12	1,750	2.52
Stonehedge	2	8	600	0.86
Sun City	4	16	2,360	3.40
Westinghouse	2	6	215	0.31
Wolf Ranch	3	16	3,500	5.04

Wastewater Treatment Plants (WWTPs)		
Name	**Average Day Capacity (mgd)**	**Peak Flow Capacity (mgd)**
San Gabriel	2.5	7.5
Dove Springs	2.5	6.25
Berry Creek	0.3	1.1
Pecan Branch	3	9
Cimarron Hills	0.2	0.8

1. In the City's datasets, SG3A LS is referred to as Southwestern Lift Station.
2. South Regional Lift Station is also referred to as the Westinghouse South Regional Lift Station
3. Gallons per minute (gpm), million gallons per day (mgd)

4.2 Conceptual Model

The three main components of the hydraulic model have been described in previous sections: the sewersheds and their associated parameters (population, area, etc.), the wastewater flow parameters, and the physical collection system infrastructure. The overall collection system was shown in **Section 1**, but it is also useful to have a conceptual understanding of the collection system and the sewer basins that dictate the flow of wastewater. **Figure 4-2** shows a schematic representation of the hydraulically critical components of the City's wastewater system with a simplistic depiction of the sewer basins in the study area. This information is useful for understanding the current system and for determining the best way to address future condition deficiencies.

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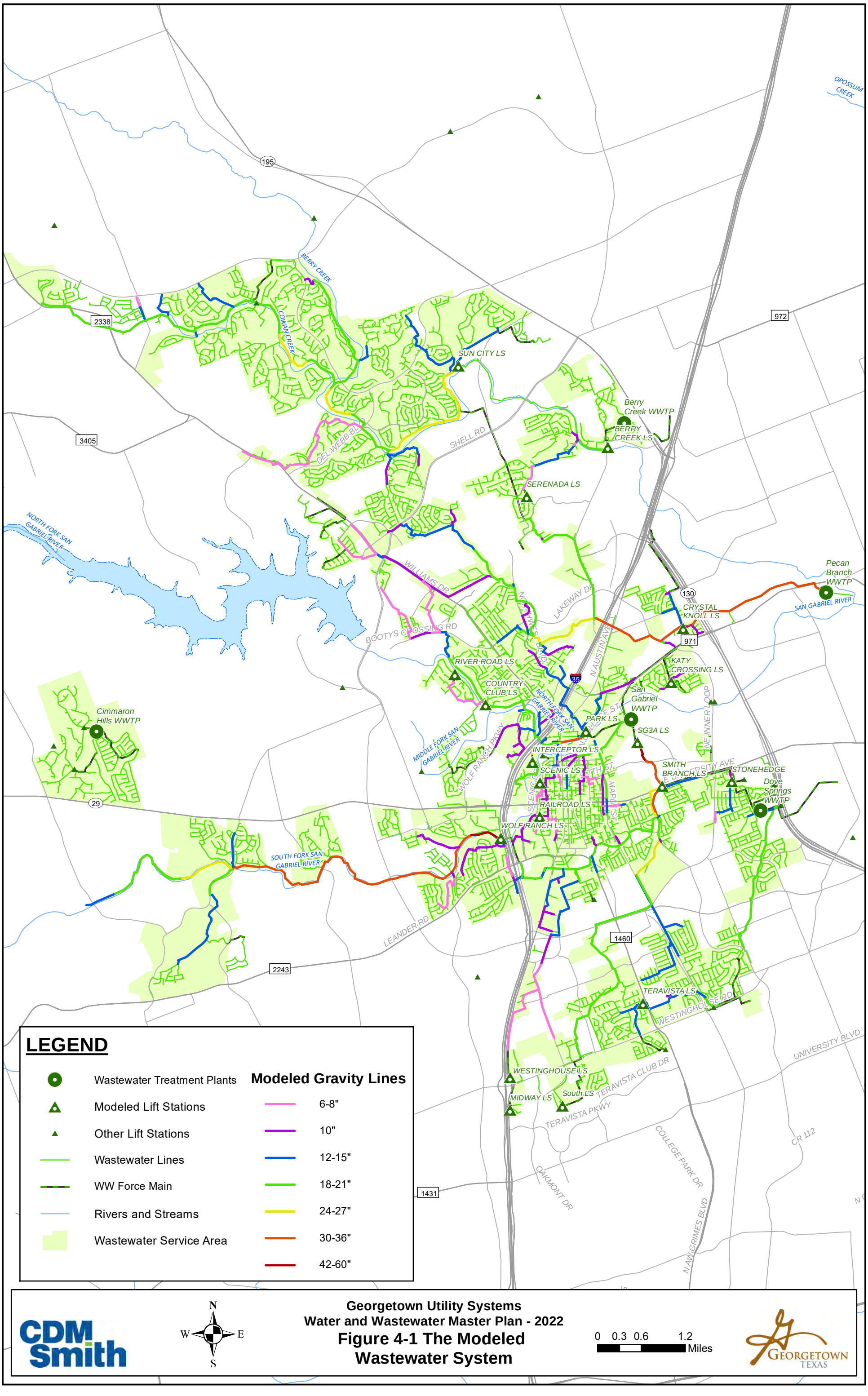
OPOSSUM CREEK
195
BERRY CREEK
2338
COWAN CREEK
SUN CITY LS
972
Berry Creek WWTP
BERRY CREEK LS
3405
DEL WEBB BLVD
SHELL RD
SERENADA LS
NORTH FORK SAN GABRIEL RIVER
WILLIAMS DR
LAKEWAY DR
BOOTYS CROSSING RD
Pecan Branch WWTP
SAN GABRIEL RIVER
130
CRYSTAL KNOLL LS
971
RIVER ROAD LS
COUNTRY CLUB LS
KATY CROSSING LS
N AUSTIN AVE
35
San Gabriel WWTP
PARK LS
SG3A LS
NORTH FORK SAN GABRIEL RIVER
MIDDLE FORK SAN GABRIEL RIVER
WOLF RANCH PKWY
INTERCEPTOR LS
SCENIC LS
SMITH BRANCH LS
STONEHEDGE
Dove Springs WWTP
RAILROAD LS
WOLF RANCH LS
Cimmaron Hills WWTP
29
SOUTH FORK SAN GABRIEL RIVER
LEANDER RD
1460
TERAVISTA LS
WESTINGHOUSE RD
UNIVERSITY BLVD
WESTINGHOUSE LS
MIDWAY LS
South LS
TERAVISTA CLUB DR
TERAVISTA PKWY
COLLEGE PARK DR
CR 112
2243
1431
OAKMONT DR
N AW GRIMES BLVD
LEGEND
Wastewater Treatment Plants
Modeled Lift Stations
Other Lift Stations
Wastewater Lines
WW Force Main
Rivers and Streams
Wastewater Service Area
Modeled Gravity Lines
6-8"
10"
12-15"
18-21"
24-27"
30-36"
42-60"
N
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S
Georgetown Utility Systems
Water and Wastewater Master Plan - 2022
Figure 4-1 The Modeled Wastewater System
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CDM Smith
GEORGETOWN TEXAS

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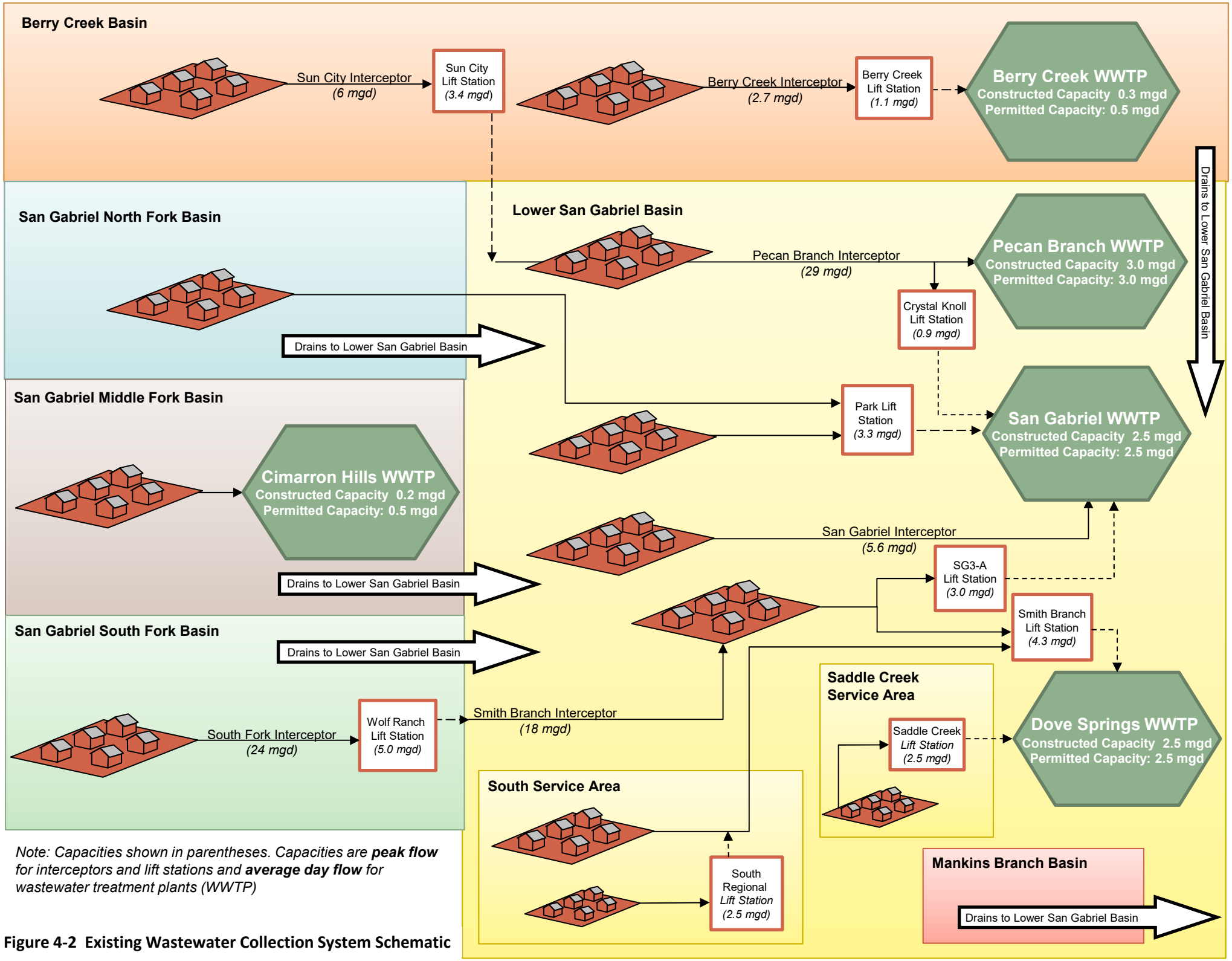

*Note: Capacities shown in parentheses. Capacities are **peak flow** for interceptors and lift stations and **average day flow** for wastewater treatment plants (WWTP)*

Figure 4-2 Existing Wastewater Collection System Schematic

4.3 Model Validation

For dry weather flow model validation, a comparison of observed and predicted flow at each WWTP is presented in **Table 4-2**. For each WWTP, the maximum observed annual average flow from 2018 to 2022 was used to compare to the model predicted results. Flow measurements during large rainfall events (greater than 2 inches in depth) were removed from the observed average to better represent dry weather conditions.

For wet weather flow model validation, a comparison of observed and predicted flow at each WWTP is presented in **Table 4-2**. For each WWTP, the total flow during the rain event was used to compare to the model predicted results.

Table 4-2 Wastewater Treatment Plant Flow Comparison

WWTP	2018–2021 Maximum Observed of Annual Average DWF (mgd)	Model Predicted Average DWF (mgd)	Observed WWF Volume (MG) March 21–22, 2022	Model Predicted WWF Volume (MG) March 21–22, 2022
Berry Creek[1]	0.20	0.20	0.29	0.45
Cimarron Hills	0.15	0.19	0.32	0.39
Dove Springs	1.67	1.69[3]	4.04	4.67[4]
Pecan Branch[1]	2.00	2.06	2.95	4.40
San Gabriel[2]	2.20	1.76[3]	5.26	4.60[4]

1. For Berry Creek, Pecan Branch, and San Gabriel, reuse production was added to the wastewater treatment plant discharge
2. Pumping between Pecan Branch and San Gabriel by way of Crystal Knoll Lift Station was not modeled. The modeled flow at Pecan Branch could be lower, and the modeled flow at San Gabriel could be higher.
3. Calibration of the total flow between Dove Springs and San Gabriel is difficult because of the varying conditions at the Smith Branch Lift Station diversion box. Dry weather flow volume at San Gabriel and Dove Springs was set to a confirmed dry weather period. The annual average is potentially influenced by WWF.
4. Predicted WWF volume between Dove Springs/San Gabriel WWTP matches observed. However, the split at the Smith Branch LS diversion box is not perfectly matched because of varying conditions.

The validation results are shown graphically in **Figure 4-3** for average annual dry weather flow along with the permitted capacity of each WWTP. **Figure 4-4** shows the difference in the modeled and observed total flow volume during the March 2022 rain event at each WWTP. Overall, the model compares well to observed values. Noticeable differences are discussed in the following bullets:

- San Gabriel/Dove Springs WWTPs: Predicted values for these WWTPs are low compared to the observed values for average day dry weather flow. This is likely due in part to the calibration period being slightly below the largest annual DWF average. The other factor is the Smith Branch Lift Station diversion box largely influences the total flows predicted at each plant.
- Pecan Branch WWTP: Predicted WWF exceeds measured WWF. This is likely due to differences in actual rainfall versus what the model is predicting over the same areas.

Matching actual rainfall over areas to measured is very difficult. The wet weather calibration as discussed in **Appendix B** is within acceptable limits.

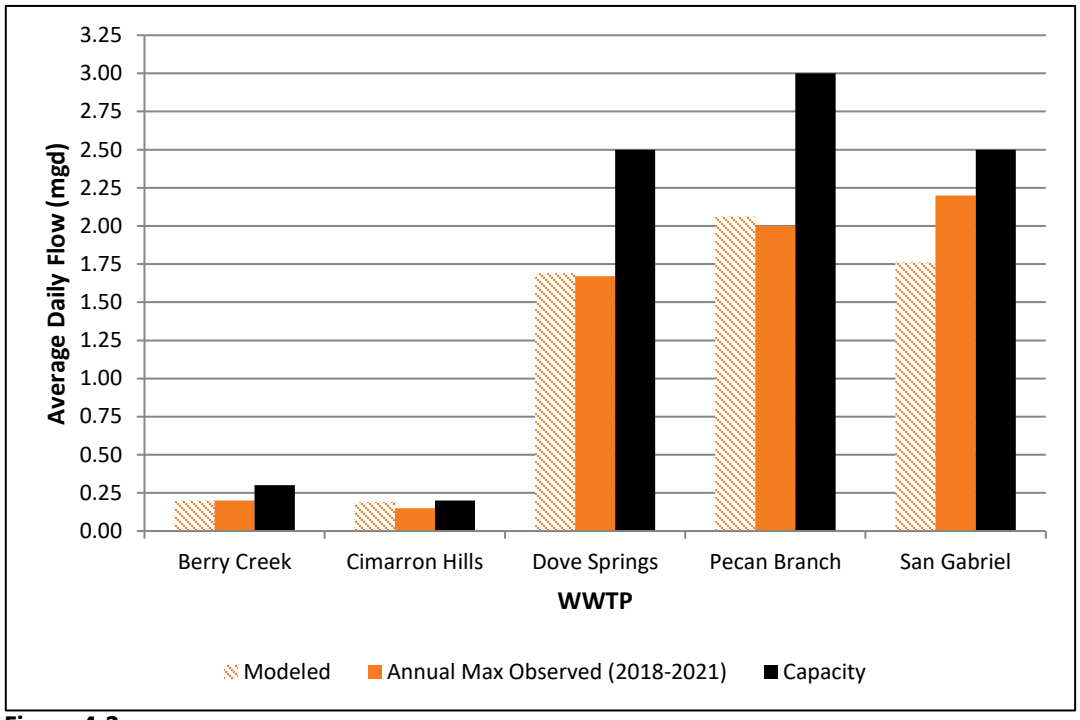

Figure 4-3
Modeled versus Observed Average Day Wastewater Treatment Plant Flow

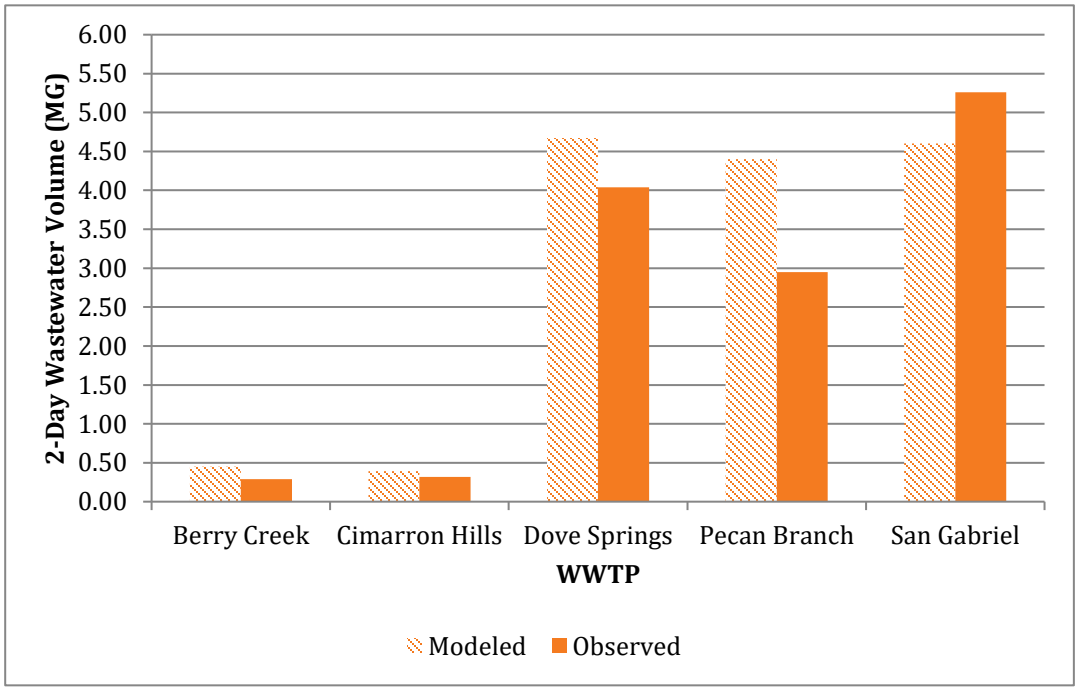

Figure 4-4
Modeled versus Observed WWTP Volume During Rainfall Event (March 21-22, 2022)

4.3.1 Previous Model Comparison

The predicted peak WWF using the same design storm as used in previous master plans was compared to the 2008–2018 WWMP models at key locations in the system. All increases and decreases in the predicted peak WWF were deemed reasonable given the known changes in the model and changes in population. **Table 4-3** summarizes the findings of this comparison.

Table 4-3 Predicted Peak WWF at Key Locations

Location	Peak WWF (mgd)[2]				Difference from 2018 to 2022 (mgd)	Comments/Notes
	2008 WWMP Model	2014 WWMP Model	2018 WWMP Model	2022 WWMP Model		
Sun City Lift Station	2.49	3.20	2.50	2.70	0.20	Upstream service area expansion
Smith Branch and SG3A Lift Stations	6.18	6.90	7.27	6.66	-0.61	Calibration of wet weather response given better data
Wolf Ranch Lift Station	1.56	1.41	1.50	1.57	0.07	Upstream service area expansion
Pecan Branch WWTP	4.95	6.40	5.56	5.18	-0.38	Calibration of wet weather response given better data
San Gabriel WWTP	8.43	7.78	8.88	8.85	-0.03	N/A
Dove Springs WWTP	3.84	4.17	4.39	5.87	1.48	Upstream service area expansion
Berry Creek WWTP	1.17	1.20	1.20	1.14	-0.06	Minor reduction to match flow data
Cimarron Hills WWTP	0.60	0.57	0.90	1.00	0.10	Increased residential growth in the service area accounts for the increase in flows

1. Peak WWF based on the design storm condition, which is discussed further in Section 5.
2. The Peak WWF for lift stations are measured as a 2-hour peak flow while all WWTPs are measured as a peak 1-hour flow to be consistent with the 2008 and 2014 WWMP values for comparison.

Section 5
Evaluation

After updating and calibrating/validating the existing conditions collection system model, the system was evaluated using a design storm to determine necessary improvement projects. Next, wastewater flows projected for the 10-year and buildout planning horizons were used to evaluate the existing collection system under future flow conditions. This section presents the design storm and hydraulic criteria used to evaluate the model and the results of the evaluation.

5.1 Design Storm

A 2-year, 24-hour design storm was developed and used in the model to evaluate the performance of the City's wastewater collection system under wet weather conditions. The design storm is used to produce the RDII in the model. The design storm rainfall depth of 4.1 inches was determined from TP40 (Hershfield 1961) for Georgetown, Texas. The Soil Conservation Service Type III distribution was applied to the rainfall depth to get the design storm shown in **Figure 5-1** in terms of intensity and cumulative depth.

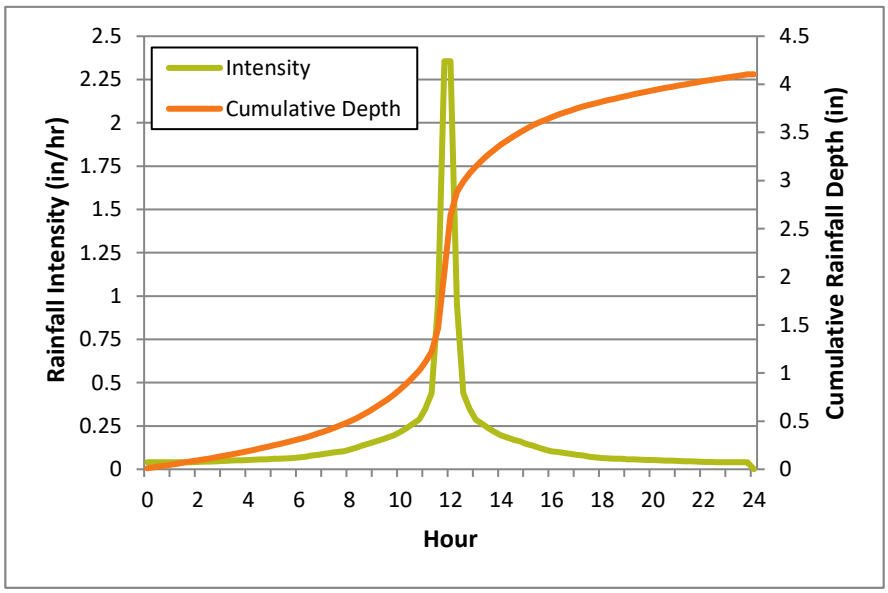

Figure 5-1
Design Storm Used for Collection System Evaluation for

5.2 Hydraulic Criteria

Hydraulic criteria were used to evaluate the City's wastewater collection system under existing and future conditions. Texas Commission on Environmental Quality (TCEQ) Design Criteria for Domestic Wastewater Systems is contained in Title 30 of the Texas Administrative Code (TAC), Chapter 217. As design criteria, not all of the criteria in Chapter 217 are applicable for evaluating an existing wastewater system based on modeling results. The criteria selected from Chapter 217 considered appropriate for a model evaluation are the following:

- Criteria of Wastewater Flow
  - TAC §217.53(a)(1): *An owner must design a wastewater collection system to handle the transport of the peak dry weather flow from the service area, plus infiltration and inflow.*

- TAC §217.53(j)(1): *An owner must ensure that a wastewater collection system's capacity is sufficient to serve the estimated future population, including institutional, industrial, and commercial flows.*

- Gravity Pipe Criteria
  - TAC §217.53(j)(3): *A collection system must be designed to prevent a surcharge in any pipe at the expected peak flow.*
  - TAC §217.53(l)(1): *All wastewater collection systems must contain slopes sufficient to allow a velocity when flowing full of not less than 2.0 feet per second.*
  - TAC §217.53(l)(2)(B): *If a velocity greater than 10 feet per second will occur when a pipe flows full, based on Manning's formula…and an "n" value of 0.013, special provisions must protect against pipe and bedding displacement.*
- Force Main Criteria
  - TAC §217.67(a)(2) *For a duplex pump station, the minimum velocity is 3.0 feet per second with one pump in operation*.
  - TAC §217.67(a)(3) *For a pump station with three or more pumps: (A) the minimum velocity in a force main is 2.0 feet per second with only the smallest pump in operation; and (B) a minimum flushing velocity of 5.0 feet per second or greater must occur in a force main at least once daily.*
  - TAC §217.67(a)(4) …[ensure] *that a pipeline with a velocity greater than 6.0 feet per second can withstand high and low negative surge pressures in the event of sudden pump failure.*
- Lift Station Criteria
  - TAC §217.61 (c): *The firm pumping capacity of a lift station* [capacity of the lift station with the largest pump out of service] *must handle the expected peak flow.*
  - TAC §217.60 (b)(7): *Pump cycle time, based on peak flow, must equal or exceed* [the recommended cycle times according to horsepower].
- WWTP Criteria
  - Average daily flow to plant is less than the existing treatment capacity.

For gravity pipes, force mains, and lift station pumping capacity, the model predicted values could be used directly to assess performance. Lift station wet well volume and WWTP capacity evaluations require additional information as discussed in the following sections. Recommendations for investigations or improvements were made where the above criteria were not met.

All design and planning criteria approved by the City are discussed in more detail in **Appendix C**.

5.2.1 Lift Station Working Volume

TCEQ recommends a minimum working volume based on design pump rate and horsepower to limit pump starts that may lead to excessive wear and tear on the pump and motor that will result in premature failure of the pumping system. To assess the adequacy of working volume, the existing volume was compared to the recommended minimum volume as determined based on minimum cycle times. The working volume is defined by the area of the wet well and the distance between the pump on and pump off elevations. Most of this information was obtained from surveys or drawings. In some cases, the pump on and off elevations had to be assumed.

The design guidelines indicate that wet wells should be sized to prevent excessive pump starts that could lead to excessive wear and tear on the pump motors. Adequate volume can be calculated from the following equation:

$$V = \frac{tQ}{4}$$

where: Q = maximum contributing capacity of the pump (gpm)
t = minimum allowable cycle time (min)
V = recommended storage volume (gallons)

Minimum cycle time should be provided by the manufacturer, but for evaluation, the minimum cycle times required by TCEQ shown in **Table 5-1** were used.

Table 5-1 Minimum Pump Cycle Time

Pump Horsepower	Minimum Cycle Time (min)
< 50	6
50–100	10
> 100	15

For evaluation, the recommended working volume was compared to the working volume calculated based on the pump on and off elevations for each pump. If all of the pumps in the lift station have the same capacity, it is only necessary to evaluate the first pump. For pumps of different capacities, the associated working volume is calculated and evaluated for each. If the lift station has at least two pumps and the lift station is set up to alternate the starting pump, the time between starts for each pump doubles, thus the volume required can be reduced by half.

5.2.2 Wastewater Treatment Plant Capacity

WWTP capacity required for existing wastewater flows was evaluated by examining observed treatment plant flow data and simulated flows at each WWTP. The simulated flows for existing conditions tend to be higher than observed because of conservative estimates of wastewater flow; therefore, the current capacity was only considered deficient if the observed flows exceed

the rated capacity of each WWTP. For future conditions, both model results and current observed flows were considered in evaluating future capacity needs.

5.3 Existing and Future Condition Evaluations

The existing system model was assessed using the hydraulic criteria presented in the previous section for existing condition wastewater flows. Future condition flows were then applied to the existing system model and were evaluated for two planning horizons: 10-year and buildout.

5.3.1 Existing System Evaluation

Model results for existing flows indicate minimal deficiencies in the system under wet weather conditions given the 2-year design storm event. The evaluation results are summarized in the following sections.

5.3.1.1 Gravity Pipe

For gravity pipes, surcharging is predicted in about 5 percent of the modeled pipes. The majority of surcharged pipe is due to RDII. Additionally, some pipes are surcharged because the water level in a downstream lift station is higher than the top of the incoming pipe. Some specific areas of predicted surcharging are listed below, with areas of RDII concern shown in **Figure 5-2**:

- Rabbit Hill Road/Westinghouse and Midway Lift Station Area: Approximately 11,450 feet of pipe is predicted to be surcharged. The model predicts potential overflows at multiple locations in this area. This area operates well below capacity during DWF. The predicted RDII response to the design storm is the driver for the capacity deficiency in this area.
- San Gabriel Basin along Hart Street/West Street from 16th St to 6th Street: Approximately 6,100 feet of pipe is predicted to be surcharged. The hydraulic grade line is predicted to be within 1 foot of ground level near Hart Street and 14th Street. This area operates well below capacity during DWF. The predicted RDII response to the design storm is the driver for the capacity deficiency in this area.
- SG3A Interceptor: This interceptor is north of Smith Branch Lift Station. Prior to the SG3A Lift Station, which pumps to the San Gabriel WWTP, roughly 230 feet of pipe is predicted to be surcharged. These pipes were sized for a peak flow capacity of 3.0 mgd, and this capacity is being exceeded in the model because the Smith Branch Lift Station is not modeled precisely. In reality, the lift station will pump more to avoid too much flow to the SG3A lift station.
- Near Booty's Crossing: With the new connection to the Public Safety Training Facility and the Lake Water Treatment Plant dewatering flow of 0.55 mgd, two sections of the wastewater line in Texas Traditions are predicted to surcharge because they are undersized for the peak flow. The predicted surcharging was anticipated with the recent change in the system, but it was understood that the level of surcharging is minimal with the hydraulic grade line well below the ground. This surcharging is only predicted to occur with the plant dewatering flow, which should only be occurring during DWF conditions.

The gradient of existing gravity pipes was also evaluated to determine if they meet the minimum requirements. The pipe should be laid at a slope that results in a velocity that is between 2 and 10 feet per second (ft/s) when flowing full. Pipes that do not meet this criterion are mostly scattered throughout the system as shown in **Figure 5-2**.

5.3.1.2 Force Mains

Force mains were evaluated according to the criteria listed in Section 5.2. Of the 19 lift station force mains modeled, 14 met the necessary criteria for TCEQ. The remaining force mains are presented in **Table 5-2** with recommendations for actions.

Table 5-2 Force Mains Evaluation

Lift Station (LS)	No. of Pumps	Force Main Diameter	Predicted Max. Velocity 1 Pump (ft/s)	Deficiency	Recommendations
INTERCEPTOR LS	2	12	2.7	Min. 3 ft/s not met	No Action. Lift station is likely to be replaced with gravity in the future.
RAILROAD LS	2	4	7.74	Exceeds max. 6 ft/s	Verify Flow. Modeled flow is greater than design capacity.
STONEHEDGE LS	2	8	10.8	Exceeds max. 6 ft/s	No Action. This velocity only applies to the short section of line before connecting into the Smith Branch force main.
WESTINGHOUSE LS	2	6	2.7	Min. 3 ft/s not met	No Action. Lift station may be retired in the future.

5.3.1.3 Lift Stations

Lift stations were assessed for pumping capacity and wet well volume. All of the modeled lift stations have enough capacity for the modeled peak WWF, but some lift stations are nearing capacity. Those lift stations and some additional observations regarding other lift stations are discussed below:

- Smith Branch and SG3A Lift Stations: These two lift stations work in conjunction to pump flow from the Smith Branch basin either to Dove Springs or San Gabriel WWTPs. The firm capacity of the Smith Branch Lift Station has increased from 4.3 to about 4.9 mgd because of the rerouting of force mains and connection with the Stonehedge Lift Station. With the SG3A Lift Station, the total firm capacity from both lift station is 7.9 mgd. The predicted existing conditions peak WWF upstream of these lift stations is 8.3 mgd. Therefore, the City should begin work on projects planned to relieve this area.

- Westinghouse and Midway Lift Stations: The Midway Lift Station, which is upstream of the Westinghouse Lift Station, has a greater capacity than the Westinghouse lift station and it is larger than needed at this time. This causes short, high-flow spikes of wastewater flow to enter the Westinghouse Lift Station wet well. These spikes of flow are low in volume and are easily pumped by the Westinghouse Lift Station; therefore, it is unnecessary to improve the lift station. Additionally, both lift stations are planned for retirement in the future with their flow routed to the South Regional Lift Station.

All other lift stations are at or below 80 percent of capacity.

Regarding the minimum guideline for working volume, Scenic and Wolf Ranch Lift Stations do not meet the minimum guideline. The minimum required cycle times have been increased since the previous master plan and are included in the design criteria in Appendix C. Based on the TCEQ recommended minimums, Scenic Lift Station does meet the minimum requirement. Similar to the last master plan, Wolf Ranch Lift Station does not meet the minimum. Smith Branch Lift Station was not evaluated because the pumps have variable frequency drives; therefore, the minimum cycle time requirement does not apply.

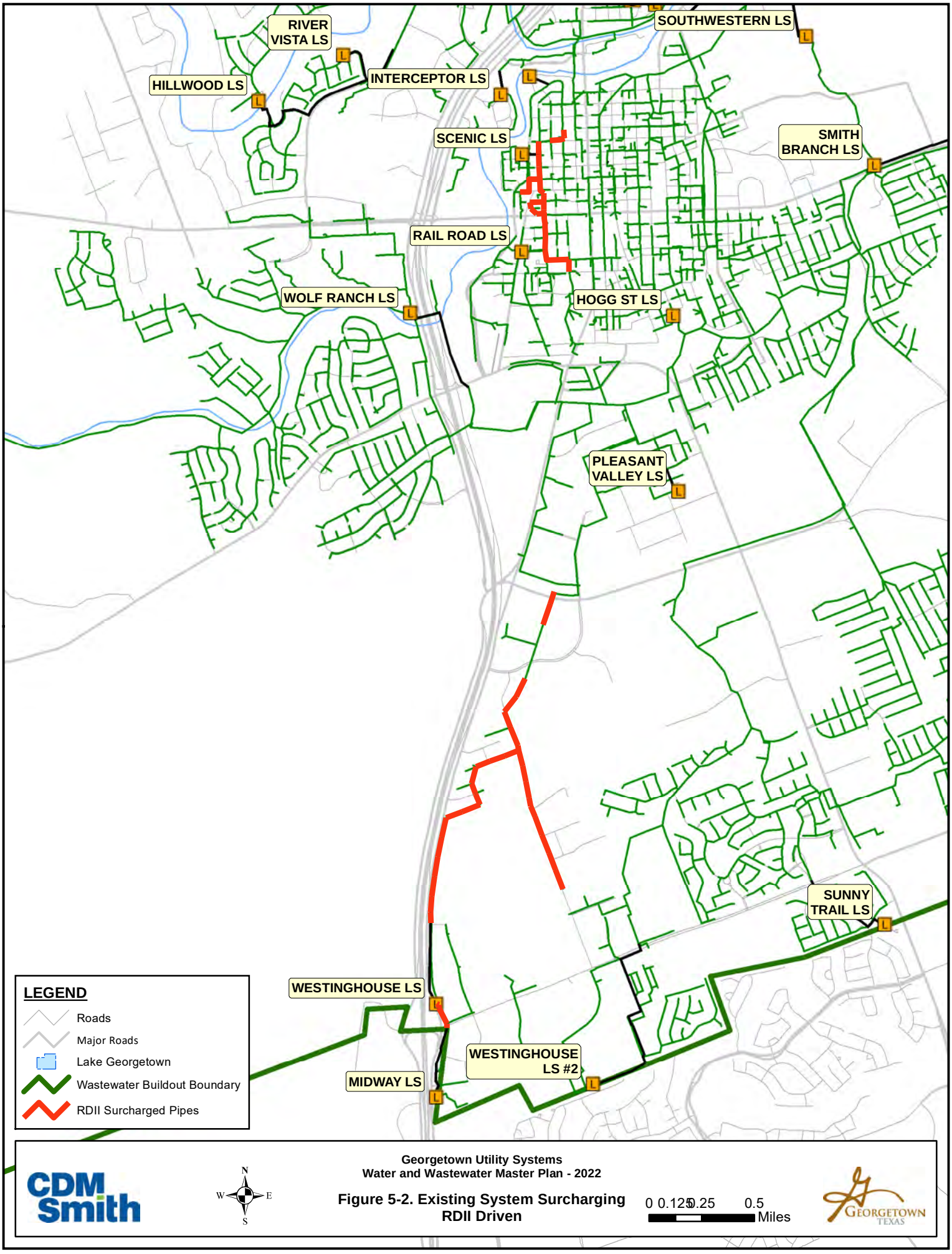

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Figure 5-2. Existing System Surcharging RDII Driven

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OPOSSUM CREEK
195
2338
COWAN CREEK
SUN CITY LS
BERRY CREEK WWTP
BERRY CREEK
BERRY CREEK LS
3405
972
SERENADA LS
NORTH FORK SAN GABRIEL RIVER
GATLIN CREEK LS
LAKESIDE LS
LAKESIDE LS 2
PECAN BRANCH WWTP
SAN GABRIEL RIVER
130
CRYSTAL KNOLL LS
971
NORTH FORK SAN GABRIEL RIVER
RIVER ROAD LS #1
RIVER ROAD LS #2
COUNTRY CLUB LS
KATY CROSSING LS
SAN GABRIEL WWTP
CIMARRON HILLS LS #2
CIMARRON HILLS WWTP
OAKS AT SAN GABE LS
CIMARRON HILLS LS #1
MIDDLE FORK SAN GABRIEL RIVER
PARK LS
SOUTHWESTERN LS
RIVER VISTA LS
INTERCEPTOR LS
BLUE HOLE LS
HILLWOOD LS
STONEHENGE LS
DOVE SPRINGS WWTP
SCENIC LS
INDIAN CREEK LS
SMITH BRANCH LS
RAIL ROAD LS
29
WOLF RANCH LS
SOUTH FORK SAN GABRIEL RIVER
PLEASANT VALLEY LS
AMBER OAK LS
1460
2243
KASPER LS
GATEWAY LS
SUNNY TRAIL LS
MAYFIELD RANCH LS
WESTINGHOUSE LS
MIDWAY LS
WESTINGHOUSE LS 2
IGHLANDS LS
1431
175
3406

LEGEND

- LIFT STATION
- TREATMENT PLANT
- Modeled Wastewater Lines
- Pipe Does Not Meet Min. Slope Req.
- Existing Gravity Main
- Major Streets
- Existing Service Area

CDM Smith

N W E S

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Figure 5-3 Gravity Pipe Gradient Evaluation

0 0.325 0.65 1.3 Miles

GEORGETOWN TEXAS

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5.3.1.4 Wastewater Treatment

As shown in **Figure 5-4**, plant discharge data from 2018–2021 indicates that all of the WWTPs have sufficient capacity for existing wastewater flows. However, each plant is nearing capacity and future expansion will be required to meet near-term capacity needs.

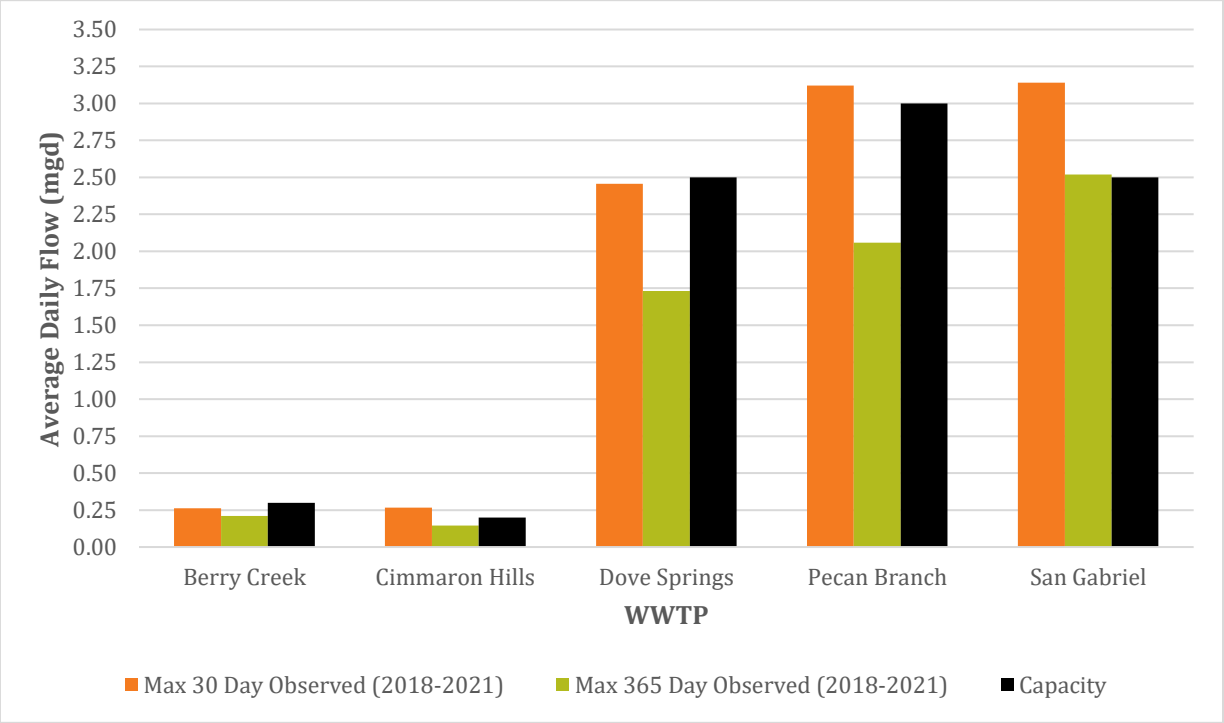

Figure 5-4
Maximum Observed 30-Day/365-Day Flow (2018–2021) Compared to Capacity

5.3.2 10-Year (2032) System Evaluation

The wastewater collection system was evaluated for future flows expected within 10 years. Gravity pipes, lift stations, and wastewater treatment were evaluated as discussed below. For future conditions, it was not necessary to evaluate force mains and lift station working volumes because the circumstances that impact those evaluations do not change with increased wastewater flows.

5.3.2.1 Gravity Pipe

Most of the existing gravity pipe is sufficient for the 10-year planning horizon. Where the system is deficient, new gravity lines are planned, as discussed in **Section 6**, to relieve the existing system. New gravity lines are also needed in areas where new growth is planned. Specific capacity concerns for the 10-year planning horizon are discussed below and identified in **Figure 5-5**:

- Smith Branch Interceptor: This is a major interceptor that runs along the south end of downtown Georgetown. It currently intercepts flow from the south service area and the South Fork area, both of which have significant growth projected in the future. The CIP projects identified to bypass the Smith Branch Interceptor within the 10-year planning horizon are listed below:
  - Cross Town Tunnel – Gravity sewer that will connect the South Fork Interceptor directly to the Smith Branch diversion gravity sewer.
  - SGI Gravity Sewer – Gravity sewer that will connect the Smith Branch diversion gravity sewer to the SGI-PB Lift Station.
  - SGI-PB Lift Station – Lift station and force main that will connect the SGI gravity sewer to the Pecan Branch WWTP.
- System through Sun City: Significant growth is anticipated in Sun City and the areas north and northwest of Sun City. The main gravity interceptor that runs through the Sun City service area does not have capacity to serve all of the growth anticipated within 10 years. The CIP projects to relieve the Sun City gravity constraints are listed below:
  - Northlands WWTP – New wastewater treatment plant. See discussion in the 10-year WWTP evaluation section for timing information.
  - CC-LS – Lift station and force main to take flow from the Sun City gravity sewer to the Northlands WWTP.
  - CC-1/CC-7 – Gravity sewer upgrades to the existing Sun City gravity sewer to expand capacity to serve future growth.

5.3.2.2 Lift Stations

Many of the existing lift stations have sufficient capacity out to 2032. Lift station restrictions predicted for 2032 are discussed below and identified in **Figure 5-5**:

- Sun City Lift Station: The Sun City Lift Station is currently near capacity and is predicted to be deficient within 10 years. The current firm capacity is 3.4 mgd. The existing and 10-year predicted peak WWF at the lift station is 2.7 mgd and 8.6 mgd, respectively, assuming no new projects to divert upstream flows. Assuming linear growth for Sun City and the areas upstream, the lift station could be at capacity in about 1 year. The Berry Creek Interceptor, which will send flow by gravity from the Sun City area to the Pecan Branch WWTP, is currently in design to relieve this lift station. Additionally, flow may be diverted upstream to the proposed Northlands WWTP.
- Smith Branch and SG3A Lift Stations: As previously discussed in Section 5.3.1.3, these two lift stations work in conjunction to pump flow from the Smith Branch basin either to Dove Springs or San Gabriel WWTPs. The total firm capacity from both lift station is 7.9 mgd. The predicted peak WWF for 2032 upstream of these lift stations is 14 mgd, assuming no projects to divert upstream flows. The project needed to relieve this area is the cross-town

tunnel and San Gabriel Interceptor, which will send flow by gravity to the to the Pecan Branch WWTP.

Beyond improvements to relieve specific lift stations, new lift stations are needed for new service areas planned within 10 years. Specific projects are discussed in Section 6.

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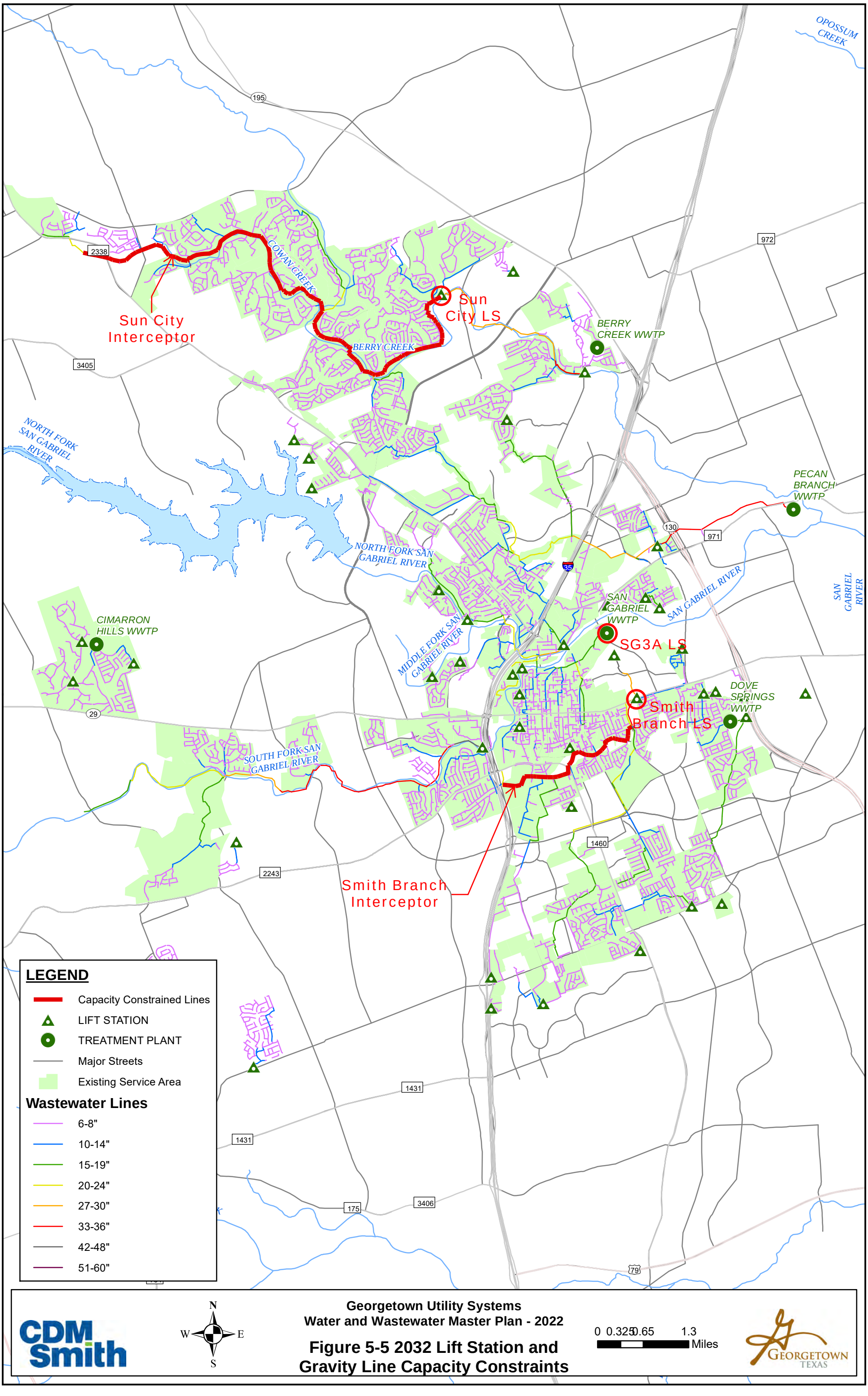

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Figure 5-5 2032 Lift Station and Gravity Line Capacity Constraints

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5.3.2.3 Wastewater Treatment – Model Analysis

The model predicted 10-year average daily flow compared to existing capacity is shown in **Figure 5-6**. Please note that by design the wastewater model flow estimates are conservative and cannot be used to directly plan for future wastewater treatment service. However, the general trends that the model is predicting have merit and are discussed below. Section 5.3.2.4 provides a separate WWTP analysis given slightly less conservative growth assumptions.

The predicted flows assume the Northlands WWTP has been constructed and is in service. Additionally, this assumes that all flow going to the Smith Branch Lift Station is directed to Pecan Branch WWTP. These results are discussed further below for each WWTP:

- Berry Creek WWTP: The model predicted flows for Berry Creek are controlled to match Berry Creek's WWTP capacity. Once the Berry Creek Interceptor project is completed, the City will have to decide how much flow to divert to the Berry Creek WWTP.
- Cimarron Hills WWTP: By 2032 the Cimarron Hills WWTP is assumed to be off line with its flow directed to the South Fork Interceptor and eventually to the Pecan Branch WWTP.
- Dove Springs WWTP: This WWTP is predicted to exceed capacity within 10 years if other improvements to reroute flow are not implemented. This WWTP is already built to the permitted capacity; therefore, it is recommended that flow from the Smith Branch basin be rerouted to the Pecan Branch WWTP for the 2032 planning horizon. However, with the diversion in place, the predicted average daily flow at Dove Springs is 2.4 mgd.
- Pecan Branch WWTP: The model predicted 10-year flows are likely high based on comparing the results of the existing conditions model to observed data, but there is significant growth in the basin, and flows are likely to exceed capacity by 2032. Additionally, flow from areas currently served by Dove Springs and San Gabriel WWTPs that exceed their capacities will likely be diverted to the Pecan Branch WWTP.
- San Gabriel WWTP: The 10-year model predicted flows exceed the capacity of this WWTP. Because of the Edward's Aquifer rules, San Gabriel WWTP will not be expanded. It is recommended instead to expand Pecan Branch WWTP and route flow there. In the interim, flow can be transferred to the Pecan Branch WWTP via the transfer pump station at the San Gabriel WWTP that uses the Crystal Knoll force main.
- Northlands WWTP: The 10-year model predicted flows to the Northlands WWTP are 2.2 mgd (average daily). This assumes all flow up to the proposed Cowan Creek Lift Station is diverted to the Northlands WWTP.

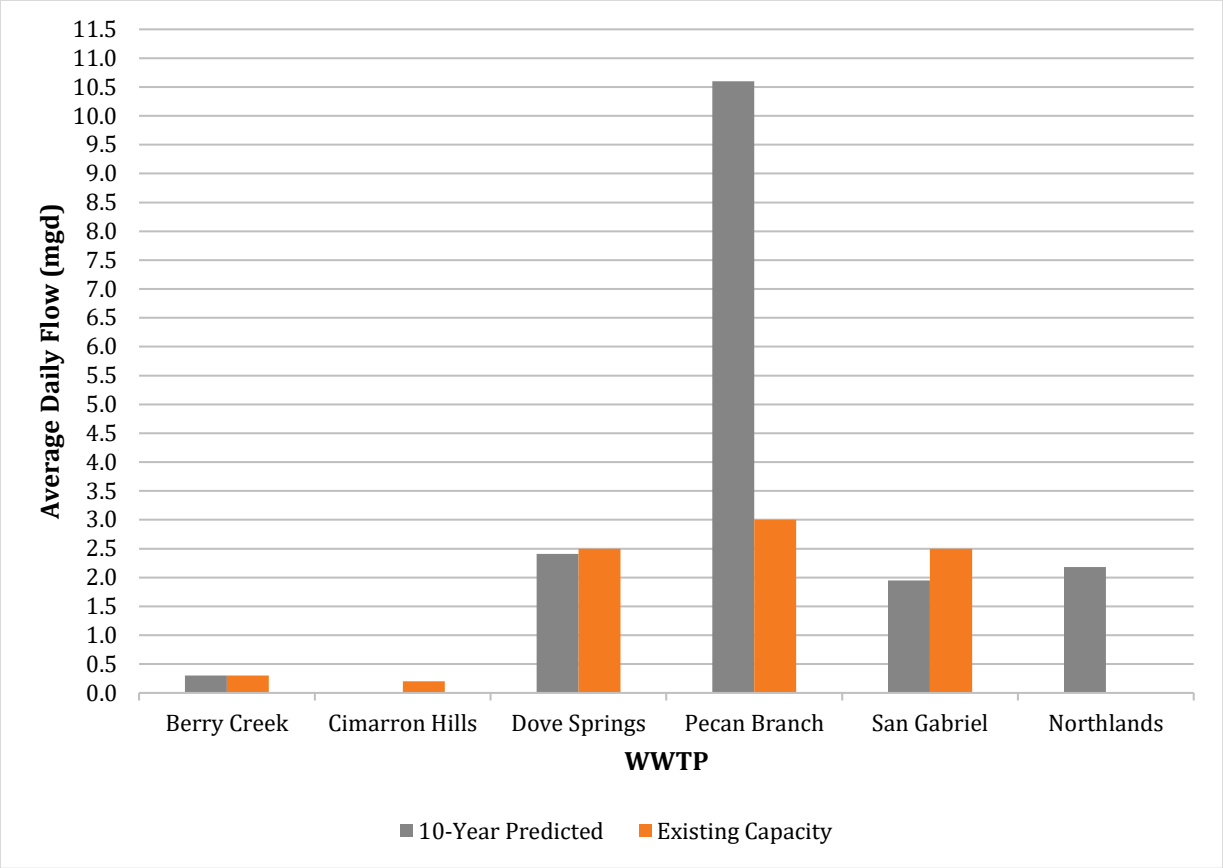

Figure 5-6
Ten-Year Predicted Average Daily Flows Compared to Existing WWTP Capacities

5.3.2.4 Wastewater Treatment – Timing Analysis

As shown above, even given the conservative nature of the model, it is clear that treatment plant capacity expansion will be required to provide future service within the City's wastewater service area. To predict when this expansion will be required, CDM Smith performed an analysis outside of the hydraulic model using the following assumptions:

- 3,500 new wastewater connections per year within the City's wastewater service area.
- 2.5 people per connection at 75 gpcd.
  - 75 gpcd chosen by dividing total average dry weather flow observed (6.22 mgd) by the estimated 2022 model population (83,749) and rounding.
  - CDM Smith will also include a representation of 100 gpcd to show how the system may operate during higher rainfall conditions.
- To spatially distribute these assumed connections, CDM Smith used the predicted model growth distribution to allocate future connections using the percentage of total growth in each service area within the model.

Northlands WWTP

The critical factor for the construction timing of the Northlands WWTP is not treatment capacity. The limiting factor in this case is an existing section of 18-inch gravity sewer that was installed at minimum slope (see upper left corner of **Figure 5-7**). The existing pipe capacity (shown in yellow) for this area is between 1.7-2.8 mgd. Existing peak wet weather flow is 0.55 mgd with predicted flows in 2032 up to 5.7 mgd. Assuming linear growth in the upstream service area, the existing gravity sewer system could be over capacity as soon as 2025 (see **Figure 5-8** for details).

Based on the lead time for design and construction, CDM Smith recommends the City begin the process for design in the near future.

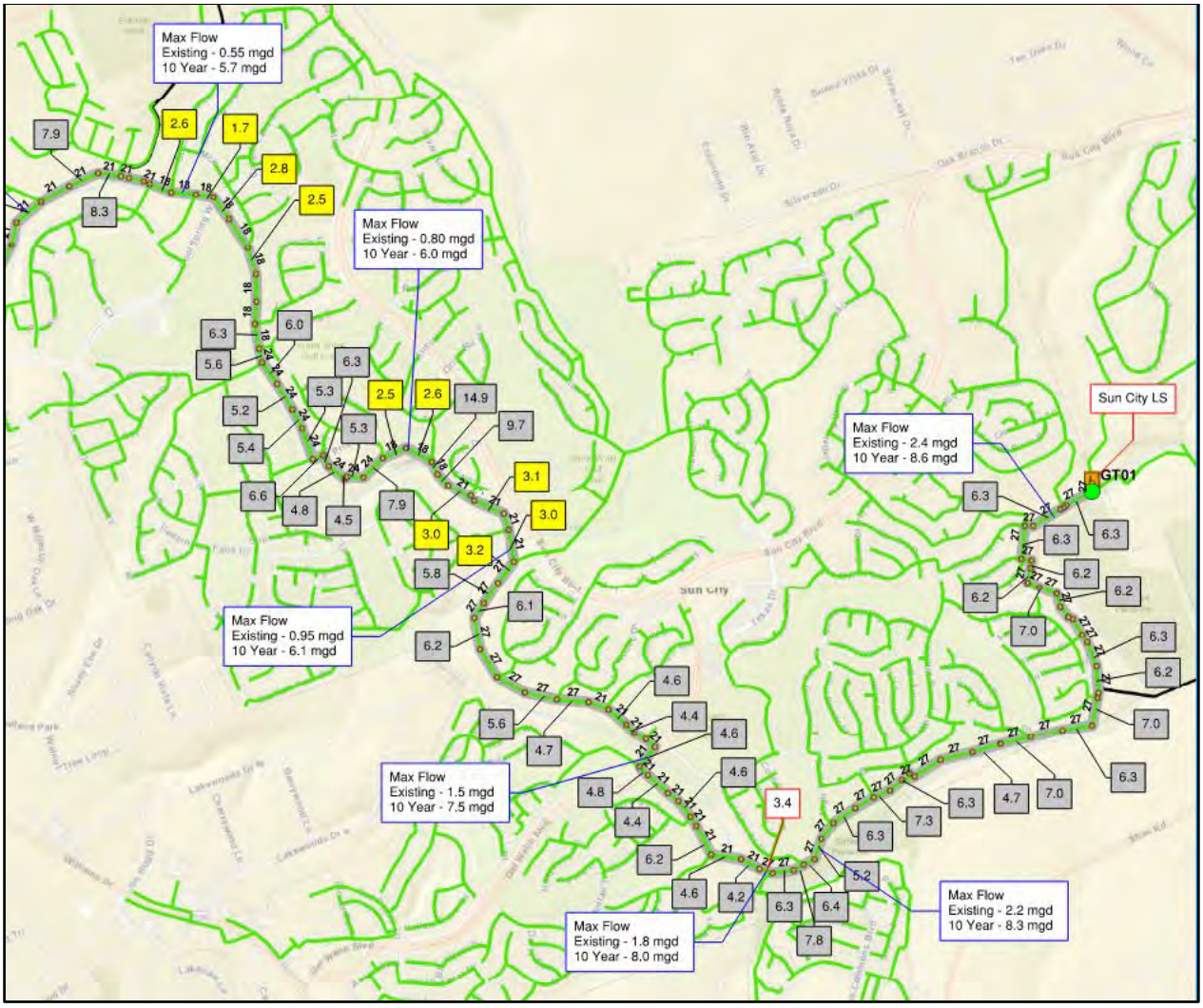

Figure 5-7
Sun City Gravity Sewer Capacity

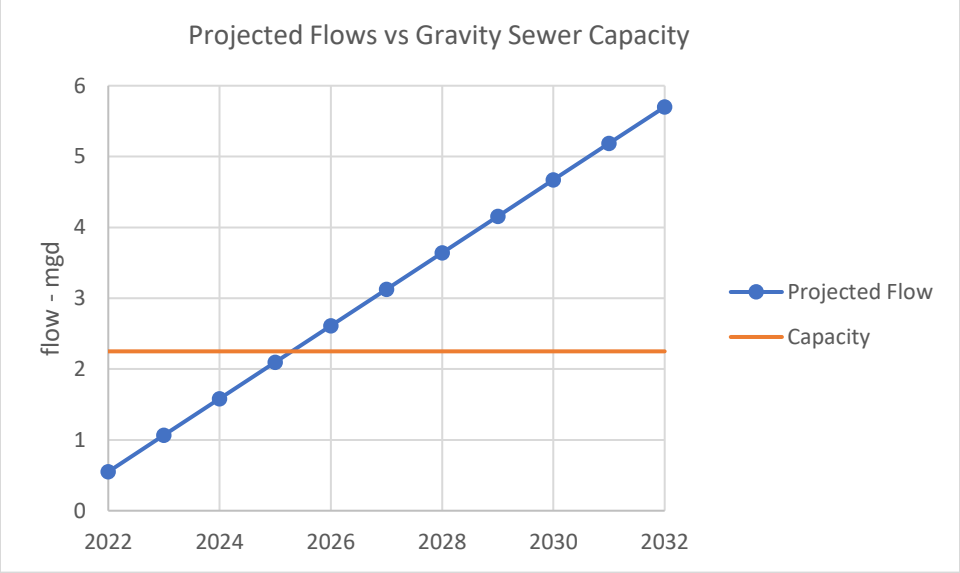

Figure 5-8
Sun City Gravity Sewer Capacity vs Projected Flows

Pecan Branch WWTP Expansion (Three Forks) Timing

Analyzing future growth and treatment capacity for the Pecan Branch WWTP can be difficult due to the existing and future wastewater system interconnectivity. In the 10-year planning scenario, the Pecan Branch WWTP will be able to take flow from:

- the South Fork interceptor via the cross-town tunnel and SGI interceptor/LS-FM
- San Gabriel WWTP via the San Gabriel diversion and SGI interceptor/LS-FM
- Sun City/Berry Creek WWTP via the Berry Creek Interceptor

Figure 5-9 below shows the existing and future treatment capacity vs the proposed flow for all areas listed above (excluding only the Dove Springs WWTP Basin). The flows begin with existing flow and grow based on the calculated area percentage growth (82%) of the proposed 3,500 connections per year at 2.5 people and 75/100 gpcd. At the growth rate of 3,500 connections per year, the City could exceed its treatment capacity as soon as 2025. However, once the Three Forks expansion is constructed, the City should have adequate treatment capacity for the foreseeable future.

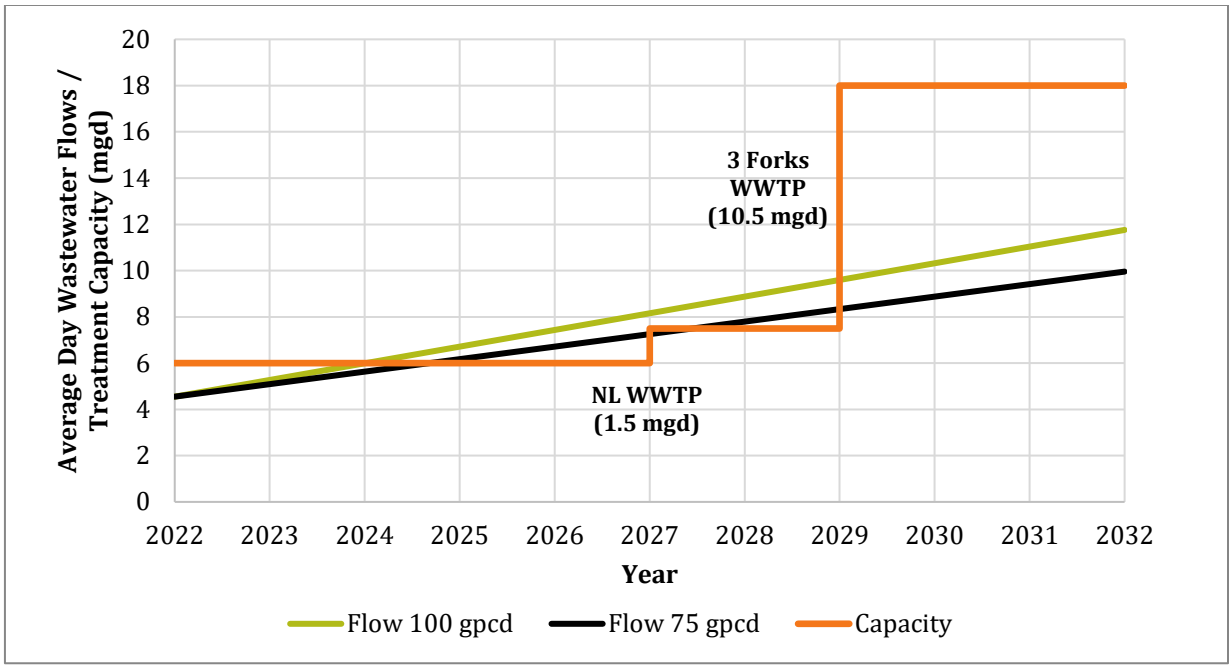

Figure 5-9
Future Treatment Capacity Excluding the Dove Springs WWTP and Service Area

5.3.3 Buildout System Evaluation

Under buildout conditions, much of the system would be deficient to convey and treat wastewater flows without the new infrastructure planned to serve the future development areas anticipated. The buildout model is mostly used to verify the sizing of this new infrastructure and to make sure deficiencies are not arising within the existing system. Each infrastructure component is discussed below with some specific areas of concern noted in **Figure 5-10**.

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COWAN CREEK

BERRY CREEK

North of Del Webb Blvd

2338

195

130

971

2243

1460

NORTH FORK SAN GABRIEL RIVER

SAN GABRIEL RIVER

MIDDLE FORK SAN GABRIEL RIVER

SOUTH FORK SAN GABRIEL RIVER

LEGEND

- Capacity Constrained Lines
- LIFT STATION
- TREATMENT PLANT
- Major Streets
- Existing Service Area

Wastewater Lines

- 6-8"
- 10-14"
- 15-19"
- 20-24"
- 27-30"
- 33-36"
- 42-48"
- 51-60"

CDM Smith

N W E S

Georgetown Utility Systems
Water and Wastewater Master Plan - 2022

Figure 5-7 Buildout Gravity Line Capacity Constraints

0 0.125 0.25 0.5 Miles

GEORGETOWN TEXAS

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5.3.3.1 Gravity Pipe

New gravity mains needed by buildout to serve the entire planned wastewater service area for the City are presented in Section 6. Deficiencies in existing gravity mains are discussed below. Note that these deficiencies account for flow from new areas that are served by projects that connect to some of these existing lines being evaluated.

- Southwestern Boulevard: A half-mile section of gravity pipe along Southwestern Boulevard, just upstream of the Smith Branch Interceptor, is predicted to surcharge under buildout conditions. Additional survey is recommended to review the model results in this area. If correct, a parallel line is recommended as part of the buildout improvements.
- Southwest Sun City: This 8-inch line north of Del Webb Boulevard is predicted to surcharge. Developments upstream will require the line to be upsized as discussed in Section 6.

5.3.3.2 Lift Stations

For buildout conditions, several lift stations are planned to be retired and new ones are planned to serve new areas. These lift stations are discussed in Section 6.

5.3.3.3 Wastewater Treatment

WWTPs are typically sized in phases, so planning for an ultimate buildout capacity is not usually needed. However, it can be helpful to predict buildout flows to plan how treatment capacity may expand over time. **Figure 5-11** shows how the City may anticipate expansions. Please note that **Figure 5-11** is based on the total model flow which as discussed previously is intended to be conservative with respect to treated flow.

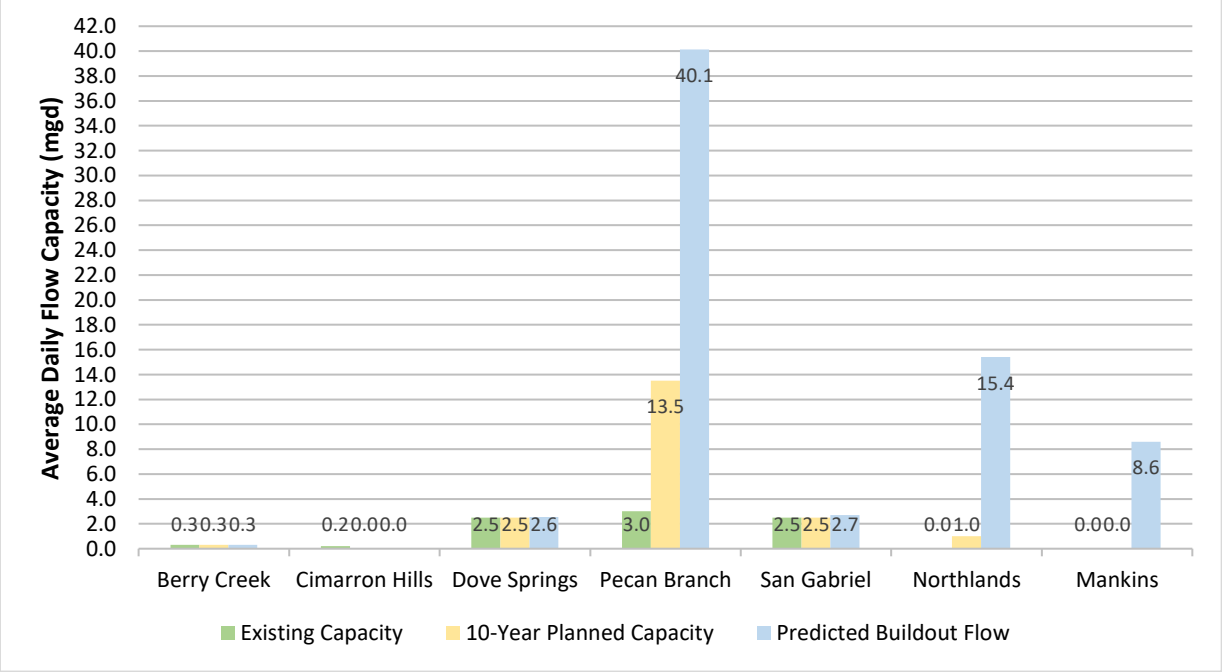

Figure 5-11
Potential WWTP Expansions

Figure 5-12 shows a graph of systemwide treatment capacity vs predicted flow given the same 75/100 gpcd assumptions and 3,500 new connections per year out to the buildout predicted population. This assumes all existing WWTPs will stay in service and does not account for basin specific growth timings or needs. Please note that the Three Forks Phase 2 expansion or the Northlands Phase 2 expansion may be required at different times dependent upon the location of increased wastewater flow and growth.

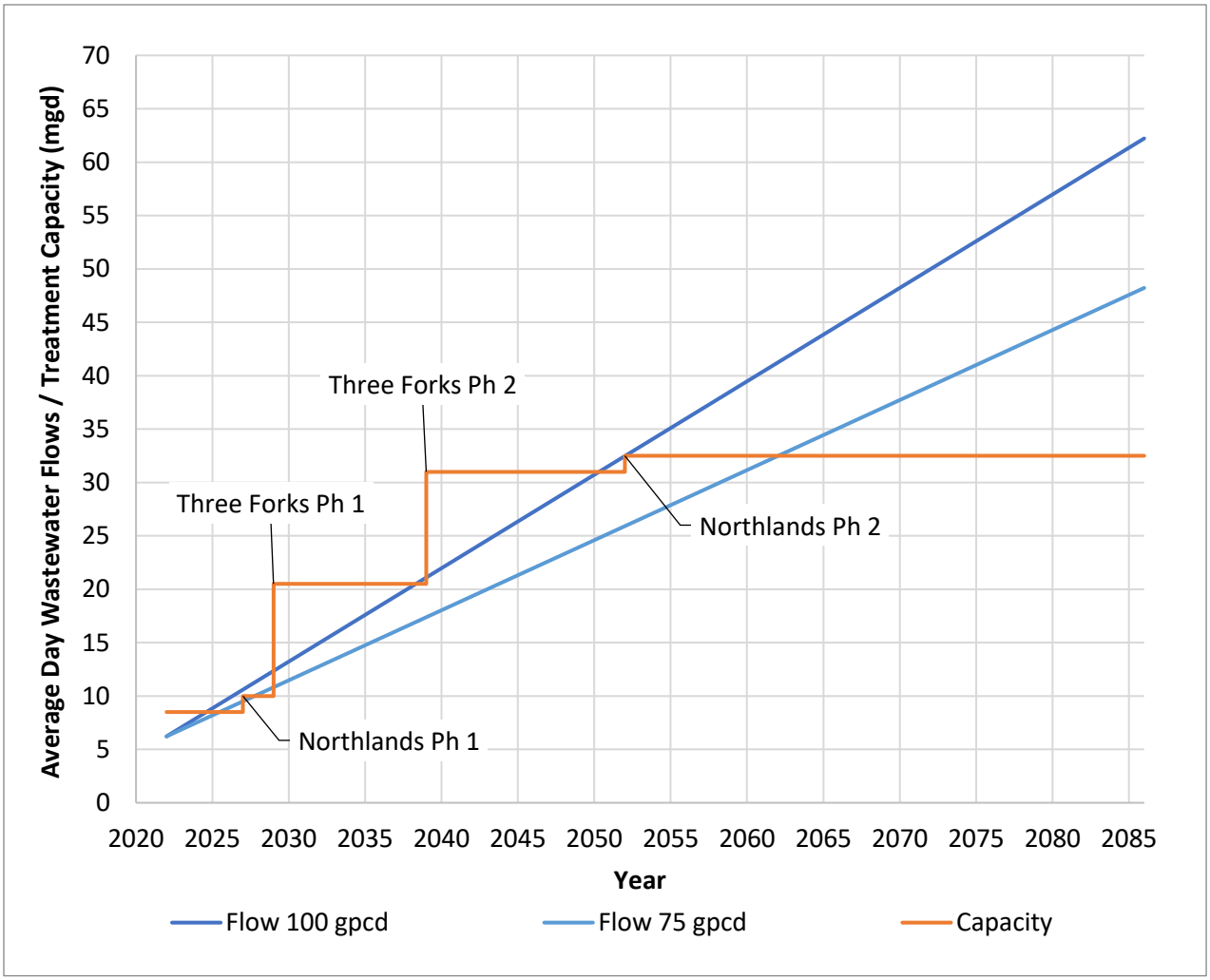

Figure 5-12
Treatment Capacity vs Flow Through Buildout

Section 6
Improvements

The overall purpose of this master plan is to identify possible deficiencies in the existing wastewater collection system based on existing and future flows and identify necessary wastewater system improvements to meet the wastewater needs of Georgetown and its service area. Existing and future condition models were developed that simulate the capacity impacts of expected changes in the magnitude of wastewater flows. Based on the results of these models, existing and predicted future deficiencies in the existing system capacity were identified and projects to serve future projected developments were located. Finally, recommended system improvements were sized and organized into individual projects to develop cost estimates and an implementation schedule for the 10-year CIP.

6.1 Cost Estimating

Total project cost estimates are provided for each project presented in **Section 6**, and a detailed breakdown of costs for each project is available in **Appendix D**. The total costs presented in this section are provided for each fiscal year (FY) of the project schedule as follows:

FY 1: 10 percent of total cost

FY 2: 20 percent of total cost

FY 3 through 5: 70 percent of total cost

Inflation was added to each cost based on the FY using varying inflation rates over the next 10 years. **Table 6-1** shows the assumed inflation.

Table 6-1 Inflation Assumptions

Year	Inflation Rate
2023	8%
2024	8%
2025	8%
2026	8%
2027	8%
2028	7%
2029	7%
2030	6%
2031	5%
2032	5%
2033	4%
2034	3.5%

6.2 Treatment and Constructability Constraints

All of the major watersheds within the City's wastewater service area ultimately drain to the Lower San Gabriel watershed (**Figure 4-2**). As a result of this hydrologic feature, any future wastewater flows must either be:

Treated prior to entering the Lower San Gabriel watershed

Conveyed through and treated within the Lower San Gabriel watershed

Pumped upstream within the source watershed or outside of the San Gabriel Basin

The third item above was deemed an impractical solution; therefore, it was not considered when evaluating improvement projects. The first and second items were considered taking into account regulatory and permitting constraints on wastewater treatment or constructability.

6.2.1 Treatment Constraints

Half of the projected service area in the South Fork Watershed is located in the Regulated Edwards Aquifer Recharge Zone (ERZ). TCEQ Chapter 213 prohibits discharge from wastewater treatment facilities within the ERZ. No-discharge facilities do exist in central Texas. However, these facilities are generally more expensive. If irrigation land is not immediately available and land purchases are necessary, no-discharge facilities can be up to twice as expensive as discharge facilities.

Approximately half of the South Fork Watershed and a majority of the active development in the Berry Creek Watershed are on the ERZ. Wastewater treatment facilities are permitted to discharge treated effluent in the Contributing Zone of the Edwards Aquifer; however, the permitting of such a plant at the downstream end of the South Fork may be difficult or not possible because of proximity to the Recharge Zone. While moving a discharge facility upstream in the watershed may make it easier to obtain a permit, the plant would not be ideally located to serve the entire watershed. The minimum effluent discharge parameters for a discharge on the Contributing Zone are 5/5/2/1 (Carbonaceous Biochemical Oxygen Demand/Total Suspended Solids/Ammonia/Total Phosphorus) milligrams per liter.

While the North Fork is not projected to develop until after the 2032 planning horizon, it is important to note the permitting challenges would nearly prohibit the discharge of wastewater effluent immediately upstream of Lake Georgetown. The nitrogen, phosphorous, and ammonia discharge requirements alone would make any WWTP very costly. In addition, Lake Georgetown also serves as a drinking water supply for several central Texas communities, exacerbating these permitting difficulties.

That being said, regulatory requirements across the country are changing to find ways to allow for water reuse opportunities. This could change how the City views the potential to discharge upstream of, or to, Lake Georgetown in the future. New treatment technologies along with changes in regulations could make this a possibility that should be explored.

6.2.2 Constructability Constraints

The North, Middle, and South Fork San Gabriel watersheds drain to the Lower San Gabriel watershed near downtown Georgetown. As a result, constructing a new gravity interceptor and/or pump station to route flows through the city presents construction challenges. Acquiring rights-of-way would be difficult and expensive.

Similarly, expanding some of the existing WWTPs would be challenging because of lack of space and the expense of acquiring new land. The San Gabriel WWTP would be the most difficult to expand because it currently discharges on the ERZ. Increased flows would have to be no-discharge or piped off the ERZ.

6.2.3 Projected Treatment Needs

As discussed in Section 5, and shown in **Figure 5-9**, two new treatment plants will be required to provide wastewater service within the next 10 years, the Northlands WWTP and the Pecan Branch WWTP – Three Forks Expansion. From the systemwide analysis shown in **Figure 5-12**, these two projects once fully developed should be able to provide service through approximately 2060. However, please note that this analysis will need to be revisited once a more clear picture of future growth and its location is available.

6.3 Proposed Improvements

Deficiencies and most improvements were identified based on the evaluations presented in **Section 5**, which used the hydraulic model and the existing and future condition wastewater flows. The treatment and constructability constraints discussed were also taken into consideration. Projects were sized using the buildout model flows, but they were selected for inclusion in the 10-year CIP based on deficiencies found in the existing and 10-year future conditions models. Please note that the buildout gravity sewer and lift station sizing was modeled to account for a scenario where the Dove Springs, San Gabriel, Cimarron Hills, and Berry Creek wastewater treatment plants have all been taken offline.

All the CIP projects are summarized with cost estimates at the end of Section 6.3. The projects are organized by facility type and start date in **Table 6-2**. Some projects listed are considered nonimpact fee projects and they are indicated as such. Cost sheets for each project can be found in **Appendix D**. The projects are shown spatially for the City's wastewater service area in **Exhibit A** (located in a pocket at the back of the report). CIP projects are shown along with the anticipated projects needed by buildout. The project IDs shown in the tables are used to identify the projects in the exhibit.

6.3.1 Near-Term System Improvements

The existing conditions evaluation showed that the wastewater collection system is performing well and there are minimal recommended improvements based on the capacity evaluations for existing conditions alone. The only required existing conditions improvements will be addressing the areas of high RDII response noted in **Figure 5-2**. Some investigations of lift stations and force mains are recommended based on the TCEQ criteria discussed in **Section 5** for design of wastewater collection systems, but the deficiencies are not extensive enough to recommend improvements.

Some significant near-term improvements are discussed here based on evaluation of the 10-year future conditions model because they are large projects that need to begin soon to address areas where significant development is anticipated.

RDII Response Reduction: Reduce RDII within the areas shown in **Figure 5-2**. Downstream of the Midway and Westinghouse Lift Station and downtown east of Scenic and Railroad Lift Stations. The 2022 flow monitoring indicates that these areas have high levels of inflow and infiltration which leads to surcharging in the downstream system.

Berry Creek Interceptor (BCI-2): The Berry Creek Interceptor is currently in design and will address predicted future capacity deficiencies at the Sun City Lift Station.

San Gabriel Interceptor (SGI-1) and lift station (SGI-PB-LS): This is a large interceptor and lift station project needed to address predicted capacity constraints at Smith Branch Lift Station and diversion to the SG3-A Lift Station. Currently, the Smith Branch and SG3-A lift stations pump flow for about 25 percent of the City's wastewater service area. This area is expected to grow significantly based on development proposed in the south and along the South Fork of the San Gabriel River. The plan within 10 years would be to build SGI-1 and the lift station and force main project SGI-PB-LS to pump flow to the Pecan Branch WWTP.

6.3.2 Ten-Year (2032) Planning Horizon Improvements

Projects needed within the 10-year planning horizon are needed to address deficiencies predicted due to future growth or to address future growth directly. Some major projects that need to begin soon were discussed under near-term improvements. The remaining projects needed to address deficiencies identified in Section 5 are discussed below:

Cross-Town Tunnel: Predicted growth along the South Fork Interceptor within the 10-year planning horizon will overwhelm the downstream capacity at the Wolf Ranch Lift Station and Smith Branch Interceptor. The 2018 WWMP recommended interim projects to delay the construction of the Cross-Town Tunnel. Changes in predicted growth over the next 10 years make construction of those projects no longer financially viable. If the projects were constructed, by the time they were operational, the predicted growth upstream would overwhelm the incremental additional capacity and the Cross-Town Tunnel would be required.

Gravity system through Sun City: In addition to the capacity limitation at the Sun City Lift Station, the gravity system upstream of the lift station has limited capacity to serve new development planned in the north and northwest. The projects proposed to address this deficiency in the 10-year planning horizon are the Cowan Creek Lift Station (CC-LS) and the new Northlands WWTP along with the CC-1 and CC-7 gravity sewer improvements upstream.

Three Forks WWTP: Additional treatment will be needed in the future as discussed in Section 5, and it is recommended that a significant portion of that be directed towards expansion of the Pecan Branch WWTP. Rather than expand the existing plant, the City is planning to construct a new treatment plant on the same site which will be called the Three Forks WWTP. The recommended expansion is 10.5 mgd for a total capacity of 13.5 mgd by 2029.

Lift stations to be retired by 2032 based on this master plan include SG3A, Sun City, Wolf Ranch, Westinghouse, and Midway.

Other projects to address future growth directly are listed in **Table 6-2** and shown in **Exhibit A**. Significant projects include gravity lines and lift stations to serve the Dove Springs and Cowan Creek basins.

6.3.3 Buildout Model

The buildout model was used to anticipate the growth of the entire service area to appropriately place and size projects that are needed within the 10-year planning horizon. All proposed gravity main and lift station 10-year CIP projects are sized for the buildout condition. As treatment plants can be phased, those projects are sized for at least the 10-year planning horizon. The projects needed beyond year 2032 are shown as "buildout" projects in **Exhibit A**. Some specific projects and plans for the system are described below:

- With the growth predicted within the southeast portion of Georgetown, the buildout model includes various gravity lines that will be tributary to the proposed Mankins WWTP.
- With the construction of the San Gabriel Interceptor (SGI-1), the Smith Branch Lift Station can be retired, but the City may choose to continue using it until the capacity of the Dove Springs WWTP is reached with flows coming from the McNutt watershed.

6.4 Implementation Schedule

The implementation schedule for the recommended 10-year CIP is shown in **Table 6-3**. It is important to recognize that a significant amount of preparation and construction is required before any of the recommended projects can be placed into service. The implementation schedule shown includes engineering, permitting, bidding, and construction services, as well as obtaining easements as needed. Note that this nominal schedule assumed approximately 2 years for construction unless otherwise specified. The actual schedule for each project will vary depending on the type of project and the location when it comes to obtaining permits and easements. When the time comes for design and construction of a specific project, a more detailed project-specific schedule should be developed.

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Table 6-2 Ten-Year Wastewater Capital Improvements by Facility

Project ID	FY Project Start	FY Project Completion	Basin or Description	Project Need	Project Type	FY 2022 Cost Estimate	Inflated Cost Estimate by Fiscal Year			Inflated Cost Estimate
							FY 1	FY 2	FY 3	
GRAVITY MAINS										
BCI-2	2023	2025	Berry Creek	New Service	New Construction	$ 80,128,000	$ 10,094,000	$ 21,803,000	$ 82,414,000	$ 114,311,000
Cimmarron	2023	2025	South Fork	Plant Decomissioning	New Construction	$ 5,029,000	$ 633,000	$ 1,368,000	$ 5,172,000	$ 7,173,000
MF-1	2023	2025	South Fork	New Service	New Construction	$ 3,009,000	$ 379,000	$ 819,000	$ 3,095,000	$ 4,293,000
MF-2	2023	2025	South Fork	New Service	New Construction	$ 1,966,000	$ 248,000	$ 535,000	$ 2,022,000	$ 2,805,000
MF-3	2023	2025	South Fork	New Service	New Construction	$ 7,329,000	$ 923,000	$ 1,994,000	$ 7,538,000	$ 10,455,000
MN-2	2023	2025	Smith Branch	New Service	New Construction	$ 2,323,000	$ 293,000	$ 632,000	$ 2,390,000	$ 3,315,000
NLWWTP - FM	2024	2026	Northlands	Plant Discharge	New Construction	$ 6,953,000	$ 946,000	$ 2,043,000	$ 7,724,000	$ 10,713,000
NL-Gr	2024	2026	Northlands	New Service	New Construction	$ 3,030,000	$ 412,000	$ 890,000	$ 3,366,000	$ 4,668,000
SGI	2024	2028	Pecan Branch	New Service	New Construction	$ 45,790,000	$ 6,230,000	$ 13,456,000	$ 50,864,000	$ 70,550,000
CC-1	2027	2029	Northlands	New Service	Existing Upsize/Parallel	$ 12,182,000	$ 2,049,000	$ 4,386,000	$ 16,425,000	$ 22,860,000
CC-2	2027	2029	Northlands	New Service	New Construction	$ 4,454,000	$ 749,000	$ 1,604,000	$ 6,005,000	$ 8,358,000
CC-7	2027	2029	Northlands	New Service	Existing Upsize/Parallel	$ 8,087,000	$ 1,361,000	$ 2,911,000	$ 10,903,000	$ 15,175,000
DBC-S1	2027	2029	Berry Creek	New Service	New Construction	$ 30,048,000	$ 5,055,000	$ 10,817,000	$ 40,511,000	$ 56,383,000
DBC-S2	2027	2029	Berry Creek	New Service	New Construction	$ 1,503,000	$ 253,000	$ 541,000	$ 2,026,000	$ 2,820,000
DBC-S3	2027	2029	Berry Creek	New Service	New Construction	$ 4,409,000	$ 742,000	$ 1,587,000	$ 5,944,000	$ 8,273,000
MB-5	2027	2029	Mankins	New Service	New Construction	$ 11,915,000	$ 2,004,000	$ 4,289,000	$ 16,063,000	$ 22,356,000
MF-5	2027	2029	South Fork	New Service	New Construction	$ 2,132,000	$ 359,000	$ 768,000	$ 2,874,000	$ 4,001,000
SECR130	2027	2029	Mankins	New Service	New Construction	$ 3,488,000	$ 587,000	$ 1,255,000	$ 4,702,000	$ 6,544,000
SEMKN	2027	2029	Mankins	New Service	New Construction	$ 4,894,000	$ 823,000	$ 1,762,000	$ 6,599,000	$ 9,184,000
Tunnel	2031	2034	Pecan Branch	New Service	New Construction	$ 78,015,000	$ 16,411,000	$ 34,463,000	$ 126,652,000	$ 177,526,000
SG DIV	2032	2034	Pecan Branch	New Service	New Construction	$ 2,615,000	$ 578,000	$ 1,213,000	$ 4,458,000	$ 6,249,000
DS-SEMKN	2032	2034	Mankins	New Service	New Construction	$ 13,627,000	$ 3,010,000	$ 6,321,000	$ 23,229,000	$ 32,560,000
NL-1	2032	2034	Northlands	New Service	New Construction	$ 19,085,000	$ 4,215,000	$ 8,852,000	$ 32,532,000	$ 45,599,000
NL-2	2032	2034	Northlands	New Service	New Construction	$ 4,876,000	$ 1,077,000	$ 2,261,000	$ 8,311,000	$ 11,649,000
Non-Impact Fee Projects										
BC-2a	2027	2029	Berry Creek	New Service/LS Retirement	New Construction	$ 3,075,000	$ 517,000	$ 1,107,000	$ 4,146,000	$ 5,770,000
BC-5	2027	2029	Berry Creek	New Service/Septic Abatement	New Construction	$ 1,770,000	$ 298,000	$ 637,000	$ 2,387,000	$ 3,322,000
BCW-1	2027	2029	Sun City	New Service	New Construction	$ 1,571,000	$ 264,000	$ 566,000	$ 2,119,000	$ 2,949,000
CC-1b	2027	2029	Northlands	New Service	New Construction	$ 1,448,000	$ 244,000	$ 521,000	$ 1,953,000	$ 2,718,000
CC-3	2027	2029	Northlands	New Service	New Construction	$ 4,091,000	$ 688,000	$ 1,473,000	$ 5,515,000	$ 7,676,000
CC-4	2027	2029	Northlands	New Service	New Construction	$ 7,192,000	$ 1,210,000	$ 2,589,000	$ 9,696,000	$ 13,495,000
CC-5	2027	2029	Northlands	New Service	New Construction	$ 941,000	$ 158,000	$ 339,000	$ 1,268,000	$ 1,765,000
CC-6	2027	2029	Northlands	New Service	New Construction	$ 1,898,000	$ 319,000	$ 683,000	$ 2,559,000	$ 3,561,000
GV-1	2027	2029	Berry Creek	New Service	New Construction	$ 5,669,000	$ 954,000	$ 2,041,000	$ 7,643,000	$ 10,638,000
RR-1	2027	2029	Northlands	New Service	New Construction	$ 2,520,000	$ 424,000	$ 907,000	$ 3,398,000	$ 4,729,000
RR-2	2027	2029	Northlands	New Service	New Construction	$ 7,413,000	$ 1,247,000	$ 2,669,000	$ 9,994,000	$ 13,910,000
SG-7a	2027	2029	Downtown	New Service	New Construction	$ 1,791,000	$ 301,000	$ 645,000	$ 2,414,000	$ 3,360,000
CR150	2032	2034	Berry Creek	New Service	New Construction	$ 5,175,000	$ 1,143,000	$ 2,400,000	$ 8,821,000	$ 12,364,000
CR152	2032	2034	Berry Creek	New Service	New Construction	$ 12,907,000	$ 2,851,000	$ 5,987,000	$ 22,002,000	$ 30,840,000
Hart-West St	2032	2034	Downtown	RDII/Infill	Existing Upsize/Parallel	$ 2,390,000	$ 528,000	$ 1,108,000	$ 4,073,000	$ 5,709,000
MB-2	2032	2034	Dove Springs	New Service	New Construction	$ 1,429,000	$ 315,000	$ 662,000	$ 2,433,000	$ 3,410,000
MF-4	2032	2034	South Fork	New Service	New Construction	$ 24,566,000	$ 5,426,000	$ 11,395,000	$ 41,876,000	$ 58,697,000
MF-6	2032	2034	South Fork	New Service	New Construction	$ 2,577,000	$ 569,000	$ 1,195,000	$ 4,392,000	$ 6,156,000
West/Mid Div	2032	2034	Smith Branch	Retire	Remove & Replace w/ Gravity	$ 3,987,000	$ 881,000	$ 1,849,000	$ 6,795,000	$ 9,525,000
					Gravity Main TOTAL	**$ 449,297,000**				**$ 858,414,000**
LIFT STATIONS AND FORCE MAINS										
CH-LS	2023	2025	South Fork	Plant Decomissioning	New Construction	$ 4,772,000	$ 601,000	$ 1,298,000	$ 4,908,000	$ 6,807,000
MF-LS	2023	2025	South Fork	New Service	New Construction	$ 4,677,000	$ 589,000	$ 1,273,000	$ 4,810,000	$ 6,672,000
MF-LS2	2023	2025	South Fork	New Service	New Construction	$ 5,984,000	$ 754,000	$ 1,628,000	$ 6,155,000	$ 8,537,000
CC-LS	2024	2026	Northlands	New Service	New Construction	$ 11,541,000	$ 1,570,000	$ 3,391,000	$ 12,820,000	$ 17,781,000
SGI-PB-LS	2025	2029	SGI Int	New Service	New Construction	$ 30,014,000	$ 4,410,000	$ 9,526,000	$ 36,007,000	$ 49,943,000
Mankins LS - West	2027	2029	Mankins	New Service	New Construction	$ 5,906,000	$ 993,000	$ 2,126,000	$ 7,961,000	$ 11,080,000
NL-LS	2027	2029	Northlands	New Service	New Construction	$ 6,281,000	$ 1,057,000	$ 2,261,000	$ 8,468,000	$ 11,786,000
Mankins LS - East	2032	2034	Mankins	New Service	New Construction	$ 7,532,000	$ 1,664,000	$ 3,494,000	$ 12,841,000	$ 17,999,000
Non-Impact Fee Projects										
LakeW-LS	2027	2029	Northlands	New Service	New Construction	$ 4,825,000	$ 812,000	$ 1,737,000	$ 6,504,000	$ 9,053,000
RRW-LS	2027	2029	Northlands	New Service	New Construction	$ 7,682,000	$ 1,292,000	$ 2,766,000	$ 10,357,000	$ 14,415,000
SETJ-01	2027	2029	South Fork	New Service	New Construction	$ 3,759,000	$ 632,000	$ 1,354,000	$ 5,069,000	$ 7,055,000
MF-LS3	2027	2029	South Fork	New Service	New Construction	$ 1,016,000	$ 171,000	$ 366,000	$ 1,370,000	$ 1,907,000
RRE-LS	2032	2034	Northlands	New Service	New Construction	$ 1,885,000	$ 416,000	$ 875,000	$ 3,214,000	$ 4,505,000
					Lift Stations and Force Mains TOTAL	**$ 91,102,000**				**$ 160,733,000**
WWTP										
Northlands Plant	2023	2027	Northlands			$ 30,343,000	$ 3,822,000	$ 8,256,000	$ 31,209,000	$ 43,287,000
Pecan Branch - Three Forks	2023	2029	Pecan Branch			$ 212,389,000	$ 26,755,000	$ 57,790,000	$ 218,448,000	$ 302,993,000
					WWTP TOTAL	**$ 242,732,000**				**$ 346,280,000**
					10-YR IMPACT FEE TOTAL	**$ 671,450,000**				**$ 1,123,056,000**
					10-YR CIP TOTAL	**$ 787,903,000**				**$ 1,372,234,000**

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Project ID	Inflated Cost Estimate	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
GRAVITY MAINS														
BCI-2	$ 114,311,000													
Cimmarron	$ 7,173,000													
MF-1	$ 4,293,000													
MF-2	$ 2,805,000													
MF-3	$ 10,455,000													
MN-2	$ 3,315,000													
NLWWTP - FM	$ 10,713,000													
NL-Gr	$ 4,668,000													
SGI	$ 70,550,000													
CC-1	$ 22,860,000													
CC-2	$ 8,358,000													
CC-7	$ 15,175,000													
DBC-S1	$ 56,383,000													
DBC-S2	$ 2,820,000													
DBC-S3	$ 8,273,000													
MB-5	$ 22,356,000													
MF-5	$ 4,001,000													
SECR130	$ 6,544,000													
SEMKN	$ 9,184,000													
Tunnel	$ 177,526,000													
SG DIV	$ 6,249,000													
DS-SEMKN	$ 32,560,000													
NL-1	$ 45,599,000													
NL-2	$ 11,649,000													
GRAVITY MAINS - NON IMPACT FEE														
BC-2a	$ 5,770,000													
BC-5	$ 3,322,000													
BCW-1	$ 2,949,000													
CC-1b	$ 2,718,000													
CC-3	$ 7,676,000													
CC-4	$ 13,495,000													
CC-5	$ 1,765,000													
CC-6	$ 3,561,000													
GV-1	$ 10,638,000													
RR-1	$ 4,729,000													
RR-2	$ 13,910,000													
SG-7a	$ 3,360,000													
CR150	$ 12,364,000													
CR152	$ 30,840,000													
Hart-West St	$ 5,709,000													
MB-2	$ 3,410,000													
MF-4	$ 58,697,000													
MF-6	$ 6,156,000													
West/Mid Div	$ 9,525,000													
LIFT STATIONS														
CH-LS	$ 6,807,000													
MF-LS	$ 6,672,000													
MF-LS2	$ 8,537,000													
CC-LS	$ 17,781,000													
SGI-PB-LS	$ 49,943,000													
Mankins LS - West	$ 11,080,000													
NL-LS	$ 11,786,000													
Mankins LS - East	$ 17,999,000													
LIFT STATIONS - NON IMPACT FEE														
LakeW-LS	$ 9,053,000													
RRW-LS	$ 14,415,000													
SETJ-01	$ 7,055,000													
MF-LS3	$ 1,907,000													
RRE-LS	$ 4,505,000													
WASTEWATER TREATMENT PLANTS														
Northlands Plant	$ 43,287,000													
Pecan Branch - Three Forks	$ 302,993,000													

= Easements, Engineering, Permitting, and Bidding

= Construction

= Project Completion

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Appendix A

Wastewater Flow Projections Modeling Methodology Technical Memorandum

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Wastewater Flow Projections Modeling Methodology
July 22, 2022

Technical Memorandum

To: *Chelsea Solomon, PE, Water Utility Director*
Wesley Wright, Systems Engineering Director

From: *Allen Woelke, PE (#54386), BCEE*
Ryan Tordella, PE (#140621)
CDM Smith, TBPE Firm No. F-3043

Date: *July 22, 2022*

Subject: *Wastewater Flow Projections Modeling Methodology*

Population growth and wastewater demands were projected through buildout to analyze the system and develop both the 10-year CIP and a conceptual buildout master plan.

This appendix describes the demand projection methodology applied. The steps were:

- Review development pipeline provided by the City, which includes details (generally type of development, stage of development, and number of units) for all development proposals that are officially in the City's development map.
- Consider utility evaluations (requests for water service by developers) that have been reviewed since the 2018 water master plan, but which are not yet in the City's official development pipeline.
- Select development pipeline and utility evaluation projects and assume target end dates, estimate population from each development, and attempt to match the total resulting population to the 2032 population estimate.
- For the areas outside of the development pipeline and utility evaluations, future land use planning areas were used to estimate future growth in conjunction with input from the City.
- For areas within the existing wastewater service area, no future infill growth was assumed, with two exceptions: Williams Drive and downtown. For these areas, specific re-development information was provided by the City which was reflected within the growth projections.

2032 Planning Horizon

For the 10-year projection (2032), the future growth was based exclusively on the development pipeline and proposed utility evaluation growth inside of the City of Georgetown's wastewater boundary shown in **Figure 1**. A summary of the major developments (500 units or more)

included in the 10-year wastewater projections is shown in **Table 1**. **Figure 2** shows the locations of the proposed developments.

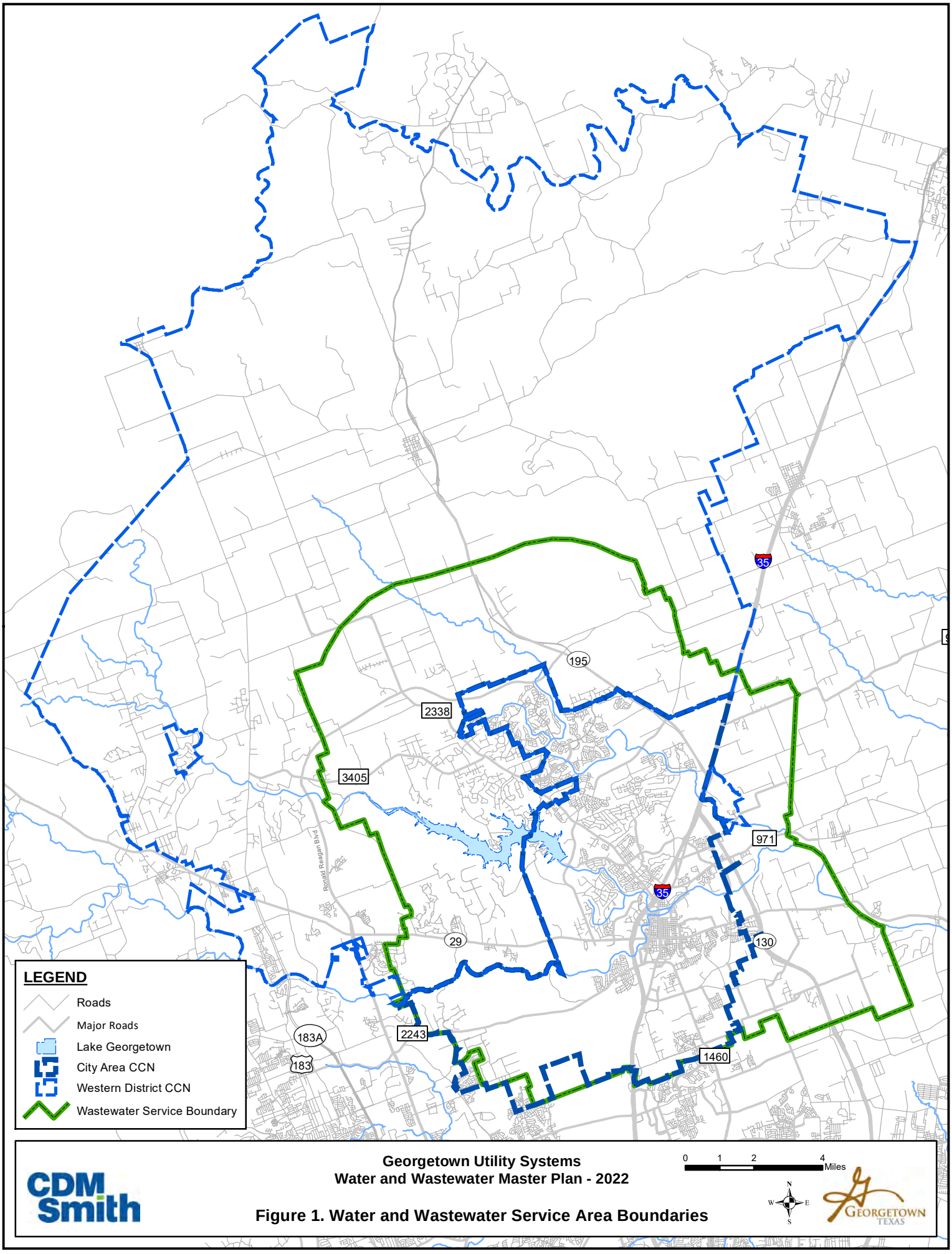
Table 1: Development Pipeline and Utility Evaluation Growth Projections Through Buildout

Name	Single Family Units	Multi-Family Units	Non-Res Acres	Total Acres	2032 Population	Buildout Population
Rock Bluff Ranch	1,656	1,000	10	859	1,993	6,040
Atkinson Assemblage	2,089	300	0	525	3,476	5,793
Tower Road	2,000	0	0	997	1,650	5,000
Shell Road PID	2,000	0	0	231	2,500	5,000
Water Oak North, Concept Plan Area	0	0	0	662	3,350	5,000
Wenzel-Gantt	1,862	0	0	575	4,655	4,655
Benton Tract (3B&J)	1,340	376	0	521	4,064	4,064
Madison	585	1,330	0	534	3,980	3,980
Wolf Lake	0	2,000	0	59	2,546	3,800
Somerset Hills	1,400	0	0	338	2,345	3,500
Parmer Ranch	1,377	0	0	401	3,443	3,443
Avery Bost	1,251	0	0	457	3,128	3,128
Ragsdale Ranch	1,230	0	5	337	2,306	3,075
Guy Hillwood Amended	684	706	0	273	3,051	3,051
TPH Tract	701	567	0	250	2,830	2,830
Sun City, Expansion 1	1,079	0	0	349	2,698	2,698
Hanover	558	620	0	278	2,573	2,573
Owens Tract (Rockin Wilco)	1,000	0	0	277	2,500	2,500
Homestead on Berry Creek	985	0	0	304	1,650	2,463
Lively MUD	1	0	0	387	1,875	1,875
Lawhon	390	390	0	118	1,716	1,716
Highland Village, Phs 2	675	0	0	121	1,688	1,688
Mansions of Georgetown III	0	880	0	129	1,672	1,672
Berry Creek Highlands	488	168	26	176	1,539	1,539
Crescent Bluff (Remainder)	610	0	0	229	1,525	1,525
2500 SE Inner Loop	0	792	0	64	,497	1,505
Parkside on the River	600	0	0	341	1,500	1,500
Parkside on the River Phase 2	577	3	0	271	1,449	1,449
Parkside on the River Phase 3	573	0	0	170	1,433	1,433
Carlson Place Subdivision	908	0	0	134	1,255	1,255
Georgetown 971	1	1	0	129	1,250	1,250
Berry Creek Crossing	0	650	0	47	1,235	1,235
Konle Tract	302	240	0	123	812	1,211

Wastewater Flow Projections Modeling Methodology
July 22, 2022

Name	Single Family Units	Multi-Family Units	Non-Res Acres	Total Acres	2032 Population	Buildout Population
Scipio WWTP - Kimbro	0	600	0	65	1,140	1,140
Novak	0	0	0	29	1,093	1,093
Hullum	175	320	8	57	1,046	1,046
Keystone Multifamily	0	550	3	51	1,045	1,045

Note 1 – Future population calculation: Single Family Unit = 2.5 People/Multi-Family Unit = 1.9 People

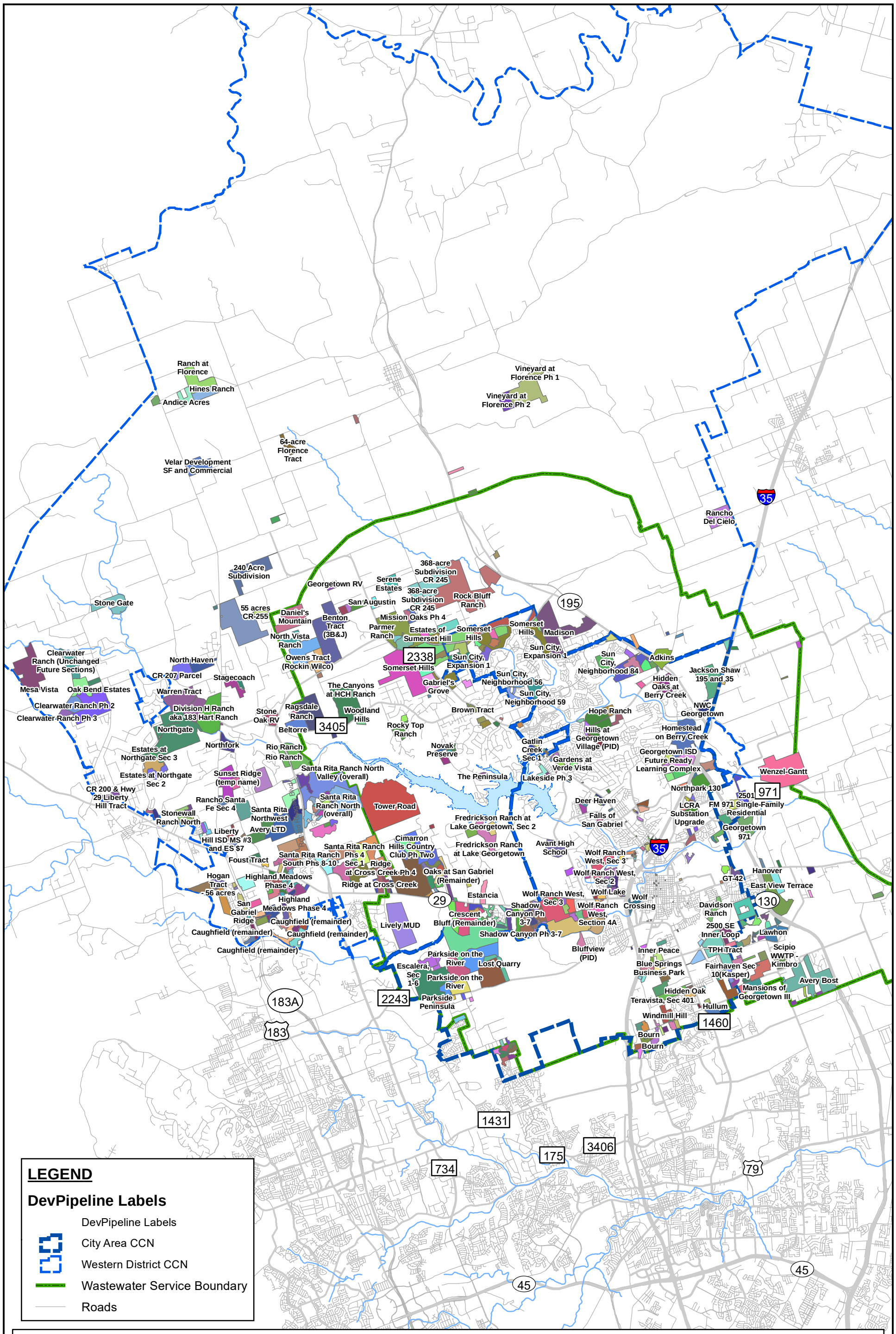


CDM Smith

Georgetown Utility Systems
Water and Wastewater Master Plan - 2022

Figure 1. Water and Wastewater Service Area Boundaries

GEORGETOWN TEXAS


Ranch at Florence
Hines Ranch
Andice Acres
Vineyard at Florence Ph 1
Vineyard at Florence Ph 2
64-acre Florence Tract
Velar Development SF and Commercial
Rancho Del Cielo
240 Acre Subdivision
Georgetown RV
Serene Estates
368-acre Subdivision CR 245
368-acre Subdivision CR 245
Rock Bluff Ranch
San Augustin
Stone Gate
55 acres CR-255
Daniel's Mountain
Benton Tract (3B&J)
Mission Oaks Ph 4
Parmer Ranch
Estates of Sumerset Hill
Somerset Hills
Somerset Hills
Madison
North Vista Ranch
Owens Tract (Rockin Wilco)
2338
Somerset Hills
Sun City, Expansion 1
Sun City, Expansion 1
Sun City, Neighborhood 84
Adkins
Jackson Shaw 195 and 35
Clearwater Ranch (Unchanged Future Sections)
North Haven
CR 207 Parcel
Stagecoach
Mesa Vista
Oak Bend Estates
Warren Tract
Clearwater Ranch Ph 2
Clearwater Ranch Ph 3
Division H Ranch aka 183 Hart Ranch
Northgate
Stone Oak RV
Ragsdale Ranch
Beltorre
3405
Woodland Hills
The Canyons at HCH Ranch
Gabriel's Grove
Sun City, Neighborhood 56
Sun City, Neighborhood 59
Hidden Oaks at Berry Creek
Brown Tract
Rocky Top Ranch
Hope Ranch
NWC Georgetown
Hills at Georgetown Village (PID)
Homestead on Berry Creek
Estates at Northgate Sec 3
Northfork
Rio Ranch
Rio Ranch
Novak Preserve
Gatlin Creek Sec 1
Gardens at Verde Vista
Georgetown ISD Future Ready Learning Complex
Estates at Northgate Sec 2
Sunset Ridge (temp name)
Santa Rita Ranch North Valley (overall)
The Peninsula
Lakeside Ph 3
Wenzel-Gantt
Northpark 130
2501
971
CR 200 & Hwy 29 Liberty Hill Tract
Rancho Santa Fe Sec 4
Santa Rita Ranch North (overall)
Tower Road
Deer Haven
Falls of San Gabriel
LCRA Substation Upgrade
FM 971 Single-Family Residential
Stonewall Ranch North
Santa Rita Northwest
Avery LTD
Fredrickson Ranch at Lake Georgetown, Sec 2
Georgetown 971
Liberty Hill ISD MS #3 and ES $7
Cimarron Hills Country Club Ph Two
Fredrickson Ranch at Lake Georgetown
Avant High School
Santa Rita Ranch Phs 4 South Phs 8-10
Sec 1 Ridge at Cross Creek Ph 4
Oaks at San Gabriel (Remainder)
Wolf Ranch West, Sec 3
Foust Tract
Ridge at Cross Creek
Wolf Ranch West, Sec 2
GT-42
Hanover
East View Terrace
Hogan Tract - 56 acres
Highland Meadows Phase 4
Estancia
Wolf Ranch West, Sec 3
Wolf Lake
Wolf Crossing
Highland Meadows Phase 4
San Gabriel Ridge
Caughfield (remainder)
Crescent Bluff (Remainder)
Shadow Canyon Ph 3-7
Wolf Ranch West, Section 4A
Davidson Ranch
2500 SE Inner Loop
Lawhon
Caughfield (remainder)
Caughfield (remainder)
Lively MUD
Shadow Canyon Ph 3-7
Bluffview (PID)
TPH Tract
Scipio WWTP - Kimbro
Parkside on the River
Escalera, Sec 1-6
Lost Quarry
Parkside on the River
Inner Peace
Blue Springs Business Park
Fairhaven Sec 10(Kasper)
Avery Bost
Mansions of Georgetown III
Hidden Oak
Teravista, Sec 401
Hullum
Windmill Hill
Bourn
Bourn
2243
Parkside Peninsula
1460
1431
3406
175
734
79
45
45
183A
183
195
35
35
29
130
LEGEND
DevPipeline Labels
DevPipeline Labels
City Area CCN
Western District CCN
Wastewater Service Boundary
Roads
N
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Georgetown Utility Systems
Water and Wastewater Master Plan - 2022
Figure 2 Planned Developments
0 0.5 1 2
Miles
CDM Smith
GEORGETOWN TEXAS

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Buildout Planning Horizon

To develop the buildout growth projections, CDM Smith coordinated with the City to use a combination of future City planning information, development pipeline and utility evaluation information, re-development areas, no growth areas, and existing flow areas where no future growth is assumed. **Figure 3** shows the resulting future growth projection map that was the basis for the 2022 Wastewater Master Plan buildout growth. The map and areas were developed with the following methodology:

- For areas of existing service, no future growth was assumed except, in specific areas of known future growth. These areas include the Williams Drive and Downtown re-development areas which will be discussed later in this memorandum.
- All proposed developments and utility evaluations shown in **Figure 2** are assumed to be 100% complete.
- The remaining area inside the ETJ was split into 2 categories: future wastewater service and areas to remain on septic service.
    - Areas to remain on septic were assumed to contribute no flow to the future wastewater system.
    - For the remaining wastewater service area, CDM Smith and the City developed a modified land use plan to represent future growth assumptions. **Table 2** describes the future land use density for each growth category.

Table 2: Future Land Use Density

Future Land Use	Residential		*Non-Residential*	
	Percent of Area	Dwelling Units per Acre[1]	% of Area	Average Day Wastewater Flow gpd/ac
Existing Service Area – No Growth	Existing wastewater flow based on 2022 flow monitoring data. See **Appendix B.**			
Open Space/Mining – No Growth	N/A			
Development Pipeline/Utility Eval	Density varies by location and given information.			
Downtown/Williams Drive Re-Development	Information for this area is specific to the redevelopment plan. See section below for details.			
Neighborhood	100%	3.5 SFUs		
Mixed Density Neighborhood	100%	3.5 SFUs		
Dry Berry Creek – High Density	100%	24 MFUs		
Dry Berry Creek – Medium Density	100%	12 MFUs		
Community Center	10%	10 MFUs	90%	1,500
Institutional			100%	950
Regional Center	25%	7 SFUs and 7 MFUs	75%	1,200
Employment Center	10%	10 MFUs	90%	900

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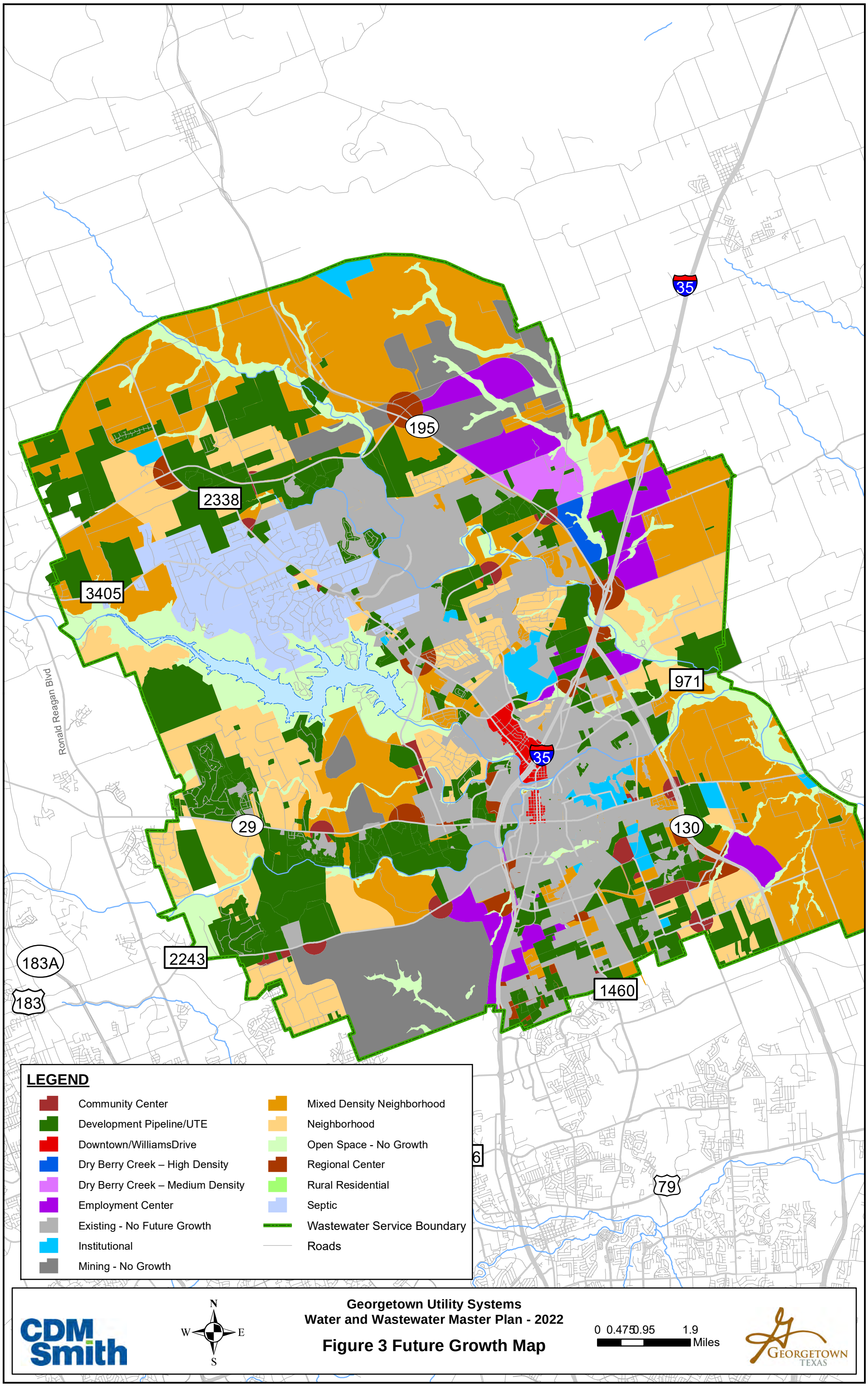
35
195
2338
3405
971
35
29
130
Ronald Reagan Blvd
183A
2243
183
1460
79
6
LEGEND
Community Center
Development Pipeline/UTE
Downtown/WilliamsDrive
Dry Berry Creek – High Density
Dry Berry Creek – Medium Density
Employment Center
Existing - No Future Growth
Institutional
Mining - No Growth
Mixed Density Neighborhood
Neighborhood
Open Space - No Growth
Regional Center
Rural Residential
Septic
Wastewater Service Boundary
Roads
CDM Smith
N
W
E
S
Georgetown Utility Systems
Water and Wastewater Master Plan - 2022
Figure 3 Future Growth Map
0 0.475 0.95 1.9
Miles
GEORGETOWN
TEXAS

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Redevelopment Areas

There are two areas of redevelopment that are considered in developing the future planning horizons' wastewater flows. One area is located along Williams Drive, and the *Williams Drive Study* (June 2017) provides the specific information on how the area is anticipated to redevelop. The proposed redevelopment land use map from that report is shown as **Figure 4**.

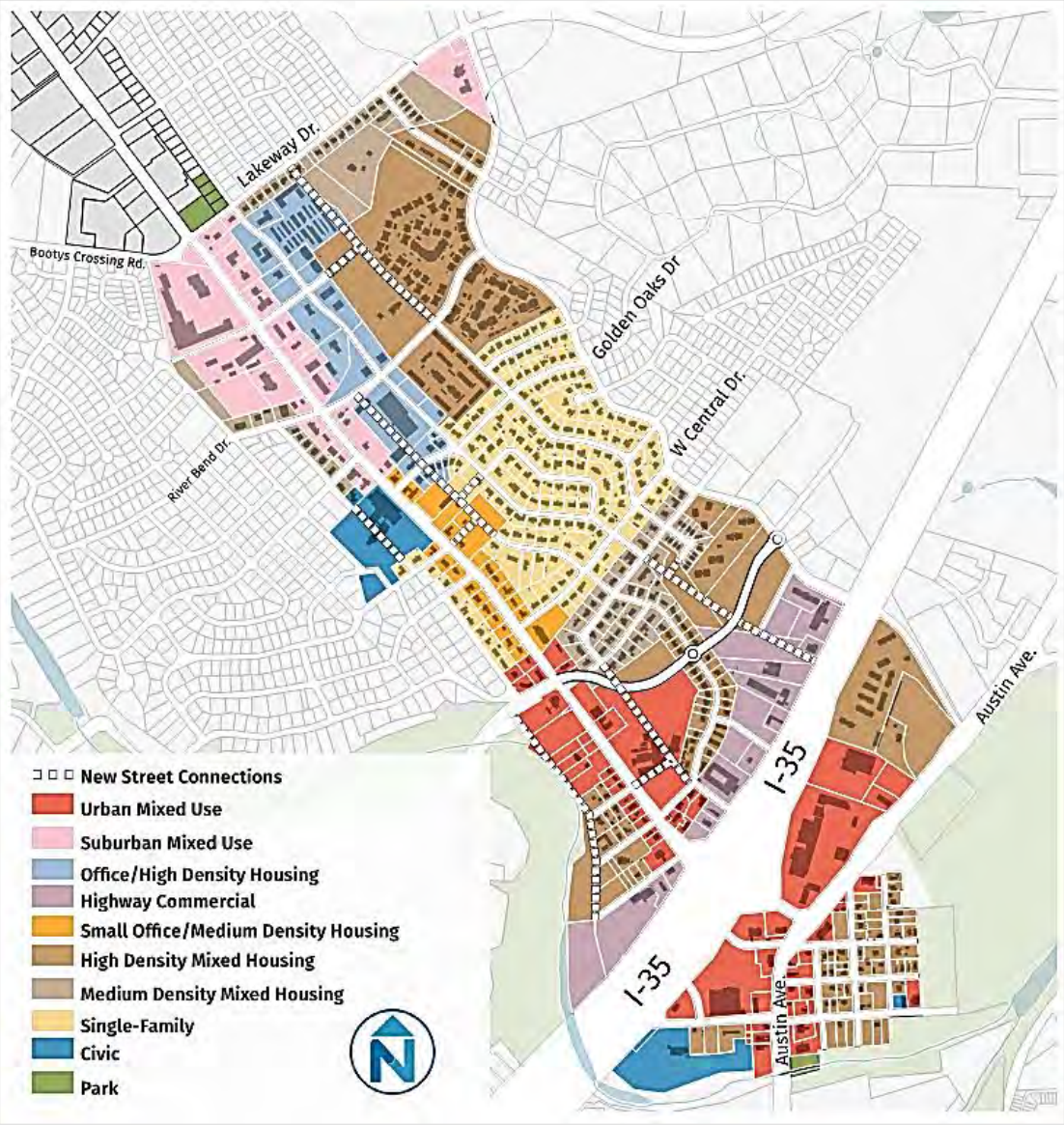

Figure 4. Land Use Plan for Williams Drive Redevelopment

Areas of redevelopment are also anticipated for the downtown area of Georgetown, but there is currently no published plan for this area. CDM Smith worked with the City to coordinate the future

projections with the most up-to-date redevelopment information available for the downtown area. The information for the downtown redevelopment used in the WWMP is shown in **Table 3**.

Table 3: Downtown Development

Address	Notes
405 S Austin Ave	40K SF office, parking
624 S Austin Ave	100K SF office
601 S Austin Ave	Restaurant
601 S Main St	84K SF parking garage, no flow
502 Main St	112K SF parking garage, no flow
414 S Austin Ave	172K SF parking garage, no flow
511 Main St	Commercial
312 University Ave W	Commercial
109 W 7th St	Commercial
200 E 8th St	Commercial
109 W 7th St	Commercial
119 W 7th St	Commercial
500 S Austin Ave	Commercial
120 W 8th St	Commercial
109 W 2nd St	MFU
1121 Austin Ave S	Commercial
215 University Ave W	Commercial

Summary of Methodology and Results

In summary, the methodology used in the master plan to project wastewater demands uses the data available in the order presented to develop the necessary values for the wastewater model. The water billing data, meter points, and wastewater flow monitoring data represent the best information available for spatially distributed information for existing conditions. The next data used are the planned developments, which provide the number of SFUs, MFUs, and commercial acreage for each planned development at each planning horizon. This information is directly translated into the values needed in the model (population and flow/acre). Next, additional information on redevelopment and limited service areas was accounted for and applied to the future land use plan, which provides the information to fill in the gaps for buildout conditions within the ETJ. The modified growth framework helps with estimating the timing of growth into each of the planning horizons.

While overall population for the City's wastewater service area can be reasonably estimated, it is more difficult to predict *where* in the system that growth will occur for any given planning horizon. For that reason, the methodology presented in this memorandum is intended to produce modeled wastewater flows that are higher than anticipated when summing those values for the system overall. This is done so that the City does not greatly underestimate growth in any particular part of the system.

A summary of the resulting values used in the wastewater model are shown in **Table 4**. **Figure 5** compares modeled population and average day dry weather flow (ADWF) to the 2018 WWMP assuming buildout of the system by the year 2086.

Table 4. Wastewater Model Values by Planning Horizon

Wastewater Model Values	Wastewater Model Planning Horizon		
	2022	2032	Buildout 2086
Modeled Population	83,749	199,274	638,531
Nonresidential Average Day Flow (mgd)	0.76	2.0	9.7
Contributing Area (ac)	18,498	33,992	92,901
Total ADWF (mgd)	6.0	15.0	69.1

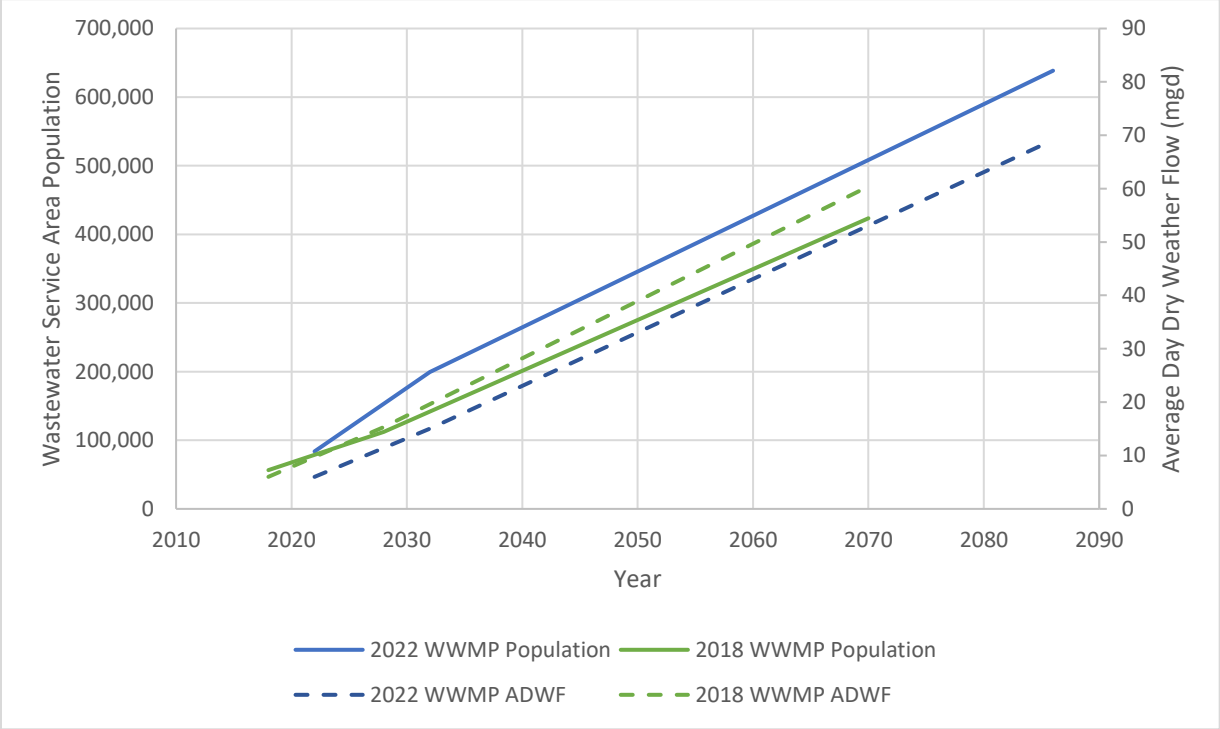

Figure 10. Modeled Wastewater Service Area Population and Average Day Dry Weather Flow Comparison to Previous Master Plans

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Appendix B

Flow Monitoring Analysis and Recommendations

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Technical Memorandum

To: *Chelsea Solomon, P.E., Water Utility Director*
Wesley Wright, Systems Engineering Director

From: *Allen Woelke, P.E. (#54386), BCEE*
Ryan Tordella, P.E. (#140621)
CDM Smith, TBPE Firm No. F-3043

Date: *January 23, 2023*

Subject: *Flow Monitoring Analysis and Recommendations*

The City regularly updates their wastewater collection system model flow parameters using collected wastewater flow data. The latest flow monitoring effort was completed from November 2021 through April of 2022 for the majority of the City of Georgetown's wastewater system.

The CDM Smith contracted with Interra Hydro to install 15 flow monitors in the City of Georgetown's wastewater collection system. The collected data was then provided to CDM Smith for evaluation and analysis. Updates were incorporated into the wastewater collection system model as best determined from the analysis as discussed herein.

The following is an overview of the information presented in this memorandum:

- Description of the collection system model and the wastewater flow components
- Description of the data collected and used for analysis
- Evaluation of dry-weather flow (DWF) and model calibration
- Evaluation of wet-weather flow (WWF) and model calibration
- Overall conclusions and recommendations for how this information is used for the 2022 Wastewater Master Plan (2022 WWMP) and future evaluations

1. Collection System Model and Wastewater Flow Components

CDM Smith developed and maintains the wastewater collection system hydraulic model using InfoWorks ICM software. The model is currently being updated as part of the 2022 WWMP, which includes updated populations and average nonresidential flows. Some of the criteria for calculating current and future wastewater flows are being updated as part of the 2022 WWMP using the recommendations provided as part of this memorandum.

The wastewater collection system is analyzed for existing conditions and future planning horizons under peak WWF conditions based on a 2-year design storm. Peak WWF consists of the following components:

- Groundwater infiltration (GWI), input as a constant
- Base wastewater flow (BWF), which is made up of diurnally varied residential or non-residential sanitary wastewater flow
- Rainfall-dependent infiltration and inflow (RDII), which is based on the RTK unit hydrograph methodology developed from flow monitoring efforts

Peak DWF is the sum of GWI and the peak BWF. Peak WWF is the sum of peak DWF and peak RDII.

The criteria used in the last master plan (2018 WWMP) to calculate the components of peak WWF under existing condition are based previous flow monitoring efforts (2017) and are shown in **Table 1**. The purpose of the 2022 flow monitoring was to determine if updates should be made to the parameters.

Table 1. Wastewater Flow Criteria for Future Development Areas

Wastewater Flow Category	Criteria
Ground Water Infiltration (GWI)	
Residential	30 gallons per capita/day (gpcd)
Nonresidential	25% of average nonresidential BWF
Base Wastewater Flow (BWF)	
Typical Residential	70 gpcd
Age Restricted Planned Unit Development	55 gpcd
Nonresidential	Based on future land use densities or information provided by developer

gpcd: gallons per capita per day

2. Wastewater Flow and Rainfall Data

Wastewater flow monitoring was conducted in 15 areas as shown in **Figure 1**. Level, velocity, and flow data was collected from November 20, 2021, to May 6, 2022 (10 monitors were from November to May and 5 were from February to May). The data collected was quality data with no issues. Rainfall data was directly collected by Interra Hydro in five locations. A significant rainfall event is defined as being equal to or greater than 1 inch in total depth over a 24-hour period at least one rain gauge. Three significant rainfall events were observed during the flow monitoring as shown in **Table 2**. **Figure 2** compares the monitored rainfall with Georgetown's design event.

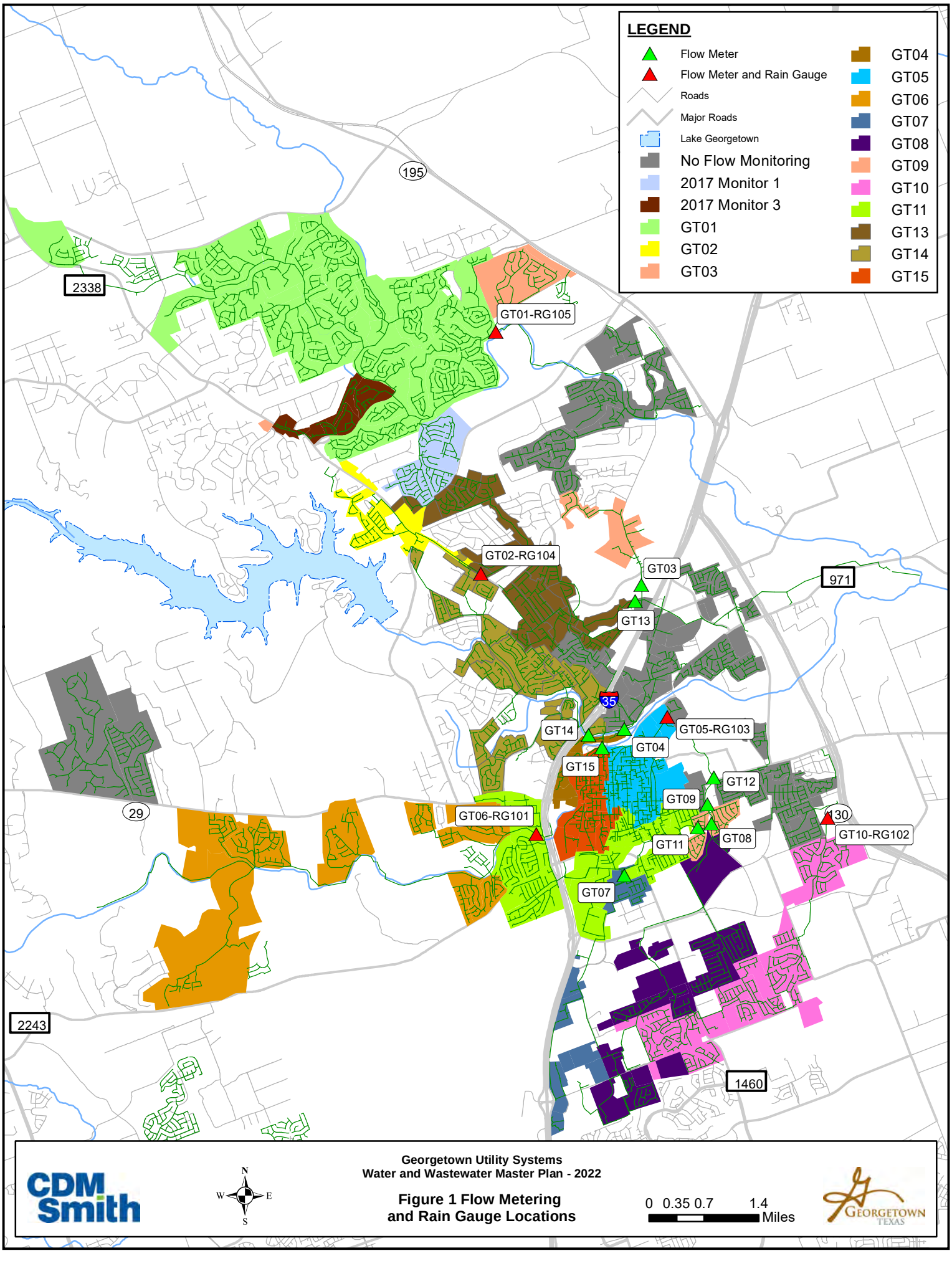

LEGEND
Flow Meter
Flow Meter and Rain Gauge
Roads
Major Roads
Lake Georgetown
No Flow Monitoring
2017 Monitor 1
2017 Monitor 3
GT01
GT02
GT03
GT04
GT05
GT06
GT07
GT08
GT09
GT10
GT11
GT13
GT14
GT15
195
2338
GT01-RG105
GT02-RG104
GT03
971
GT13
35
GT14
GT05-RG103
GT04
GT15
GT12
GT09
29
GT06-RG101
130
GT10-RG102
GT11
GT08
GT07
2243
1460
Georgetown Utility Systems
Water and Wastewater Master Plan - 2022
Figure 1 Flow Metering
and Rain Gauge Locations
0 0.35 0.7 1.4
Miles
CDM Smith
GEORGETOWN TEXAS

Table 2. Rain Events

Rain Gauges	Event 1 (March 21, 2022)	Event 2 (April 25, 2022)	Event 3 (May 5, 2022)
	Rainfall Depth by Storm Event (inches)		
RG 101 – Wolf Ranch LS	1.63	1.76	1.35
RG 102 – Saddle Creek LS	1.33	1.21	0.91
RG 103 – San Gabriel WWTP	1.62	1.25	1.54
RG 104 – Williams Drive	0.13	0.44	1.6
RG 105 – Sun City LS	0.49	0.39	1.04

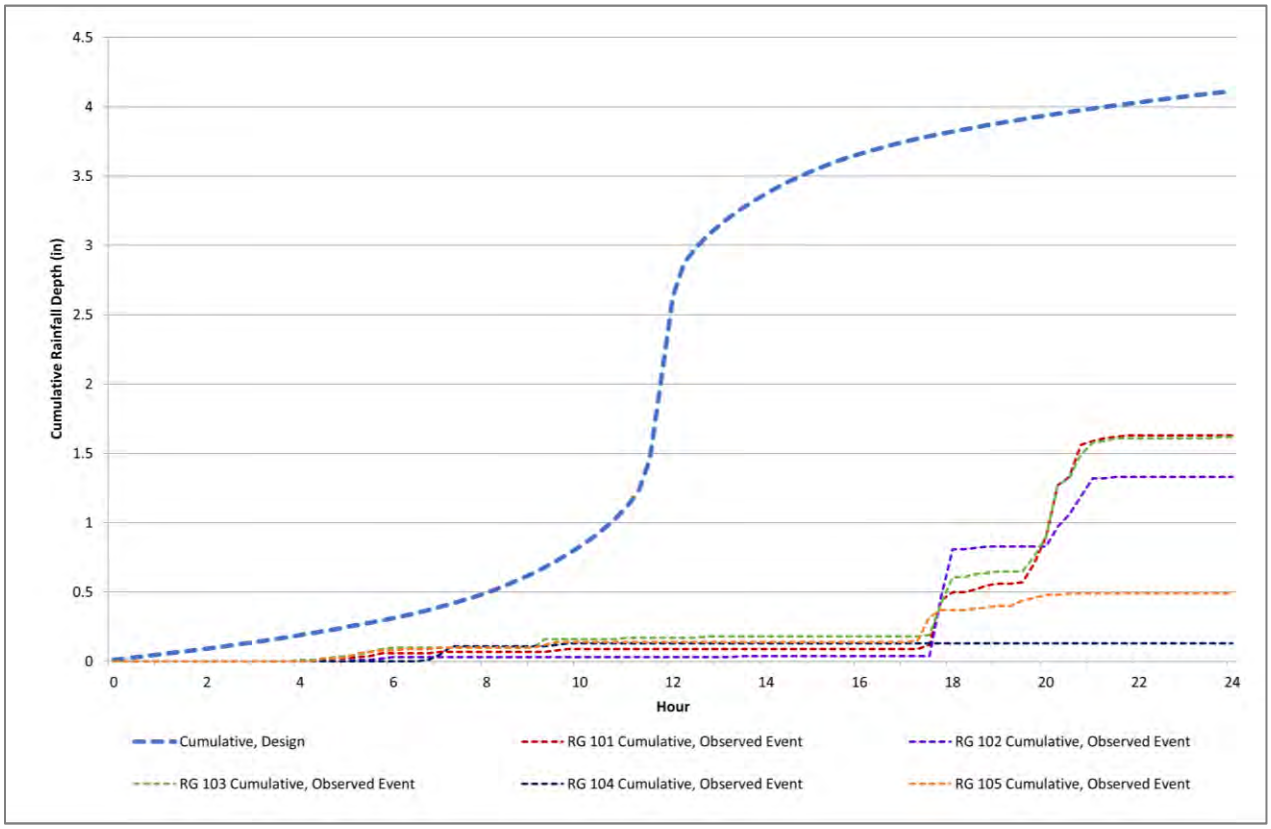


Figure 2. Design Rainfall Event Compared to the Observed March 2022 Rainfall Event

The rain event graphed in **Figure 2** (March 2022) is the event that was used for wet weather calibration. This event was less than a 1-year storm in terms of peak hour intensity and total volume. Please note that the northern portion of Georgetown did not see much rainfall during this event. The May 5th rainfall event was used for wet weather calibration in those areas.

3. Dry Weather Flow Analysis

DWF statistics were developed by selecting flow from specific dry weather days. A day is considered a dry day if no rainfall is observed between the time of the flow and two days previous. Dry weather flow days that were considered statistically different from the rest of the population were removed from analysis. Weekday and weekend dry weather flow statistics were developed separately. In order to be consistent with previous modeling updates, only weekday flows were considered critical for the analysis and modeling. Weekend flows typically have smaller peaks; therefore, they are not necessary to model when developing the design peak WWF.

Observed DWF was compared to modeled DWF at each monitor location. Diurnal base flow hydrographs for flow monitored sewersheds were routed through the hydraulic model. The modeled flows produced by simulation of existing dry-weather conditions were then compared to the actual data recorded at each flow monitor. The model parameters shown in Table 1 were adjusted to calibrate simulated flow to observed conditions. The following criteria were used for dry-weather calibration:

- Predicted peak flow rates are within ±10 percent of observed peak flow rates
- Predicted volumes over the course of 24 hours are within ±10 percent of observed volumes

As shown in **Table 2**, the model provides a good simulation of dry-weather base flows at the locations calibrated. Monitor GT12 records flow downstream of the Smith Branch LS diversion box. The diversion box consists of a manually operated sluice gate and overflow weir. Both the sluice gate and overflow weir allow the City to divert flow away from the Smith Branch Lift Station (Dove Springs WWTP) and send flow through the SGA interceptor to the San Gabriel WWTP. In order to calibrate to this monitor, detailed information is required to understand the operation and what triggers the utilization of the weir. Based on the flow monitoring data, no correlation could be made between flow and weir operation; thus, the monitor was not used in calibration.

Table 2. Dry Weather Flow Calibration Statistics

		Volume			Hourly Peak Flow		
Monitor	Upstream Monitors	Monitored (mgd)	Modeled (mgd)	Percent Difference (%)	Monitored (mgd)	Modeled (mgd)	Percent Difference (%)
GT01	None	1.01	1.04	2%	1.50	1.49	0%
GT02	None	0.13	0.13	2%	0.21	0.18	-15%
GT03	GT01	1.06	1.13	6%	1.61	1.67	4%
GT04	GT14, GT15	0.73	0.75	2%	1.12	1.07	-4%
GT05	None	0.29	0.29	1%	0.38	0.37	-3%
GT06	None	0.37	0.38	1%	0.51	0.47	-9%
GT07	None	0.10	0.10	2%	0.21	0.21	3%

GT08	None	0.40	0.39	-2%	0.61	0.57	-8%
GT09	GT08, GT11	1.46	1.41	-3%	1.92	1.82	-5%
GT10	None	0.41	0.40	-3%	0.69	0.57	-18%
GT11	GT06, GT07	0.87	0.94	8%	1.22	1.25	2%
GT12[1]	Overflow Smith Branch LS	1.06	1.19	12%	1.29	1.25	-3%
GT13	GT02	0.68	0.68	1%	1.05	1.07	1%
GT14	None	0.36	0.37	4%	0.68	0.52	-23%
GT15	None	0.30	0.31	3%	0.47	0.43	-9%

Note 1 – Calibration for monitor basin GT12 is not applicable because of the varying nature of the user settings at the Smith Branch LS diversion structure.

Simulated DWF was calibrated by adjusting the parameters for BWF, GWI and the diurnal profiles related to the BWF peaking factors given the updated population and non-residential wastewater flows updated as part of the 2022 WWMP. **Table 3** shows the modeled population and non-residential wastewater flows in the model along with the calibrated parameter for each flow monitor area. Note these values do not represent the design parameters decided upon for the master planning efforts. As shown in Table 3, the BWF factor ranges from 30 gpcd to 80 gpcd and are comparable to those used in previous master planning efforts. In areas where the gpcd is on the lower side it is likely that the existing population is over estimated. CDM Smith estimated the existing population based on the 2021 water meter locations and use types (2.5 people per SFU and 1.9 people per MFU).

Table 3. Calibrated 2022 Dry Weather Flow Parameter

Monitor	Upstream Monitor	Population (p)	Calibrated BWF Factor (gpcd)	Nonresidential Flow (mgd)
GT01	None	17,591	39	30,300
GT02	None	1,566	40	44,800
GT03	GT01	19,694	30	30,800
GT04	GT14, GT15	9,386	30	129,500
GT05	None	2,553	42	193,700
GT06	None	4,854	68	4,300
GT07	None	836	48	46,800

GT08	None	7,186	54	1,500
GT09	GT08, GT11	20,586	30	93,900
GT10	None	7,260	45	50,800
GT11	GT06, GT07	12,093	30	92,400
GT13	GT02	7,054	80	156,600
GT14	None	6,158	35	27,100
GT15	None	2,050	51	100,000

(1) Calibration for monitor basin GT12 is not applicable because of the varying nature of the user settings at the Smith Branch LS diversion structure.

4. Wet Weather Flow Analysis and Calibration

To prioritize the sewersheds in terms of their I/I contribution, the peak wet-weather to average dry-weather flow ratio (i.e. the peaking factor) was calculated. Even if the infiltration volume is low, inflow could be producing high peaks that lead to overflows and surcharging.

Wet-Weather Peaking Factor

To prioritize the sewersheds in terms of their I/I contribution, the peak wet-weather to average dry-weather flow ratio (i.e. the peaking factor) was calculated. Even if the infiltration volume is low, inflow could be producing high peaks that lead to overflows and surcharging.

The wet-weather peaking factor can help guide sanitary sewer evaluation survey prioritization, like the Edwards Aquifer Recharge Zone (EARZ) work the City performs annually. To calculate the peaking factors, the peak hour wet weather flow for a given event was divided by the basins ADF.

The maximum peaking factor for each sewershed is categorized in **Table 4**. Based on industry standards and CDM Smith's experience analyzing I/I for utilities, a peaking factor of less than 2.5 represents a low RDII response (Level 1). A peaking factor of less than 4.0 may indicate investigation is required (Level 2), and peaking factors over 4.0 are areas that are high priority for investigation into RDII responses (Level 3). The TCEQ 217 design requirements for sanitary systems requires a peaking factor of 4.0 when actual data is not available. Actual peaking factors in excess of 4.0 would exceed the design basis of the City's collection system.

Table 4. Wet-Weather Peaking Factor Level Summary

Wet-Weather Peaking Factor	Flow Monitors	Number of Monitors in Level (#)
Less than 2.5	GT01, GT02, GT03, GT04, GT10, GT13, GT14	7
2.5 to 4.0	GT05, GT06, GT09, GT11, GT15	5
Greater than 4.0	GT07, GT08	2

The calculated wet-weather peaking factors and peak wet-weather wastewater flows measured during all events for each sewershed are presented in **Table 5**. Each peaking factor is color-coded based on the categories described above. Level 1 peaking factors, indicating sewers are in good condition, are shaded in green. Level 2 peaking factors, indicating sewers may require investigation, are shaded in blue. Peaking factors with a Level of 3, indicating the sewers are in fair to poor condition, are shaded red.

Table 5. Wet-Weather Peaking Factor

Monitor	Upstream Monitor	Wet-Weather Peaking Factor			Peak Hour WWF (mgd)			ADF (mgd)
		March 21, 2022	April 25, 2022	May 5, 2022	March 21, 2022	April 25, 2022	May 5, 2022	
GT01	None	1.56	1.51	1.48	1.59	1.54	1.51	1.02
GT02	None	1.56	1.67	1.84	0.21	0.22	0.25	0.13
GT03	GT01	1.85	1.47	N/A	1.89	1.50	N/A	1.02
GT04	GT14, GT15	2.23	1.92	2.11	1.57	1.36	1.49	0.71
GT05	None	3.13	1.80	2.08	1.19	0.68	0.79	0.38
GT06	None	2.77	2.29	2.45	1.03	0.85	0.91	0.37
GT07	None	22.77	2.26	2.65	2.21	0.22	0.26	0.10
GT08	None	4.13	1.71	1.65	1.66	0.69	0.67	0.40
GT09	GT06, GT07, GT11, GT08	2.94	1.36	1.65	4.49	2.08	2.52	1.53
GT10	None	2.36	1.96	1.68	0.94	0.78	0.67	0.40
GT11	GT06, GT07	3.58	1.68	1.89	3.12	1.47	1.65	0.87
GT13	GT02	1.77	1.58	1.63	1.15	1.02	1.05	0.65
GT14	None	1.15	0.98	N/A	0.74	0.63	N/A	0.65
GT15	None	3.04	1.19	1.17	1.07	0.42	0.41	0.35

(1) Peaking Factor for GT12 is not applicable because of the varying nature of the user settings at the Smith Branch LS diversion structure.

A peak wet-weather flow greater than or equal to 4 times the average indicates higher than typical system I/I. Overall, peaking factors ranged from 1 to 22.77. Of the 14 flow monitors, 7 recorded high peaking factors, the majority of which occurred during the March 21, 2022 event.

It should be noted flow monitors did not consistently record high peaking factors during all three storm events. Texas is currently in a drought and the antecedent moisture conditions before the second and third rain events were extremely dry. Additionally, the rainfall across the city varied significantly during each rainfall event with the northern area receiving little to no rain during the March 2022 event.

As shown in **Table 5**, the monitor with the largest RDII peaking factor is GT07. The service area for this monitor is the area surrounding the Westinghouse and Midway lift stations just east of I-35. It is recommended that the City investigate and try to eliminate sources of RDII in this area.

For the GT15 service area, CDM Smith recommends investigating for possible RDII reduction. As discussed in Section 5 of the 2022 WWMP, this area is largely affected by the design storm and is predicted to nearly overflow. Any reduction in RDII response may postpone the need for the future infrastructure project recommended for that area.

Overall, the City of Georgetown's system is largely resistant to RDII. The effort the City puts into maintenance and RDII reduction is clearly shown by the results in **Table 5**.

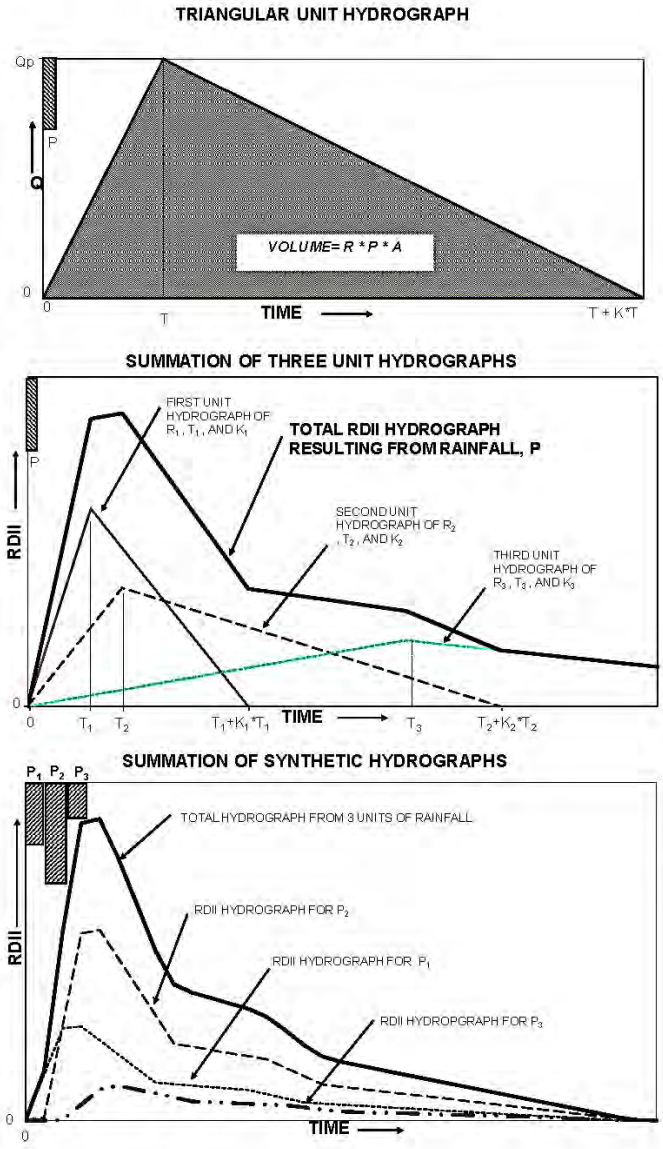
Wet-Weather Calibration

The next step of model calibration involved comparing predicted RDI/I flows to those measured in the system for the March 21, 2022 storm event. This storm was chosen since most flow monitors recorded their highest peaking factors. An average of 1.5 inches (southern Georgetown) and 0.3 inches (northern Georgetown) of rainfall fell during the March 2022 storm. The return period for this storm event was less than a 1-year event.

RDII flows were simulated using the unit hydrograph parameters; this methodology is consistent with past wastewater collection system modeling updates. Using the unit hydrograph method, RDII unit hydrographs are characterized by the following three parameters:

- R: The fraction of rainfall volume that enters the sanitary sewer
- T: The time from the onset of rainfall to the peak of the wet weather hydrograph
- K: The ratio of the time of hydrograph recession to the time to hydrograph peak

Three sets of RTKs were developed for the observed rainfall event to represent the fast, medium, and slow responses usually associated with RDII. The summation of these three unit hydrographs typically yields an improved representation of the RDII response compared to a single unit hydrograph. See **Figure 3** below for details on the RTK unit hydrograph method.



DEFINITION OF TERMS:

P = PRECIPITATION DEPTH OVER TIME STEP
T = TIME TO PEAK OF THE UNIT HYDROGRAPH
Qp = PEAK FLOW OF THE UNIT HYDROGRAPH
K = RECESSION COEFFICIENT
VOLUME = AREA OF SHADED REGION
VOLUME = VOLUME OF RDII IN UNIT HYDROGRAPH
R = FRACTION OF RAINFALL THAT BECOMES RDII
A = SEWERED AREA

T_1, T_2, & T_3 = TIME TO PEAK OF THE RESPECTIVE UNIT HYDROGRAPHS
K_1, K_2 & K_3 = RECESSION COEFFICIENTS OF THE RESPECTIVE UNIT HYDROGRAPHS
R_1, R_2 & R_3 = R-VALUES OF THE RESPECTIVE UNIT HYDROGRAPHS
R = FRACTION OF RAINFALL, P, THAT BECOMES RD
$R = R_1 + R_2 + R_3$

P_1, P_2, & P_3 = SUCCESSIVE RAINFALL DEPTHS OVER EACH TIME STEP
TOTAL HYDROGRAPH= SUMMATION OF SYNTHETIC HYDROGRAPHS RESULTING FROM EACH UNIT OF RAINFALL

Figure 3 Triangular Unit Hydrograph

RDII flows were simulated using the unit hydrograph parameters. Rainfall from the three recorded events were added to the base flow hydrographs to develop RDII hydrographs for each monitored sewershed. Unit hydrograph flow parameters were then calibrated to obtain a good match between modeled flows and actual data recorded at the flow monitors located on the trunk sewers. The following criteria were used for wet-weather calibration:

- Predicted peak flow rates are within -10 to +25 percent of observed peak flow rates

- Predicted volumes over the course of 24 hours are within -10 to +20 percent of observed volumes

The shape of the predicted rainfall response matched well with actual monitored response. **Table 4** provides modeled and monitored peak flows for the calibration storm events.

Table 4. Wet Weather Flow Calibration Statistics

	Volume			Hourly Peak Flow		
Monitor	Monitored (mgd)	Modeled (mgd)	Percent Difference (%)	Monitored (mgd)	Modeled (mgd)	Percent Difference (%)
GT01	3.13	3.17	1%	1.59	1.54	-3%
GT02	0.38	0.41	7%	0.21	0.19	-9%
GT03	3.34	3.46	4%	1.89	1.75	-8%
GT04	2.28	2.53	11%	1.57	1.69	8%
GT05	1.16	1.04	-10%	1.19	1.17	-2%
GT06	1.18	1.30	9%	1.03	1.06	3%
GT07	0.95	0.84	-11%	2.21	2.07	-6%
GT08[1]	1.16	1.37	18%	1.66	1.75	5%
GT09	5.32	5.33	0%	4.49	5.26	17%
GT10	1.22	1.37	12%	0.94	1.12	20%
GT11	3.51	3.66	4%	3.12	3.34	7%
GT12[2]	2.38	1.51	-37%	2.68	1.78	-33%
GT13	2.08	2.20	6%	1.15	1.23	7%
GT14	1.12	1.20	7%	0.74	0.82	10%
GT15	1.04	1.12	8%	1.07	1.07	0%

1 – To adequately represent the RDII response shape for monitor basin GT08, some additional volume was required.

2 – Calibration for monitor basin GT12 is not applicable because of the varying nature of the user settings at the Smith Branch LS diversion structure.

5. Conclusions and Recommendations

The calibrated parameters from the 2022 flow monitoring presented in this memo were developed from several days of dry-weather flow data and calibrated using the hydraulic model. These parameters are reasonable but potentially low due to possible overestimation of the population in some areas.

The peak wet-weather flow to average dry-weather flow ratio is a good indicator for RDII. Even if the volume of infiltration is low, inflow could be producing high peaks that lead to overflows and surcharging. Peaking factors greater than four are considered high in the City's system. One monitor recorded peaking factors greater than four during the monitoring period.

RDII parameters were developed and calibrated based on less than 1-year observed rainfall events. Rainfall was not consistent across the service area meaning that rainfall could be more intense in an isolated subbasin and non-existent in another area. It is preferable to use a rainfall event that is consistent throughout the service area if available. However, the model matched the wet-weather response reasonably well.

Based on the results of the calibrated model, it is recommended to use the parameters provided in **Table 5** for the 2022 WWMP planning criteria for DWF and RDII, respectively. These parameters are based on discussions with the City regarding the limitations and comparisons to previous flow monitoring efforts.

Table 5. Wastewater Flow Criteria for Future Development Areas

Wastewater Flow Category	Criteria
Ground Water Infiltration (GWI)	
Residential	30 gallons per capita/day (gpcd)
Nonresidential	25% of average nonresidential BWF
Base Wastewater Flow (BWF)	
Typical Residential	70 gpcd
Age Restricted PUD	55 gpcd
Nonresidential	Based on future land use densities or information provided by developer
BWF Peaking Factors	
Residential	2.1
Nonresidential	1.5
Rainfall-Dependent Inflow and Infiltration (RDII)	
Peak RDII	750 gal/ac/day

Note: gpcd is gallons per capita per day

REFERENCES

The Chartered Institution of Water and Environmental Management, Urban Drainage Group. 2017. *Code of Practice for the Hydraulic Modelling of Urban Drainage Systems, Version 01*. London: The Chartered Institution of Water and Environmental Management.

Appendix C

Wastewater Planning Criteria Technical Memorandum; Water and Wastewater Systems Design Criteria Technical Memorandum

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Technical Memorandum

To: *Chelsea Solomon, PE, Water Utility Director*
Wesley Wright, Systems Engineering Director

From: *Allen Woelke, PE (#54386), BCEE*
Ryan Tordella, PE (#140621)
CDM Smith, TBPE Firm No. F-3043

Date: *July 22, 2022*

Subject: *Wastewater Planning Criteria*

This technical memorandum (TM) provides recommendations for planning-level criteria for wastewater infrastructure for the City of Georgetown. These criteria are intended for planning and modeling of the wastewater collection systems. When evaluating these systems, planning and modeling criteria may be different from design criteria. The planning criteria considers the implications of applying such criteria system-wide when sizing major infrastructure or evaluating operations. The *Georgetown Utility Systems Water and Wastewater Design Criteria* (2018) Design Criteria TM outlines specific design criteria that the City can use to guide developers and engineers when designing portions of the City's wastewater systems.

The following planning-level criteria represent CDM Smith's recommendations after reviewing criteria from nearby municipalities (including the City of Austin), previous City work, and the Texas Commission on Environmental Quality (TCEQ) Texas Administrative Code (TAC). Additional recommendations come from reviewing historical billing records, wastewater flow monitoring data, and CDM Smith's experience in developing wastewater models. The purpose of this memorandum is to specify criteria that pertain to flows which might require additional information that is specific to the municipality and necessary for modeling and master planning. For all other design criteria, refer to the appropriate section of the TAC and the supporting Design Criteria TM.

1.0 Wastewater System Planning Criteria

The following criteria were developed for sizing infrastructure at a planning level and for modeling of the wastewater collection system model (wastewater model). The criteria are presented with some explanation of how they were derived.

1.1 Wastewater Flow Criteria

Average day and peak wet-weather wastewater flows are the basis for sizing gravity mains, lift stations, and wastewater treatment plants. Calculation of such flows are to consider expected future conditions flows out to 50 years according to TAC §217.53(a)(3).

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Peak wet weather flow (WWF) is made up of the following components:

- Groundwater Infiltration (GWI), which is a constant flow from groundwater that leaks into the system through cracks in pipes and other structure defects
- Base Wastewater Flow (BWF), which is made up of sanitary wastewater flows that are produced by people and businesses, and it will vary throughout the day depending on water usage and other factors
- Rainfall-Dependent Inflow and Infiltration (RDII), which is peaked based on the peak of the rainfall event simulated

Average day flow or dry weather flow (DWF) is the sum of GWI and the average day BWF. Peak DWF adds a maximum day peaking factor to the BWF. Finally, peak WWF is the sum of peak DWF and peak RDII. The required flow for designing wastewater collection system infrastructure must take into account RDII (TAC §217.53(a)(1)). **Figure 1** shows the components of wastewater flow and how they may vary with time.

Criteria have been established by TCEQ and nearby municipalities that can help to predict such flows, but the City has conducted flow monitoring to assist with developing applicable criteria for the City's system to be used for planning purposes as discussed in the following sections.

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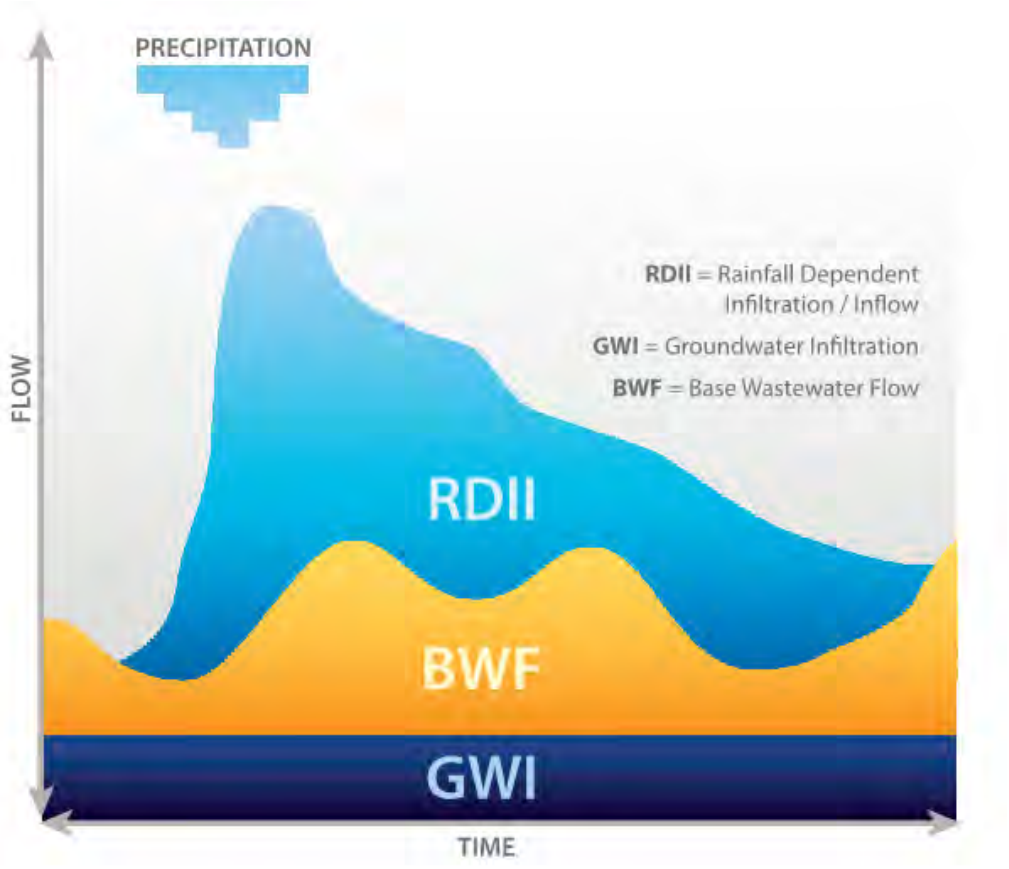

Figure 1. Components of Wastewater Flow

1.1.1 Average Residential and Nonresidential

The criteria for residential average day unit wastewater flow were developed from flow monitoring efforts from 2008, 2010, 2017, and 2022 and from discussions with the City. The established criteria are presented in Table 1 in units of gpcd.

Table 1. Residential Average Day Unit Wastewater Flows

DWF Category	Unit Flow (gpcd)
GWI	30
BWF	
Typical Residential	70
Sun City	30
Age-Restricted PUD	55

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For a standard residential LUE, the resulting average day DWF is calculated as follows:

*2.5 people/LUE * (70 gpcd + 30 gpcd) = 250 gpd/LUE*

Nonresidential GWI is assumed and added as **25 percent of nonresidential BWF**. Nonresidential BWF is difficult to estimate, because wastewater flows can vary significantly for even similar types of businesses. The different methods for estimating nonresidential BWF in order of preference are outlined below:

- Use specific knowledge of the usage from the developer to estimate the average daily BWF.
- Estimate the average daily BWF from the proposed square footage of the facility. Every 1,660 square feet is equal to 1 LUE at 175 gpd/LUE (2.5 people/LUE * 70 gpcd).
- For large development areas (approximately 20 acres or more), the nonresidential unit flows developed for the Future Land Use Plan densities may be used.

As part of the 2022 WWMP, the City's Future Land Use Plan was updated and used to project and distribute wastewater flows in the system. Through discussions with the City, a table was developed that shows the densities used to determine population and nonresidential wastewater flows for each land use category. This table, shown here as **Table 2**, can be used to make a comparison between what has been planned as part of the 2022 WWMP and what a particular developer is planning. It may also be used if specific development data is unavailable. Please note that all values for nonresidential flow represent average day. The same conversion units for residential dwelling units that were discussed in the water section apply to wastewater as well.

Table 2: Future Land Use Density

Future Land Use	Residential		*Non-Residential*	
	Percent of Area	Dwelling Units per Acre[1]	% of Area	Average Day Wastewater Flow gpd/ac
Existing Service Area – No Growth	Existing wastewater flow based on 2022 flow monitoring data.			
Open Space/Mining – No Growth	N/A			
Development Pipeline/Utility Eval	Density varies by location and given information.			
Downtown/Williams Drive Re-Development	Information for this area is specific to the redevelopment plan. See section below for details.			
Neighborhood	100%	3.5 SFUs		
Mixed Density Neighborhood	100%	3.5 SFUs		
Dry Berry Creek – High Density	100%	24 MFUs		
Dry Berry Creek – Medium Density	100%	12 MFUs		
Community Center	10%	10 MFUs	90%	1,500
Institutional			100%	950
Regional Center	25%	7 SFUs and 7 MFUs	75%	1,200
Employment Center	10%	10 MFUs	90%	900

1. A dwelling unit is defined as single family (SFU) or multifamily (MFU)

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1.1.3 Dry-Weather Flow Peaking Factor

The design criteria for the peaking factor is included in the Design Criteria TM and uses an equation to vary the peaking factor based on average day BWF. For planning, the peaking factors used in the model are based on calibration of the diurnal pattern of wastewater flows by flow metered areas. The typical residential peaking factor, and the factor applied to areas not metered or new areas, is 2.1, which is applied to the average day residential BWF. Nonresidential BWF is peaked at 1.5 times the average flow.

1.1.4 Rainfall-Dependent Inflow and Infiltration

RDII flow was calibrated in the model using flow monitoring data that has been collected in 2017 and 2022. Existing areas that have not been flow monitored have been assumed to have a peak RDII flow of 1,000 gallons per acre per day (gpad). Recent flow monitoring compared to previous flow monitoring in the Sun City service area has shown that new development areas do not have has high of a peak RDII flow in the main interceptors. Through discussions with the City and in comparing with the City of Austin criteria, it has been decided that a peak RDII flow of 750 gpad is used for planning and modeling purposes when planning and sizing infrastructure. For design, the criterion of 1,000 gpad remains.

1.2 Determination of Pipe Size

For sizing, the design and planning-level criteria are similar. The concepts most applicable to planning are presented here. For more detailed information, refer to the Design Criteria TM.

For sewer mains, 15 inches in diameter or smaller, use the larger size as determined below:

- The main must be designed such that the Peak DWF must not exceed 65 percent of the capacity of the pipe flowing full.
- The main must be designed such that the Peak WWF must not exceed 80 percent of the capacity of the pipe flowing full.
- For sewer mains, 18 inches in diameter or larger, the main must be designed such that the peak WWF must not exceed 80 percent of the capacity of the pipe flowing full.

TCEQ also states in TAC §217.53(j)(3) that a collection system must be designed to prevent a surcharge in any pipe at the expected peak flow.

Allowable pipe sizes are as follows:

- The minimum diameter of all gravity sewer mains must be 8 inches. For service line sizes, refer to the City's Standard Details.

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- For gravity lines larger than 8 inches, the following sizes will be the only sizes allowed for use in the gravity system: 12, 15, 18, 21, 24, 30, 36, and 42 inches. Larger sizes may be approved on a case-by-case basis.

The minimum velocity at full pipe capacity must not be less than 2 fps from the Manning's equation and using a minimum Manning's n of 0.013 (TAC §217.53(l)(1)). Using the same criteria, the maximum design velocity should not exceed 10 fps (otherwise pipe protection is required) (TAC §217.53(l)(2)(B)).

The minimum allowable slope for 8-inch mains must be 0.005 ft/ft (0.5 percent grade). According to TAC §217.53(l)(2)(A), the minimum and maximum slope for larger pipes must be based on meeting the minimum and maximum required velocity and minimum Manning's n. The table from TAC §217.53(l)(2)(A) is shown here as **Table 7** for the allowable pipe sizes greater than 8 inches.

Table 7. Minimum and Maximum Slope for Gravity Sewer

Pipe Diameter (inches)	Minimum Slope (Percent)	Maximum Slope (Percent)
12	0.20	4.88
15	0.15	3.62
18	0.11	2.83
21	0.09	2.30
24	0.08	1.93
30	0.055	1.43
36	0.045	1.12
42	0.037	0.90

For the 2022 WWMP, gravity sewer projects have been sized based on the slope of the existing ground in the approximate location of the proposed main or the minimum slope requirement if the existing ground slope is not sufficient. A minimum ground cover of approximately 5 feet is also considered when determining slope for sizing.

1.3 Lift Stations, Force Mains, and Wet Well Capacity

For planning and modeling of proposed lift stations, the only applicable criterion is with regard to the design flow. According to TAC §217.61 (c), lift stations must be sized to have a firm capacity that can pump the design flow (peak WWF). Firm capacity is defined as the lift station capacity with the largest pump out of service.

Force mains must have a 4-inch minimum inside diameter. According to TAC §217.67 (a)(2) and (4), force mains must be sized to have minimum velocity of 3.0 fps with one pump in operation and a maximum velocity of 6.0 fps. If the velocity will be greater than 6.0 fps, additional design considerations should be considered as discussed in TAC §217.67 (a)(4).

For evaluation of existing lift stations, the additional following criteria were considered:

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- Wet well storage volume must be designed to provide adequate storage volume at peak design flows.
- Minimum pump cycle times are required to avoid excessive wear and tear on the pump motors. **Table 8** gives shows the required minimum cycle times given by pump horsepower. Using the minimum cycle time and the pump design capacity, an adequate working wet well volume can be determined.

Table 8. Minimum Pump Cycle Time

Pump Horsepower	Minimum Cycle Time (min)
<50	6
50–100	10
>100	15

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Technical Memorandum

To: *Chelsea Solomon, PE, Water Utility Director*
Wesley Wright, Systems Engineering Director

From: *Allen Woelke, PE (#54386), BCEE*
Ryan Tordella, PE (#140621)
CDM Smith, TBPE Firm No. F-3043

Design Criteria is in Draft and not finalized as of yet

Date: *July 22, 2022*

Subject: *City of Georgetown Water and Wastewater Systems Design Criteria*

This appendix provides recommendations for minimum basic design criteria for water and wastewater infrastructure for the City of Georgetown (City). These systems fall within the Full Purpose Jurisdiction of the City of Georgetown and its Extraterritorial jurisdiction (ETJ) but do not address major facilities such as water and wastewater treatment plants. Generally, these systems will be owned, operated, and maintained by the City unless private. Some systems, such as certain municipal utility districts, will not be operated by the City immediately upon completion, but it is likely that the City will take over operation and maintenance at some time in the future.

All project manuals must include the appropriate City Standard Specifications. All projects are required to be built in accordance with these City Standard Specifications, which include other requirements not addressed here. All variations are subject to the approval of the City. Additional requirements for specific projects may be established where the conditions of service to the tract and related system operation and maintenance needs warrant.

The following information is provided to assist engineers and the general public in the design and construction of water and wastewater facilities. All drawings for such facilities must be prepared by or under the supervision of a Registered Professional Engineer, licensed in the State of Texas. It will be the responsibility of the engineer to confirm that the plans are in compliance with the latest versions of all applicable federal, state and local ordinances, rules and regulations.

For the design of any water or wastewater system, the Texas Administrative Code (TAC), which includes the Texas Commission on Environmental Quality (TCEQ), criteria must, at a minimum, be met. This information is not intended to be inclusive of all requirements by TCEQ. For all other design criteria, refer to the appropriate section of the TAC.

These additional requirements include, but are not limited to, the following:

- TAC Design Criteria for Domestic Wastewater Systems - TCEQ

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- TAC Rules and Regulations for Public Water Systems - TCEQ
- The Unified Development Code and Ordinances of the City of Georgetown
- City of Georgetown Standard Specifications
- The City of Georgetown Water, Reclaimed Water, and Wastewater Criteria
- TAC Use of Reclaimed Water - TCEQ
- Edward's Aquifer Recharge Program
- USFW Salamander

I. Water Design Criteria

A. Size/Capacity Determination

1. General

   The Hazen Williams Friction Coefficient (C-value) must be assigned as a function of the pipe size. The following guides should be applied for new pipes: for an 8- to 12-inch line, use C=100; for a 16- to 24-inch line, use C=120; and for a 30 inch and larger line, use C=130.

2. Demand: Design criteria for calculating demands are outlined in Table **1.A.2**.

Table 1.A.2 - Water Demand Criteria

Criteria Category	System-Wide Criteria	Residential, Special Areas	
		Sun City or Similar	Berry Creek or Similar
People per Connection[1]	2.5	1.9	2.5
Residential Average Day Demand (gpcd)	145	296	305
Nonresidential Average Day Demand	case-by-case	N/A	N/A
Nonrevenue Water, percent of total average day demand inclusive of nonrevenue water	15%	15%	15%
Maximum Day to Average Day Ratio	2	2.4	2.4
Recommended Maximum Day Demand per Connection (gallons per minute [gpm] per connection)[3]	0.73	1.10	1.50
Peak Hour to Maximum Day Ratio	1.8	3.33	2.73

1. Areas similar to Berry Creek may also consider up to 3.21 people per connection for large lots (greater than 0.5 acres).
2. The average day demand for Sun City and Berry Creek is based on the average plus one standard deviation of billing data in those areas.
3. The system-wide criteria include a factor for a nonresidential component of demand that is calculated as 23 percent of the average day residential demand.
4. N/A = Not Applicable

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If the City specifies special conditions for a development, the criteria for "Residential, Special Areas" may be required.

3. The system-wide criterion for nonresidential demand must be determined on a case-by-case basis or by using TCEQ minimum criteria. TCEQ provides minimum requirements for maximum daily demand for particular facilities. **Table I.A.3**, which comes from TAC §290.45(d)(1), includes minimum requirements for determining maximum daily demands for various types of nonresidential facilities. As the TCEQ requirements do not include hotel/motel, such use must use two people per room and use the residential, system-wide criteria.

   If the only information available is total number of connections, residential and nonresidential, a maximum day demand of 0.73 gpm per connection must be used.

Table I.A.3 - Recommended Maximum Daily Demand for Nonresidential Facilities from TAC 290.45(d)(1)

Type of Facility	Gallons per Person
Restaurants	18
Schools without cafeterias, gymnasiums, or showers	18
Schools with cafeterias, but no gymnasiums or showers	24
Schools with cafeterias, gymnasiums, and showers	30
Youth camps without flush toilets, showers, or dining halls	6
Youth camps with flush toilets, but no showers or dining halls	24
Youth camps with flush toilets, showers, and dining halls	42
Office buildings	18
Hospitals (based on number of beds)	720
Institutions, other than hospitals	240
Factories (exclusive of industrial processes)	24
Parks	6
Swimming pools	12
Country clubs	120
Airports (per passenger)	6
Self-service laundries	60
Service stations/stores	12

4. Units used to represent residential dwelling units for the City service area include the following:

   – Single-family unit (SFU) = 2.5 people

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- Multifamily unit (MFU) = 1.9 people

An LUE is approximately 2.5 people-based the City's assessment of population and Fiscal Area Zones; therefore, a multifamily LUE is approximately equal to 0.75 LUEs. Two other residential dwelling types not specifically included in Table 2 include the following:

- Age-restricted unit = 1.9 people
- Single-family large-lot unit = 3.21 people

Age-restricted units are similar to MFUs in terms of people per dwelling unit. The single-family large-lot unit is a special designation for areas with large lots. This density was found to be the average density of existing lots in the Western District around the year 2012. The designation is recommended for developments with lots of 0.5 acres or greater.

If the maximum static pressure exceeds 80 pounds per square inch (psi), a pressure reducing valve (PRV) will be required on the property owner's side of the water meter and should be shown on the plan view.

Minimum operating static pressure is 50 psi at the highest elevation meter location using average day demand.

5. Peak Hour Demand Requirements

   a. The maximum allowable velocity must not exceed 5 feet per second (fps).

   b. The minimum pressure at any point in the affected pressure zone must not be less than 40 psi.

6. Emergency Demand (Fire Flow) Requirements

   a. The maximum allowable velocity must not exceed 10 fps.

   b. Fire flow (reference current district adopted Fire Code) requirements will be determined in accordance with the fire code adopted by the jurisdictional Fire department.

   c. The minimum residual pressure at any point in the affected pressure zone at maximum day plus fire flow must not be less than 20 psi.

   d. Required fire pumps, for high-rise buildings, as defined in the building code, must be supplied by connections to a minimum of two water mains. The domestic waterline will be allowed off one of the fire lines. Domestic water lines must be metered either after the fire line or along the fire line that includes the domestic waterline. Separate supply piping must be provided between each connection to the water main and the pumps.

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Each connection and the supply piping between the connection and the pumps must be sized to supply the flow and pressure required for the pumps to operate.

Exception: Two connections to the same main must be permitted provided the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through at least one of the connections.

7. Sizing of Water Mains - Computer modeling is preferred for sizing water mains. However, for water mains less than 16 inches in diameter other engineering calculation methods may be accepted. The largest size, as determined by comparing the service area's peak hour demand and maximum day plus fire flow demand, must be used. Size of water mains will be required to be increased if shown larger on the current Master Plan or if required based on Utility Evaluation.

8. Storage Requirements - If it is determined by the City that additional storage is required, the following criteria must be used:

   a. The Engineer may be required to provide computer simulations as determined on a case-by-case basis.

   b. Elevated storage capacity is required at 55 gallons per person to provide sufficient capacity for firefighting.

   c. Ground storage capacity is required at 130 gallons per person.

   d. Elevated storage must provide a minimum of 50 psi of static pressure at the highest service elevation in pressure zone.

   e. Additional storage beyond what is stated above may be required as determined by the Master Plan, Utility Evaluation, or fire service requirements.

9. Pumping

   TAC §290.45(b)(2)(F) states that the total service pump capacity must provide each pump station or pressure plane with two or more pumps that have a total capacity of 2.0 gpm per connection or that have a total capacity of at least 1,000 gpm and the ability to meet peak hourly demands with the largest pump out of service, whichever is less. For systems that provide an elevated storage capacity of 200 gallons per connection, two service pumps with a minimum combined capacity of 0.6 gallons per minute per connection are required at each pump station or pressure plane.

B. Mains

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1. Minimum main size must be 8 inches with consideration for 6-inch pipe in cul-de-sacs less than 200 feet in length. Provision must be made in these cases for an automatic flush valve with meter at the end of the 6-inch lines.

2. The minimum size for any street type, however, will be governed by various factors, which include fire protection requirements, high-density land usage, and the designer's consideration of general system gridding, future transmission mains, neighboring developments, and area configuration.

3. Transmission line sizes will be determined on a case-by-case basis.

4. Looped systems are required, but it is recognized that in certain situations, short sections of dead-end pipe may be more practical. When a dead-end section of water main containing more than 100 gallons of water is approved for installation, the following requirements must be met:

    a. If a dead-end section is installed for future connection or extension, and no service will be taken from the stub prior to the future connection or extension, a valve must be placed at the location where the main becomes a dead end (i.e., at the tee).

    b. If a dead end is installed and service is to be provided via the dead end:

        - The water demand from the service (or services) must be sufficient to turn over the water every 72 hours.

        - If the service(s) do not provide sufficient demand to turn over the water every 72 hours, an approved automatic flushing device and meter must be installed and programmed such that the 72-hour criterion is met.

5. Water mains should be located, where maintenance can be accomplished with the least interference with traffic, structures, and other utilities.

    a. The separation between water and wastewater mains must comply with TCEQ rules or have a variance approved by TCEQ before submittal to the City. A minimum horizontal separation distance of 5 feet, measured from outer diameter (OD) of pipe to OD of pipe, must be maintained between existing or proposed water mains and all other utilities and/or conduits to maintain trench integrity.

    b. Mains should normally be located on the high side of the street; however, mains must be installed on both sides of all divided road/highways. Roads/highways, where opposing lanes of traffic are separated by a vehicle obstruction, must be considered a divided road/highway. The location assignment must be according to City of Georgetown Standard details.

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c. Within the right-of-way (ROW), mains should be located outside the pavement or curbs, as outlined by city standard details, etc., wherever feasible. When mains are located outside of the ROW, they must be within a dedicated utility easement. Main assignments in such city streets must be approved by the City, assignments for lines in county or state roads must also be approved by the county or state engineer or its designee.

6. Piping materials and appurtenances must conform to City of Georgetown Standard Specifications and the Georgetown Water Utility's Standard Products List.

7. Minimum depth of cover over the uppermost projection of the pipe and all appurtenances must be as follows:

   a. Water piping installed in undisturbed ground in easements of undeveloped areas, which are not within existing or planned streets, roads, or other traffic areas, must be laid with at least 36 inches of cover.

   b. Water piping installed in existing streets, roads, or other traffic areas must be laid with at least 48 inches of cover below finished grade.

   c. Unless approved by the City, installation of water piping in proposed new streets will not be permitted until paving and drainage plans have been approved and the roadway traffic areas excavated to the specified or standard paving subgrade, with all parkways and sidewalk areas graded according to any applicable provisions of the drainage plans or sloped upward from the curb line to the ROW at minimum slope of ¼ inch per foot. Piping and appurtenances installed in such proposed streets must be laid with at least 36 inches of cover below the actual subgrade. The maximum depth will be as approved by the Georgetown Water Utility for the specific materials, application, and conditions.

8. For mains 16 inches in diameter and larger and on smaller mains where appropriate, hydrants or drain valves must be placed at low points and on the up-slope side of all valve locations.

9. All fire lines must have a gate valve on the line at the connection to the main line and a backflow preventer inside the property line but be accessible for inspection by City personnel. All unmetered fire lines must have a Georgetown Water Utility-approved flow detection device. This flow detection service must be located such that no more than 100 gallons of water is contained between the device and the point where the fire line is connected to the City's main.

10. On water mains 16 inches in diameter and larger and on smaller mains where appropriate, combination air valves will be placed at all high points and air/vacuum valves must be placed at the down-slope side of all valve locations. Air/vacuum and vacuum release valves must be approved on a case-by-case basis. All mains 24 inches and larger will include an 18-inch outlet with blind flange installation at high points where the installation of an air

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release valve (ARV) would be necessary. In the absence of an ARV requirement, an 18-inch outlet with blind flange must be placed every 2500 feet.

11. Joint restraint for pipes larger than 16 inches in diameter must be by use of integral, factory joint restraint systems, or by restraint gaskets, and thrust restraint.

12. Joint restraint must be provided for all pipe bends and where necessary when joint deflection is utilized. When joint restraint is required in intersections, extend the joint restraint, at a minimum, to the point of curvature (PC) of the curb line. Notes must be placed in both plan and profile views and must include at a minimum the type of restraint to be utilized and the beginning and ending stations of the restraint. Concrete thrust blocking will also be required. The proximity of other utilities and structures must be taken into account when specifying the use of thrust blocking. The use of thrust blocks will be prohibited in the downtown area because of the congestion of utilities, structures, and excavations in the ROW.

13. Allowable pipe sizes.

    The following sizes will be the only sizes allowed for use in the system: 6 (fire-hydrant leads and services only), 8, 12, 16, 24, 30, 36, and 42 inches. Larger sizes may be approved on a case-by-case basis.

14. Connections of new mains to existing mains must be made by cutting in a tee. Tapping sleeves may be allowed in lieu of cutting in a tee on a case-by-case basis. Full-body tapping sleeves must be used. A tapping sleeve will not be allowed if the materials and conditions of the existing main preclude tapping. “Size-on-size” taps will not be permitted, unless made by use of an approved full bodied mechanical joint size-on-size tapping sleeve.

C. Valves

1. There must be a valve on each fire hydrant lead restrained to the main. These and all valves 24 inches and smaller must be resilient seated gate valves.

2. Valves must be located at the intersection of two or more mains and must be spaced so that no more than 30 customers will be without water during a shutout. For lines smaller than 24 inches, typical spacing should be 500 feet in high-density areas and 1,200 feet in residential area. Mains 24 inches and larger must be valved at intervals not to exceed 2,000 feet.

3. At dead ends, gate valves must be located one pipe length (10-foot minimum) from the end points of the main. The Engineer must provide—and show drawings of—complete restraint for all such valves, pipe extensions, and end caps.

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4. Branch piping (both new and future branches) must be separated from the main with gate valves.

5. For all mains, valves at intersections must be placed at PC of the curb line.

6. Valves must be located so that isolating any segment of water main requires closing of no more than three valves.

7. The operating nut or extension of any valve must be between 18 inches and 24 inches below finished grade.

8. Valves with valve extensions and those at pressure zone boundaries must be equipped with a locking-type debris cap.

9. All vertical gate valves larger than 16 inches must have the bonnet located in a vault or manhole. All horizontal gate valves larger than 16 inches must have the valve actuator (gearing) located in a vault or manhole.

10. Valves having "push on" joints are not permitted for fire hydrant leads and laterals.

11. The use of butterfly valves should be discussed with the City. Gate valves are recommended for valves 16 inches and smaller and butterfly valves are recommended for valves 24 inches and larger.

12. Water mains must be designed so that valves can be installed vertically unless conditions dictate otherwise.

D. Fire Hydrants

1. Hydrants must be installed at the intersection of two streets and between intersections where necessary, at distances not in excess of 300 feet between hydrants in commercial or other high-density areas and not more than 500 feet in residential areas.

2. Hydrants must be installed on both sides of all divided road/highways to provide adequate firefighting coverage. Roads/highways where opposing lanes of traffic are separated by a vehicle obstruction must be considered a divided road/highway.

3. The entire fire hydrant assembly must have restrained joints and thrust blocking.

4. Fire hydrants must not be designed to be within 9 feet in any direction of any wastewater main, lateral, or service regardless of material of construction.

5. Fire hydrants must be designed so as not to interfere with sidewalk ramps, trash receptacles, and street light and signal pole foundations.

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6. When fire hydrants are subjected to pressures above 150 psi, they must have an attached PRV installed to reduce the operating pressure of the fire hydrants below 150 psi.

7. When new water lines are installed along with new fire hydrant leads, the drawings must indicate existing fire hydrants are to be replaced with a new one, if it is older than 10 years old.

E. Services

1. Water services must be in accordance with City of Georgetown Standard Details. More than two meters on a single service line will be considered on a case-by-case basis.

2. Individual meter services and fire lines will not be taken from transmission lines. Transmission lines are generally considered to be 24 inches in diameter or larger. May be approved by the development engineer on a case-by-case basis.

3. Water meters must be placed within the public ROW or in an easement. Water meter boxes are not allowed in sidewalks or driveways.

4. Service taps to the main must have a minimum separation distance of 3 feet.

5. Service taps, regardless of type, must not be made in vaults.

F. Water Meters for Multifamily and Commercial Customers

1. Properties with two, three, or four living units must have an individual water meter serving each living unit.

2. Commercial and multifamily properties must purchase and install a separate meter or meters to measure water used for all common areas and outdoor purposes, including swimming pools, fountains, permanently installed irrigation systems, and irrigation with quick-coupler hose bibbs.

3. All multifamily, manufactured home rental community, or multiple-use facility, to provide for the measurement of the quantity of water, if any, consumed by the occupants of each unit, must install either:

    a. Submeters, owned by the property owner or manager, for each dwelling unit or rental unit

    b. Individual meters for each dwelling unit or rental unit

4. Bypasses must be provided on all meters 3 inches and larger.

G. Easements

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1. Easements for water mains must be a minimum of 15 feet wide, or twice the depth of the main, measured from finished grade to pipe flow line, or 1 foot for each inch diameter of pipe rounded to the nearest 5-foot increment, whichever is greater. Mains must be centered on the easement. Narrower easements will be considered where the Engineer provides evidence, to the satisfaction of the City, that maintenance activities will not be hindered by the reduced width.

2. Easement documents and the meters and bounds must be reviewed and approved by the City prior to recordation in the real property records of the appropriate county. Easement recordation in the real property records of the appropriate county is required prior to City approval of construction plans.

H. Requirements for Existing and Proposed Water Infrastructure beneath Circular Intersections or Other Geometric Street Features

1. Installation of Circular Intersections or Other Geometric Street Features over existing water infrastructure.

    a. Existing water infrastructure may be allowed to exist beneath circular intersections or other geometric street features such as, but not limited to, modern roundabouts, medians, bulb-outs, splitter islands, channelization islands, and other types of physical roadway features. These features may contain hardscaping, landscaping, water quality features, public art, permanent structures, street furniture, or other similar amenities.

    b. The planning and design of these features and their amenities must include consideration for access, maintenance, protection, testing, cleaning, and operations of the water infrastructure. Where existing water facilities are to remain, trees with root zones of 18 inches in depth or greater at maturity may be considered for inclusion provided the drip lines at maturity of the proposed trees are not located within a minimum horizontal separation of 7.5 feet from any water infrastructure. Public art, permanent structures, and other similar amenities may be considered for inclusion provided they are not located within a minimum horizontal separation of 7.5 feet from any water infrastructure. The drip lines at maturity of ornamental trees with root zones at maturity of less than 18 inches in depth, grasses, woody or herbaceous shrubs, and street furniture may be located within a minimum horizontal separation of 7.5 feet from any water infrastructure.

    c. The need for relocating, replacing or protecting in place existing water infrastructure beneath these features and their amenities must be determined on a case-by-case basis by the City.

2. Installation of Circular Intersections or Other Geometric Street Features in new areas of development with no existing water infrastructure.

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a. Proposed water infrastructure may be placed beneath proposed circular intersections or other geometric street features such as, but not limited to, modern roundabouts, medians, bulb-outs, splitter islands, channelization islands, and other types of physical roadway features. These features may contain hardscaping, landscaping, water quality features, public art, permanent structures, street furniture, or other similar amenities.

b. The planning and design of these features and their amenities must include consideration for access, maintenance, protection, testing, cleaning, and operations of utility infrastructures. Trees with root zones of 18 inches in depth or greater at maturity may be considered for inclusion provided the drip lines at maturity of the proposed trees are not located within a minimum horizontal separation of 7.5 feet from any water infrastructure. Public art, permanent structures, and other similar amenities may be considered for inclusion provided they are not located within a minimum horizontal separation of 7.5 feet from any water infrastructure. The drip lines at maturity of ornamental trees with root zones at maturity of less than 18 inches in depth, grasses, woody or herbaceous shrubs, and street furniture may be located within a minimum horizontal separation of 7.5 feet from any water infrastructure.

c. The need for alternative alignments or the inclusion of protective systems for the proposed water infrastructure beneath these features and their amenities must be determined on a case-by-case basis by the City.

II. Reclaimed Water Systems

A. Size/Capacity Determination

1. General

a. The Hazen Williams Friction Coefficient (C-value) must be assigned as a function of the pipe size. The following guides should be applied for new pipes: for an 8 to 12-inch line, use C=100; for a 16 to 24-inch line, use C=120; and for a 30 inch and larger line, use C=130.

b. Maximum static pressure = 120 psi.

2. Peak Demand Requirements

a. The maximum velocity must not exceed 5 fps.

b. The minimum pressure at any point in the affected pressure zone must not be less than 35 psi.

c. Mains must be sized to accommodate max day flows of:

- 8,100 gallons per irrigated acre

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- 28 gallons per ton of cooling
- Indoor use based on fixture units

3. Emergency Demand (Fire Flow) Requirements:

   None – fire flows are provided by the water system.

4. Plans must include a detail of a reclaimed water identification sign. Plans must show the posting locations for the sign.

B. Mains

1. Sizing of Mains - Computer modeling is preferred for sizing reclaimed water mains. However, for mains less than 16 inches in diameter other engineering calculation methods may be accepted. Standard main sizes are: 6, 8, 12, 16, 24, 30, 36, 42, and 48 inches. A 4-inch pipe size must be considered for mains less than 200 feet in length.

2. All reclaimed water mains must be constructed of ductile iron pipe, Pressure Class 350 minimum for pipe 12 inches in diameter and smaller and Pressure Class 250 for pipe greater than 12 inches in diameter. For 12-inch diameter and smaller mains, polyvinyl chloride (PVC) pipe, conforming to the requirements of AWWA C-900, DR 14 will be acceptable. Plans must indicate that all mains and appurtenances must be manufactured in purple, factory painted purple, or bagged in purple. Color must match Pantone 522.

3. Mains should be located where maintenance can be accomplished with the least interference with traffic, structures, and other utilities. When mains are located outside of the ROW, they must be within a dedicated utility easement. Main assignments in such city streets must be approved by the City. Assignments for lines in county roads must also be approved by the county engineer. A minimum horizontal separation distance of 5 feet, measured from OD of pipe to OD of pipe, must be maintained between existing or proposed reclaimed water mains and all other utilities and/or conduits to maintain trench integrity.

4. The separation of reclaimed mains from water and wastewater mains must comply with TCEQ rules.

5. Piping materials and appurtenances must conform to City of Georgetown Standard Specifications, Standard Details, and the Utility's Standard Products List.

6. Minimum depth of cover over the uppermost projection of the pipe and all appurtenances must comply with City of Georgetown Standard Details; maximum depth will be as approved by the Georgetown Water Utility for the specific materials, application and conditions.

7. For mains of 16 inches and larger, drain valves must be placed at low points.

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8. On water mains 16 inches in diameter and larger, automatic air release valves will be placed at all high points and at the down-slope side of all valve locations. Air/vacuum and vacuum release valves must be approved on a case-by-case basis. All reclaimed mains twenty-24 inches and larger will include an 18-inch outlet with blind flange installation at high points where the installation of an ARV would be necessary. In the absence of an ARV requirement, an 18-inch outlet with blind flange must be placed every 2,500 feet.

9. If needed as determined by the City for a reclaimed system, dead-end mains must terminate with a flushing device and flushing devices must be installed as necessary to facilitate flushing of the system.

10. If needed as determined by the City for a reclaimed system, mains must have an approved flushing device located at the high point between main intersections.

11. Joint restraint for pipes larger than 16-inch diameter must be by use of integral, factory joint restraint systems, or by restraint gaskets.

12. Joint restraint must be provided for all pipe bends and where necessary when joint deflection is utilized. When joint restraints are required in intersections, the joint restraints must extend, at a minimum, to the PC of the curb line. Notes must be placed in both plan and profile views and must include at a minimum the type of restraint to be utilized and the beginning and ending stations of the restraint.

13. The proximity of other utilities and structures must be taken into account when specifying the use of thrust blocking. The use of thrust blocks will be prohibited in the downtown area because of the congestion of utilities, structures, and excavations in the ROW. Concrete thrust blocking may be approved on a case-by-case basis.

14. Connections of new reclaimed mains to existing reclaimed mains must be made by cutting in a tee. Tapping sleeves may be allowed in lieu of cutting in a tee on a case-by-case basis. Full-body tapping sleeves must be used. A tapping sleeve will not be allowed if the materials and conditions of the existing main preclude tapping. “Size on size” taps will not be permitted, unless made by use of an approved full bodied mechanical joint tapping sleeve.

C. Valves

1. All valves 24 inches and smaller, must be resilient seated gate valves.

2. Valves must be located at the intersection of two or more mains. For lines smaller than 24 inches, typical spacing should be 500 feet in high-density areas and 1,200 feet in residential area. Mains 24 inches and larger must be valved at intervals not to exceed 2,000 feet.

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3. At dead ends, gate valves must be located one pipe length ten (10-ft. minimum) from the end points of the main. The Engineer must provide —and show drawings of—complete restraint for all such valves, pipe extensions, and end caps.

4. Branch piping (both new and future branches) must be separated from the main with gate valves.

5. For all reclaimed mains, valves at intersections must be placed at PC of the curb line.

6. Valves must be located so that isolating any main intersection requires closing of no more than three valves.

7. The operating nut or extension of any valve must be between 18 inches and 24 inches below finished grade.

8. Valves with valve extensions and those at pressure zone boundaries must be equipped with a locking-type debris cap.

   The use of butterfly valves should be discussed with the City. Gate valves are recommended for valves 16 inches and smaller and butterfly valves are recommended for valves 24 inches and larger.

9. All horizontal gate valves larger than 16 inches must have the valve actuator (gearing) located in a vault or manhole.

10. The use of butterfly valves should be discussed with the City. Gate valves are recommended for valves 16 inches and smaller and butterfly valves are recommended for valves 24 inches and larger.

11. Valve boxes and lids must be square, with “Non-Potable Water” indicated on the lid.

12. Reclaimed water mains must be designed so that valves can be installed vertically unless conditions dictate otherwise.

D. Services

1. Reclaimed water services must be in accordance with City of Georgetown Standard Details.

2. The plans must show the locations of backflow prevention assemblies.

3. The plans must show irrigation lines, sizes, and specify pipe color (purple). All sprinkler heads and sprinkler control box covers must be purple.

4. The plans must show reclaimed meter locations and specify a color (purple).

5. Services for cooling towers or interior building use must have a separate meter.

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6. Meter boxes and vaults must be square or rectangular with "Reclaimed Water" cast into the lid.

7. Reclaimed water meters must be placed within the public ROW or in an easement. Reclaimed water meter boxes are not allowed in sidewalks or driveways.

8. Service taps to reclaimed mains must be separated from other taps and pipe joints by a minimum distance of 3 feet.

9. Service taps, regardless of type, must not be made in vaults.

E. Easements

1. Easements for reclaimed water mains must be a minimum of 15 feet wide, or twice the depth of the main, measured from finished grade to pipe flow line, whichever is greater. Mains must be centered on the easement. Narrower easements will be considered where the Engineer provides evidence, to the satisfaction of the City, that maintenance activities will not be hindered by the reduced width.

2. Easement documents and the metes and bounds must be reviewed and approved by the City prior to recordation with the County. Easement recordation at the County is required prior to City approval of construction plans.

F. Requirements for Existing and Proposed Reclaimed Water Infrastructure beneath Circular Intersections or Other Geometric Street Features

1. Installation of Circular Intersections or Other Geometric Street Features over existing reclaimed water infrastructure.

   a. Existing reclaimed water infrastructure may be allowed to exist beneath circular intersections or other geometric street features such as, but not limited to, modern roundabouts, medians, bulb-outs, splitter islands, channelization islands, and other types of physical roadway features. These features may contain hardscaping, landscaping, water quality features, public art, permanent structures, street furniture, or other similar amenities.

   b. The planning and design of these features and their amenities must include consideration for access, maintenance, protection, testing, cleaning, and operations of the reclaimed water infrastructure. Where existing reclaimed water facilities are to remain, proposed trees may be considered for inclusion provided the tree is a utility compatible species (as denoted in ECM Appendix F) and is not planted within 5 horizontal feet from any reclaimed water infrastructure. Public art, permanent structures, and other similar amenities may be considered for inclusion provided they

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are not located within a minimum horizontal separation of 5 feet from any reclaimed water infrastructure.

c. The need for relocating, replacing or protecting in place reclaimed existing water infrastructure beneath these features and their amenities must be determined on a case-by-case basis by the City.

2. Installation of Circular Intersections or Other Geometric Street Features in new areas of development with no existing reclaimed water infrastructure.

a. Proposed reclaimed water infrastructure may be placed beneath proposed circular intersections or other geometric street features such as, but not limited to, modern roundabouts, medians, bulb-outs, splitter islands, channelization islands, and other types of physical roadway features. These features may contain hardscaping, landscaping, water quality features, public art, permanent structures, street furniture, or other similar amenities.

b. The planning and design of these features and their amenities must include consideration for access, maintenance, protection, testing, cleaning, and operations of utility infrastructures. Trees may be considered for inclusion provided the tree is a utility compatible species (as denoted in ECM Appendix F) and is not planted within 5 horizontal feet from any reclaimed water infrastructure. Public art, permanent structures, and other similar amenities may be considered for inclusion provided they are not located within a minimum horizontal separation of 5 feet from any reclaimed water infrastructure.

c. The need for alternative alignments or the inclusion of protective systems for the proposed reclaimed water infrastructure beneath these features and their amenities must be determined on a case-by-case basis by the City.

III. Wastewater Design Criteria

A. Determination of Wastewater Flow

1. Average day and peak wet weather wastewater flows are the basis for sizing gravity mains, lift stations, and wastewater treatment plants.

2. Peak wet weather flow (WWF) is made up of the following components:

a. Groundwater infiltration (GWI), which is a constant flow from groundwater that leaks into the system through cracks in pipes and other structure defects.

b. Base wastewater flow (BWF), BWF is made up of sanitary wastewater flows that are produced by people and businesses, and it will vary throughout the day depending on water usage and other factors.

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c. Rainfall-dependent infiltration and inflow (RDII), which is peaked based on the peak of the rainfall event simulated.

d. Average day flow or dry weather flow (DWF) is the sum of GWI and the average day BWF. Peak DWF adds a maximum day peaking factor to the BWF. Finally, peak WWF is the sum of peak DWF and peak RDII. The required flow for designing wastewater collection system infrastructure must take into account RDII.

3. The City has conducted flow monitoring to assist with developing the following design criteria:

   a. Residential SFU must be assumed to produce an average wastewater flow of 250 gallons per day. This includes the following factors:

      – SFU = 2.5 people

      – GWI = 30 gallons per capita per day (gpcd)

      – BWF = 70 gpcd

   b. Nonresidential (e.g., commercial, industrial, institutional) wastewater flows will be evaluated on a case-by-case basis. Estimates can be made using the following:

      – Use table from TAC §217.32(a)(3), which provides detailed guidelines for determining the average DWF for many nonresidential uses.

      – Estimate the average daily BWF from the proposed square footage of the facility. Every 1,660 square feet is equal to 1 LUE at 175 gallons per day/LUE (2.5 people/LUE * 70 gpcd).

      – For large development areas (approximately 20 acres or more), the nonresidential unit flows developed for the future land use plan densities may be used. This information is available in the 2018 WWMP.

3. RDII

   In sizing sewers, external contributions are accounted for by including 1,000 gallons per day per acre served for RDII. For sewers in the Edwards Aquifer Zone, refer to the TCEQ requirements. Strict attention must be given to minimizing RDII.

4. Peaking Factor for BWF

   Use the following equation to calculate the peaking factor for BWF (Metcalf & Eddy, Inc. (1981) Wastewater Engineering: Collection and Pumping of Wastewater):

$$PF = 2.8(AvgBWF)^{-0.0732}$$

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where *PF* is the peaking factor and *AvgBWF* is the average day BWF.

5. Peak WWF

   The peak WWF is obtained by adding RDII to the peak DWF. In designing for an existing facility, flow measurement must be used in lieu of calculations for the preexisting developed area.

B. Determination of Pipe Size

1. Minimum Size

   The minimum diameter of all gravity sewer mains must be 8 inches. For service line sizes, refer to the City Standard Details.

2. Design Requirements

   a. For sewer mains, 15 inches in diameter or smaller, use the larger size as determined below:

      – The main must be designed such that the Peak DWF must not exceed 65 percent of the capacity of the pipe flowing full.

      – The main must be designed such that the Peak WWF must not exceed 85 percent of the capacity of the pipe flowing full.

   b. For sewer mains, 18 inches in diameter or larger, the main must be designed such that the peak WWF must not exceed 80 percent of the capacity of the pipe flowing full.

3. Design Velocities

   The minimum velocity at full pipe capacity must not be less than 2 fps from the Manning's equation and using a minimum Manning's n of 0.013 (TAC §217.53(l)(1)). Using the same criteria, the maximum design velocity should not exceed 10 fps (TAC §217.53(l)(2)(B)). Velocities in excess of 10 fps may be considered under special conditions where no other options are available. In such cases, proper consideration must be given to pipe material, abrasive characteristics of the wastewater flows, turbulence, and displacement by erosion or shock.

4. Minimum Slope

   The minimum allowable slope for 8 inch mains within the City's service area must be 0.005 ft/ft (0.5 percent grade). According to TAC 217.53(l)(2)(A), the minimum and maximum slope for larger pipes must be based on meeting the minimum and maximum required

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velocity and minimum Manning's n. The table from TAC 217.53(l)(2)(A) is shown here as **Table III.B.4** for the allowable pipe sizes greater than 8 inches.

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Table III.B.4 - Minimum and Maximum Slope for Gravity Sewer

Pipe Diameter (inches)	Minimum Slope (Percent)	Maximum Slope (Percent)
12	0.20	4.88
15	0.15	3.62
18	0.11	2.83
21	0.09	2.30
24	0.08	1.93
30	0.055	1.43
36	0.045	1.12
42	0.037	0.90

5. Allowable Pipe Sizes

   The following sizes will be the only sizes allowed for use in the gravity system: 6 (for services only), 8, 12, 15, 18, 21, 24, 30, 36, and 42 inches. Larger sizes may be approved on a case-by-case basis.

C. Design Considerations

1. Materials and Standards

   All materials and appurtenances must conform to the City Standard Products List.

2. Protecting Public Water Supply

   No physical connection must be made between a drinking water supply and a sewer or any appurtenance thereof. An air gap of a minimum of two inlet pipe diameters between the potable water supply and the overflow level connected to the sewer must be provided.

3. Location

   The location of the wastewater main must be in conformance with the City Standard Details. Alternative assignments must be approved by the City. Outside the city limits, the design engineer must coordinate utility assignments with both the City and the appropriate county authority.

4. Separation Distance

   The separation between wastewater mains and other utilities must be in accordance with the TAC.

5. Steep Grades

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Where the pipe grade exceeds 12 percent and the construction is outside of any pavement, concrete retards conforming to the City standards will be required at intervals of no more than 25 feet (preferably at joint locations).

6. Depth of Cover

   The minimum depth of cover over the uppermost projection of the main must be as follows:

   a. Wastewater piping installed in natural ground in easements or other undeveloped areas which are not within existing or planned streets, roads or other traffic areas, must be laid with at least 42 inches of cover.

   b. Wastewater piping installed in existing streets, roads or other traffic areas must be laid with at least 66 inches of cover.

   c. Wastewater piping installed in proposed streets must be laid with at least 48 inches of cover below the actual subgrade. The maximum depth must be as approved by the Georgetown Water Utility for the specific material, application, and conditions.

7. Turbulence

   Wastewater lines must be designed to minimize turbulence to prevent release of sulfide gases and subsequent corrosion.

8. Wastewater infrastructure installed roughly parallel to a stream provided that:

   a. Such infrastructure is installed on the side of the stream opposite the spring and is installed no closer than 25 feet from the bank of the stream.

   b. Wastewater infrastructure must not cross a stream associated with a spring within the spring buffer (see the Georgetown Unified Development Code, 11.07.030).

9. Curved wastewater mains are prohibited.

D. Manholes

1. Location

   Manholes must be located and spaced to facilitate inspection and maintenance of the wastewater main. All manholes must be accessible to maintenance equipment, including 2½ ton straight trucks, dump trucks, vacuum trucks, and standard (not compact) sizes of backhoes and loaders. Manholes must be placed at the following locations:

   a. Intersections of mains

   b. Horizontal alignment changes

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c. Vertical grade changes

d. Change of pipe size

e. Change of pipe material

f. The point of discharge of a force main into a gravity wastewater main

g. Intersection of service lines to main lines 24 inches and larger

h. A manhole is required at the point of connection of a building service line to the public wastewater service stub for multifamily projects exceeding 15 dwelling units and for commercial developments {containing more than 4,000 square feet} requiring a water meter greater than 2 inches.

- At the upstream end of mains
- At other locations as required by Section 13.05 (Wastewater Regulations) of the Georgetown Unified Development Code

2. Spacing

   Manhole spacing for lines smaller than 24 inches should not exceed 500 feet; for larger mains, spacing may be increased according to TAC or as approved by the City.

3. Covers

   All manholes not located in paved areas must have bolted, watertight covers.

4. Corrosion Prevention

   Manholes must be constructed of or lined with a corrosion resistant material. Where new construction ties into an existing manhole, the existing manholes must be lined, coated, or replaced with a corrosion resistant material.

5. All lines into manholes, including drop connections, must match crown-to-crown where feasible. Any deviation must be approved in advance by the City.

6. Drop manholes will have a maximum of 8 feet of drop and are not allowed where the main size exceeds 15 inches.

7. Minimum inside manhole diameters must be as indicated in **Table III.D.7.**

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Table III.D.7 – Minimum Inside Manhole Diameter Requirements

Main Size	Depth Less than 20 Feet	Depth 20—30 Feet	Depth Greater than 30 Feet
Up to 15 inches	48 inches	60 inches	72 inches
18—24 inches	60 inches	60 inches	72 inches
30 and 36 inches	72 inches	72 inches	72 inches

Note 1: In the event a structure is used inside a manhole, the clear space between the structure and the manhole wall must be a minimum of 48 inches.

Note 2: If more than two pipes connect to a manhole, or if two pipes connect to a manhole at an angle other than 180 degrees from each other, larger diameters may be required to accommodate mandrel insertion and hydraulically efficient flow.

Note 3: Access to mains 42 inches and larger must be by junction boxes designed by a structural engineer.

Note 4: New pipe connections to existing manholes must provide a minimum of 12 inches of clearance between the existing pipe OD and the new core hole OD measured on the inside surface of the manhole, regardless of the orientation of the pipes with respect to one another. New precast manholes must have holes for pipe penetrations separated far enough apart to ensure the structural integrity of the manhole wall.

8. Where a separation of 9 feet between a water main and a manhole cannot be achieved, as approved by the Georgetown Water Utility, the joints in the wastewater manhole must be made watertight using externally applied joint wraps.

9. All manhole bases, for manholes to be constructed on existing lines, must be cast in place.

10. Manhole and junction box inverts must have a minimum slope of 2.5 percent between the inlet and outlet pipe inverts or have a minimum difference of 0.10 feet between the inlet and out pipe inverts, whichever provides the maximum difference in invert elevation between the inlet and outlet pipes.

11. For manholes and junction boxes located below groundwater:

    a. When the interior surface of a concrete manhole or junction box is coated with a urethane, polyurethane, or epoxy liner, the exterior surface of that portion of a manhole or junction box located below groundwater level must be water proofed using a flexible system applied to the exterior surface. The drawings must indicate which structures must be waterproofed and the elevation to which waterproofing must be applied (2 feet above groundwater level).

    b. Manhole joints below the groundwater level must be sealed by installing a joint wrap material over the joint on the manhole exterior.

    c. Construction joints in cast-in-place junction boxes must be waterproofed using water stops.

E. Ventilation

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Ventilation must be provided as required by TCEQ Rules and Regulations.

F. Inverted Siphons

1. Siphons must have a minimum of two barrels. The peak DWF must be used to size the smallest barrel. The minimum pipe size must be 6 inches with a minimum flow velocity of 3.0 fps at peak DWF. Three-barrel siphons must be designed to carry the capacity of the incoming gravity wastewater mains(s) with one barrel out of service.

2. An additional corrosion resistant pipe must be designed to allow for the free flow of air between the inlet and outlet siphon boxes. The diameter of this air jumper must not be smaller than one-half the diameter of the upstream sewer. Air jumper pipe design must provide for removal of condensate water that will collect in the pipe.

3. Siphon inlet and outlet structures must be manufactured with approved corrosion resistant material and must provide for siphon cleaning and maintenance requirements.

G. Service Lines

1. Wastewater service lines between the main and property line must have an inside diameter not less than 6 inches. The minimum grade allowed for service lines is 1 percent. In all new systems, grade breaks exceeding allowable joint deflection must be made with approved fittings and must not exceed a cumulative total of 45 degrees. No service connections must be made to mains larger than 15 inches in diameter.

2. Usually wastewater services are placed along the common property line between two lots where there is no conflict with other utilities' services. All other Georgetown Water Utility service is usually located at the other lot corner. Wastewater service should be placed 4 feet on the low (or right, if on a level ground) side of the lot, 9 feet from the water service (located on the other side of the lot line). Services to lots without a water/wastewater easement will terminate at the property line with a cleanout; service to lots having a 5 foot by 5 foot water/wastewater easement will terminate within the easement. For details, see the City Standard Details.

3. Wastewater cleanouts are not allowed in sidewalks or driveways.

4. Large Diameter Cleanouts are required for service lines that are 8 inches in diameter and when industrial waste monitoring is required. They must be located at the property line within the public ROW or utility easement line to indicate the line of responsibility of the utility. They must not be located in traffic areas, paved parking areas or sidewalks.

5. Manholes are required for services larger than 8 inches in diameter. They must be located within the public ROW or utility easement line to indicate the line of responsibility of the utility.

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H. Easements

1. Easements for wastewater mains must be a minimum of 15 feet wide, or twice the depth of the main, measured from finished grade to pipe flow line, whichever is greater. Mains must be centered on the easement. Narrower easements will be considered where the Engineer provides evidence, to the satisfaction of the City, that maintenance activities will not be hindered by the reduced width.

2. Easement documents and the metes and bounds must be reviewed and approved by the City prior to recordation in the real property records of the appropriate county. Easement recordation in the real property records of the appropriate county is required prior to City approval of construction plans.

I. Requirements for Existing and Proposed Wastewater Infrastructure beneath Circular Intersections or Other Geometric Street Features

1. Installation of Circular Intersections or Other Geometric Street Features over existing wastewater infrastructure.

   a. Existing wastewater infrastructure may be allowed to exist beneath circular intersections or other geometric street features such as, but not limited to, modern roundabouts, medians, bulb-outs, splitter islands, channelization islands, and other types of physical roadway features. These features may contain hardscaping, landscaping, water quality features, public art, permanent structures, street furniture, or other similar amenities.

   b. The planning and design of these features and their amenities must include consideration for access, maintenance, protection, testing, cleaning, and operations of the wastewater infrastructure. Where existing wastewater facilities are to remain, trees with root zones of 18 inches in depth or greater at maturity may be considered for inclusion provided the drip lines at maturity of the proposed trees are not located within a minimum horizontal separation of 7.5 feet from any wastewater infrastructure. Public art, permanent structures, and other similar amenities may be considered for inclusion provided they are not located within a minimum horizontal separation of 7.5 feet from any wastewater infrastructure. The drip lines at maturity of ornamental trees with root zones at maturity of less than 18 inches in depth, grasses, woody or herbaceous shrubs, and street furniture may be located within a minimum horizontal separation of 7.5 feet from any wastewater infrastructure.

   c. The need for relocating, replacing or protecting in place existing wastewater infrastructure beneath these features and their amenities must be determined on a case-by-case basis by the City.

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2. Installation of Circular Intersections or Other Geometric Street Features in new areas of development with no existing wastewater infrastructure

    a. Proposed wastewater infrastructure may be placed beneath proposed circular intersections or other geometric street features such as, but not limited to, modern roundabouts, medians, bulb-outs, splitter islands, channelization islands, and other types of physical roadway features. These features may contain hardscaping, landscaping, water quality features, public art, permanent structures, street furniture, or other similar amenities.

    b. The planning and design of these features and their amenities must include consideration for access, maintenance, protection, testing, cleaning, and operations of utility infrastructures. Trees with root zones of 18 inches in depth or greater at maturity may be considered for inclusion provided the drip lines at maturity of the proposed trees are not located within a minimum horizontal separation of 7.5 feet from any wastewater infrastructure. Public art, permanent structures, and other similar amenities may be considered for inclusion provided they are not located within a minimum horizontal separation of 7.5 feet from any wastewater infrastructure. The drip lines at maturity of ornamental trees with root zones at maturity of less than 18 inches in depth, grasses, woody or herbaceous shrubs, and street furniture may be located within a minimum horizontal separation of 7.5 feet from any wastewater infrastructure.

    c. The need for alternative alignments or the inclusion of protective systems for the proposed wastewater infrastructure beneath these features and their amenities must be determined on a case-by-case basis by the City.

J. Lift Stations (excluding low-pressure systems)

Lift stations are discouraged and will be allowed only where conventional gravity service is not feasible (lift station installation cost plus 30 years operation and maintenance expense is less than installation cost for gravity system). This subsection details the specific design criteria for wastewater lift stations proposed for immediate or future City operation and maintenance within the City of Georgetown or its ETJ. Additional requirements for individual lift stations may be imposed by the Director of the City or the director's designee as conditions warrant.

In addition to these criteria, all lift stations must meet the TAC §217 rules and the City Submersible Wastewater Lift Station General Specifications.

1. Flow Development

In accordance with TAC §217.61 (c), lift stations must be sized to have a firm capacity that can pump the design flow (peak WWF), which is described in **Section III.A**. A minimum of

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two pumps must be required for all lift station. The capacity of the pumps must be such that the peak WWF can be handled with the largest pump out of service (firm capacity).

2. Wet Well Design

   a. The bottom of the wet well must have a minimum slope to the intake of two vertical to one horizontal. There must be no projections in the wet well, which would allow deposition of solids.

   b. The wet well volume must be sized to provide adequate storage volume at peak design flows and a pump cycle time of sufficient duration to prevent pump short cycling and consequential motor damage. Pump cycle time, defined as the sum of "pump off" time plus "pump on" time, must be shown in **Table III.J.4.b**.

Table III.J.4.b - Minimum Pump Cycle Time

Pump Horsepower	Minimum Cycle Time (minutes)
Less than or equal to 50	10
51–75	15
76–250	30
Greater than 250	45

   c. Volume between "pump on" and "pump off" elevation (of the pump cycle) must be determined by the following criteria:

$$V = \frac{\theta q}{4}$$

Where: V is volume in gallons, q = pump capacity in gpm, and θ is the minimum cycle time in minutes

   d. All "pump on" levels must have a minimum separation of 1 foot between levels. All "pump off" levels must be at least 6 inches above the top of the pump casing. For more than two pumps, the "pump off" levels must be staged with a minimum separation of 1 foot between levels.

   e. An example of a two-pump staging sequence follows:

      – High-level alarm

      – Lag pump on

      – Lead pump on

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- Lag pump off
- Lead pump off
- Low-level alarm

f. The high-level alarm must be at least 1 foot above the last (highest) "pump on" level in the wet well and also at least 1 foot below the flow line of the lowest influent line into the wet well.

g. For lift stations with three pumps or more, the following method for calculating the wet well volume may be used:

$$V_1 = \frac{\theta q_1}{4}$$

and

$$K = (q_1 - q_2) + q_1$$

and

$$V_2 = V'NV_1$$

Where:

V_1 = working volume for the first pump in gallons

θ = minimum cycle time in minutes

q_1 = capacity of the first pump in gpm

q_2 = capacity of the second pump in gpm

K = the ratio of the discharge increment to the discharge of the first pump, dimensionless

V_2 = working volume for the second pump gallons

V' = the ratio of additional draw down volume to the volume for one pump, dimensionless

N = number of pumps

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Steps:

1) Calculate V1 and K.
2) Locate K on **Table III.J.2.g** and read the corresponding value for V').
3) Then calculate V2.

TABLE III.J.2.g – V′ values Corresponding to various K Values

K	V′	K	V′	K	V′
0.00	0.00	2.10	1.36	3.49	2.63
0.33	0.00	2.13	1.39	3.53	2.67
0.44	0.01	2.17	1.42	3.57	2.70
0.53	0.04	2.20	1.45	3.61	2.74
0.62	0.08	2.23	1.49	3.65	2.77
0.70	0.12	2.27	1.52	3.69	2.81
0.77	0.16	2.30	1.55	3.73	2.85
0.84	0.21	2.34	1.58	3.77	2.88
0.90	0.25	2.37	1.62	3.81	2.92
0.96	0.29	2.41	1.65	3.85	2.96
1.02	0.34	2.45	1.68	3.89	3.00
1.07	0.38	2.48	1.71	3.93	3.03
1.12	0.42	2.52	1.75	3.97	3.07
1.17	0.46	2.55	1.78	4.01	3.11
1.22	0.51	2.59	1.81	4.05	3.15
1.26	0.55	2.62	1.84	4.09	3.18
1.30	0.59	2.66	1.88	4.13	3.22
1.34	0.63	2.70	1.91	4.17	3.26
1.38	0.66	2.73	1.94	4.21	3.30
1.42	0.70	2.77	1.97	4.25	3.34
1.46	0.74	2.81	2.01	4.29	3.38
1.50	0.78	2.84	2.04	4.33	3.42
1.54	0.81	2.88	2.07	4.38	3.45
1.57	0.85	2.92	2.11	4.42	3.49
1.61	0.89	2.95	2.14	4.46	3.53
1.65	0.92	2.99	2.18	4.50	3.57
1.68	0.96	3.03	2.21	4.54	3.61
1.72	0.99	3.07	2.24	4.58	3.65

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TABLE III.J.2.g – V′ values Corresponding to various K Values

K	V′	K	V′	K	V′
1.75	1.03	3.10	2.28	4.63	3.69
1.79	1.06	3.14	2.31	4.67	3.73
1.82	1.09	3.18	2.35	4.71	3.77
1.86	1.13	3.22	2.38	4.75	3.81
1.89	1.16	3.26	2.42	4.79	3.85
1.92	1.19	3.29	2.45	4.84	3.89
1.96	1.23	3.33	2.49	4.88	3.93
1.99	1.26	3.37	2.52	4.92	3.97
2.03	1.29	3.41	2.56	4.96	4.01
2.06	1.33	3.45	2.59	5.01	4.05

K = Pump discharge (Dimensionless)
V′ = Volume (Dimensionless)
Source: ALBERT PINCINE

h. An example of a three-pump starting sequence is as follows:

- High-level alarm
- Third pump on
- Second pump on
- First pump on
- Third pump off
- Second pump off
- First pump off
- Low-level alarm

For the location of the high-level alarm, refer to the example of a two-pump starting sequence.

3. Wet Well Detention Time

a. Calculate the detention time (T_d) in the wet well for the maximum WWF, maximum DWF, and average DWF using the following equation:

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$$T_d = t_f + t_e$$

Where:

t_f = (v) / (i) = time to fill the wet well in minutes

t_e = (v) / (q - i) = time to empty the wet well in minutes

Where:

v = Volume of wet well between "pump on" and "pump off" elevations in gallons

q = Pump capacity in gpm

i = Flow into the station corresponding to the maximum WWF, maximum DWF, or average DWF in gpm

b. Maximum detention time must be calculated with i = minimum DWF.

c. Odor control must be provided for the wet well if the total detention time in the wet well and force main system exceeds 180 minutes.

4. Static Head

The static head must be calculated for "pump on" and "pump off" elevations in the wet well.

5. Net Positive Suction Head

The net positive suction head (NPSH) required by the pump selected must be compared with the NPSH available in the system at the eye of the impeller. The engineer must consult the pump manufacturer for the NPSH required values for that pump and compare them with calculated values for the NPSH available. The NPSH available should be greater than the NPSH required for a flooded suction pump. The following equation may be used for calculating the NPSH available:

$$NPSH = P_B + H_S - P_V - H_{fs}$$

Where:

P_B = barometric pressure in feet absolute

H_S = minimum static suction head in feet

P_V = vapor pressure of liquid in feet absolute

H_{fs} = friction loss in suction in feet

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6. Suction Piping Design

    a. All suction piping must be flanged ductile iron and have a minimum diameter of 4 inches. Each pump must have a separate suction pipe.

    b. Suction piping must have a velocity of 3 to 5 fps.

    c. All suction pipes inside the wet well must be equipped with a flare type, down-turned intake. The distance between the bottom of the flare and the floor of the wet well must be between D/3 and D/2 where D is the diameter of the flare inlet.

7. Force Main Design

    a. All force mains must be ductile iron with noncorrosive lining or an approved high-density polyethylene with a minimum inside diameter of 4 inches. PVC may also be considered as approved by the City. Force main pipe within the station must be flanged. Flexible fittings must be provided at the exit wall.

    b. In accordance with TAC §217.67 (a)(2) and (4), force mains must be sized to have minimum velocity of 3.0 fps with one pump in operation and a maximum velocity of 6.0 fps. If the velocity will be greater than 6.0 fps, additional design considerations should be considered as discussed in TAC §217.67 (a)(4). During initial development phases, flow velocities may be as low as 2.5 feet per second.

    c. The maximum time required to flush the force main must be calculated on the basis of average DWF. Flush time must be calculated for average DWF using the following equations:

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$$T_{flush} = (t_f - t_e) \times \frac{L}{\left(\frac{\theta}{2}\right)(V_{fm})\left(\frac{60\ sec}{1\ min}\right)}$$

Where:

L = Force main length in feet

t_e = Time to empty wet well in minutes

t_f = Time to fill wet well in minutes

V_{fm} = Flow velocity in the force main in fps

θ = Pump cycle time in minutes

*$t_e = \frac{V}{q-i}$

*$t_f = \frac{V}{i}$

i = average DWF in gpm

*See Section III.J.3.a, "Wet Well Detention Time," for an explanation of V and q.

d. Odor and corrosion control must be provided for the force main if the force main detention time exceeds 30 minutes if dual force mains are not feasible.

e. Location and size of all air release valves must be evaluated for odor or nuisance potential to adjacent property by the design engineer.

   – The use of air release valves must be restricted to installations where there are not possible alternatives.

f. Sulfide Generation Potential.

   Lift station/force main systems must be evaluated for their sulfide generation potential and their ability to achieve scouring velocities during average DWF periods. If the evaluation indicates that sulfide concentration of greater than 2 parts per million and solids deposition are likely, the design must:

   – Define a workable sulfide control technique that will minimize sulfide formation in the force main.

   – Include "pig" launching stations and recovery points to allow cleaning of the force main.

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- Protect the gravity main and manholes downstream of the force main from corrosion. The length of pipe to be protected must be determined on a case-by-case basis.

g. The force main must discharge into its own distinct manhole. (i.e., multiple force mains must not discharge into a single manhole.)

h. Thrust restraint when required must be shown on the plan view.

8. Head Loss Curves

a. Data points for the system capacity curve must be provided in tabular form and graphed with pump head capacity curve on the same graph. Two system capacity curves must be plotted using the Hazen Williams coefficient values of C = 100 and C= 140.

b. Pump output in gpm at maximum and minimum head must be clearly shown on the system curve for each pump and combination of pumps.

c. For stations with two or more pumps operating in parallel, multiple and single operation points must be plotted on the system curve.

d. Pumps with the highest efficiencies at all operating points must be used.

e. If pumps are equipped with smaller impellers during startup to handle lower than design flows, impellers sized to handle the design flow must also be provided.

9. Buoyancy Calculations

The lift station design must include a complete analysis of buoyant forces on the entire lift station structure.

10. Water Hammer

a. Calculations for water hammer showing maximum pressures, which would occur upon total power failure while pumping, must be provided using the following equations.

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$$p = \frac{aV}{2.31 \times g} + operating\ pressure\ of\ pipe\ (psi)$$

Where:

p = water hammer pressure (psi)

a = pressure wave velocity (fps)

w = specific weight of water (62.4 pounds per cubic foot)

g = acceleration of gravity (32.2 ft/s^2)

k = bulk modulus of water (300,000 psi)

d = inside diameter of pipe (inches)

E = Young's modulus of pipe (psi)

t = pipe wall thickness (inches)

v = flow velocity in pipe (fps)

b. Surge control measures must be provided when pressures, including those due to water hammer, exceed the pressure rating of the pipe.

11. Suction Specific Speed

a. Suction specific speed of the pumps must be calculated using the following formula:

$$SSS = \Omega(Q)^{.5}/(H)^{.75}$$

Where:

SSS = suction specific speed (revolutions per minute [rpm])

Q = flow at the best efficiency point, gpm

H = NPSH required at maximum impeller speed (feet)

Ω = speed of pump and motor in rpm

b. Suction specific speed should be below 9,000 rpm to ensure that the pump will not cavitate because of internal recirculation.

12. Stiffness Ratio

a. To ensure that the pump shaft does not bend an excessive amount, the engineer must calculate the stiffness ratio of the shaft using the following equation:

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$$\text{Stiffness Ratio} = L^3/D^4$$

where:

L = distance from impeller centerline to the centerline of the inboard bearing (inches)

D = diameter of shaft (inches)

b. The stiffness ratio must not exceed 60.

13. Energy Calculations

For lift stations with flows exceeding 75 gpm but less than 1,000 gpm, and if the engineer is considering a submersible type lift station as an option then the engineer must submit cost comparisons for submersible stations versus wet well/dry well stations. These cost comparisons should include the initial station costs, installation costs, and power costs for the life of the station.

Energy costs for each type station must be calculated using the following equations:

a. Calculate the water horsepower required.

$$P = \frac{Qh \times 8.34\ lb/gal}{33{,}000\ ft - lb\ min/hp}$$

where:

P = water horsepower (hp)

Q = flow, gpm

h = head, feet (ft)

b. Calculate the brake horsepower required.

$$Bhp = \frac{P}{pump\ efficiency^*}$$

where:

Bhp = brake horsepower (hp)

P = water horsepower (hp)

* Use the most efficient pumps for the application.

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c. Calculate the electrical horsepower required.

$$Ehp = \frac{Bhp}{motor\ efficiency^*}$$

where:

Ehp = electrical horsepower (hp)

Bhp = brake horsepower (hp)

*Use the most efficient motors for the application

d. Calculate the power required in kilowatts (kW).

$$EkW = Ehp \times 0.746\ kW/hp$$

e. Calculate daily power consumption in kilowatt hours (kWh).

$$E = [(EkW_1)(t_1) + (EkW_2)(t_2) + (EkW_3)(t_3) \dots]$$

where:

E = total power consumption, kWh per day

EkW_n = power required, kW for pumps 1,2,...,n

t_n = estimated pump run time in hours per day for pumps 1,2,...,n

f. Calculate the estimated cost for power consumption over the life of the station.

$$C = ET\left(\frac{\$0.06}{kWh}\right)$$

C = (E)($0.06/kWh)(T)

where:

C = cost of power over the life of the station (dollars)

E = power consumption (–kWh per day)

T = time the station is expected to be in service (days)

g. Stress and thrust calculations for internal station piping and bends must be provided for stations with flows over 1,000 gpm.

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14. Sump Design

    The following items apply for lift station dry well sump pumps:

    a. Dual submersible sump pumps, each with a minimum capacity of 1,000 gallons per hour, must be provided.

    b. The design head of the sump pumps should be the static head from the sump to 1 foot above the 100-year flood level plus allowances for pipe friction both inside and outside the pump chamber.

    c. Sump piping must be galvanized steel with a minimum diameter of 2 inches.

    d. Sump discharge from the dry well must be installed through the wall of the wet well at a point not less than 12 inches above the top of the influent pipe and grouted in place with a watertight seal.

    e. The dry well floor must slope toward the sump pit.

15. Specific Station Requirements

    a. All stations will be required to have an equipment-lifting device.

    b. Engineering calculations are required showing that temperatures inside the dry well do not exceed 85 degrees Fahrenheit while the pumps are operating.

    c. Stations with motors greater than 100 hp must use a horizontal pump/motor configuration.

    d. Stations with motors 75 hp and larger must have reduced voltage starters of the auto transformer or solid-state soft start type. Part winding starters and motors are not acceptable. Motors larger than 75 hp must be designed with a maximum temperature rise not to exceed 80 degrees Celsius (°C) over a 40°C ambient temperature. Motors larger than 300 hp may require a higher temperature rise and may be specifically approved with such.

    e. Motors 75 hp and smaller must be provided with high efficiency frames. Maximum temperature rise must not exceed 90°C over a 40°C ambient temperature.

    f. Stations deeper than 30 feet, measured from the finished floor to the top of the entrance tube, must require an electrically powered personnel lift.

    g. Entrance hatches larger than 40 inches in diameter must be spring loaded.

    h. Valves higher than 6 feet above the floor must have chain operators.

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i. Any potable water supply below the overflow elevation of the wet well must be protected by an air gap.

j. All lift stations must have a backup power source. Looped service from two different substations is adequate backup power. If a backup electric system is not feasible, a diesel generator may be located on the lift station site instead. Generator must be equipped with noise and air pollution control devices.

k. Flow monitoring will be provided for all lift stations.

16. Wastewater Lift Station Specifications

In addition to the design criteria presented in this document, the Georgetown Water Utility has "Wastewater Lift Station General Specifications and Drawings." These documents delineate minimum City requirements as they relate to the construction and installation of wastewater lift stations. Copies of these documents are available and can be obtained from the Georgetown Water Utility.

17. Alternate Wastewater Systems

a. General

- Low-pressure wastewater systems are discouraged and will be allowed only where conventional gravity service is not possible. For the purpose of these criteria, low-pressure sewer service is defined as private grinder pump facilities or private septic tank effluent pump facilities that do not convert to gravity flow at or prior to the property line. There must be no more than one grinder pump facility per single-family or duplex residential lot. Each grinder pump must discharge to a gravity flow system. Grinder pump facilities for commercial establishments, public utility districts, or condominiums will be considered on a case-by-case basis.

- The distance for each grinder pump from the property line to the gravity main must not exceed 200 feet.

- Flows may be calculated using the lift station design criteria disregarding the Infiltration/Inflow flow component.

- If the above criteria are applicable and a low-pressure wastewater service is necessary, the Georgetown Water Utility will be responsible for maintaining the portion within the ROW only.

- Design and installation of the property owner's pumping system, as well as all associated plumbing must be reviewed, approved, and inspected by the City. The system must be designed as a complete system including all connections, pumps,

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etc. for lots being served by the system. If the above criteria are not applicable, refer to lift station design criteria.

b. Connection to Gravity Main.

- Each grinder pump facility must be individually tied into a manhole on an existing gravity main. If a manhole does not exist, one must be constructed. Construction costs and all other associated costs must be the responsibility of the property owner.

- The connection to the gravity main must be designed to minimize turbulence and the release of hydrogen sulfide. The discharge point must be at or below the springline of the gravity main.

c. Cleanout and Valve Assemblies.

- A cleanout and corrosion resistant eccentric plug valve must be placed just inside of the ROW where City maintenance begins and private maintenance ends. This cleanout will allow the property owner's system to be isolated and the City's portion of the system to be pressurized, flushed, or rodded.

- Cleanouts and corrosion resistant eccentric plug valves must also be installed at bends of 45 degrees and greater.

- Refer to applicable standard detail(s) in the City Standards Manual.

d. Separation Requirements.

The separation between low-pressure sewer lines and waterlines must comply with City of Georgetown Standard Specifications and all other applicable rules and regulations.

e. Grinder Pump System General Specifications and Drawings.

In addition to the design criteria presented in this document, the Georgetown Water Utility maintains "Grinder Pump System General Specifications and Drawings." These documents delineate minimum City requirements as they relate to the construction and installation of grinder pump systems. Copies of these documents are available and can be obtained from Georgetown Water Utility.

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Appendix D

Cost Sheets

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Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Berry Creek Basin
Proposed Gravity Main Project: BCI-2

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	36-inch Wastewater Line (0-8ft depth)	5,203	LF	$ 448.27	$ 2,332,000
2	42-inch Wastewater Line (0-8ft depth)	6,151	LF	$ 522.98	$ 3,217,000
3	54-inch Wastewater Line (0-8ft depth)	12,272	LF	$ 672.41	$ 8,251,000
4	Additional Cost of >8ft Deep 36-inch Line	5,203	LF	$ 136.03	$ 708,000
5	Additional Cost of >8ft Deep 42-inch Line	6,151	LF	$ 234.17	$ 1,440,000
6	Additional Cost of >8ft Deep 54-inch Line	12,272	LF	$ 227.17	$ 2,788,000
7	Install in Rock	144,944	CY	$ 30.00	$ 4,348,000
8	8-ft Diameter Manhole (0-8ft depth)	32	EA	$ 24,554.57	$ 786,000
9	Box Manhole (0-8ft depth)	32	EA	$ 35,238.12	$ 1,128,000
10	Additional Cost of >8ft Deep 8-ft Diameter Manhole	32	EA	$ 11,831.79	$ 379,000
11	Additional Cost of >8ft Deep Box Manhole	32	EA	$ 15,065.10	$ 482,000
12	54-inch Bored Highway Crossing	3,000	LF	$ 2,837.16	$ 8,511,000
13	54-inch Bored Stream Crossing	3,000	LF	$ 2,837.16	$ 8,511,000
14	Trench Safety/Silt Fence	23,625	LF	$ 4.75	$ 112,000
15	Revegetation	23,625	LF	$ 7.00	$ 165,000
16	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
17	Tree Retention 36"	520	LF	$ 576.00	$ 300,000
18	Tree Retention 42"	615	LF	$ 648.00	$ 399,000
19	Tree Retention 54"	1,227	LF	$ 792.00	$ 972,000
20	Miscellaneous	1	LS	$ 8,966,000.00	$ 8,966,000
		Construction Subtotal			**$ 53,798,000**
	Bonds & Insurance				$ 1,614,000
	Mobilization/Demobilization				$ 2,690,000
	Contractor Overhead & Profit				$ 8,070,000
		Construction Total			**$ 66,172,000**
	Professional Services				$ 9,926,000
	Easements	50-foot Permanent			$ 3,243,000
		40-foot Temporary			$ 632,000
		Easment Acquisition			$ 155,000
		Project Total			**$ 80,128,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
South Fork Basin
Proposed Gravity Main Project: Cimarron

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
1	12-inch Wastewater Line (0-8ft depth)	7,467	LF	$	118.08	$	882,000
2	15-inch Wastewater Line (0-8ft depth)	1,587	LF	$	147.60	$	234,000
3	24-inch Bored Highway Crossing	400	LF	$	1,261	$	504,000
4	30-inch Bored Stream Crossing	100	LF	$	1,576	$	158,000
5	Install in Rock	5,295	CY	$	30.00	$	159,000
6	5-ft Diameter Manhole (0-8ft depth)	17	EA	$	9,636.97	$	164,000
7	6-ft Diameter Manhole (0-8ft depth)	5	EA	$	12,901.65	$	65,000
8	Trench Safety/Silt Fence	9,054	LF	$	4.75	$	43,000
9	Revegetation	9,054	LF	$	7.00	$	63,000
10	Traffic Control (Lump Sum)	1	LS	$	3,000.00	$	3,000
11	Tree Retention 12"	747	LF	$	288.00	$	215,000
12	Tree Retention 15"	159	LF	$	324.00	$	51,000
13	Miscellaneous	1	LS	$	508,000.00	$	508,000
	Construction Subtotal					**$**	**3,049,000**
	Bonds & Insurance					$	91,000
	Mobilization/Demobilization					$	152,000
	Contractor Overhead & Profit					$	457,000
	Construction Total					**$**	**3,749,000**
	Professional Services					$	562,000
	Easements	20 Foot Permanent				$	339,000
		25 Foot Permanent				$	109,000
		40 Foot Temporary				$	242,000
		Easement Acquisition				$	28,000
	Project Total					**$**	**5,029,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
South Fork Basin
Proposed Gravity Main Project: MF-1

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	12-inch Wastewater Line (0-8ft depth)	5,224	LF	$ 118.08	$ 617,000
2	Additional Cost of >8ft Deep 12-inch Line	5,224	LF	$ 11.99	$ 63,000
3	Install in Rock	8,982	CY	$ 30.00	$ 269,000
4	5-ft Diameter Manhole (0-8ft depth)	15	EA	$ 9,636.97	$ 145,000
5	Additional Cost of >8ft Deep 5-ft Diameter Manhole	15	EA	$ 2,109.03	$ 32,000
6	24-inch Bored Road Crossing	100	LF	$ 1,260.96	$ 126,000
7	Trench Safety/Silt Fence	5,224	LF	$ 4.75	$ 25,000
8	Revegetation	5,224	LF	$ 7.00	$ 37,000
9	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
10	Tree Retention	522	LF	$ 288.00	$ 150,000
11	Miscellaneous	1	LS	$ 293,000.00	$ 293,000
	Construction Subtotal				**$ 1,760,000**
	Bonds & Insurance				$ 53,000
	Mobilization/Demobilization				$ 88,000
	Contractor Overhead & Profit				$ 264,000
	Construction Total				**$ 2,165,000**
	Professional Services				$ 325,000
	Easements	25 Foot Permanent			$ 359,000
		40 Foot Temporary			$ 140,000
		Easement Acquisition			$ 20,000
	Project Total				**$ 3,009,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
South Fork Basin
Proposed Gravity Main Project: MF-2

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	15-inch Wastewater Line (0-8ft depth)	3,129	LF	$ 147.60	$ 462,000
2	Additional Cost of >8ft Deep 15-inch Line	3,129	LF	$ 11.44	$ 36,000
3	Install in Rock	4,972	CY	$ 30.00	$ 149,000
4	6-ft Diameter Manhole (0-8ft depth)	9	EA	$ 12,901.65	$ 116,000
5	Additional Cost of >8ft Deep 6 Manhole	9	EA	$ 2,091.79	$ 19,000
6	Trench Safety/Silt Fence	3,129	LF	$ 4.75	$ 15,000
7	Revegetation	3,129	LF	$ 7.00	$ 22,000
8	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
9	Tree Retention	313	LF	$ 324.00	$ 101,000
10	Miscellaneous	1	LS	$ 185,000.00	$ 185,000
	Construction Subtotal				**$ 1,108,000**
	Bonds & Insurance				$ 33,000
	Mobilization/Demobilization				$ 55,000
	Contractor Overhead & Profit				$ 166,000
	Construction Total				**$ 1,362,000**
	Professional Services				$ 204,000
	Easements	35 Foot Permanent			$ 301,000
		40 Foot Temporary			$ 84,000
		Easement Acquisition			$ 15,000
	Project Total				**$ 1,966,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
South Fork Basin
Proposed Gravity Main Project: MF-3

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
1	24-inch Wastewater Line (0-8ft depth)	6,431	LF	$	298.85	$	1,922,000
2	Additional Cost of >8ft Deep 24-inch Line	6,431	LF	$	14.97	$	96,000
3	Install in Rock	14,070	CY	$	30.00	$	422,000
4	6-ft Diameter Manhole (0-8ft depth)	18	EA	$	12,901.65	$	232,000
5	Additional Cost of >8ft Deep 6 Manhole	18	EA	$	2,604.66	$	47,000
6	36-inch Bored Highway Crossing	400	LF	$	1,891.44	$	757,000
7	Trench Safety/Silt Fence	6,431	LF	$	4.75	$	31,000
8	Revegetation	6,431	LF	$	7.00	$	45,000
9	Traffic Control (Lump Sum)	1	LS	$	3,000.00	$	3,000
10	Tree Retention 30"	643	LF	$	432.00	$	278,000
11	Miscellaneous	1	LS	$	767,000.00	$	767,000
	Construction Subtotal					**$**	**4,600,000**
	Bonds & Insurance					$	138,000
	Mobilization/Demobilization					$	230,000
	Contractor Overhead & Profit					$	690,000
	Construction Total					**$**	**5,658,000**
	Professional Services					$	849,000
	Easements	35 Foot Permanent				$	618,000
		40 Foot Temporary				$	172,000
		Easement Acquisition				$	32,000
	Project Total					**$**	**7,329,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Smith Branch Basin
Proposed Gravity Main Project: MN-2

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	8-inch Wastewater Line (0-8ft depth)	2,999	LF	$ 78.72	$ 236,000
2	10-inch Wastewater Line (0-8ft depth)	1,705	LF	$ 98.40	$ 168,000
3	12-inch Wastewater Line (0-8ft depth)	1,111	LF	$ 118.08	$ 131,000
4	Additional Cost of >8ft Deep 8-inch Line	2,999	LF	$ 11.28	$ 34,000
5	Additional Cost of >8ft Deep 10-inch Line	1,705	LF	$ 4.10	$ 7,000
6	Additional Cost of >8ft Deep 12-inch Line	1,111	LF	$ 20.51	$ 23,000
7	5-ft Diameter Manhole (0-8ft depth)	19	EA	$ 9,636.97	$ 183,000
8	Additional Cost of >8ft Deep 5-ft Diameter Manhole	19	EA	$ 1,380.62	$ 26,000
9	Trench Safety/Silt Fence	5,815	LF	$ 4.75	$ 28,000
10	Revegetation	5,815	LF	$ 7.00	$ 41,000
11	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
12	Tree Retention 8"	300	LF	$ 240.00	$ 72,000
13	Tree Retention 10"	170	LF	$ 264.00	$ 45,000
14	Tree Retention 12"	111	LF	$ 288.00	$ 32,000
15	Miscellaneous	1	LS	$ 206,000.00	$ 206,000
	Construction Subtotal				**$ 1,235,000**
	Bonds & Insurance				$ 37,000
	Mobilization/Demobilization				$ 62,000
	Contractor Overhead & Profit				$ 185,000
	Construction Total				**$ 1,519,000**
	Professional Services				$ 228,000
	Easements	25 Foot Permanent			$ 399,000
		40 Foot Temporary			$ 155,000
		Easement Acquisition			$ 22,000
	Project Total				**$ 2,323,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands WWTP
Northlands WWTP Discharge Line
Proposed Force Main Project: NLWWTP-FM

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	24-inch Force Main	10,000	LF	$ 288.00	$ 2,880,000
2	Install in Rock	8,476	CY	$ 30.00	$ 254,000
3	Trench Safety/Silt Fence	10,000	LF	$ 4.75	$ 48,000
4	Revegetation	10,000	LF	$ 7.00	$ 70,000
5	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
6	Tree Retention 36"	1,000	LF	$ 432.00	$ 432,000
7	Miscellaneous	1	LS	$ 737,000.00	$ 737,000
	Construction Subtotal				**$ 4,424,000**
	Bonds & Insurance				$ 133,000
	Mobilization/Demobilization				$ 221,000
	Contractor Overhead & Profit				$ 664,000
	Construction Total				**$ 5,442,000**
	Professional Services				$ 816,000
	Easements 20 Foot Permanent				$ 449,000
	35 Foot Permanent				$ -
	40 Foot Temporary				$ 219,000
	Easement Acquisition				$ 27,000
	Project Total				**$ 6,953,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Lift Station and Force Main Project: NL-GR

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	30-inch Wastewater Line (0-8ft depth)	1,167	LF	$ 373.56	$ 436,000
2	36-inch Wastewater Line (0-8ft depth)	1,519	LF	$ 448.27	$ 681,000
3	Install in Rock	2,856	LF	$ 30.00	$ 86,000
4	6-ft Diameter Manhole (0-8ft depth)	4	EA	$ 12,901.65	$ 52,000
5	8-ft Diameter Manhole (0-8ft depth)	5	EA	$ 24,554.57	$ 123,000
6	Trench Safety/Silt Fence	2,687	LF	$ 4.75	$ 13,000
7	Revegetation	2,687	LF	$ 7.00	$ 19,000
8	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
9	Tree Retention 30"	117	LF	$ 504.00	$ 59,000
10	Tree Retention 36"	152	LF	$ 576.00	$ 88,000
11	Miscellaneous	1	LS	$ 312,000.00	$ 312,000
	Construction Subtotal				**$ 1,872,000**
	Bonds & Insurance				$ 56,000
	Mobilization/Demobilization				$ 94,000
	Contractor Overhead & Profit				$ 281,000
	Construction Total				**$ 2,303,000**
	Professional Services				$ 345,000
	Easements	40 Foot Permanent			$ 295,000
		40 Foot Temporary			$ 72,000
		Easement Acquisition			$ 15,000
	Project Total				**$ 3,030,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Pecan Branch Basin
Proposed Gravity Main Project: SGI

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	48-inch Wastewater Line (0-8ft depth)	5,211	LF	$ 597.70	$ 3,114,000
2	60-inch Wastewater Line (0-8ft depth)	13,625	LF	$ 747.12	$ 10,180,000
3	Additional Cost of >8ft Deep 48-inch Line	5,211	LF	$ 264.36	$ 1,377,000
4	Additional Cost of >8ft Deep 60-inch Line	13,625	LF	$ 261.41	$ 3,562,000
5	Box Manhole (0-8ft depth)	51	EA	$ 35,238.12	$ 1,797,000
6	Additional Cost of >8ft Deep Box Manhole	51	EA	$ 12,329.36	$ 629,000
7	72-inch Bored Stream Crossing	200	LF	$ 3,782.88	$ 757,000
8	72-inch Bored Highway Crossing	400	LF	$ 3,782.88	$ 1,513,000
9	72-inch Bored Road Crossing	100	LF	$ 3,782.88	$ 378,000
10	Trench Safety/Silt Fence	18,836	LF	$ 4.75	$ 89,000
11	Revegetation	18,836	LF	$ 7.00	$ 132,000
12	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
13	Tree Retention 48"	521	LF	$ 720.00	$ 375,000
14	Tree Retention 60"	1,363	LF	$ 864.00	$ 1,177,000
15	Miscellaneous	1	LS	$ 5,017,000.00	$ 5,017,000
	Construction Subtotal				**$ 30,100,000**
	Bonds & Insurance				$ 903,000
	Mobilization/Demobilization				$ 1,505,000
	Contractor Overhead & Profit				$ 4,515,000
	Construction Total				**$ 37,023,000**
	Professional Services				$ 5,553,000
	Easements 50 Foot Permanent				$ 2,586,000
	40 Foot Temporary				$ 504,000
	Easement Acquisition				$ 124,000
	Project Total				**$ 45,790,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Gravity Main Project: CC-1

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	30-inch Wastewater Line (0-8ft depth)	8,721	LF	$ 373.56	$ 3,258,000
2	36-inch Wastewater Line (0-8ft depth)	112	LF	$ 448.27	$ 50,000
3	Additional Cost of >8ft Deep 30-inch Line	8,721	LF	$ 44.85	$ 391,000
4	Additional Cost of >8ft Deep 36-inch Line	112	LF	$ 138.80	$ 16,000
5	Install in Rock	17,376	CY	$ 30.00	$ 521,000
6	6-ft Diameter Manhole (0-8ft depth)	23	EA	$ 12,901.65	$ 297,000
7	8-ft Diameter Manhole (0-8ft depth)	2	EA	$ 24,554.57	$ 49,000
8	Additional Cost of >8ft Deep 6-ft Diameter Manhole	23	EA	$ 1,548.85	$ 36,000
9	Additional Cost of >8ft Deep 8-ft Diameter Manhole	2	EA	$ 7,602.79	$ 15,000
10	42-inch Bored Highway Crossing	400	LF	$ 2,206.68	$ 883,000
11	42-inch Bored Road Crossing	100	LF	$ 2,206.68	$ 221,000
12	Trench Safety/Silt Fence	8,833	LF	$ 4.75	$ 42,000
13	Revegetation	8,833	LF	$ 7.00	$ 62,000
15	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
16	Tree Retention 30"	872	LF	$ 504.00	$ 440,000
17	Tree Retention 36"	11	LF	$ 576.00	$ 6,000
18	Miscellaneous	1	LS	$ 1,258,000.00	$ 1,258,000
	Construction Subtotal				**$ 7,548,000**
	Bonds & Insurance				$ 226,000
	Mobilization/Demobilization				$ 377,000
	Contractor Overhead & Profit				$ 1,132,000
	Construction Total				**$ 9,283,000**
	Professional Services				$ 1,392,000
	Easements	50-ft permanent			$ 1,213,000
		40-ft temporary			$ 236,000
		Easment Acquisition			$ 57,960
	Project Total				**$ 12,182,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Gravity Main Project: CC-2

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	18-inch Wastewater Line (0-8ft depth)	2,955	LF	$ 177.12	$ 523,000
2	Additional Cost of >8ft Deep 21-inch Line	2,955	LF	$ 25	$ 73,000
3	Install in Rock	4,732	CY	$ 30.00	$ 142,000
4	6-ft Diameter Manhole (0-8ft depth)	9	EA	$ 12,901.65	$ 116,000
5	Additional Cost of >8ft Deep 6-ft Diameter Manhole	9	EA	$ 1,796.07	$ 16,000
6	33-inch Bored Highway Crossing	400	LF	$ 1,734	$ 694,000
7	33-inch Bored Highway Crossing	400	LF	$ 1,734	$ 694,000
8	Trench Safety/Silt Fence	2,955	LF	$ 4.75	$ 14,000
9	Revegetation	2,955	LS	$ 7.00	$ 21,000
10	Traffic Control (Lump Sum)	1	LF	$ 3,000.00	$ 3,000
11	Tree Retention	296	LS	$ 360.00	$ 106,000
12	Miscellaneous	1		$ 480,000.00	$ 480,000
	Construction Subtotal				**$ 2,882,000**
	Bonds & Insurance				$ 86,000
	Mobilization/Demobilization				$ 144,000
	Contractor Overhead & Profit				$ 432,000
	Construction Total				**$ 3,544,000**
	Professional Services				$ 532,000
	Easements	35 Foot Permanent			$ 284,000
		40 Foot Temporary			$ 79,000
		Easement Acquisition			$ 15,000
	Project Total				**$ 4,454,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Gravity Main Project: CC-7

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	36-inch Wastewater Line (0-8ft depth)	5,411	LF	$ 448.27	$ 2,426,000
2	Additional Cost of >8ft Deep 36-inch Line	5,411	LF	$ 94.75	$ 513,000
3	Install in Rock	15,190	CY	$ 30.00	$ 456,000
4	8-ft Diameter Manhole (0-8ft depth)	15	EA	$ 24,554.57	$ 368,000
5	Additional Cost of >8ft Deep 8-ft Diameter Manhole	15	EA	$ 5,190.15	$ 78,000
6	Trench Safety/Silt Fence	5,411	LF	$ 4.75	$ 26,000
7	Revegetation	5,411	LF	$ 7.00	$ 38,000
8	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
9	Tree Retention	541	LF	$ 576.00	$ 312,000
10	Miscellaneous	1	LS	$ 844,000.00	$ 844,000
	Construction Subtotal				**$ 5,064,000**
	Bonds & Insurance				$ 152,000
	Mobilization/Demobilization				$ 253,000
	Contractor Overhead & Profit				$ 760,000
	Construction Total				**$ 6,229,000**
	Professional Services				$ 934,000
	Easements	50 foot permanent			$ 743,000
		40 foot temporary			$ 145,000
		Easment Acquisition			$ 35,520
	Project Total				**$ 8,087,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Berry Creek Basin
Proposed Gravity Main Project: DBC-S1

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	21-inch Wastewater Line (0-8ft depth)	3,500	LF	$ 206.64	$ 723,000
2	24-inch Wastewater Line (0-8ft depth)	3,231	LF	$ 298.85	$ 966,000
3	30-inch Wastewater Line (0-8ft depth)	3,622	LF	$ 373.56	$ 1,353,000
4	36-inch Wastewater Line (0-8ft depth)	11,868	LF	$ 448.27	$ 5,320,000
5	Additional Cost of >8ft Deep 24-inch Line	3,231	LF	$ 10.68	$ 34,000
6	Additional Cost of >8ft Deep 30-inch Line	3,622	LF	$ 13.88	$ 50,000
7	Additional Cost of >8ft Deep 36-inch Line	11,868	LF	$ 76.48	$ 908,000
8	39-inch Bored Highway Crossing	800	LF	$ 2,049	$ 1,639,000
9	39-inch Bored Road Crossing	200	LF	$ 2,049	$ 410,000
10	36-inch Bored Stream Crossing	200	LF	$ 1,891.44	$ 378,000
11	Install in Rock	43,241	CY	$ 30.00	$ 1,297,000
12	6-ft Diameter Manhole (0-8ft depth)	31	EA	$ 12,901.65	$ 400,000
13	8-ft Diameter Manhole (0-8ft depth)	31	EA	$ 24,554.57	$ 761,000
14	Additional Cost of >8ft Deep 6-ft Diameter Manhole	21	EA	$ 460.91	$ 10,000
15	Additional Cost of >8ft Deep 8-ft Diameter Manhole	31	EA	$ 4,189.17	$ 130,000
16	Trench Safety/Silt Fence	22,221	LF	$ 4.75	$ 106,000
17	Revegetation	22,221	LF	$ 7.00	$ 156,000
18	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
19	Tree Retention 21"	350	LF	$ 396.00	$ 139,000
20	Tree Retention 24"	323	LF	$ 432.00	$ 140,000
21	Tree Retention 30"	362	LF	$ 504.00	$ 183,000
22	Tree Retention 36"	1,187	LF	$ 576.00	$ 684,000
23	Miscellaneous	1	LS	$ 3,158,000.00	$ 3,158,000
	Construction Subtotal				**$ 18,948,000**
	Bonds & Insurance				$ 568,000
	Mobilization/Demobilization				$ 947,000
	Contractor Overhead & Profit				$ 2,842,000
	Construction Total				**$ 23,305,000**
	Professional Services				$ 3,496,000
	Easements	25 Foot Permanent			$ 240,000
		35 Foot Permanent			$ 659,000
		50 Foot Permanent			$ 1,629,000
		40 Foot Temporary			$ 594,000
		Easement Acquisition			$ 124,880.00
	Project Total				**$ 30,048,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Berry Creek Basin
Proposed Gravity Main Project: DBC-S2

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
1	8-inch Wastewater Line (0-8ft depth)	4,136	LF	$	78.72	$	326,000
2	Install in Rock	2,825	CY	$	30.00	$	85,000
3	5-ft Diameter Manhole (0-8ft depth)	12	EA	$	9,636.97	$	116,000
4	Trench Safety/Silt Fence	4,136	LF	$	4.75	$	20,000
5	Revegetation	4,136	LF	$	7.00	$	29,000
6	Traffic Control (Lump Sum)	1	LS	$	3,000.00	$	3,000
7	Tree Retention	414	LF	$	240.00	$	99,000
8	Miscellaneous	1	LS	$	136,000.00	$	136,000
	Construction Subtotal					**$**	**814,000**
	Bonds & Insurance					$	24,000
	Mobilization/Demobilization					$	41,000
	Contractor Overhead & Profit					$	122,000
	Construction Total					**$**	**1,001,000**
	Professional Services					$	150,000
	Easements	20 Foot Permanent				$	227,000
		40 Foot Temporary				$	111,000
		Easement Acquisition				$	13,520.00
	Project Total					**$**	**1,503,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Berry Creek Basin
Proposed Gravity Main Project: DBC-S3

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	15-inch Wastewater Line (0-8ft depth)	7,298	LF	$ 147.60	$ 1,077,000
2	Additional Cost of >8ft Deep 15-inch Line	7,298	LF	$ 1.95	$ 14,000
3	22-inch Bored Road Crossing	100	LF	$ 1,156	$ 116,000
4	30-inch Bored Road Crossing	100	LF	$ 1,576	$ 158,000
5	Install in Rock	7,343	CY	$ 30.00	$ 220,000
6	6-ft Diameter Manhole (0-8ft depth)	20	EA	$ 12,901.65	$ 258,000
7	Additional Cost of >8ft Deep 6-ft Diameter Manhole	20	EA	$ 170.68	$ 3,000
9	Trench Safety/Silt Fence	7,298	LF	$ 4.75	$ 35,000
10	Revegetation	7,298	LF	$ 7.00	$ 51,000
11	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
12	Tree Retention	730	LF	$ 324.00	$ 236,000
13	Miscellaneous	1	LS	$ 434,000.00	$ 434,000
	Construction Subtotal				**$ 2,605,000**
	Bonds & Insurance				$ 78,000
	Mobilization/Demobilization				$ 130,000
	Contractor Overhead & Profit				$ 391,000
	Construction Total				**$ 3,204,000**
	Professional Services				$ 481,000
	Easements	25 Foot Permanent			$ 501,000
		40 Foot Temporary			$ 195,000
		Easement Acquistion			$ 27,840.00
	Project Total				**$ 4,409,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Mankins Basin
Proposed Gravity Main Project: MB-5

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	12-inch Wastewater Line (0-8ft depth)	6,254	LF	$ 118.08	$ 738,000
2	15-inch Wastewater Line (0-8ft depth)	7,968	LF	$ 147.60	$ 1,176,000
3	18-inch Wastewater Line (0-8ft depth)	1,153	LF	$ 177.12	$ 204,000
4	21-inch Wastewater Line (0-8ft depth)	3,778	LF	$ 206.64	$ 781,000
5	Additional Cost of >8ft Deep 15-inch Line	7,968	LF	$ 13.60	$ 108,000
6	Additional Cost of >8ft Deep 18-inch Line	1,153	LF	$ 3.27	$ 4,000
7	Additional Cost of >8ft Deep 21-inch Line	3,778	LF	$ 63.37	$ 239,000
8	33-inch Bored Highway Crossing	400	LF	$ 1,734	$ 694,000
9	33-inch Bored Stream Crossing	200	LF	$ 1,734	$ 347,000
10	5-ft Diameter Manhole (0-8ft depth)	17	EA	$ 9,636.97	$ 164,000
11	6-ft Diameter Manhole (0-8ft depth)	36	EA	$ 12,901.65	$ 464,000
12	Additional Cost of >8ft Deep 6-ft Diameter Manhole	36	EA	$ 238.42	$ 9,000
13	Trench Safety/Silt Fence	19,153	LF	$ 4.75	$ 91,000
14	Revegetation	19,153	LF	$ 7.00	$ 134,000
15	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
16	Tree Retention 12"	625	LS	$ 288.00	$ 180,000
17	Tree Retention 15"	797	LF	$ 324.00	$ 258,000
18	Tree Retention 18"	115	LF	$ 360.00	$ 42,000
19	Tree Retention 21"	378	LF	$ 396.00	$ 150,000
20	Miscellaneous	1	LS	$ 1,157,000.00	$ 1,157,000
	Construction Subtotal				**$ 6,943,000**
	Bonds & Insurance				$ 208,000
	Mobilization/Demobilization				$ 347,000
	Contractor Overhead & Profit				$ 1,041,000
	Construction Total				**$ 8,539,000**
	Professional Services				$ 1,281,000
	Easements	20 Foot Permanent			$ 343,000
		35 Foot Permanent			$ 1,240,000
		40 Foot Temporary			$ 512,000
	Project Total				**$ 11,915,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
South Fork Basin
Proposed Gravity Main Project: MF-5

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
1	8-inch Wastewater Line (0-8ft depth)	5,515	LF	$	78.72	$	434,000
2	15-inch Wastewater Line (0-8ft depth)	86	LF	$	147.60	$	13,000
3	Additional Cost of >8ft Deep 15-inch Line	86	LF	$	60.81	$	5,000
4	Install in Rock	4,533	CY	$	30.00	$	136,000
5	5-ft Diameter Manhole (0-8ft depth)	15	EA	$	9,636.97	$	145,000
6	6-ft Diameter Manhole (0-8ft depth)	2	EA	$	12,901.65	$	26,000
7	Additional Cost of >8ft Deep 6 Manhole	2	EA	$	5,315.12	$	11,000
8	Trench Safety/Silt Fence	5,601	LF	$	4.75	$	27,000
9	Revegetation	5,601	LF	$	7.00	$	39,000
10	Traffic Control (Lump Sum)	1	LS	$	3,000.00	$	3,000
11	Tree Retention 8"	552	LF	$	240.00	$	132,000
12	Tree Retention 15"	9	LF	$	324.00	$	3,000
13	Miscellaneous	1	LS	$	195,000.00	$	195,000
	Construction Subtotal					**$**	**1,169,000**
	Bonds & Insurance					$	35,000
	Mobilization/Demobilization					$	58,000
	Contractor Overhead & Profit					$	175,000
	Construction Total					**$**	**1,437,000**
	Professional Services					$	216,000
	Easements	20 Foot Permanent				$	303,000
		35 Foot Permanent				$	8,000
		40 Foot Temporary				$	150,000
		Easement Acquisition				$	18,440.00
	Project Total					**$**	**2,132,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Mankins Basin
Proposed Gravity Main Project: SECR130

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
1	18-inch Wastewater Line (0-8ft depth)	5,466	LF	$	177.12	$	968,000
2	Additional Cost of >8ft Deep 18-inch Line	5,466	LF	$	33.02	$	181,000
3	6-ft Diameter Manhole (0-8ft depth)	15	EA	$	12,901.65	$	194,000
4	Additional Cost of >8ft Deep Manhole	15	EA	$	2,405.51	$	36,000
5	Trench Safety/Silt Fence	5,466	LF	$	4.75	$	26,000
6	Revegetation	5,466	LF	$	7.00	$	38,000
7	Traffic Control (Lump Sum)	1	LS	$	3,000.00	$	3,000
8	Tree Retention	547	LF	$	360.00	$	197,000
9	Miscellaneous	1	LS	$	329,000.00	$	329,000
	Construction Subtotal					**$**	**1,972,000**
	Bonds & Insurance					$	59,000
	Mobilization/Demobilization					$	99,000
	Contractor Overhead & Profit					$	296,000
	Construction Total					**$**	**2,426,000**
	Professional Services					$	364,000
	Easements	35 Foot Permanent				$	525,000
		40 Foot Temporary				$	146,000
		Easement Acquisition				$	26,840.00
	Project Total					**$**	**3,488,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Mankins Basin
Proposed Gravity Main Project: SEMKN

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	21-inch Wastewater Line (0-8ft depth)	792	LF	$ 206.64	$ 164,000
2	27-inch Wastewater Line (0-8ft depth)	4,351	LF	$ 336.20	$ 1,463,000
3	Additional Cost of >8ft Deep 21-inch Line	792	LF	$ 16.27	$ 13,000
4	Additional Cost of >8ft Deep 27-inch Line	4,351	LF	$ 32.29	$ 140,000
5	39-inch Bored Road Crossing	100	LF	$ 2,049	$ 205,000
6	6-ft Diameter Manhole (0-8ft depth)	15	EA	$ 12,901.65	$ 194,000
7	Additional Cost of >8ft Deep 6-ft Diameter Manhole	15	EA	$ 1,239.04	$ 19,000
8	Trench Safety/Silt Fence	5,143	LF	$ 4.75	$ 24,000
9	Revegetation	5,143	LF	$ 7.00	$ 36,000
10	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
11	Tree Retention 21"	79	LF	$ 396.00	$ 31,000
12	Tree Retention 27"	435	LF	$ 468.00	$ 204,000
13	Miscellaneous	1	LS	$ 499,000.00	$ 499,000
	Construction Subtotal				**$ 2,995,000**
	Bonds & Insurance				$ 90,000
	Mobilization/Demobilization				$ 150,000
	Contractor Overhead & Profit				$ 449,000
	Construction Total				**$ 3,684,000**
	Professional Services				$ 553,000
	Easements	35 Foot Permanent			$ 494,000
		40 Foot Temporary			$ 138,000
		Easement Acquisition			$ 25,280
	Project Total				**$ 4,894,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Pecan Branch Basin
Proposed Gravity Main Project: Tunnel

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
1	Tunnel Bore 48-inch (36" Pipe)	429	LF	$	2,521.92	$	1,081,000
2	Tunnel Bore 66-inch (54" Pipe)	12,932	LF	$	3,467.64	$	44,843,000
3	Trench Safety/Silt Fence	1,000	LF	$	4.75	$	5,000
4	Revegetation	1,000	LF	$	7.00	$	7,000
5	Traffic Control (Lump Sum)	1	LS	$	10,000.00	$	10,000
6	Tree Retention	1	LS	$	15,000.00	$	15,000
7	Miscellaneous	1	LS	$	9,192,000.00	$	9,192,000
	Construction Subtotal					**$**	**55,153,000**
	Bonds & Insurance					$	1,655,000
	Mobilization/Demobilization					$	2,758,000
	Contractor Overhead & Profit					$	8,273,000
	Construction Total					**$**	**67,839,000**
	Professional Services					$	10,176,000
	Project Total					**$**	**78,015,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Pecan Branch Basin
Proposed Gravity Main Project: SG DIV

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	30-inch Wastewater Line (0-8ft depth)	1,920	LF	$ 373.56	$ 717,000
2	Additional Cost of >8ft Deep 30-inch Line	1,920	LF	$ 111.20	$ 214,000
3	6-ft Diameter Manhole (0-8ft depth)	6	EA	$ 12,901.65	$ 77,000
4	Additional Cost of >8ft Deep 6-ft Diameter Manhole	6	EA	$ 4,860.08	$ 29,000
5	42-inch Bored Road Crossing	100	LF	$ 2,206.68	$ 221,000
6	Trench Safety/Silt Fence	1,920	LF	$ 4.75	$ 9,000
7	Revegetation	1,920	LF	$ 7.00	$ 13,000
8	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
9	Tree Retention 30"	192	LF	$ 504.00	$ 97,000
10	Miscellaneous	1	LS	$ 276,000.00	$ 276,000
	Construction Subtotal				**$ 1,656,000**
	Bonds & Insurance				$ 50,000
	Mobilization/Demobilization				$ 83,000
	Contractor Overhead & Profit				$ 248,000
	Construction Total				**$ 2,037,000**
	Professional Services				$ 306,000
	Easements	40 Foot Permanent			$ 211,000
		40 Foot Temporary			$ 51,000
		Easement Acquisition			$ 10,000
	Project Total				**$ 2,615,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Mankins Basin
Proposed Gravity Main Project: DS-SEMKN

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	30-inch Wastewater Line (0-8ft depth)	7,371	LF	$ 373.56	$ 2,754,000
2	36-inch Wastewater Line (0-8ft depth)	3,937	LF	$ 448.27	$ 1,765,000
3	Additional Cost of >8ft Deep 30-inch Line	7,371	LF	$ 33.01	$ 243,000
4	Additional Cost of >8ft Deep 36-inch Line	3,937	LF	$ 74.99	$ 295,000
5	48-inch Bored Stream Crossing	200	LF	$ 2,522	$ 504,000
6	6-ft Diameter Manhole (0-8ft depth)	20	EA	$ 12,901.65	$ 258,000
7	8-ft Diameter Manhole (0-8ft depth)	11	EA	$ 24,554.57	$ 270,000
8	Additional Cost of >8ft Deep 6-ft Diameter Manhole	20	EA	$ 1,140.04	$ 23,000
9	Additional Cost of >8ft Deep 8-ft Diameter Manhole	11	EA	$ 4,107.74	$ 45,000
10	Trench Safety/Silt Fence	11,308	LF	$ 4.75	$ 54,000
11	Revegetation	11,308	LF	$ 7.00	$ 79,000
12	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
13	Tree Retention 30"	737	LF	$ 504.00	$ 372,000
14	Tree Retention 36"	394	LF	$ 576.00	$ 227,000
15	Miscellaneous	1	LS	$ 1,378,000.00	$ 1,378,000
	Construction Subtotal				**$ 8,270,000**
	Bonds & Insurance				$ 248,000
	Mobilization/Demobilization				$ 414,000
	Contractor Overhead & Profit				$ 1,241,000
	Construction Total				**$ 10,173,000**
	Professional Services				$ 1,526,000
	Easements 50 Foot Permanent				$ 1,552,000
	40 Foot Temporary				$ 302,000
	Easement Acquisition				$ 74,160
	Project Total				**$ 13,627,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Gravity Main Project: NL-1

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	24-inch Wastewater Line (0-8ft depth)	2,772	LF	$ 298.85	$ 828,000
2	27-inch Wastewater Line (0-8ft depth)	6,395	LF	$ 336.20	$ 2,150,000
3	30-inch Wastewater Line (0-8ft depth)	6,789	LF	$ 373.56	$ 2,536,000
4	36-inch Wastewater Line (0-8ft depth)	4,622	LF	$ 448.27	$ 2,072,000
5	42-inch Wastewater Line (0-8ft depth)	1,773	LF	$ 522.98	$ 927,000
6	54-inch Wastewater Line (0-8ft depth)	112	LF	$ 672.41	$ 76,000
7	Additional Cost of >8ft Deep 24-inch Line	2,772	LF	$ 39.90	$ 111,000
8	Additional Cost of >8ft Deep 27-inch Line	6,395	LF	$ 30.59	$ 196,000
9	Additional Cost of >8ft Deep 30-inch Line	6,789	LF	$ 32.97	$ 224,000
10	Additional Cost of >8ft Deep 36-inch Line	4,622	LF	$ 38.79	$ 179,000
11	Additional Cost of >8ft Deep 42-inch Line	1,773	LF	$ 7.01	$ 12,000
12	Additional Cost of >8ft Deep 54-inch Line	112	LF	$ 70.16	$ 8,000
13	Install in Rock	42,515	CY	$ 30.00	$ 1,275,000
14	6-ft Diameter Manhole (0-8ft depth)	43	EA	$ 12,901.65	$ 555,000
15	8-ft Diameter Manhole (0-8ft depth)	19	EA	$ 24,554.57	$ 467,000
16	Box Manhole (0-8ft depth)	2	EA	$ 35,238.12	$ 70,000
17	Additional Cost of >8ft Deep 6-ft Diameter Manhole	43	EA	$ 1,550.81	$ 67,000
18	Additional Cost of >8ft Deep 8-ft Diameter Manhole	19	EA	$ 1,609.97	$ 31,000
19	Additional Cost of >8ft Deep Box Manhole	2	EA	$ 4,652.69	$ 9,000
20	42-inch Bored Stream Crossing	200	LF	$ 2,206.68	$ 441,000
21	Trench Safety/Silt Fence	22,463	LF	$ 4.75	$ 107,000
22	Revegetation	22,463	LF	$ 7.00	$ 157,000
23	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
24	Tree Retention 24"	277	LF	$ 432.00	$ 120,000
25	Tree Retention 27"	640	LF	$ 468.00	$ 299,000
26	Tree Retention 30"	679	LF	$ 504.00	$ 342,000
27	Tree Retention 36"	462	LF	$ 576.00	$ 266,000
28	Tree Retention 42"	177	LF	$ 648.00	$ 115,000
29	Tree Retention 54"	11	LF	$ 792.00	$ 9,000
30	Miscellaneous	1	LS	$ 2,730,000.00	$ 2,730,000
	Construction Subtotal				**$ 10,868,000**
	Bonds & Insurance				$ 326,000
	Mobilization/Demobilization				$ 543,000
	Contractor Overhead & Profit				$ 1,630,000
	Construction Total				**$ 13,367,000**
	Professional Services				$ 2,005,000
	Easements	35 Foot Permanent			$ 266,000.00
		50 Foot Permanent			$ 2,703,000.00
		40 Foot Temporary			$ 601,000.00
		Easement Acquisition			$ 143,000.00
	Project Total				**$ 19,085,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Gravity Main Project: NL-2

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	12-inch Wastewater Line (0-8ft depth)	3,161	LF	$ 118.08	$ 373,000
2	15-inch Wastewater Line (0-8ft depth)	6,337	LF	$ 147.60	$ 935,000
3	Install in Rock	8,378	CY	$ 30.00	$ 251,000
4	5-ft Diameter Manhole (0-8ft depth)	9	EA	$ 9,636.97	$ 87,000
5	6-ft Diameter Manhole (0-8ft depth)	17	EA	$ 12,901.65	$ 219,000
6	27-inch Bored Road Crossing	100	LF	$ 1,419	$ 142,000
7	Trench Safety/Silt Fence	3,161	LF	$ 4.75	$ 15,000
8	Revegetation	3,161	LF	$ 7.00	$ 22,000
9	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
10	Tree Retention 12"	316	LF	$ 288.00	$ 91,000
11	Tree Retention 15"	634	LF	$ 324.00	$ 205,000
12	Miscellaneous	1	LS	$ 469,000.00	$ 469,000
	Construction Subtotal				**$ 2,812,000**
	Bonds & Insurance				$ 84,000
	Mobilization/Demobilization				$ 141,000
	Contractor Overhead & Profit				$ 422,000
	Construction Total				**$ 3,459,000**
	Professional Services				$ 519,000
	Easements	20 Foot Permanent			$ 174,000
		25 Foot Permanent			$ 435,000
		40 Foot Temporary			$ 254,000
		Easement Acquisition			$ 35,000
	Project Total				**$ 4,876,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Berry Creek Basin
Proposed Gravity Main Project: BC-2a

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	8-inch Wastewater Line (0-8ft depth)	1,788	LF	$ 78.72	$ 141,000
2	10-inch Wastewater Line (0-8ft depth)	3,716	LF	$ 98.40	$ 366,000
3	Additional Cost of >8ft Deep 8-inch Line	1,788	LF	$ 19.66	$ 35,000
4	Additional Cost of >8ft Deep 10-inch Line	3,716	LF	$ 29.21	$ 109,000
5	20-inch Bored Road Crossing	100	LF	$ 1,051	$ 105,000
6	Install in Rock	10,389	CY	$ 30.00	$ 312,000
7	5-ft Diameter Manhole (0-8ft depth)	17	EA	$ 9,636.97	$ 164,000
8	Additional Cost of >8ft Deep Manhole	17	EA	$ 2,860.52	$ 49,000
9	Trench Safety/Silt Fence	5,503	LF	$ 4.75	$ 26,000
10	Revegetation	5,503	LF	$ 7.00	$ 39,000
11	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
12	Tree Retention 8"	179	LF	$ 240.00	$ 43,000
13	Tree Retention 10"	372	LF	$ 264.00	$ 98,000
14	Miscellaneous	1	LS	$ 298,000.00	$ 298,000
	Construction Subtotal				**$ 1,788,000**
	Bonds & Insurance				$ 54,000
	Mobilization/Demobilization				$ 89,000
	Contractor Overhead & Profit				$ 268,000
	Construction Total				**$ 2,199,000**
	Professional Services				$ 330,000
	Easements	25 Foot Permanent			$ 378,000
		40 Foot Temporary			$ 147,000
		Easement Acquisiton			$ 21,000
	Project Total				**$ 3,075,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Berry Creek Basin
Proposed Gravity Main Project: BC-5

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
1	10-inch Wastewater Line (0-8ft depth)	3,926	LF	$	98.40	$	386,000
2	Install in Rock	2,873	CY	$	30.00	$	86,000
3	5-ft Diameter Manhole (0-8ft depth)	11	EA	$	9,636.97	$	106,000
4	22-inch Bored Road Crossing	100	LF	$	1,156	$	116,000
5	Trench Safety/Silt Fence	3,926	LF	$	4.75	$	19,000
6	Revegetation	3,926	LF	$	7.00	$	27,000
7	Traffic Control (Lump Sum)	1	LS	$	3,000.00	$	3,000
8	Tree Retention	393	LF	$	264.00	$	104,000
9	Miscellaneous	1	LS	$	169,000.00	$	169,000
	Construction Subtotal					**$**	**1,016,000**
	Bonds & Insurance					$	30,000
	Mobilization/Demobilization					$	51,000
	Contractor Overhead & Profit					$	152,000
	Construction Total					**$**	**1,249,000**
	Professional Services					$	187,000
	Easements	20 Foot Permanent				$	216,000
		40 Foot Temporary				$	105,000
		Easement Acquisition				$	13,000.00
	Project Total					**$**	**1,770,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Sun City Basin
Proposed Gravity Main Project: BCW-1

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	8-inch Wastewater Line (0-8ft depth)	3,961	LF	$ 78.72	$ 312,000
2	Additional Cost of >8ft Deep 8-inch Line	3,961	LF	$ 3.82	$ 15,000
3	Install in Rock	3,665	CY	$ 30.00	$ 110,000
4	5-ft Diameter Manhole (0-8ft depth)	11	EA	$ 9,636.97	$ 106,000
5	Additional Cost of >8ft Deep Manhole	11	EA	$ 467.97	$ 5,000
6	Trench Safety/Silt Fence	3,961	LF	$ 4.75	$ 19,000
7	Revegetation	3,961	LF	$ 7.00	$ 28,000
8	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
9	Tree Retention	396	LF	$ 240.00	$ 95,000
10	Miscellaneous	1	LS	$ 139,000.00	$ 139,000
	Construction Subtotal				**$ 832,000**
	Bonds & Insurance				$ 25,000
	Mobilization/Demobilization				$ 42,000
	Contractor Overhead & Profit				$ 125,000
	Construction Total				**$ 1,024,000**
	Professional Services				$ 154,000
	Easements	25 Foot Permanent			$ 272,000
		40 Foot Temporary			$ 106,000
		Easement Acquisition			$ 15,000
	Project Total				**$ 1,571,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Gravity Main Project: CC-1b

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	8-inch Wastewater Line (0-8ft depth)	1,986	LF	$ 78.72	$ 156,000
2	Install in Rock	1,519	CY	$ 30.00	$ 46,000
3	5-ft Diameter Manhole (0-8ft depth)	6	EA	$ 9,636.97	$ 58,000
4	20-inch Bored Highway Crossing	400	LF	$ 1,051	$ 420,000
5	Trench Safety/Silt Fence	1,986	LF	$ 4.75	$ 9,000
6	Revegetation	1,986	LF	$ 7.00	$ 14,000
7	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
8	Tree Retention	199	LF	$ 240.00	$ 48,000
9	Miscellaneous	1	LS	$ 151,000.00	$ 151,000
	Construction Subtotal				**$ 905,000**
	Bonds & Insurance				$ 27,000
	Mobilization/Demobilization				$ 45,000
	Contractor Overhead & Profit				$ 136,000
	Construction Total				**$ 1,113,000**
	Professional Services				$ 167,000
	Easements	20 Foot Permanent			$ 109,000.00
		40 Foot Temporary			$ 53,000.00
		Easement Acquisition			$ 6,000.00
	Project Total				**$ 1,448,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Gravity Main Project: CC-3

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	12-inch Wastewater Line (0-8ft depth)	2,895	LF	$ 118.08	$ 342,000
2	15-inch Wastewater Line (0-8ft depth)	1,567	LF	$ 147.60	$ 231,000
3	5-ft Diameter Manhole (0-8ft depth)	9	EA	$ 9,636.97	$ 87,000
4	6-ft Diameter Manhole (0-8ft depth)	5	EA	$ 12,901.65	$ 65,000
5	Install in Rock	2,954	CY	$ 30.00	$ 89,000
6	27-inch Bored Highway Crossing	400	LF	$ 1,419	$ 567,000
7	27-inch Bored Highway Crossing	400	LF	$ 1,419	$ 567,000
8	Trench Safety/Silt Fence	4,462	LF	$ 4.75	$ 21,000
9	Revegetation	4,462	LF	$ 7.00	$ 31,000
10	Traffic Control (Lump Sum)	1	LS	$ 15,000.00	$ 15,000
11	Tree Retention 12"	290	LF	$ 288.00	$ 83,000
12	Tree Retention 15"	157	LF	$ 324.00	$ 51,000
13	Miscellaneous	1	LS	$ 430,000.00	$ 430,000
	Construction Subtotal				**$ 2,579,000**
	Bonds & Insurance				$ 77,000
	Mobilization/Demobilization				$ 129,000
	Contractor Overhead & Profit				$ 387,000
	Construction Total				**$ 3,172,000**
	Professional Services				$ 476,000
	Easements	20 Foot Permanent			$ 199,000
		25 Foot Permanent			$ 108,000
		40 foot Temporary			$ 119,000
		Easment Acquisition			$ 17,000
	Project Total				**$ 4,091,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Gravity Main Project: CC-4

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	18-inch Wastewater Line (0-8ft depth)	6,924	LF	$ 177.12	$ 1,226,000
2	21-inch Wastewater Line (0-8ft depth)	4,933	LF	$ 206.64	$ 1,019,000
3	Install in Rock	10,617	CY	$ 30.00	$ 319,000
4	6-ft Diameter Manhole (0-8ft depth)	33	EA	$ 12,901.65	$ 426,000
5	Trench Safety/Silt Fence	11,856	LF	$ 4.75	$ 56,000
6	Revegetation	11,856	LF	$ 7.00	$ 83,000
7	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
8	Tree Retention 18"	692	LF	$ 360.00	$ 249,000
9	Tree Retention 21"	493	LF	$ 396.00	$ 195,000
10	Miscellaneous	1	LS	$ 676,000.00	$ 676,000
	Construction Subtotal				**$ 4,252,000**
	Bonds & Insurance				$ 128,000
	Mobilization/Demobilization				$ 213,000
	Contractor Overhead & Profit				$ 638,000
	Construction Total				**$ 5,231,000**
	Professional Services				$ 785,000
	Easements 25 Foot Permanent				$ 814,000.00
	40 Foot Temporary				$ 317,000.00
	Easement Acquisition				$ 45,000.00
	Project Total				**$ 7,192,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Gravity Main Project: CC-5

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	8-inch Wastewater Line (0-8ft depth)	2,570	LF	$ 78.72	$ 202,000
2	Install in Rock	1,720	CY	$ 30.00	$ 52,000
3	5-ft Diameter Manhole (0-8ft depth)	8	EA	$ 9,636.97	$ 77,000
4	Trench Safety/Silt Fence	2,570	LF	$ 4.75	$ 12,000
5	Revegetation	2,570	LF	$ 7.00	$ 18,000
6	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
7	Tree Retention	257	LF	$ 240.00	$ 62,000
8	Miscellaneous	1	LS	$ 85,000.00	$ 85,000
	Construction Subtotal				**$ 511,000**
	Bonds & Insurance				$ 15,000
	Mobilization/Demobilization				$ 26,000
	Contractor Overhead & Profit				$ 77,000
	Construction Total				**$ 629,000**
	Professional Services				$ 94,000
	Easements	20 Foot Permanent			$ 141,000.00
		40 Foot Temporary			$ 69,000.00
		Easement Acquisition			$ 8,000.00
	Project Total				**$ 941,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Gravity Main Project: CC-6

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	12-inch Wastewater Line (0-8ft depth)	1,880	LF	$ 118.08	$ 222,000
2	15-inch Wastewater Line (0-8ft depth)	1,625	LF	$ 147.60	$ 240,000
3	Additional Cost of >8ft Deep 12-inch Line	1,880	LF	$ 20.25	$ 38,000
4	Install in Rock	3,921	CY	$ 30.00	$ 118,000
5	5-ft Diameter Manhole (0-8ft depth)	6	EA	$ 9,636.97	$ 58,000
6	6-ft Diameter Manhole (0-8ft depth)	6	EA	$ 12,901.65	$ 77,000
7	Additional Cost of >8ft Deep 5-ft Diameter Manhole	6	EA	$ 1,305.99	$ 8,000
8	Trench Safety/Silt Fence	3,505	LF	$ 4.75	$ 17,000
9	Revegetation	3,505	LF	$ 7.00	$ 25,000
10	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
11	Tree Retention 12"	188	LF	$ 288.00	$ 54,000
12	Tree Retention 15"	162	LF	$ 324.00	$ 53,000
13	Miscellaneous	1	LS	$ 183,000.00	$ 183,000
	Construction Subtotal				**$ 1,096,000**
	Bonds & Insurance				$ 33,000
	Mobilization/Demobilization				$ 55,000
	Contractor Overhead & Profit				$ 164,000
	Construction Total				**$ 1,348,000**
	Professional Services				$ 202,000
	Easements	25 Foot Permanent			$ 241,000
		40 Foot Temporary			$ 94,000
		Easement Acquisition			$ 13,000
	Project Total				**$ 1,898,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Berry Creek Basin
Proposed Gravity Main Project: GV-1

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	10-inch Wastewater Line (0-8ft depth)	2,090	LF	$ 98.40	$ 206,000
2	12-inch Wastewater Line (0-8ft depth)	1,673	LF	$ 118.08	$ 198,000
3	18-inch Wastewater Line (0-8ft depth)	4,352	LF	$ 177.12	$ 771,000
4	Additional Cost of >8ft Deep 12-inch Line	1,673	LF	$ 32.07	$ 54,000
5	Additional Cost of >8ft Deep 18-inch Line	4,352	LF	$ 66.26	$ 288,000
6	Install in Rock	17,918	CY	$ 30.00	$ 538,000
7	5-ft Diameter Manhole (0-8ft depth)	13	EA	$ 9,636.97	$ 125,000
8	6-ft Diameter Manhole (0-8ft depth)	12	EA	$ 12,901.65	$ 155,000
9	Additional Cost of >8ft Deep 5-ft Diameter Manhole	6	EA	$ 9,569.76	$ 57,000
10	Additional Cost of >8ft Deep 6-ft Diameter Manhole	12	EA	$ 4,826.33	$ 58,000
11	Trench Safety/Silt Fence	8,114	LF	$ 4.75	$ 39,000
12	Revegetation	8,114	LF	$ 7.00	$ 57,000
13	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
14	Tree Retention 10"	209	LF	$ 264.00	$ 55,000
15	Tree Retention 12"	167	LF	$ 288.00	$ 48,000
16	Tree Retention 18"	435	LF	$ 360.00	$ 157,000
17	Miscellaneous	1	LS	$ 562,000.00	$ 562,000
	Construction Subtotal				**$ 3,371,000**
	Bonds & Insurance				$ 101,000
	Mobilization/Demobilization				$ 169,000
	Contractor Overhead & Profit				$ 506,000
	Construction Total				**$ 4,147,000**
	Professional Services				$ 622,000
	Easements 20 Foot Permanent				$ 115,000
	25 Foot Permanent				$ 115,000
	35 Foot Permanent				$ 418,000
	40 Foot Temporary				$ 217,000
	Easement Acquisition				$ 35,000
	Project Total				**$ 5,669,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Gravity Main Project: RR-1

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	8-inch Wastewater Line (0-8ft depth)	1,000	LF	$ 78.72	$ 79,000
2	10-inch Wastewater Line (0-8ft depth)	999	LF	$ 98.40	$ 98,000
3	12-inch Wastewater Line (0-8ft depth)	3,916	LF	$ 118.08	$ 462,000
4	Install in Rock	4,416	CY	$ 30.00	$ 132,000
5	5-ft Diameter Manhole (0-8ft depth)	19	EA	$ 9,636.97	$ 183,000
6	Trench Safety/Silt Fence	5,915	LF	$ 4.75	$ 28,000
7	Revegetation	5,915	LF	$ 7.00	$ 41,000
8	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
9	Tree Retention 8"	100	LF	$ 240.00	$ 24,000
10	Tree Retention 10"	100	LF	$ 264.00	$ 26,000
11	Tree Retention 12"	392	LF	$ 288.00	$ 113,000
12	Miscellaneous	1	LS	$ 238,000.00	$ 238,000
	Construction Subtotal				**$ 1,427,000**
	Bonds & Insurance				$ 43,000
	Mobilization/Demobilization				$ 71,000
	Contractor Overhead & Profit				$ 214,000
	Construction Total				**$ 1,755,000**
	Professional Services				$ 263,000
	Easements	20 Foot Permanent			$ 325,000
		40 Foot Temporary			$ 158,000
		Easement Acquisition			$ 19,000.00
	Project Total				**$ 2,520,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Proposed Gravity Main Project: RR-2

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	12-inch Wastewater Line (0-8ft depth)	8,507	LF	$ 118.08	$ 1,004,000
2	15-inch Wastewater Line (0-8ft depth)	2,000	LF	$ 147.60	$ 295,000
3	18-inch Wastewater Line (0-8ft depth)	1,002	LF	$ 177.12	$ 178,000
4	Additional Cost of >8ft Deep 12-inch Line	8,507	LF	$ 36.43	$ 310,000
5	Additional Cost of >8ft Deep 15-inch Line	2,000	LF	$ 80.66	$ 161,000
6	Additional Cost of >8ft Deep 18-inch Line	1,002	LF	$ 45.01	$ 45,000
7	Install in Rock	23,931	CY	$ 30.00	$ 718,000
8	5-ft Diameter Manhole (0-8ft depth)	23	EA	$ 9,636.97	$ 222,000
9	6-ft Diameter Manhole (0-8ft depth)	10	EA	$ 12,901.65	$ 129,000
10	Additional Cost of >8ft Deep 5-ft Diameter Manhole	23	EA	$ 2,349.30	$ 54,000
11	Additional Cost of >8ft Deep 6-ft Diameter Manhole	10	EA	$ 4,232.16	$ 42,000
12	Trench Safety/Silt Fence	11,509	LF	$ 4.75	$ 55,000
13	Revegetation	11,509	LF	$ 7.00	$ 81,000
14	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
15	Tree Retention 12"	851	LF	$ 288.00	$ 245,000
16	Tree Retention 15"	200	LF	$ 324.00	$ 65,000
17	Tree Retention 18"	100	LF	$ 360.00	$ 36,000
18	Miscellaneous	1	LS	$ 729,000.00	$ 729,000
	Construction Subtotal				**$ 4,372,000**
	Bonds & Insurance				$ 131,000
	Mobilization/Demobilization				$ 219,000
	Contractor Overhead & Profit				$ 656,000
	Construction Total				**$ 5,378,000**
	Professional Services				$ 807,000
	Easements 25 Foot Permanent				$ 584,000
	35 Foot Permanent				$ 289,000
	40 Foot Temporary				$ 308,000
	Easement Acquisition				$ 47,000
	Project Total				**$ 7,413,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Smith Branch Basin
Proposed Gravity Main Project: SG-7a

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	10-inch Wastewater Line (0-8ft depth)	2,580	LF	$ 98.40	$ 254,000
2	Additional Cost of >8ft Deep 10-inch Line	2,580	LF	$ 2.92	$ 8,000
3	22-inch Bored Highway Crossing	400	LF	$ 1,156	$ 462,000
5	5-ft Diameter Manhole (0-8ft depth)	8	EA	$ 9,636.97	$ 77,000
6	Additional Cost of >8ft Deep Manhole	8	EA	$ 285.52	$ 2,000
7	Trench Safety/Silt Fence	2,580	LF	$ 4.75	$ 12,000
8	Revegetation	2,580	LF	$ 7.00	$ 18,000
9	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
10	Tree Retention	258	LF	$ 264.00	$ 68,000
11	Miscellaneous	1	LS	$ 181,000.00	$ 181,000
	Construction Subtotal				**$ 1,085,000**
	Bonds & Insurance				$ 33,000
	Mobilization/Demobilization				$ 54,000
	Contractor Overhead & Profit				$ 163,000
	Construction Total				**$ 1,335,000**
	Professional Services				$ 200,000
	Easements	25 Foot Permanent			$ 177,000
		40 Foot Temporary			$ 69,000
		Easement Acquisition			$ 10,000
	Project Total				**$ 1,791,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Berry Creek Basin
Proposed Gravity Main Project: CR150

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	8-inch Wastewater Line (0-8ft depth)	2,197	LF	$ 78.72	$ 173,000
2	12-inch Wastewater Line (0-8ft depth)	3,864	LF	$ 118.08	$ 456,000
3	15-inch Wastewater Line (0-8ft depth)	4,232	LF	$ 147.60	$ 625,000
3	Additional Cost of >8ft Deep 12-inch Line	3,864	LF	$ 7.76	$ 30,000
4	Additional Cost of >8ft Deep 15-inch Line	4,232	LF	$ 15.68	$ 66,000
5	24-inch Bored Stream Crossing	100	LF	$ 1,261	$ 126,000
6	27-inch Bored Stream Crossing	100	LF	$ 1,419	$ 142,000
7	5-ft Diameter Manhole (0-8ft depth)	18	EA	$ 9,636.97	$ 173,000
8	6-ft Diameter Manhole (0-8ft depth)	12	EA	$ 12,901.65	$ 155,000
9	Additional Cost of >8ft Deep 5-ft Diameter Manhole	11	EA	$ 633.39	$ 7,000
10	Additional Cost of >8ft Deep 6-ft Diameter Manhole	12	EA	$ 1,370.47	$ 16,000
11	Trench Safety/Silt Fence	10,293	LF	$ 4.75	$ 49,000
12	Revegetation	10,293	LF	$ 7.00	$ 72,000
13	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
14	Tree Retention 8"	220	LF	$ 240.00	$ 53,000
15	Tree Retention 12"	386	LF	$ 288.00	$ 111,000
16	Tree Retention 15"	423	LF	$ 324.00	$ 137,000
17	Miscellaneous	1	LS	$ 479,000.00	$ 479,000
	Construction Subtotal				**$ 2,873,000**
	Bonds & Insurance				$ 86,000
	Mobilization/Demobilization				$ 144,000
	Contractor Overhead & Profit				$ 431,000
	Construction Total				**$ 3,534,000**
	Professional Services				$ 530,000
	Easements 20 Foot Permanent				$ 121,000
	25 Foot Permanent				$ 265,000
	35 Foot Permanent				$ 407,000
	40 Foot Temporary				$ 275,000
	Easement Acquisition				$ 42,720
	Project Total				**$ 5,175,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Berry Creek Basin
Proposed Gravity Main Project: CR152

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	8-inch Wastewater Line (0-8ft depth)	1,395	LF	$ 78.72	$ 110,000
2	10-inch Wastewater Line (0-8ft depth)	1,527	LF	$ 98.40	$ 150,000
3	12-inch Wastewater Line (0-8ft depth)	1,035	LF	$ 118.08	$ 122,000
4	15-inch Wastewater Line (0-8ft depth)	6,223	LF	$ 147.60	$ 919,000
5	18-inch Wastewater Line (0-8ft depth)	7,426	LF	$ 177.12	$ 1,315,000
6	21-inch Wastewater Line (0-8ft depth)	7,396	LF	$ 206.64	$ 1,528,000
7	5-ft Diameter Manhole (0-8ft depth)	14	EA	$ 9,636.97	$ 135,000
8	6-ft Diameter Manhole (0-8ft depth)	57	EA	$ 12,901.65	$ 735,000
9	Trench Safety/Silt Fence	25,001	LF	$ 4.75	$ 119,000
10	Revegetation	25,001	LF	$ 7.00	$ 175,000
11	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
12	Tree Retention 8"	139	LF	$ 240.00	$ 33,000
13	Tree Retention 10"	153	LF	$ 264.00	$ 40,000
14	Tree Retention 12"	103	LF	$ 288.00	$ 30,000
15	Tree Retention 15"	622	LF	$ 324.00	$ 202,000
16	Tree Retention 18"	743	LF	$ 360.00	$ 267,000
17	Tree Retention 21"	740	LF	$ 396.00	$ 293,000
18	Miscellaneous	1	LS	$ 1,235,000.00	$ 1,235,000
	Construction Subtotal				**$ 7,411,000**
	Bonds & Insurance				$ 222,000
	Mobilization/Demobilization				$ 371,000
	Contractor Overhead & Profit				$ 1,112,000
	Construction Total				**$ 9,116,000**
	Professional Services				$ 1,367,000
	Easements 20 Foot Permanent				$ 217,000
	25 Foot Permanent				$ 1,445,000
	40 Foot Temporary				$ 669,000
	Easement Acquistion				$ 93,240
	Project Total				**$ 12,907,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
San Gabriel Basin
Proposed Gravity Main Project: Hart-West St

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	15-inch Wastewater Line (0-8ft depth)	4,245	LF	$ 147.60	$ 627,000
2	Additional Cost of >8ft Deep 15-inch Line	4,245	LF	$ 22.70	$ 96,000
3	6-ft Diameter Manhole (0-8ft depth)	12	EA	$ 12,901.65	$ 155,000
4	Additional Cost of >8ft Deep 6-ft Diameter Manhole	12	EA	$ 1,567.84	$ 19,000
5	Trench Safety/Silt Fence	4,245	LF	$ 4.75	$ 20,000
6	Revegetation	4,245	LF	$ 7.00	$ 30,000
7	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
8	Tree Retention 15"	425	LF	$ 324.00	$ 138,000
9	Miscellaneous	1	LS	$ 218,000.00	$ 218,000
	Construction Subtotal				**$ 1,306,000**
	Bonds & Insurance				$ 39,000
	Mobilization/Demobilization				$ 65,000
	Contractor Overhead & Profit				$ 196,000
	Construction Total				**$ 1,606,000**
	Professional Services				$ 241,000
	Easements	35 Foot Permanent			$ 408,000
		40 Foot Temporary			$ 114,000
		Easement Acquisition			$ 21,000
	Project Total				**$ 2,390,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Dove Springs Basin
Proposed Gravity Main Project: MB-2

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	8-inch Wastewater Line (0-8ft depth)	2,488	LF	$ 78.72	$ 196,000
2	10-inch Wastewater Line (0-8ft depth)	1,400	LF	$ 98.40	$ 138,000
3	Additional Cost of >8ft Deep 10-inch Line	1,400	LF	$ 16.96	$ 24,000
4	5-ft Diameter Manhole (0-8ft depth)	13	EA	$ 9,636.97	$ 125,000
5	Additional Cost of >8ft Deep Manhole	5	EA	$ 1,660.95	$ 8,000
6	Trench Safety/Silt Fence	3,888	LF	$ 4.75	$ 18,000
7	Revegetation	3,888	LF	$ 7.00	$ 27,000
8	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
9	Tree Retention 8"	249	LF	$ 240.00	$ 60,000
10	Tree Retention 10"	140	LF	$ 264.00	$ 37,000
11	Miscellaneous	1	LS	$ 127,000.00	$ 127,000
	Construction Subtotal				**$ 763,000**
	Bonds & Insurance				$ 23,000
	Mobilization/Demobilization				$ 38,000
	Contractor Overhead & Profit				$ 114,000
	Construction Total				**$ 938,000**
	Professional Services				$ 141,000
	Easements	20 Foot Permanent			$ 137,000
		25 Foot Permanent			$ 96,000
		40 Foot Temporary			$ 104,000
		Easement Acquisition			$ 13,480
	Project Total				**$ 1,429,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
South Fork Basin
Proposed Gravity Main Project: MF-4

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	21-inch Wastewater Line (0-8ft depth)	17,188	LF	$ 206.64	$ 3,552,000
2	24-inch Wastewater Line (0-8ft depth)	4,889	LF	$ 298.85	$ 1,461,000
3	27-inch Wastewater Line (0-8ft depth)	6,410	LF	$ 336.20	$ 2,155,000
4	36-inch Wastewater Line (0-8ft depth)	1,421	LF	$ 448.27	$ 637,000
5	Additional Cost of >8ft Deep 24-inch Line	4,889	LF	$ 2.77	$ 14,000
6	Additional Cost of >8ft Deep 27-inch Line	6,410	LF	$ 24.40	$ 156,000
7	Additional Cost of >8ft Deep 36-inch Line	1,421	LF	$ 71.89	$ 102,000
8	39-inch Bored Stream Crossing	200	LF	$ 2,049	$ 410,000
9	Install in Rock	37,517	CY	$ 30.00	$ 1,126,000
10	6-ft Diameter Manhole (0-8ft depth)	76	EA	$ 12,901.65	$ 981,000
11	Additional Cost of >8ft Deep 6-ft Diameter Manhole	32	EA	$ 936.36	$ 30,000
12	8-ft Diameter Manhole (0-8ft depth)	5	EA	$ 24,554.57	$ 123,000
13	Additional Cost of >8ft Deep 8-ft Diameter Manhole	5	EA	$ 3,937.69	$ 20,000
14	Trench Safety/Silt Fence	29,907	LF	$ 4.75	$ 142,000
15	Revegetation	29,907	LF	$ 7.00	$ 209,000
16	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
17	Tree Retention 21"	1,719	LF	$ 396.00	$ 681,000
18	Tree Retention 24"	489	LF	$ 432.00	$ 211,000
19	Tree Retention 27"	641	LF	$ 468.00	$ 300,000
20	Tree Retention 36"	142	LF	$ 576.00	$ 82,000
21	Miscellaneous	1	LS	$ 2,479,000.00	$ 2,479,000
	Construction Subtotal				**$ 14,874,000**
	Bonds & Insurance				$ 446,000
	Mobilization/Demobilization				$ 744,000
	Contractor Overhead & Profit				$ 2,231,000
	Construction Total				**$ 18,295,000**
	Professional Services				$ 2,744,000
	Easements	25 Foot Permanent			$ 1,180,000
		35 Foot Permanent			$ 336,000
		50 Foot Permanent			$ 1,075,000
		40 Foot Temporary			$ 800,000
		Easement Acquisition			$ 135,640.00
	Project Total				**$ 24,566,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
South Fork Basin
Proposed Gravity Main Project: MF-6

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
1	8-inch Wastewater Line (0-8ft depth)	5,455	LF	$	78.72	$	429,000
2	Additional Cost of >8ft Deep 8-inch Line	5,455	LF	$	6.59	$	36,000
3	20-inch Bored Stream Crossing	200	LF	$	1,051	$	210,000
4	Install in Rock	5,635	CY	$	30.00	$	169,000
5	5-ft Diameter Manhole (0-8ft depth)	15	EA	$	9,636.97	$	145,000
6	Additional Cost of >8ft Deep 5-ft Diameter Manhole	15	EA	$	806.73	$	12,000
7	Trench Safety/Silt Fence	5,455	LF	$	4.75	$	26,000
8	Revegetation	5,455	LF	$	7.00	$	38,000
9	Traffic Control (Lump Sum)	1	LS	$	3,000.00	$	3,000
10	Tree Retention	546	LF	$	240.00	$	131,000
11	Miscellaneous	1	LS	$	240,000.00	$	240,000
	Construction Subtotal					**$**	**1,439,000**
	Bonds & Insurance					$	43,000
	Mobilization/Demobilization					$	72,000
	Contractor Overhead & Profit					$	216,000
	Construction Total					**$**	**1,770,000**
	Professional Services					$	266,000
	Easements	25 Foot Permanent				$	374,000
		40 Foot Temporary				$	146,000
		Easement Acquisition				$	20,800.00
	Project Total					**$**	**2,577,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Smith Branch Basin
Proposed Gravity Main Project: West-Mid Div

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	8-inch Wastewater Line (0-8ft depth)	3,663	LF	$ 78.72	$ 288,000
2	12-inch Wastewater Line (0-8ft depth)	3,321	LF	$ 118.08	$ 392,000
3	Additional Cost of >8ft Deep 8-inch Line	3,663	LF	$ 15.77	$ 58,000
4	Additional Cost of >8ft Deep 12-inch Line	3,321	LF	$ 44.32	$ 147,000
5	20-inch Bored Road Crossing	100	LF	$ 1,051	$ 105,000
6	20-inch Bored Highway Crossing	400	LF	$ 1,051	$ 420,000
7	5-ft Diameter Manhole (0-8ft depth)	21	EA	$ 9,636.97	$ 202,000
8	Additional Cost of >8ft Deep 5-ft Diameter Manhole	21	EA	$ 2,840.35	$ 60,000
9	Trench Safety/Silt Fence	6,983	LF	$ 4.75	$ 33,000
10	Revegetation	6,983	LF	$ 7.00	$ 49,000
11	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
12	Tree Retention 8"	366	LF	$ 240.00	$ 88,000
13	Tree Retention 12"	332	LF	$ 288.00	$ 96,000
14	Miscellaneous	1	LS	$ 388,000.00	$ 388,000
	Construction Subtotal				**$ 2,329,000**
	Bonds & Insurance				$ 70,000
	Mobilization/Demobilization				$ 116,000
	Contractor Overhead & Profit				$ 349,000
	Construction Total				**$ 2,864,000**
	Professional Services				$ 430,000
	Easements	25 Foot Permanent			$ 479,000
		40 Foot Temporary			$ 187,000
		Easement Acquisition			$ 27,000
	Project Total				**$ 3,987,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
South Fork Basin
Cimarron Hills Lift Station and Force Main
Proposed Lift Station and Force Main Project: CH-LS

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	10-inch Force Main	5,866	LF	$ 120.00	$ 704,000
2	18-inch Wastewater Line (0-8ft depth)	253	LF	$ 177.12	$ 45,000
3	Additional Cost of >8ft Deep 18-inch Line	253	LF	$ 9.37	$ 2,000
4	6-ft Diameter Manhole (0-8ft depth)	2	EA	$ 12,901.65	$ 26,000
5	Additional Cost of >8ft Deep 6-ft Diameter Manhole	2	EA	$ 682.59	$ 1,000
6	Install in Rock	4,005	CY	$ 30.00	$ 120,000
7	Trench Safety/Silt Fence	6,119	LF	$ 4.75	$ 29,000
8	Revegetation	6,119	LF	$ 7.00	$ 43,000
9	Traffic Control (Lump Sum)	1	LS	$ 15,000.00	$ 15,000
10	Tree Retention 10"	587	LF	$ 264.00	$ 155,000
11	Tree Retention 18"	25	LF	$ 360.00	$ 9,000
12	1.8 mgd Lift Station	1.8	MGD	$ 750,000.00	$ 1,350,000
13	Miscellaneous	1	LS	$ 500,000.00	$ 500,000
	Construction Subtotal				**$ 2,999,000**
	Bonds & Insurance				$ 90,000
	Mobilization/Demobilization				$ 150,000
	Contractor Overhead & Profit				$ 450,000
	Construction Total				**$ 3,689,000**
	Professional Services				$ 553,000
	Easements	20 Foot Permanent			$ 322,000
		35 Foot Permanent			$ 24,000
		40 Foot Temporary			$ 164,000
		Easement Acquisition			$ 20,000
	Project Total				**$ 4,772,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
South Fork Basin
North Fork Lift Station and Force Main
Proposed Lift Station and Force Main Project: MF-LS

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
1	8-inch Force Main	2,458	LF	$	96.00	$	236,000
2	Install in Rock	1,821	CY	$	30.00	$	55,000
3	Trench Safety/Silt Fence	2,458	LF	$	4.75	$	12,000
4	Revegetation	2,458	LF	$	7.00	$	17,000
5	Traffic Control (Lump Sum)	1	LS	$	3,000.00	$	3,000
6	Tree Retention 12"	246	LF	$	240.00	$	59,000
7	2 mgd Lift Station	2.00	MGD	$	750,000.00	$	1,500,000
8	Future 1 mgd Expansion	1	LS	$	750,000.00	$	750,000
9	Miscellaneous	1	LS	$	526,000.00	$	526,000
	Construction Subtotal					**$**	**3,158,000**
	Bonds & Insurance					$	95,000
	Mobilization/Demobilization					$	158,000
	Contractor Overhead & Profit					$	474,000
	Construction Total					**$**	**3,885,000**
	Professional Services					$	583,000
	Easements	20 Foot Permanent				$	135,000
		40 Foot Temporary				$	66,000
		Easement Acquisition				$	8,000
	Project Total					**$**	**4,677,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: Near-Term CIP
South Fork Basin
Middle Fork Lift Station and Force Main
Proposed Lift Station and Force Main Project: MF-LS2

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	8-inch Force Main	3,483	LF	$ 96.00	$ 334,000
2	Install in Rock	2,580	CY	$ 30.00	$ 77,000
3	Trench Safety/Silt Fence	3,483	LF	$ 4.75	$ 17,000
4	Revegetation	3,483	LF	$ 7.00	$ 24,000
5	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
6	Tree Retention 8"	348	LF	$ 240.00	$ 84,000
7	1.5 mgd Lift Station	2.5	MGD	$ 750,000.00	$ 1,875,000
8	Future 10.5 mgd Expansion	1.0	LS	$ 937,500.00	$ 937,500
9	Miscellaneous	1	LS	$ 670,000.00	$ 670,000
	Construction Subtotal				**$ 4,021,500**
	Bonds & Insurance				$ 121,000
	Mobilization/Demobilization				$ 201,000
	Contractor Overhead & Profit				$ 603,000
	Construction Total				**$ 4,946,500**
	Professional Services				$ 742,000
	Easements	20 Foot Permanent			$ 191,000
		40 Foot Temporary			$ 93,000
		Easement Acquisition			$ 11,000
	Project Total				**$ 5,984,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: Near-Term CIP
Northlands Basin
Cowan Creek Lift Station and Force Main
Proposed Lift Station and Force Main Project: CC-LS

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	24-inch Force Main	2,201	LF	$ 288.00	$ 634,000
2	Trench Safety/Silt Fence	2,201	LF	$ 4.75	$ 10,000
3	Revegetation	2,201	LF	$ 7.00	$ 15,000
4	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
5	Tree Retention	220	LF	$ 432.00	$ 95,000
6	5.6 mgd Lift Station	5.6	MGD	$ 750,000.00	$ 4,200,000
7	Future 13 mgd Expansion	1	LS	$ 2,100,000.00	$ 2,100,000
8	Miscellaneous	1	LS	$ 991,000.00	$ 991,000
	Construction Subtotal				**$ 8,048,000**
	Bonds & Insurance				$ 241,000
	Mobilization/Demobilization				$ 402,000
	Contractor Overhead & Profit				$ 1,207,000
	Construction Total				**$ 9,898,000**
	Professional Services				$ 1,485,000
	Easements	25 Foot Permanent			$ 151,000
		40 Foot Temporary			$ 1,000
		Easement Acquisition			$ 6,000
		Project Total			**$ 11,541,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: Near-Term CIP
San Gabriel East Basin
San Gabriel-Pecan Branch Interceptor Lift Station and Force Main
Proposed Lift Station and Force Main Project: SGI-PB-LS

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	30-inch Force Main	5,600	LF	$ 360.00	$ 2,016,000
2	42-inch Bored Road Crossing	100	LF	$ 2,206.68	$ 221,000
3	Trench Safety/Silt Fence	5,600	LF	$ 4.75	$ 27,000
4	Revegetation	5,600	LF	$ 7.00	$ 39,000
5	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
6	Tree Retention 30"	560	LF	$ 504.00	$ 282,000
7	13 mgd Lift Station	13	MGD	$ 750,000.00	$ 9,750,000
8	Future 33 mgd Expansion	1	LS	$ 4,875,000.00	$ 4,875,000
9	Miscellaneous	1	LS	$ 3,443,000.00	$ 3,443,000
	Construction Subtotal				**$ 20,656,000**
	Bonds & Insurance				$ 620,000
	Mobilization/Demobilization				$ 1,033,000
	Contractor Overhead & Profit				$ 3,098,000
	Construction Total				**$ 25,407,000**
	Professional Services				$ 3,811,000
	Easements	40 Foot Permanent			$ 615,000
		40 Foot Temporary			$ 150,000
		Easement Acquisition			$ 31,000
	Project Total				**$ 30,014,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Maknins Basin
Mankins West Lift Station and Force Main
Proposed Lift Station and Force Main Project: Mankins LS West

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
1	8-inch Force Main	9,383	LF	$	96.00	$	901,000
2	20-inch Bored Highway Crossing	400	LF	$	1,050.80	$	420,000
3	Trench Safety/Silt Fence	9,383	LF	$	4.75	$	45,000
4	Revegetation	9,383	LF	$	7.00	$	66,000
5	Traffic Control (Lump Sum)	1	LS	$	3,000.00	$	3,000
6	Tree Retention	938	LF	$	240.00	$	225,000
7	1.8 mgd Lift Station	1.8	MGD	$	750,000.00	$	1,350,000
8	Miscellaneous	1	LS	$	602,000.00	$	602,000
	Construction Subtotal					**$**	**3,612,000**
	Bonds & Insurance					$	108,000
	Mobilization/Demobilization					$	181,000
	Contractor Overhead & Profit					$	542,000
	Construction Total					**$**	**4,443,000**
	Professional Services					$	666,000
	Easements	20 Foot Permanent				$	515,000
		40 Foot Temporary				$	251,000
		Easement Acquisition				$	31,000
		Project Total				**$**	**5,906,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Northlands Lift Station and Force Main
Proposed Lift Station and Force Main Project: NL-LS

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	36-inch Force Main	3,279	LF	$ 432.00	$ 1,417,000
2	54-inch Wastewater Line (0-8ft depth)	253	LF	$ 672.41	$ 170,000
3	Additional Cost of >8ft Deep 54-inch Line	253	LF	$ 35.58	$ 9,000
4	Box Manhole (0-8ft depth)	2	EA	$ 35,238.12	$ 70,000
5	Additional Cost of >8ft Deep Box Manhole	2	EA	$ 1,864.35	$ 4,000
6	Install in Rock	4,223	CY	$ 30.00	$ 127,000
7	Trench Safety/Silt Fence	3,533	LF	$ 4.75	$ 17,000
8	Revegetation	3,533	LF	$ 7.00	$ 25,000
9	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
10	Tree Retention 36"	328	LF	$ 576.00	$ 189,000
11	Tree Retention 54"	25	LF	$ 792.00	$ 20,000
12	1.2 mgd Lift Station	1.2	MGD	$ 750,000.00	$ 900,000
13	Future 23 mgd LS Expansion	1.0	LS	$ 450,000.00	$ 450,000
	Miscellaneous	1	LS	$ 680,000.00	$ 680,000
	Construction Subtotal				**$ 4,081,000**
	Bonds & Insurance				$ 122,000
	Mobilization/Demobilization				$ 204,000
	Contractor Overhead & Profit				$ 612,000
	Construction Total				**$ 5,019,000**
	Professional Services				$ 753,000
	Easements	40 Foot Permanent			$ 360,000
		50 Foot Permanent			$ 35,000
		40 Foot Temporary			$ 94,000
		Easement Acquisition			$ 20,000
		Project Total			**$ 6,281,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Maknins Basin
Mankins East Lift Station and Force Main
Proposed Lift Station and Force Main Project: Mankins LS East

Item No.	Item Description	Quantity	Unit		Unit Cost		Total Cost
1	12-inch Force Main	16,278	LF	$	144.00	$	2,344,000
2	24-inch Bored Highway Crossing	400	LF	$	1,260.96	$	504,000
3	Trench Safety/Silt Fence	16,278	LF	$	4.75	$	77,000
4	Revegetation	16,278	LF	$	7.00	$	114,000
5	Traffic Control (Lump Sum)	1	LS	$	3,000.00	$	3,000
6	Tree Retention 12'	1,628	LF	$	288.00	$	469,000
7	0.1 mgd Lift Station	0.1	MGD	$	750,000.00	$	75,000
8	Future LS Expansion	1	LS	$	37,500.00	$	37,500
9	Miscellaneous	1	LS	$	725,000.00	$	725,000
	Construction Subtotal					**$**	**4,348,500**
	Bonds & Insurance					$	130,000
	Mobilization/Demobilization					$	217,000
	Contractor Overhead & Profit					$	652,000
	Construction Total					**$**	**5,347,500**
	Professional Services					$	802,000
	Easements	20 Foot Permanent				$	894,000
		40 Foot Temporary				$	435,000
		Easement Acquisition				$	53,000
		Project Total				**$**	**7,532,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Lake West Lift Station and Force Main
Proposed Lift Station and Force Main Project: LakeW-LS

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	12-inch Force Main	6,999	LF	$ 144.00	$ 1,008,000
2	24-inch Wastewater Line (0-8ft depth)	253	LF	$ 298.85	$ 76,000
3	Additional Cost of >8ft Deep 24-inch Line	253	LF	$ 15.81	$ 4,000
4	6-ft Diameter Manhole (0-8ft depth)	2	EA	$ 12,901.65	$ 26,000
5	Additional Cost of >8ft Deep 6-ft Diameter Manhole	2	EA	$ 682.59	$ 1,000
6	Install in Rock	5,023	CY	$ 30.00	$ 151,000
7	Trench Safety/Silt Fence	7,253	LF	$ 4.75	$ 34,000
8	Revegetation	7,253	LF	$ 7.00	$ 51,000
9	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
10	Tree Retention 12"	700	LF	$ 288.00	$ 202,000
11	Tree Retention 24"	25	LF	$ 432.00	$ 11,000
12	0.8 mgd Lift Station	0.8	MGD	$ 750,000.00	$ 600,000
13	Future 2.1 mgd LS Expansion	1.0	LS	$ 300,000.00	$ 300,000
14	Miscellaneous	1	LS	$ 493,000.00	$ 493,000
	Construction Subtotal				**$ 2,960,000**
	Bonds & Insurance				$ 89,000
	Mobilization/Demobilization				$ 148,000
	Contractor Overhead & Profit				$ 444,000
	Construction Total				**$ 3,641,000**
	Professional Services				$ 546,000
	Easements	20 Foot Permanent			$ 384,000
		50 Foot Permanent			$ 35,000
		40 Foot Temporary			$ 194,000
		Easement Acquisition			$ 25,000
	Project Total				**$ 4,825,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands Basin
Ronald Reagan Lift Station and Force Main West
Proposed Lift Station and Force Main Project: RRW-LS

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	16-inch Force Main	7,040	LF	$ 192.00	$ 1,352,000
2	30-inch Wastewater Line (0-8ft depth)	253	LF	$ 373.56	$ 95,000
3	Additional Cost of >8ft Deep 30-inch Line	253	LF	$ 112.47	$ 28,000
4	6-ft Diameter Manhole (0-8ft depth)	2	EA	$ 12,901.65	$ 26,000
5	Additional Cost of >8ft Deep 6-ft Diameter Manhole	2	EA	$ 3,884.30	$ 8,000
6	Install in Rock	6,027	CY	$ 30.00	$ 181,000
7	28-inch Bored Road Crossing	100	LF	$ 1,471.12	$ 147,000
8	Trench Safety/Silt Fence	7,293	LF	$ 4.75	$ 35,000
9	Revegetation	7,293	LF	$ 7.00	$ 51,000
10	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
11	Tree Retention 16"	704	LF	$ 336.00	$ 237,000
12	Tree Retention 30"	25	LF	$ 504.00	$ 13,000
13	1.7 mgd Lift Station	1.7	MGD	$ 750,000.00	$ 1,275,000
14	Future 2.9 mgd LS Expansion	1.0	LS	$ 637,500.00	$ 638,000
15	Miscellaneous	1	LS	$ 818,000.00	$ 818,000
	Construction Subtotal				**$ 4,907,000**
	Bonds & Insurance				$ 147,000
	Mobilization/Demobilization				$ 245,000
	Contractor Overhead & Profit				$ 736,000
	Construction Total				**$ 6,035,000**
	Professional Services				$ 905,000
	Easements	25 Foot Permanent			$ 483,000
		50 Foot Permanent			$ 35,000
		40 Foot Temporary			$ 195,000
		Easement Acquisition			$ 29,000
	Project Total				**$ 7,682,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
South Fork Basin
South ETJ Lift Station and Force Main
Proposed Lift Station and Force Main Project: SETJ-01

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	10-inch Force Main	8,173	LF	$ 120.00	$ 981,000
2	15-inch Wastewater Line (0-8ft depth)	253	LF	$ 147.60	$ 37,000
3	Additional Cost of >8ft Deep 15-inch Line	253	LF	$ 7.81	$ 2,000
4	6-ft Diameter Manhole (0-8ft depth)	2	EA	$ 12,901.65	$ 26,000
5	Additional Cost of >8ft Deep 6-ft Diameter Manhole	2	EA	$ 682.59	$ 1,000
6	Install in Rock	6,293	CY	$ 30.00	$ 189,000
7	Trench Safety/Silt Fence	8,427	LF	$ 4.75	$ 40,000
8	Revegetation	8,427	LF	$ 7.00	$ 59,000
9	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
10	Tree Retention 10"	817	LF	$ 264.00	$ 216,000
11	Tree Retention 15"	25	LF	$ 324.00	$ 8,000
12	0.2 mgd Lift Station	0.2	MGD	$ 750,000.00	$ 150,000
13	Future 2.3 mgd LS Expansion	1.0	LS	$ 75,000.00	$ 75,000
14	Miscellaneous	1	LS	$ 357,000.00	$ 357,000
	Construction Subtotal				**$ 2,144,000**
	Bonds & Insurance				$ 64,000
	Mobilization/Demobilization				$ 107,000
	Contractor Overhead & Profit				$ 322,000
	Construction Total				**$ 2,637,000**
	Professional Services				$ 396,000
	Easements	20 Foot Permanent			$ 449,000
		35 Foot Permanent			$ 24,000
		40 Foot Temporary			$ 225,000
		Easement Acquisition			$ 28,000
	Project Total				**$ 3,759,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
South Fork Basin
Middle Fork Lift Station and Force Main
Proposed Lift Station and Force Main Project: MF-LS3

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	4-inch Force Main	2,517	LF	$ 48.00	$ 121,000
2	Install in Rock	1,523	CY	$ 30.00	$ 46,000
3	Trench Safety/Silt Fence	2,517	LF	$ 4.75	$ 12,000
4	Revegetation	2,517	LF	$ 7.00	$ 18,000
5	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
6	Tree Retention	252	LF	$ 192.00	$ 48,000
7	0.3 mgd Lift Station	0.3	MGD	$ 750,000.00	$ 225,000
8	Miscellaneous	1	LS	$ 95,000.00	$ 95,000
	Construction Subtotal				**$ 568,000**
	Bonds & Insurance				$ 17,000
	Mobilization/Demobilization				$ 28,000
	Contractor Overhead & Profit				$ 85,000
	Construction Total				**$ 698,000**
	Professional Services				$ 105,000
	Easements	20 Foot Permanent			$ 138,000
		40 Foot Temporary			$ 67,000
		Easement Acquisition			$ 8,000
	Project Total				**$ 1,016,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northalnds Basin
Ronald Reagan Lift Station and Force Main East
Proposed Lift Station and Force Main Project: RRE-LS

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	10-inch Force Main	2,630	LF	$ 120.00	$ 316,000
2	15-inch Wastewater Line (0-8ft depth)	15	LF	$ 147.60	$ 2,000
3	Additional Cost of >8ft Deep 15-inch Line	253	LF	$ 7.81	$ 2,000
4	6-ft Diameter Manhole (0-8ft depth)	2	EA	$ 12,901.65	$ 26,000
5	Additional Cost of >8ft Deep 6-ft Diameter Manhole	2	EA	$ 682.59	$ 1,000
6	Install in Rock	1,946	CY	$ 30.00	$ 58,000
7	Trench Safety/Silt Fence	2,645	LF	$ 4.75	$ 13,000
8	Revegetation	2,645	LF	$ 7.00	$ 19,000
9	Traffic Control (Lump Sum)	1	LS	$ 3,000.00	$ 3,000
10	Tree Retention 10"	263	LF	$ 264.00	$ 69,000
11	Tree Retention 15"	2	LF	$ 324.00	$ 486
12	0.4 mgd Lift Station	0.4	MGD	$ 750,000.00	$ 300,000
13	Future 1.1 mgd LS Expansion	1.0	LS	$ 150,000.00	$ 150,000
	Miscellaneous	1	LS	$ 192,000.00	$ 192,000
	Construction Subtotal				**$ 1,151,486**
	Bonds & Insurance				$ 35,000
	Mobilization/Demobilization				$ 58,000
	Contractor Overhead & Profit				$ 173,000
	Construction Total				**$ 1,417,486**
	Professional Services				$ 213,000
	Easements	20 Foot Permanent			$ 144,000
		35 Foot Permanent			$ 24,000
		40 Foot Temporary			$ 77,000
		Easement Acquisition			$ 10,000
		Project Total			**$ 1,885,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Northlands WWTP
New WWTP (2 MGD): NL WWTP

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	New 1.5 mgd Plant	1.5	MGD	$ 13,000,000	$ 19,500,000
2	Miscellaneous	1	LS	$ 1,950,000	$ 1,950,000
		Construction Subtotal			**$21,450,000**
		Bonds & Insurance			$ 644,000
		Mobilization/Demobilization			$ 1,073,000
		Contractor Overhead & Profit			$ 3,218,000
		Construction Total			**$ 26,385,000**
		Professional Services			$ 3,958,000
		Project Total			**$ 30,343,000**

Georgetown Utility Systems
2022 Wastewater Master Plan: 10-Year CIP
Pecan Branch/Three Forks
WWTP Expansion (10.5 mgd): PBWWTP

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	10.5 MGD New Plant	10.5	MGD	$ 13,000,000	$ 136,500,000
2	Miscellaneous	1	LS	$ 13,650,000	$ 13,650,000
		Construction Subtotal			**$ 150,150,000**
		Bonds & Insurance			$ 4,505,000
		Mobilization/Demobilization			$ 7,508,000
		Contractor Overhead & Profit			$ 22,523,000
		Construction Total			**$ 184,686,000**
		Professional Services			$ 27,703,000
		Project Total			**$ 212,389,000**

Appendix E

Wastewater Capital Improvement Profiles

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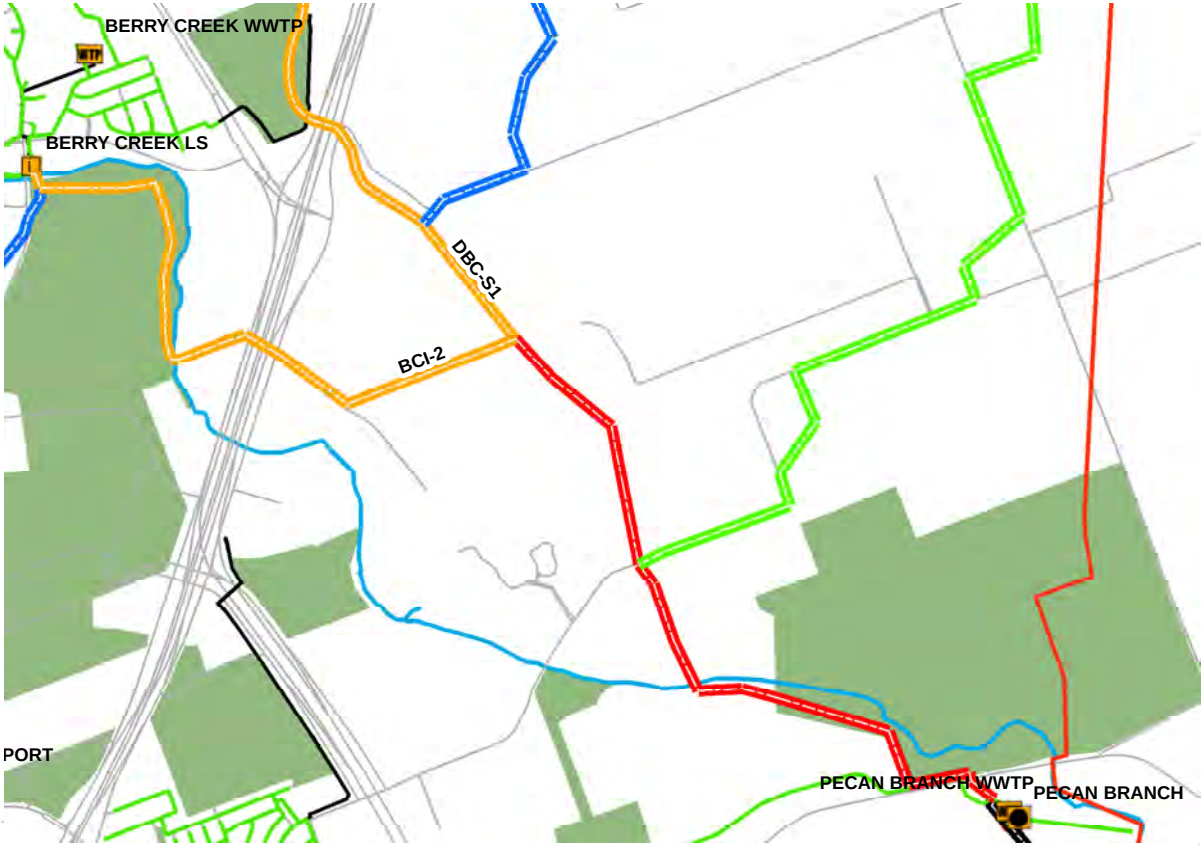
Figure E-1 Profile for BCI-2

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



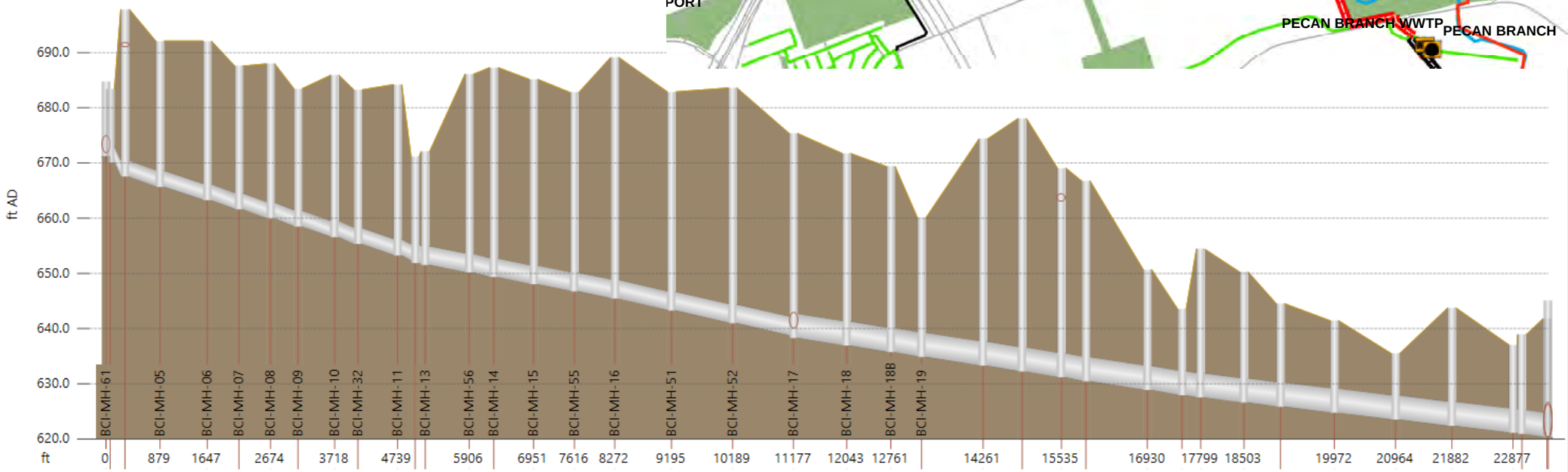


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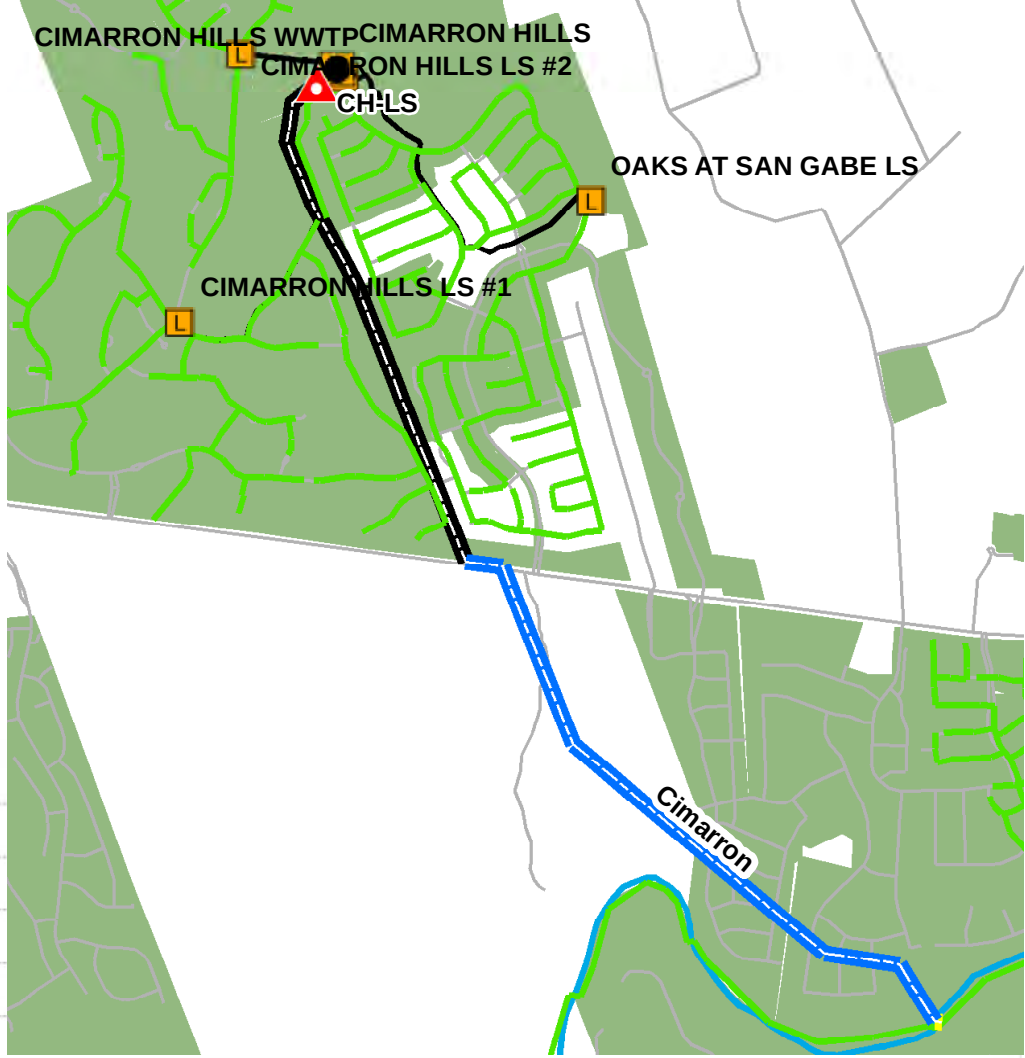
Figure E-2 Profile for Cimarron

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



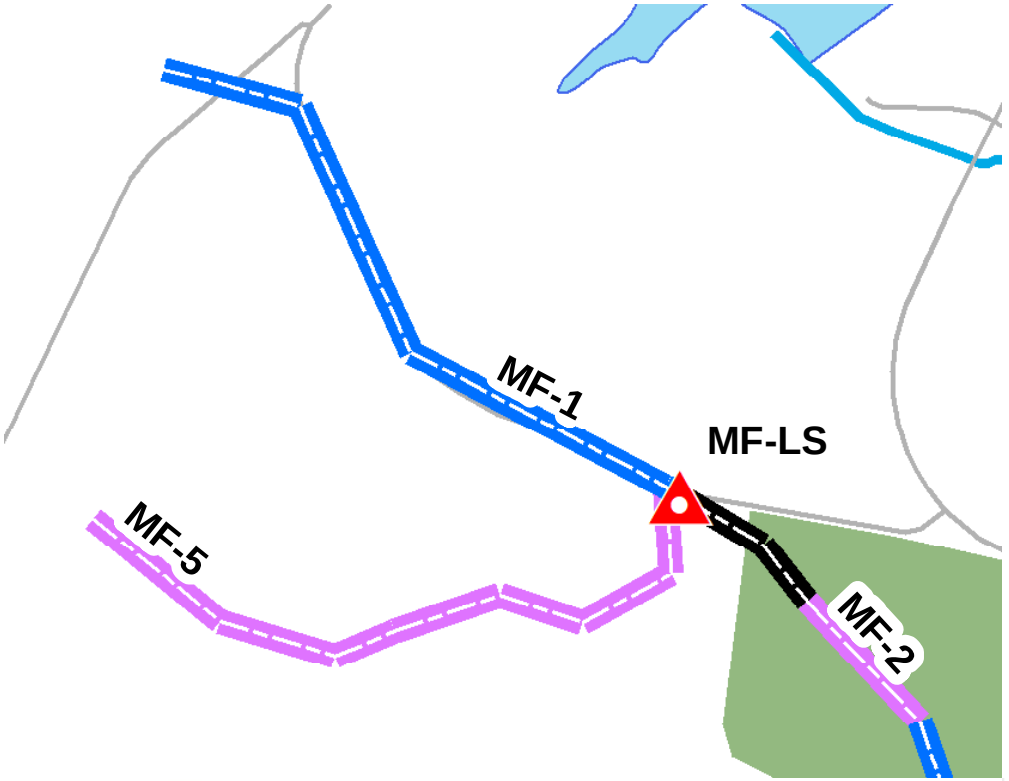


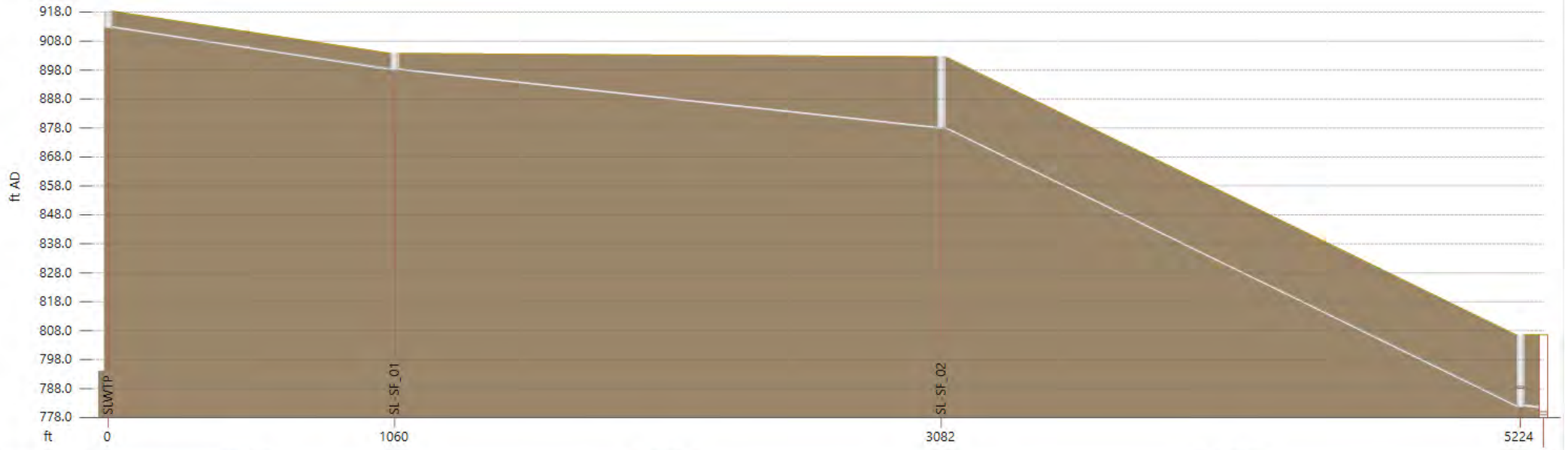
Link	Cimarron-01.1	Cimarron-02.1	Cimarron-03.1	Cimarron-04.1	Cimarron-05.1
length (ft)	1696.4	2137.0	3633.6	849.0	737.7
width (in)	12.0	12.0	12.0	15.0	15.0
us inv (ft AD)	960.000	932.900	846.900	769.900	764.900
ds inv (ft AD)	933.000	847.000	770.000	765.000	755.290
grad (%)	1.592	4.020	2.116	0.577	1.303
pfc (MGD)	2.91	4.62	3.35	3.17	4.77

Node	Cimarron-01	Cimarron-02	Cimarron-03	Cimarron-04	Cimarron-05	-
ground (ft AD)	970.000	938.000	853.000	775.000	770.000	-

Figure E-3 Profile for MF-1

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



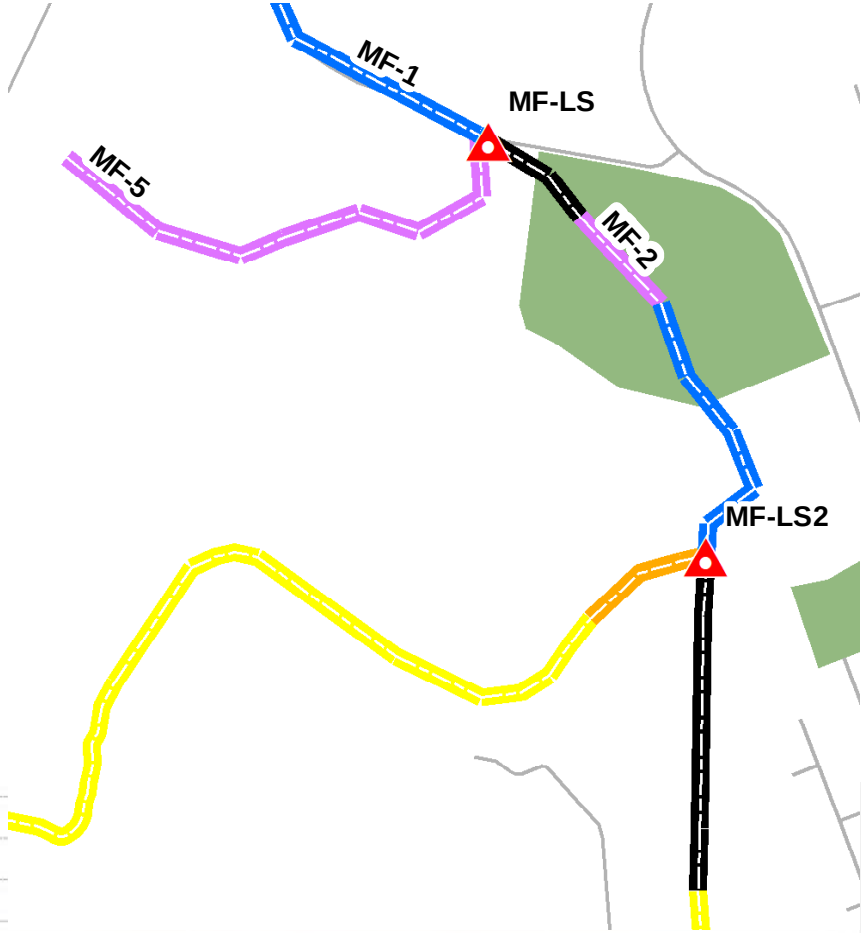


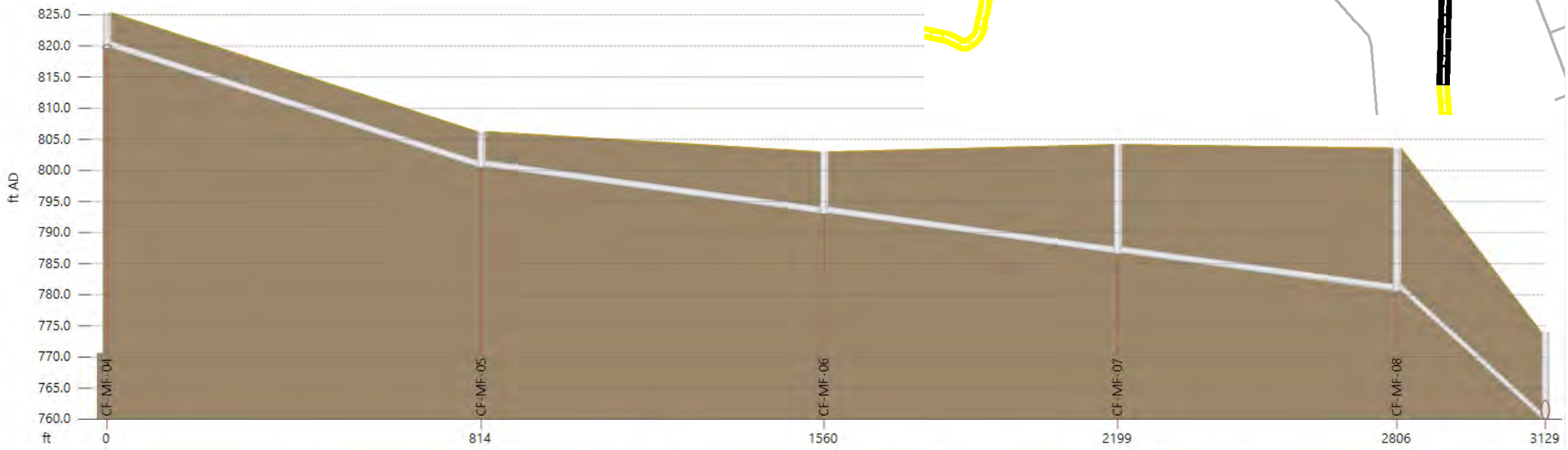
Link	SLWTP.1	SL-SF_01.1	SL-SF_02.1	-
length (ft)	1059.5	2022.1	2142.4	-
width (in)	12.0	12.0	12.0	-
us inv (ft AD)	912.363	897.806	877.585	-
ds inv (ft AD)	897.806	877.585	781.529	-
grad (%)	1.374	1.000	4.484	-
pfc (MGD)	2.70	2.30	4.88	-

Node	SLWTP	SL-SF_01	SL-SF_02	SL-SF_03a
ground (ft AD)	918.310	903.753	902.585	806.529

Figure E-4 Profile for MF-2

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



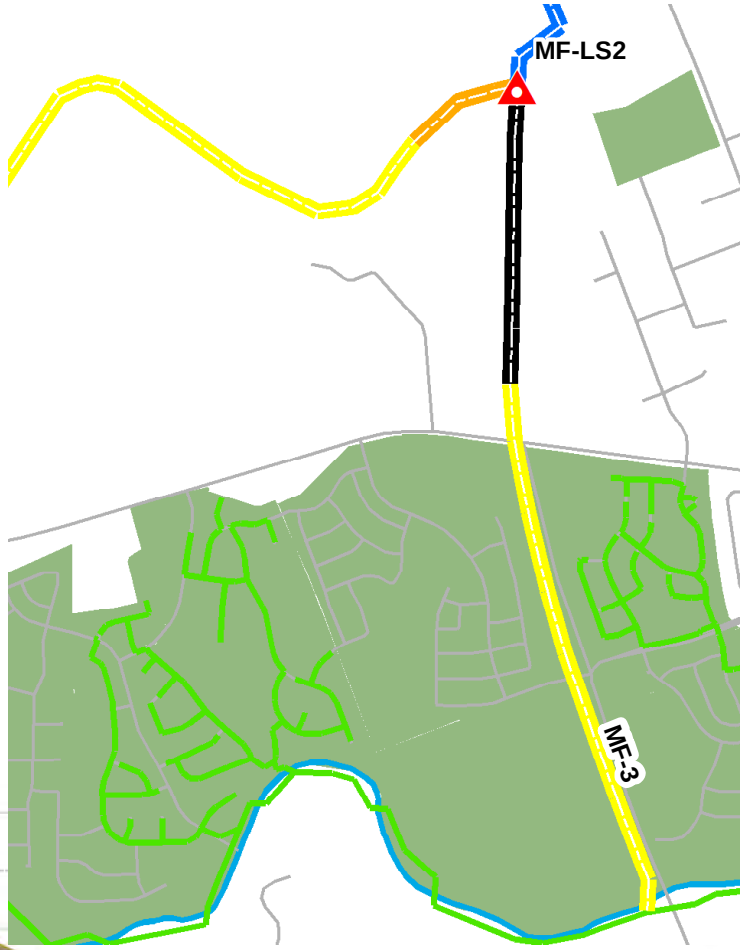


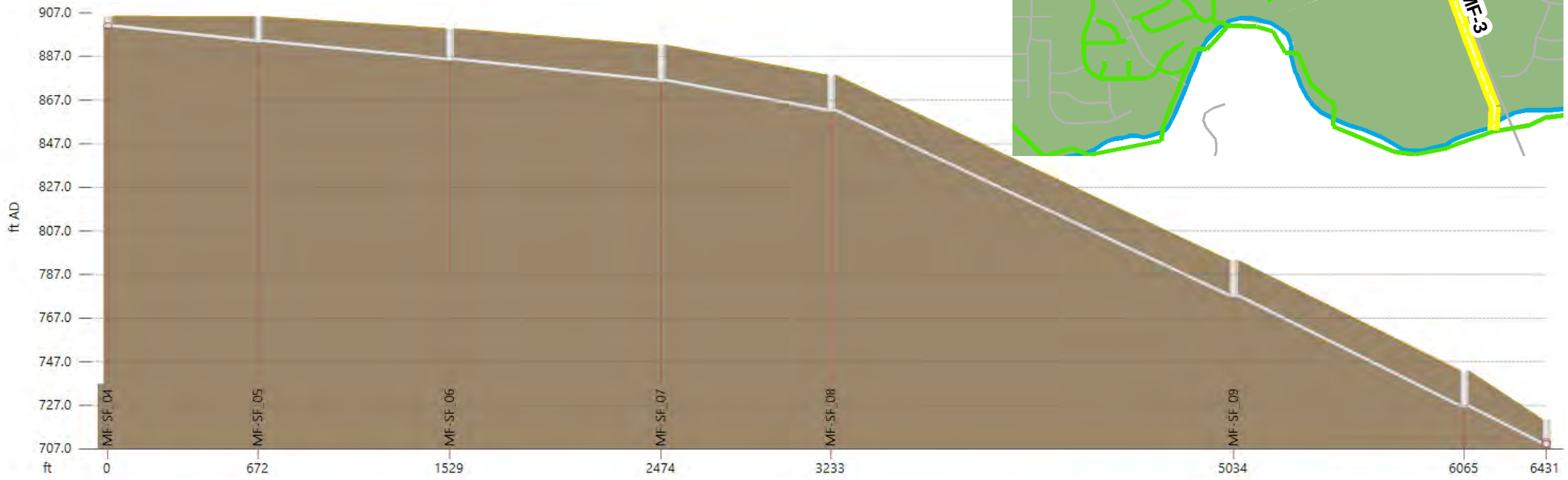
Link	CF-MF-04.1	CF-MF-05.1	CF-MF-06.1	CF-MF-07.1	CF-MF-08.1
length (ft)	814.4	745.4	639.1	607.4	322.9
width (in)	15.0	15.0	15.0	15.0	15.0
us inv (ft AD)	819.606	800.482	793.028	786.637	780.563
ds inv (ft AD)	800.482	793.028	786.637	780.563	760.100
grad (%)	2.348	1.000	1.000	1.000	6.337
pfc (MGD)	6.40	4.18	4.18	4.18	10.51

Node	CF-MF-04	CF-MF-05	CF-MF-06	CF-MF-07	CF-MF-08	-
ground (ft AD)	825.351	806.227	802.963	804.140	803.563	774.000

Figure E-5 Profile for MF-3

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



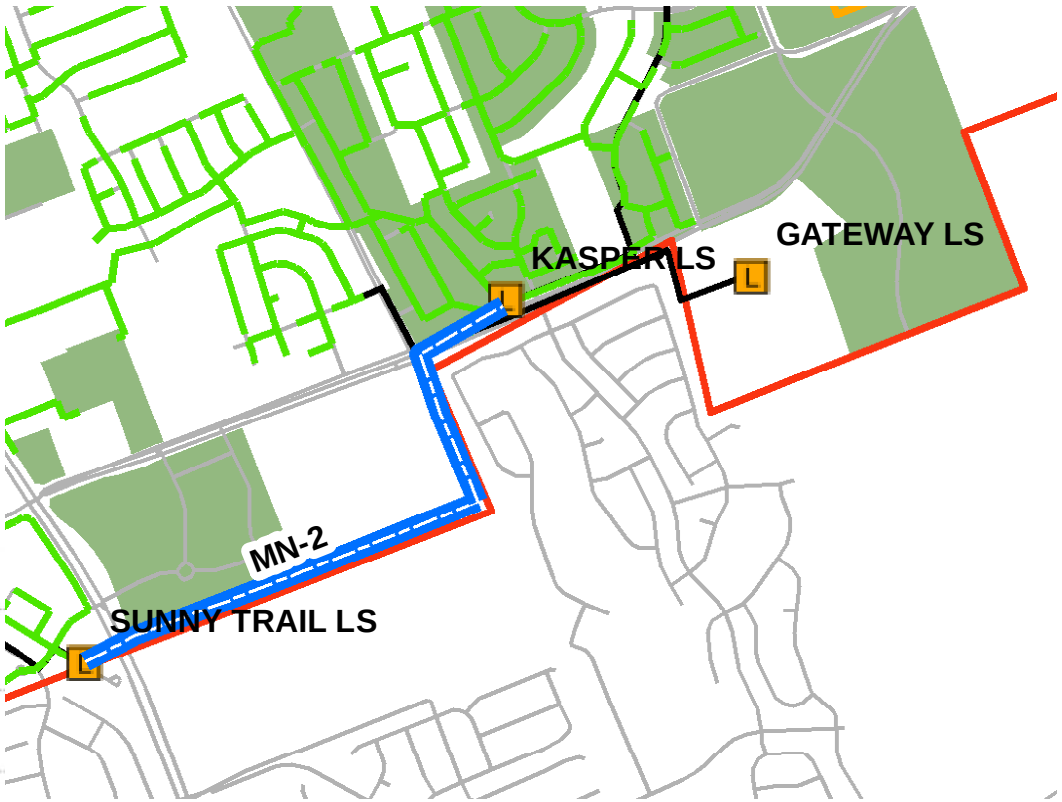


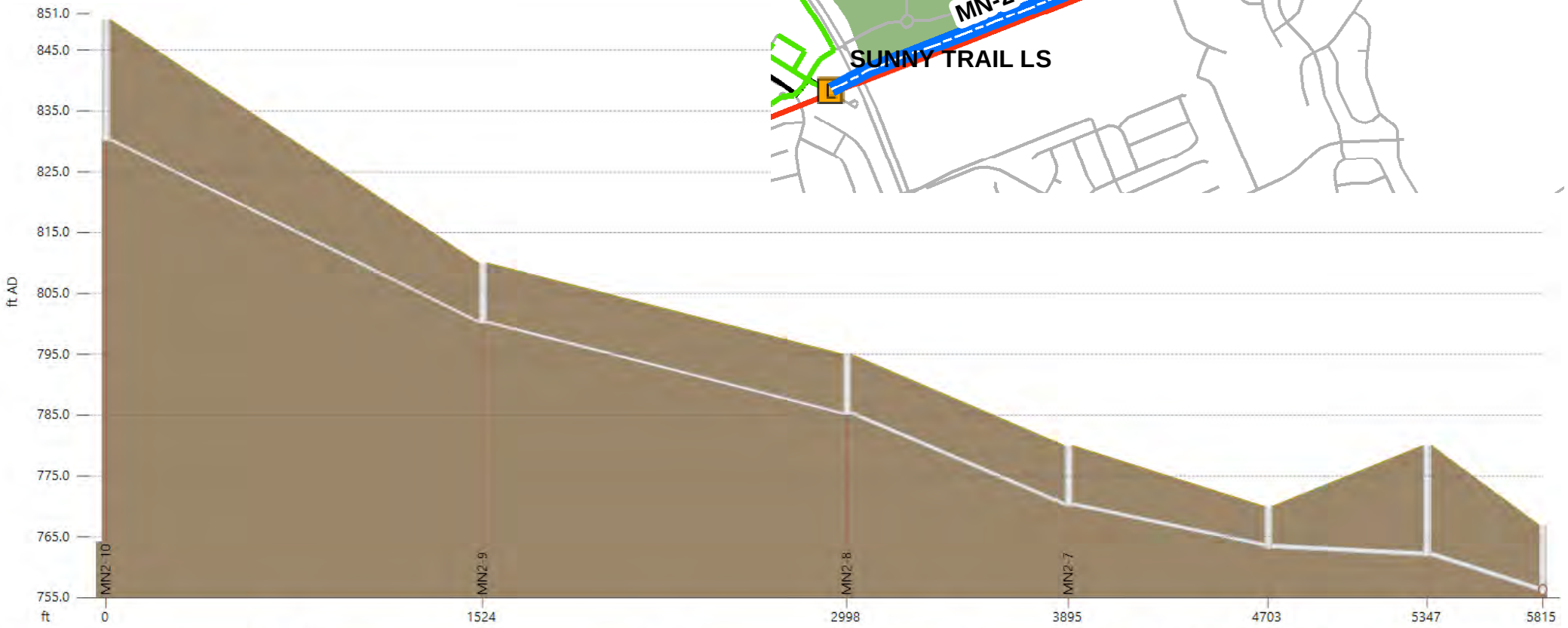
Link	MF-SF_04.1	MF-SF_05.1	MF-SF_06.1	MF-SF_07.1	MF-SF_08.1	MF-SF_09.1	MF-SF_10.1
length (ft)	672.0	857.2	944.6	759.4	1800.5	1030.8	366.6
width (in)	24.0	24.0	24.0	24.0	24.0	24.0	24.0
us inv (ft AD)	900.132	893.257	884.901	875.182	861.478	776.458	725.946
ds inv (ft AD)	893.257	884.901	875.182	861.478	776.458	725.946	708.740
grad (%)	1.023	0.975	1.029	1.804	4.722	4.900	4.693
pfc (MGD)	14.79	14.44	14.83	19.64	31.78	32.37	31.68

Node	MF-SF_04	MF-SF_05	MF-SF_06	MF-SF_07	MF-SF_08	MF-SF_09	MF-SF_10	-
ground (ft AD)	905.440	905.233	899.682	892.182	878.478	793.458	742.946	-

Figure E-6 Profile for MN-2

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)





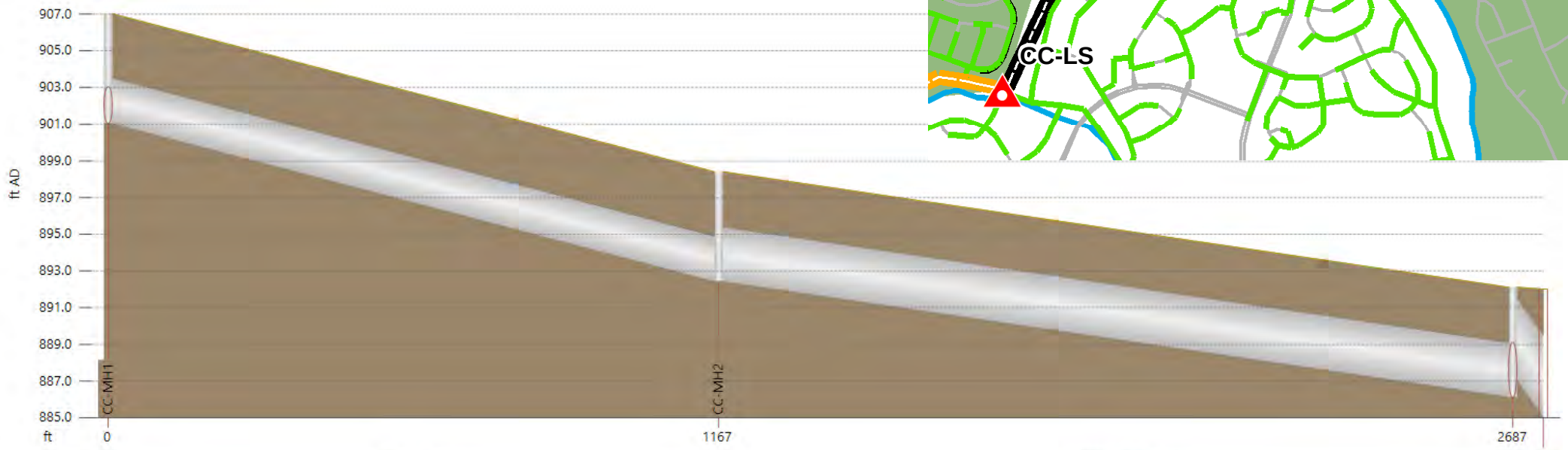
Link	MN2-10.1	MN2-9.1	MN2-8.1	MN2-7.1	MN2-6.1	MN2-5.1
length (ft)	1524.3	1474.2	896.2	808.5	643.9	467.5
width (in)	8.0	8.0	10.0	10.0	12.0	12.0
us inv (ft AD)	830.000	800.000	785.000	770.000	763.000	761.712
ds inv (ft AD)	800.000	785.000	770.000	763.333	761.712	756.000
grad (%)	1.968	1.018	1.674	0.825	0.200	1.222
pfc (MGD)	1.10	0.79	1.83	1.29	1.03	2.55

Node	MN2-10	MN2-9	MN2-8	MN2-7	MN2-6	MN2-5	-
ground (ft AD)	850.000	810.000	795.000	780.000	770.000	780.000	-

Figure E-7 Profile for NL-Gr

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



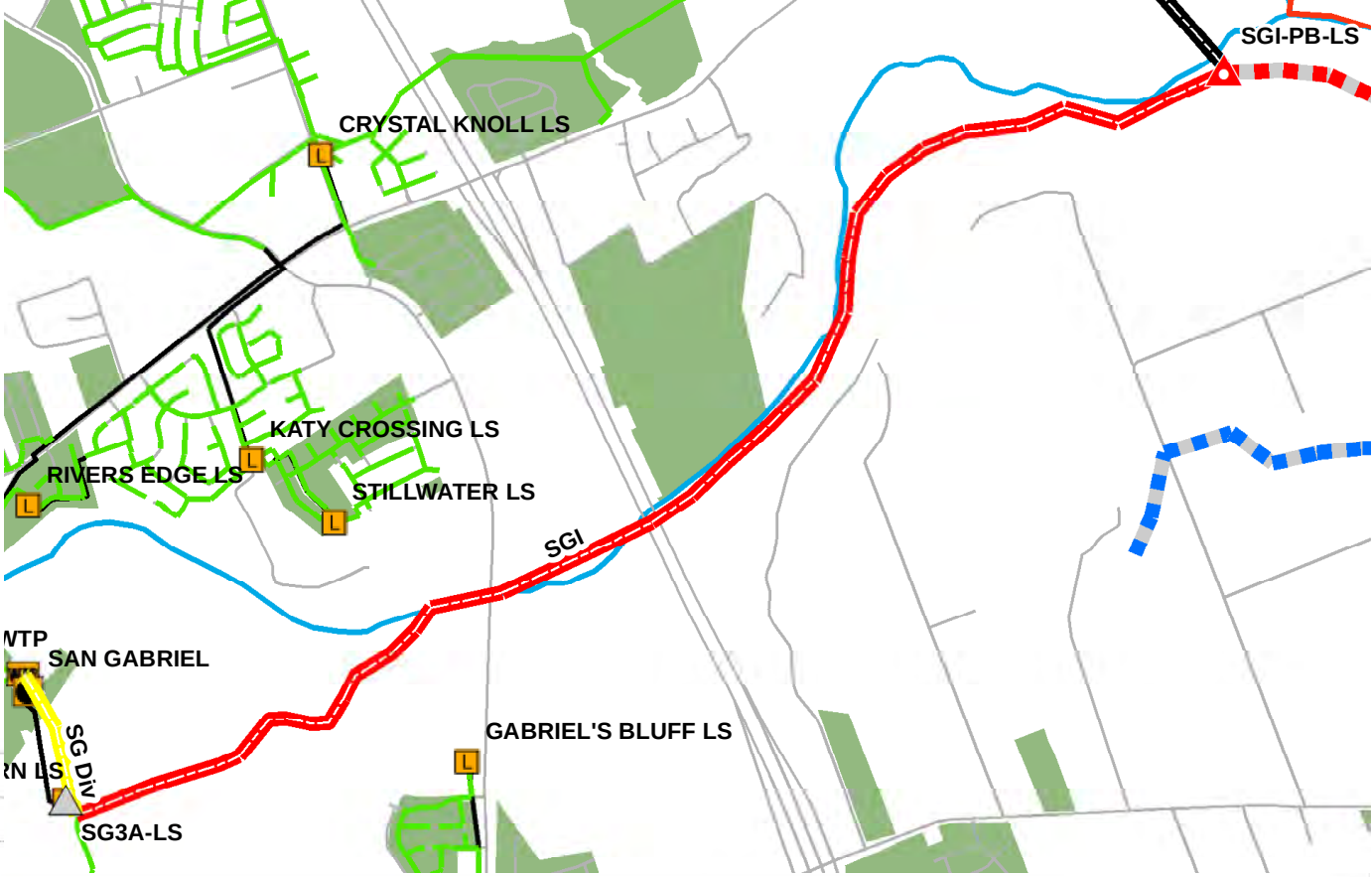


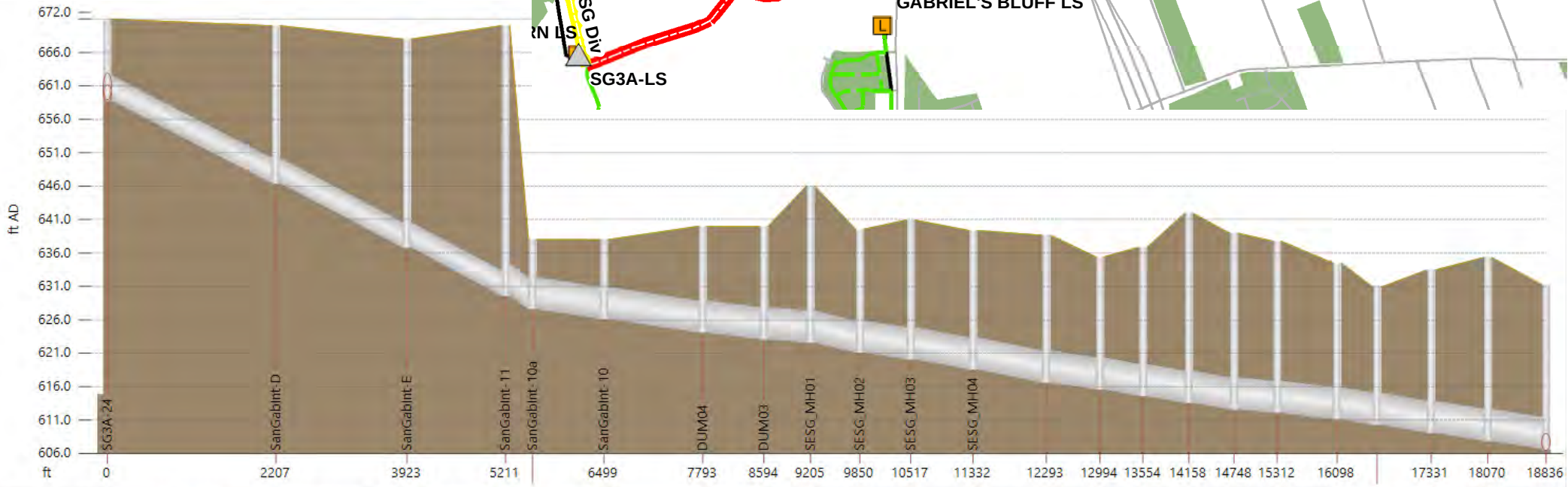
Link	CC-MH1.1	CC-MH2.1	-
length (ft)	1167.4	1519.4	58.4
width (in)	30.0	36.0	54.0
us inv (ft AD)	901.021	892.409	-
ds inv (ft AD)	892.409	886.110	-
grad (%)	0.738	0.415	-
pfc (MGD)	22.77	27.76	-

Node	CC-MH1	CC-MH2	Northlands_US
ground (ft AD)	907.021	898.409	892.110

Figure E-8 Profile for SGI

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)





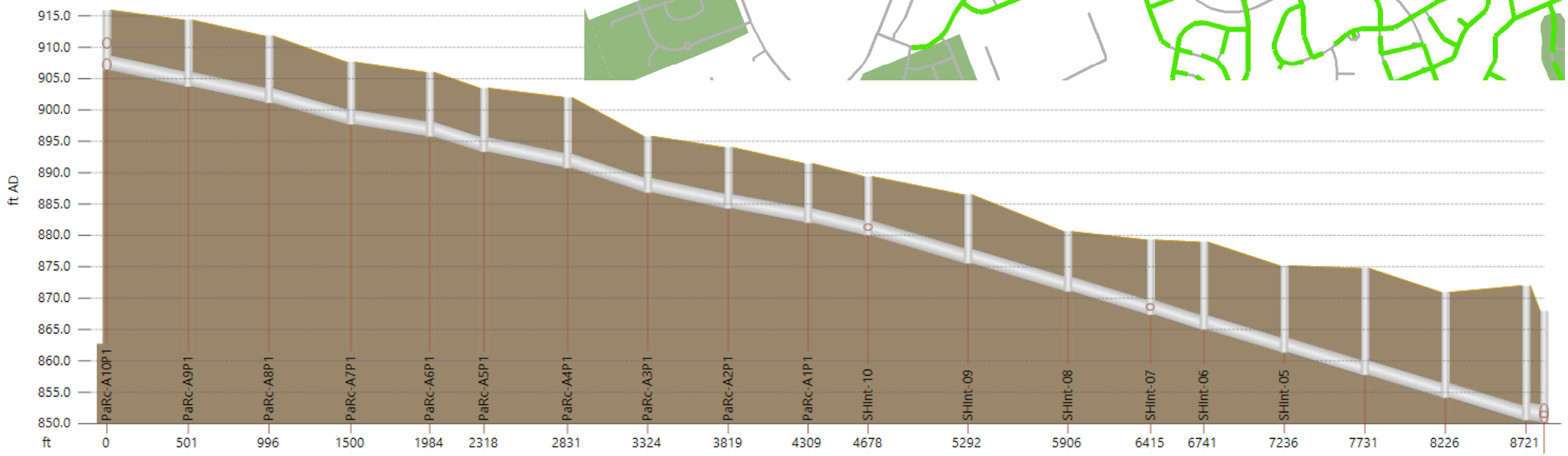
Link	SG3A-24.2	SanGabInt-D.1	SanGabInt-E.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
length (ft)	2207.3	1715.6	1287.7	-	932.4	1294.0	800.5	610.9	644.9	666.8	815.5	960.7	700.8	560.9	603.4	590.3	564.2	786.1	524.4	708.1	739.4	765.5
width (in)	48.0	48.0	48.0	-	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
us inv (ft AD)	658.700	646.330	636.715	-	627.500	626.034	624.000	-	-	-	620.000	618.500	616.500	-	-	-	-	612.000	-	610.200	609.000	607.800
ds inv (ft AD)	646.330	636.715	629.498	-	626.034	624.000	623.000	-	-	-	618.500	616.500	615.500	-	-	-	-	611.000	-	609.000	607.800	606.600
grad (%)	0.560	0.560	0.560	-	0.157	0.157	0.125	0.082	0.233	0.150	0.184	0.208	0.143	0.178	0.166	0.169	0.089	0.127	0.153	0.169	0.162	0.157
pfc (MGD)	69.51	69.51	69.51	-	66.75	66.74	59.50	48.16	81.19	65.19	72.20	76.81	63.59	71.08	68.53	69.29	50.11	60.04	65.75	69.30	67.82	66.65

Node	SG3A-24	SanGabInt-D	SanGabInt-E	-	-	-	DUM04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ground (ft AD)	671.000	670.000	668.000	670.000	-	638.000	640.000	-	-	-	-	639.367	638.642	-	-	-	-	-	-	-	-	-	-

Figure E-9 Profile for CC-1

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)





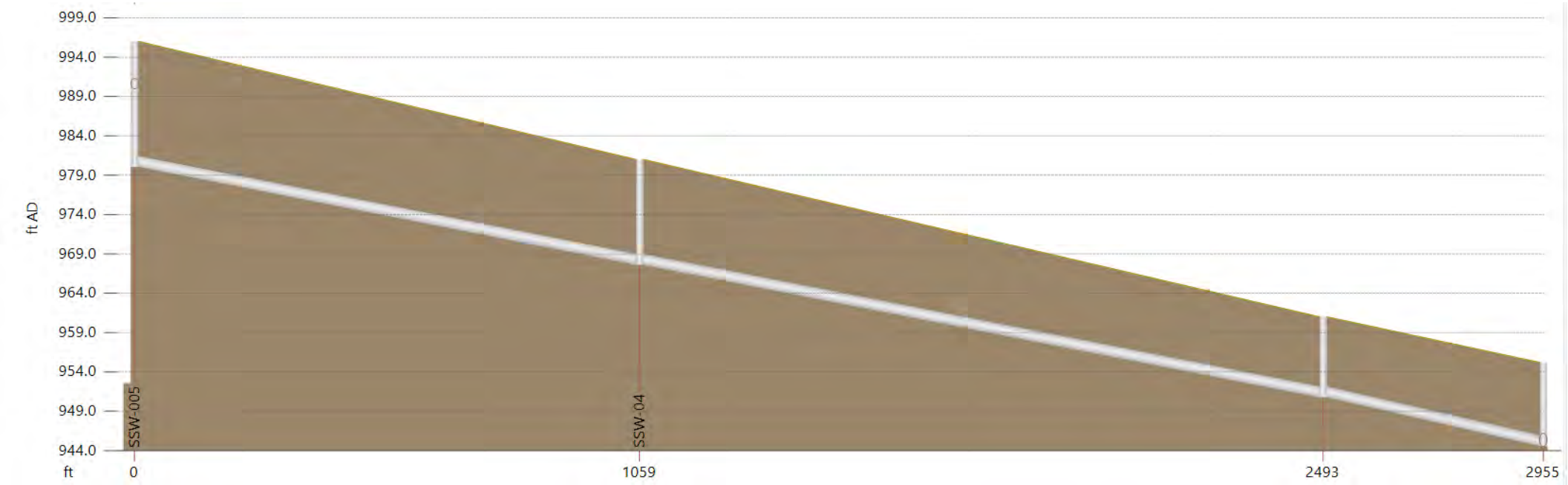
Link	-	-	-	-	-	PaRc-A5P1.1	-	-	-	-	SHint-10.1	SHint-09.1	SHint-08.1	-	SHint-06.1	SHint-05.1	SHint-04.1	SHint-03.1	-
length (ft)	500.7	495.5	503.5	484.8	333.4	513.3	492.4	495.9	489.7	369.2	613.9	613.8	509.1	326.1	494.7	495.0	495.0	495.0	-
width (in)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	-
us inv (ft AD)	906.260	903.660	901.060	897.600	895.700	893.250	890.670	886.760	884.180	881.950	879.910	875.450	870.990	867.270	864.860	861.260	857.650	854.050	-
ds inv (ft AD)	903.760	901.160	897.700	895.800	893.350	890.770	886.860	884.280	882.050	880.000	875.550	871.090	867.370	864.960	861.360	857.750	854.150	850.540	-
grad (%)	0.499	0.505	0.667	0.371	0.705	0.483	0.774	0.500	0.435	0.528	0.710	0.710	0.711	0.708	0.707	0.709	0.707	0.709	-
pfc (MGD)	18.74	18.83	21.66	16.16	22.26	18.43	23.32	18.75	17.49	19.27	22.34	22.35	22.36	22.32	22.30	22.33	22.29	22.33	-

Node	-	-	-	-	-	-	PaRc-A4P1	-	-	-	SHint-10	SHint-09	SHint-08	-	-	SHint-05	SHint-04	SHint-03	-
ground (ft AD)	-	914.310	911.770	907.600	905.990	903.460	902.000	895.800	894.000	891.460	889.360	886.450	880.590	879.260	878.910	875.130	874.720	870.910	-

Figure E-10 Profile for CC-2

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)





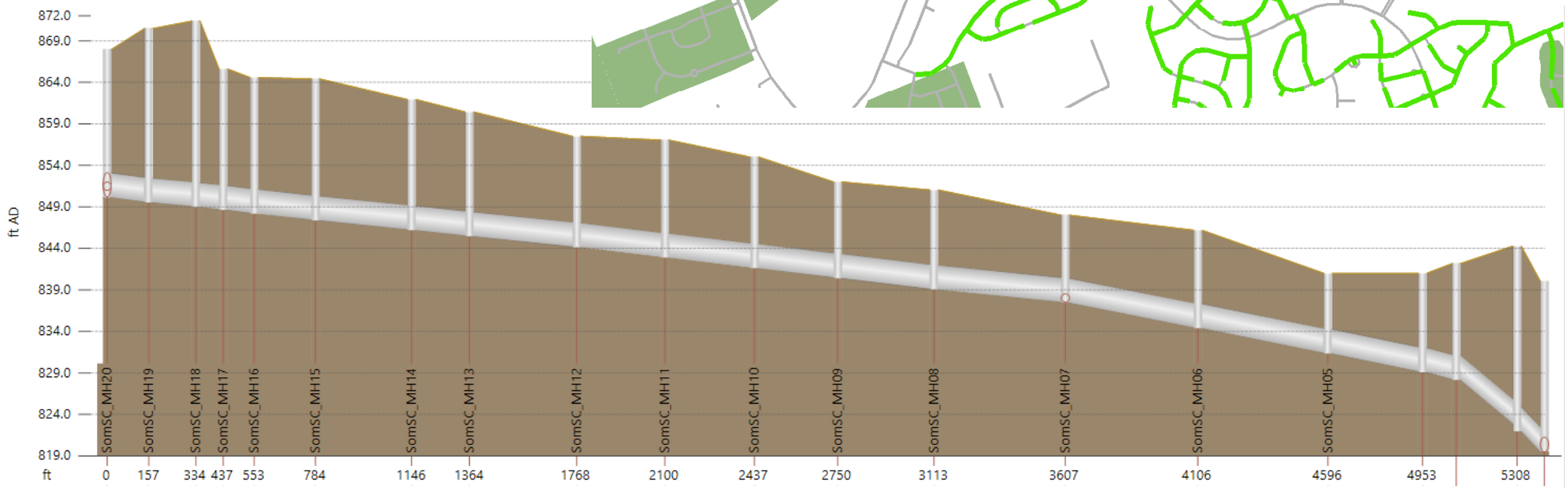
Link	SSW-005.1	SSW-04.1	SSW-03.1
length (ft)	1059.1	1433.6	462.3
width (in)	18.0	18.0	18.0
us inv (ft AD)	980.000	967.561	950.725
ds inv (ft AD)	967.561	950.725	944.520
grad (%)	1.174	1.174	1.342
pfc (MGD)	7.36	7.36	7.87

Node	SSW-005	SSW-04	SSW-03	PaRc-A4P2
ground (ft AD)	996.000	981.000	961.000	955.210

Figure E-11 Profile for CC-7

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



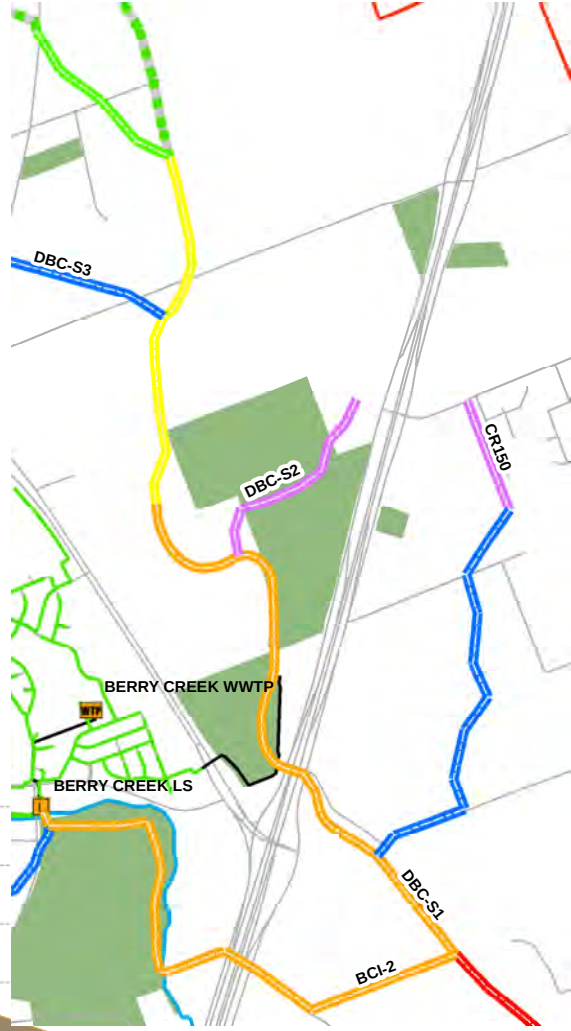


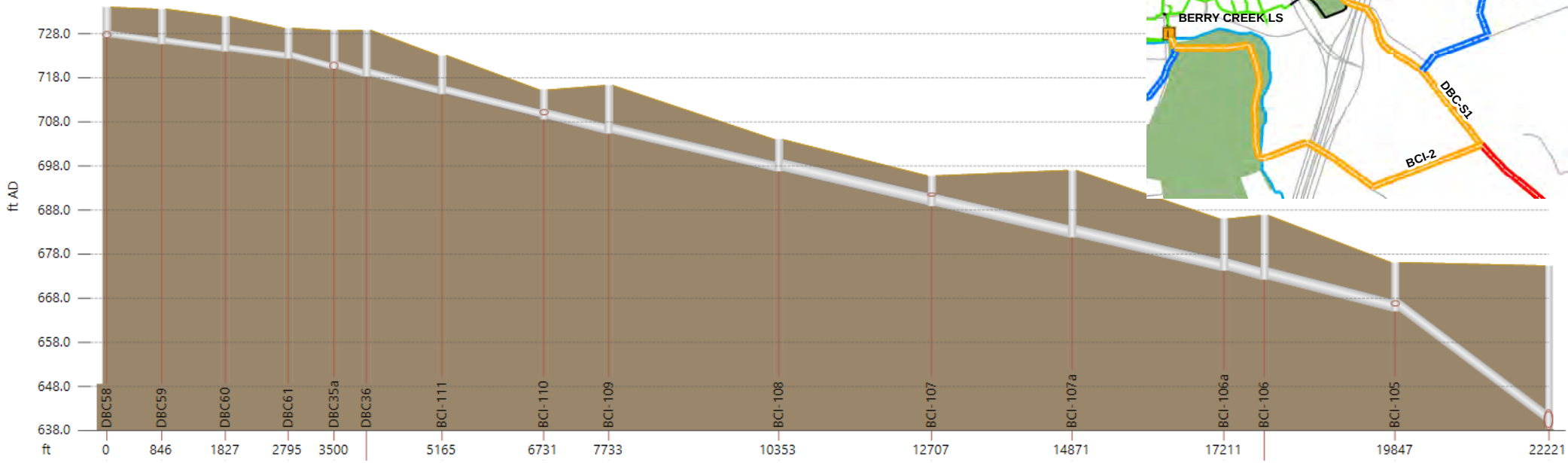
Link	-	-	-	-	-	-	-	SomSC_MH13.1	-	-	-	-	SomSC_MH08.1	SomSC_MH07.1	SomSC_MH06.1	-	-	-	-
length (ft)	156.6	177.2	-	-	230.6	362.1	217.6	404.1	331.7	336.9	313.9	362.8	494.1	499.0	490.1	356.1	-	228.6	-
width (in)	36.0	36.0	-	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	-
us inv (ft AD)	-	-	-	-	848.120	847.320	846.140	845.400	844.080	842.820	841.550	840.360	838.990	837.400	834.340	831.280	-	828.100	-
ds inv (ft AD)	-	-	-	-	847.420	846.240	845.500	844.180	842.920	841.650	840.460	839.090	837.500	834.440	831.380	829.140	-	822.880	-
grad (%)	0.326	0.248	-	-	0.303	0.298	0.294	0.302	0.350	0.347	0.347	0.350	0.302	0.593	0.604	0.601	-	2.283	-
pfc (MGD)	24.60	21.48	-	-	23.75	23.55	23.38	23.69	25.49	25.41	25.41	25.51	23.67	33.20	33.51	33.42	-	65.14	-

Node		-	-	-	-	-	-	-	-	-	-	-	SomSC_MH08	SomSC_MH07	SomSC_MH06	SomSC_MH05	-	-	-
ground (ft AD)		-	-	-	-	864.400	861.930	860.430	857.500	857.040	855.000	852.000	851.030	848.000	846.180	841.000	841.000	-	-

Figure E-12 Profile for DBC-S1

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



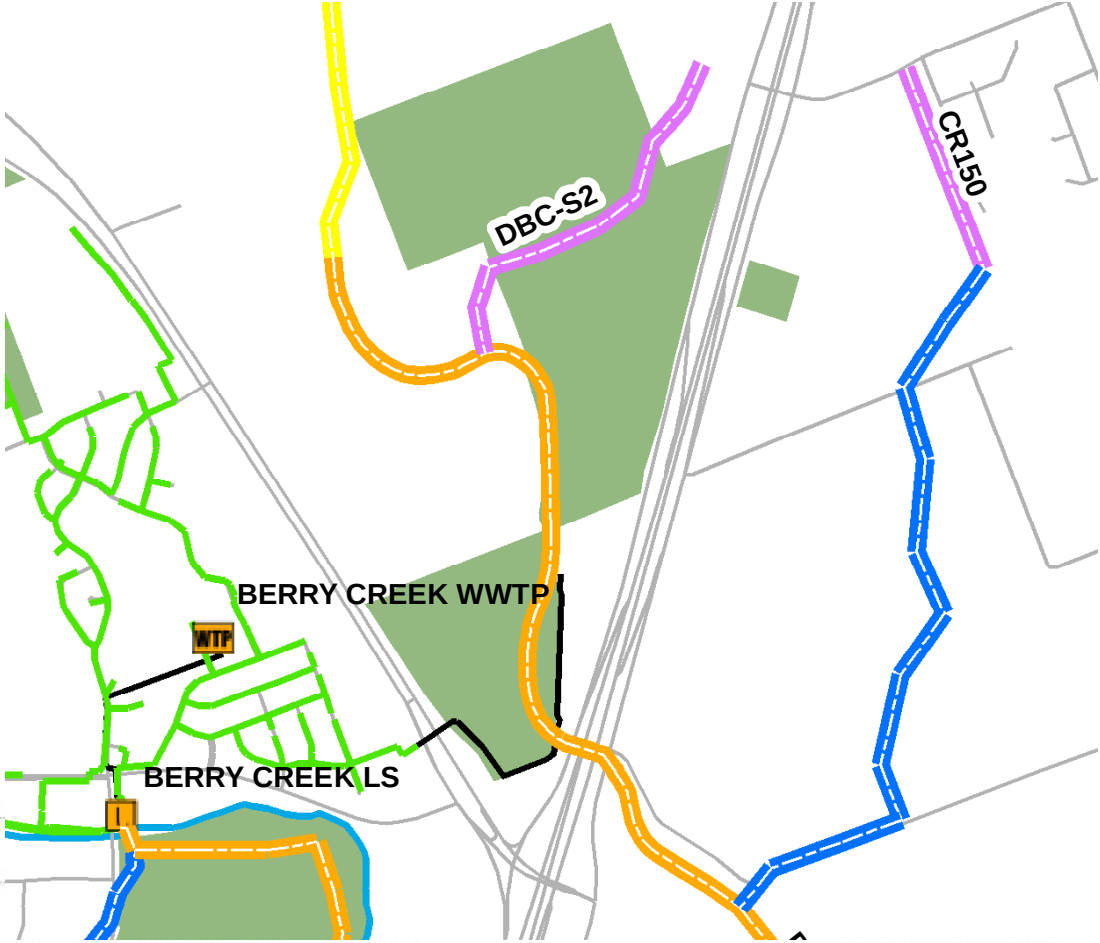


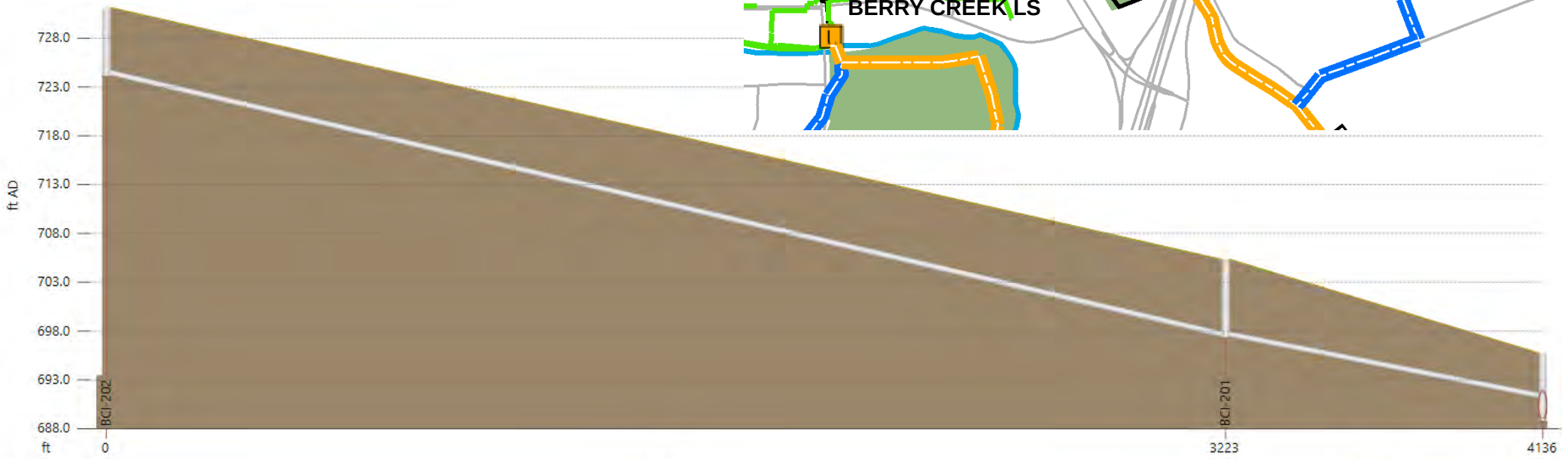
Link	-	DBC59.1	DBC60.1	-	-	DBC36.1	BCI-111.1	BCI-110.1	BCI-109.1	BCI-108.1	BCI-107.1	BCI-107a.1	-	BCI-106.1	BCI-105.1
length (ft)	845.9	980.6	968.7	705.1	-	1165.2	1566.5	1001.7	2619.9	2354.1	2163.8	2340.3	621.6	2014.7	2373.5
width (in)	21.0	21.0	21.0	21.0	24.0	24.0	24.0	30.0	30.0	36.0	36.0	36.0	36.0	36.0	36.0
us inv (ft AD)	727.000	725.557	723.884	-	-	718.177	714.254	708.480	705.216	696.680	688.760	681.736	-	672.122	664.955
ds inv (ft AD)	725.557	723.884	722.232	-	-	714.254	708.980	705.216	696.680	689.010	681.736	674.140	-	664.955	640.000
grad (%)	0.171	0.171	0.171	0.337	-	0.337	0.337	0.326	0.326	0.326	0.325	0.325	0.325	0.356	1.051
pfc (MGD)	4.23	4.23	4.23	5.94	8.48	8.49	8.48	15.13	15.13	24.61	24.56	24.56	24.56	25.71	44.21

Node	-	DBC59	DBC60	-	-	-	BCI-111	BCI-110	BCI-109	BCI-108	BCI-107	BCI-107a	BCI-106a	BCI-106	BCI-105	-
ground (ft AD)	-	-	731.890	-	-	-	723.080	715.230	716.260	703.980	695.760	697.000	686.000	686.781	676.120	675.350

Figure E-13 Profile for DBC-S2

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)





Link		BCI-202.1		BCI-201.1	
length (ft)		3222.6		913.8	
width (in)		8.0		8.0	
us inv (ft AD)		724.130		697.353	
ds inv (ft AD)		697.353		691.093	
grad (%)		0.831		0.685	
pfc (MGD)		0.71		0.65	
Node	BCI-202		BCI-201		BCI-107
ground (ft AD)	731.130		705.350		695.760

Figure E-14 Profile for DBC-S3

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



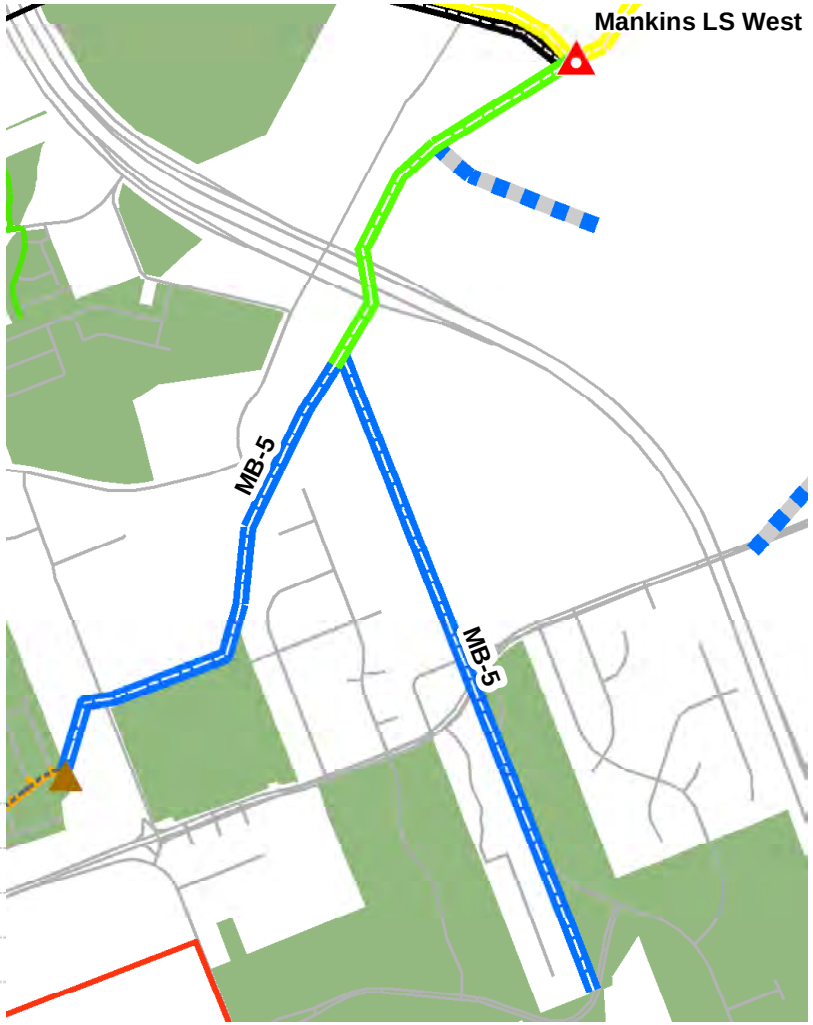


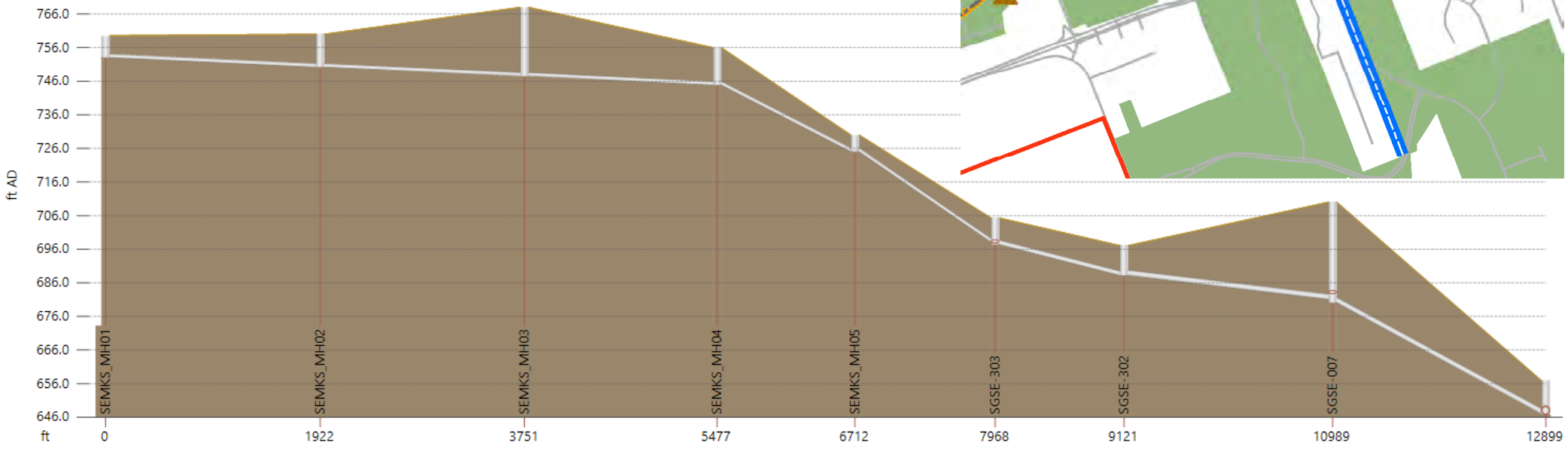
Link	BCI-302.1	BCI-301.1
length (ft)	3987.0	3311.1
width (in)	15.0	15.0
us inv (ft AD)	786.467	741.660
ds inv (ft AD)	741.660	709.480
grad (%)	1.124	0.972
pfc (MGD)	4.43	4.12

Node	BCI-302	BCI-301	BCI-110
ground (ft AD)	800.150	748.660	715.230

Figure E-15 Profile for MB-5

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



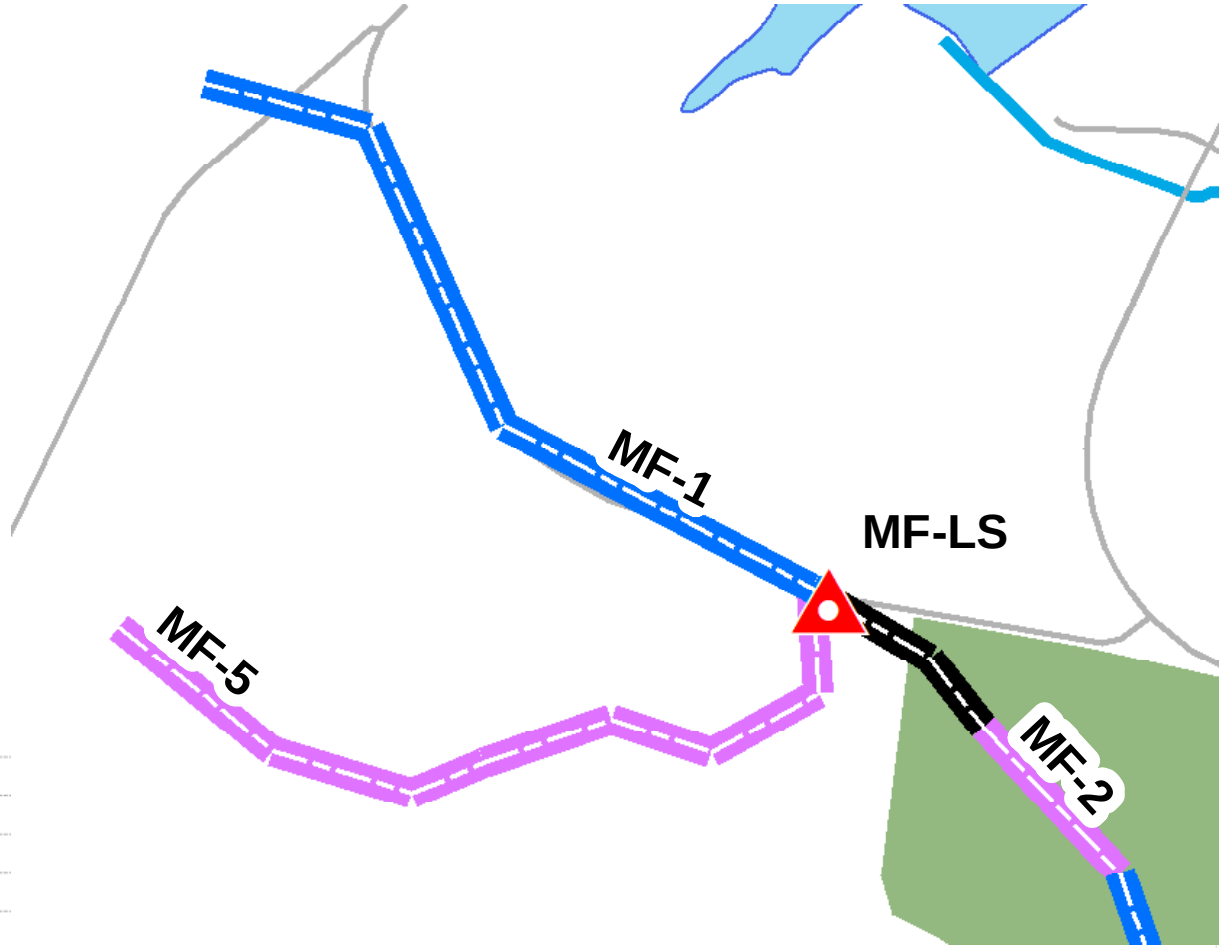


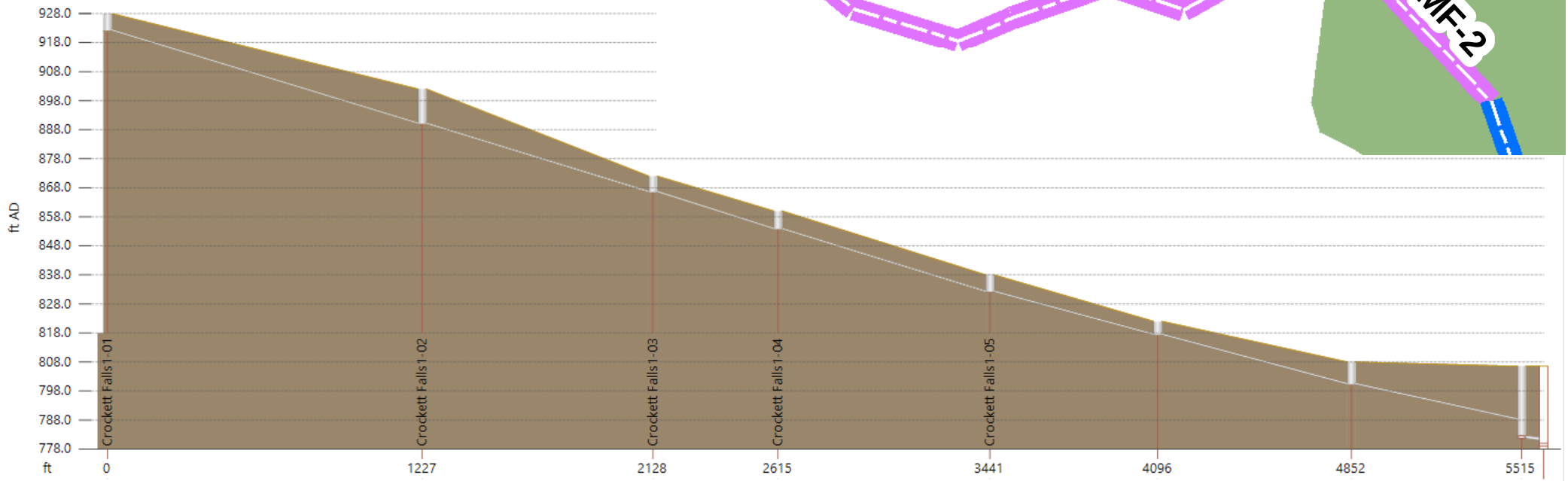
Link	SEMKS_MH01.1	SEMKS_MH02.1	SEMKS_MH03.1	SEMKS_MH04.1	SEMKS_MH05.1	SGSE-303.1	SGSE-302.1	SGSE-007.2
length (ft)	1922.1	1828.6	1726.1	1234.8	1256.4	1153.1	1868.1	1909.4
width (in)	15.0	15.0	15.0	15.0	15.0	18.0	21.0	21.0
us inv (ft AD)	753.000	750.117	747.374	744.785	725.000	697.291	688.082	680.000
ds inv (ft AD)	750.117	747.374	744.785	725.000	698.000	688.082	681.000	646.800
grad (%)	0.150	0.150	0.150	1.602	2.149	0.799	0.379	1.739
pfc (MGD)	1.62	1.62	1.62	5.29	6.12	6.07	6.31	13.51

Node	SEMKS_MH01	SEMKS_MH02	SEMKS_MH03	SEMKS_MH04	SEMKS_MH05	SGSE-303	SGSE-302	SGSE-007	SEMKN_MH09
ground (ft AD)	759.580	760.000	768.000	756.000	730.000	705.290	697.090	710.000	656.844

Figure E-16 Profile for MF-5

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



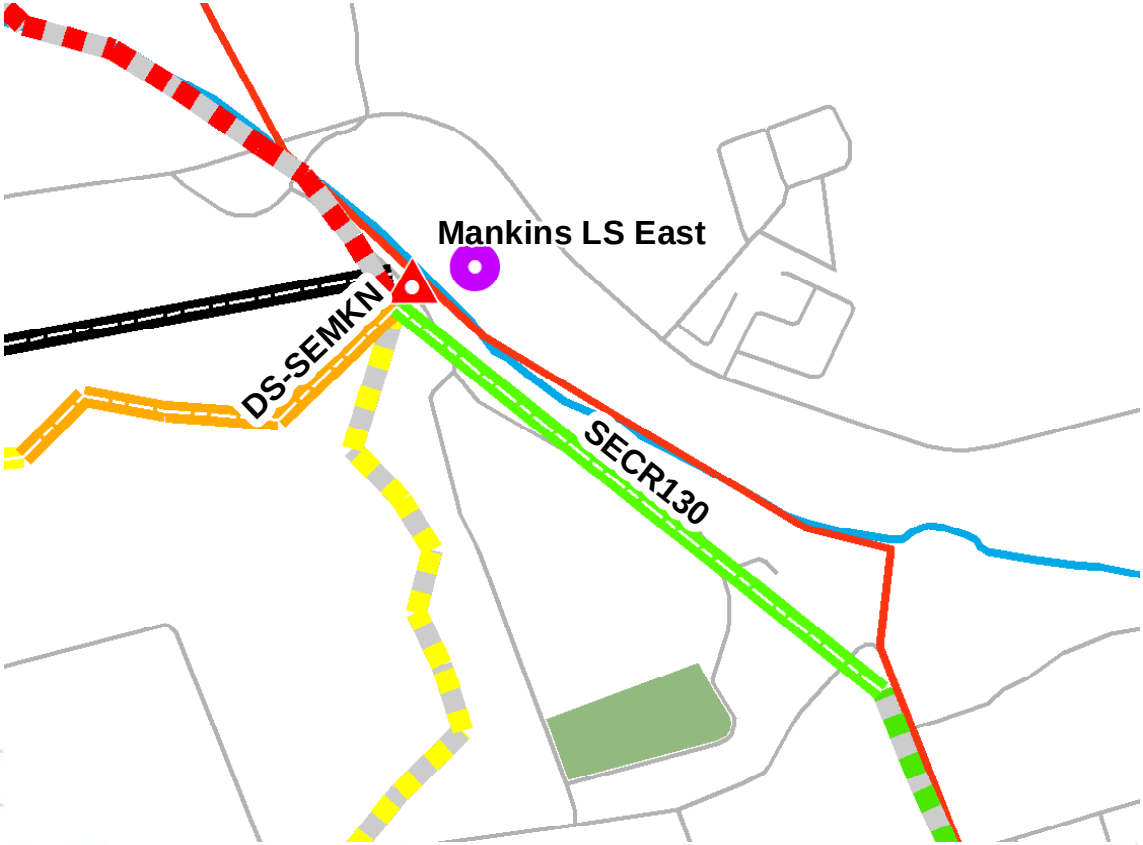


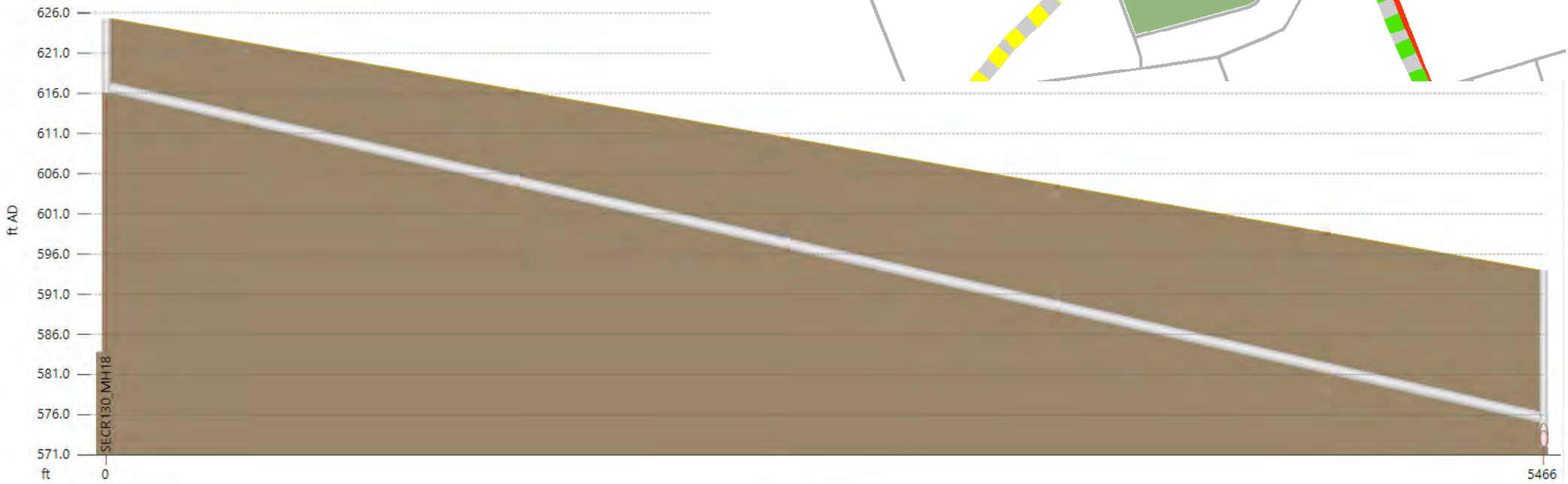
Link	Crockett Falls1-01.1	Crockett Falls1-02.1	-	Crockett Falls1-04.1	Crockett Falls1-05.1	Crockett Falls1-06.1	Crockett Falls1-07.1	-
length (ft)	1227.1	900.4	487.1	826.9	654.1	756.2	663.5	-
width (in)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	-
us inv (ft AD)	922.000	889.909	866.362	853.624	832.000	817.260	800.220	-
ds inv (ft AD)	889.909	866.362	853.624	832.000	817.260	800.220	788.000	-
grad (%)	2.615	2.615	2.615	2.615	2.253	2.253	1.842	-
pfc (MGD)	1.26	1.26	1.26	1.26	1.17	1.17	1.06	-

Node	Crockett Falls1-01	Crockett Falls1-02	Crockett Falls1-03	Crockett Falls1-04	Crockett Falls1-05	Crockett Falls1-06	Crockett Falls1-07	SL-SF_03a
ground (ft AD)	928.000	902.000	872.000	860.000	838.000	822.000	808.000	806.529

Figure E-17 Profile for SECR130

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)

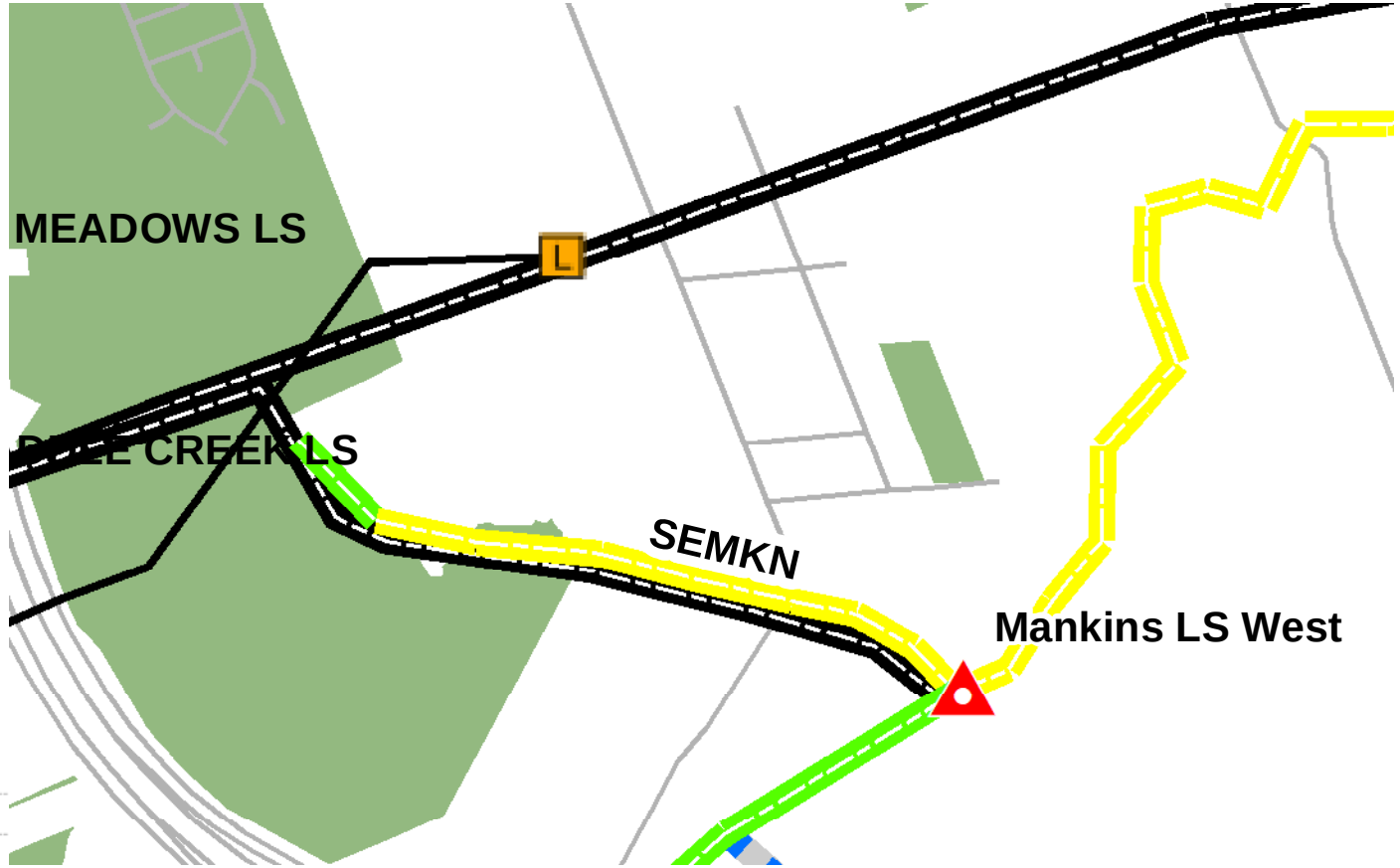


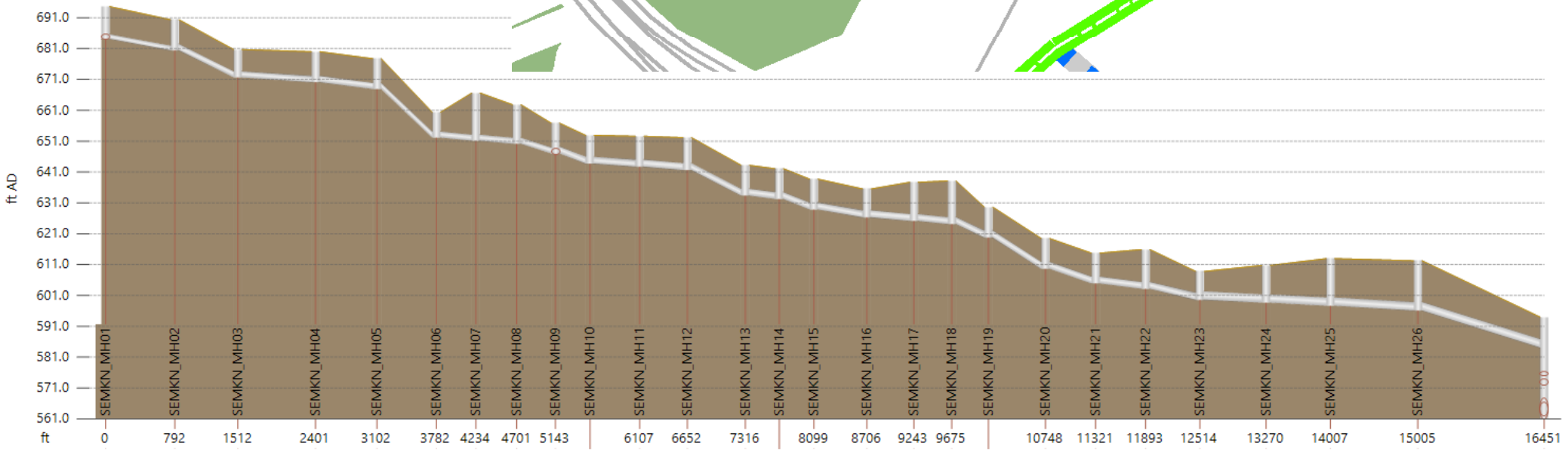


Link		SECR130_MH18.1	
length (ft)		5466.0	
width (in)		18.0	
us inv (ft AD)		616.000	
ds inv (ft AD)		575.000	
grad (%)		0.750	
pfc (MGD)		5.88	
Node	SECR130_MH18		DUM-01
ground (ft AD)	625.289		594.000

Figure E-18 Profile for SEMKN

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



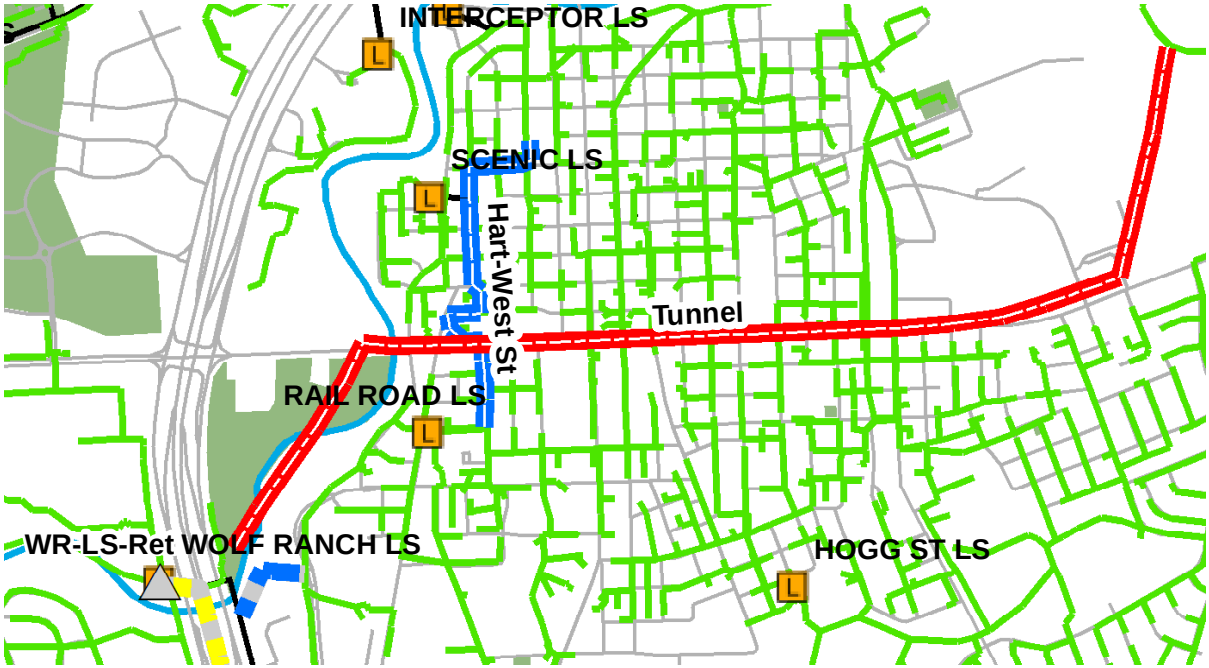


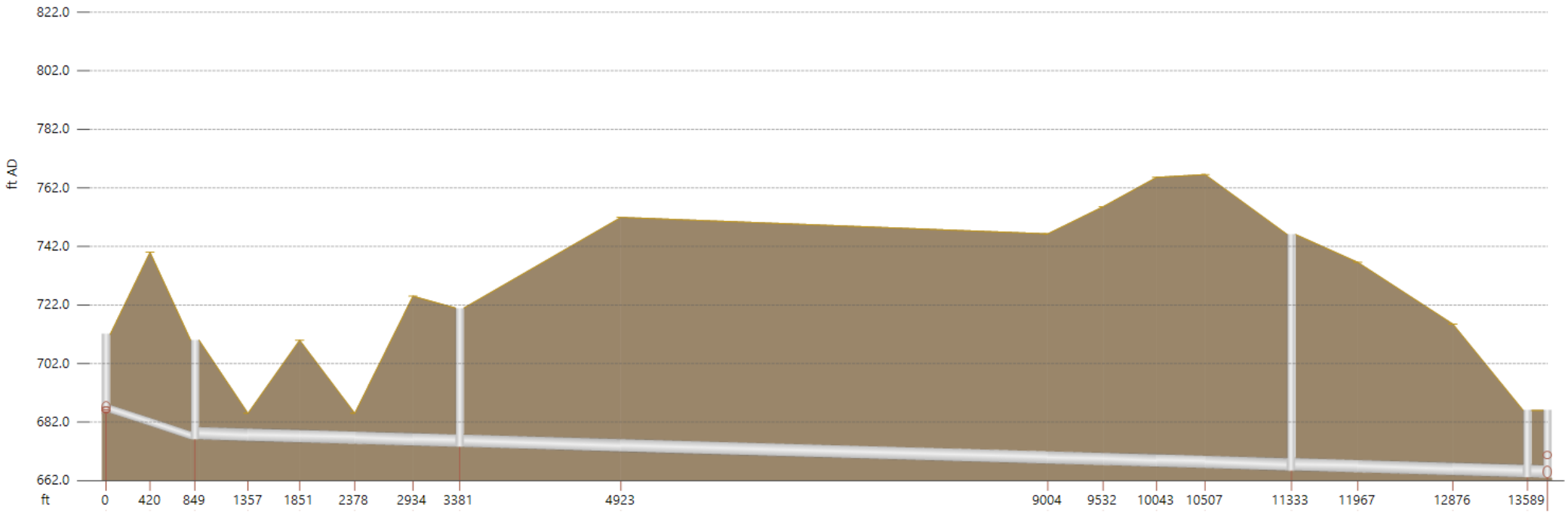
Link	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SEMKN_MH26.1
length (ft)		792.0	720.3	888.9	701.2	680.0	452.0	466.8	441.9	-	567.3	545.2	664.2	-	-	606.7	537.3	432.2	-	652.2	572.9	572.3	620.9	755.9	736.6	998.8	1445.3			
width (in)		21.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	36.0	36.0	36.0	36.0			
us inv (ft AD)		684.000	680.338	671.500	669.987	667.753	-	-	-	-	-	-	641.500	-	-	628.698	-	-	-	619.646	-	-	603.000	599.500	598.500	597.500	596.000			
ds inv (ft AD)		680.338	671.500	669.987	667.753	652.000	-	-	-	-	-	-	633.182	-	-	626.200	-	-	-	609.452	-	-	599.500	598.500	597.500	596.000	584.000			
grad (%)		0.462	1.227	0.170	0.319	2.317	0.221	0.214	0.714	-	0.176	0.204	1.252	-	-	0.412	0.223	0.231	-	1.563	0.824	0.302	0.564	0.132	0.136	0.150	0.830			
pfc (MGD)		6.96	22.18	8.26	11.30	30.47	9.42	9.27	16.92	-	11.13	11.96	29.67	-	-	17.01	12.53	12.75	-	33.15	24.07	14.58	19.91	15.68	15.89	16.71	39.28			

Node	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SEMKN_MH26	-
ground (ft AD)	-	690.338	680.696	679.987	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	610.742	612.949	612.254	594.000	

Figure E-19 Profile for Tunnel

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



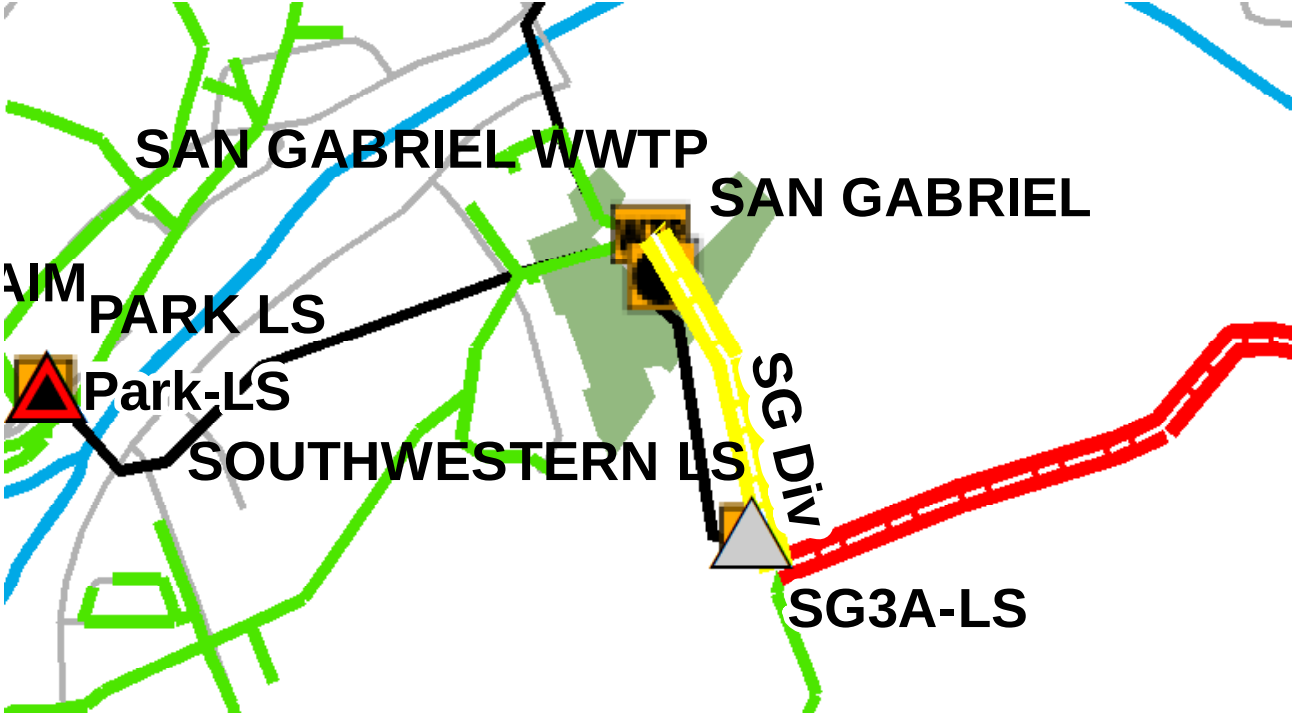


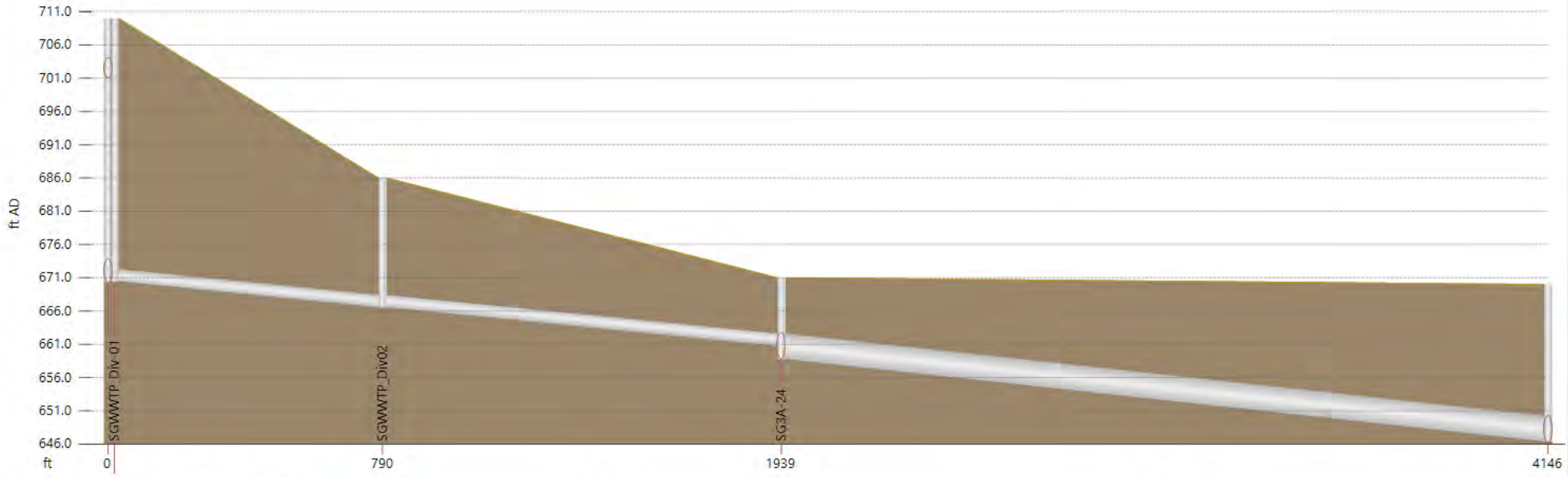
Link	-	-	-	-	-	-	-	Tunnel-00.2	Tunnel-01.1	-	-	-	Tunnel-05.1	-	Tunnel-07.1	-	-
length (ft)	420.4	428.8	508.0	494.1	526.7	556.2	446.9	1541.6	4081.3	528.1	511.4	463.4	826.7	633.1	909.0	713.4	-
width (in)	36.0	36.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	-
us inv (ft AD)	-	-	676.000	-	674.983	674.448	-	673.429	671.864	667.720	667.184	-	666.194	665.355	664.712	663.789	-
ds inv (ft AD)	-	-	675.484	-	674.448	673.883	-	671.864	667.720	667.184	666.665	-	665.355	664.712	663.789	663.065	-
grad (%)	1.051	1.073	0.102	0.101	0.102	0.102	0.102	0.102	0.102	0.101	0.101	0.102	0.101	0.102	0.102	0.101	-
pfc (MGD)	44.21	44.66	40.51	40.48	40.51	40.51	40.51	40.50	40.50	40.49	40.49	40.52	40.49	40.51	40.51	40.49	-

Node		-	-	-	-	-	-	Tunnel-00	Tunnel-01	Tunnel-02	-	-	-	-	Tunnel-07	Tunnel-08	-
ground (ft AD)		-	-	-	-	-	-	720.980	751.940	746.300	-	-	766.550	746.060	736.580	715.510	-

Figure E-20 Profile for SG DIV

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)





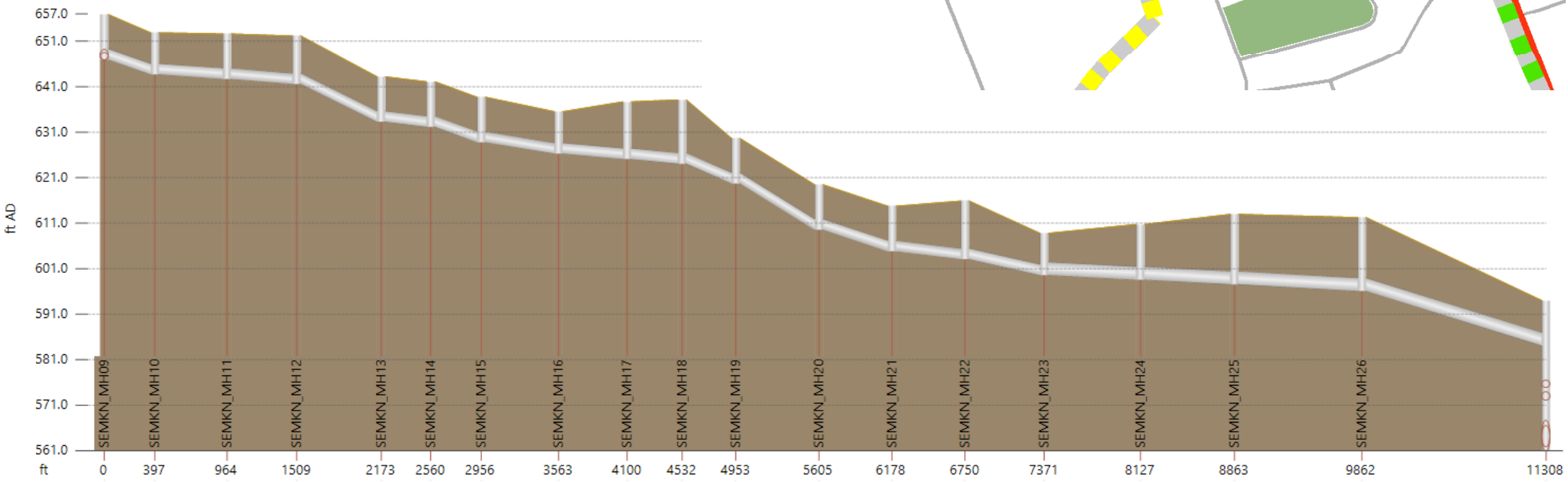
Link	SGWWTP_Div-01.1	SGWWTP_Div02.1	SG3A-24.2
length (ft)	771.9	1148.3	2207.3
width (in)	24.0	24.0	48.0
us inv (ft AD)	670.400	666.501	658.700
ds inv (ft AD)	666.501	660.700	646.330
grad (%)	0.505	0.505	0.560
pfc (MGD)	10.39	10.39	69.51

Node	SGWWTP_Div-01	SGWWTP_Div02	SG3A-24	SanGabInt-D
ground (ft AD)	710.000	686.000	671.000	670.000

Figure E-21 Profile for DS-SEMKN

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



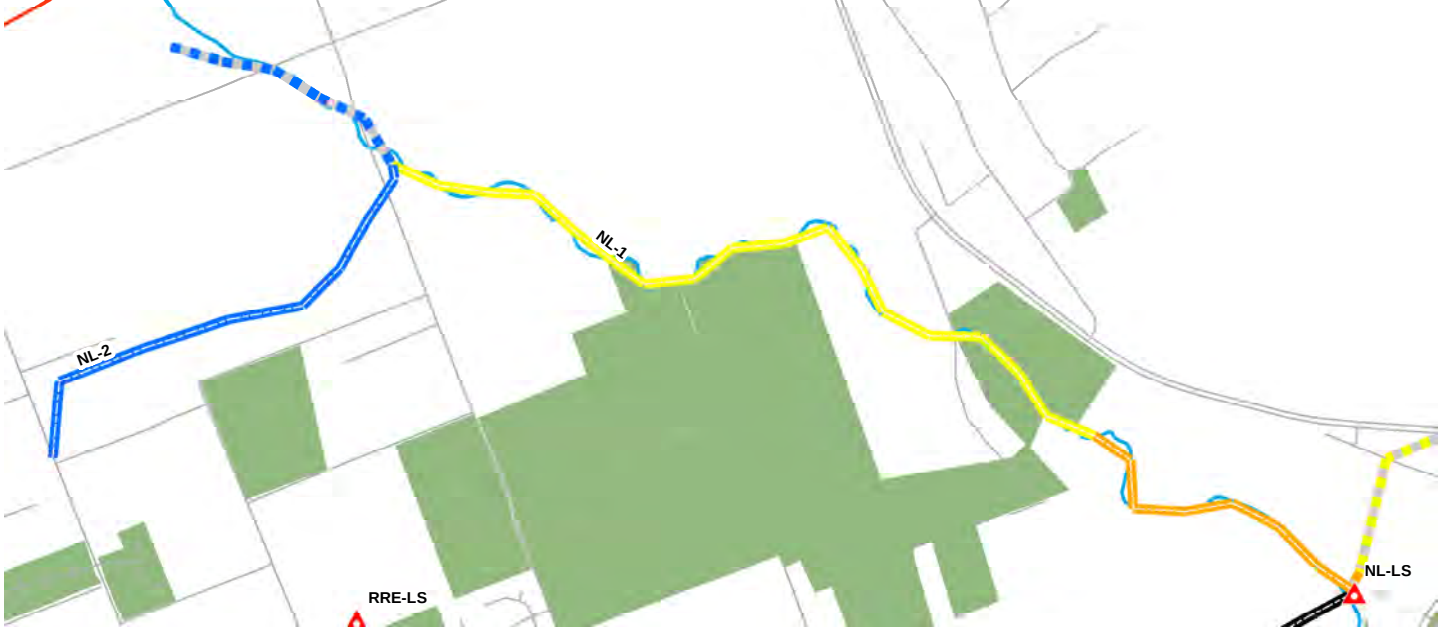


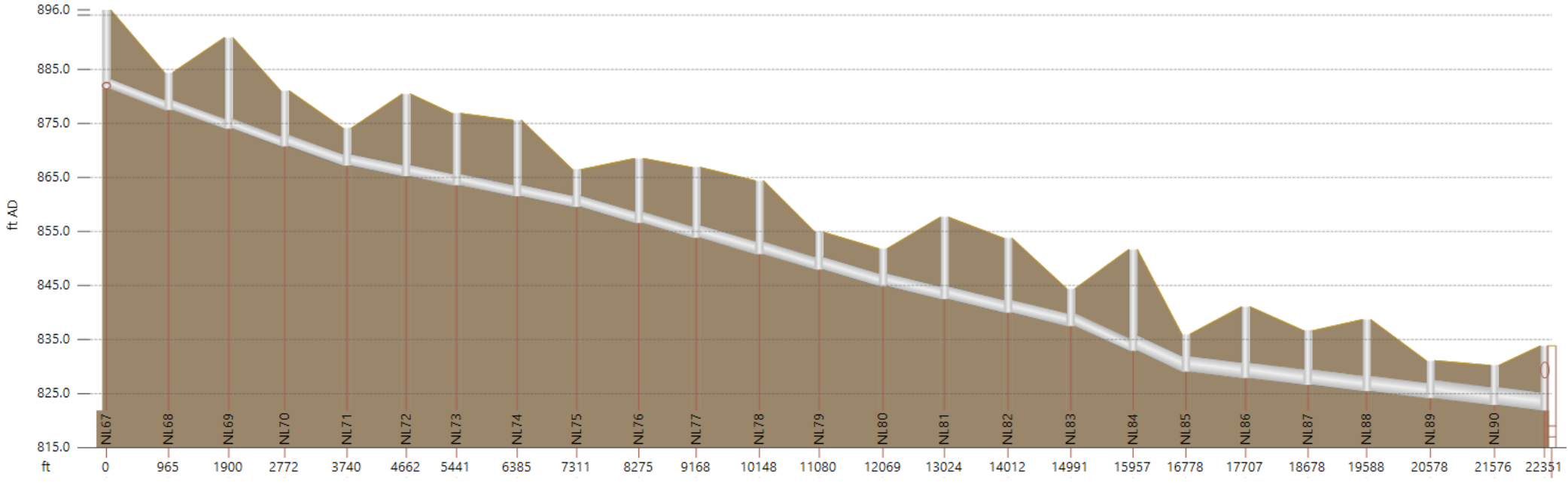
Link	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SEMKN_MH25.1	SEMKN_MH26.1
length (ft)	396.7	567.3	545.2	664.2	387.1	395.8	606.7	537.3	432.2	420.3	652.2	572.9	572.3	620.9	755.9	736.6	998.8	1445.3
width (in)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	36.0	36.0	36.0	36.0
us inv (ft AD)	-	643.610	642.610	641.500	-	-	628.698	626.200	625.000	624.000	619.646	609.452	604.731	603.000	599.500	598.500	597.500	596.000
ds inv (ft AD)	-	642.610	641.500	633.182	-	-	626.200	625.000	624.000	619.646	609.452	604.731	603.000	599.500	598.500	597.500	596.000	584.000
grad (%)	0.815	0.176	0.204	1.252	0.283	0.856	0.412	0.223	0.231	1.036	1.563	0.824	0.302	0.564	0.132	0.136	0.150	0.830
pfc (MGD)	23.94	11.13	11.96	29.67	14.10	24.53	17.01	12.53	12.75	26.98	33.15	24.07	14.58	19.91	15.68	15.89	16.71	39.28

Node	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SEMKN_MH25	SEMKN_MH26	DUM-01
ground (ft AD)	-	-	652.602	652.152	643.182	-	638.698	635.522	-	-	629.646	619.452	614.731	615.879	608.789	610.742	612.949	612.254	594.000

Figure E-22 Profile for NL-1

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



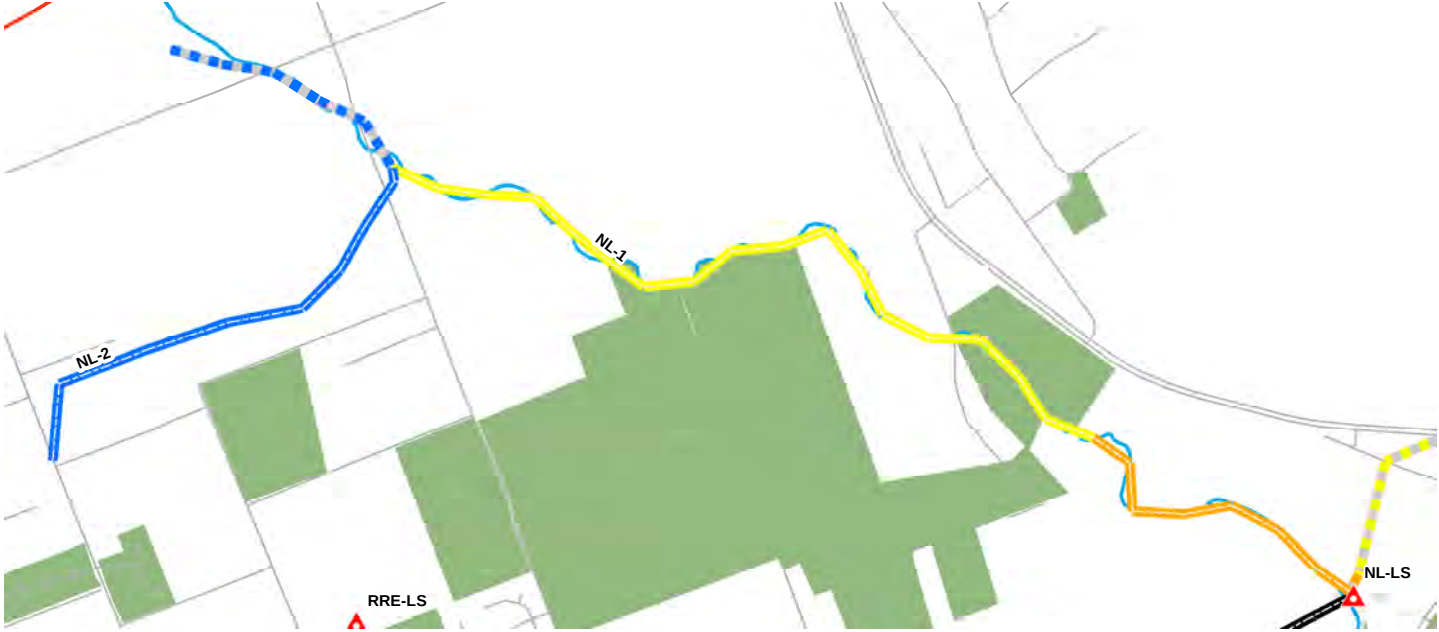


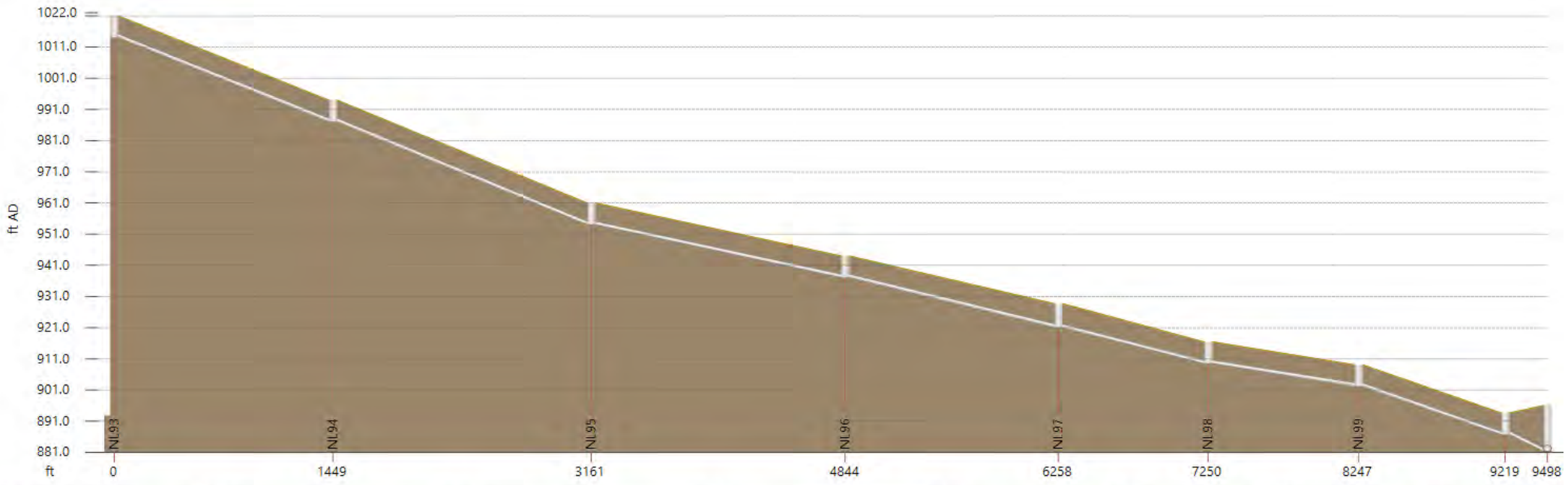
Link	NL67.1	NL68.1	NL69.1	NL70.1	NL71.1	NL72.1	NL73.1	NL74.1	NL75.1	NL76.1	NL77.1	NL78.1	NL79.1	NL80.1	NL81.1	NL82.1	NL83.1	NL84.1	NL85.1	NL86.1	NL87.1	NL88.1	NL89.1	NL90.1
length (ft)	965.0	935.2	872.1	967.5	922.1	778.9	943.7	926.9	963.8	892.4	980.7	931.8	988.5	955.7	987.6	978.9	965.8	821.5	928.9	970.7	909.8	990.8	997.5	775.2
width (in)	24.0	24.0	24.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	36.0	36.0	36.0	36.0	36.0	42.0	42.0
us inv (ft AD)	881.296	877.409	873.936	870.697	867.104	-	863.460	861.439	859.453	856.488	853.743	850.726	847.859	844.811	842.395	839.898	837.423	832.875	829.007	827.807	826.554	825.379	824.099	-
ds inv (ft AD)	877.409	873.936	870.697	867.104	865.129	-	861.439	859.453	856.488	853.743	850.726	847.859	844.811	842.395	839.898	837.423	832.875	829.007	827.807	826.554	825.379	824.099	822.812	-
grad (%)	0.403	0.371	0.371	0.371	0.214	0.214	0.214	0.214	0.308	0.308	0.308	0.308	0.308	0.253	0.253	0.253	0.471	0.471	0.129	0.129	0.129	0.129	0.129	0.129
pfc (MGD)	9.28	8.91	8.91	12.20	9.27	9.27	9.27	9.27	11.10	11.10	14.71	14.71	14.72	13.33	13.33	13.33	18.19	29.58	15.49	15.49	15.49	15.49	23.36	23.36

Node	-	NL68	NL69	NL70	NL71	NL72	NL73	NL74	NL75	NL76	NL77	NL78	NL79	NL80	NL81	NL82	NL83	NL84	NL85	NL86	NL87	NL88	NL89	NL90	-
ground (ft AD)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	853.743	-	-	-	-	-	-	831.099	-	-

Figure E-23 Profile for NL-2

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)





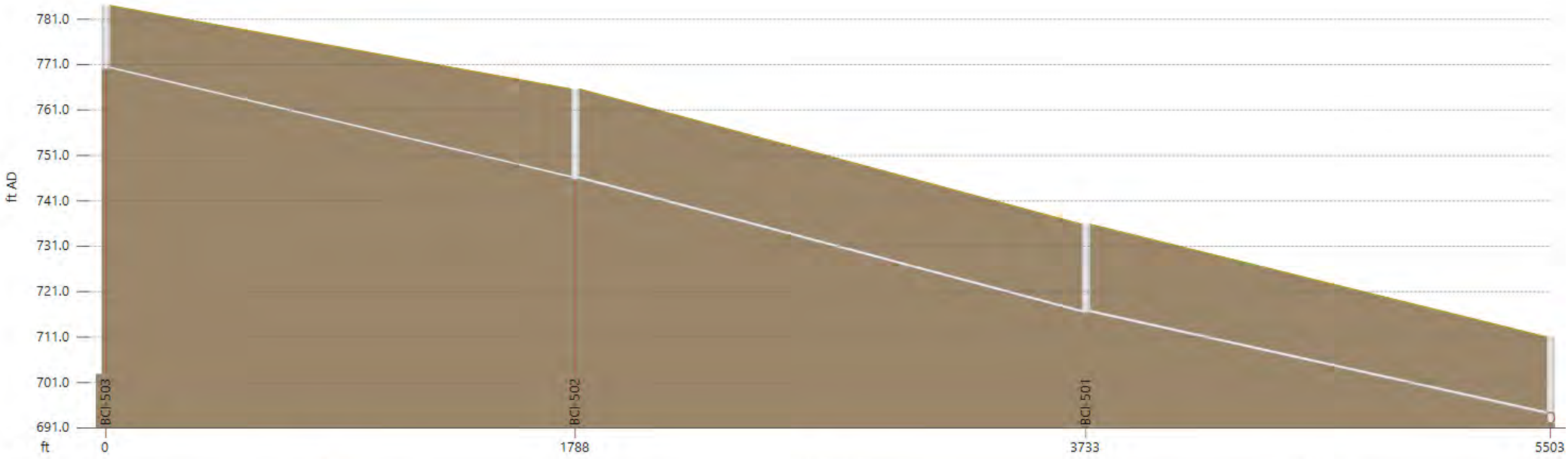
Link	NL93.1	NL94.1	NL95.1	NL96.1	NL97.1	NL98.1	NL99.1	-
length (ft)	1449.1	1712.1	1682.6	1414.1	991.9	997.5	971.5	279.3
width (in)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
us inv (ft AD)	1014.000	987.000	954.000	937.000	921.000	909.457	902.091	-
ds inv (ft AD)	987.000	954.000	937.000	921.000	909.457	902.091	886.652	-
grad (%)	1.863	1.927	1.010	1.131	1.164	0.738	1.589	1.917
pfc (MGD)	5.70	5.80	4.20	4.44	4.50	3.59	5.26	5.78

Node	NL93	NL94	NL95	NL96	NL97	NL98	NL99	NL100
ground (ft AD)	1021.000	994.000	961.000	944.000	928.714	916.457	909.091	893.652

Figure E-24 Profile for BC-2a

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)





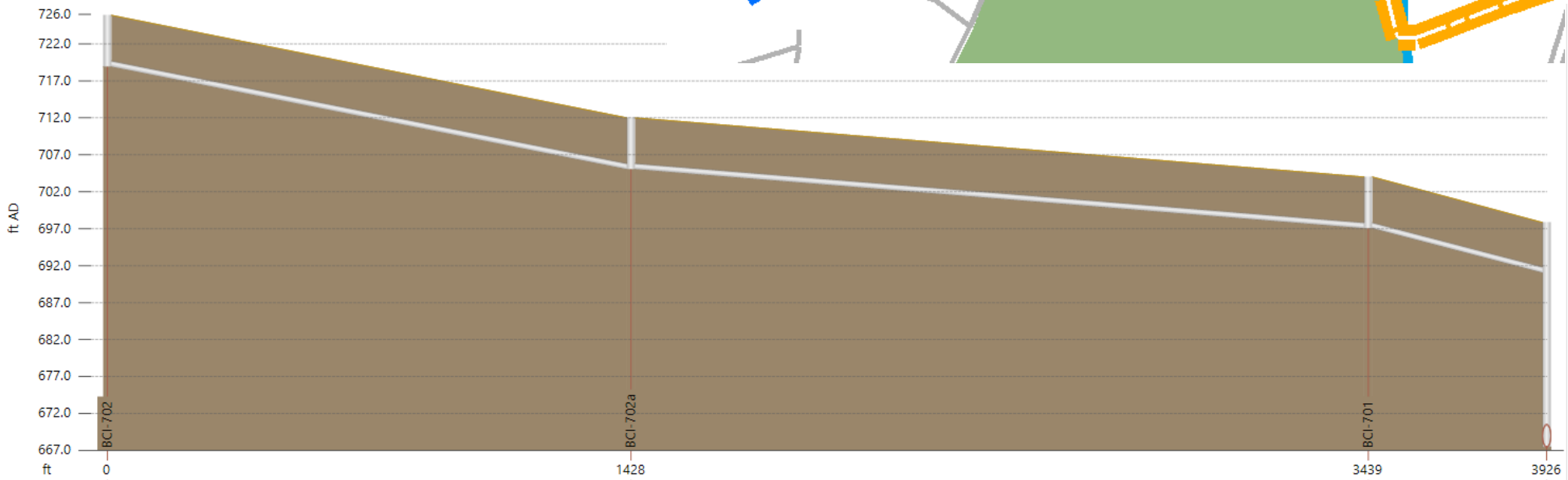
Link	BCI-503.1	BCI-502.1	BCI-501.1
length (ft)	1787.5	1945.8	1770.1
width (in)	8.0	10.0	10.0
us inv (ft AD)	770.000	745.699	716.332
ds inv (ft AD)	746.000	716.332	693.940
grad (%)	1.343	1.509	1.265
pfc (MGD)	0.91	1.74	1.59

Node	BCI-503	BCI-502	BCI-501	BCI_MH19
ground (ft AD)	784.000	765.640	735.850	711.070

Figure E-25 Profile for BC-5

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



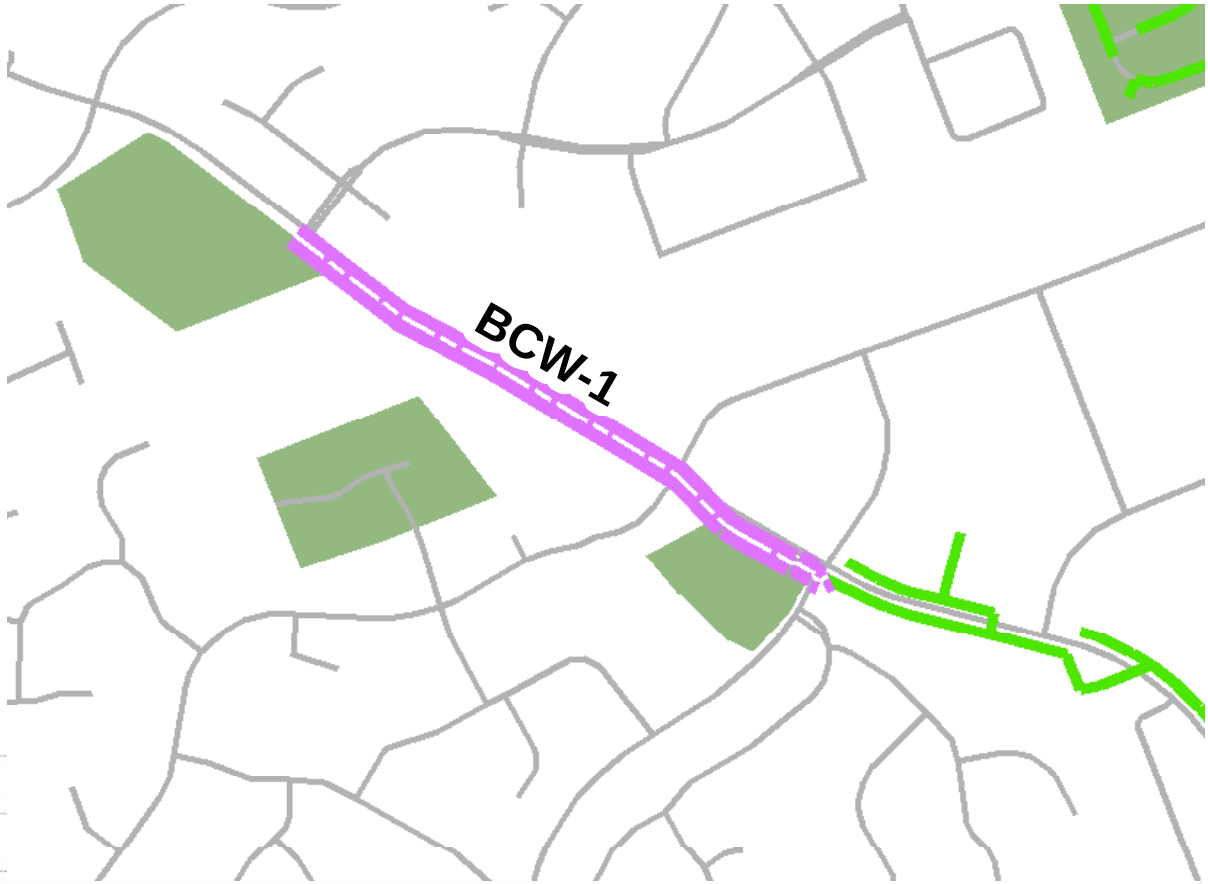


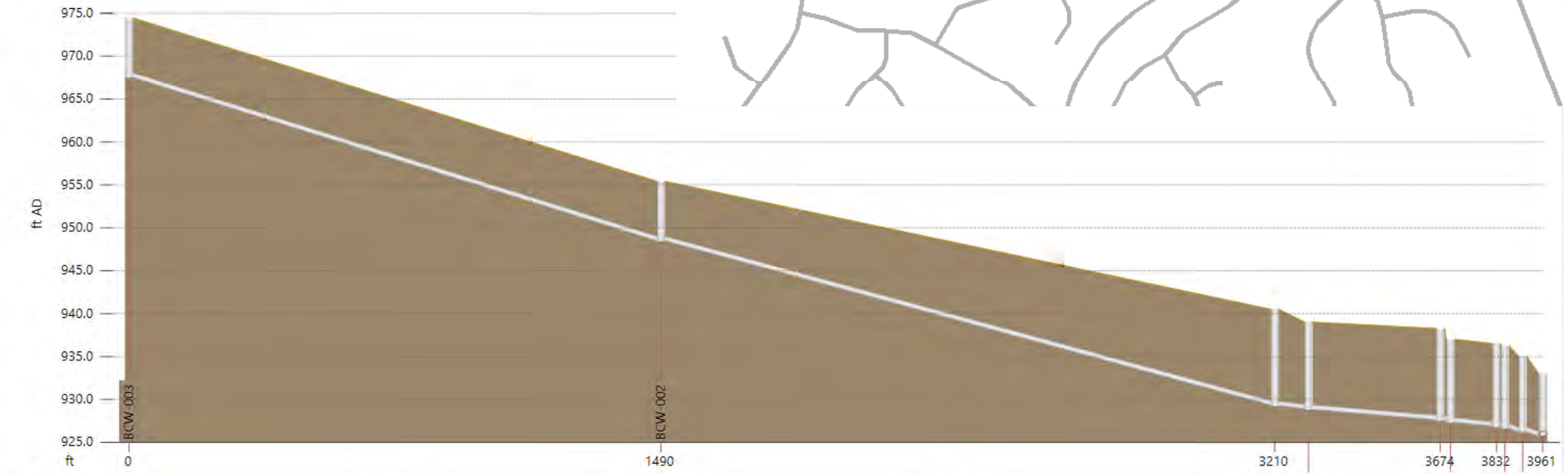
Link	BCI-702.1	BCI-702a.1	BCI-701.1
length (ft)	1428.0	2011.2	486.6
width (in)	10.0	10.0	10.0
us inv (ft AD)	718.870	705.000	697.000
ds inv (ft AD)	705.000	697.000	691.000
grad (%)	0.971	0.398	1.233
pfc (MGD)	1.40	0.89	1.57

Node	BCI-702	BCI-702a	BCI-701	BCI-MH-04
ground (ft AD)	725.870	712.000	704.000	697.840

Figure E-26 Profile for BCW-1

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



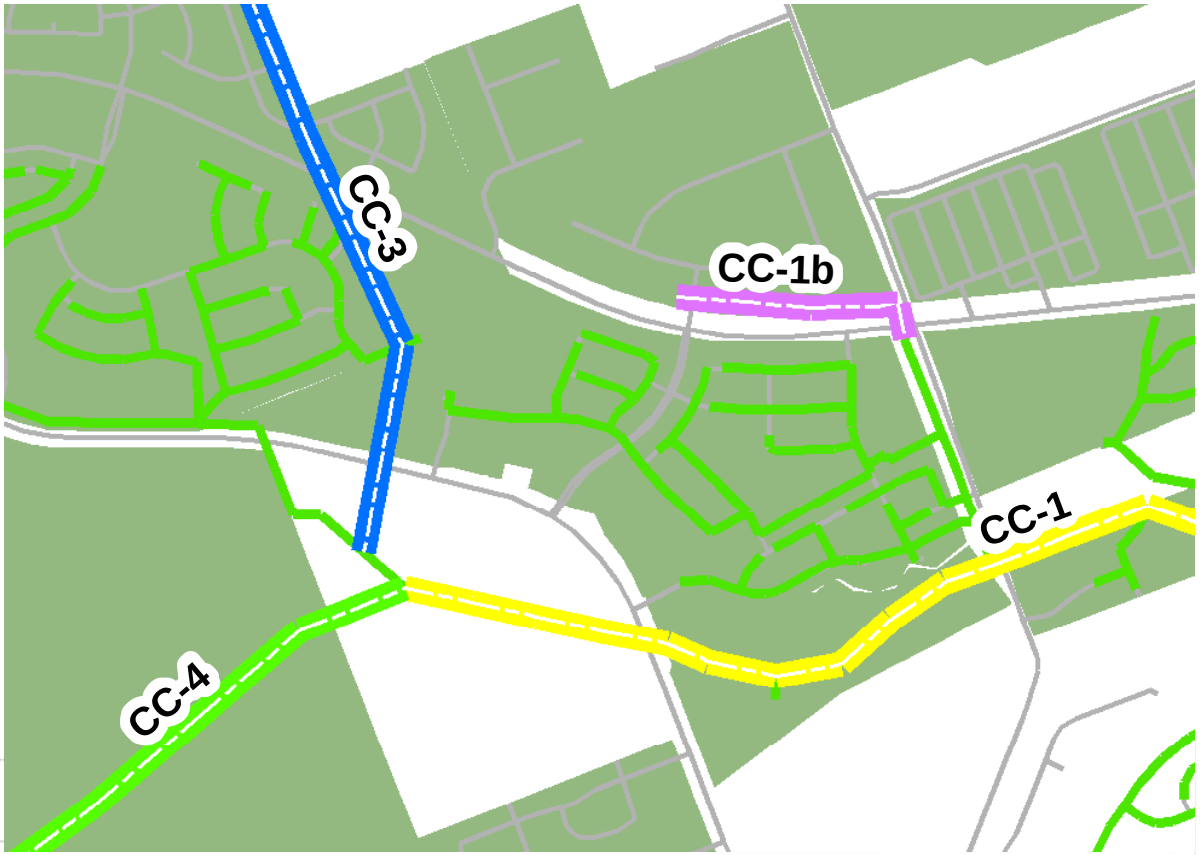


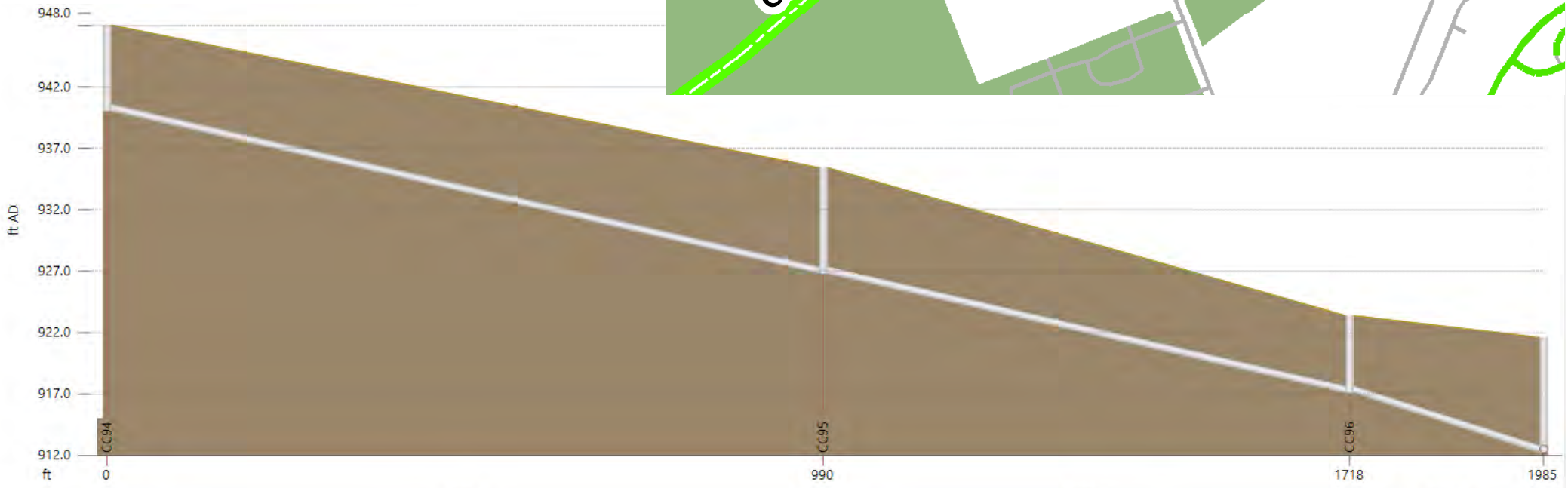
Link	BCW-003.1	BCW-002.1	-	OMM_MHA06.1	-	-	-
length (ft)	1490.4	1719.6	95.1	368.7	129.6	-	-
width (in)	8.0	8.0	8.0	8.0	8.0	-	-
us inv (ft AD)	967.440	948.400	-	928.760	-	-	-
ds inv (ft AD)	948.400	929.270	-	927.540	-	-	-
grad (%)	1.278	1.112	-	0.331	0.332	-	-
pfc (MGD)	0.88	0.82	0.45	0.45	0.45	-	-

Node	BCW-003	BCW-002	OMM_MHA07	-	-	-	-		
ground (ft AD)	974.440	955.400	940.500	939.000	938.250	-	-		

Figure E-27 Profile for CC-1b

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



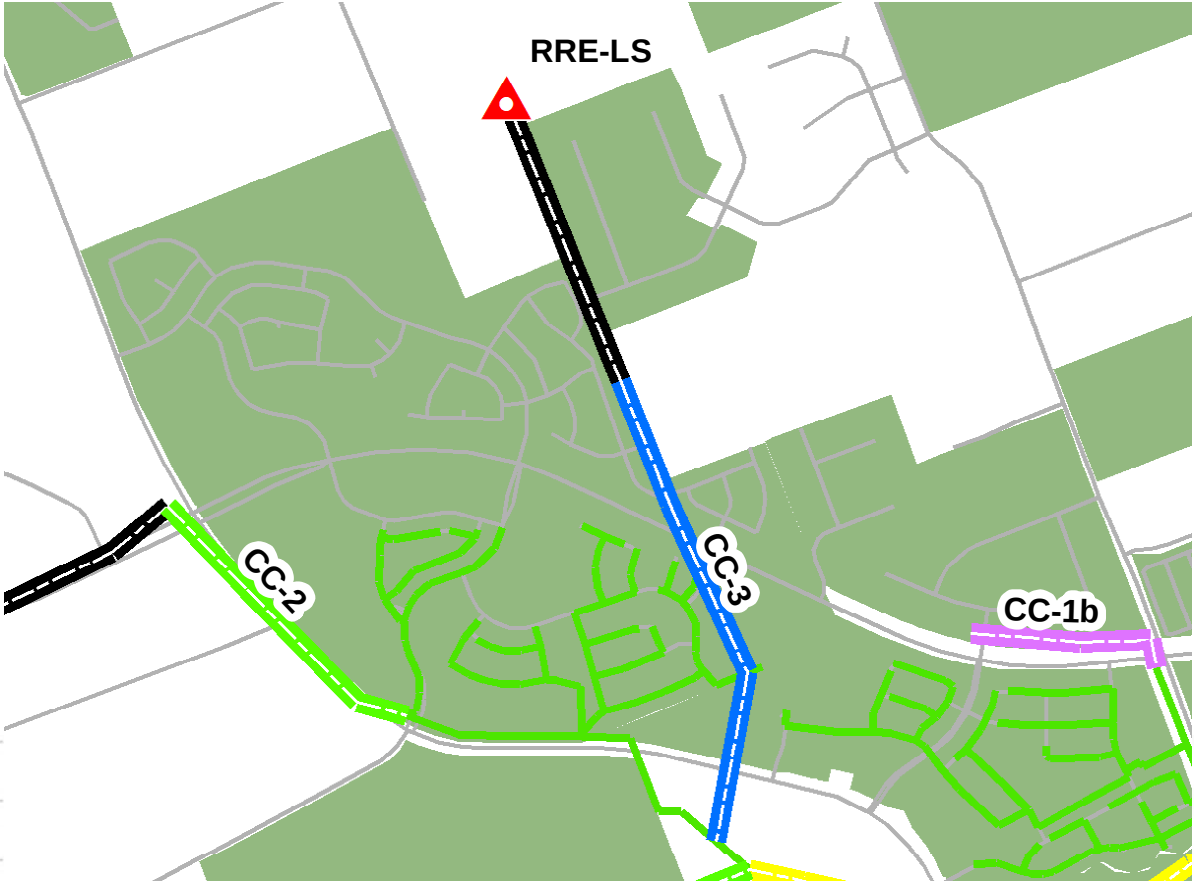


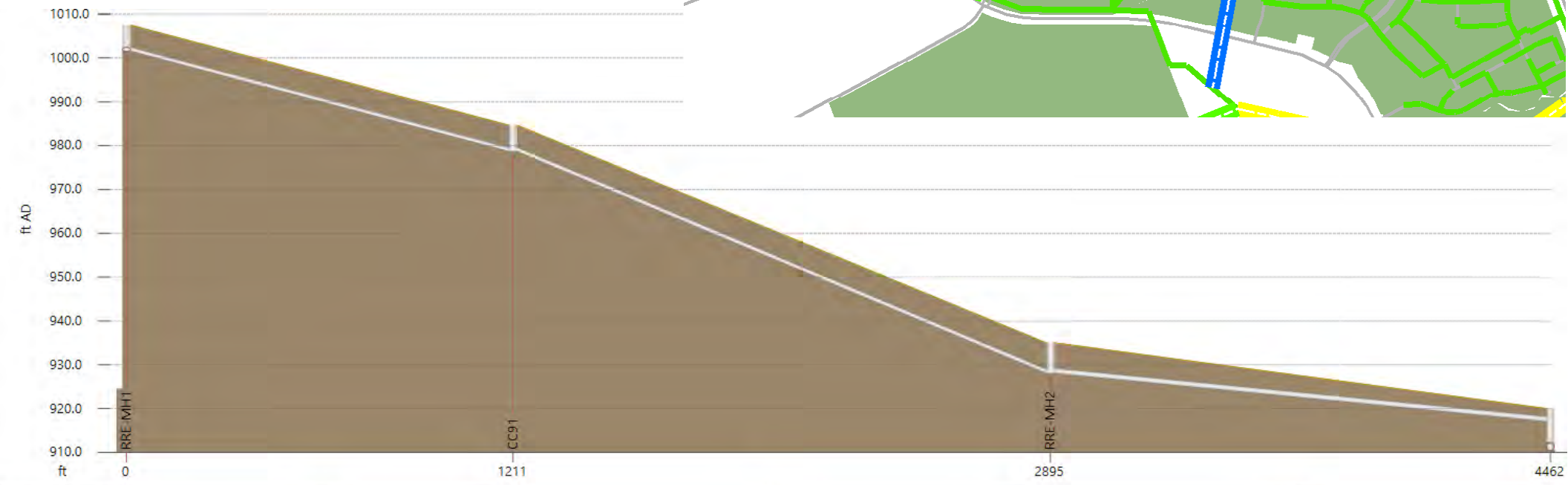
Link	CC94.1	CC95.1	CC96.1
length (ft)	990.0	727.7	267.8
width (in)	8.0	8.0	8.0
us inv (ft AD)	940.000	926.775	917.055
ds inv (ft AD)	926.775	917.055	912.210
grad (%)	1.336	1.336	1.810
pfc (MGD)	0.90	0.90	1.05

Node	CC94	CC95	CC96	SHSeF-1
ground (ft AD)	947.041	935.433	923.400	921.630

Figure E-28 Profile for CC-3

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)





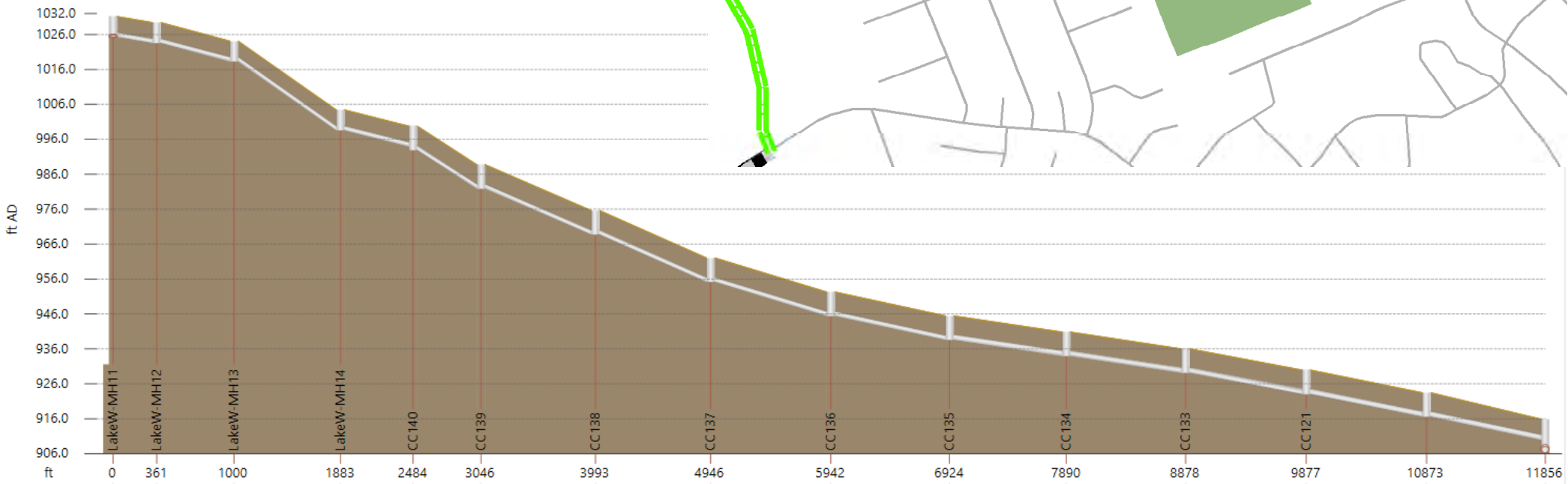
Link	RRE-MH1.1	CC91.2	RRE-MH2.1
length (ft)	1211.1	1683.9	1567.0
width (in)	12.0	12.0	15.0
us inv (ft AD)	1001.516	978.659	928.000
ds inv (ft AD)	978.659	928.000	917.000
grad (%)	1.887	3.008	0.702
pfc (MGD)	3.16	3.99	3.50

Node	RRE-MH1	CC91	RRE-MH2	PaRc-A11P1
ground (ft AD)	1007.516	984.659	935.000	920.000

Figure E-29 Profile for CC-4

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



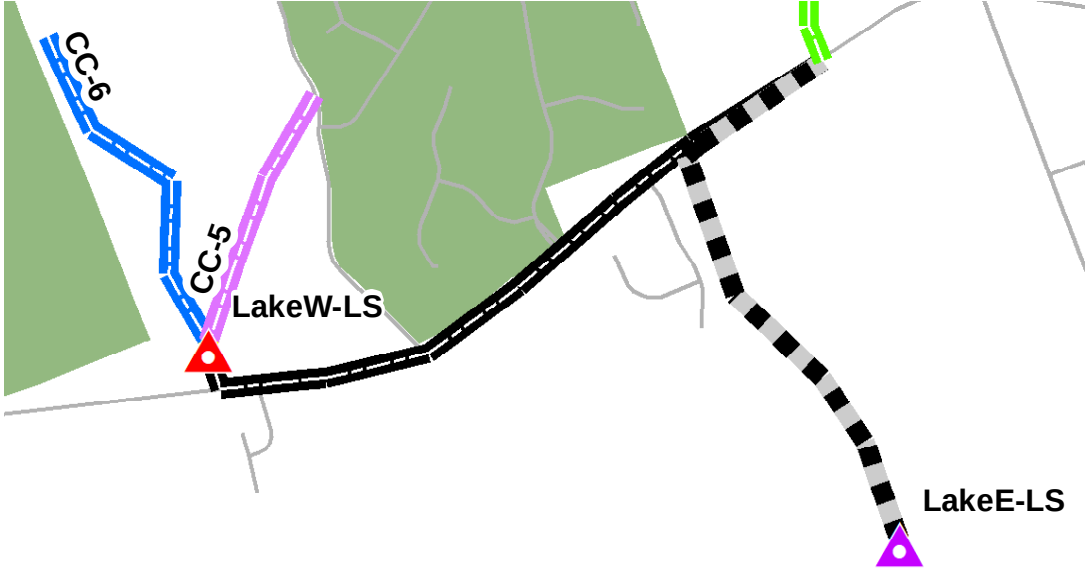


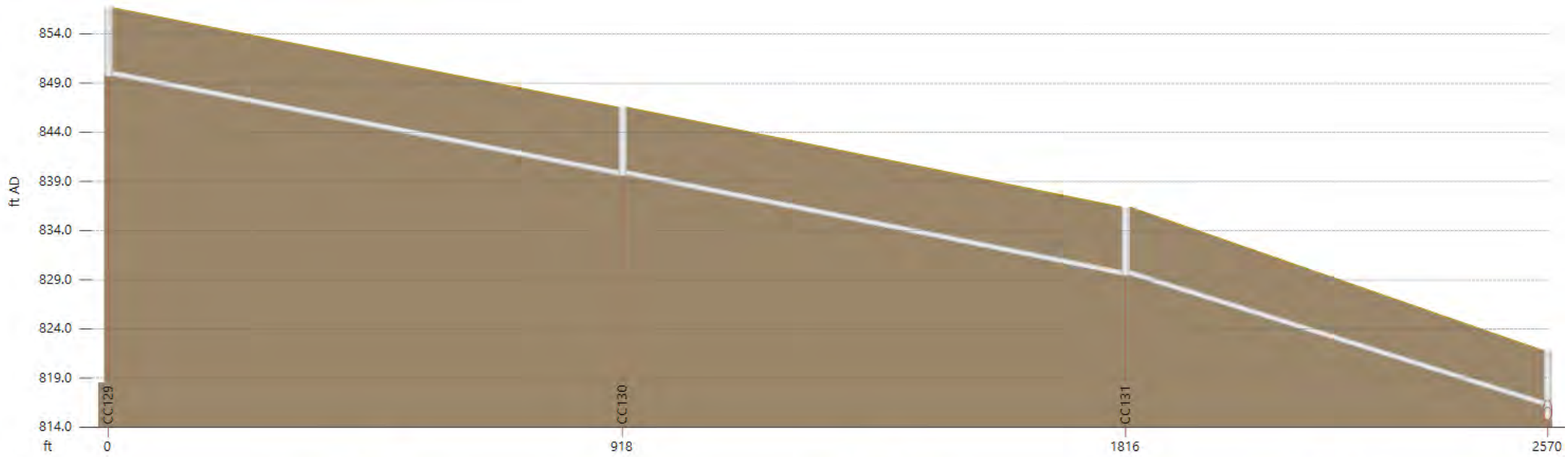
Link	-	-	LakeW-MH13.1	-	CC140.1	CC139.1	CC138.1	CC137.1	CC136.1	CC135.1	CC134.1	CC133.1	CC121.1	CC122.1
length (ft)	361.1	638.9	882.8	600.8	562.6	946.6	952.8	996.2	981.9	966.7	987.9	999.0	995.4	983.6
width (in)	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	21.0	21.0	21.0	21.0	21.0
us inv (ft AD)	-	1023.406	1018.134	998.403	992.770	981.717	968.604	955.064	945.300	938.456	933.824	929.010	922.951	916.458
ds inv (ft AD)	-	1018.134	998.403	993.777	981.717	968.604	955.064	945.300	938.456	933.824	929.010	922.951	916.458	909.801
grad (%)	0.482	0.825	2.235	0.770	1.965	1.385	1.421	0.980	0.697	0.479	0.487	0.607	0.652	0.677
pfc (MGD)	4.72	6.17	10.15	5.96	9.52	7.99	8.09	6.72	5.67	7.09	7.15	7.98	8.27	8.43

Node		-	-	-	CC140	CC139	CC138	CC137	CC136	CC135	CC134	CC133	CC121	CC122	-
ground (ft AD)		-	1024.134	1004.403	999.777	988.717	975.604	962.064	952.300	945.456	940.824	936.010	929.951	923.458	-

Figure E-30 Profile for CC-5

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



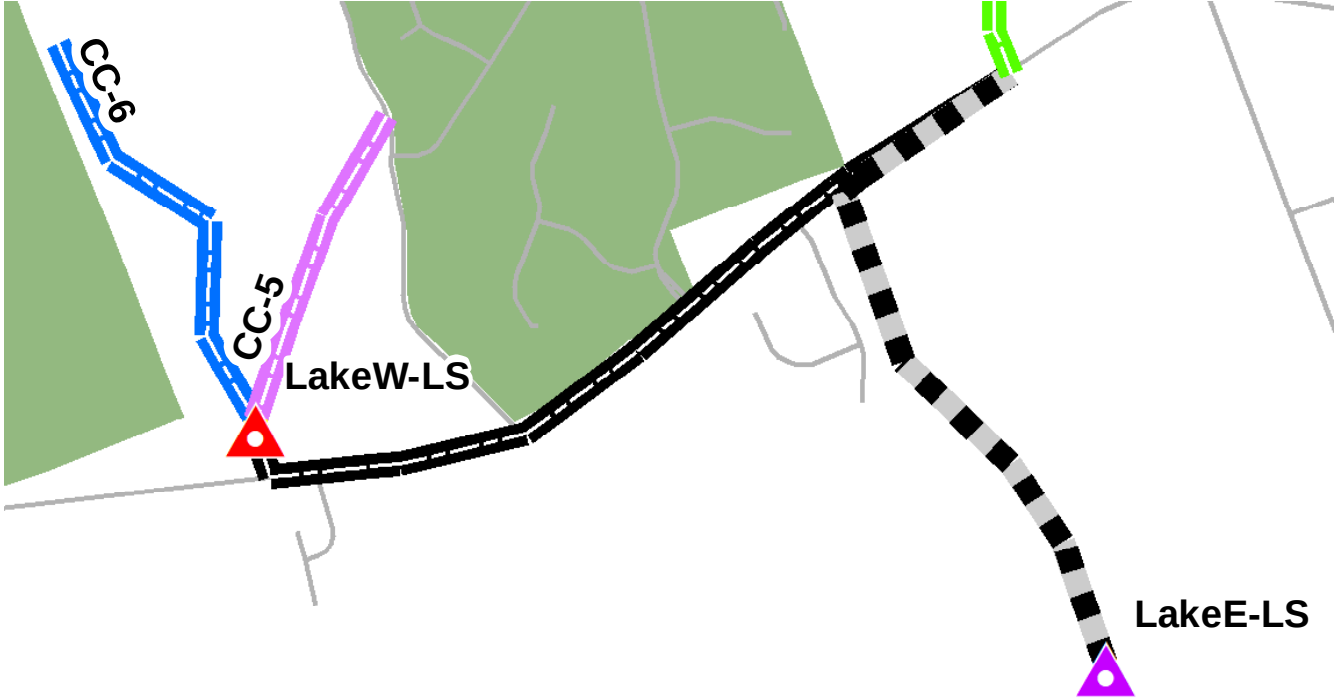


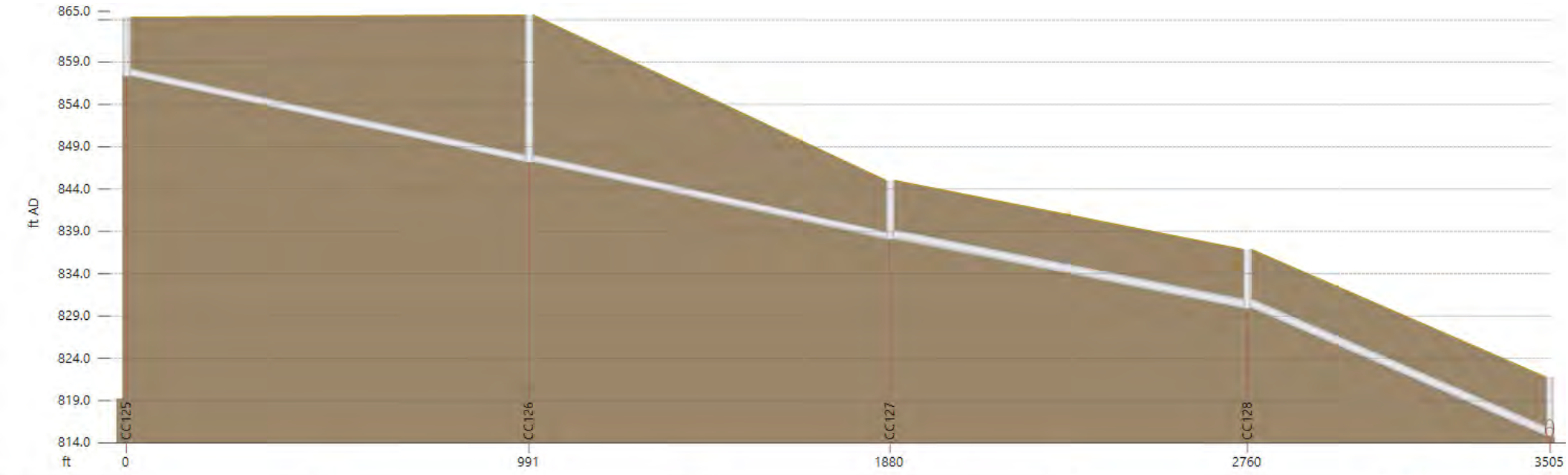
Link	CC129.1	CC130.1	CC131.1
length (ft)	917.7	898.4	753.5
width (in)	8.0	8.0	8.0
us inv (ft AD)	849.660	839.539	829.388
ds inv (ft AD)	839.539	829.388	816.113
grad (%)	1.103	1.130	1.762
pfc (MGD)	0.82	0.83	1.04

Node	CC129	CC130	CC131	LakeW-USLS
ground (ft AD)	856.660	846.539	836.388	821.780

Figure E-31 Profile for CC-6

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)





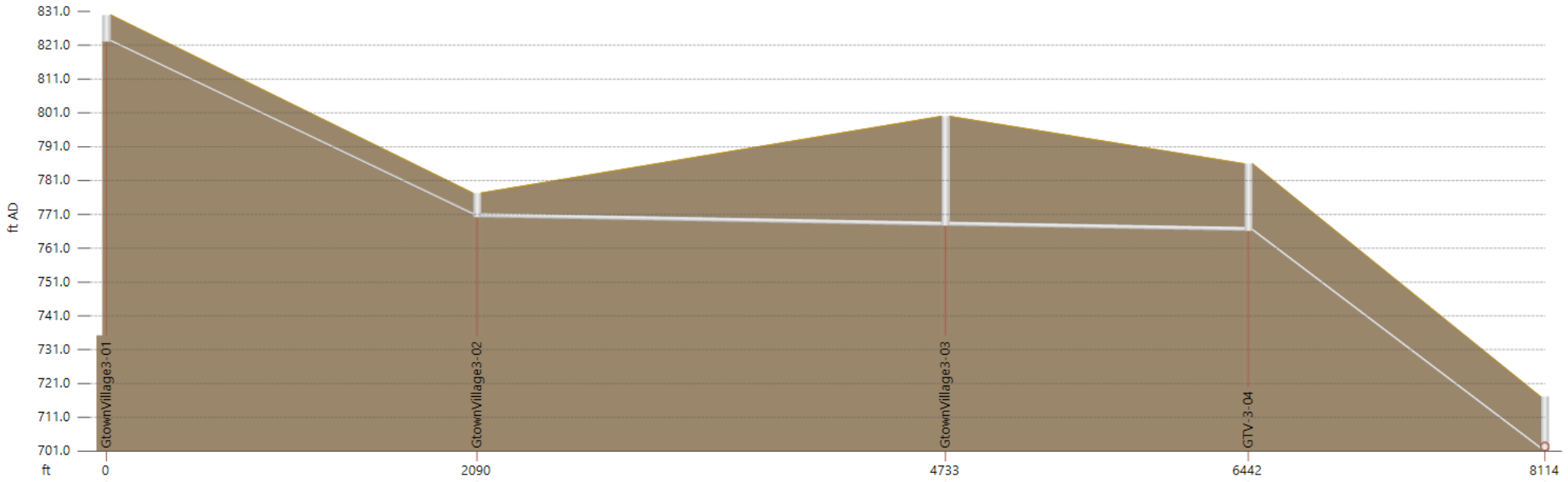
Link	CC125.1	CC126.1	CC127.1	CC128.1
length (ft)	990.7	889.1	879.8	745.1
width (in)	12.0	12.0	15.0	15.0
us inv (ft AD)	857.298	847.143	838.030	829.867
ds inv (ft AD)	847.143	838.030	829.867	814.780
grad (%)	1.025	1.025	0.928	2.025
pfc (MGD)	2.33	2.33	4.02	5.94

Node	CC125	CC126	CC127	CC128	LakeW-USLS
ground (ft AD)	864.298	864.583	845.030	836.867	821.780

Figure E-32 Profile for GV-1

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



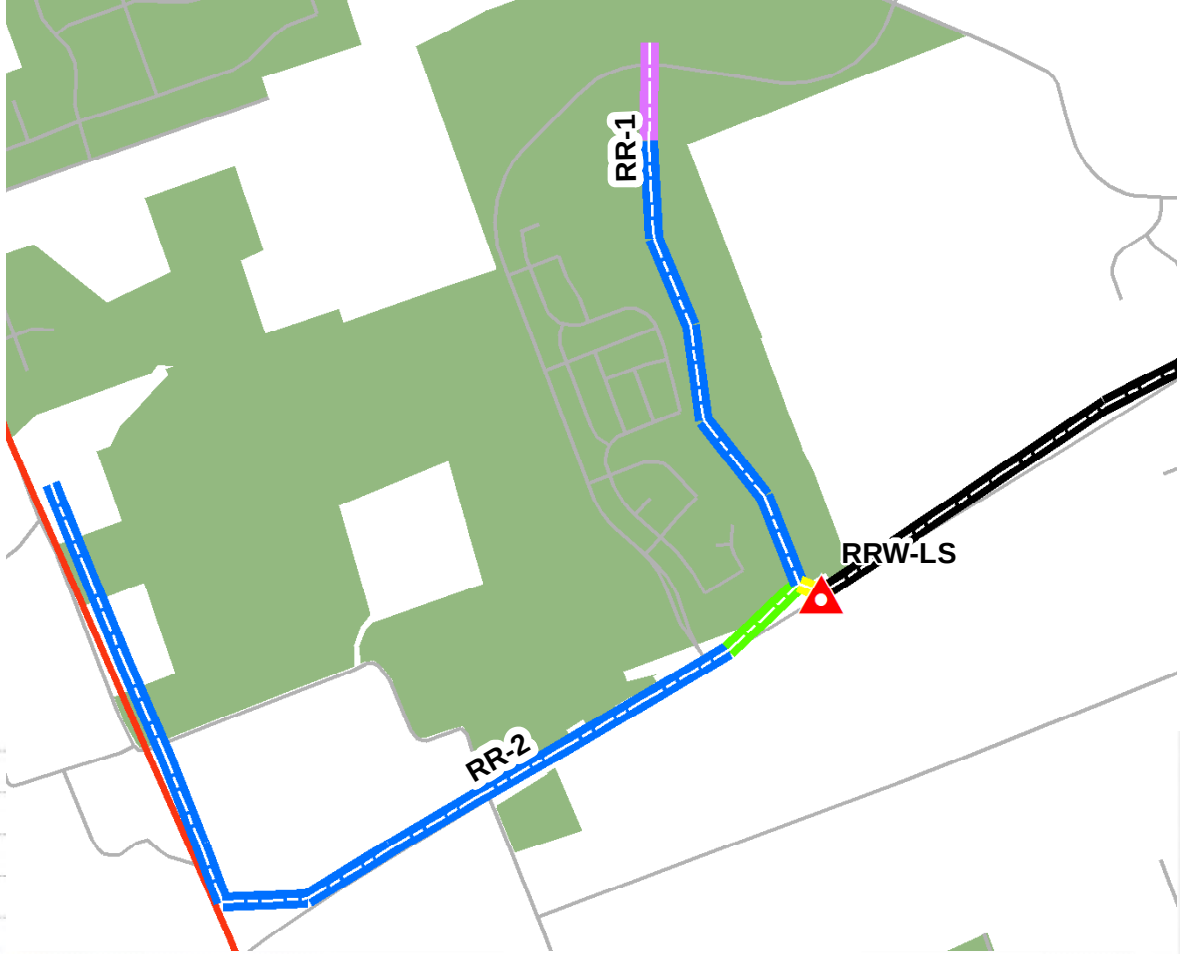


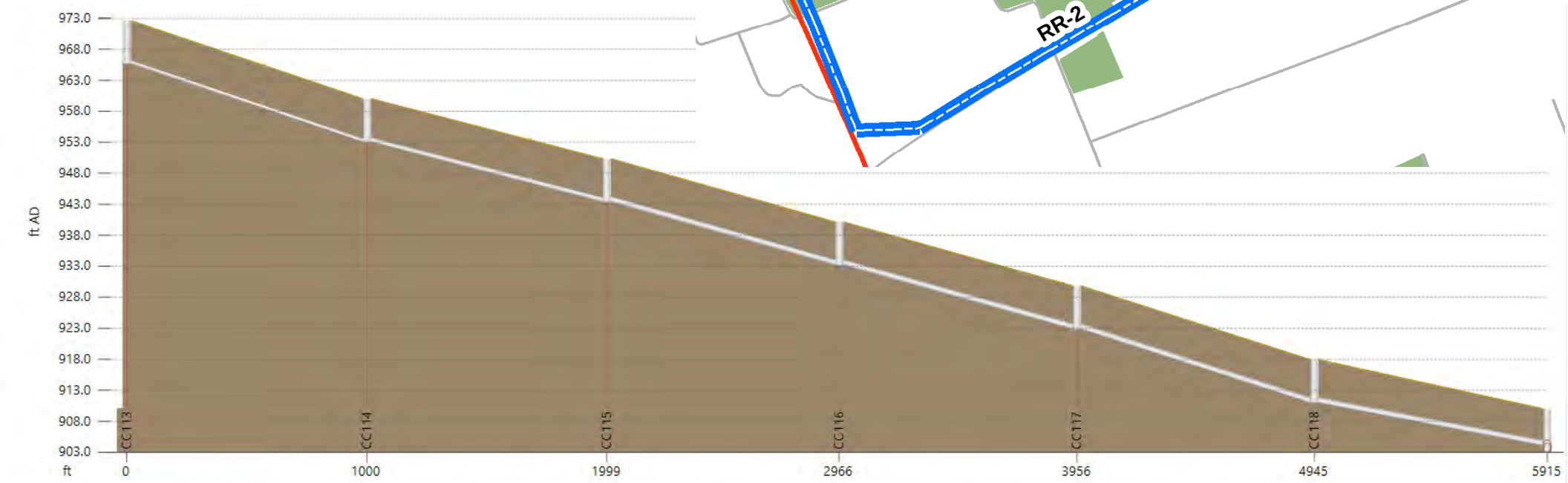
Link	GtownVillage3-01.1	GtownVillage3-02.1	GtownVillage3-03.1	GTV-3-04.1
length (ft)	2090.1	2642.8	1708.8	1672.6
width (in)	10.0	18.0	18.0	12.0
us inv (ft AD)	822.000	770.022	767.519	765.991
ds inv (ft AD)	770.855	767.519	765.991	701.500
grad (%)	2.447	0.095	0.089	3.856
pfc (MGD)	2.22	2.09	2.03	4.52

Node	GtownVillage3-01	GtownVillage3-02	GtownVillage3-03	GTV-3-04	BCI_MH25
ground (ft AD)	830.000	777.350	800.000	786.000	717.130

Figure E-33 Profile for RR-1

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



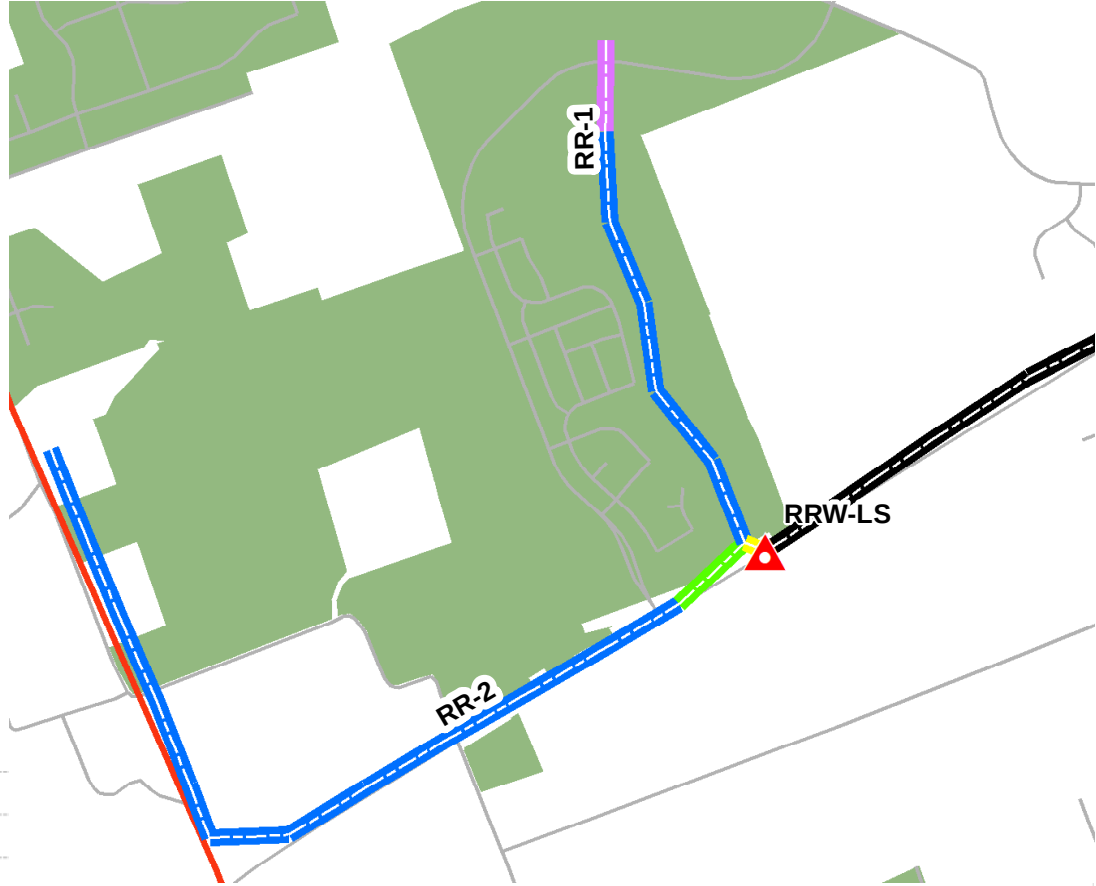


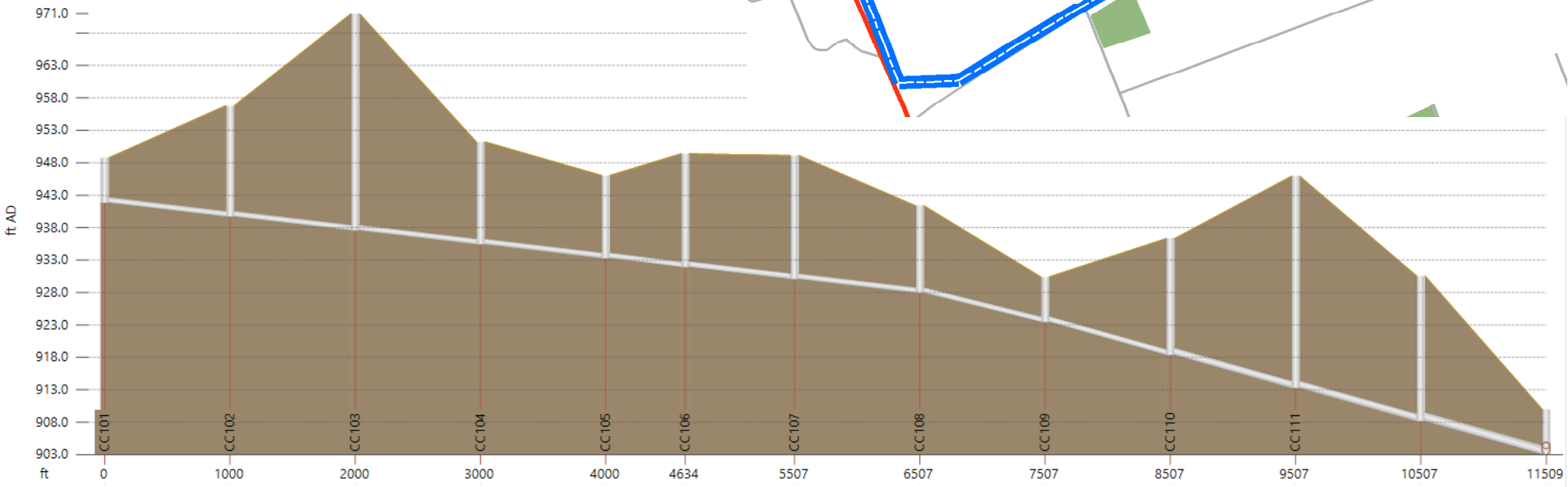
Link	CC113.1	CC114.1	CC115.1	CC116.1	CC117.1	CC118.1
length (ft)	1000.0	998.6	967.4	990.1	988.8	969.9
width (in)	8.0	10.0	12.0	12.0	12.0	12.0
us inv (ft AD)	965.615	953.016	943.341	933.151	922.829	910.930
ds inv (ft AD)	953.016	943.341	933.151	922.829	910.930	904.003
grad (%)	1.260	0.969	1.053	1.043	1.203	0.714
pfc (MGD)	0.88	1.39	2.36	2.35	2.53	1.95

Node	CC113	CC114	CC115	CC116	CC117	CC118	RRW-USLS
ground (ft AD)	972.615	960.016	950.341	940.151	929.829	917.930	910.003

Figure E-34 Profile for RR-2

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



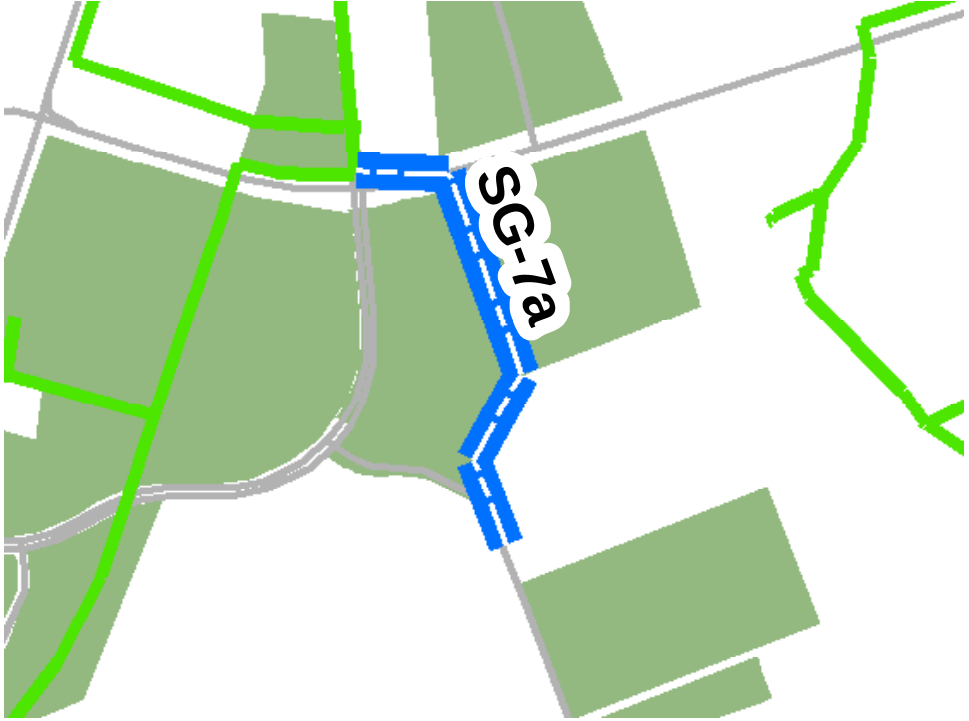


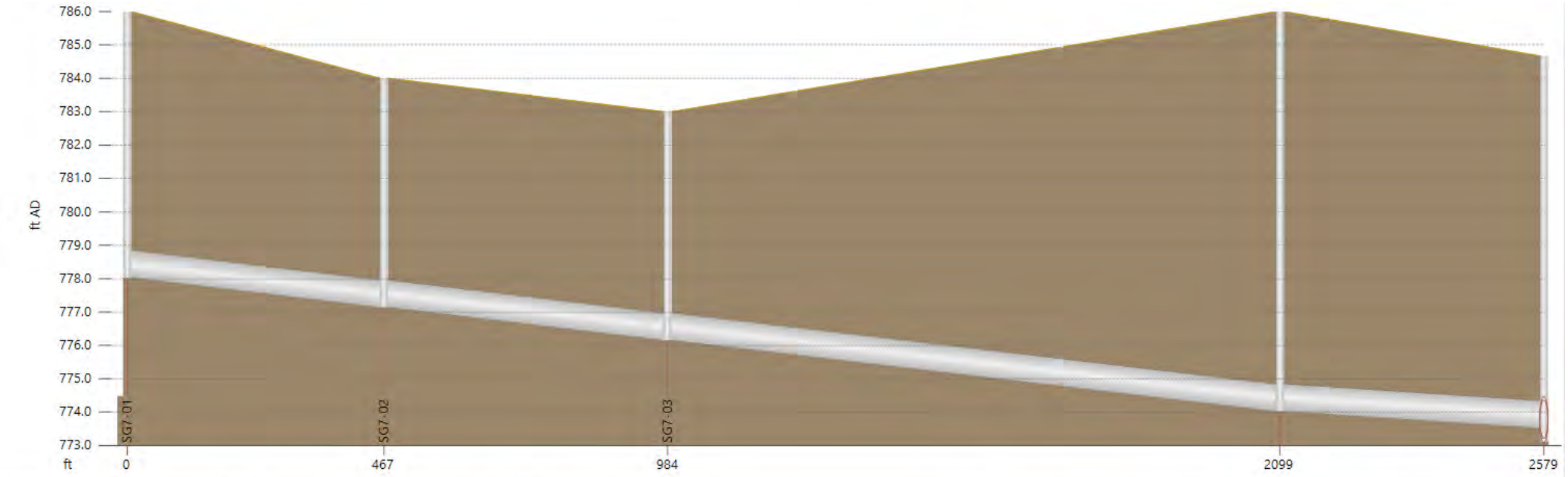
Link	CC101.1	CC102.1	CC103.1	CC104.1	CC105.1	CC106.1	CC107.1	CC108.1	CC109.1	CC110.1	CC111.1	CC112.1
length (ft)	1000.0	1000.0	1000.0	999.6	634.0	873.3	999.6	1000.0	1000.0	1000.0	1000.0	1002.3
width (in)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	15.0	15.0	18.0
us inv (ft AD)	941.776	939.638	937.501	935.363	933.226	931.871	930.004	927.867	923.407	918.309	913.211	908.113
ds inv (ft AD)	939.638	937.501	935.363	933.226	931.871	930.004	927.867	923.407	918.309	913.211	908.113	903.003
grad (%)	0.214	0.214	0.214	0.214	0.214	0.214	0.214	0.446	0.510	0.510	0.510	0.510
pfc (MGD)	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.54	1.64	2.98	2.98	4.85

Node	CC101	CC102	CC103	CC104	CC105	CC106	CC107	CC108	CC109	CC110	CC111	CC112	-
ground (ft AD)	948.776	956.800	971.000	951.234	946.047	949.377	949.131	941.368	930.407	936.306	945.925	930.561	910.003

Figure E-35 Profile for SG-7a

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



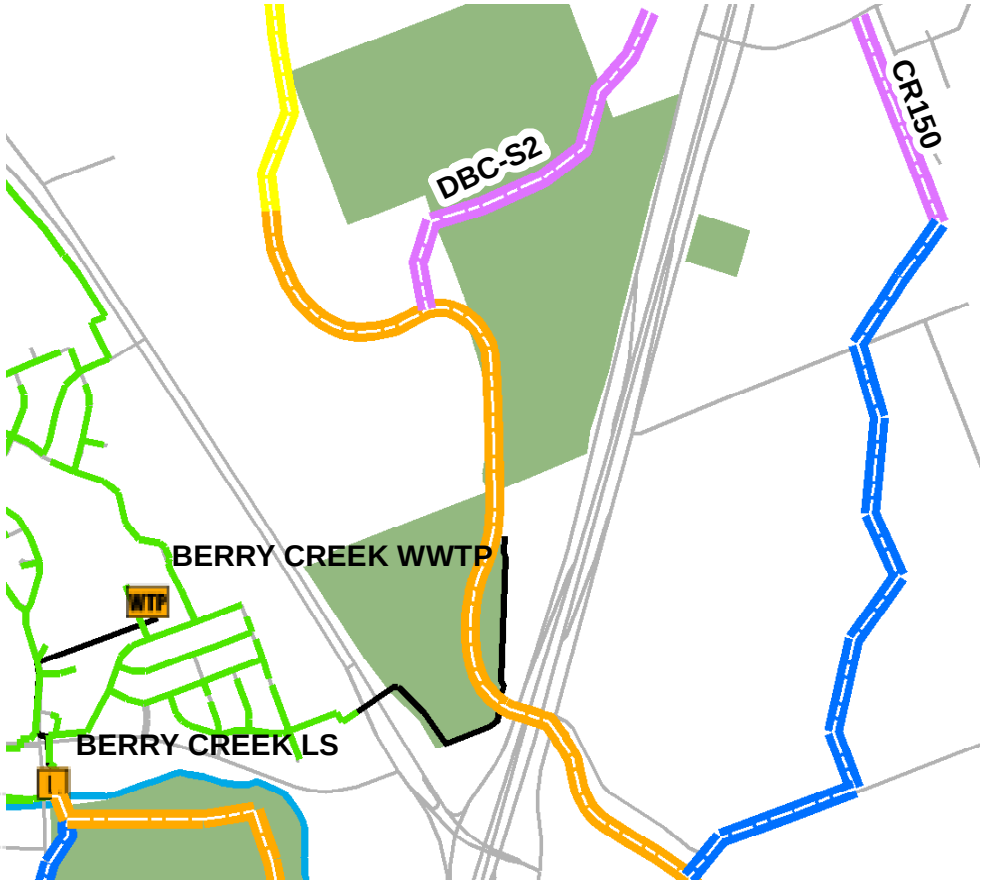


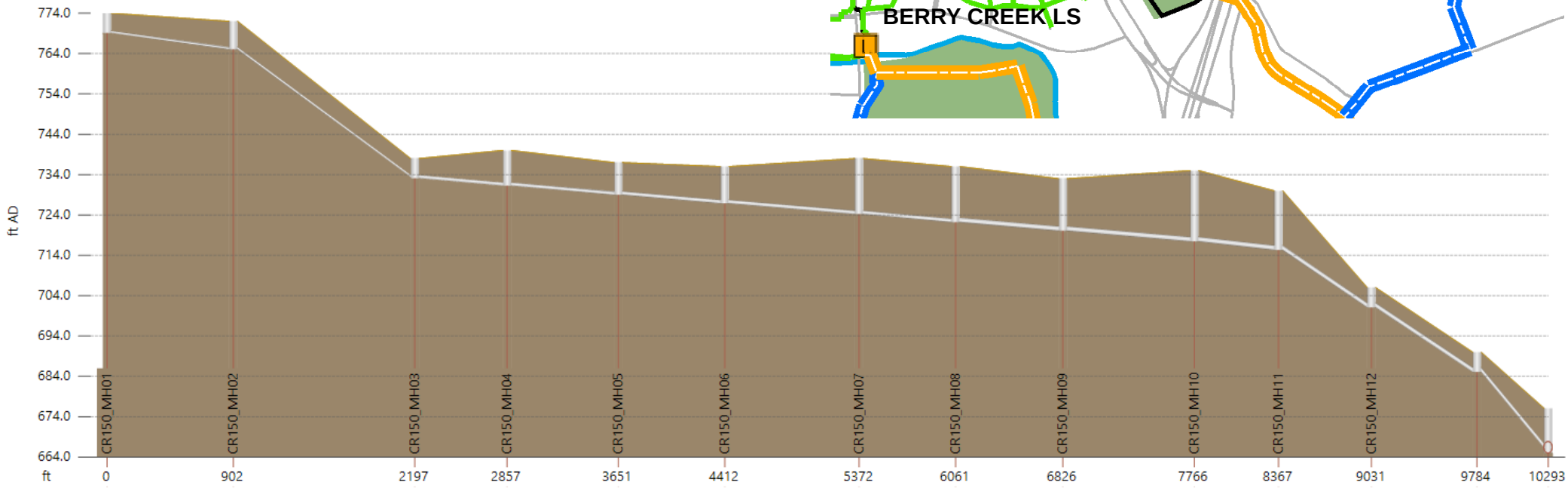
Link	SG7-01.1	SG7-02.1	SG7-03.1	SG7-04.1
length (ft)	467.5	516.6	1114.6	480.8
width (in)	10.0	10.0	10.0	10.0
us inv (ft AD)	778.023	777.131	776.145	774.018
ds inv (ft AD)	777.131	776.145	774.018	773.517
grad (%)	0.191	0.191	0.191	0.104
pfc (MGD)	0.62	0.62	0.62	0.46

Node	SG7-01	SG7-02	SG7-03	SG7-04	SB-MH20
ground (ft AD)	786.000	784.000	783.000	786.000	784.670

Figure E-36 Profile for CR150

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



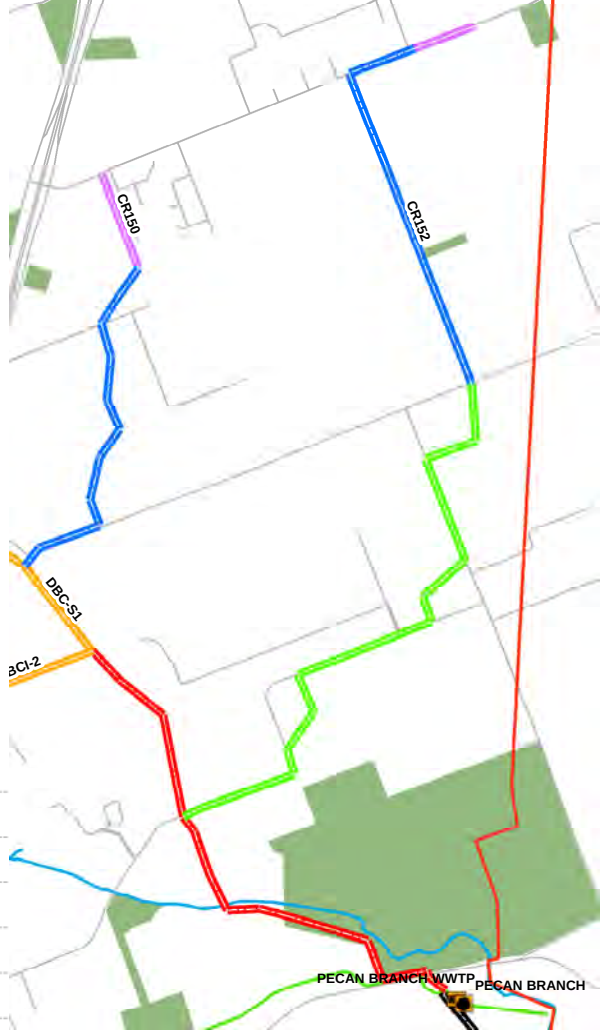


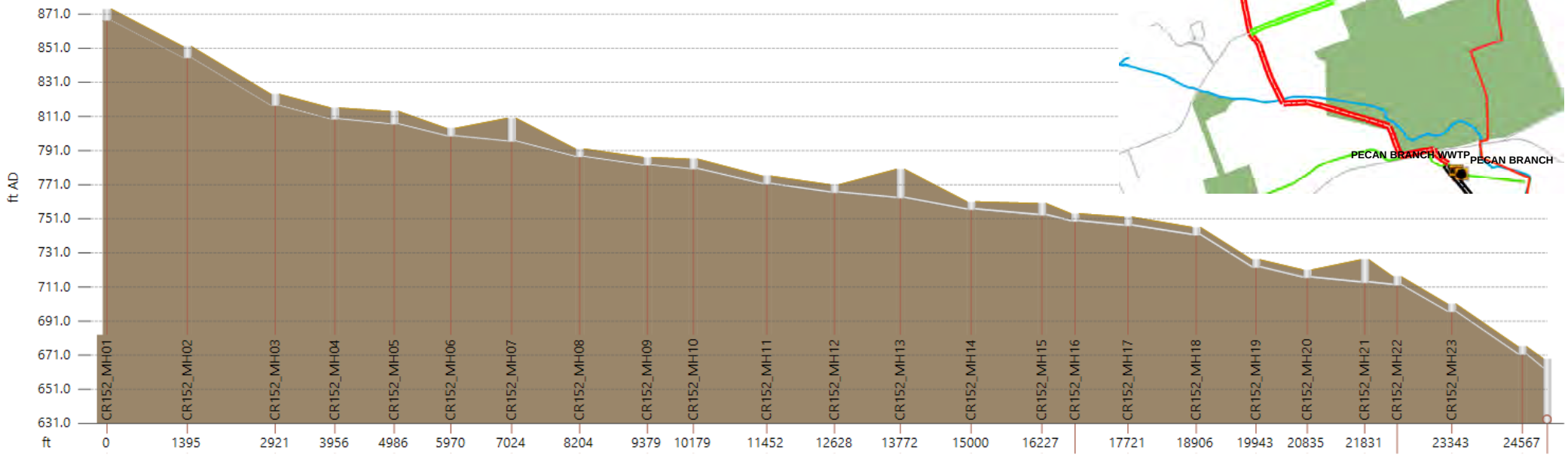
Link	CR150_MH01.1	CR150_MH02.1	-	CR150_MH04.1	CR150_MH05.1	CR150_MH06.1	-	CR150_MH08.1	CR150_MH09.1	-	-	CR150_MH12.1	-
length (ft)	901.5	1295.9	659.2	794.6	760.8	959.7	689.2	765.2	939.5	600.9	664.4	753.2	509.0
width (in)	8.0	8.0	12.0	12.0	12.0	12.0	12.0	15.0	15.0	15.0	15.0	15.0	15.0
us inv (ft AD)	769.000	765.000	733.000	731.150	728.920	726.790	724.100	722.170	720.020	717.370	715.280	701.000	685.000
ds inv (ft AD)	765.000	733.333	731.150	728.920	726.790	724.100	722.170	720.020	717.370	715.280	701.000	685.000	666.205
grad (%)	0.444	2.444	0.281	0.281	0.280	0.280	0.280	0.281	0.282	0.348	2.149	2.124	3.693
pfc (MGD)	0.52	1.22	1.22	1.22	1.22	1.22	1.22	2.21	2.22	2.46	6.12	6.09	8.02

Node	-	CR150_MH02	CR150_MH03	CR150_MH04	CR150_MH05	CR150_MH06	CR150_MH07	CR150_MH08	CR150_MH09	CR150_MH10	-	CR150_MH12	-	-
ground (ft AD)	774.000	772.000	738.000	740.000	737.000	736.000	738.000	736.000	733.000	735.000	730.000	706.000	690.000	-

Figure E-37 Profile for CR152

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



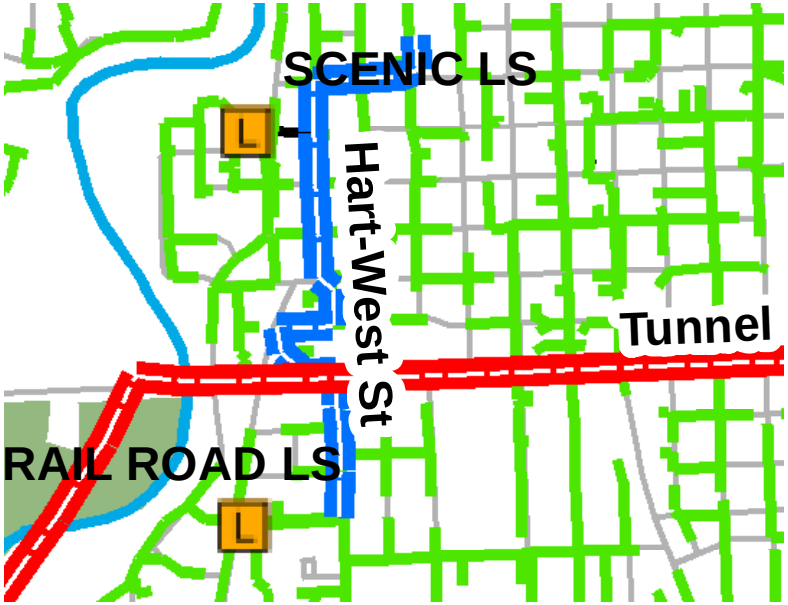


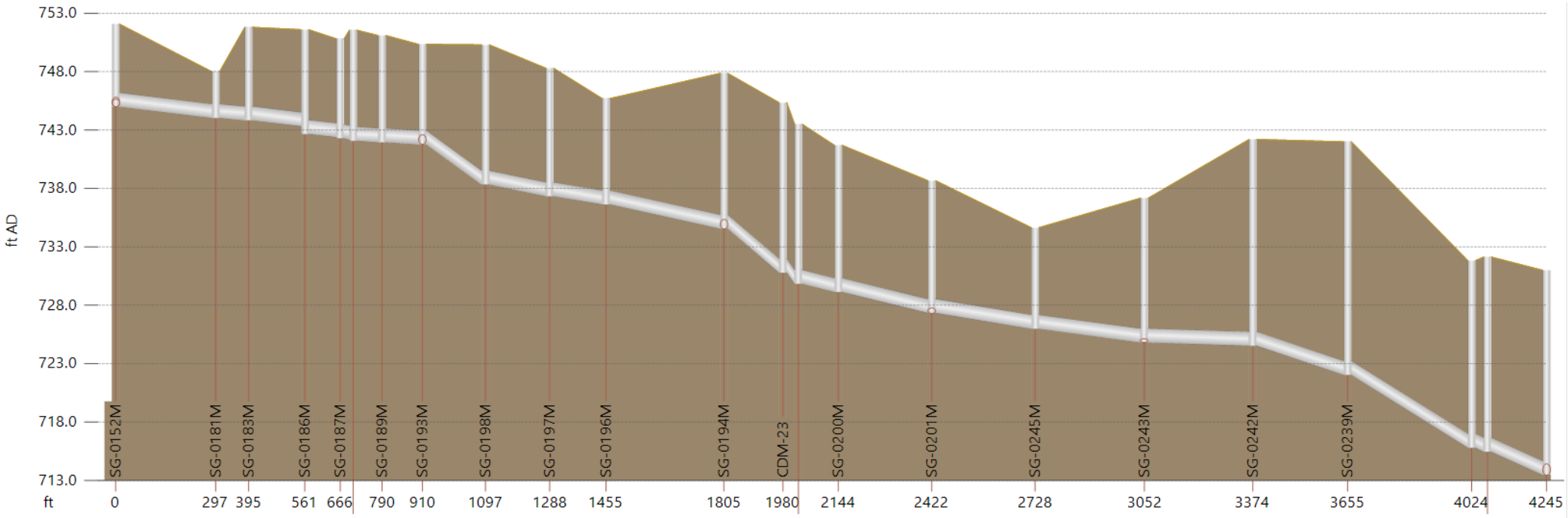
Link	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
length (ft)	1394.6	1526.6	1034.6	1029.8	984.2	1054.3	1179.9	1175.1	799.7	1273.2	1176.0	1143.6	1228.3	1226.8	-	916.5	1184.9	1037.3	892.3	995.7	-	946.9	1224.6	-
width (in)	8.0	10.0	12.0	15.0	15.0	15.0	15.0	15.0	15.0	18.0	18.0	18.0	18.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	18.0	18.0	-
us inv (ft AD)	867.000	845.000	817.000	809.000	806.110	799.000	796.040	787.000	-	779.760	771.000	766.000	762.790	756.000	-	749.000	746.430	741.000	-	716.000	-	711.620	696.000	-
ds inv (ft AD)	845.000	817.000	809.000	806.100	799.000	796.000	787.000	782.000	-	771.000	766.000	762.800	756.000	752.600	-	746.400	741.000	722.000	-	713.200	-	696.000	671.000	-
grad (%)	1.578	1.834	0.773	0.282	0.722	0.285	0.766	0.425	0.275	0.688	0.425	0.280	0.553	0.277	-	0.284	0.458	1.832	0.672	0.281	-	1.650	2.041	-
pfc (MGD)	0.98	1.92	2.03	2.22	3.55	2.23	3.66	2.72	2.19	5.63	4.43	3.59	5.05	5.39	8.04	5.46	6.93	13.86	8.40	5.43	5.47	8.72	9.70	-

Node	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ground (ft AD)	-	852.000	824.000	-	-	-	810.000	792.000	-	-	776.000	771.000	780.000	761.000	-	-	-	746.000	-	-	-	-	-	-	-	-	-

Figure E-38 Profile for Hart-West St

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



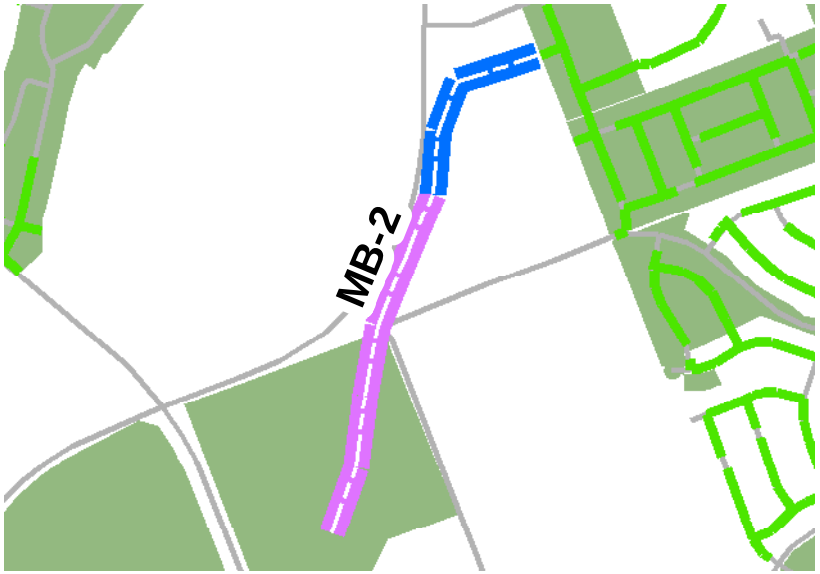


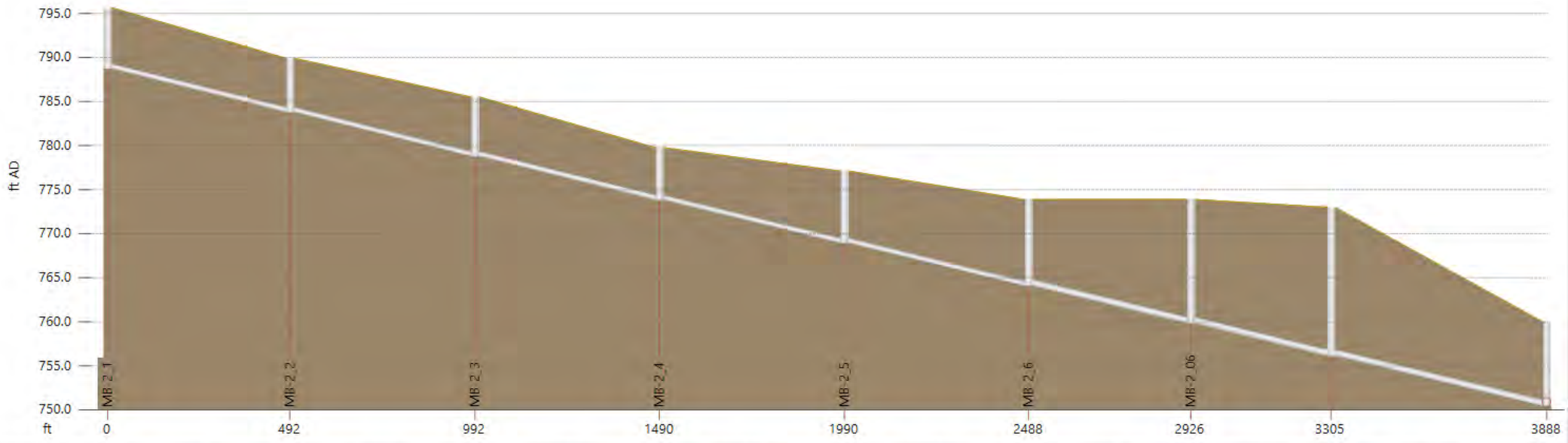
Link		SG-0152M.1	-	-	-	-	-	-	-	-	SG-0196M.1	-	-	-	SG-0200M.1	SG-0201M.1	SG-0245M.1	SG-0243M.1	SG-0242M.1	SG-0239M.1	-	-
length (ft)		296.9	-	166.6	-	-	-	186.9	190.7	167.4	349.6	175.0	-	-	277.3	306.7	324.1	322.0	281.0	368.4	-	175.0
width (in)		15.0	-	15.0	15.0	-	15.0	15.0	15.0	15.0	15.0	15.0	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	-	15.0
us inv (ft AD)		744.970	-	-	-	-	-	741.740	738.300	-	736.600	734.520	-	-	729.100	727.310	725.950	724.780	724.500	722.000	-	715.420
ds inv (ft AD)		744.000	-	-	-	-	-	738.300	737.300	-	734.520	730.758	-	-	727.310	725.950	724.780	724.500	722.000	715.770	-	713.440
grad (%)		0.327	-	0.300	-	-	-	1.840	0.524	0.418	0.595	2.149	-	-	0.646	0.443	0.361	0.087	0.890	1.691	-	1.132
pfc (MGD)		2.39	-	2.29	2.12	-	1.62	5.67	3.02	2.70	3.22	6.12	-	3.21	3.36	2.78	2.51	1.23	3.94	5.43	-	4.44

Node	-	-	-	-			-	-	-	-	-	-	-	-	-	SG-0201M	SG-0245M	SG-0243M	SG-0242M	SG-0239M	-	-	-
ground (ft AD)	-	-	-	-			-	-	-	-	745.700	747.860	-	-	-	738.670	734.650	737.170	742.200	742.000	731.830	-	-

Figure E-39 Profile for MB-2

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



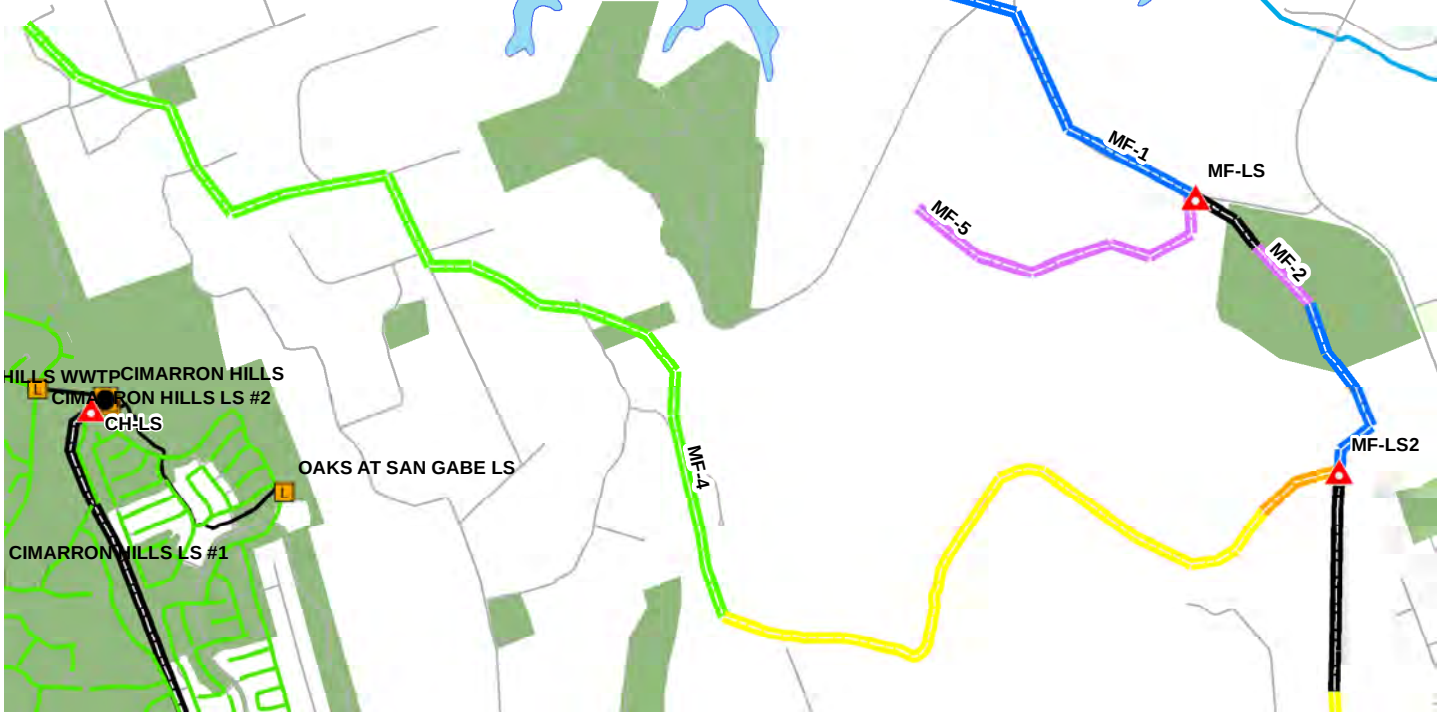


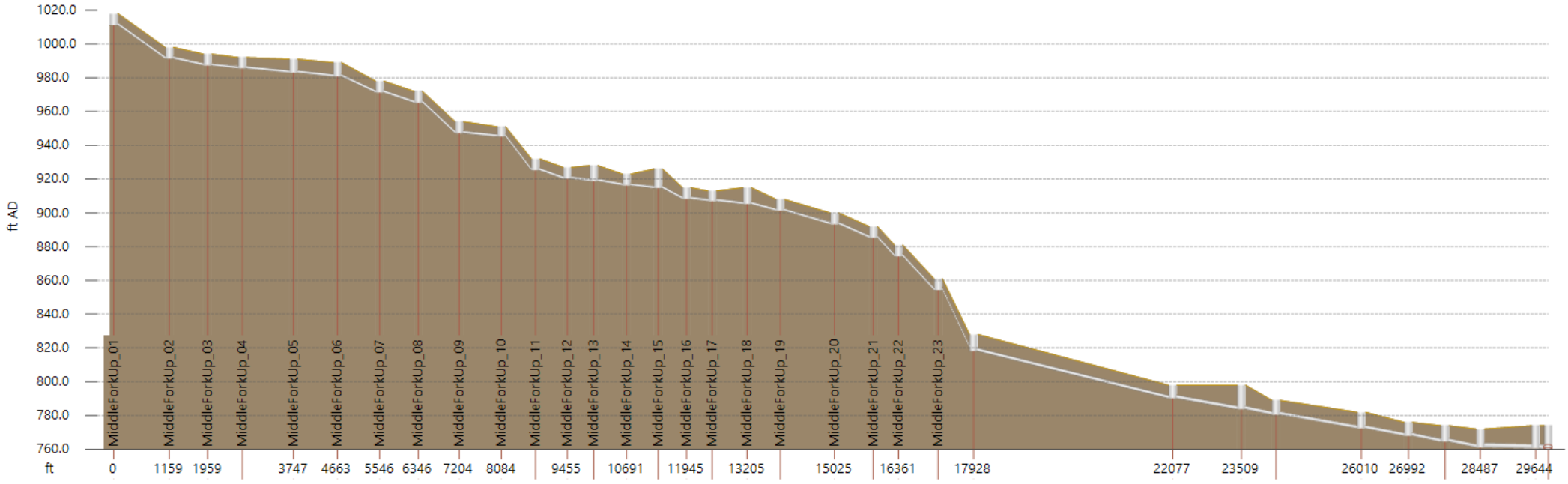
Link	MB-2_1.1	MB-2_2.1	MB-2_3.1	MB-2_4.1	MB-2_5.1	MB-2_6.1	MB-2_06.1	MB-2_07.1
length (ft)	492.3	499.9	498.2	499.9	497.4	438.3	378.6	583.3
width (in)	8.0	8.0	8.0	8.0	8.0	10.0	10.0	10.0
us inv (ft AD)	788.670	783.747	778.748	773.766	768.890	764.038	759.763	756.070
ds inv (ft AD)	783.747	778.748	773.766	768.890	764.038	759.763	756.070	750.380
grad (%)	1.000	1.000	1.000	0.975	0.975	0.975	0.975	0.975
pfc (MGD)	0.78	0.78	0.78	0.77	0.77	1.40	1.40	1.40

Node	MB-2_1	MB-2_2	MB-2_3	MB-2_4	MB-2_5	MB-2_6	MB-2_06	MB-2_07	MB-2_09d
ground (ft AD)	795.655	789.919	785.530	779.766	777.113	773.880	773.880	772.998	760.000

Figure E-40 Profile for MF-4

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



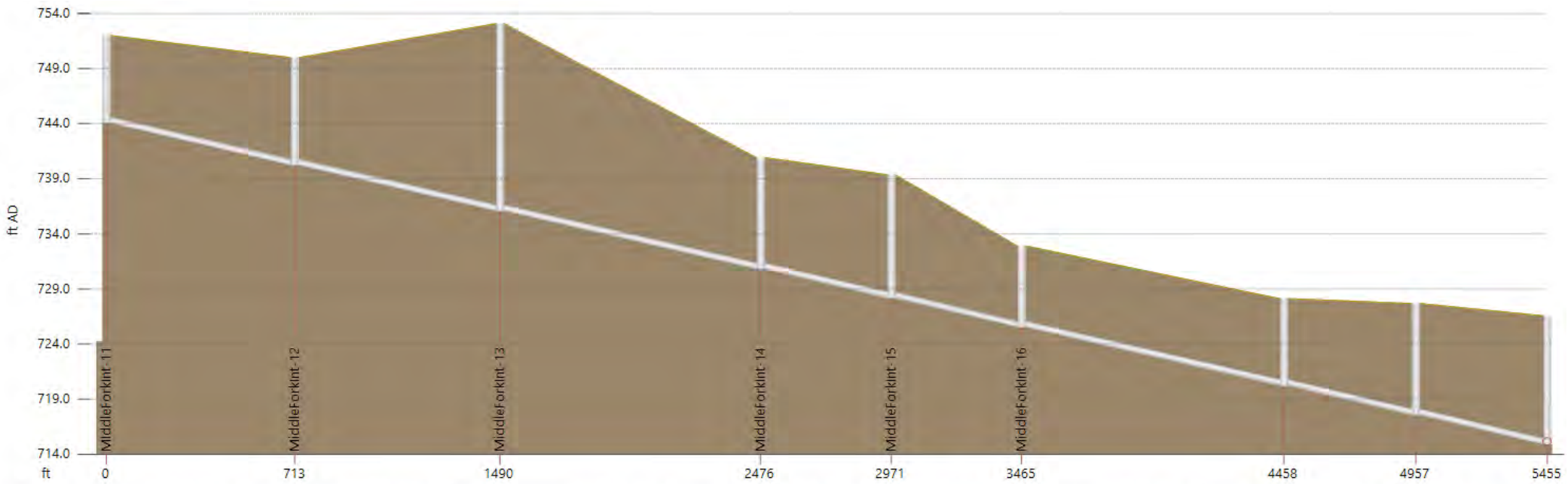


| Link | - | - | -

Figure E-41 Profile for MF-6

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)



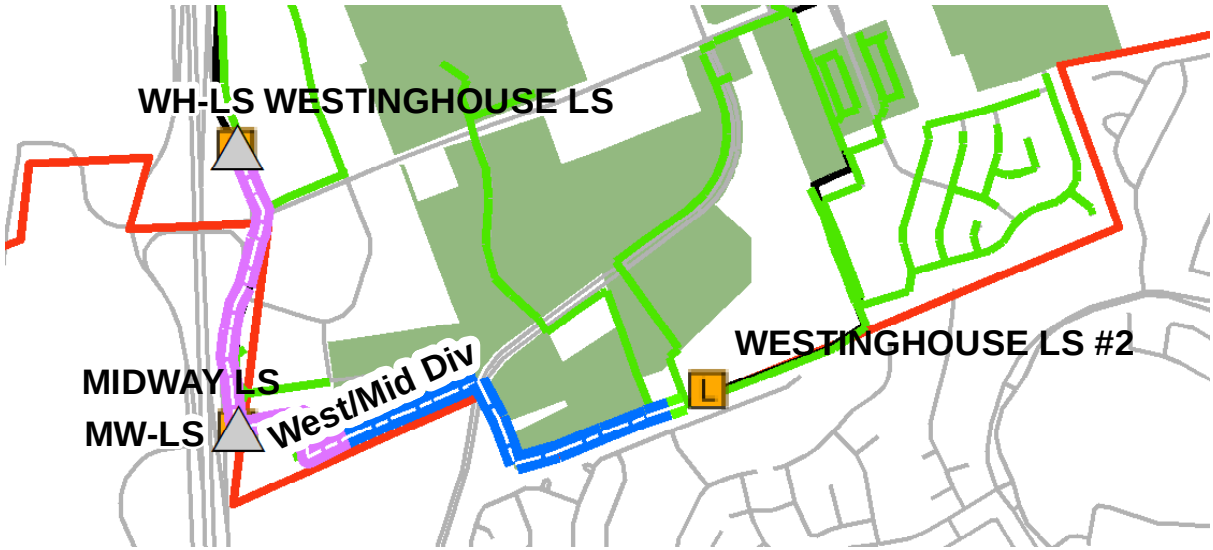


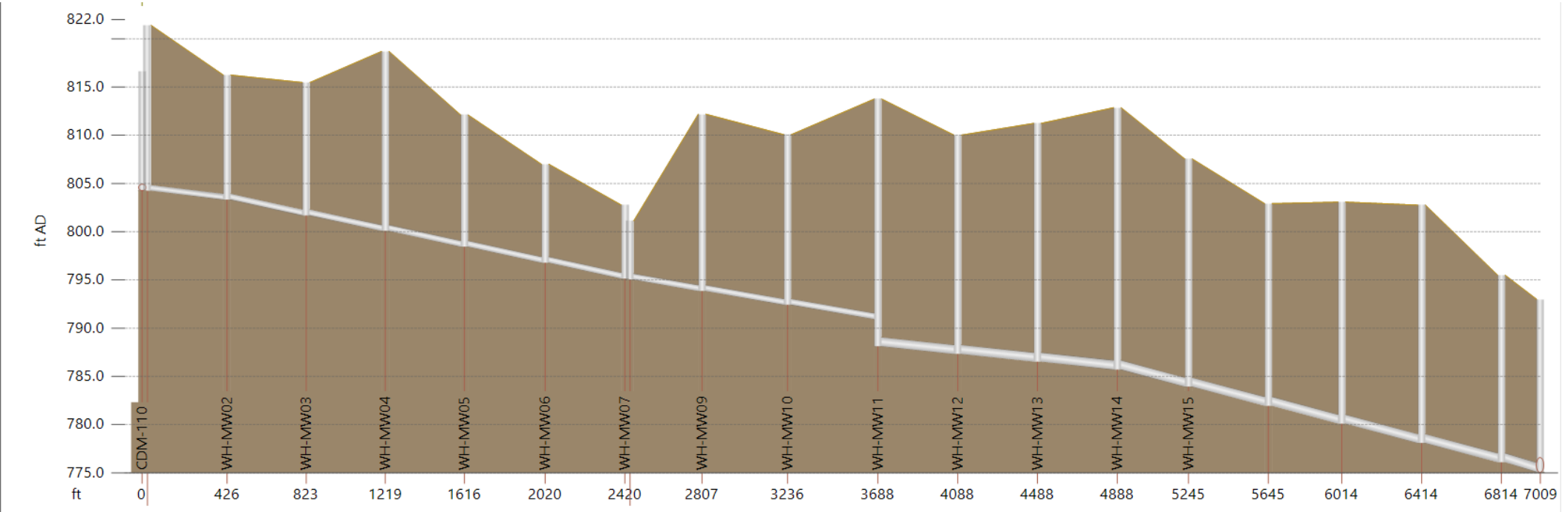
Link	MiddleForkInt-11.2	MiddleForkInt-12.1	MiddleForkInt-13.1	MiddleForkInt-14.1	MiddleForkInt-15.1	MiddleForkInt-16.1	MiddleForkInt-17.1	MiddleForkInt-18.1
length (ft)	713.4	776.5	986.6	494.7	493.5	993.1	499.1	498.5
width (in)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
us inv (ft AD)	744.000	740.180	736.033	730.763	728.121	725.485	720.181	717.515
ds inv (ft AD)	740.180	736.033	730.763	728.121	725.485	720.181	717.515	714.852
grad (%)	0.535	0.534	0.534	0.534	0.534	0.534	0.534	0.534
pfc (MGD)	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57

Node	-	MiddleForkInt-12	MiddleForkInt-13	MiddleForkInt-14	MiddleForkInt-15	MiddleForkInt-16	MiddleForkInt-17	MiddleForkInt-18	-
ground (ft AD)	752.000	750.000	753.077	740.926	739.369	732.906	728.129	727.681	726.568

Figure E-42 Profile for West/Mid Div

Profile Key	
width (in)	Diameter in inches
us inv (ft AD)	Upstream Invert Elevation (ft)
ds inv (ft AD)	Downstream Invert Elevation (ft)
grad (%)	Gradient in percent
pfc (MGD)	Pipe Full Capacity (mgd)
Project Name	Master Plan Project Name
ground (ft AD)	Manhole Rim Elevation (ft)





Link	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
length (ft)	399.3	396.4	396.3	396.6	404.6	399.9	361.0	428.6	452.9	400.0	400.0	400.0	357.0	400.0	368.4	400.0	400.0	-	
width (in)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
us inv (ft AD)	804.210	803.299	801.670	800.041	798.412	796.749	795.000	793.809	792.395	788.085	787.285	786.485	785.685	783.900	781.899	780.056	778.056	-	
ds inv (ft AD)	803.299	801.670	800.041	798.412	796.749	795.105	793.809	792.395	790.900	787.285	786.485	785.685	783.900	781.899	780.056	778.056	776.055	-	
grad (%)	0.228	0.411	0.411	0.411	0.411	0.411	0.330	0.330	0.330	0.200	0.200	0.200	0.500	0.500	0.500	0.500	0.500	-	
pfc (MGD)	0.37	0.50	0.50	0.50	0.50	0.50	0.45	0.45	0.45	1.03	1.03	1.03	1.63	1.63	1.63	1.63	1.63	1.63	

Node	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ground (ft AD)	-	816.243	815.472	818.693	812.103	806.998	-	-	812.187	810.071	813.756	810.022	811.235	812.865	807.551	802.918	803.071	802.761	-

Exhibit A

Ten-Year Capital Improvements Plan and Buildout Proposed Projects, Georgetown Utility Systems

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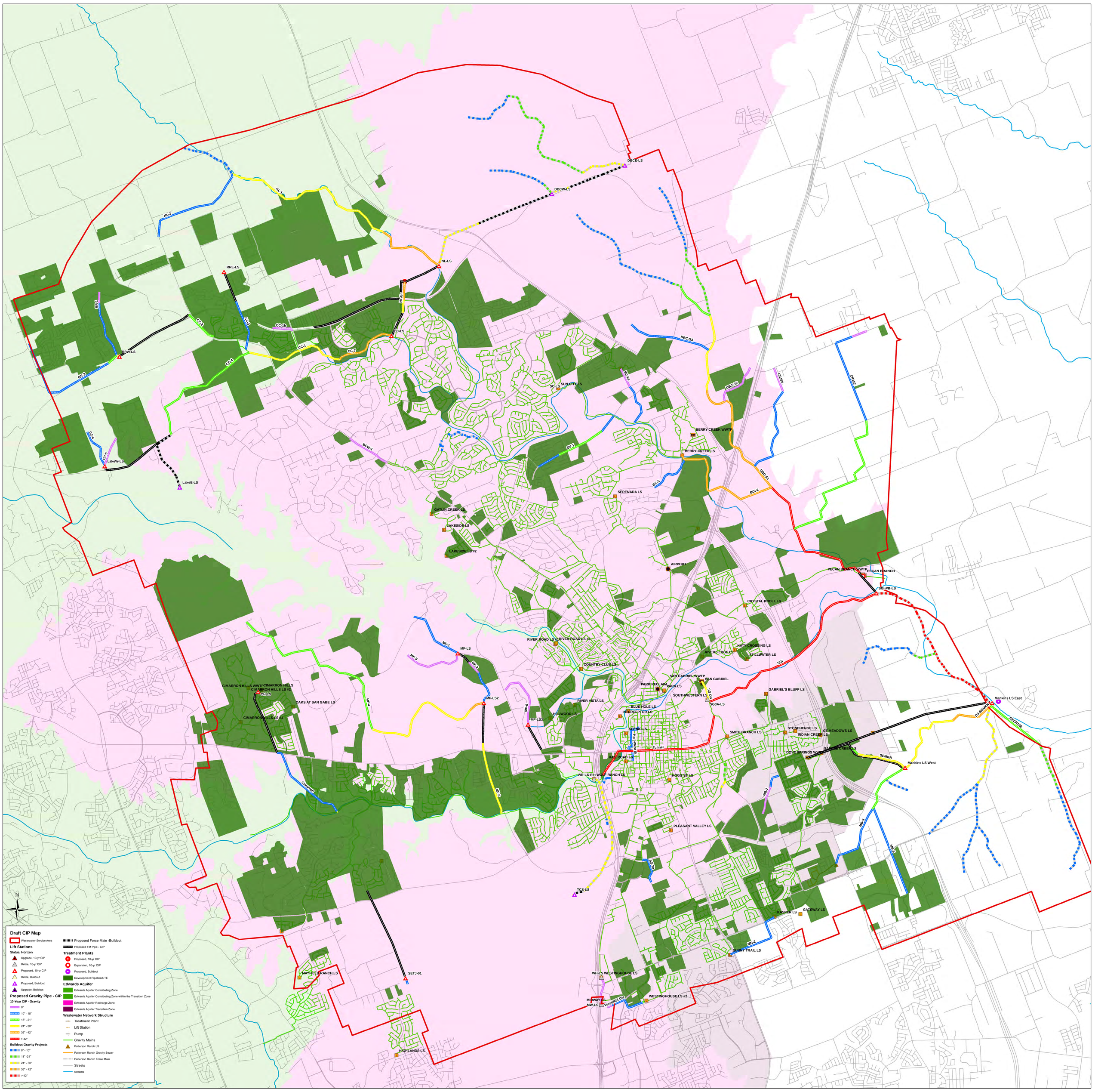

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Retire, 10-yr CIP
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Proposed, Buildout
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10" - 15"
18" - 21"
24" - 30"
36" - 42"
> 42"
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18" -21"
24" - 30"
36" - 42"
> 42"
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RRE-LS
RRW-LS
CC-LS
LakeW-LS
LakeE-LS
SUN CITY LS
BERRY CREEK WWTP
BERRY CREEK LS
SERENADA LS
GATLIN CREEK LS
LAKESIDE LS
LAKESIDE LS #2
AIRPORT
PECAN BRANCH WWTP
PECAN BRANCH
SGI-PB-LS
CRYSTAL KNOLL LS
RIVER ROAD LS #1
RIVER ROAD LS #2
COUNTRY CLUB LS
KATY CROSSING LS
RIVERS EDGE LS
STILLWATER LS
SAN GABRIEL WWTP
SAN GABRIEL
PARK RECLAIM
PARK LS
SOUTHWESTERN LS
GABRIEL'S BLUFF LS
CIMARRON HILLS WWTP
CIMARRON HILLS
CIMARRON HILLS LS #2
CH-LS
OAKS AT SAN GABE LS
CIMARRON HILLS LS #1
RIVER VISTA LS
BLUE HOLE LS
INTERCEPTOR LS
HILLWOOD LS
SCENIC LS
SMITH BRANCH LS
STONEHENGE LS
INDIAN CREEK LS
GT MEADOWS LS
DOVE SPRINGS WWTP
SAVANNE CREEK LS
Mankins LS East
Mankins LS West
RAIL ROAD LS
WR-LS-Ret WOLF RANCH LS
HOGG ST LS
PLEASANT VALLEY LS
TCS-LS
KASPER LS
GATEWAY LS
SUNNY TRAIL LS
WH-LS WESTINGHOUSE LS
WESTINGHOUSE LS #2
MIDWAY LS
MW-LS
MAYFIELD RANCH LS
SETJ-01
HIGHLANDS LS
Cimarron
Tunnel



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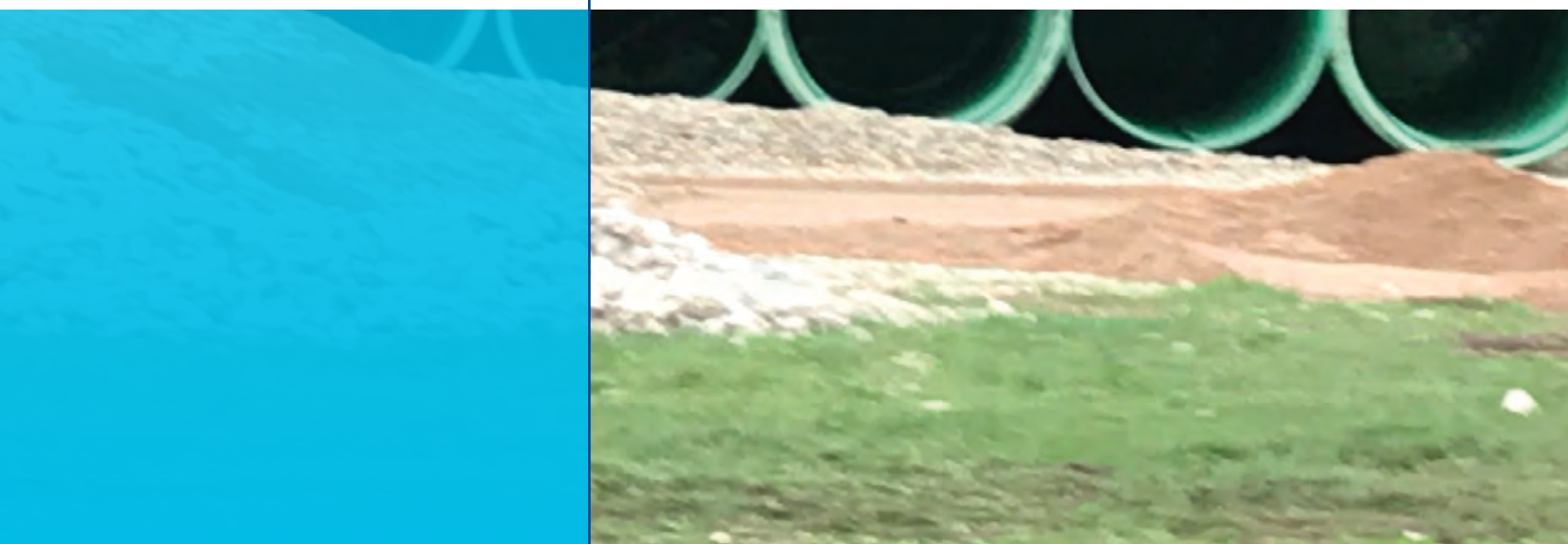

EXHIBIT 4

Georgetown – San Gabriel River Flood Protection Planning Study

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Executive Summary

The Georgetown – San Gabriel River Flood Protection Planning Study (hereinafter referred to as the FPPS) is flood hazard mitigation assessment and stormwater planning for the Berry Creek, Mankins Branch, Pecan Branch, Smith Branch, North Fork San Gabriel River, Middle Fork San Gabriel River, South Fork San Gabriel River, and San Gabriel River watersheds (hereinafter referred to as the Study Area).

This FPPS is a combination of two planning grants to develop flood hazard mitigation plans for the following watersheds:

- TWDB Contract No. 1448321724: flood hazard mitigation planning for the Pecan Branch, Berry Creek, Mankins Branch, Smith Branch and Middle Fork San Gabriel River watersheds under a joint funding effort by the City of Georgetown and the Texas Water Development Board (TWDB); and

- TWDB Contract No. 1548321877: flood hazard mitigation planning for the North Fork San Gabriel River, South Fork San Gabriel River, and San Gabriel River under a joint funding effort by the City of Georgetown, Williamson County, City of Leander, City of Liberty Hill and the TWDB.

This FPPS focuses on the referenced watersheds that have experienced flooding problems ranging from localized storms to the major Tropical Storm Hermine of 2010. The flood hazard mitigation planning criteria that was identified in the two flood hazard mitigation planning grant applications was used as the basis for preparing the FPPS, though some criteria was modified and adapted for the study as actual hydrologic and hydraulic conditions were identified and the needs of each community were refined.

Public input was an important component of this FPPS. Input was received, with TWDB approval, from three public meetings, interviews with residents in the flood prone areas, and coordination with city and county officials. In addition to the public meetings, a series of technical working meetings were held with representatives from the City of Georgetown, Williamson County and the City of Leander.

The FPPS has identified a total of 62 proposed projects totaling $349,014,535 in construction cost to address flood hazard mitigation issues throughout the Study Area. Obviously, not all projects can be funded at once, so an effort was made to prioritize the projects. In a series of working meetings, representatives from the City of Georgetown, Williamson County and City of Leander identified the flood hazard problems (flooded structures and flooded channel crossings) and approved flood hazard mitigation improvements prioritization criteria. The proposed flood hazard mitigation improvement projects were divided into two tiers: Tier I (highest priority projects) and Tier II (all remaining projects that are not Tier I projects). These prioritizations were not intended to be an absolute ranking of projects, but intended to provide the stakeholders and communities

with input considerations for future flood hazard mitigation improvement projects. A table summarizing the prioritized Tier I projects is shown below.

Table ES-1. Summary of Prioritized Projects

Jurisdiction	Number of Projects	Total Construction Cost
City of Georgetown & ETJ		
Tier I	10	$20,080,072
Tier II	5	$30,780,783
All Other Improvement Projects	31	$177,858,912
Williamson County		
	1	$4,919,573
City of Leander & ETJ		
	1	$800,000
City of Liberty Hill		
	3	$47,222,621
Burnet County		
	11	$56,771,245

It is important to recognize that these projects are needed to address existing flood hazard problems based on existing development. It is essential that future developments control stormwater flows so that they do not increase flooding.

1.0 Introduction

The watersheds of Berry Creek, Mankins Branch, Pecan Branch, Smith Branch, North Fork San Gabriel River, Middle Fork San Gabriel River, South Fork San Gabriel River, and San Gabriel River (Study Area) in Williamson County and Burnet County (see Figure 2-1). The Study Area covers approximately 25% of the land area of Williamson County and 20% of the land area of Burnet County. Williamson County is one of the fastest growing counties in the State of Texas. Furthermore, the Central Texas area, including both Williamson and Burnet Counties, is one of the fastest growing regions in the Nation. The Texas Colorado River Floodplain Coalition All Hazards Plan reports that as of 2008 the population of Williamson County had grown 182.5% since 1990. The population in 2008 was reported at 394,193. The population growth is expected to continue to increase putting more property at potential flood risk. Table 1-1 presents the latest growth statistics within the Study Area as reported by the United States Census Bureau. Roughly 66% of the Study Area is undeveloped, with over half of the Study Area located in the ETJ of Georgetown, and approximately 33% of the Study Area currently in the City of Georgetown incorporated limits. Accurate flood risk information coupled with flood reduction measures are essential to the long-term viability of the Planning Area.

Table 1-1 Study Area Growth Statistics

	Population 2010 (Base)	Population 2013 (Estimate)	% Change
City of Georgetown	47,438	54,898	15.7
Williamson County	422,617	471,014	11.5
Burnet County	42,753	43,823	2.5
City of Leander	26,310	31,717	20.6
City of Liberty Hill	8,397	8,836	5.2

The City of Georgetown is the central hub of Williamson County, with its rich history pre-dating European settlements and unique culture. This region provides numerous opportunities for businesses and residential development. With the heart of the Study Area located off Interstate Highway I-35, this region is key to major transport routes from Mexico to the remainder of the United States, making the successful management of this region a critical goal for local governments, the State of Texas and the remainder of the United States.

In 2008, the Georgetown City Council adopted the 2030 Comprehensive Plan, which guides Georgetown into the 21st Century faced with new opportunities and challenges. Two of the 2030 Georgetown Comprehensive Plan vision statements included “Quality of Life” and “Quality Growth/Sustainable Development”. These two statements include language such as “conserve land and natural resources”, “preserve our irreplaceable natural resources, our lakes, rivers and hill country scenery” and “encourage conservation development and other approaches that retain rural character and promote retention of open space”. It is clear from the 2030 Comprehensive Plan that

conservation of water resources is a critical goal of the city and is essential to the long-term goals of this region.

The City of Georgetown conducted a Master Drainage Plan Study in 2000, which included portions of the watershed areas within the Study Area. However, of the watersheds studied in 2000, the previously developed hydrologic and hydraulic information for these watersheds is now outdated. Development (commercial and residential) has occurred in the Study Area and it is now important to evaluate the impact of this development and the current growth patterns on the hydrologic/hydraulic conditions within the Study Area.

In 2009, the Williamson County Commissioners' Court adopted the Williamson County Long-Range Transportation Plan which presented the roadway and transit improvements to be built or improved over the next 20 years to help address anticipated growth in the County. The Williamson County Long-Range Transportation Plan identified many new and existing roadway improvements within the Study Area. Updated hydrologic and hydraulic information is needed to assist Williamson County in its design the roadway crossings at the existing waterways.

In 2013, The Burnet County Commissioners' Court adopted the Burnet County Comprehensive Plan. The Comprehensive Plan identified citizen's quality of life including "manage growth", "economic development", and "required water (and traffic) impact studies with new development" as well as "identify and address Critical Road Safety Issues". Updated hydrologic and hydraulic information is needed to assist Burnet County to manage the quality of life goals identified in its Comprehensive Plan.

In 2015, the City of Leander adopted the updated Comprehensive Plan to service as a guide to the City's future growth. The Comprehensive Plan included emphasis on open spaces, restriction on development within the 100-year floodplains, Low Impact Development approach to site development and stormwater management, and reduction of stormwater pollution.

A portion of the Study Area is subject to frequent flooding due to inadequate drainage infrastructure and development within the floodplains. This was evidenced by the widespread destruction from the September 8, 2010 Tropical Storm Hermine event and the June 27, 2007 flood event. It is critical to the communities that detailed hydrologic/hydraulic analyses and floodplain mapping be performed using the latest modeling techniques and more accurate topographic information so that the flooding problems can be identified and economical, effective and prioritized flood hazard mitigation measures can be implemented.

The current Flood Insurance Rate Map (FIRM) for the watersheds within the planning area is over 20 years old and is based on outdated and inaccurate peak discharges and base flood information. Specifically, although the FIRM was updated in April 2008, new hydrologic/hydraulic analyses and floodplain mappings were not performed. The 2008 updates were formed to convert the FIRM into a digital format and incorporated approved Letter of Map Revisions (LOMRs) at the time. Based on a review of the Federal Emergency Management Agency (FEMA) website, there has been over forty LOMR approvals since 2008. An updated comprehensive drainage plan, with accurate hydrologic/hydraulic modeling of the floodplains, was identified as a needed effective

tool to manage quality and sustainable growth in the Study Area floodplains and to provide the necessary information as the first step in revising FIRM if the communities desire to do so.

2.0 Scope of Flood Protection Planning Study

2.1 Flood Protection Planning Study Overview

The FPPS Study Area consists of the Berry Creek, Mankins Branch, Pecan Branch, Smith Branch, North Fork San Gabriel River, Middle Fork San Gabriel River, South Fork San Gabriel River, and San Gabriel River (from the confluence of the North and South Forks to the City of Georgetown ETJ Limit). The studied creeks within the Study Area are all tributaries of the San Gabriel River located within Williamson County and Burnet County. The Study Area is within the Brazos River Basin.

The Berry Creek, Mankins Branch, Pecan Branch, Smith Branch, and Middle Fork San Gabriel River watersheds cover approximately 90% of the most populated area within the City of Georgetown limits and its ETJ areas and experienced significant flooding during the 2010 Tropical Storm Hermine event. Stormwater runoff along North Fork San Gabriel River through the City of Georgetown is regulated by Lake Georgetown located on the west side of Georgetown.

2.2 Technical Standards and Assumptions Impacting the Plan

The FPPS utilized the standards and assumptions outlined in the two applications to the Texas Water Development Board (TWDB) for flood protection planning grants for comprehensive flood protection planning studies of the Study Area watersheds. The criteria outlined in the grant applications describe standards that are commonly used in Central Texas for evaluating risk and drainage infrastructure design and construction. Drainage structures are typically designed to handle a specific design storm, which is selected based on the desired level of safety and economic risk. The design storms utilized in the FPPS are as follows:

- Assessment and protection of flooded structures (i.e. homes, businesses, etc.) within Problem Areas: 24-hour, 100-year storm event under Existing Conditions land development density;
- Assessment and improvements to flooded road crossings within the City of Georgetown jurisdiction: 24-hour, 100-year storm event under Existing Conditions land development density;
- Assessment and improvements to flooded crossings outside the City of Georgetown jurisdiction: 24-hour, 25-year storm event under Existing Conditions land development density.

The use of the 100-year design storm is standard in flood evaluations and flood protection of structures. It is the standard used by flood insurance providers, funding entities, and regulators in making determinations with respect to flooded structures.

The 100-year design storm was used to assess flooded crossings within the City of Georgetown jurisdiction to comply with the City of Georgetown hydraulic design criteria and to reflect the high

level of risk to the public posed by flooding significant crossings within the highly developed urban setting.

The 25-year design storm was used to assess local crossings within the City of Georgetown's ETJ and flooded crossings outside the City of Georgetown jurisdiction to comply with the Williamson County hydraulic design criteria and to reflect the current rural or undeveloped conditions within Williamson County and Burnet County.

While hydrologic and hydraulic modeling of potential future development conditions were analyzed as part of this study, all hydraulic analyses of flooded structures and crossings were based upon existing development conditions and do not account for future development. It is assumed that future development will be regulated by the governmental jurisdictions to a sufficient degree so that flood risk will not be significantly increased. This is a very important concept and is consistent with standard drainage design practices. However, it is incumbent on the governmental jurisdictions and communities involved to properly manage future development and to enforce development regulations to ensure that these conditions are met.

2.3 Public Meetings and Technical Working Meetings

Throughout the FPPS process, a series of four public meetings were held to communicate the planning process, status and results, and to solicit valuable input from the public to help focus ongoing analysis efforts (one public meeting has yet to be held as of the Draft FPPS Report submittal). The first public meeting was held in April 2015 to present the proposed study watershed delineations to be included in the FPPS and to gather input regarding existing flooding issues in these areas. The second public meeting was held in July 2016 to present the update proposed study watershed delineations, to continue to gather input regarding existing flooding issues in these areas, and to present draft floodplain mappings within the watersheds. The third public meeting was held in July 2017 to present updated floodplain mappings and identification of structures within the floodplains of the study watersheds. The fourth public meeting will be conducted after the submittal of the Draft FPPS Report to gather input regarding the recommended flood hazard mitigation improvements.

In addition to the public meetings, a series of technical working sessions were held with representatives from the City of Georgetown, Williamson County, and the City of Leander. During these working meetings, alternatives were discussed and the criteria for prioritization and selection of the recommended flood hazard mitigation improvements were determined. These working meetings provided an excellent opportunity for the affected stakeholders to collaboratively identify the impacts of the flood hazards and to assist in developing a prioritized list of projects to address flood hazard issues throughout the Study Area.

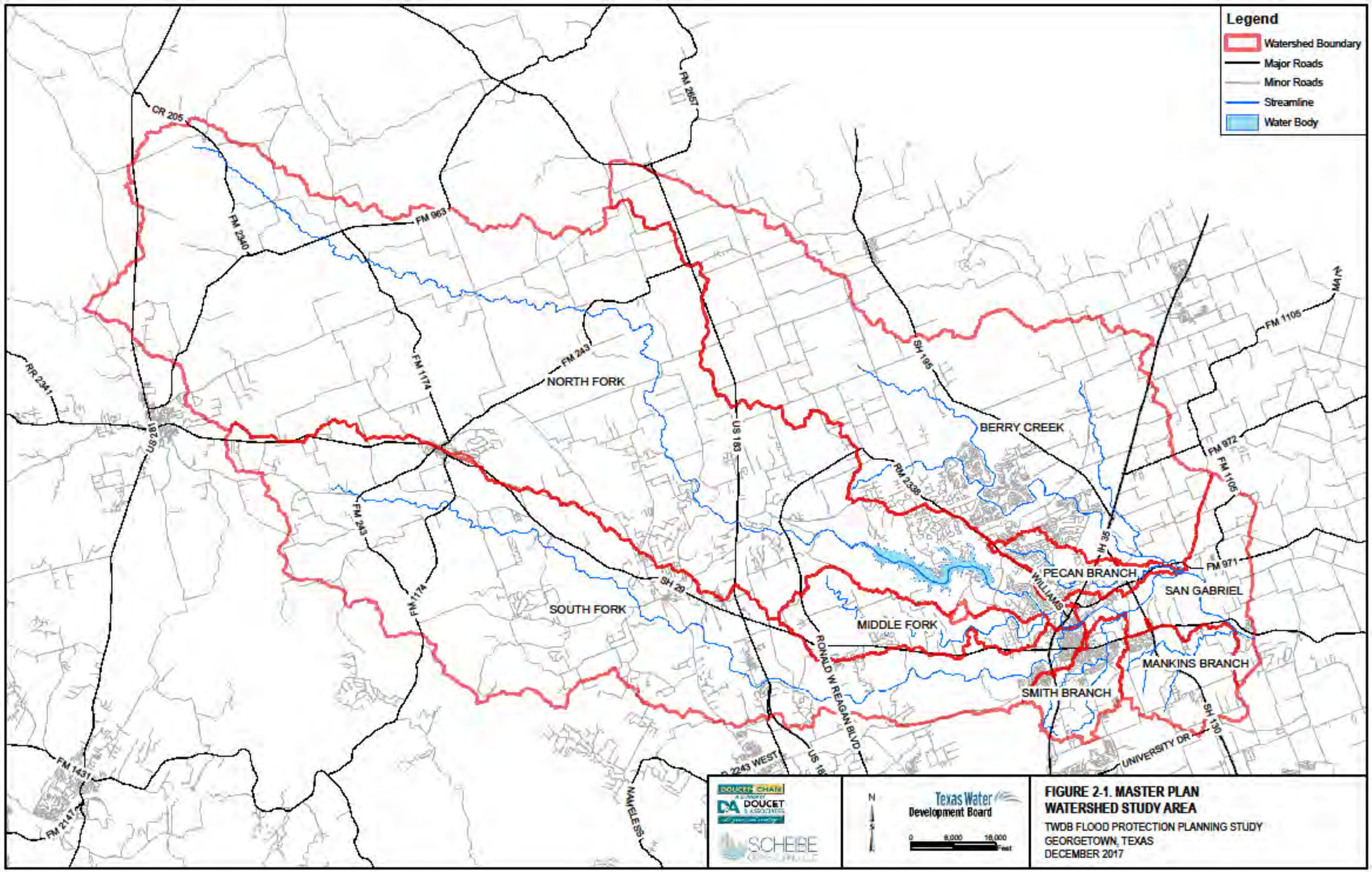
A summary of the Study Area watersheds is provided in Table 2-1.

Table 2-1 Study Area Summary

Watershed	Drainage Area (Sq. Miles)	Study Stream Miles (1)
Berry Creek (2)	126	35.2
Mankins Branch (3)	13	10.1
Pecan Branch (4)	7	9.2
Smith Branch (5)	10	9.4
Middle Fork San Gabriel River	17	13.1
North Fork San Gabriel River	251	50.1
South Fork San Gabriel River	134	37.3
San Gabriel River (6)	19	11.1

Notes:

(1) Study Stream miles represents stream miles along main channels only.
(2) Berry Creek, Dry Berry Creek, and Cowan Creek
(3) Mankins Branch and Mankins Branch Tributary #2
(4) Pecan Branch and Pecan Branch Tributary #1
(5) Smith Branch and West Fork Smith Branch
(6) From confluence of North Fork San Gabriel River and South Fork San Gabriel River downstream to City of Georgetown ETJ, excluding Berry Creek, Mankins Branch, Pecan Branch, Smith Branch, and Middle Fork San Gabriel River watersheds.


Legend
Watershed Boundary
Major Roads
Minor Roads
Streamline
Water Body
CR 205
FM 2657
FM 963
FM 2340
FM 1174
FM 243
NORTH FORK
RR 2341
US 281
US 183
SH 195
FM 1105
MAIN
BERRY CREEK
RM 2338
FM 972
IH 35
PECAN BRANCH
WILLIAMS
FM 971
SAN GABRIEL
SH 29
SOUTH FORK
MIDDLE FORK
RONALD W REAGAN BLVD
MANKINS BRANCH
SMITH BRANCH
SH 130
UNIVERSITY DR
FM 2243 WEST
FM 1431
FM 2147
NAMELESS
DOUCET + CHAN
DOUCET & ASSOCIATES
SCHEIBE
N
Texas Water Development Board
0 8,000 16,000 Feet
FIGURE 2-1. MASTER PLAN WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

3.0 Overview of Watershed Study Areas

The Georgetown – San Gabriel River Flood Protection Planning Study's (FPPS) watershed study area (Study Area) encompasses approximately 25% of Williamson County and 20% of Burnet County. Average daily temperatures range from a high of 60 to a low of 36 degrees Fahrenheit (F) in January, and a high of 96 degrees F to a low of 66 degrees F in August. The mean annual precipitation is approximately 37.3 inches with the majority occurring between May and October. Williamson County has an average of 50.5 days of precipitation (i.e. measurable precipitation over 0.01 inch), and its average daily humidity ranges from a high of 90% in March to a low of 65% in September, for an overall annual average humidity of 75.3%. Heavy rainfall can occur over the Study Area from a variety of atmospheric conditions including tropical storm and hurricane events originating from the Gulf of Mexico.

The San Gabriel River watershed encompasses a total of 1,366.5 square miles, including 790.6 square miles outside (downstream) of the limits of the Study Area. The Study Area topography is characterized by the Balcones Fault Zone, forming the Edwards Escarpment, that is aligned roughly parallel to Interstate Highway 35 from southwest to northeast, dividing the Study Area into two distinct topographic and geologic regions: (1) Edwards Plateau (forming the Texas Hill Country) west of the Escarpment and (2) Texas Coastal Plan east of the Escarpment. The San Gabriel River bisects the Escarpment, flowing roughly from the northwest to the southwest within the Study Area and connecting to the Brazos River southeast of the Study Area.

The U.S. Army Corps of Engineers' Lake Georgetown impoundment on the North Fork San Gabriel River provides significant flood protection within the Study Area, especially north of Downtown. Additionally, local floodplain regulations provide a significant measure of protection for newly developed areas.

Significant portions of the Study Area, along the Balcones Fault Zone primarily west of Dry Berry Creek and Smith Branch, are within the Edwards Aquifer Zone, consisting of the Recharge Zone, Contributing Zone, and Transition Zone. The environmental sensitivity of the Edwards Aquifer Zone is protected by the Edwards Aquifer Chapter 213 Rules, administered by the Texas Commission on Environmental Quality (TCEQ).

The Study Area consists of the following eight watershed areas, which are discussed in the following sections:

- Berry Creek Watershed Study Area
- Mankins Branch Watershed Study Area
- Pecan Branch Watershed Study Area
- Smith Branch Watershed Study Area
- North Fork San Gabriel River Watershed Study Area
- Middle Fork San Gabriel River Watershed Study Area
- South Fork San Gabriel River Watershed Study Area

- San Gabriel River Watershed Study Area

An overview of the limits of the above watershed study areas is shown on Figure 2-1 and is summarized in Table 2-1.

3.1 Berry Creek Watershed Study Area

3.1.1 Watershed Topography

The Berry Creek Watershed Study Area is located within Williamson County along the north side of the City of Georgetown and extending northwestward into Burnet County. Its confluence with the San Gabriel River is east of S.H. 130 near its FM 971 crossing. The drainage features in this watershed include two primary topographic features: (1) Texas Coastal Plain generally east of I.H. 35, and (2) Edwards Plateau generally west of I.H. 35.

West of I.H. 35, the contributing watersheds of Berry Creek and its Cowan Creek and Dry Berry Creek study tributaries lie within the Edwards Plateau, and are characterized by karst topography, rugged hills of limestone or granite, thin layers of topsoil, large areas of exposed rocks and boulders which make the area prone to flash flooding. After Berry Creek and Dry Berry Creek flow across the Balcones Escarpment near I.H. 35, the slope of the land begins to flatten resulting in broader floodplains.

Ground topography ranges from a high point of approximately 1150 feet NAVD 88 at the northwest limits of the watershed to a low point of approximately 610 feet NAVD 88 at the southeast limits of the watershed within the Study Area.

A portion of the Berry Creek Watershed, along the Balcones Fault Zone, is within the Edwards Aquifer Zone.

An overview of the Berry Creek Watershed is shown on Figure 3-1.

3.1.2 Watershed Surficial Geology

The areas within the Berry Creek watershed west of I.H. 35 consist of soils that are classified as hydrologic soil group “D” per U.S. Department of Agriculture standard classification. These soils are primarily clays at or near the surface causing low infiltration with high runoff potential. The Lower Berry Creek and Dry Berry Creek areas consist of soils that are a mix of soils that are classified as hydrologic soil groups “B”, “C” and “D”. These soils are primarily gravel and clay at or near the surface causing moderate permeability. Gravel pits within the watershed reduce the runoff to the creek.

3.1.3 Watershed Residential/Commercial Development

The Berry Creek watershed is highly developed within the City of Georgetown jurisdiction primarily from the Sun City Boulevard creek crossing to its confluence with the San Gabriel River. Upstream portions of the watershed are primarily undeveloped.

3.2 Mankins Branch Watershed Study Area

3.2.1 Watershed Topography

The Mankins Branch Study Area is located within Williamson County along the southeast side of the City of Georgetown, east of the Smith Branch Watershed. Its confluence with the San Gabriel River is east of S.H. 130 near its McShepherd Road crossing. The drainage features in this watershed are in the Texas Coastal Plain generally east of I.H. 35, characterized by flattened land slopes resulting in broader floodplains.

Ground topography ranges from a high point of approximately 852 feet NAVD 88 at the northwest limits of the watershed to a low point of approximately 578 feet NAVD 88 at the southeast limits of the watershed within the Study Area.

A portion of the Mankins Branch Watershed is located within the Edwards Aquifer Transition Zone.

An overview of the Mankins Branch Watershed is shown on Figure 3-2.

3.2.2 Watershed Surficial Geology

The areas within the Mankins Branch watershed consist of a range of soils that are classified as hydrologic soil groups “B” through “D” per U.S. Department of Agriculture standard classification. The hydrologic soil group “B” is located along the lower portion of Mankins Branch and adjacent to the San Gabriel River. This soil group has well-draining soils with lower runoff potential. The hydrologic soil groups “C” and “D” are located in a low density residential and agricultural area. These soils are primarily clay at or near the surface causing limited infiltration with high runoff potential.

3.2.3 Watershed Residential/Commercial Development

The Mankins Branch watershed is lightly developed within the City of Georgetown jurisdiction, primarily or totally residential.

3.3 Pecan Branch Watershed Study Area

3.3.1 Watershed Topography

The Pecan Branch Watershed Study Area is located within Williamson County on the north-central side of the City of Georgetown. Its confluence with the San Gabriel River is east of S.H. 130, just upstream of the Berry Creek confluence, and its watershed extends east-northeast of the San Gabriel River to Williams Drive. The drainage features in this area include two primary topographic features: Texas Coastal Plain generally east of I.H. 35, and Edwards Plateau west of I.H. 35.

West of I.H. 35, the contributing subbasins of Pecan Branch are composed of the Edwards Plateau, characterized by shallow soils and steep topography (up to 10% slopes). As the flows approach I.H. 35, the slope of the land begins to flatten resulting in broader floodplains. Pecan Branch crosses I.H. 35 through a series of culverts, and on the east side of I.H. 35 the watershed is within prairieland characterized by flat to gently rolling topography (less than 0.5% slopes).

Ground topography ranges from a high point of approximately 904 feet NAVD 88 at the northwest limits of the watershed to a low point of approximately 610 feet NAVD 88 at the southeast limits of the watershed.

The Pecan Branch Watershed is located entirely within the Edwards Aquifer Recharge Zone.

An overview of the Pecan Branch Watershed is shown on Figure 3-3.

3.3.2 Watershed Surficial Geology

The areas within the Pecan Branch watershed west of I.H. 35 consist of soils that are classified as hydrologic soil group D per U.S. Department of Agriculture standard classification. Group "D" soils are primarily clayey at or near the surface causing low infiltration with high runoff potential.

The areas within the Pecan Branch watershed east of I.H. 35 consist of soils that are classified as hydrologic soil group "B" generally within the channel, group "C" generally in upland areas, and group "D" in lower-lying areas outside the channel per U.S. Department of Agriculture standard classification. Group "B" soils are primarily silt loam or loam at or near the surface causing moderate infiltration with moderately low runoff potential. Group "C" soils are primarily sandy clay loam at or near the surface causing moderately low infiltration with moderately high runoff potential.

3.3.3 Watershed Residential/Commercial Development

The Pecan Branch watershed is nearly fully developed within the City of Georgetown City Limits and ETJ west of I.H. 35 consisting mostly of low- and medium-density residential with limited agricultural, commercial, and airport land uses. East of I.H. 35, the watershed is less developed with impervious coverage generally less than 20% and consists mostly of agricultural and rural residential with limited commercial and institutional land uses (primarily along I.H. 35 corridor).

3.4 Smith Branch Watershed Study Area

3.4.1 Watershed Topography

The Smith Branch Watershed Study Area is located within Williamson County on the south side of the City of Georgetown. Its confluence with the San Gabriel River is west of S.H. 130, and its watershed extends southeast of the San Gabriel River west of I.H. 35 and south of Leander Road (Ranch Road 2243). The study area includes the West Fork of Smith Branch with headwaters west of I.H. 35 and main stem confluence east of Quail Valley Drive near Hutto Street. The drainage features in this area include two primary topographic features: Texas Coastal Plain generally east of I.H. 35, and Edwards Plateau west of I.H. 35.

East of I.H. 35, the contributing subbasins of Smith Branch are composed of the Edwards Plateau, characterized by shallow soils and steep topography (up to 10% slopes). As the flows approach I.H. 35, the slope of the land begins to flatten resulting in broader floodplains. Smith Branch crosses I.H. 35 through a series of culverts and a bridge (northbound access road), and on the east side of I.H. 35 the watershed is within prairieland characterized by flat to gently rolling topography (less than 0.5% slopes).

Ground topography ranges from a high point of approximately 956 feet NAVD 88 at the southern limits of the watershed to a low point of approximately 636 feet NAVD 88 at the northeast limits of the watershed.

The Smith Branch Watershed is located entirely within the Edwards Aquifer Recharge Zone.

An overview of the Smith Branch Watershed is shown on Figure 3-4.

3.4.2 Watershed Surficial Geology

The areas within the Smith Branch watershed west of I.H. 35 consist of soils that are classified as hydrologic soil group "D" per U.S. Department of Agriculture standard classification. Group "D" soils are primarily clayey at or near the surface causing low infiltration with high runoff potential. The areas within the Smith Branch watershed east of I.H. 35 consist of soils that are classified primarily as hydrologic soil group "D" per U.S. Department of Agriculture standard classification with limited areas of group "B" within the channel up to the West Fork Confluence and group "C" in upland areas. Group "B" soils are primarily silt loam or loam at or near the surface causing moderate infiltration with moderately low runoff potential. Group "C" soils are primarily sandy clay loam at or near the surface causing moderately low infiltration with moderately high runoff potential.

3.4.3 Watershed Residential/Commercial Development

The Smith Branch watershed is highly developed within the City of Georgetown City Limits along the west and north portions of the watershed consisting mostly of residential and commercial development with limited institutional land uses. The south and east portions of the watershed along the outer edges of the City Limits are less developed with impervious coverage generally less than 20% and consist mostly of agricultural and rural residential with limited low- and medium-density residential land uses.

3.5 North Fork San Gabriel River Watershed Study Area

3.5.1 Watershed Topography

The North Fork San Gabriel River Watershed Study Area is located within Williamson County along the north side of the City of Georgetown and extending northwestward into Burnet County. Its confluence with the San Gabriel River is east of S.H. 130 near its FM 971 crossing. The drainage features in this watershed are within two primary topographic features: (1) Texas Coastal Plain generally east of I.H. 35, and (2) Edwards Plateau generally west of I.H. 35.

West of I.H. 35, the contributing North Fork San Gabriel River watershed lies within the Edwards Plateau and is characterized by karst topography, rugged hills of limestone or granite, thin layers of topsoil, large areas of exposed rocks and boulders making the area prone to flash flooding. East of I.H. 35, the slope of the land begins to flatten resulting in broader floodplains.

Ground topography ranges from a high point of approximately 1595 feet NAVD 88 at the northwest limits of the watershed to a low point of approximately 659 feet NAVD 88 at the southeast limits of the watershed within the Study Area.

A portion of the North Fork San Gabriel River, along the Balcones Fault Zone, is within the Edwards Aquifer Zone.

Flooding along the North Fork San Gabriel River, as it flows into the urban Georgetown area, is controlled by Lake Georgetown.

An overview of the North Fork San Gabriel River Watershed is shown on Figure 3-5.

3.5.2 Watershed Surficial Geology

The areas within the North Fork San Gabriel River watershed consist of soils that are classified as hydrologic soil group "D" per U.S. Department of Agriculture standard classification. These soils are primarily clay at or near the surface causing low infiltration with high runoff potential. The areas near the North Fork San Gabriel River consist of soils that are classified as hydrologic soil group "B". These soils are primarily well-draining at or near the surface causing higher infiltration with low runoff potential. Areas upstream of Lake Georgetown are rural with little development.

3.5.3 Watershed Residential/Commercial Development

The North Fork San Gabriel River is highly developed within the City of Georgetown jurisdiction primarily from the River Road creek crossing downstream of Lake Georgetown to its confluence with the San Gabriel River.

3.6 Middle Fork San Gabriel River Watershed Study Area

3.6.1 Watershed Topography

The Middle Fork San Gabriel River Watershed Study Area is located within Williamson County along the west side of the City of Georgetown and extending westward into Williamson County. Its confluence with the San Gabriel River is west of I.H. 35 downstream of the Country Club Road crossing over the San Gabriel River. The drainage features in this watershed are within the Edwards Plateau generally west of I.H. 35, which is characterized by karst topography, rugged hills of limestone or granite, thin layers of topsoil, large areas of exposed rocks and boulders making the area prone to flash flooding.

Ground topography ranges from a high point of approximately 1074 feet NAVD 88 at the northwest limits of the watershed to a low point of approximately 678 feet NAVD 88 at the southeast limits of the watershed within the Study Area.

A portion of the Middle Fork San Gabriel River, along the Balcones Fault Zone, is within the Edwards Aquifer Zone.

An overview of the Middle Fork San Gabriel River Watershed is shown on Figure 3-6.

3.6.2 Watershed Surficial Geology

The areas within the Middle Fork San Gabriel River watershed west of I.H. 35 consist predominately of soils that are classified as hydrologic soil group "D" per U.S. Department of Agriculture standard classification. These soils are primarily clay at or near the surface causing

low infiltration with high runoff potential. There are gravel pits within the watershed that reduce the runoff to the river.

3.6.3 Watershed Residential/Commercial Development

The Middle Fork San Gabriel River is lightly developed within the City of Georgetown and Williamson County jurisdictions.

3.7 South Fork San Gabriel River Watershed Study Area

3.7.1 Watershed Topography

The South Fork San Gabriel River Watershed Study Area is located primarily within Williamson County with upper portions extending northwest into Burnet County. The watershed includes portions of the Cities of Burnet, Bertram, Liberty Hill, and Leander, and the southwest and central (downtown) portions of the City of Georgetown. The southern watershed boundary roughly follows the Travis County boundary line within the upper-central portion of the watershed, and the northern watershed boundary general follows S.H. 29. Its confluence with the North Fork San Gabriel River is east of I.H. 35. The drainage features in this area include one primary topographic feature: the Edwards Plateau.

The contributing subbasins of South Fork San Gabriel River are composed of the Edwards Plateau, characterized by shallow soils and steep topography (up to 10% slopes). The channel slope is as steep as 0.7% slope within the upper 7 miles and flattens out to a consistent 0.25% slope in the lower 30 miles.

Ground topography ranges from a high point of approximately 1,516 feet NAVD 88 at the northwest limits of the watershed to a low point of approximately 659 feet NAVD 88 at the eastern limits of the watershed.

Portions of the South Fork San Gabriel River Watershed are located within the Edwards Aquifer Contributing Zone and Recharge Zone.

An overview of the South Fork San Gabriel River is shown in Figure 3-7.

3.7.2 Watershed Surficial Geology

The South Fork San Gabriel River watershed primarily consists of soils that are classified as hydrologic soil group “D” per U.S. Department of Agriculture standard classification. Group “D” soils are primarily clayey at or near the surface causing low infiltration with high runoff potential. The watershed also includes limited areas of group “B” within the channel and group “C” in upland areas. Group “B” soils are primarily silt loam or loam at or near the surface causing moderate infiltration with moderately low runoff potential. Group “C” soils are primarily sandy clay loam at or near the surface causing moderately low infiltration with moderately high runoff potential.

3.7.3 Watershed Residential/Commercial Development

The South Fork San Gabriel River watershed is mostly undeveloped, primarily consisting of pasture land, woods, and rural residential land uses. Areas within the City of Georgetown City Limits and ETJ include low- to high-density residential, regional commercial, and mining land

uses. Areas along the S.H. 29, U.S. 183, and Ronald Reagan Boulevard corridors also include low- to high-density residential and regional commercial land uses.

3.8 San Gabriel River Watershed Study Area

3.8.1 Watershed Topography

The San Gabriel River Watershed Study Area is located within Williamson County along the central portion of the City of Georgetown, from the confluence of the North Fork San Gabriel River with the South Fork San Gabriel River and extending to the east limits of the FPPS (i.e. the E.T.J. of the City of Georgetown). The drainage features in this watershed are within two primary topographic features: (1) Texas Coastal Plain generally east of I.H. 35, and (2) Edwards Plateau generally west of I.H. 35.

West of I.H. 35, the contributing watersheds of the San Gabriel River, within the Edwards Plateau, are characterized by karst topography, rugged hills of limestone or granite, thin layers of topsoil, large areas of exposed rocks and boulders making the area prone to flash flooding. After the San Gabriel River flows across the Balcones Escarpment near I.H. 35, the slope of the land begins to flatten resulting in broader floodplains.

Ground topography ranges from a high point of approximately 1595 feet NAVD 88 at the west limits of the watershed to a low point of approximately 575 feet NAVD 88 at the east limits of the watershed within the Study Area.

A portion of the San Gabriel River, along the Balcones Fault Zone, is within the Edwards Aquifer Zone.

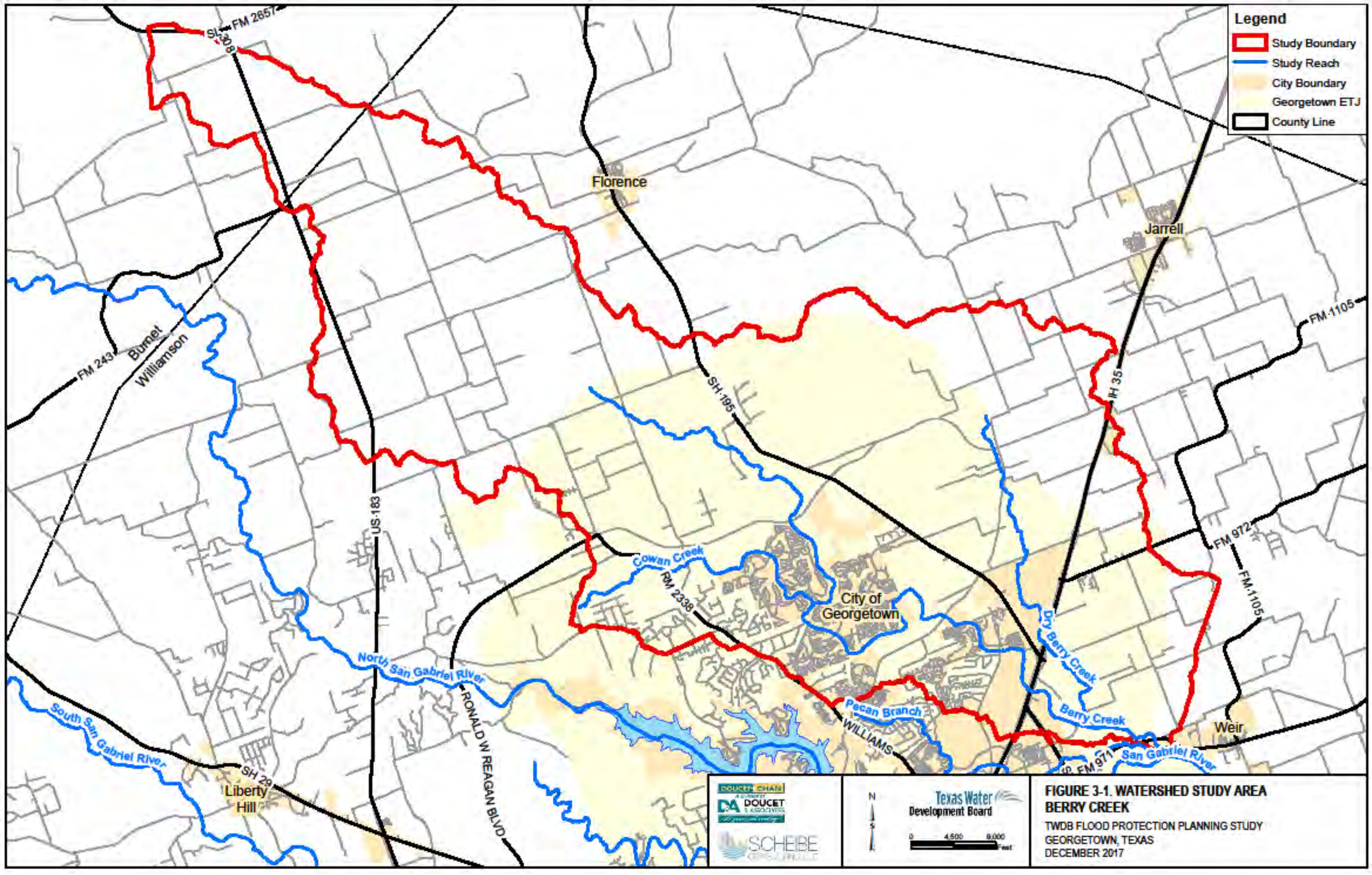
An overview of the San Gabriel River Watershed, starting from the confluence of the north and south forks of the San Gabriel Rivers to the City of Georgetown E.T.J. is shown on Figure 3-8.

3.8.2 Watershed Surficial Geology

The areas within the San Gabriel River watershed from the confluence of the north and south forks of the San Gabriel River to the City of Georgetown E.T.J. consist of soils that range in classification as hydrologic soil groups “B” through “D” per U.S. Department of Agriculture standard classification. The hydrologic soil group “B” is located along the river’s alluvial system. This soil group has well-draining soils with lower runoff potential. The hydrologic soil groups “C” soils and “D” soils are in both urban and rural areas. The soils are primarily clays at or near the surface which has limited infiltration and have a high runoff potential.

3.8.3 Watershed Residential/Commercial Development

The area adjacent to the San Gabriel River is highly developed within the City of Georgetown jurisdiction primarily from its confluence with the north and south forks of the San Gabriel River to the S.H. 130 crossing. Downstream of the S.H. 130 crossing the area is dominantly agriculture with low development.


Legend
Study Boundary
Study Reach
City Boundary
Georgetown ETJ
County Line
SH 29
FM 2657
Florence
Jarrell
FM 1105
FM 243
Burnet
Williamson
SH 195
IH 35
US 183
Cowan Creek
RM 2338
City of Georgetown
FM 972
FM 1105
Dry Berry Creek
North San Gabriel River
RONALD W REAGAN BLVD
Pecan Branch
WILLIAMS
Berry Creek
Weir
South San Gabriel River
SH 29
Liberty Hill
San Gabriel River
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
N
S
Texas Water Development Board
0 4,500 9,000 Feet
FIGURE 3-1. WATERSHED STUDY AREA
BERRY CREEK
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

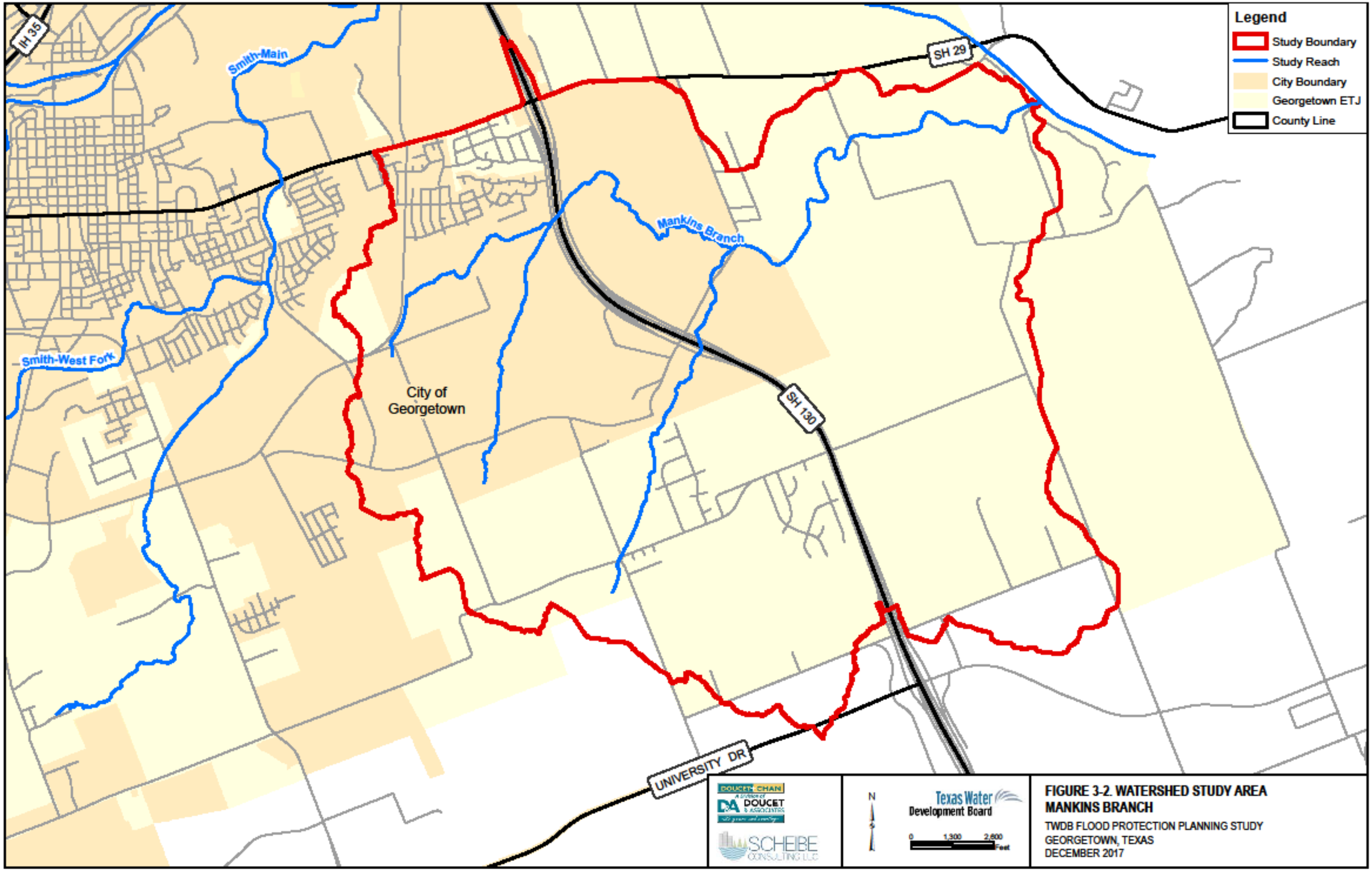
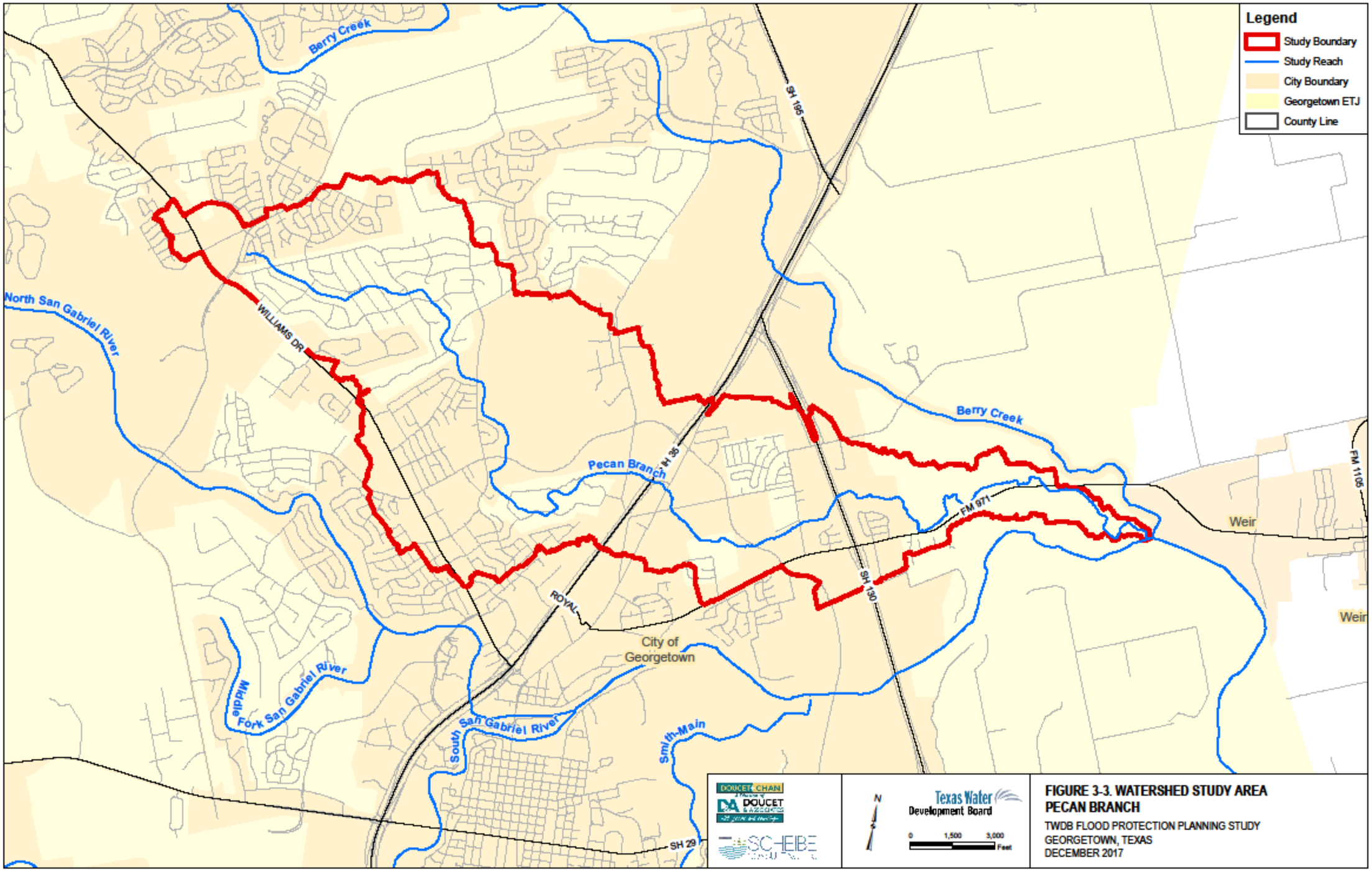
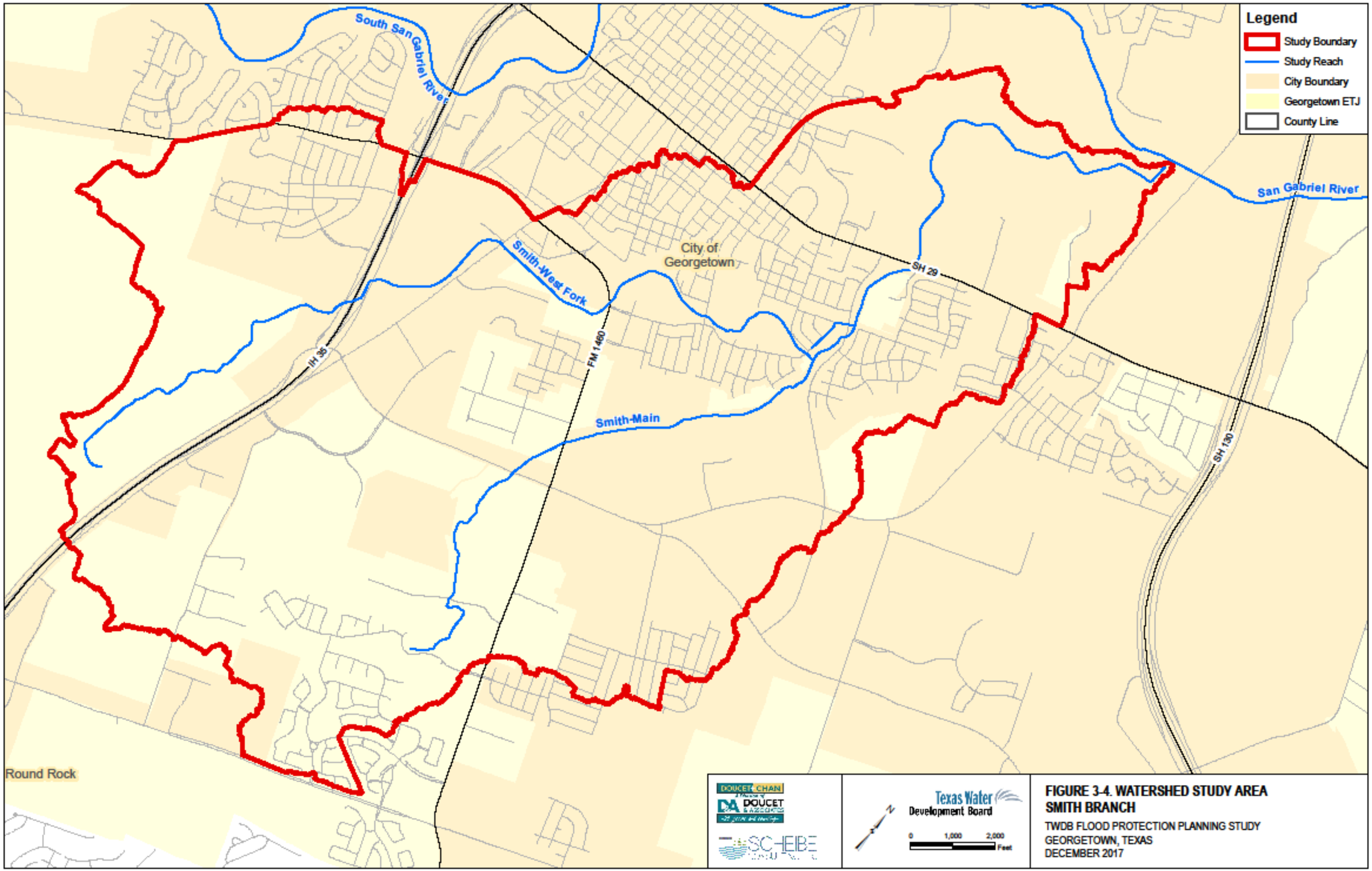


FIGURE 3-2. WATERSHED STUDY AREA MANKINS BRANCH
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Study Boundary
Study Reach
City Boundary
Georgetown ETJ
County Line
Berry Creek
SH 195
North San Gabriel River
WILLIAMS DR
Berry Creek
Pecan Branch
IH 35
FM 971
Weir
FM 1105
SH 130
ROYAL
City of Georgetown
Middle Fork San Gabriel River
South San Gabriel River
Smith-Main
SH 29
Weir
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
N
Texas Water Development Board
0 1,500 3,000 Feet
FIGURE 3-3. WATERSHED STUDY AREA
PECAN BRANCH
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017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South San Gabriel River
San Gabriel River
Smith-West Fork
Smith-Main
City of Georgetown
IH 35
FM 1460
SH 29
SH 130
Round Rock
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
Texas Water Development Board
0 1,000 2,000 Feet
FIGURE 3-4. WATERSHED STUDY AREA
SMITH BRANCH
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

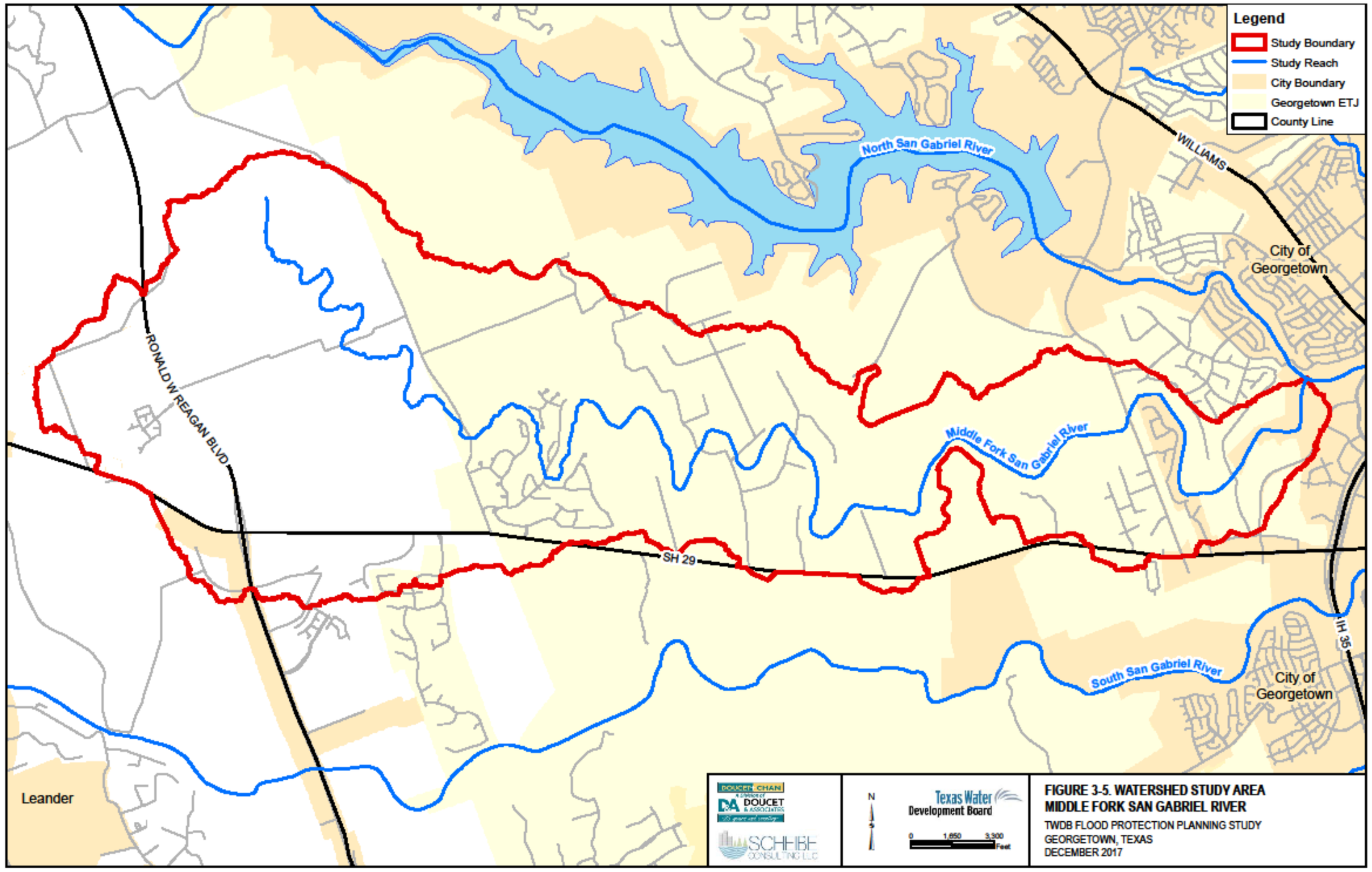
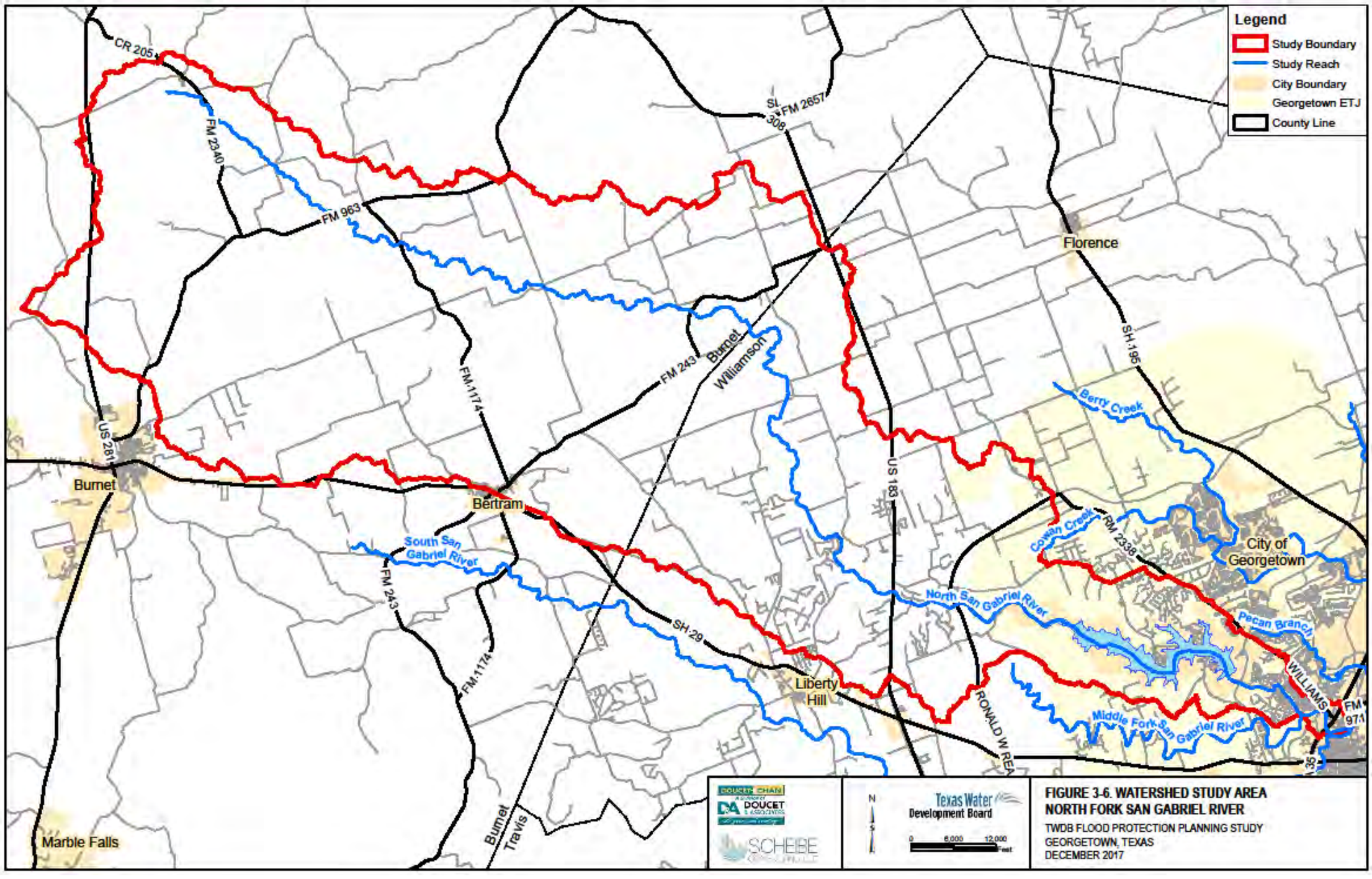


FIGURE 3-5. WATERSHED STUDY AREA
MIDDLE FORK SAN GABRIEL RIVER
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017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Study Reach
City Boundary
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County Line
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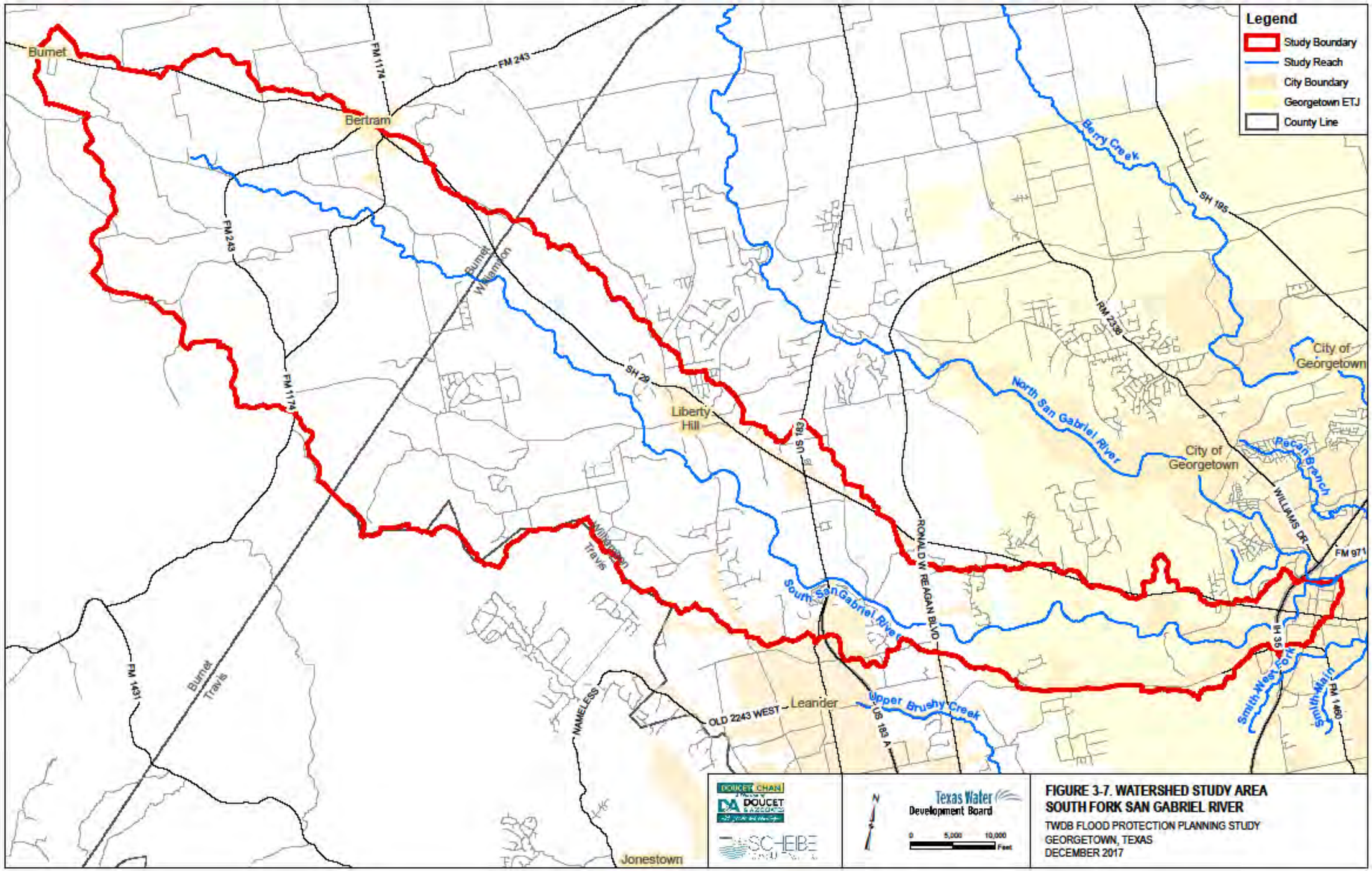
SL 308
FM 2657
Florence
SH 195
FM 243
Burnet
Williamson
FM 1174
US 281
Burnet
Bertram
South San Gabriel River
FM 243
FM 1174
US 183
Berry Creek
Cowan Creek
FM 2338
City of Georgetown
North San Gabriel River
Pecan Branch
WILLIAMS
FM 971
SH 29
Liberty Hill
RONALD W REA
Middle Fork San Gabriel River
Marble Falls
Burnet
Travis
DOUCET CHAIN
DOUCET & ASSOCIATES
SCHEIBE
N
Texas Water Development Board
0 6,000 12,000
feet
FIGURE 3-6. WATERSHED STUDY AREA
NORTH FORK SAN GABRIEL RIVER
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Study Boundary
Study Reach
City Boundary
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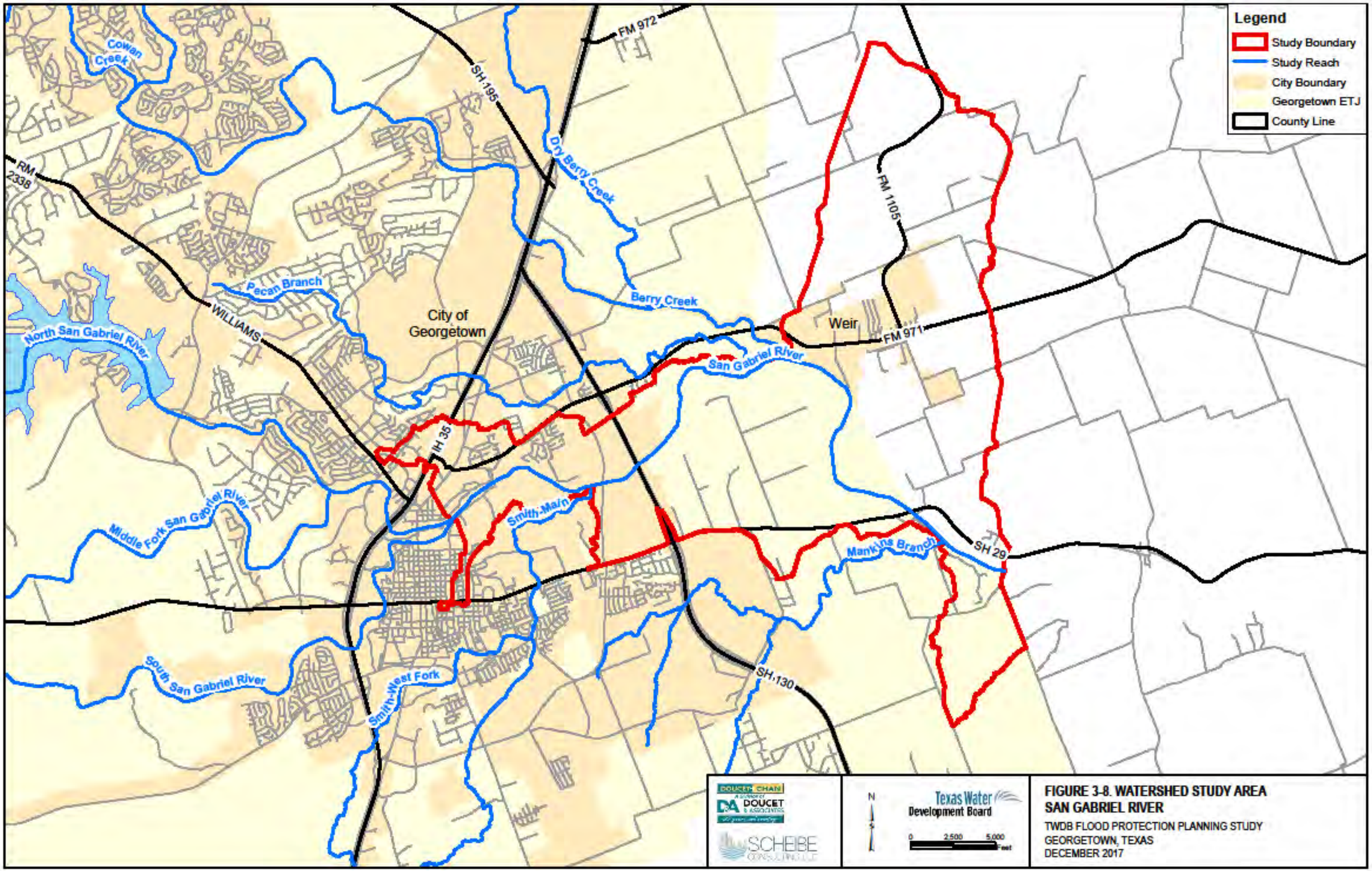
County Line
Burnet
Bertram
Liberty Hill
Leander
Jonestown
City of Georgetown
FM 1174
FM 243
FM 1431
SH 29
SH 195
US 183
US 183 A
RM 2338
RONALD W. REAGAN BLVD
WILLIAMS DR
FM 971
IH 35
FM 1460
Berry Creek
North San Gabriel River
South San Gabriel River
Pecan Branch
Smith-West Fork
Smith-Main
Upper Brushy Creek
NAMELESS
Burnet
Williamson
Travis
DOUCET CHAIN
DOUCET & ASSOCIATES
SCHEIBE
Texas Water Development Board
0 5,000 10,000 Feet
FIGURE 3-7. WATERSHED STUDY AREA
SOUTH FORK SAN GABRIEL RIVER
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Study Boundary
Study Reach
City Boundary
Georgetown ETJ
County Line
Cowan Creek
FM 972
SH 195
Dry Berry Creek
RM 2338
FM 1105
Pecan Branch
Berry Creek
City of Georgetown
Weir
FM 971
WILLIAMS
North San Gabriel River
San Gabriel River
IH 35
Middle Fork San Gabriel River
Smith-Main
Mankins Branch
SH 29
South San Gabriel River
Smith-West Fork
SH 130
DOUCET-CHAN
DOUCET & ASSOCIATES
SCHEIBE CONSULTING LLC
N
Texas Water Development Board
0 2,500 5,000 Feet
FIGURE 3-8. WATERSHED STUDY AREA
SAN GABRIEL RIVER
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

4.0 Flood Protection Planning Study Methodology

Certain areas within the Study Area experience flooding problems on an annual basis. Other areas experience flooding only during significant rainfall events. The specific study areas included in this flood protection planning study were selected based on the data provided in the two applications to the Texas Water Development Board (TWDB) for flood protection planning grants and the impacts of relatively recent significant rainfall events. This FPPS provides mapping of the effective regulatory FEMA floodplains, existing development flow conditions floodplains, and future development flow conditions floodplains, as well as identifies structures that currently lie within the FEMA and updated existing development flow conditions floodplains. Areas with a significant number of structures shown to be at risk of flooding by the 100-year flood were initially considered as the study area focus for this FPPS. Based on meetings with Stakeholders and the public as well as site visits, a more specific list of problem areas was created.

Watershed delineations were generated for the identified problem areas based on available topographic information. The watershed boundaries were used in the hydrologic analysis, which led to the analysis of the 100-year storm events. Respective peak discharge rates and runoff hydrographs were developed for the existing development conditions available at the time of this analysis as well as for the projected fully developed conditions within the Study Area watersheds.

Following the hydrologic analysis, the water surface elevations and flood profiles were developed for the existing development and future development flow conditions for each Study Area stream. Hydrologic and hydraulic evaluations were performed in accordance with the criteria discussed in Appendix A and Appendix B of this report.

In general, the approach to evaluating the identified Study Area's existing stream systems included the following steps:

- Review the existing data available to be used in this study, including existing studies and plans;
- Subdivide the major watersheds into sub-watersheds based on watershed topography and drainage systems;
- Determine the subbasin hydrologic properties;
- Supplement available data with field reconnaissance and surveying;
- Determine the geometric properties of the channel and overbank features from available data, site reconnaissance, and field surveying;
- Develop design storm rainfall totals and time distribution;
- Develop the hydrologic modeling to estimate peak discharge rates and volumes at key locations;
- Develop detailed hydraulic models to determine water surface elevations and floodplain limits;
- Identify stream system and road crossing conveyance inadequacies;
- Develop and analyze conceptual alternatives to improve stream and crossing conveyance performance and minimize potential flooding and flood damages; and

- Select and prioritize the preferred alternatives for flood hazard mitigation.

This FPPS did not include validation of regulatory FEMA floodplains or formal delineation of new FEMA floodplains in currently unmapped areas of the Study Area. This FPPS is a planning document, and so, identified solutions will require further analysis and detailed definition in order to develop final plans to protect structures and road crossings from flooding.

4.1 Review of Historical Flooding and Existing Studies

Multiple data sources were used to determine where historical flooding problems have occurred and to identify potential solutions. Valuable input and information was received from:

- City of Georgetown Staff;
- Williamson County Staff;
- Texas Water Development Board Staff;
- The general public during Public Meetings and during follow-up conversations;
- U.S. Army Corps of Engineers.

This information was compiled during the FPPS and was constantly evaluated and updated throughout the planning process. In addition, the following specific information was received:

Table 4-1 Historical Flooding and Existing Studies

Report	Date	Author	Description
Interviews with City of Georgetown	2015	D+C	Interviews were conducted with floodplain administrator, engineering and maintenance personnel to help identify problem areas, causes of problems, and obtain recent floodplain studies.
City of Georgetown Drainage Master Plan	2000	Raymond Chan & Associates	This report details the drainage areas of Berry Creek, Mankins Branch, Pecan Branch, Smith Branch, and Middle Fork.
Hermine Storm Flood Complaints	2010	City of Georgetown	Compilation of Hermine Storm flood complaints
FEMS FIS and FIRM	2008	FEMA	FIS and FIRM panels

4.1.1 Berry Creek Watershed Study Area

The Sun City development is located within the Berry Creek Watershed. The development's plans and LOMR for Berry Creek were reviewed and incorporated into the study.

4.1.2 Mankins Branch Watershed Study Area

Excluding the City of Georgetown Drainage Master Plan, this FPPS study team is unaware of any ongoing or prior drainage studies relating to the Mankins Branch Study Area.

4.1.3 Pecan Branch Watershed Study Area

Local drainage studies have been performed for various developments within the Pecan Branch watershed (e.g., Georgetown Municipal Airport). While these studies generally focus on local drainage along tributaries and upland areas, and are not directly applicable to the regional focus of this FPPS, drainage information (i.e., flow patterns, land use, impervious coverage, etc.) were reviewed and used as appropriate. An informal report prepared by Paul J. Hanley documenting flooding issues within the Golden Oaks Estates Subdivision during the May 20, 2015 storm event was also incorporated into this study as appropriate.

4.1.4 Smith Branch Watershed Study Area

In June 2014, a FEMA LOMR application was submitted by Kasberg, Patrick & Associates, LP (KPA) on behalf of the City of Georgetown and was later accepted as effective on September 15, 2016. The 2016 LOMR detailed study established new peak flow rates and water surface elevations for the entire West Fork of Smith Branch and the main stem of Smith Branch up to approximately 1,000 feet north of CR 166. The LOMR models, results, and floodplains were reviewed and assessed as part of this study.

4.1.5 North Fork San Gabriel River Watershed Study Area

The Water Management Section within the U.S. Corp of Engineers- Fort Worth District provided stage/storage/discharge information and historical data on Lake Georgetown.

4.1.6 Middle Fork San Gabriel River Watershed Study Area

Excluding the City of Georgetown Drainage Master Plan, this FPPS study team is unaware of any ongoing or prior drainage studies relating to the Middle Fork Study Area.

4.1.7 South Fork San Gabriel River Watershed Study Area

The HEC-HMS hydrology models and spatial files developed as part of the Upper Brushy Creek Watershed Study and Flood Protection Plan and provided by Williamson County were reviewed for consistency with the South Fork San Gabriel River Watershed Study Area. Excluding the City of Georgetown Drainage Master Plan, the FFP study team is unaware of any other ongoing or prior drainage studies relating the South Fork San Gabriel River Watershed Study Area.

4.1.8 San Gabriel River Watershed Study Area

This FPPS study team is unaware of any ongoing or prior drainage studies relating to the San Gabriel River Study Area downstream of South Fork San Gabriel River confluence.

4.2 Hydrology Methodology

The purpose of the hydrologic analysis was to estimate peak discharge rates in key locations that were then used to evaluate capacities of the existing stream systems as well as assess proposed flood hazard mitigation measures. In general, the hydrologic analysis performed as part of this FPPS utilized the Unit Hydrograph Method and design storms as outlined in the Appendix A

Hydrology. Detailed information regarding the hydrologic analysis and the results of the analysis can be found in Appendix A.

4.3 Hydraulics and Floodplain Mapping Methodology

The purposes of the hydraulic analysis were to determine the flooding extents and depths within each community, evaluate capacities of existing streams and structures, and ultimately to size proposed flood hazard mitigation measures. The level of detail for hydraulic analysis was consistent throughout each study area, roughly equivalent to a FEMA Flood Insurance Study by detailed methods (Zone AE) with the exception that no floodway analyses were performed. A HEC-RAS hydraulic model was developed for each study stream to evaluate flows based on both existing and future watershed conditions. The HEC-RAS models were improved with collected field survey data and information from as-built construction plans. Detailed information regarding the hydraulic analyses inputs, methods, and results can be found in Appendix B.

4.4 Stakeholder and Public Input

Throughout the FPPS process, technical input was received from the City of Georgetown, Williamson County, TxDOT (and its consultants), U.S. Army Corps of Engineers, and key stakeholders during formal and informal working sessions as well as telephone consultation meetings. The first two working sessions were with the City of Georgetown staff and included identification of historic flood problem areas and flooded channel crossings and development of future land use assumptions. The third working session was with City of Georgetown staff and included discussion of preliminary floodplain mapping findings and preliminary identification of flooded structures and crossings within the Study Area floodplains. The fourth working session included City of Georgetown staff, Williamson County staff, and City of Leander staff and included discussion of proposed flood hazard mitigation alternatives, including selection of alternatives and prioritization of projects.

Working sessions were also conducted with TxDOT and its consultants with respect to TxDOT plans for improvements to I.H. 35 roadway, bridges and drainage structures through the City of Georgetown. Telephone consultations were conducted with the U.S. Army Corps of Engineers with respect to its normal and flood operations of Lake Georgetown and to obtain updated reservoir flood routing data.

Also throughout the FPPS process, public input was received at formal public meetings and through telephone consultation meetings. The first two public meetings received public comment on preliminary floodplain mappings and identification of historic flood problem areas and flooded channel crossings. Public comment continued after these first two meetings to further clarify the extent of flooding experienced by the public, especially during the Tropical Storm Hermine event. The third public meeting provided more detailed floodplain mapping and identification of flood problem areas and channel crossings throughout the Study Area.

4.5 Flood Hazard Problem Definition Methodology

Flood hazard problems, in the form of flooded structures in problem areas and flooded road crossings over streams were defined within each study area based on information provided by the

stakeholders, information gathered at the public meetings, field reconnaissance, the hydrologic and hydraulic analyses performed as part of the FPPS, and information from previous studies. Areas and channel crossings currently experiencing flooding and areas at risk for potential flooding under Existing Conditions were identified as problem areas and as flooded road crossings. In some cases, multiple flooding issues were combined into a single problem area. The identified problem areas and flooded road crossings were discussed with the stakeholders during the second through fourth working sessions and agreed upon by the parties present.

Section 5 provides a summary of the identified flood hazard problems. The Appendix C "Project Alternatives Evaluation and Selection" provides a more detailed discussion of the methodology used to define the problem areas and flooded channel crossings.

4.6 Development of Project Alternative Methodology

For each identified problem area including flooded structures, multiple alternatives including structural and non-structural measures were initially considered to mitigate flooding issues associated with the problem area. For problem areas with a single clear and feasible solution, only one alternative was carried forward. Mitigation alternatives were developed with input from the community during public and stakeholder meetings. Each project alternative consisted of proposed improvements designed to meet the 100-year storm criteria whenever possible. Consideration was also given to the potential of causing or worsening any downstream problems with proposed improvements. Significant adverse impacts were identified in a few instances (e.g. Pecan Branch) but final designs of any improvements will need to consider this in each improvement location. Improvements considered include:

Structural Approach:

- Detention/Retention Facility;
- Channel Improvements, particularly using the Natural Channel Method;
- Roadway Bridge/Culvert Improvements;
- Levees/Berms/Floodwalls; and
- Combination of any of two or more of the above.

Non-Structural Approach:

- Update the COG Drainage Criteria Manual and existing land development ordinance as well as the other participating communities flood protection regulations, if necessary;
- Buy-outs of the flooded properties;
- Installation of Early Flood Warning systems;
- Installation of flood warning signs and barricades at frequent inundated roadway crossings; and
- Develop pubic information publications describing flood risks and flood insurance.

For each identified flooded road crossing, a crossing upgrade was designed to achieve the flood protection criteria of the local drainage criteria manual, subdivision regulations, or design & construction standards for each applicable jurisdiction (i.e., City of Georgetown, Williamson County, City of Leander, or City of Liberty Hill). Crossing upgrades were designed based on the

current roadway classification (i.e., local, collector, or arterial) based on the City of Georgetown Transportation Plan and other available data. Crossing upgrades included upgrades to existing culvert crossings, replacement of existing culvert crossings with bridges, and upgrades to existing bridges as required to meet the local criteria.

4.7 Alternatives Evaluation & Selection Methodology

The identified flood mitigation alternatives were evaluated and selected based on their flood mitigation benefits, total project cost, and overall feasibility. Benefit/cost analyses were performed using ESRI ArcMap and spreadsheet software to evaluate the cost effectiveness of each alternative as described in Section 4.8. Flood mitigation benefits included estimated reduction in damages for structures (residences, commercial and public facilities).

Estimates of total project cost were developed for each problem area mitigation alternative and flooded crossing upgrade, which included structural costs associated with new culverts, bridges, and ponds, excavation and grading, demolition, potential utility relocations, temporary and permanent erosion controls, and repaving as applicable. Material and construction costs were based on unit prices from recent bid tabulations for similar regional construction projects. Design contingencies, engineering, permitting, and administrative costs were then added to develop a total project cost. At the request of the communities, easement and ROW acquisition costs were not included due to high level of variability. Therefore, potential easement acquisition efforts are qualitatively considered in final project prioritization as discussed in Section 4.9. The methodologies used for concept design and cost estimation of alternatives are described in Appendix C.

Two meetings were also conducted to present identified problem areas and obtain citizens and stakeholders input on the potential flood mitigation alternatives. A public meeting was held in July 2017 to review and discuss the new 100-year floodplain maps, identified problem areas, and potential mitigation alternatives for each area. The public meeting included representatives from the City of Georgetown, Williamson County, and TWDB. Additionally, a stakeholder meeting was held in November 2017 to review and discuss the various mitigation alternatives and roadway crossing upgrades. The stakeholder meeting included representatives from the City of Georgetown, the City of Leander, and Williamson County. In each meeting, problem areas and potential mitigation alternatives were presented, and technical input was provided to the meeting participants. Discussion items during the meeting included:

- Known flood problems and extent of identified problem areas;
- Basic issue(s) to be addressed by each project;
- Types of improvements associated with each project,
- Cost, location, and level of flood protection of each project;
- Technical and qualitative factors for each project; and
- The most favorable alternative for each project.

Tables C-2 through C-5 in Appendix C list the principal improvement components of each alternative. Table C-6 provides a listing of each mitigation alternative and crossing upgrade and its associated estimated construction cost.

4.8 Benefit-To-Cost Analysis Methodology

The relative feasibility of improvement alternatives is primarily measured by reviewing and comparing respective benefit factors. The total project cost for each alternative was estimated as described in Section 4.7 and Appendix C. The benefit of each alternative is the relative monetary savings (damage reduction) of a given improvement being "in-place", compared to it "not being in-place". This value is determined from the difference between estimated damages without the project and estimated damage with the project for a range of storm events with each having a defined frequency of occurrence.

For this analysis, in the absence of field surveyed finished floor elevation data, it was conservatively assumed that a structure fully or partially within the limits (foot print) of flooding was flooded, resulting in damages equal to the full WCAD improvement value for that flooded structure. The total structural damages associated with each storm frequency was multiplied by the annual probability for that frequency (e.g., total 5-year structural damage x 0.2), resulting in an annualized damage associated with each storm frequency. The sum of annual damages for all storm frequencies results in a total annualized damage estimate. The present value of the total annualized damage estimate over an assumed project life of 50-years were compared for with- and without-project conditions. The difference of these present values for each alternative is the flood mitigation benefit. The methodologies used for benefit/cost analyses of alternatives are described in detail in Appendix C.

The benefit-cost ratio is the most commonly applied tool for determining the cost-effectiveness of undertaking an improvement. In general, when the benefits expected exceed the cost of implementation, the project can be deemed viable. However, the methodology used in this analysis provides a more qualitative benefit-cost ranking factor for the purposes of project prioritization and may not definitively indicate project viability. The methodology does provide a good tool for comparing various alternatives in the context of costs and benefits and allows comparisons between alternatives.

4.9 Flood Hazard Mitigation Definition and Prioritization Methodology

During working sessions three and four, the stakeholders agreed to the general evaluation criteria and the prioritization criteria of the recommended flood hazard mitigation projects. The result of the working session was a prioritized list of projects throughout the Study Area that will help identify the relative priority for funding the various projects.

Section 6 provides a summary of the recommended flood hazard mitigation projects and their construction costs. Section 7 provides a summary of the prioritization of the recommended flood hazard mitigation projects. Appendix C provides detailed discussion of the costs and methodology used to prioritize the recommended flood hazard mitigation projects.

5.0 Identified Flood Hazard Problems

Initial phases of the Georgetown – San Gabriel FPPS process included:

- Review of previous studies;
- Field reconnaissance of the study areas;
- Hydrologic and hydraulic analyses and floodplain mapping for each study area;
- Discussions with the public and stakeholders.

These activities resulted in identifying specific problem areas and flooded road crossings within each study area. The problem areas with flooded structures are identified with an alpha-numeric identification numbers representing the study area and numbered sequentially. For example, the specific problem areas discussed in this FPPS for the Berry Creek Watershed Study Area are identified as BC01, BC02, BC03, etc. The flooded road crossings are identified by the roadway name. The following sections provide a general description of the problems and flooded crossings identified in each study area followed by more detailed description of each identified problem area and flooded crossing.

5.1 Berry Creek Watershed Study Area

Flooding issues were identified in the Berry Creek Watershed Study Area based on information gathered from City of Georgetown staff, public input, information gathered from site visits, previous studies, FPPS hydrologic and hydraulic analyses, as well as floodplain mapping. Flooding of residences, property and road crossings located along Berry Creek are the primary concern in this area.

Berry Creek has a total drainage area of 125.4 square miles, causing a significant amount of uncontrolled water to be carried to downstream residential areas lining tributaries and the main channel. As large flows reach the residential areas, limited stream flow capacity results in the flooding of homes, property and road crossings.

The 100-year Existing Conditions floodplain developed by this FPPS reasonably follows the Effective FEMA floodplain boundaries along most of the Berry Creek, Dry Berry Creek and Cowan Creek channels. However, there are several locations where the 100-year Existing Conditions floodplain significantly exceeds the boundaries of the existing 100-year Effective FEMA floodplain as shown on floodplain mapping in Appendix B.

There are a significant number of identified flood hazard issues associated with the Berry Creek main channel and along its tributaries Cowan Creek and Dry Berry Creek. Along the Berry Creek, Cowan Creek and Dry Berry Creek channels there were 25 structures whose residents reported some degree of flooding during the Tropical Storm Hermine event within the floodplain (there were more reports of flooded structures outside the floodplain), and there are 54 structures identified in this FPPS as potentially flooded by the 100-year Existing Conditions flood event within five problem areas. It also must be considered that some homes flooded during Tropical

Storm Hermine but homeowners elected to not report the flooding. Eleven significant roadway channel crossings are flooded within this study area.

The following sections describe the specific flood hazard issues associated with each flood problem area and flooded channel crossing shown on Figure 5-1.

5.1.1 RM 2338/Andice Road Crossing

The existing crossing (eight 9'x7' box culverts) across Cowan Creek is flooded beginning at the 50-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 1.2 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through its Right-of-Way.

5.1.2 CR 245 Crossing

The existing crossing (two 8'x4' box culverts and two 3' arch culverts) across Cowan Creek is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 2.0 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through its Right-of-Way.

5.1.3 BC01 Problem Area

Uncontrolled flows originating in the Cowan Creek watershed and development within the watershed result in the flooding of 6 residential structures along Independence Creek Lane, upstream of the Cool Spring Way crossing. Approximately 1,300 feet of the floodplain along the south side of the Cowan Creek channel experiences flooding due to inadequate conveyance capacity.

5.1.4 CR 241

The existing crossing (bridge with 155' length of opening) across Berry Creek is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 1.1 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.1.5 CR 245

The existing crossing (bridge with 180' length of opening) across Berry Creek is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 4.7 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.1.6 BC02 Problem Area

Uncontrolled flows originating in the main Berry Creek watershed and development within the watershed result in the flooding of 14 residential structures along Bonham Loop, Crockett Loop, Dawson Trail, Dove Hollow Trail, and Fox Home Lane, upstream of the Sun City Boulevard

crossing. Approximately 1,400 feet of the floodplain along the north and south sides of the Berry Creek channel experiences flooding due to inadequate conveyance capacity.

5.1.7 Sun City Boulevard Crossing

The existing crossing (bridge with 110' length of opening) across Berry Creek is flooded beginning at the 50-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 2.0 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.1.8 BC03 Problem Area

Uncontrolled flows originating in the main Berry Creek watershed and tributary Cowan Creek watershed and development within the watersheds result in the flooding of 15 residential structures along Great Frontier Drive, Stockman Trail, Warbler Way, and Painted Bunting Lane, between the Sun City Boulevard crossing and the Del Webb Boulevard crossing. Approximately 1,300 feet of the floodplain along the north and south sides of the Berry Creek channel experiences flooding due to inadequate conveyance capacity.

5.1.9 BC04 Problem Area

Uncontrolled flows originating in the main Berry Creek and Cowan Creek watersheds as well as from development within those watersheds result in flooding of 8 residential structures along Durango Trail and Crystal Springs Drive, downstream of the Del Webb Boulevard crossing. Approximately 3,400 feet of the floodplain along the north and south sides of the Berry Creek channel experiences flooding due to inadequate conveyance capacity.

5.1.10 BC05 Problem Area

Uncontrolled flows originating in the main Berry Creek and Cowan Creek watersheds as well as from development within those watersheds result in flooding of 11 residential structures along Lone Star Drive and Trail Rider Way, downstream of the Del Webb Boulevard crossing. Approximately 1,600 feet of the floodplain along the north side of the Berry Creek channel experiences flooding due to inadequate conveyance capacity.

5.1.11 CR 152

The existing crossing (bridge with 200' length of opening) across Berry Creek is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 7.6 feet over the approach roadway profile and a maximum of 0.6' over the bridge crossing profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.1.12 FM 971

The existing crossing (bridge with 300' length of opening) across Berry Creek is flooded beginning at the 25-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 4.6 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.1.13 Live Oaks Trail

The existing crossing (four 8'x4' box culverts) across Dry Berry Creek is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 4.0 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.1.14 CR 234

The existing crossing (eight 7' arch culverts) across Dry Berry Creek is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 4.4 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.1.15 CR 143

The existing crossing (five 12'x6' box culverts) across Dry Berry Creek is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 5.6 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.1.16 CR 152

The existing crossing (bridge with 400' length of opening) across Dry Berry Creek is flooded beginning at the 50-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 1.3 feet over the approach roadway surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.2 Mankins Branch Watershed Study Area

Flooding issues were identified in the Mankins Branch Watershed Study Area based on information gathered from City of Georgetown staff, public input, information gathered from site visits, previous studies, FPPS hydrologic and hydraulic analyses, as well as floodplain mapping. Flooding of road crossings located along Mankins Branch are the primary concern in this area.

Mankins Branch has a total drainage area of 13.2 square miles, causing a significant amount of uncontrolled water to be carried to the main and tributary channels. As the large flows reach these channels, the channels become restricted, resulting in the flooding of several road crossings.

The 100-year Existing Conditions floodplain developed by this FPPS reasonably follows the Effective FEMA floodplain boundaries all along the Mankins Branch channel as shown on floodplain mapping in Appendix B.

The only identified flood hazard issues associated with Mankins Branch are the four significant roadway channel crossings that are flooded within this study area.

The following sections describe the specific flood hazard issues associated with each flooded channel crossing shown on Figure 5-2.

5.2.1 Hutto Road Crossing

The existing crossing (four 4.5' arch culverts) is flooded beginning at the 25-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 1.0 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.2.2 CR 104/Bell Gin Road Crossing

The existing crossing (4' culvert) is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 2.0 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.2.3 CR 100/McShepherd Road Crossing

The existing crossing (three 4' arch culverts) is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 10.9 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.2.4 Rockridge Lane Crossing (not shown on Figure 5-2)

The existing crossing (nine 3.5' arch culverts) is flooded beginning at the design 100-year Existing Conditions event, and the design 100-year Existing Conditions event flood depth is a maximum of 0.2 feet over the crossing's road surface profile. This crossing is not considered a significant crossing due to its proximity to S.E. Inner Loop to bypass the crossing in case of flood overtopping.

5.3 Pecan Branch Watershed Study Area

Flooding issues were identified in the Pecan Branch Watershed Study Area based on information gathered from City of Georgetown staff, public input, information gathered from site visits, previous studies, FPPS hydrologic and hydraulic analyses, as well as floodplain mapping. Flooding of residences, property and road crossings located along Pecan Branch are the primary concern in this area. It should be noted that this study focuses on the main stem of Pecan Branch as the source of flooding and does not evaluate local flooding potential or flooding due to tributaries to Pecan Branch.

Pecan Branch has a total drainage area of 7.3 square miles, causing a significant amount of uncontrolled water to be carried to downstream residential areas lining the tributaries and main channel. As the large flows reach the residential areas, the channels become restricted, resulting in the flooding of homes, property and several road crossings.

The 100-year Existing Conditions floodplain developed by this FPPS reasonably follows the Effective FEMA floodplain boundaries along most of the Pecan Branch channel. However, there are several areas (primarily upstream of I.H. 35) where the FPPS floodplain differs from the boundaries of the Effective FEMA floodplain as shown on floodplain mapping in Appendix B.

There are a significant number of identified flood hazard issues associated with the main stem of Pecan Branch. There were 24 structures whose residents reported some degree of flooding during the Tropical Storm Hermine event, and there are 33 structures identified as potentially flooded by the 100-year Existing Conditions flood event within five problem areas. Eleven (11) significant road crossings are flooded within this study area.

The following sections describe the specific flood hazard issues associated with each flood problem area and flooded road crossing shown on Figure 5-3.

5.3.1 PB01 Problem Area – Golden Oaks Subdivision

The Golden Oaks Subdivision located within the City of Georgetown ETJ between Lakeway Drive and Airport Road just west of IH35 includes 17 structures whose residents reported some degree of flooding during the Tropical Storm Hermine event and 8 structures identified as potentially flooded by the 100-year Existing Conditions flood event. The subdivision includes two local roads as emergency access routes: Shady Hollow Drive and Golden Oaks Road, both of which are flooded in storm events as frequent as the 5-year event. Homes within this subdivision are located within the heavily wooded channel and overbank areas and may experience property and structure flooding in storm events as frequent as the 5-year event.

5.3.2 PB02 Problem Area – I.H. 35 Crossing

The Pecan Branch crossing of the I.H. 35 southbound access and main lanes/northbound access road each consist of three (3) 10’x8’ concrete box culverts and are flooded in storm events as frequent as the 25-year event and 100-year event, respectively. Due to its undersized culverts, I.H. 35 impounds a significant amount of water roughly one quarter mile upstream (west) of the crossing; however, no structures appear to be flooded due to the crossing. In the past, this flooded crossing has resulted in loss of life, and therefore, is considered a significant flood problem area. Mitigation alternatives for this problem area must consider hydrologic impacts of removing flood volume storage if the culvert capacity is increased.

5.3.3 PB03 Problem Area – Serenada Subdivision

The Serenda Subdivision located within the City of Georgetown ETJ between West Sequoia Spur and Northwest Boulevard north of Williams Drive 8 structures identified as potentially flooded by the 100-year Existing Conditions flood event. There were no residents who reported flooding during the Tropical Storm Hermine event; however, significant development has occurred within the watershed since this event in 2010. The subdivision includes a number of flooded crossings along collector roadways including West Sequoia Spur, Esparada Drive, and Serenada Drive, as well as flooded local roadways with alternate emergency access routes including La Paloma Drive, Val Verde Drive, and Seville Drive. Homes within this subdivision are located within the heavily wooded channel and overbank areas and may experience property and structure flooding in storm events as frequent as the 5-year event.

5.3.4 PB04 Problem Area – Canyon Road / Reata Trails

Canyon Road is located within the Georgetown City Limits in the Reata Trails Subdivision on the east side of Northwest Boulevard. This area includes 9 structures along the east side of Canyon Road whose residents reported some degree of flooding during the Tropical Storm Hermine event and 13 structures identified as potentially flooded by the 100-year Existing Conditions flood event. These homes are located along the west side of Pecan Branch where the channel capacity is reduced due to a large earthen outcropping along the east bank.

5.3.5 PB05 Problem Area – Lonnie Thomas Road

Lonnie Thomas Road is located within the City of Georgetown ETJ just west of CR 152. This area includes 4 structures identified as potentially flooded by the 100-year Existing Conditions flood event. There were no residents who reported flooding during the Tropical Storm Hermine event; however, significant development has occurred within the watershed since this event in 2010. Homes in this area are located in close proximity to the channel along the north side of Pecan Branch.

5.3.6 West Sequoia Spur Crossing

The existing crossing (single 48" dia. CMP) across Pecan Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 2.0 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing.

5.3.7 Esperada Drive Crossing

The existing crossing (one (1) 3.25' and three (3) 5' CMP arch culverts) across Pecan Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 2.0 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing.

5.3.8 Serenada Drive Crossing

The existing crossing (two (2) 3' and three (3) 5' CMP arch culverts) across Pecan Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 2.8 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing.

5.3.9 West Shady Hollow Drive Crossing

The existing crossing (four (4) 4' CMP arch culverts) across Pecan Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 4.5 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing. This crossing is a classified as a local roadway with no alternate emergency access route.

5.3.10 West Golden Oaks Road Crossing

The existing crossing (three (3) 5' CMP arch culverts) across Pecan Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 5.0 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing. This crossing is a classified as a local roadway with no alternate emergency access route.

5.3.11 Airport Road Crossing

The existing crossing (four (4) 3.2' CMP arch culverts) across Pecan Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 10.2 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing. Since the City of Georgetown has indicated no plans to upgrade this crossing and the possibility of closing the roadway altogether, this crossing is not included in further analysis. Hydraulic impacts due to removal of the crossing were found to be negligible due to the low elevation of the roadway and its close proximity to the backwater effects of I.H. 35.

5.3.12 Austin Avenue Crossing

The existing crossing (three (3) 8' x 8' concrete box culverts) across Pecan Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 2.4 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing.

5.3.13 CR 151 Crossing

The existing crossing (five (5) 6.4' CMP arch culverts) across Pecan Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 2.9 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing.

5.3.14 Northeast Inner Loop Crossing

The existing crossing (six (6) 6.4' CMP arch culverts) across Pecan Branch is flooded beginning at the 25-year flood event, and the design 100-year Existing Conditions event flood depth is 2.0 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing.

5.3.15 CR 152 Crossing

The existing crossing (single 1.6' CMP arch culvert) across Pecan Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 4.1 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing.

5.3.16 FM 971 Crossing

The existing crossing (five (5) 8' x 5' concrete box culverts) across Pecan Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 3.0 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing.

5.4 Smith Branch Watershed Study Area

Flooding issues were identified in the Smith Branch Watershed Study Area based on information gathered from City of Georgetown staff, public input, information gathered from site visits, previous studies, FPPS hydrologic and hydraulic analyses, as well as floodplain mapping. Flooding of residences, property and road crossings located along main stem and west fork of Smith Branch are the primary concern in this area.

Smith Branch has a total drainage area of 9.2 square miles, causing a significant amount of uncontrolled water to be carried to downstream residential areas lining the tributaries and main channels. As the large flows reach the residential areas, the channels become restricted, resulting in the flooding of homes, property and several road crossings.

The 100-year Existing Conditions floodplain developed by this FPPS reasonably follows the Effective FEMA floodplain boundaries along most of the Smith Branch channel as shown on floodplain mapping in Appendix B.

There are a significant number of identified flood hazard issues associated with the main stem of Smith Branch. There were 29 structures whose residents reported some degree of flooding during the Tropical Storm Hermine event, and there are 17 structures identified as potentially flooded by the 100-year Existing Conditions flood event within three problem areas. Seven (7) significant road crossings are flooded within this study area.

The following sections describe the specific flood hazard issues associated with each flood problem area and flooded road crossing shown on Figure 5-4.

5.4.1 SB01 Problem Area – West Fork Confluence

The area surrounding the West Fork confluence with Smith Branch, located primarily within the Georgetown City Limits and entirely within its ETJ, includes 18 structures whose residents reported some degree of flooding during the Tropical Storm Hermine event (8 of which have since been bought out by the City of Georgetown) and 6 remaining structures identified as potentially flooded by the 100-year Existing Conditions flood event. Flooded structures are located within the Quail Valley Subdivision along the main stem of Smith Branch and within the University Park Subdivision due to overflows from the West Fork to the north along Quail Valley Drive. Channel capacity in this problem area is limited due to a constriction along the east bank of the main stem immediately downstream of the West Fork confluence. The hydraulic efficiency of the confluence is also impaired by the near 90-degree angle at which the West Fork enters the main stem. Furthermore, the undersized culvert crossing at Quail Valley Drive has the potential to back water up to the north through the University Park Subdivision in extreme storm events.

5.4.2 SB02 Problem Area – Rabbit Hollow Subdivision

The Rabbit Hollow Subdivision located within the City of Georgetown ETJ along the main stem of Smith Branch northwest of the intersection of FM 1460 and the Southeast Inner Loop includes 6 structures identified as potentially flooded by the 100-year Existing Conditions flood event. There were no residents who reported flooding during the Tropical Storm Hermine event; however, development has occurred within the watershed since this event in 2010, and the event itself may not have resulted in 100-year flood levels within this area. Homes within this subdivision are located within a low-lying area near the channel and may experience property and structure flooding in storm events as frequent as the 5-year event.

5.4.3 SB03 Problem Area – Williamson County Juvenile Justice Center

The Williamson County Juvenile Justice Center (WCJDC) is located along the main stem of Smith Branch within the Georgetown City Limits just inside of the Southeast Inner Loop. While outside of the 100-year Existing Conditions floodplain limits, WCJDC has been identified as a potentially flooded structure by Williamson County staff, as it has experienced some degree of flooding since its construction circa 2002.

5.4.4 CR 166 Crossing

The existing crossing (two (2) 3.2' CMP arch culverts) across Smith Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 2.7 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing. This crossing is a classified as a local roadway with no alternate emergency access route.

5.4.5 I.H. 35 Southbound Frontage Road Crossing

The existing crossing (three (3) 7' x 6' concrete box culverts) across the West Fork of the Smith Branch is flooded beginning at the 100-year flood event, and the design 100-year Existing Conditions event flood depth is 3.5 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing.

5.4.6 Madison Oaks Avenue Crossing

The existing crossing (four (4) 10' x 6' concrete box culverts) across Smith Branch is flooded beginning at the 25-year flood event, and the design 100-year Existing Conditions event flood depth is 1.6 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing. This crossing is a commercial driveway serving several businesses including a Greyhound bus station with no alternate emergency access route.

5.4.7 S. Austin Avenue Crossing

The existing crossing (four (4) 9' x 7' concrete box culverts) across Smith Branch is flooded beginning at the 100-year flood event, and the design 100-year Existing Conditions event flood depth is 0.8 feet over the crossing. Based on site reconnaissance observations and hydraulic

analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing.

5.4.8 Quail Valley Drive Crossing

The existing crossing (six (6) 8' x 4' concrete box culverts) across Smith Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 3.8 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing. This crossing is included in flood problem area SB01.

5.4.9 E. University Avenue Crossing

The existing crossing (118' span bridge) across Smith Branch is flooded beginning at the 25-year flood event, and the design 100-year Existing Conditions event flood depth is 1.8 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing. This crossing is a classified as a local roadway with no alternate emergency access route.

5.4.10 Smith Creek Road Crossing

The existing crossing (single 4.6' x 8.1' concrete box culvert) across Smith Branch is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is 6.0 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 100-year Existing Conditions flood event through the crossing.

5.5 Middle Fork San Gabriel River Watershed Study Area

Flooding issues were identified in the Middle Fork San Gabriel River Watershed Study Area based on information gathered from City of Georgetown staff, public input, information gathered from site visits, previous studies, FPPS hydrologic and hydraulic analyses, as well as floodplain mapping. Flooding of road crossings located along the Middle Fork San Gabriel River are the primary concern in this area.

Middle Fork San Gabriel River has a total drainage area of 16.9 square miles, causing a significant amount of uncontrolled water to be carried to the main channel. As the large flows reach the channel, the channel becomes restricted, resulting in the flooding of several road crossings.

The 100-year Existing Conditions floodplain developed by this FPPS reasonably follows the Effective FEMA floodplain boundaries along most of the Middle Fork San Gabriel River channel. However, the 100-year Existing Conditions floodplain significantly exceeds the boundaries of the existing 100-year Effective FEMA floodplain from Estancia Way to Gabriel Forest as shown on floodplain mapping in Appendix B.

The only identified flood hazard issues associated with Middle Fork San Gabriel River are the three significant road crossings that are flooded within this study area.

The following sections describe the specific flood hazard issues associated with each flooded channel crossing shown on Figure 5-5.

5.5.1 Cross Creek Road Crossing

The existing crossing (four 5' culverts) is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 4.0 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.5.2 Cedar Hollow Road Crossing

The existing crossing (four 4' arch culverts) is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 7.1 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.5.3 Rancho Bueno Drive Crossing

The existing crossing (six 4' culverts) is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 5.3 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.6 North Fork San Gabriel River Watershed Study Area

Flooding issues were identified in the North Fork San Gabriel River Watershed Study Area based on information gathered from City of Georgetown staff, public input, information gathered from site visits, previous studies, FPPS hydrologic and hydraulic analyses, as well as floodplain mapping. Flooding of residences, property and road crossings located along North Fork San Gabriel River are the primary concern in this area.

North Fork San Gabriel River has a total drainage area of 251.0 square miles. Approximately 246.4 square miles of its drainage area discharges into Lake Georgetown (an in-line U.S. Army Corps of Engineers flood control reservoir), and approximately 4.6 square miles of its drainage area is between Lake Georgetown and the confluence with the San Gabriel River. The runoff from the uncontrolled drainage area upstream of Lake Georgetown causes a significant amount of uncontrolled water to be carried to downstream residential areas lining the main channel. As the large flows reach the residential areas, the channels become restricted, resulting in the flooding of homes, property and several road crossings.

The 100-year Existing Conditions floodplain developed by this FPPS reasonably follows the Effective FEMA floodplain boundaries along most of the North Fork San Gabriel River channel and within the Lake Georgetown 100-year flood pool. However, the 100-year Existing Conditions floodplain significantly exceeds the boundaries of the existing 100-year Effective FEMA

floodplain between Lake Georgetown and Northcross Road as shown on floodplain mapping in Appendix B.

There are several identified flood hazard issues associated with the North Fork San Gabriel River main channel. There were 3 structures whose residents reported some degree of flooding during the Tropical Storm Hermine event within the floodplain (there were more reports of flooded structures outside the floodplain), and there are 15 structures identified as potentially flooded by the 100-year Existing Conditions flood event within three flood problem areas. Nine significant road crossings are flooded within this study area.

The following sections describe the specific flood hazard issues associated with each flood problem area and flooded road crossings shown on Figure 5-6.

5.6.1 FM 2340 Crossing

The existing crossing (bridge with 36' length of opening) is flooded beginning at the 5-year flood event, and the design 25-year Existing Conditions event flood depth is a maximum of 3.6 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 25-year Existing Conditions flood event through the Right-of-Way.

5.6.2 CR 203 Crossing

The existing crossing (9" culvert) is flooded beginning at the 5-year flood event, and the design 25-year Existing Conditions event flood depth is a maximum of 4.2 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 25-year Existing Conditions flood event through the Right-of-Way.

5.6.3 CR 202 Crossing

The existing crossing (two 2' culverts) is flooded beginning at the 5-year flood event, and the design 25-year Existing Conditions event flood depth is a maximum of 1.2 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 25-year Existing Conditions flood event through the Right-of-Way.

5.6.4 RM 963 Crossing

The existing crossing (bridge with 100' length of opening) is flooded beginning at the 25-year flood event, and the design 25-year Existing Conditions event flood depth is a maximum of 0.6 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 25-year Existing Conditions flood event through the Right-of-Way.

5.6.5 RM 1174 Crossing

The existing crossing (bridge with 250' length of opening) is flooded beginning at the 25-year flood event, and the design 25-year Existing Conditions event flood depth is a maximum of 0.7 feet over the crossing's road surface profile. Based on site reconnaissance observations and

hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 25-year Existing Conditions flood event through the Right-of-Way.

5.6.6 CR 200 Crossing

The existing crossing (bridge with 140' length of opening) is flooded beginning at the 10-year flood event, and the design 25-year Existing Conditions event flood depth is a maximum of 2.8 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 25-year Existing Conditions flood event through the Right-of-Way.

5.6.7 FM 243 Crossing

The existing crossing (bridge with 200' length of opening) is flooded beginning at the 25-year flood event, and the design 25-year Existing Conditions event flood depth is a maximum of 1.7 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 25-year Existing Conditions flood event through the Right-of-Way.

5.6.8 NF01 Problem Area

Uncontrolled flows originating in the North Fork San Gabriel River watershed upstream of Lake Georgetown and development within the watershed result in the flooding of 9 residential structures along River Road, approximately 2.5 miles upstream of U.S. 183. Approximately 4,600 feet of the floodplain along the south and west side of the North San Gabriel River channel experiences flooding due to inadequate conveyance capacity.

5.6.9 CR 257 Crossing

The existing crossing (bridge with 175' length of opening) is flooded beginning at the 10-year flood event, and the design 25-year Existing Conditions event flood depth is a maximum of 3.7 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 25-year Existing Conditions flood event through the Right-of-Way.

5.6.10 NF02/NF03 Problem Areas

Uncontrolled flows originating in the North Fork San Gabriel River watershed upstream of Lake Georgetown and development within the watershed result in the flooding of 6 residential structures (with possibility of one or two commercial structures in this area as well) along CR 256, between U.S. 183 and Ronald W. Reagan Boulevard crossings. Approximately 3,100 feet of the floodplain along the north side of the North Fork San Gabriel River channel experiences flooding due to inadequate conveyance capacity.

5.6.11 CR 258 Crossing

The existing crossing (bridge with 70' length of opening) is flooded beginning at the 5-year flood event, and the design 100-year Existing Conditions event flood depth is a maximum of 22.6 feet over the crossing's road surface profile. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to safely convey the design 100-year Existing Conditions flood event through the Right-of-Way.

5.7 South Fork San Gabriel River Watershed Study Area

Flooding issues were identified in the South Fork San Gabriel River Watershed Study Area based on information gathered from City of Georgetown staff, public input, information gathered from site visits, previous studies, FPPS hydrologic and hydraulic analyses, as well as floodplain mapping. Flooding of residences, property and road crossings located along the main stem of the South Fork San Gabriel River are the primary concern in this area.

South Fork San Gabriel River has a total drainage area of 134.5 square miles, causing a significant amount of uncontrolled water to be carried to downstream residential areas lining the tributaries and main channel.

The 100-year Existing Conditions floodplain developed by this FPPS reasonably follows the Effective FEMA floodplain boundaries along most of the South Fork San Gabriel River as shown on floodplain mapping in Appendix _.

There are several identified flood hazard issues associated with the South Fork San Gabriel River. There were 2 structures whose residents reported some degree of flooding during the Tropical Storm Hermine event, and there are 9 structures identified as potentially flooded by the 100-year Existing Conditions flood event within a single flood problem area. Three significant roadway crossings are flooded within this study area.

The following sections describe the specific flood hazard issues associated with each flood problem area and flooded road crossing shown on Figure 5-7.

5.7.1 SFSG01 Problem Area – High Gabriel / S. San Gabriel Ranches

The High Gabriel and South San Gabriel Ranches Subdivisions located within the City of Leander ETJ just east of U.S. 183 includes 9 structures identified as potentially flooded by the 100-year Existing Conditions flood event. There were no residents who reported flooding during the Tropical Storm Hermine event; however, significant development has occurred within the watershed since this event in 2010. Homes within this subdivision are located within the low-lying overbank areas of the river and may experience property and structure flooding during the 100-year storm event.

5.7.2 CR 330B Crossing

The existing crossing (two (2) 4’ CMP culverts) is flooded beginning at the 5-year flood event, and the design 25-year Existing Conditions event flood depth is 2.7 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 25-year Existing Conditions flood event through the crossing.

5.7.3 CR 323 Crossing

The existing crossing (60’ span bridge) is flooded beginning at the 5-year flood event, and the design 25-year Existing Conditions event flood depth is 15.0 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 25-year Existing Conditions flood event through the crossing.

5.7.4 FM 1869 Crossing

The existing crossing (210' span bridge) is flooded beginning at the 25-year flood event, and the design 25-year Existing Conditions event flood depth is 1.9 feet over the crossing. Based on site reconnaissance observations and hydraulic analysis, the crossing does not have sufficient capacity to convey the design 25-year Existing Conditions flood event through the crossing.

5.8 San Gabriel River Watershed Study Area

Flooding issues were identified in the San Gabriel River Watershed Study Area based on information gathered from City of Georgetown staff, public input, information gathered from site visits, previous studies, FPPS hydrologic and hydraulic analyses, as well as floodplain mapping. Flooding of residences and property located along the San Gabriel River are the primary concern in this area.

San Gabriel River has a total drainage area of 575.9 square miles, although 246.4 square files empty into Lake Georgetown that captures and controls a majority of storm runoff, even runoff from a 100-year event. The runoff from the remaining 329.5 square mile uncontrolled drainage area causes a significant amount of uncontrolled water to be carried to downstream residential areas lining the main channel. As the large flows reach the developed areas, the channels become restricted, resulting in the flooding of homes and property.

The 100-year Existing Conditions floodplain developed by this FPPS reasonably follows the Effective FEMA floodplain boundaries along most of the San Gabriel River channel. However, the 100-year Existing Conditions floodplain significantly exceeds the boundaries of the existing 100-year Effective FEMA floodplain at the San Gabriel River's confluence with Pecan Branch and Berry Creek as shown on floodplain mapping in Appendix B.

There are several identified flood hazard issues associated with the San Gabriel River main channel. There were 3 structures whose residents reported some degree of flooding during the Tropical Storm Hermine event within the floodplain (there were more reports of flooded structures outside the floodplain), and there are 26 structures identified as potentially flooded by the 100-year Existing Conditions flood event within two flood problem areas. There are no significant road crossings that are flooded within this study area.

The following sections describe the specific flood hazard issues associated with each flood problem area shown on Figure 5-8.

5.8.1 SG01 Problem Area

Flows originating in the North Fork San Gabriel River downstream of Lake Georgetown, South Fork San Gabriel River, Middle Fork San Gabriel River, Pecan Branch, Berry Branch, and Mankins Branch and development within the watershed are resulting in the flooding of 10 residences along CR 103, downstream of the confluence with Berry Creek and Pecan Branch. Approximately 5,400 feet of the floodplain along the south side of the San Gabriel River channel is experiencing flood hazard flooding due to inadequate conveyance capacity.

5.8.2 SG02 Problem Area

Flows originating in the North Fork San Gabriel River downstream of Lake Georgetown, South Fork San Gabriel River, Middle Fork San Gabriel River, Pecan Branch, Berry Branch, and Mankins Branch and development within the watershed are resulting in the flooding of 16 residences (excluding RV trailers in a mobile home park in this area) along McShepherd Road, S.H. 29, Water Valley Drive, and Grist Mill Loop, downstream of the CR 100 crossing. Approximately 4,100 feet of the floodplain along the south and north sides of the San Gabriel River channel are experiencing flood hazard flooding due to inadequate conveyance capacity.


Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
CR 241
CR 245
Berry Creek
CR 243
CR 241
SUNSET ACRES LN
195
BAR T DR
FISHER RD
CR 245
CR 246
PVR 904
RAWHIDE LN
N
Texas Water Development Board
0
1,150
2,300
Feet
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE CONSULTING LLC
FIGURE 5-1. FLOOD HAZARD AREAS
BERRY CREEK
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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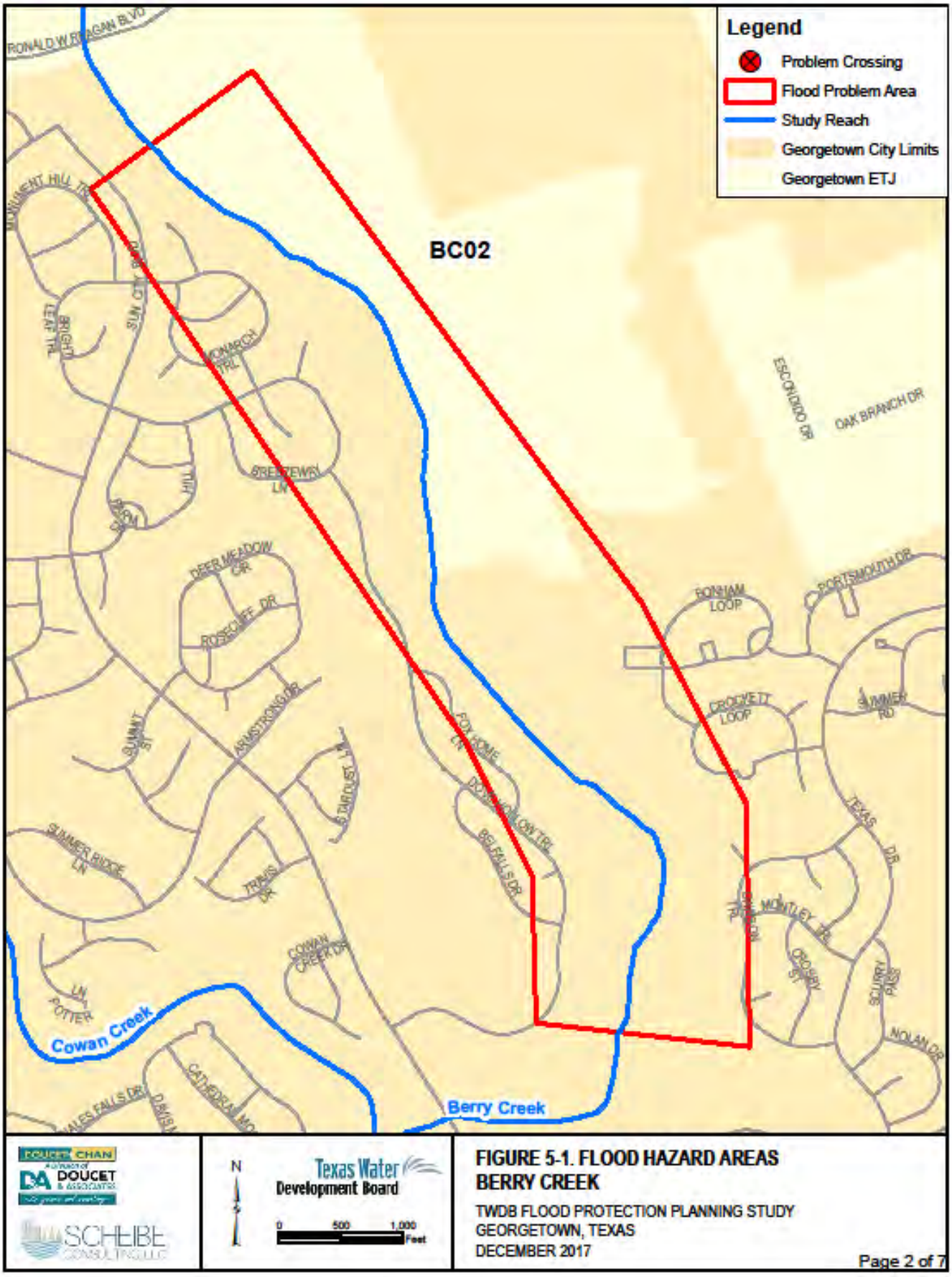
Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
BC02
Cowan Creek
Berry Creek
RONALD W REAGAN BLVD
MONUMENT HILL TRL
SUN CITY BLVD
BRIGHT LEAF TRL
MONARCH TRL
BREEZEWAY LN
DEER MEADOW CIR
ROSECLIFF DR
ARMSTRONG DR
SUMMIT ST
STARDUST LN
SUMMER RIDGE LN
TRAVIS DR
COWAN CREEK DR
POTTER LN
CATHEDRAL MO
FOX HOME LN
DOVERMOWLOW TRL
BELFALLS DR
ESCONDIDO DR
OAK BRANCH DR
BONHAM LOOP
PORTSMOUTH DR
CROCKETT LOOP
SUMMER RD
TEXAS DR
MONTLEY TRL
CROSBY ST
SCURRY PASS
NOLAN DR
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE CONSULTING LLC
N
Texas Water Development Board
0 500 1,000 Feet
FIGURE 5-1. FLOOD HAZARD AREAS
BERRY CREEK
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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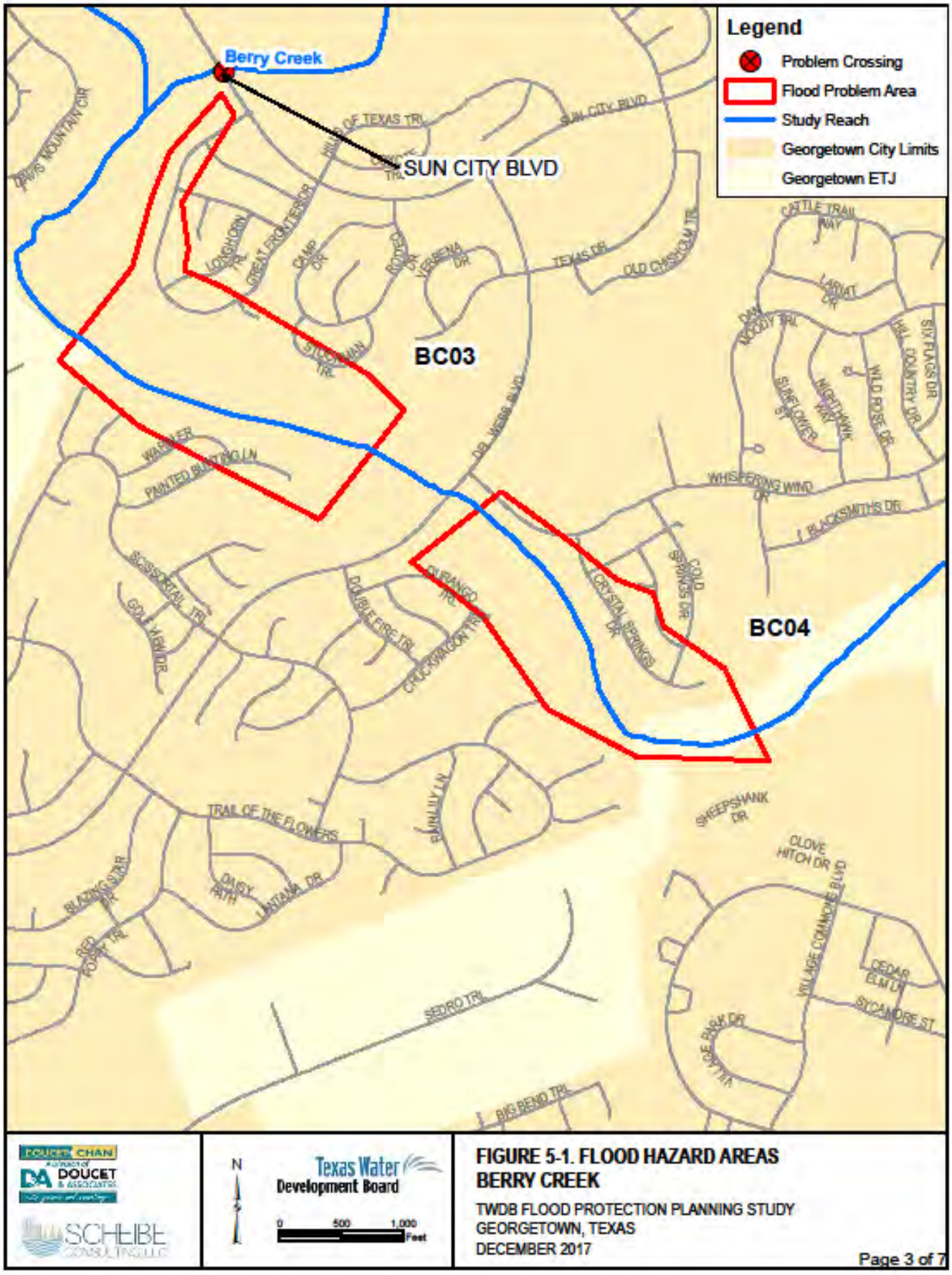

FIGURE 5-1. FLOOD HAZARD AREAS
BERRY CREEK

TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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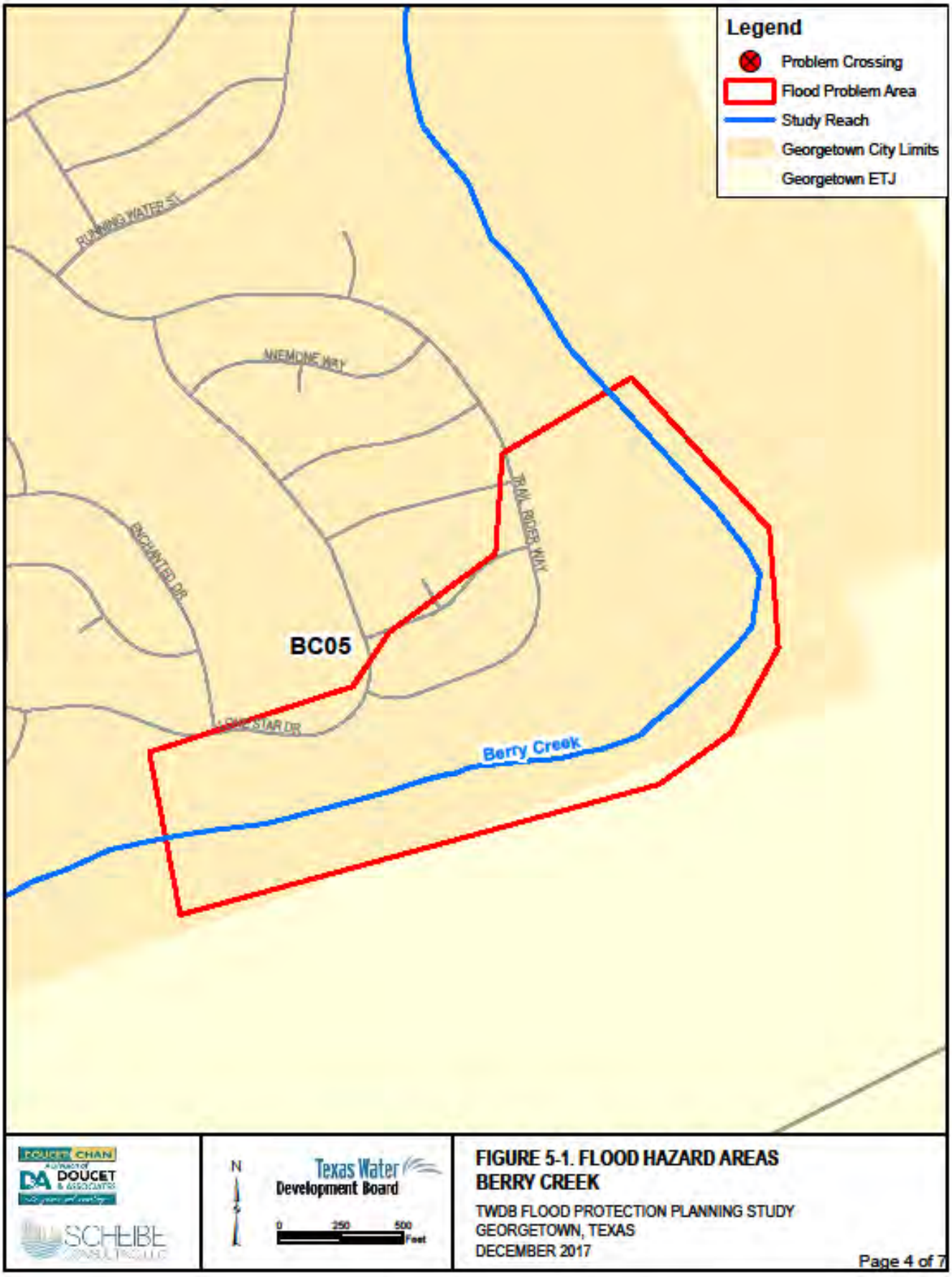
Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
RUNNING WATER ST
MNEMONE WAY
ENCHANTED DR
LONE STAR DR
RAIL RIDER WAY
BC05
Berry Creek
N
Texas Water Development Board
0
250
500
Feet
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE CONSULTING LLC
FIGURE 5-1. FLOOD HAZARD AREAS
BERRY CREEK
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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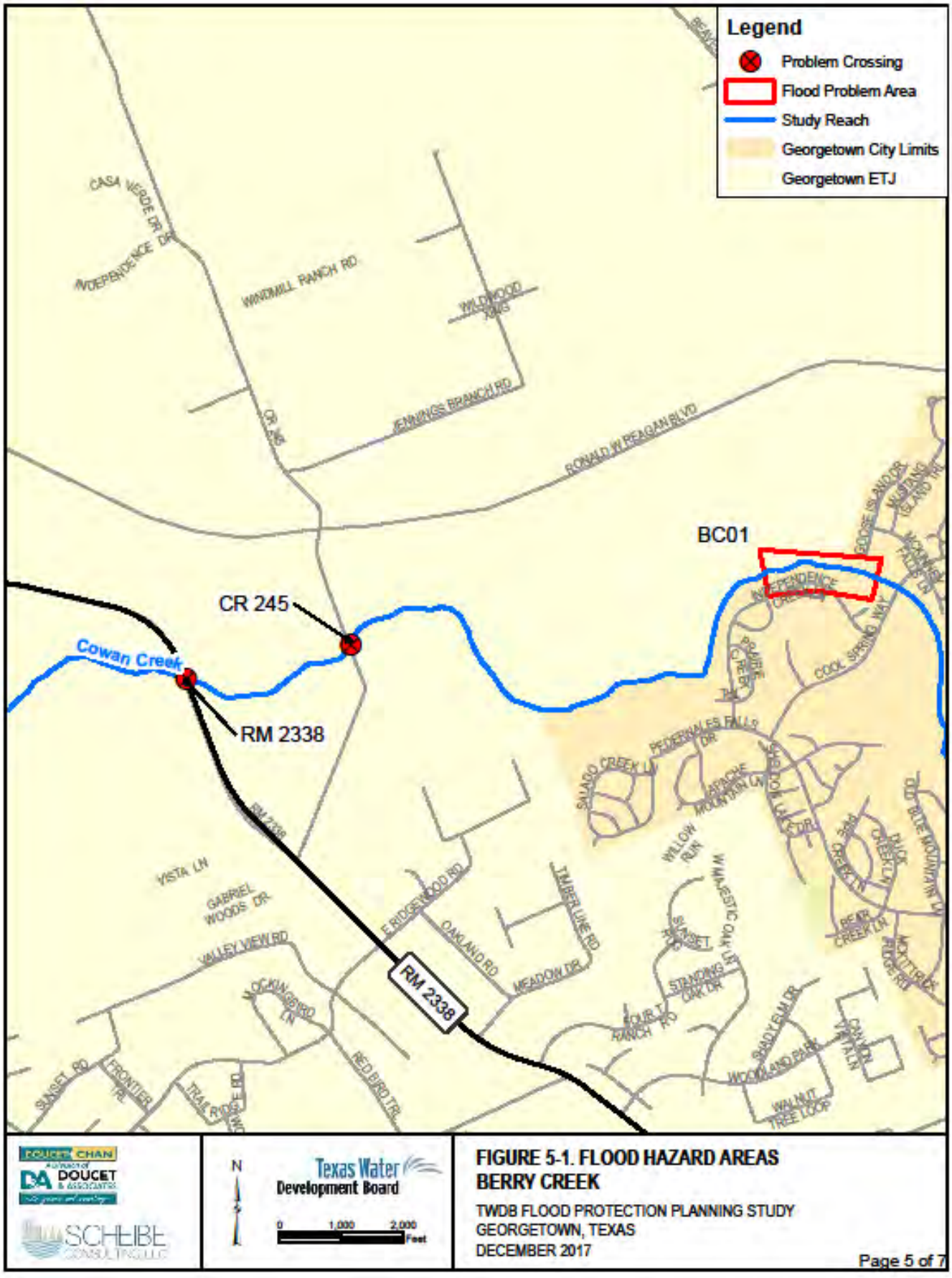
Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
BC01
CR 245
Cowan Creek
RM 2338
RM 2338
CASA VERDE DR
INDEPENDENCE DR
WINDMILL RANCH RD
WILDWOOD AVE
JENNINGS BRANCH RD
RONALD W REAGAN BLVD
GOOSE ISLAND DR
COOL SPRING WAY
PEDERNALES FALLS DR
SALADO CREEK LN
APACHE MOUNTAIN LN
WILLOW RUN
W MAJESTIC OAK LN
STANDING OAK DR
SHADY ELM DR
WOODLAND PARK
WALNUT TREE LOOP
VISTA LN
GABRIEL WOODS DR
VALLEY VIEW RD
E RIDGEWOOD RD
OAKLAND RD
MEADOW DR
TIMBER LINE RD
MOCKINGBIRD LN
RED BIRD TRL
SUNSET RD
FRONTIER TRL
TRAIL RIDGE RD
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE CONSULTING LLC
N
Texas Water Development Board
0 1,000 2,000 Feet
FIGURE 5-1. FLOOD HAZARD AREAS
BERRY CREEK
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
LIVE OAKS TRAIL
CR 234
CR 143
RONALD W REAGAN BLVD
BURSON LN
LIVE OAK TRLS
CR 146
CR 147
PVR 914
CR 142
IH 35
SH 195
FM 972
N
0
1,000
2,000
Feet
Texas Water Development Board
DOUCET & ASSOCIATES
SCHEIBE CONSULTING LLC
FIGURE 5-1. FLOOD HAZARD AREAS
BERRY CREEK
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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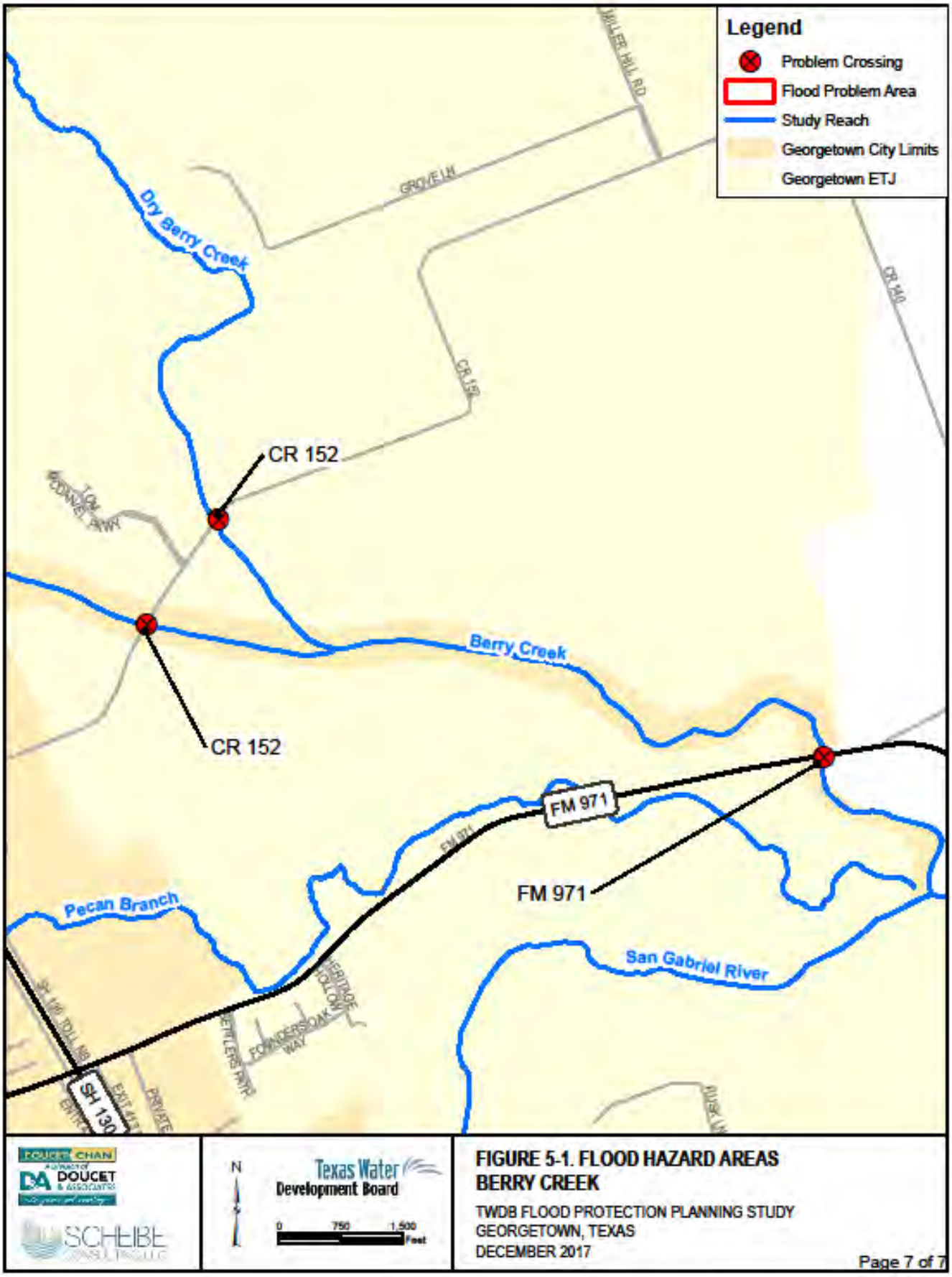
Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
Dry Berry Creek
CR 152
CR 152
Berry Creek
FM 971
FM 971
Pecan Branch
San Gabriel River
SH 130
N
Texas Water Development Board
0
750
1,500
Feet
FIGURE 5-1. FLOOD HAZARD AREAS
BERRY CREEK
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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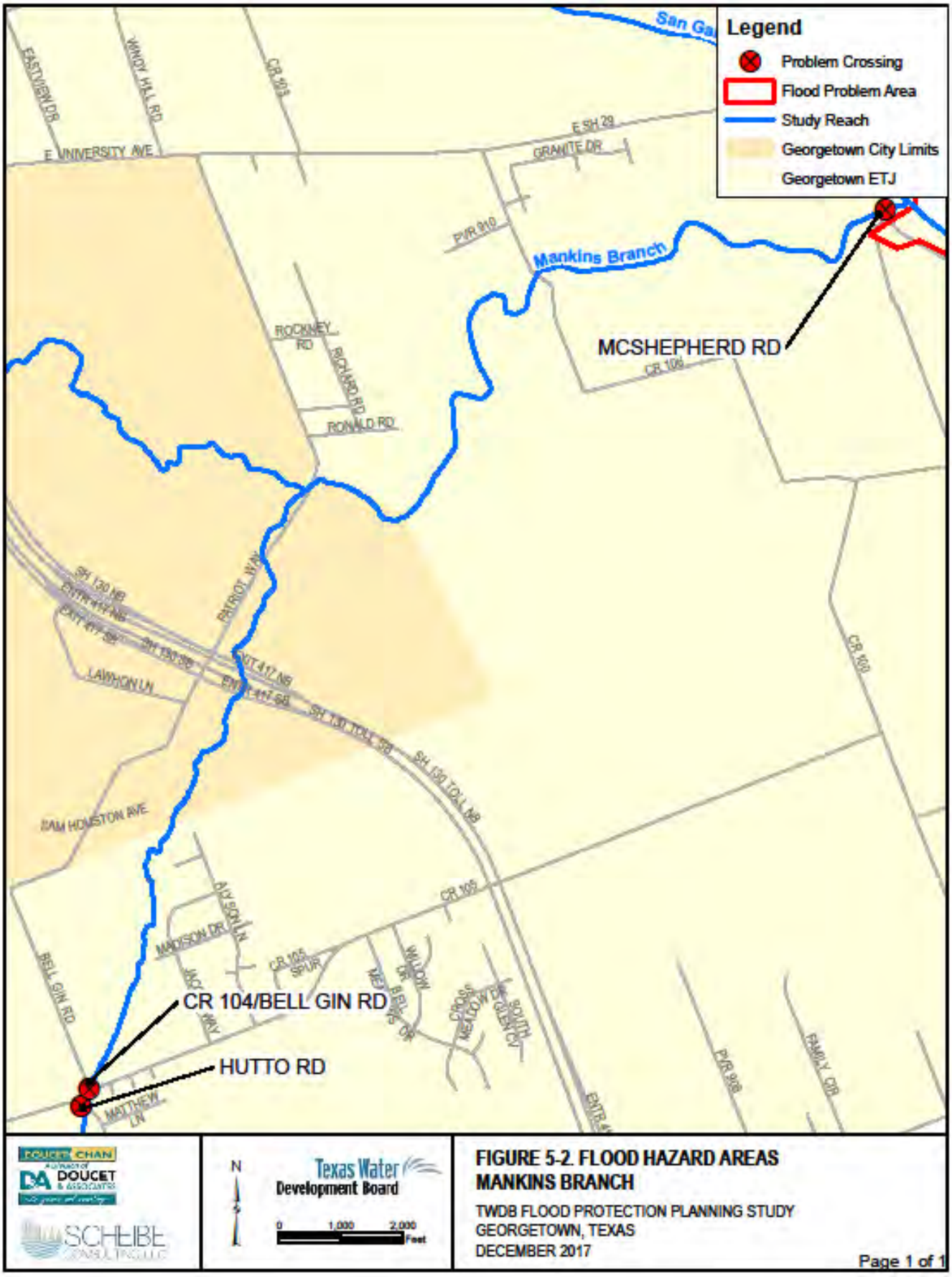
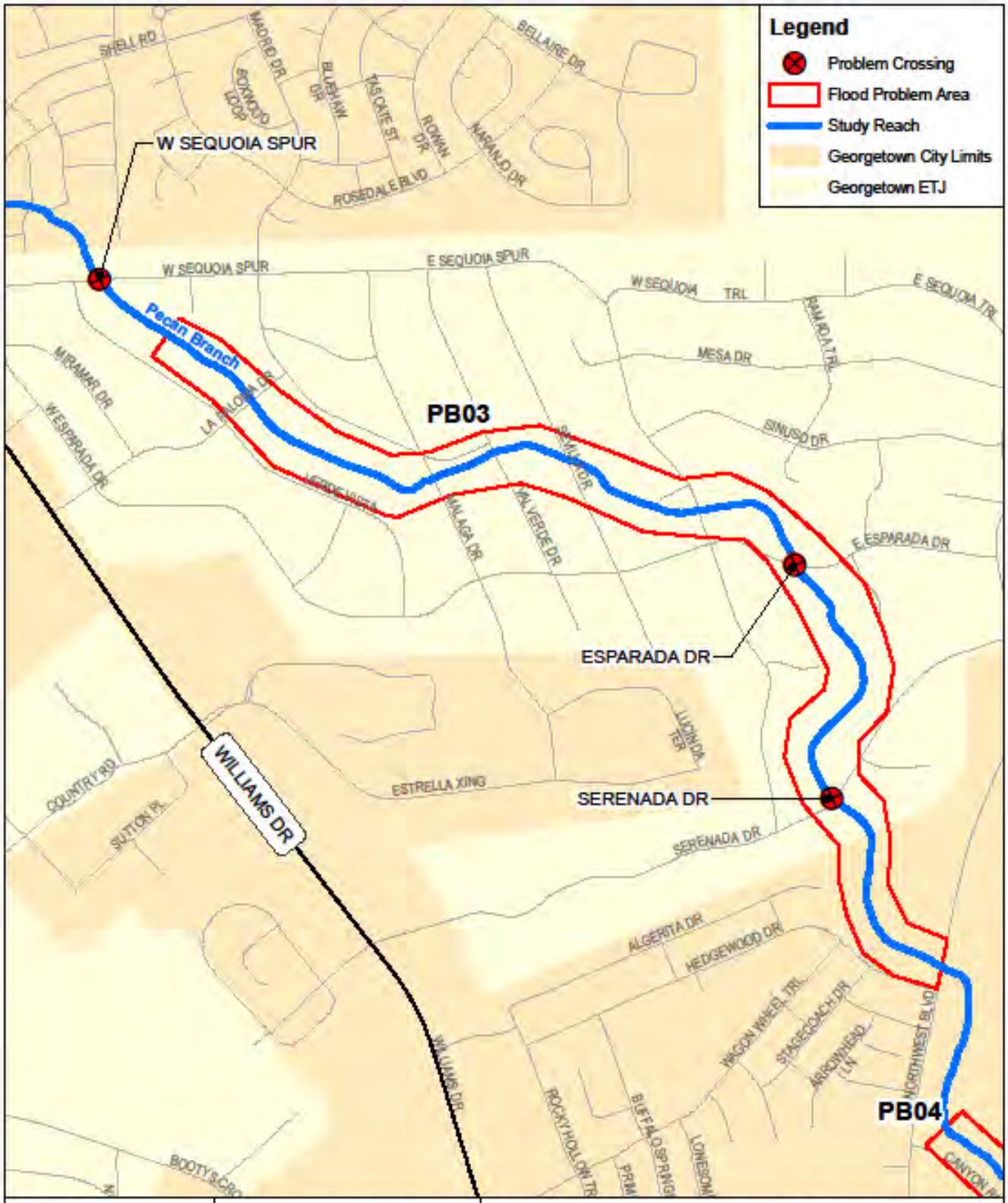

Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
Mankins Branch
MCSHEPHERD RD
CR 104/BELL GIN RD
HUTTO RD
E UNIVERSITY AVE
E SH 29
GRANITE DR
ROCKNEY RD
RICHARD RD
RONALD RD
PATRIOT WAY
LAWHON LN
SAM HOUSTON AVE
CR 105
CR 100
MADISON DR
BELL GIN RD
MATTHEW LN
FAMILY DR
N
Texas Water Development Board
0 1,000 2,000 Feet
FIGURE 5-2. FLOOD HAZARD AREAS
MANKINS BRANCH
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
Page 1 of 1


Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
W SEQUOIA SPUR
PB03
ESPARADA DR
SERENADA DR
PB04
WILLIAMS DR
Pecan Branch
SHELL RD
MADRID DR
BOXWOOD LOOP
BLUEHAW DR
TASCATE ST
ROMAN DR
BELLAIRE DR
NARANJO DR
ROSEDALE BLVD
E SEQUOIA SPUR
W SEQUOIA TRL
E SEQUOIA TRL
RAMROA TRL
MESA DR
SINUSO DR
MIRAMAR DR
W ESPARADA DR
LA MALLORCA CT
MALAGA DR
VALVERDE DR
SEVILLA DR
E ESPARADA DR
LUCINDA TER
ESTRELLA XING
COUNTRY RD
SUTTON PL
SERENADA DR
ALGERITA DR
HEDGEWOOD DR
HIGGIN WHEEL TRL
STAGECOACH DR
ARROWHEAD LN
NORTHWEST BLVD
ROCKY HOLLOW TR
BUFFALO SPRING
LONESOME
CANYON
BOOTYS CROSS
Texas Water Development Board
0 500 1,000 Feet
FIGURE 5-3. IDENTIFIED PROBLEM AREAS
PECAN BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
Page 1 of 3

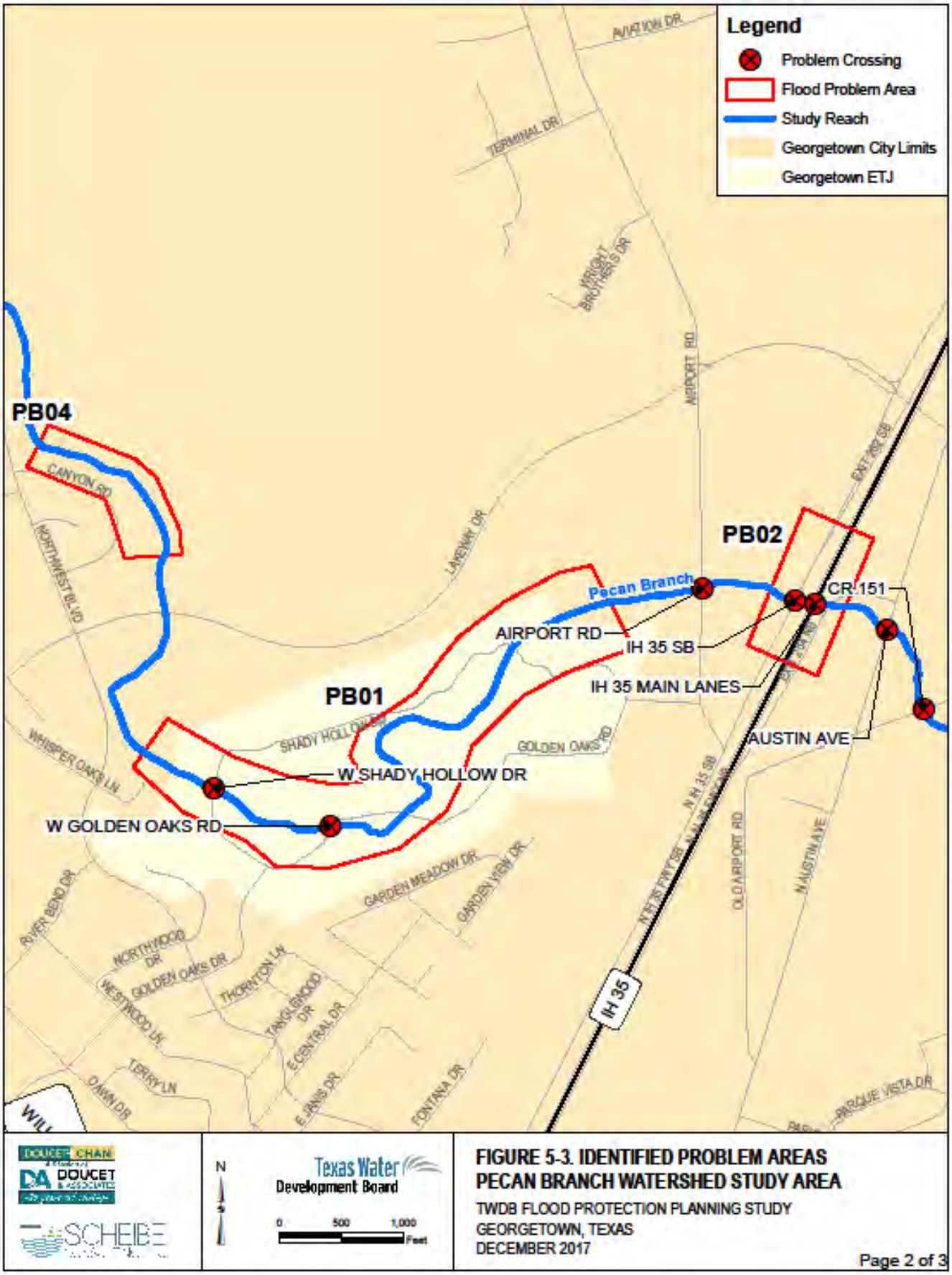


FIGURE 5-3. IDENTIFIED PROBLEM AREAS
PECAN BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

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FIGURE 5-3. IDENTIFIED PROBLEM AREAS
PECAN BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
Page 3 of 3

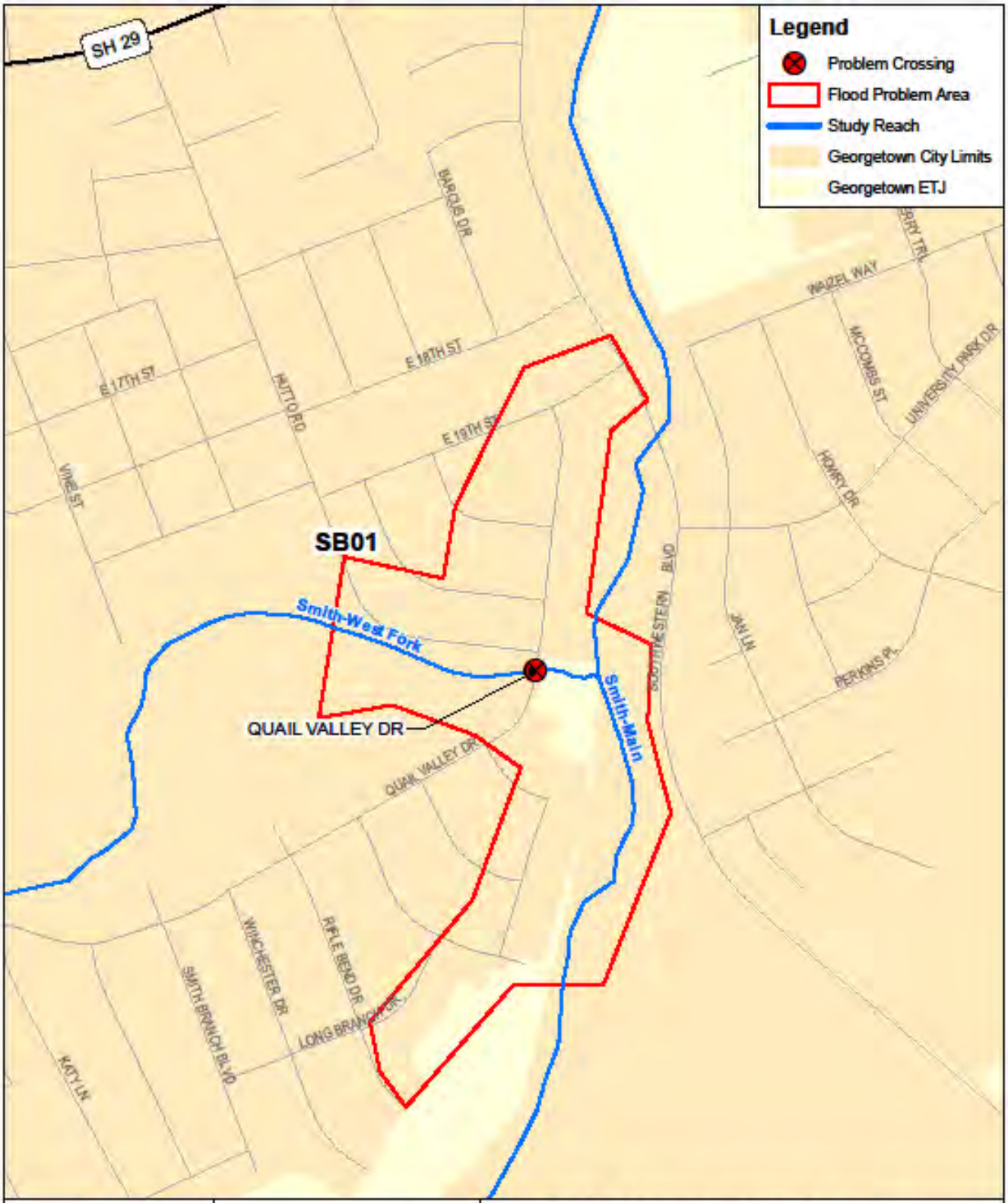

FIGURE 5-4. IDENTIFIED PROBLEM AREAS
SMITH BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

Page 1 of 3


Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
PLEASANT VALLEY DR
SUNBEE VALLEY LN
THUNDER VALLEY TRL
VALLEY OAKS LOOP
SB02
RABBIT HOLLOW LN
RABBIT RUN
COTTONTAIL LN
FM 1460
Smith Main
SE INNER LOOP
N
Texas Water Development Board
0
250
500
Feet
FIGURE 5-4. IDENTIFIED PROBLEM AREAS
SMITH BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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Smith-West Fork
SB01
SB02
SB03
Smith-Main
Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
QUAIL VALLEY DR
MAPLE ST
KATY LN
SMITH BRANCH BLVD
WINCHESTER DR
RIFLE BEND DR
LONG BRANCH DR
GEORGIAN DR
WILCO WAY
SE INNER LOOP
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
N
Texas Water Development Board
0 250 500 Feet
FIGURE 5-4. IDENTIFIED PROBLEM AREAS
SMITH BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
CROSS CREEK RD
RANCHO BUENO DR
CEDAR HOLLOW RD
Middle Fork San Gabriel River
SH 29
LIGHTNING RANCH RD
WEST LAKE PKWY
WIND RIDGE CV
LOST RIVER
CHAPARRAL RD
ESTANCIA WAY
CANTERA WAY
OLD CREEKSIDE
CROSS CREEK RD
WATER SONG
ROSES PRING
DOVETAIL LN
GREEN LEAF LN
INDIGO LN
E CIMARRON HILLS TRL
LIMESTONE DR
WAYCROSS DR
CEDAR HOLLOW RD
BLUE QUAIL DR
EAGLE POINT DR
HARRISON LN
LOST OAK CV
OAK MEADOW DR
N
0
1,000
2,000
Feet
Texas Water Development Board
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE CONSULTING, LLC
FIGURE 5-5. FLOOD HAZARD AREAS
MIDDLE FORK
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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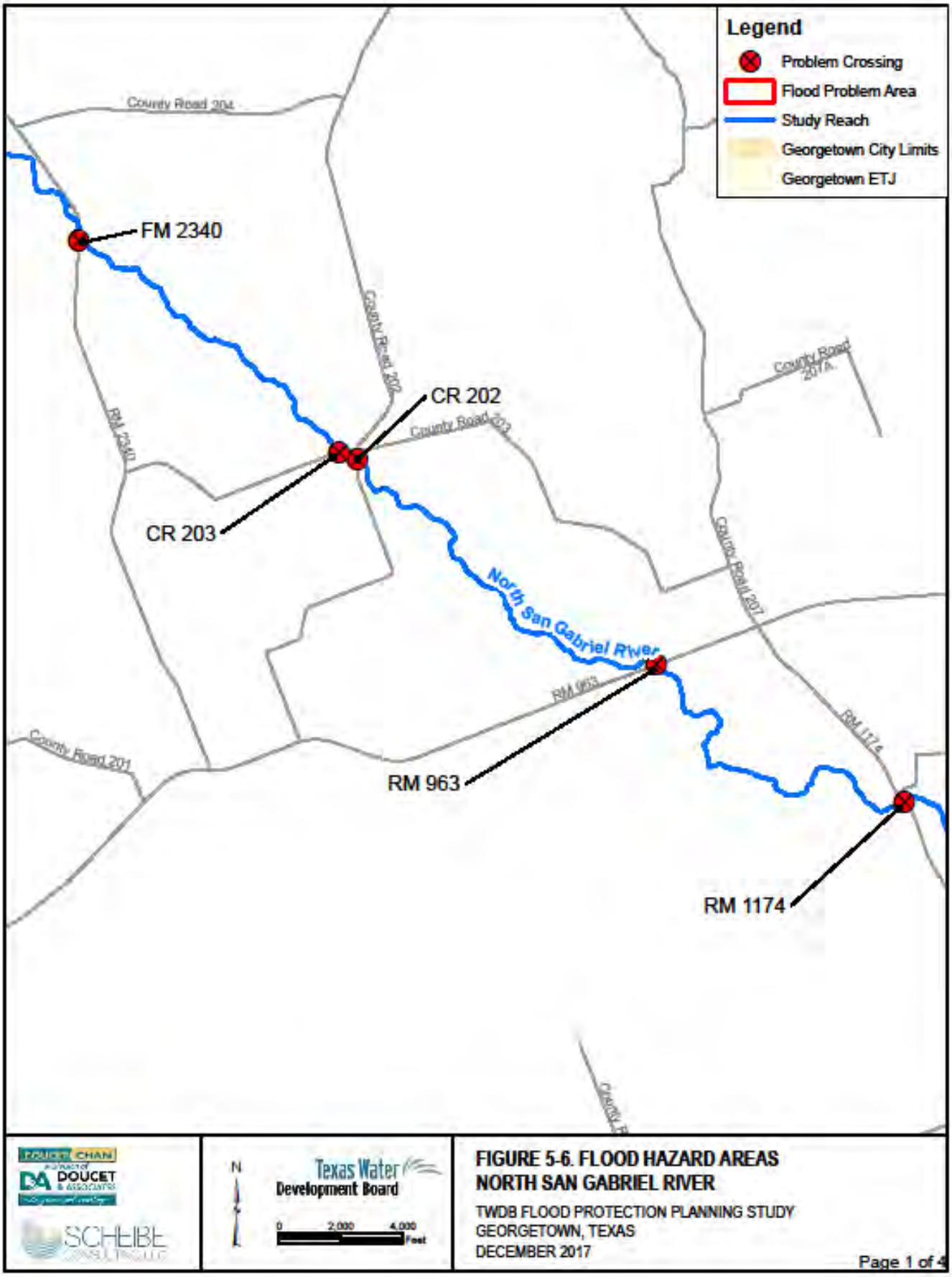
Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
County Road 204
FM 2340
County Road 202
CR 202
County Road 203
County Road 217A
RM 2340
CR 203
North San Gabriel River
County Road 207
RM 963
RM 1174
County Road 201
RM 963
RM 1174
N
Texas Water Development Board
0
2,000
4,000
Feet
FIGURE 5-6. FLOOD HAZARD AREAS
NORTH SAN GABRIEL RIVER
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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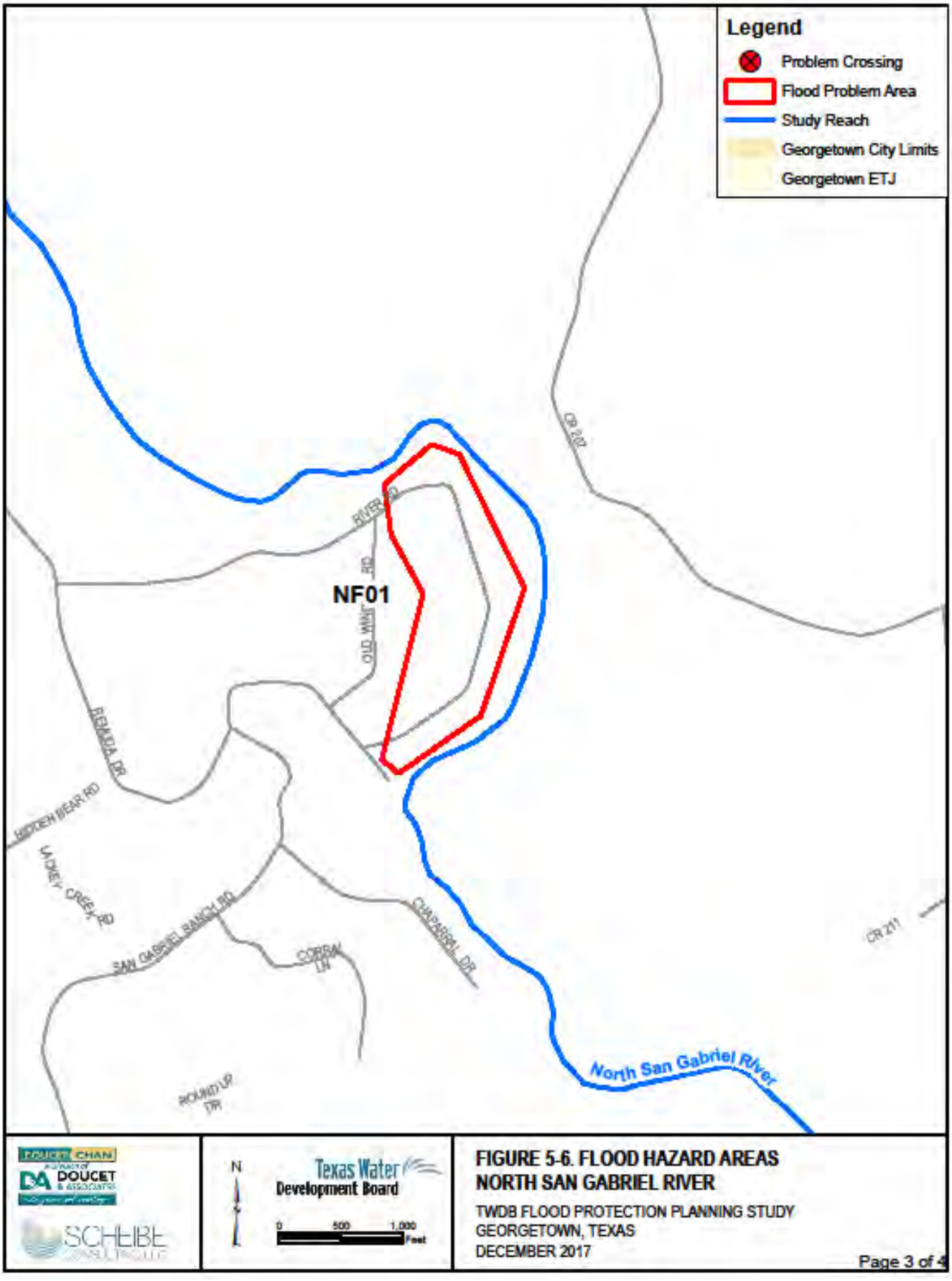
Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
CR 200
FM 243
North San Gabriel River
Shady Grove
County Road 210
County Road 212
County Road 214
County Road 272
County Road 282
RM 243
Burnet
Williamson
N
Texas Water Development Board
0 2,000 4,000 Feet
FIGURE 5-6. FLOOD HAZARD AREAS
NORTH SAN GABRIEL RIVER
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
Page 2 of 4


Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
NF01
RIVER RD
OLD WINE RD
CR 207
BEMIDA DR
HIDDEN BEAR RD
LACKEY CREEK RD
SAN GABRIEL RANCH RD
CORRAL LN
CHAPARRAL DR
CR 211
ROUND UP DR
North San Gabriel River
N
0
500
1,000
Feet
Texas Water Development Board
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE CONSULTING LLC
FIGURE 5-6. FLOOD HAZARD AREAS
NORTH SAN GABRIEL RIVER
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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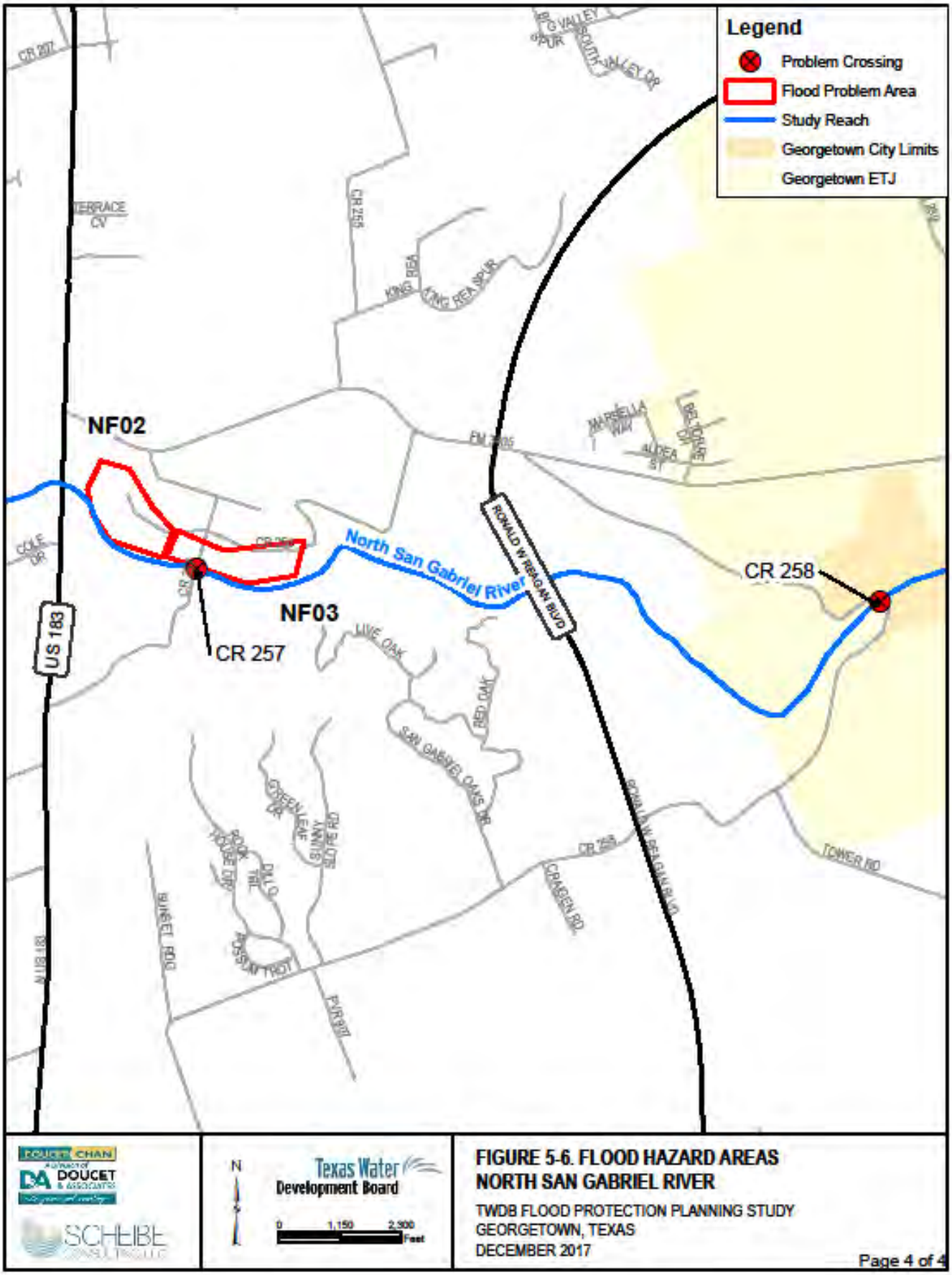

FIGURE 5-6. FLOOD HAZARD AREAS
NORTH SAN GABRIEL RIVER
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
Page 4 of 4

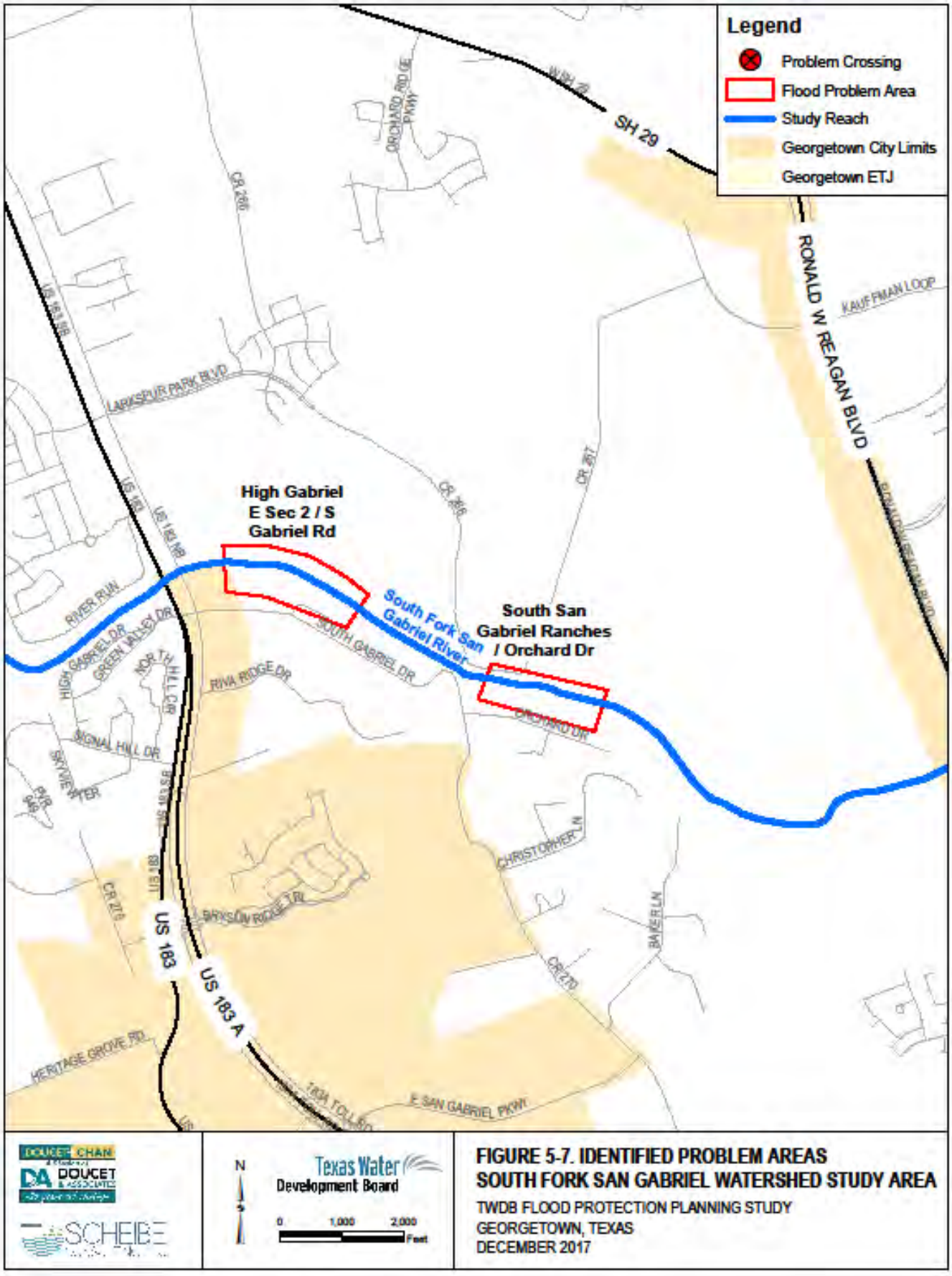

FIGURE 5-7. IDENTIFIED PROBLEM AREAS
SOUTH FORK SAN GABRIEL WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

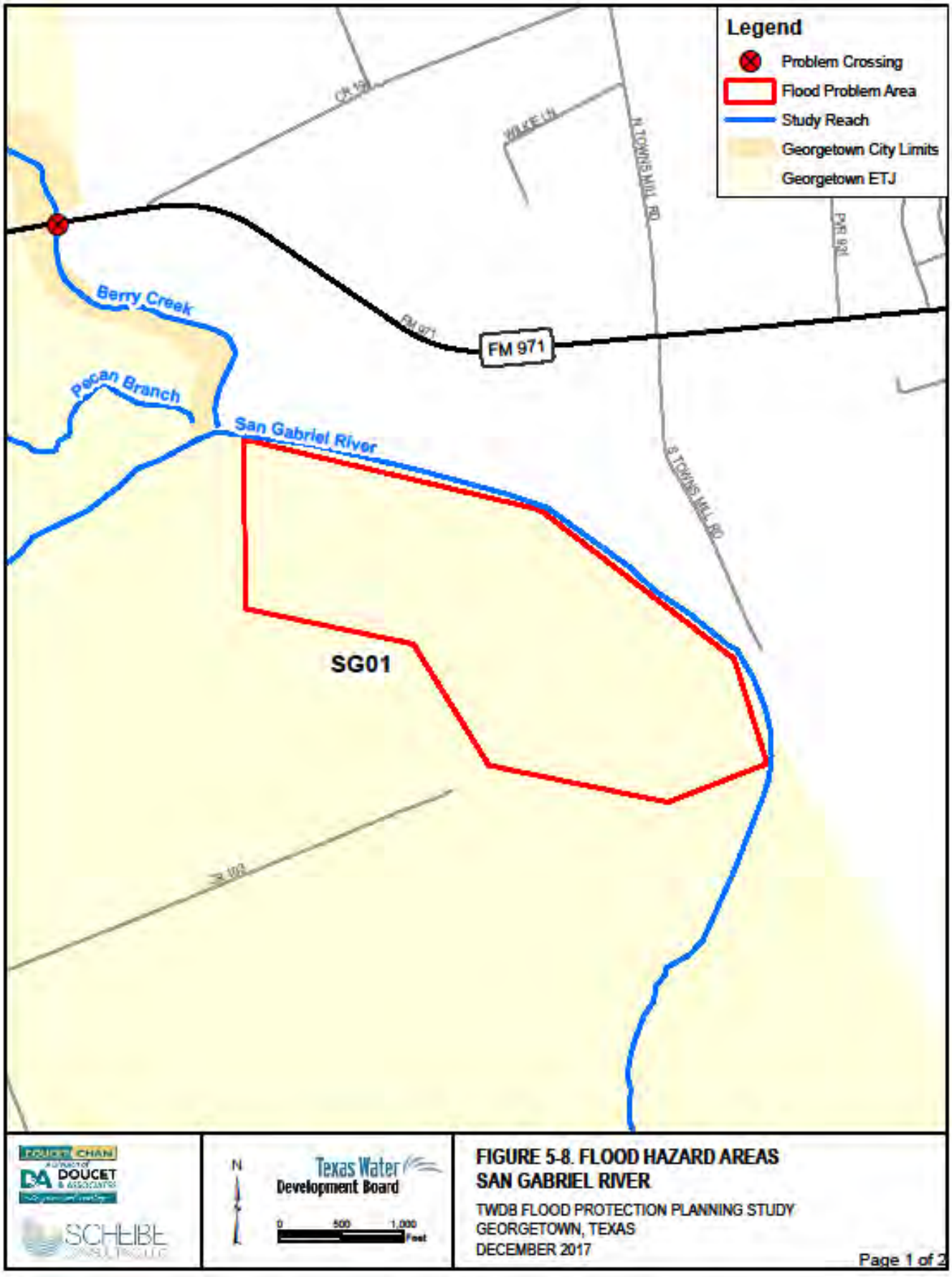

FIGURE 5-8. FLOOD HAZARD AREAS SAN GABRIEL RIVER

TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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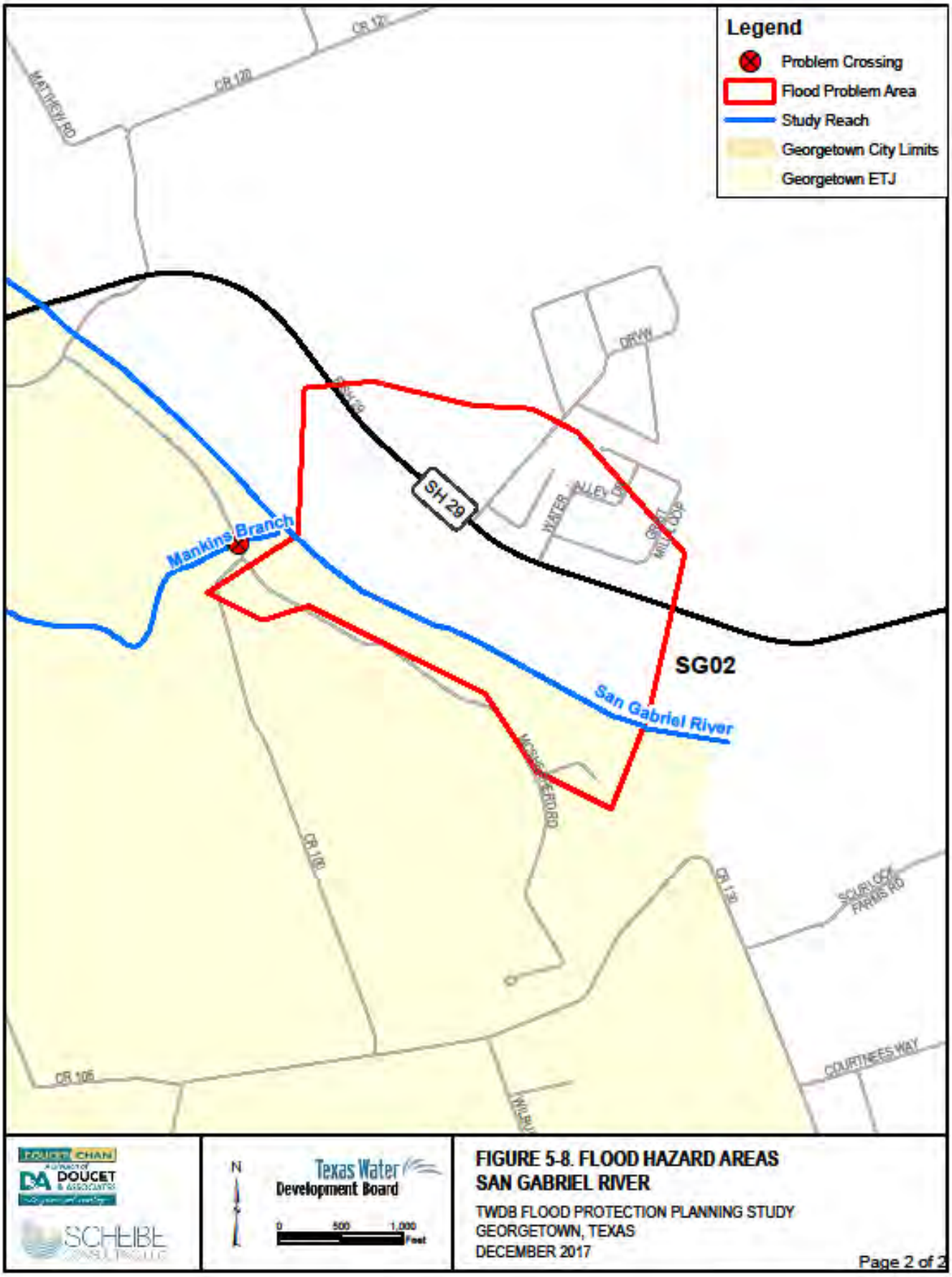
Legend
Problem Crossing
Flood Problem Area
Study Reach
Georgetown City Limits
Georgetown ETJ
CR 120
MATTHEW RD
SH 29
Mankins Branch
SG02
San Gabriel River
CR 105
CR 139
SCURLOCK FARMS RD
COURTNEES WAY
N
Texas Water Development Board
0 500 1,000 Feet
FIGURE 5-8. FLOOD HAZARD AREAS
SAN GABRIEL RIVER
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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6.0 Recommended Flood Hazard Mitigation Improvements

Stormwater infrastructure deficiencies are identified in Section 5 for each watershed of the Study Area. Various project alternatives were developed to address these inadequacies. During working meetings with the stakeholders, alternatives were developed to address these inadequacies. Prioritization of the proposed improvements is discussed in Section 7.

Projects and project construction costs are summarized in Table 6-1. All costs presented in this section are conceptual in nature and were estimated using the methodology discussed in Appendix C. The selected alternatives for each Study Area are discussed below. Information on the other alternatives can be found in Appendix C.

6.1 Berry Creek Watershed Study Area Specific Projects

The issues of concern within the Berry Creek Watershed Study Area are largely due to the lack of conveyance capacity of the channels and/or road crossing openings. This lack of conveyance capacity results in flooding of structures, property and road crossings. To address these inadequacies in the current channel systems, several mitigation measures were developed as shown on Figure 6-1.

6.1.1 RM 2338/Andice Road Crossing

This project involves replacing the existing culverts at this Cowan Creek crossing with larger box culverts that do not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be seven 9’ x 7’ box culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.1.2 CR 245 Crossing

This project involves replacing the existing culverts at this Cowan Creek crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 350’ opening length. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.1.3 BC01 Problem Area

This project involves improvements to this Cowan Creek channel reach to prevent flooding of the 6 residential structures within this problem area. To protect the residential structures, 7,066 cubic yards of channel excavation along 1,275 feet of Cowan Creek is required. The purpose of this improvement is to provide sufficient channel capacity and flood protection for the design 100-year Existing Conditions flood event to be conveyed through the channel in this area without flooding the residential structures.

6.1.4 CR 241

This project involves replacing the existing bridge at this Berry Creek crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 700' opening length. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.1.5 CR 245

This project involves replacing the existing bridge at this Berry Creek crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with an 800' opening length. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.1.6 BC02 Problem Area

This project involves improvements to this Berry Creek channel reach to prevent flooding of the 14 residential structures within this problem area. To protect the residential structures, 47,954 cubic yards of channel excavation along 1,350 feet of Berry Creek is required. The purpose of this improvement is to provide sufficient channel capacity and flood protection for the design 100-year Existing Conditions flood event to be conveyed through the channel in this area without flooding the residential structures.

6.1.7 Sun City Boulevard Crossing

This project involves lengthening the existing bridge at this Berry Creek crossing with an additional span such that the lengthened bridge does not impede the flow of water in the channel. For the crossing to not impede flow, the existing bridge should be lengthened by 60' to result in a total length of 170'. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.1.8 BC03 Problem Area

This project involves improvements to this Berry Creek channel reach to prevent flooding of the 15 residential structures within this problem area. To protect the residential structures, 24,570 cubic yards of channel excavation and 2,000 feet of berms along 1,300 feet of Berry Creek is required. The purpose of this improvement is to provide sufficient channel capacity and flood protection for the design 100-year Existing Conditions flood event to be conveyed through the channel in this area without flooding the residential structures.

6.1.9 BC04 Problem Area

This project involves improvements to this Berry Creek channel reach to prevent flooding of the 8 residential structures within this problem area. To protect the residential structures, 90,277 cubic yards of channel excavation along 3,355 feet of Berry Creek is required. The purpose of this improvement is to provide sufficient channel capacity and flood protection for the design 100-year Existing Conditions flood event to be conveyed through the channel in this area without flooding the residential structures.

6.1.10 BC05 Problem Area

This project involves improvements to the Berry Creek channel to prevent flooding of the 11 residential structures within this problem area. To protect the residential structures, 105,297 cubic yards of channel excavation along 1,580 feet of Berry Creek is required. The purpose of this improvement is to provide sufficient channel capacity and flood protection for the design 100-year Existing Conditions flood event to be conveyed through the channel in this area without flooding the residential structures.

6.1.11 CR 152

This project involves replacing the existing bridge at this Berry Creek crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 700' opening length. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.1.12 FM 971

This project involves replacing the existing bridge at this Berry Creek crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 500' opening length. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.1.13 Live Oaks Trail

This project involves replacing the existing bridge at this Berry Creek crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 500' opening length. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.1.14 CR 234

This project involves replacing the existing culverts at this Dry Berry Creek crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 450' opening length. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.1.15 CR 143

This project involves replacing the existing culverts at this Dry Berry Creek crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with an 800' opening length. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.1.16 CR 152

This project involves raising the roadway approach to this existing bridge at the Dry Berry Creek crossing such that the existing bridge and raised roadway crossing do not impede the flow of water

in the channel. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.1.17 Regional Detention (not shown on Figure 6-1)

This potential future project involves construction of an off-channel peak flow shaving detention reservoir within the Berry Creek watershed upstream of the CR 241 crossing as an alternative to constructing the Problem Areas BC02 through BC05 improvements and the CR 241, CR 245, Sun City Boulevard, and CR 152 crossing improvements on Berry Creek. For the detention reservoir to significantly reduce peak design 100-year Existing Condition flows along Berry Creek to eliminate the reference flood hazard mitigation measures, the reservoir would require a storage volume of between 1,000 to 1,400 acre-feet.

6.2 Mankins Branch Watershed Study Area Specific Projects

The issues of concern within the Mankins Branch Watershed Study Area are largely due to the lack of conveyance capacity of the channels and/or road crossing openings. This lack of conveyance capacity results in flooding of road crossings. To address these inadequacies in the current channel systems, several mitigation measures were developed as shown on Figure 6-2.

6.2.1 Hutto Road Crossing

This project involves replacing the existing culverts at this Mankins Branch crossing with larger box culverts that do not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be four 5’ x 4’ box culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.2.2 CR 104/Bell Gin Road Crossing

This project involves replacing the existing culvert at this Mankins Branch crossing with larger box culverts that do not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be four 4’ x 5’ box culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.2.3 CR 100/McShepherd Road Crossing

This project involves replacing the existing culverts at this Mankins Branch crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 200’ opening length. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.3 Pecan Branch Watershed Study Area Specific Projects

The issues of concern within the Pecan Branch Watershed Study Area are largely due to the lack of conveyance capacity of the channels and/or road crossing openings. This lack of conveyance capacity results in flooding of structures, property and road crossings. To address these

inadequacies in the current channel systems, several mitigative measures were developed as shown on Figure 6-3.

6.3.1 PB01 Problem Area – Golden Oaks Subdivision

This project involves constructing a 100 ac-ft peak-shaving detention pond along the east side of Pecan Branch. The pond would include an earthen lateral weir to divert flows into the detention pond and an outlet pipe with a flap gate to prevent flow entering the pond during the rising limb of the hydrograph. The purpose of the pond is to significantly reduce downstream peak flow rates within the Golden Oaks Subdivision during events greater than the 25-year storm event.

6.3.2 PB02 Problem Area – I.H. 35 Crossing

This project involves upgrading the existing southbound frontage and main lane/northbound frontage culverts at the Pecan Branch crossing with two (2) additional 10' x 8' concrete box culverts and three (3) additional 10' x 8' concrete box culverts, respectively. The purpose of this improvement is to provide sufficient capacity to prevent the 100-year Existing Conditions flood event from flooding the main lanes of I.H. 35. In order to prevent downstream hydrologic impacts, this alternative would require mitigation of lost flood volume storage upstream of the improved crossing. Therefore, the 100 ac-ft peak shaving detention pond included in PB01 is proposed as part of this alternative. Detention ponds in other locations or configurations within the I.H. 35 corridor may also be feasible as long as they can be sized to sufficiently mitigate downstream flow increases.

6.3.3 PB03 Problem Area – Serenada Subdivision

This project involves 3,550 feet of channel improvements along Pecan Branch between Val Verde Drive and Serenda Drive. Channel improvements would require clearing of brush and vegetation within a 75' wide area. Permanent easements within existing residential properties must be obtained in order to maintain the efficiency and improved hydraulic capacity of the channel. The purpose of this improvement is to provide improved channel capacity and flood protection thereby reducing flooding of residential structures along the channel. Full 100-year flood protection for all structures cannot be attained without significant channel improvements that may not be feasible due to project cost, easement requirements, and environmental impacts.

6.3.4 PB04 Problem Area – Canyon Road / Reata Trails

This project involves 1,200 feet of channel improvements including 8,175 cubic yards of excavation along the west bank of Pecan Branch behind Canyon Road. The purpose of this improvement is to provide sufficient channel capacity and flood protection for the design 100-year Existing Conditions flood event to be conveyed through the channel in this area without flooding the residential structures. In order to provide full 100-year Existing Conditions flood protection for these homes, excavation within the channel banks is required and may result in environmental impacts. Additionally, permanent easements within existing residential properties must be obtained within limits of proposed excavation.

6.3.5 PB05 Problem Area – Lonnie Thomas Road

This project involves 1,050 feet of channel improvements along Pecan Branch south of Lonnie Thomas Road and west of CR 152. Channel improvements would require clearing of brush and vegetation within a 10-acre area. Permanent easements within existing residential properties must

be obtained in order to maintain the efficiency and improved hydraulic capacity of the channel. The purpose of this improvement is to provide improved channel capacity and flood protection thereby reducing flooding of residential structures along the channel. Full 100-year flood protection for all structures cannot be attained without significant channel improvements that may not be feasible due to project cost, easement requirements, and environmental impacts.

6.3.6 West Sequoia Spur Crossing

This project involves replacing the existing culvert at the Pecan Branch crossing with a new culvert crossing that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should include four (4) 5' RCP culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.3.7 Esperada Drive Crossing

This project involves replacing the existing culverts at the Pecan Branch crossing with a new culvert crossing that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should include five (5) 10' x 6' concrete box culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.3.8 Serenada Drive Crossing

This project involves replacing the existing culverts at the Pecan Branch crossing with a new culvert crossing that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should include five (5) 10' x 6' concrete box culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.3.9 West Shady Hollow Drive Crossing

This project involves replacing the existing culverts at the Pecan Branch crossing with a new culvert crossing that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should include seven (7) 10' x 6' concrete box culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.3.10 West Golden Oaks Road Crossing

This project involves replacing the existing culverts at the Pecan Branch crossing with a new culvert crossing that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should include seven (7) 10' x 6' concrete box culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.3.11 Airport Road Crossing

Since the City of Georgetown has indicated no plans to upgrade this crossing and the possibility of closing the roadway altogether, no upgrades are recommended to this crossing. Hydraulic impacts due to removal of the crossing were found to be negligible due to the low elevation of the roadway and its close proximity to the backwater effects of I.H. 35.

6.3.12 Austin Avenue Crossing

This project involves upgrading the existing culverts to include six (6) 8' x 8' concrete box culverts that do not impede the flow of water in the channel. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.3.13 CR 151 Crossing

This project involves replacing the existing culverts at the Pecan Branch crossing with a new culvert crossing that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should include ten (10) 10' x 8' concrete box culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.3.14 Northeast Inner Loop Crossing

This project involves replacing the existing culverts at the Pecan Branch crossing with a new culvert crossing that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should include ten (10) 10' x 6' concrete box culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.3.15 CR 152 Crossing

This project involves replacing the existing culverts at the Pecan Branch crossing with a new culvert crossing that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should include ten (10) 10' x 6' concrete box culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.3.16 FM 971 Crossing

This project involves replacing the existing culverts at the Pecan Branch crossing with a new culvert crossing that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should include fifteen (15) 10' x 10' concrete box culverts or a bridge with an equivalent hydraulic capacity. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.4 Smith Branch Watershed Study Area Specific Projects

The issues of concern within the Smith Branch Watershed Study Area are largely due to the lack of conveyance capacity of the channels and/or road crossing openings. This lack of conveyance capacity results in flooding of structures, property and road crossings. To address these inadequacies in the current channel systems, several mitigation measures were developed as shown on Figure 6-4.

6.4.1 SB01 Problem Area – West Fork Confluence

This project involves channel improvements including 14,500 cubic yards of excavation near the West Fork confluence of Smith Branch and the addition of four (4) 10' x 4' concrete box culverts

at the Quail Valley Drive crossing. The purpose of this project is to improve channel capacity and hydraulic efficiency of the West Fork confluence to minimize overtopping and flooding of residential structures in the area.

6.4.2 SB02 Problem Area – Rabbit Hollow Subdivision

This project involves the buy-out of flood prone structures within the low-lying problem area. No viable structural alternatives were identified as part of this study. Structural alternatives evaluated included channel improvements, upgrades to FM 1460, and detention ponds.

6.4.3 SB03 Problem Area – Williamson County Juvenile Detention Center

This project involves channel improvements and added inline flood volume storage adjacent to and upstream of the WCJDC. The purpose of this project is to improve channel capacity and reduce peak flows to minimize flooding potential at the WCJDC. Maintenance of the abandoned Maple Street roadway embankment located immediately upstream of the WCJDC is critical to the success of this project, as its removal would exacerbate flooding potential of the WCJDC.

6.4.4 CR 166 Crossing

This project involves replacing the existing culverts at the Smith Branch crossing with a new culvert crossing that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should include four (4) 5’ x 5’ concrete box culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.4.5 I.H. 35 Southbound Frontage Road Crossing

Since the tailwater from the I.H. 35 main lanes culvert crossing controls flooding at this crossing of the West Fork of Smith Branch, and no structures are affected upstream of the crossing, cost-effective improvements were not able to be developed for this crossing at a water level that meets applicable criteria.

6.4.6 Madison Oaks Avenue Crossing

This project involves raising the roadway a minimum of 1.5’ in order for the 100-year Existing Conditions flood event to be conveyed through the crossing. No improvements to the existing culvert configuration are recommended at this crossing at a water level that meets applicable criteria.

6.4.7 S. Austin Avenue Crossing

This project involves raising the roadway a minimum of 0.7’ in order for the 100-year Existing Conditions flood event to be conveyed through the crossing. No improvements to the existing culvert configuration are recommended at this crossing at a water level that meets applicable criteria.

6.4.8 Quail Valley Drive Crossing

This project involves the addition of four (4) 10’ x 4’ concrete box culverts at the Quail Valley Drive crossing. These crossing improvements are included in project SB01.

6.4.9 E. University Avenue Crossing

This project involves replacing the existing culverts at the Smith Branch crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new bridge should include a 150' span. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.4.10 Smith Creek Road Crossing

This project involves replacing the existing culverts at the Smith Branch crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new bridge should include a 150' span. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.5 Middle Fork San Gabriel River Watershed Study Area Specific Projects

The issues of concern within the Middle Fork San Gabriel River Watershed Study Area are largely due to the lack of conveyance capacity of the channels and/or road crossing openings. This lack of conveyance capacity results in flooding of road crossings. To address these inadequacies in the current channel systems, several mitigation measures were developed as shown on Figure 6-5.

6.5.1 Cross Creek Road Crossing

This project involves replacing the existing culverts at this Middle Fork San Gabriel River crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 550' opening length. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be safely conveyed through the Right-of-Way.

6.5.2 Cedar Hollow Road Crossing

This project involves replacing the existing culverts at this Middle Fork San Gabriel River crossing with larger box culverts that do not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be nine 12' x 10' box culverts. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be safely conveyed through the Right-of-Way.

6.5.3 Rancho Bueno Drive Crossing

This project involves replacing the existing culverts at this Middle Fork San Gabriel River crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 90' opening length. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be safely conveyed through the Right-of-Way.

6.6 North Fork San Gabriel River Watershed Study Area Specific Projects

The issues of concern within the North Fork San Gabriel River Watershed Study Area are largely due to the lack of conveyance capacity of the channels and/or road crossing openings. This lack of conveyance capacity results in flooding of structures, property and road crossings. To address these inadequacies in the current channel systems, several mitigation measures were developed as shown on Figure 6-6.

6.6.1 FM 2340 Crossing

This project involves replacing the existing low water bridge at this North Fork San Gabriel River crossing with box culverts that do not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be eight 9' x 7' box culverts. The purpose of this improvement is to provide sufficient capacity for the design 25-year Existing Conditions flood event to be safely conveyed through the Right-of-Way.

6.6.2 CR 203 Crossing

This project involves replacing the existing low water culvert at this North Fork San Gabriel River crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 200' opening length. The purpose of this improvement is to provide sufficient capacity for the design 25-year Existing Conditions flood event to be safely conveyed through the Right-of-Way.

6.6.3 CR 202 Crossing

This project involves replacing the existing low water culverts at this North Fork San Gabriel River crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 200' opening length. The purpose of this improvement is to provide sufficient capacity for the design 25-year Existing Conditions flood event to be safely conveyed through the Right-of-Way.

6.6.4 RM 963 Crossing

This project involves replacing the existing bridge at this North Fork San Gabriel River crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 250' opening length. The purpose of this improvement is to provide sufficient capacity for the design 25-year Existing Conditions flood event to be safely conveyed through the Right-of-Way.

6.6.5 RM 1174 Crossing

This project involves replacing the existing bridge at this North Fork San Gabriel River crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 300' opening length. The purpose of this improvement is to provide sufficient capacity for the design 25-year Existing Conditions flood event to be safely conveyed through the Right-of-Way.

6.6.6 CR 200 Crossing

This project involves replacing the existing bridge at this North Fork San Gabriel River crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 300' opening length. The purpose of this improvement is to provide sufficient capacity for the design 25-year Existing Conditions flood event to be safely conveyed through the Right-of-Way.

6.6.7 FM 243 Crossing

This project involves replacing the existing bridge at this North Fork San Gabriel River crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 300' opening length. The purpose of this improvement is to provide sufficient capacity for the design 25-year Existing Conditions flood event to be safely conveyed through the Right-of-Way.

6.6.8 NF01 Problem Area

This project involves improvements to this North Fork San Gabriel River channel reach to prevent flooding of the 9 residential structures within this problem area. To protect the residential structures, 731,945 cubic yards of channel excavation along 4,580 feet of North Fork San Gabriel River is required. The purpose of this improvement is to provide sufficient channel capacity and flood protection for the design 100-year Existing Conditions flood event to be conveyed through the channel in this area without flooding the residential structures.

6.6.9 CR 257 Crossing

This project involves replacing the existing bridge at this North Fork San Gabriel River crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 200' opening length. The purpose of this improvement is to provide sufficient capacity for the design 25-year Existing Conditions flood event to be safely conveyed through the Right-of-Way.

6.6.10 NF02/NF03 Problem Areas

This project involves improvements to this North Fork San Gabriel River channel reach to prevent flooding of the 6 residential structures (with possibility of one or two commercial structures in this area as well) within this problem area. To protect the residential structures, 820,326 cubic yards of channel excavation along 3,090 feet of North Fork San Gabriel River is required. The purpose of this improvement is to provide sufficient channel capacity and flood protection for the design 100-year Existing Conditions flood event to be conveyed through the channel in this area without flooding the residential structures.

6.6.11 CR 258 Crossing

This project involves replacing the existing bridge at this North Fork San Gabriel River crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new crossing should be a bridge with a 300' opening length. The purpose of this improvement is to provide sufficient capacity for the design 100-year Existing Conditions flood event to be safely conveyed through the Right-of-Way.

6.7 South Fork San Gabriel River Watershed Study Area Specific Projects

The issues of concern within the South Fork San Gabriel River Watershed Study Area are largely due to the lack of conveyance capacity and/or road crossing openings. This lack of conveyance capacity results in flooding of structures, property and road crossings. To address these inadequacies in the current channel systems, several mitigation measures were developed as shown on Figure 6-7.

6.7.1 SFSG01 Problem Area – High Gabriel / S. San Gabriel Ranches

This project involves the buy-out of flood prone structures within the low-lying problem area. No viable structural alternatives were identified as part of this study. Structural alternatives evaluated included channel improvements and detention ponds.

6.7.2 CR 330B Crossing

This project involves replacing the existing culverts at the Smith Branch crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new bridge should include a 50’ span. The purpose of this improvement is to provide sufficient capacity for the design 25-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.7.3 CR 323 Crossing

This project involves replacing the existing culverts at the Smith Branch crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new bridge should include a 100’ span. The purpose of this improvement is to provide sufficient capacity for the design 25-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.7.4 FM 1869 Crossing

This project involves replacing the existing culverts at the Smith Branch crossing with a new bridge that does not impede the flow of water in the channel. For the crossing to not impede flow, the new bridge should include a 300’ span. The purpose of this improvement is to provide sufficient capacity for the design 25-year Existing Conditions flood event to be conveyed through the crossing at a water level that meets applicable criteria.

6.8 San Gabriel River Watershed Study Area Specific Projects

The issues of concern within the San Gabriel River Watershed Study Area are largely due to the lack of conveyance capacity of the channels and/or road crossing openings. This lack of conveyance capacity results in flooding of structures and property. To address these inadequacies in the current channel systems, several mitigation measures were developed as shown on Figure 6-8.

6.8.1 SG01 Problem Area

This project involves improvements to this San Gabriel River channel reach to prevent flooding of the 10 residential structures within this problem area. To protect the residential structures, 227,568

cubic yards of channel excavation along 5,310 feet of San Gabriel River is required. The purpose of this improvement is to provide sufficient channel capacity and flood protection for the design 100-year Existing Conditions flood event to be conveyed through the channel in this area without flooding the residential structures.

6.8.2 SG02 Problem Area

This project involves improvements to this San Gabriel River channel reach to prevent flooding of the 16 residential structures (excluding RV trailers in a mobile home park in this area) within this problem area. To protect the residential structures, 279,669 cubic yards of channel excavation along 4,070 feet of San Gabriel River is required. The purpose of this improvement is to provide sufficient channel capacity and flood protection for the design 100-year Existing Conditions flood event to be conveyed through the channel in this area without flooding the residential structures.

6.9 Summary of Recommended Flood Hazard Mitigation Improvement Costs

Table 6-1 shows a summary of all the recommended flood hazard mitigation projects and their estimated construction costs. Unit costs and development are described in Appendix C.

Table 6-1 Flood Hazard Mitigation Project Construction Costs

Berry Creek Watershed			
Description	**Issue to be Addressed**	**Description of Improvements**	**Total Cost**
CR 241 (Berry)	Overtopped Roadway	Upgrade to 700-ft span Bridge	$ 14,331,000
CR 245 (Berry)	Overtopped Roadway	Upgrade to 800-ft span Bridge	$ 9,667,000
BC02 - Dove Hollow/Dawson (Berry)	Flooded Structures	1,350 LF Channel Improvements 47,954 CY Excavation	$ 2,310,000
Sun City Boulevard	Overtopped Roadway	Lengthen Existing Bridge 60-ft	$ 639,000
BC03 - Painted Bunting (Berry)	Flooded Structures	1,300 LF Channel Improvements 2,000 LF Berms 24,570 CY Excavation	$ 3,648,000
BC04 - Crystal Springs (Berry)	Flooded Structures	3,355 LF Channel Improvements 90,277 CY Excavation	$ 4,016,000
BC05 - Trail Rider (Berry)	Flooded Structures	1,580 LF Channel Improvements 105,297 CY Excavation	$ 4,116,000
RM 2338 (Cowan)	Overtopped Roadway	Upgrade to (7) 9'x7' RBC	$ 2,473,000
CR 245 (Cowan)	Overtopped Roadway	Upgrade to 350-ft span Bridge	$ 9,667,000
BC01 - Independence Creek (Cowan)	Flooded Structures	1,275 LF Channel Improvements 7,066 CY Excavation	$ 934,000
Live Oaks Trail (Dry Berry)	Overtopped Roadway	Upgrade to 400-ft span Bridge	$ 4,613,000
CR 234 (Dry Berry)	Overtopped Roadway	Upgrade to 450-ft span Bridge	$ 8,150,000
CR 143 (Dry Berry)	Overtopped Roadway	Upgrade to 800-ft span Bridge	$ 12,774,000
CR 152 (Dry Berry)	Overtopped Roadway	Raise Overbank Roadway	$ 1,913,000
CR 152 (Berry)	Overtopped Roadway	Upgrade to 700-ft span Bridge	$ 9,345,000
FM 971 (Berry)	Overtopped Roadway	Upgrade to 500-ft span Bridge	$ 14,961,000

Table 6-1 Flood Hazard Mitigation Project Construction Costs (continued)

Mankins Branch Watershed			
Description	**Issue to be Addressed**	**Description of Improvements**	**Total Cost**
Hutto Road	Overtopped Roadway	Upgrade to (4) 5'x4' RBC	$ 1,538,000
CR 104/Bell Gin Road	Overtopped Roadway	Upgrade to (4) 4'x5' RBC	$ 1,067,000
McShepherd Road	Overtopped Roadway	Upgrade to 200-ft span Bridge	$ 4,657,000

Pecan Branch Watershed			
Description	**Issue to be Addressed**	**Description of Improvements**	**Total Cost**
PB01 - Golden Oaks Subdivision	Flooded Structures	Construct 100 ac-ft Peak Shaving Pond	$ 8,899,000
PB02 - I.H. 35	Overtopped Roadway	Upgrade SB to (5) 10'x8' RBC Upgrade ML to (6) 10'x8' RBC	$ 10,823,000
PB03 - Serenada Subdivision	Flooded Structures	3,550 LF Channel Clearing & Maintenance	$ 408,000
PB04 - Canyon Rd	Flooded Structures	1,200 LF Channel Improvements 8,175 CY Excavation	$ 814,000
PB05 - Lonnie Thomas Dr	Flooded Structures	1,050 LF Channel Clearing & Maintenance	$ 295,000
West Sequoia Spur	Overtopped Roadway	Upgrade to (4) 5' Dia RCP	$ 1,303,000
Esperada Drive	Overtopped Roadway	Upgrade to (5) 10'x6' RBC	$ 2,771,000
Serenada Drive	Overtopped Roadway	Upgrade to (5) 10'x6' RBC	$ 2,028,000
West Shady Hollow Drive	Overtopped Roadway	Upgrade to (7) 10'x6' RBC	$ 1,850,000
West Golden Oaks Road	Overtopped Roadway	Upgrade to (7) 10'x6' RBC	$ 2,454,000
Airport Road	Overtopped Roadway	No Improvements Recommended	n/a

Table 6-1 Flood Hazard Mitigation Project Construction Costs (continued)

Pecan Branch Watershed (continued)			
Description	**Issue to be Addressed**	**Description of Improvements**	**Total Cost**
North Austin Avenue	Overtopped Roadway	Upgrade to (6) 8'x8' RBC	$ 4,040,000
CR 151	Overtopped Roadway	Upgrade to (10) 10'x8' RBC	$ 6,051,000
NE Inner Loop	Overtopped Roadway	Upgrade to (10) 10'x6' RBC	$ 3,572,000
CR 152	Overtopped Roadway	Upgrade to (10) 10'x6' RBC	$ 4,815,000
FM 971	Overtopped Roadway	Upgrade to (15) 10'x10' RBC	$ 8,272,000

Smith Branch Watershed			
Description	**Issue to be Addressed**	**Description of Improvements**	**Total Cost**
SB01 - West Fork Confluence	Flooded Structures	750 LF Channel Improvements 14,500 CY Excavation Improvements to Quail Valley Dr. Crossing	$ 1,887,000
SB02 - Rabbit Hollow Subdivision	Flooded Structures	Buy-out flood prone structures	$ 765,000
SB03 - Wilco Juvenile Justice Center	Flooded Property	Not included in this study	n/a
CR 166	Overtopped Roadway	Upgrade to (4) 5'x5' RBC	$ 660,000
I.H. 35 Southbound Frontage Road	Overtopped Roadway	No Improvements Recommended	n/a
Madison Oaks Avenue	Overtopped Roadway	Raise roadway 1.5'	$ 668,000
S. Austin Avenue	Overtopped Roadway	Raise roadway 0.7'	$ 3,083,000
Quail Valley Drive	Overtopped Roadway	Add (4) 10'x4' RBC	see SB01
E. University Avenue	Overtopped Roadway	Upgrade to 150-ft span Bridge	$ 2,750,000
Smith Creek Road	Overtopped Roadway	Upgrade to 150-ft span Bridge	$ 8,306,000

Table 6-1 Flood Hazard Mitigation Project Construction Costs (continued)

Middle Fork San Gabriel River Watershed			
Description	**Issue to be Addressed**	**Description of Improvements**	**Total Cost**
Cross Creek Road	Overtopped Roadway	Upgrade to 550-ft span Bridge	$ 9,166,000
Cedar Hollow Road	Overtopped Roadway	Upgrade to (9) 12'x10' RBC	$ 5,931,000
Rancho Bueno Drive	Overtopped Roadway	Upgrade to 90-ft span Bridge	$ 4,165,000

North Fork San Gabriel River Watershed			
Description	**Issue to be Addressed**	**Description of Improvements**	**Total Cost**
FM 2340	Overtopped Roadway	Upgrade to (8) 9'x7' RBC	$ 3,623,000
CR 203	Overtopped Roadway	Upgrade to 200-ft span Bridge	$ 6,860,000
CR 202	Overtopped Roadway	Upgrade to 200-ft span Bridge	$ 7,209,000
RM 963	Overtopped Roadway	Upgrade to 250-ft span Bridge	$ 4,257,000
RM 1174	Overtopped Roadway	Upgrade to 300-ft span Bridge	$ 4,551,000
CR 200	Overtopped Roadway	Upgrade to 300-ft span Bridge	$ 6,406,000
FM 243	Overtopped Roadway	Upgrade to 300-ft span Bridge	$ 10,581,000
NF01 - River Road	Flooded Structures	4,580 LF Channel Improvements 731,945 CY Excavation	$ 21,773,000
CR 257	Overtopped Roadway	Upgrade to 200-ft span Bridge	$ 3,174,000
NF02, NF 03 - CR 257	Flooded Structures	3,090 LF Channel Improvements 820,326 CY Excavation	$ 22,275,000
CR 258	Overtopped Roadway	Upgrade to 300-ft span Bridge	$ 6,745,000

Table 6-1 Flood Hazard Mitigation Project Construction Costs (continued)

South Fork San Gabriel River Watershed			
Description	**Issue to be Addressed**	**Description of Improvements**	**Total Cost**
SFSG01 - High Gabriel / S. San Gabriel Ranches	Flooded Structures	Buy-out flood prone structures	$ 2,385,000
CR 330B	Overtopped Roadway	Upgrade to 50-ft span Bridge	$ 2,629,000
CR 323	Overtopped Roadway	Upgrade to 100-ft span Bridge	$ 3,909,000
FM 1869	Overtopped Roadway	Upgrade to 300-ft span Bridge	$ 4,920,000

San Gabriel River Watershed			
Description	**Issue to be Addressed**	**Description of Improvements**	**Total Cost**
SG01 - CR 103	Flooded Structures	5,310 LF Channel Improvements 227,568 CY Excavation	$ 8,794,000
SG02 - McShepherd Road	Flooded Structures	4,070 LF Channel Improvements 279,669 CY Excavation	$ 11,470,000


Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
CR 245
Upgrade to 800-ft Bridge
CR 241
Upgrade to 700-ft Bridge
Berry Creek
CR 241
CR 245
CR 246
CR 243
SUNSET ACRES LN
BAR T DR
FISHER RD
PVR 904
RAWHIDE LN
CASA VE
195
N
Texas Water Development Board
0
1,150
2,300
Feet
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE CONSULTING LLC
FIGURE 6-1. RECOMMENDED IMPROVEMENTS
BERRY CREEK
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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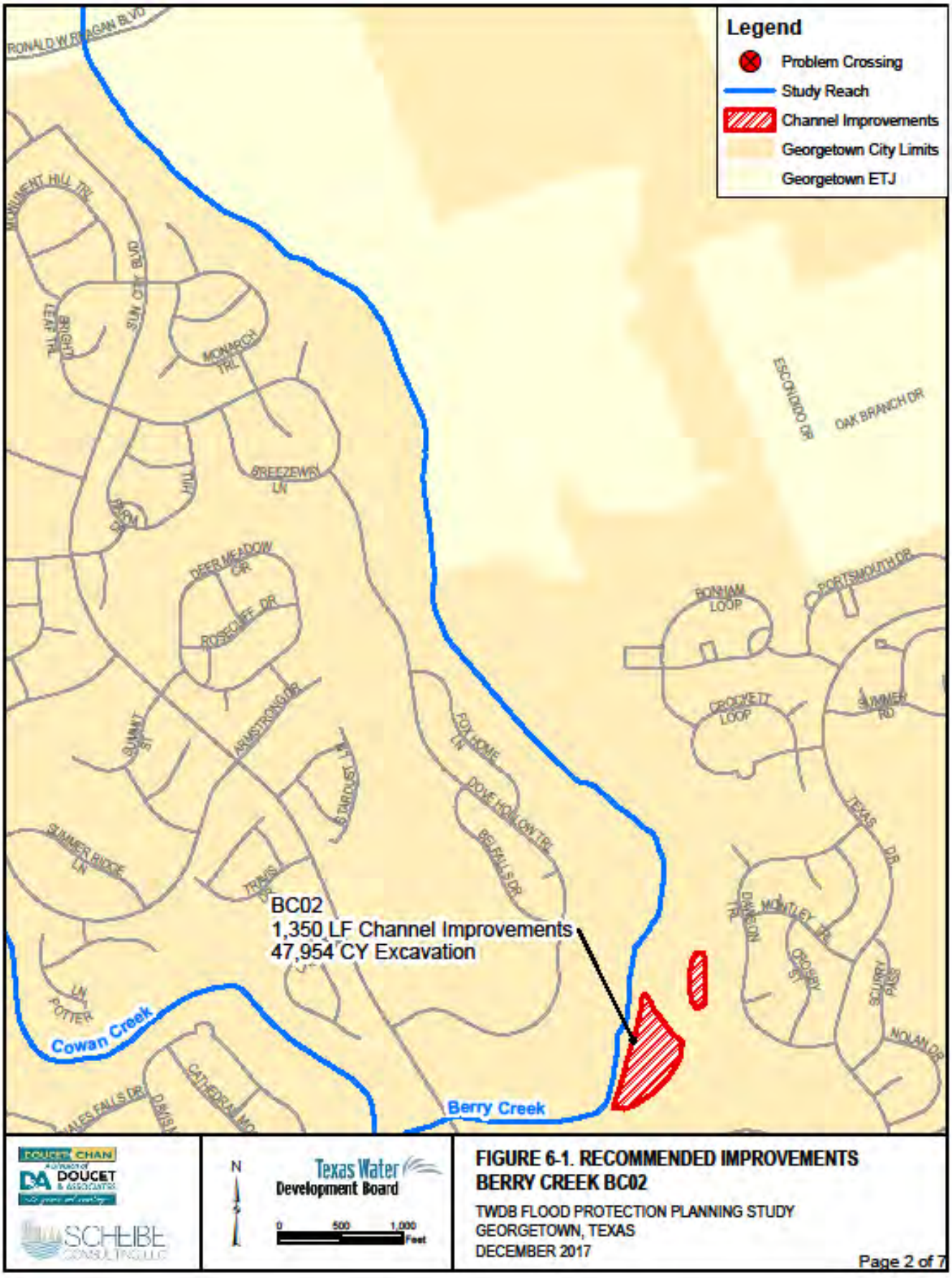
Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
RONALD W REAGAN BLVD
MONUMENT HILL TRL
SUN CITY BLVD
BRIGHT LEAF TRL
MONARCH TRL
BREEZEWAY LN
DEER MEADOW CIR
ROSECLIFF DR
ARMSTRONG DR
SUMMIT ST
STARDUST LN
FOX HOME LN
DOVE HOLLOW TRL
BIG FALLS DR
SUMMER RIDGE LN
TRINITY DR
POTTER LN
Cowan Creek
ESCONDIDO DR
OAK BRANCH DR
BONHAM LOOP
PORTSMOUTH DR
CROCKETT LOOP
SUMMER RD
TEXAS DR
DAWSON TRL
MONTLEY TRL
CROSBY ST
SCURRY PASS
NOLAN DR
BC02
1,350 LF Channel Improvements
47,954 CY Excavation
Berry Creek
N
0
500
1,000
Feet
Texas Water Development Board
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE CONSULTING LLC
FIGURE 6-1. RECOMMENDED IMPROVEMENTS
BERRY CREEK BC02
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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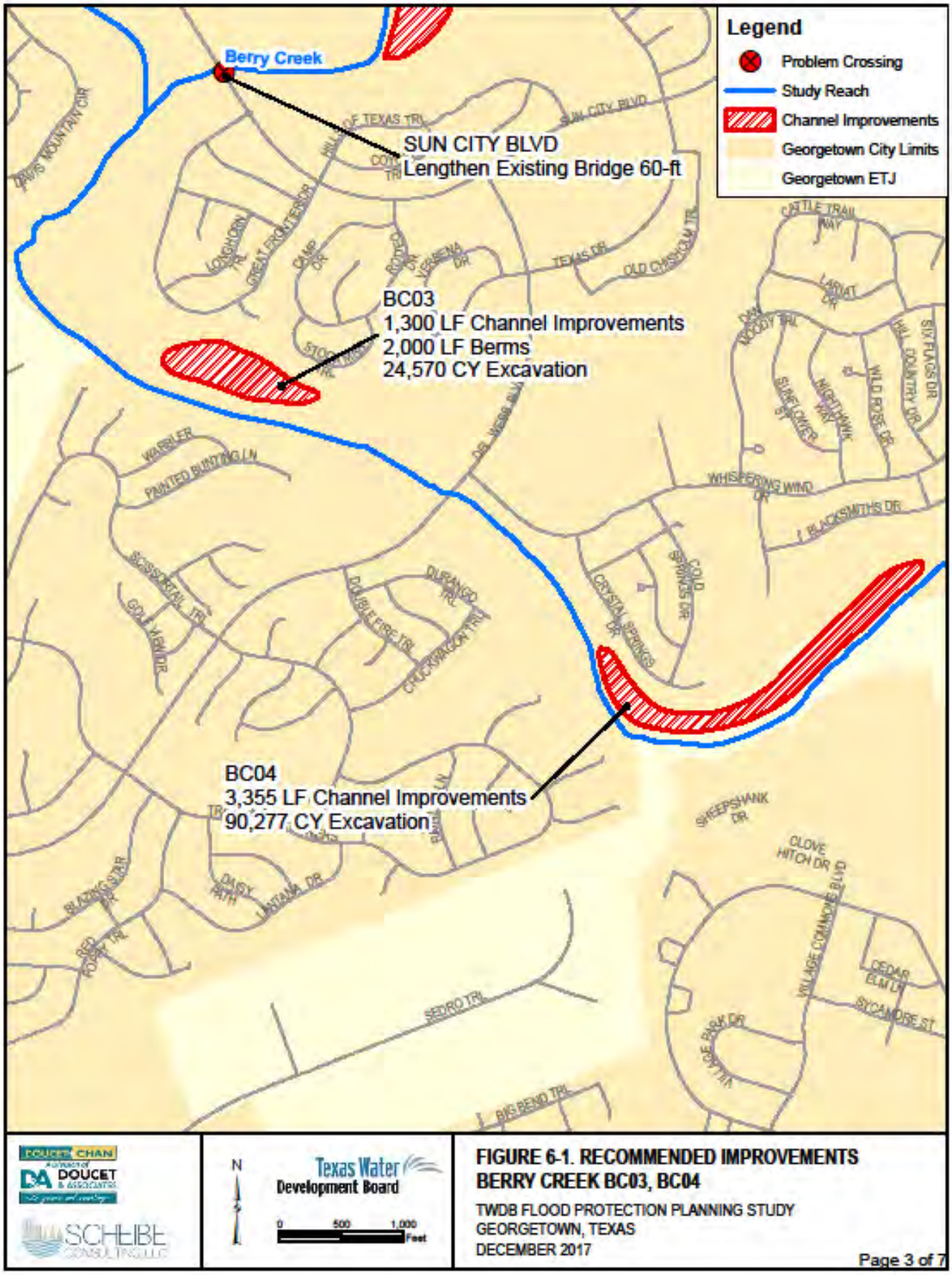
Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
Berry Creek
SUN CITY BLVD
Lengthen Existing Bridge 60-ft
BC03
1,300 LF Channel Improvements
2,000 LF Berms
24,570 CY Excavation
BC04
3,355 LF Channel Improvements
90,277 CY Excavation
DAVIS MOUNTAIN CIR
HILL OF TEXAS TRL
SUN CITY BLVD
LONGHORN TRL
GREAT FRONTIER DR
CAMP DR
VERBENA DR
TEXAS DR
OLD CHISHOLM TRL
CATTLE TRAIL WAY
LARIAT DR
DAN MOODY TRL
SIX FLAGS DR
HILL COUNTRY DR
WILD ROSE DR
NIGHTHAWK WAY
SUNFLOWER ST
WARBLER
PAINTED BUNTING LN
WHISPERING WIND DR
BLACKSMITHS DR
SCISSORTAIL TRL
GOLF VIEW DR
DURANGO TRL
DOUBLE FIRE TRL
CHUCKWAGON TRL
CRYSTAL SPRINGS DR
COLD SPRINGS DR
SHEEPSHANK DR
CLOVE HITCH DR
VILLAGE COMMONS BLVD
CEDAR ELM LN
SYCAMORE ST
VILLAGE PARK DR
BLAZING STAR DR
DAISY PATH
LANTANA DR
RED POPPY TRL
SEDRO TRL
BIG BEND TRL
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE CONSULTING LLC
N
Texas Water Development Board
0 500 1,000 Feet
FIGURE 6-1. RECOMMENDED IMPROVEMENTS
BERRY CREEK BC03, BC04
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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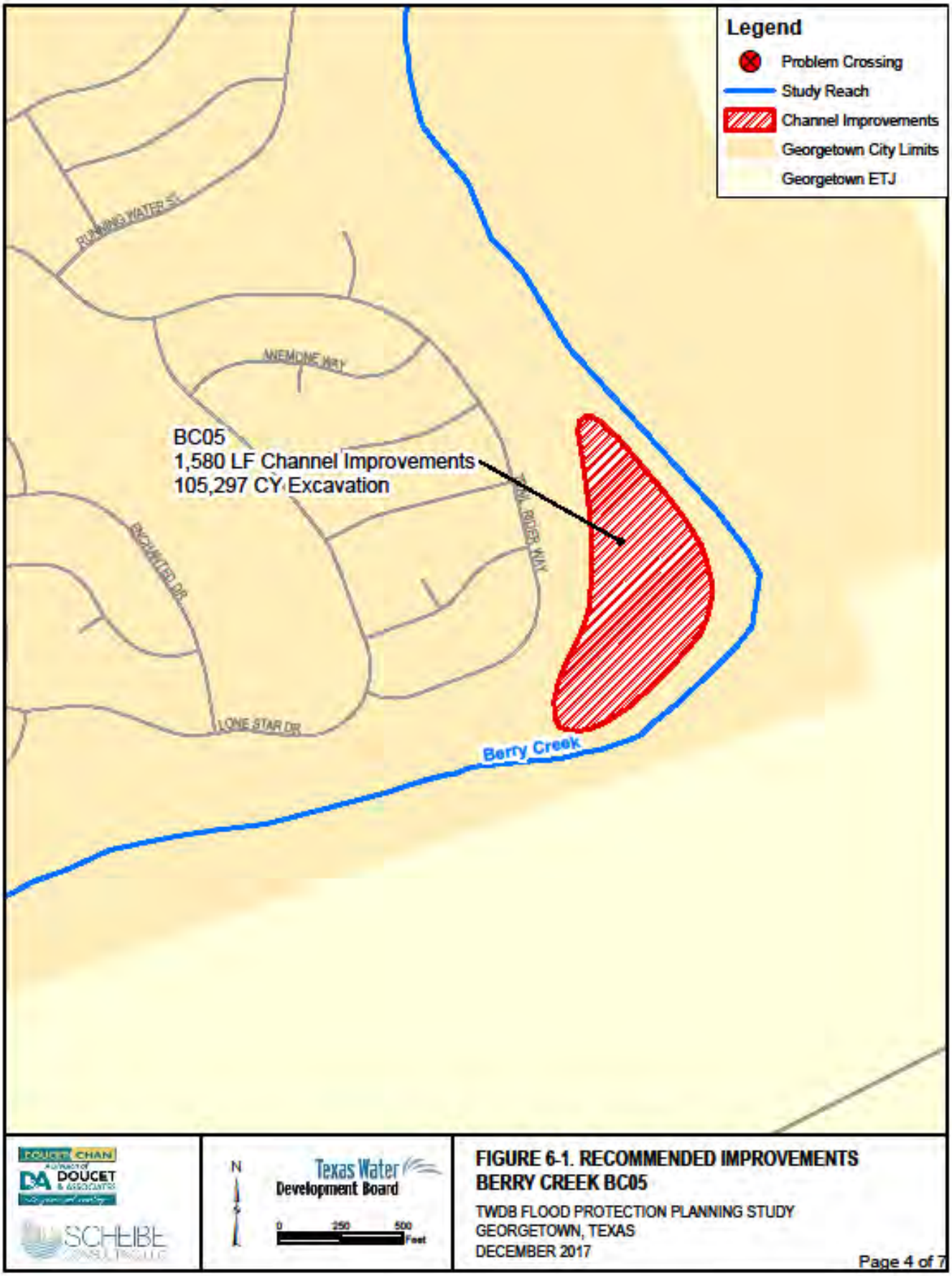
Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
RUNNING WATER ST
ANEMONE WAY
BC05
1,580 LF Channel Improvements
105,297 CY Excavation
SAN GABRIEL WAY
ENCHANTED DR
LONE STAR DR
Berry Creek
N
0
250
500
Feet
Texas Water Development Board
FIGURE 6-1. RECOMMENDED IMPROVEMENTS
BERRY CREEK BC05
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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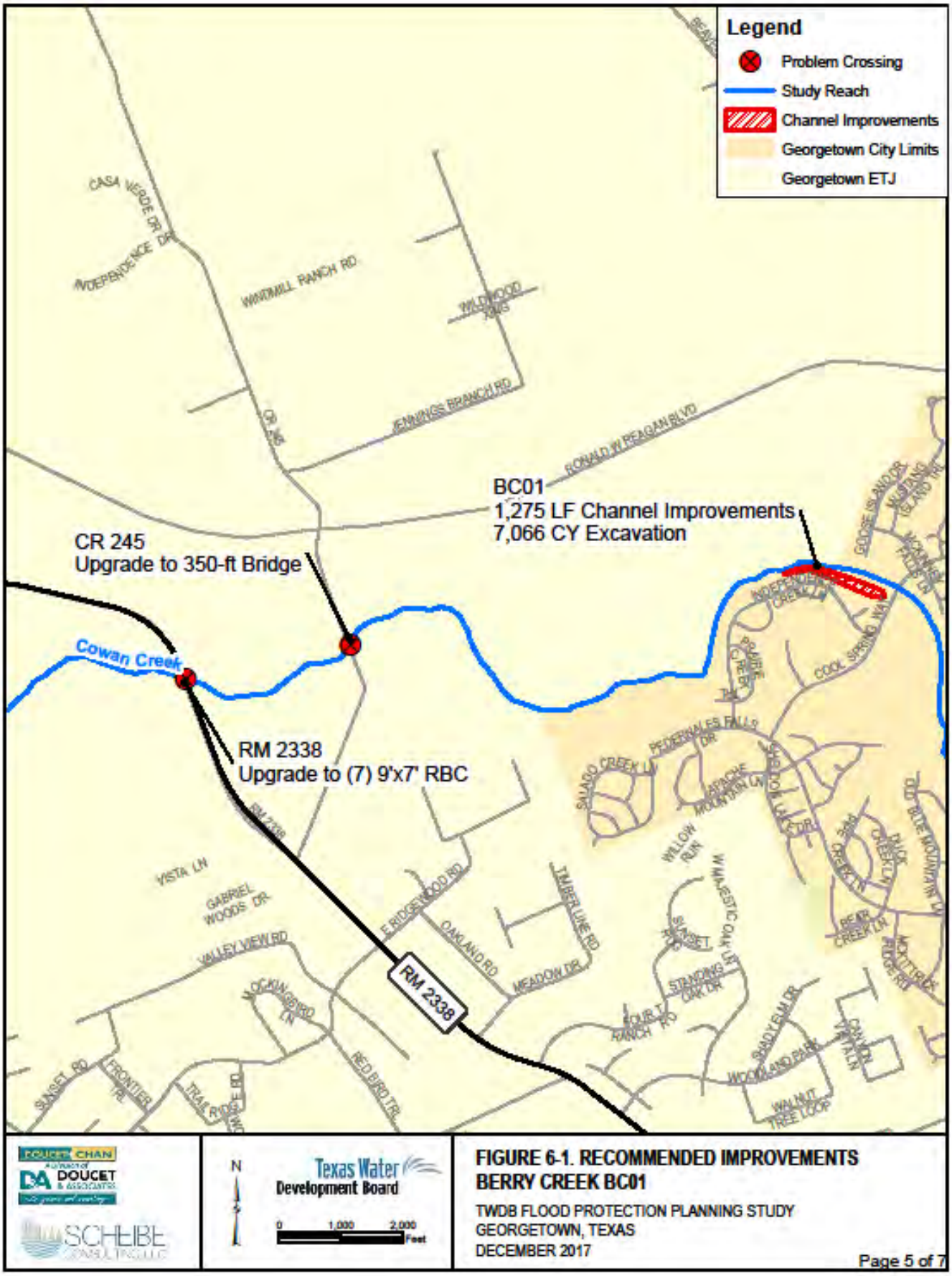
Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
BC01
1,275 LF Channel Improvements
7,066 CY Excavation
CR 245
Upgrade to 350-ft Bridge
Cowan Creek
RM 2338
Upgrade to (7) 9'x7' RBC
RM 2338
CASA VERDE DR
INDEPENDENCE DR
WINDMILL RANCH RD
JENNINGS BRANCH RD
RONALD W REAGAN BLVD
VISTA LN
GABRIEL WOODS DR
VALLEY VIEW RD
E RIDGEWOOD RD
OAKLAND RD
MEADOW DR
TIMBER LINE RD
RED BIRD TRL
SUNSET RD
FRONTIER TRL
TRAIL RIDGE RD
SALADO CREEK LN
PEDERNALES FALLS DR
APACHE MOUNTAIN LN
WILLOW RUN
W MAJESTIC OAK LN
STANDING OAK DR
SHADY ELM DR
WOODLAND PARK
WALNUT TREE LOOP
COOL SPRING WAY
BEAR CREEK LN
DUCK CREEK LN
OLD BLUE MOUNTAIN LN
GOOSE ISLAND DR
MUSTANG ISLAND TRL
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE CONSULTING, LLC
N
Texas Water Development Board
0 1,000 2,000 Feet
FIGURE 6-1. RECOMMENDED IMPROVEMENTS
BERRY CREEK BC01
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
RONALD W REAGAN BLVD
LIVE OAKS TRAIL
Upgrade to 400-ft Bridge
BURSON LN
LIVE OAK TRLS
CR 146
CR 234
Upgrade to 450-ft Bridge
CR 147
PVR 914
CR 143
Upgrade to 800-ft Bridge
CR 142
IH 35
SH 195
FM 972
N
Texas Water Development Board
0 1,000 2,000 Feet
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE CONSULTING LLC
FIGURE 6-1. RECOMMENDED IMPROVEMENTS
BERRY CREEK
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
Dry Berry Creek
GROVE LN
CR 152
CR 152
Raise Overbank Roadway
Berry Creek
CR 152
Upgrade to 700-ft Bridge
FM 971
FM 971
Upgrade to 500-ft Bridge
Pecan Branch
San Gabriel River
SH 130
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
N
Texas Water Development Board
0
750
1,500
Feet
FIGURE 6-1. RECOMMENDED IMPROVEMENTS
BERRY CREEK
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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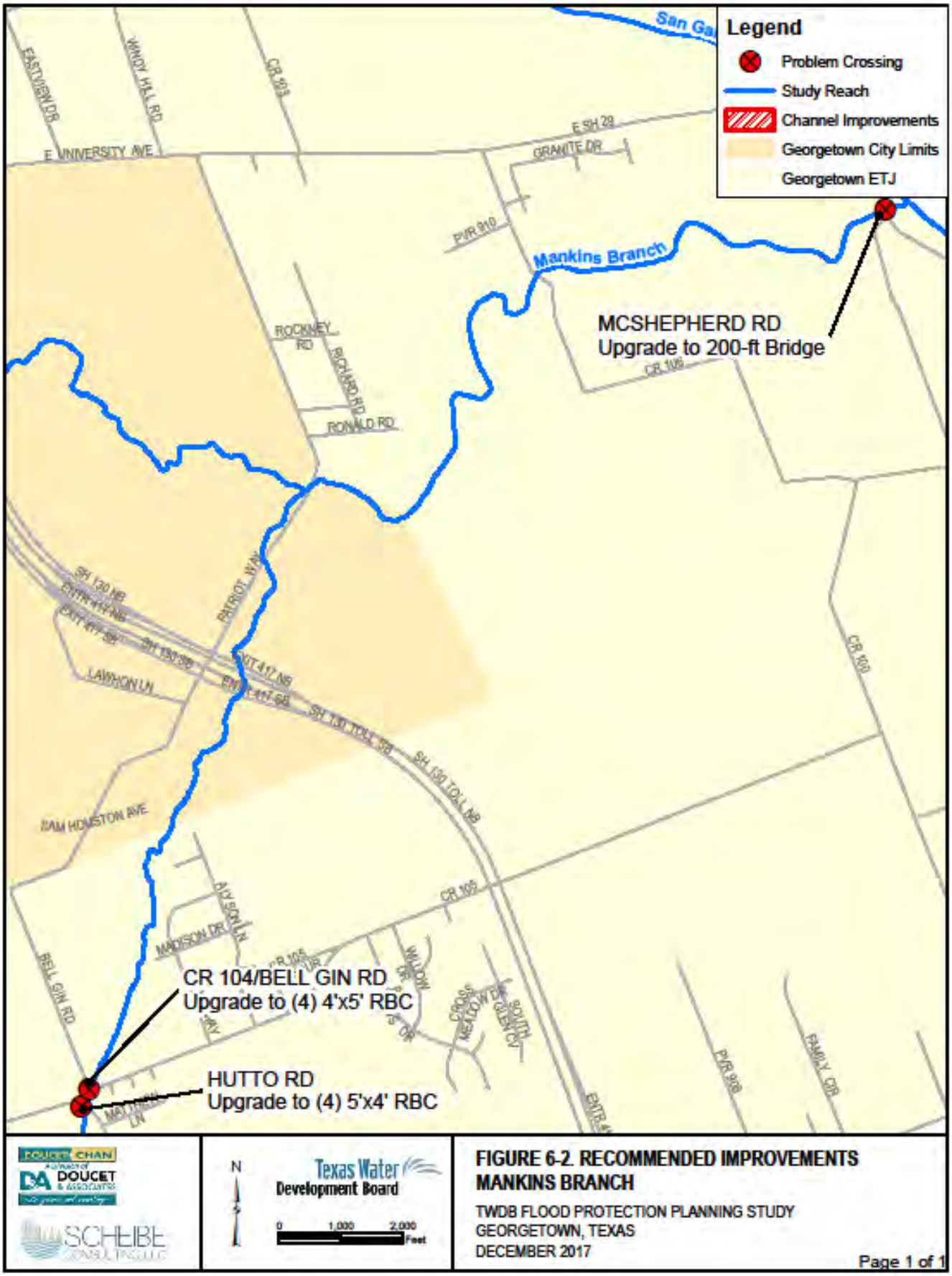
Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
Mankins Branch
MCSHEPHERD RD
Upgrade to 200-ft Bridge
CR 104/BELL GIN RD
Upgrade to (4) 4'x5' RBC
HUTTO RD
Upgrade to (4) 5'x4' RBC
E UNIVERSITY AVE
E SH 29
GRANITE DR
P/R 910
ROCKNEY RD
RICHARD RD
RONALD RD
CR 105
PATROL WAY
SH 130 NB
EXIT 417 NB
EXIT 417 SB
SH 130 SB
LAWHON LN
SH 130 TOLL SB
SH 130 TOLL NB
SAM HOUSTON AVE
CR 100
CR 105
MADISON DR
BELL GIN RD
WILLOW CIR
CROSS MEADOW DR
SOUTH GLEN CV
P/R 908
FAMILY CIR
DOUCET & ASSOCIATES
SCHEIBE CONSULTING LLC
N
Texas Water Development Board
0 1,000 2,000 Feet
FIGURE 6-2. RECOMMENDED IMPROVEMENTS
MANKINS BRANCH
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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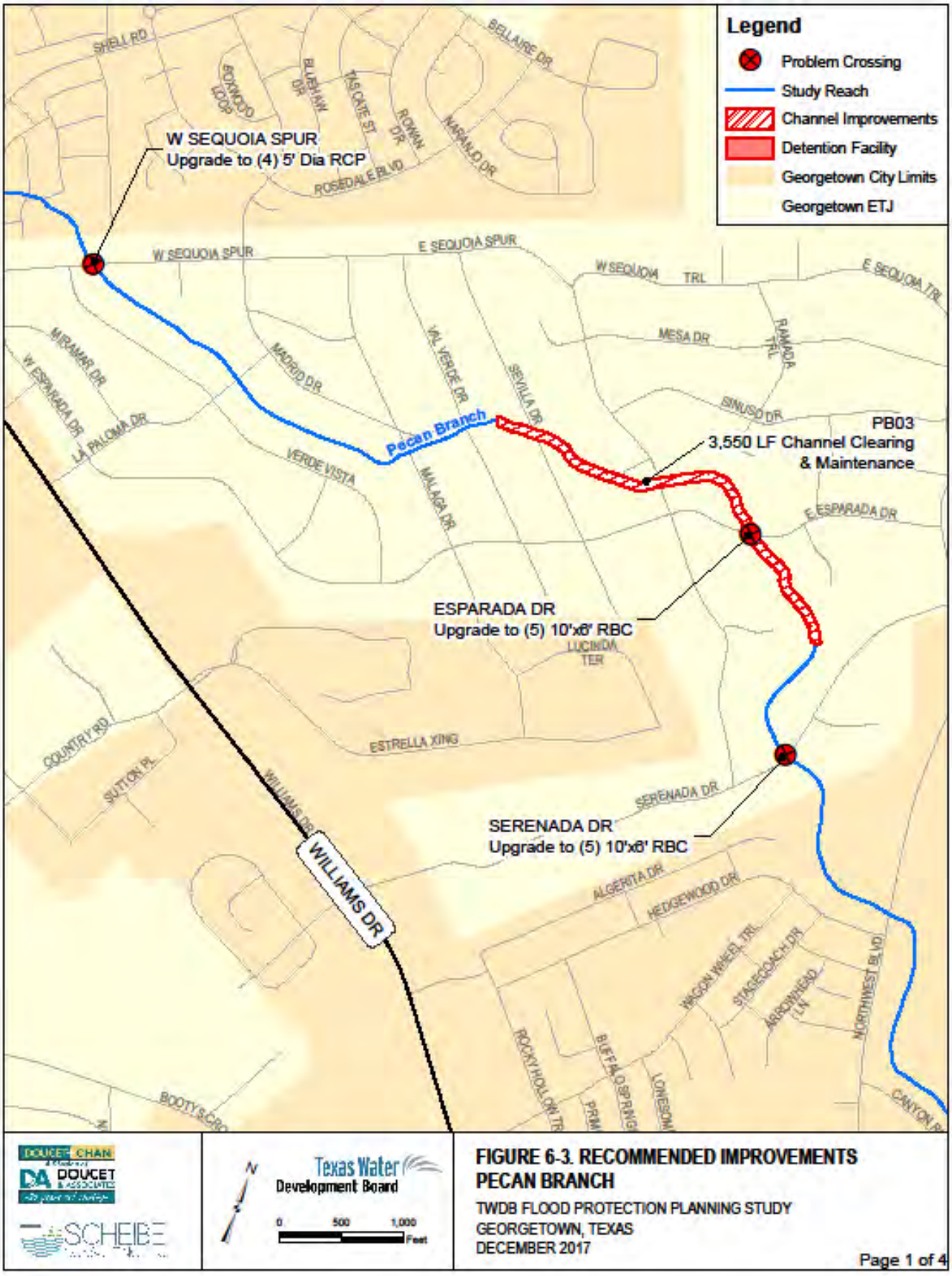
Legend
Problem Crossing
Study Reach
Channel Improvements
Detention Facility
Georgetown City Limits
Georgetown ETJ
W SEQUOIA SPUR
Upgrade to (4) 5' Dia RCP
PB03
3,550 LF Channel Clearing
& Maintenance
ESPARADA DR
Upgrade to (5) 10'x8' RBC
SERENADA DR
Upgrade to (5) 10'x8' RBC
Pecan Branch
WILLIAMS DR
SHELL RD
BELLAIRE DR
ROSEDALE BLVD
W SEQUOIA SPUR
E SEQUOIA SPUR
W SEQUOIA TRL
E SEQUOIA TRL
MESA DR
RAMADA TRL
SINUSO DR
MIRAMAR DR
W ESPARADA DR
LA PALOMA DR
MADRID DR
VAL VERDE DR
SEVILLA DR
VERDE VISTA
MALAGA DR
E ESPARADA DR
LUCINDA TER
ESTRELLA XING
COUNTRY RD
SUTTON PL
SERENADA DR
ALGERITA DR
HEDGEWOOD DR
WAGON WHEEL TRL
STAGECOACH DR
ARROWHEAD LN
NORTHWEST BLVD
ROCKY HOLLOW TR
BUFFALO SPRING
LONESOME
CANYON R
BOOTY'S CROSSING
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
N
Texas Water Development Board
0
500
1,000
Feet
FIGURE 6-3. RECOMMENDED IMPROVEMENTS
PECAN BRANCH
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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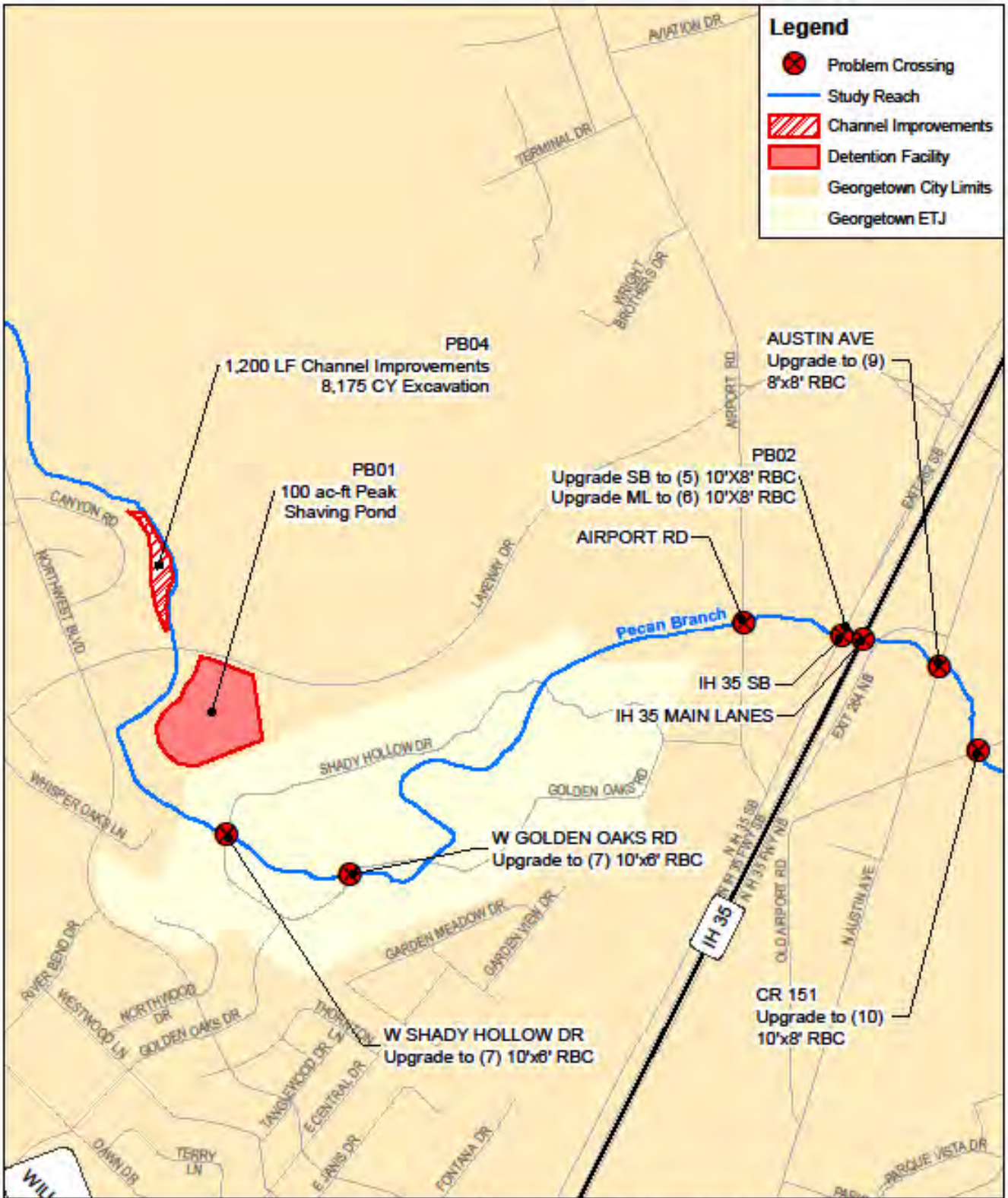
Legend
Problem Crossing
Study Reach
Channel Improvements
Detention Facility
Georgetown City Limits
Georgetown ETJ
PB04
1,200 LF Channel Improvements
8,175 CY Excavation
PB01
100 ac-ft Peak
Shaving Pond
PB02
Upgrade SB to (5) 10'X8' RBC
Upgrade ML to (6) 10'X8' RBC
AUSTIN AVE
Upgrade to (9)
8'x8' RBC
AIRPORT RD
IH 35 SB
IH 35 MAIN LANES
W GOLDEN OAKS RD
Upgrade to (7) 10'x6' RBC
W SHADY HOLLOW DR
Upgrade to (7) 10'x6' RBC
CR 151
Upgrade to (10)
10'x8' RBC
Pecan Branch
AVIATION DR
TERMINAL DR
WRIGHT BROTHERS DR
AIRPORT RD
CANYON RD
NORTHWEST BLVD
LAKEWAY DR
SHADY HOLLOW DR
GOLDEN OAKS RD
WHISPER OAKS LN
GARDEN MEADOW DR
GARDEN VIEW DR
RIVER BEND DR
WESTWOOD LN
NORTHWOOD DR
GOLDEN OAKS DR
THORNTON
TANGLEWOOD DR
E CENTRAL DR
E JANIS DR
FONTANA DR
DAWN DR
TERRY LN
IH 35
OLD AIRPORT RD
N AUSTIN AVE
EXIT 264 NB
EXIT 265 SB
PARQUE VISTA DR
N
Texas Water Development Board
0
500
1,000
Feet
FIGURE 6-3. RECOMMENDED IMPROVEMENTS
PECAN BRANCH
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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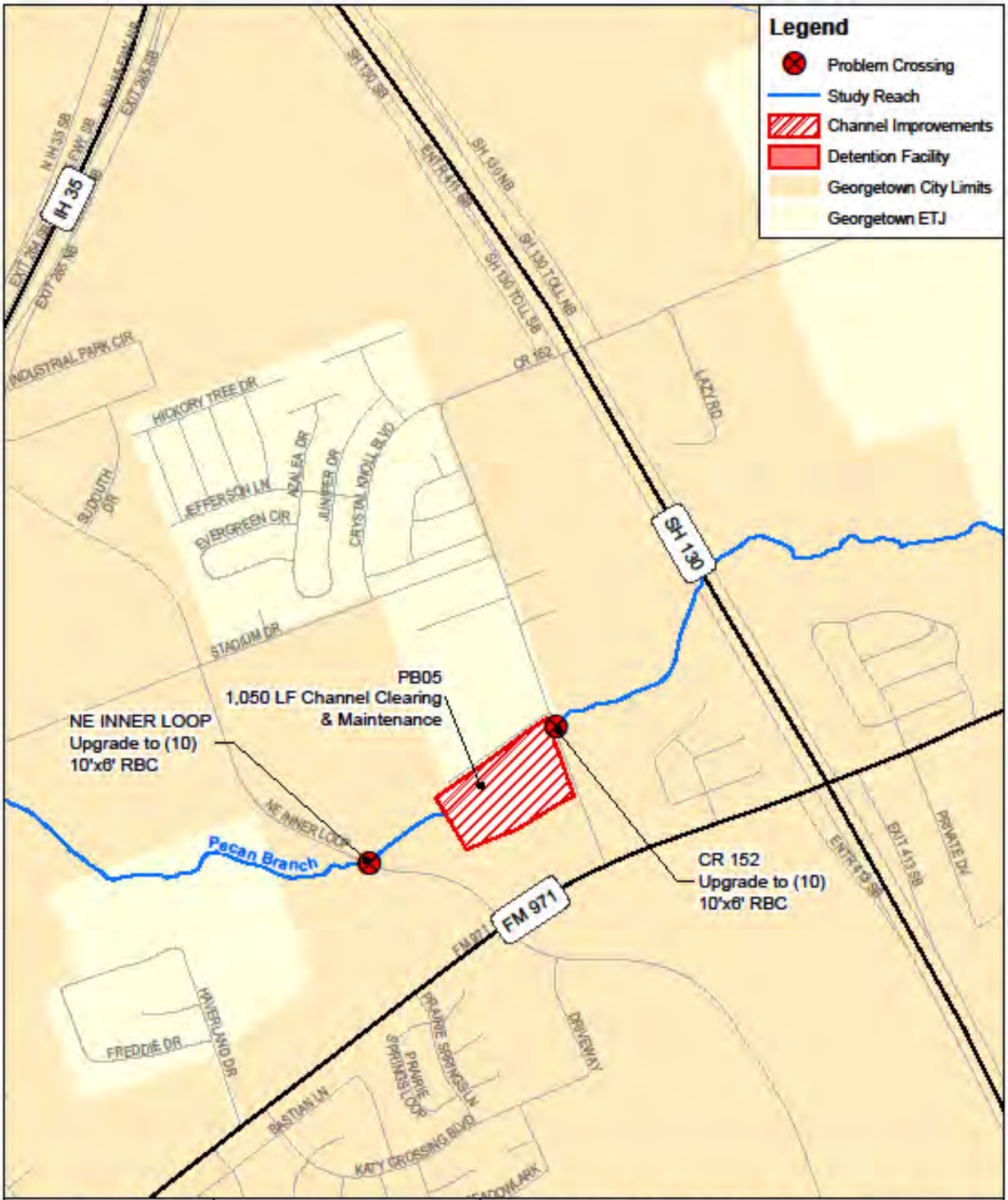

FIGURE 6-3. RECOMMENDED IMPROVEMENTS PECAN BRANCH

TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

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Legend
Problem Crossing
Study Reach
Channel Improvements
Detention Facility
Georgetown City Limits
Georgetown ETJ
FM 971
Upgrade to (15) 10'x10' Box Culv
FM 971
Pecan Branch
FM 971
San Gabriel River
FM 971
RUSK LN
N
Texas Water Development Board
0
500
1,000
Feet
FIGURE 6-3. RECOMMENDED IMPROVEMENTS
PECAN BRANCH
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
FM 1460
Smith Main
CR 166
Upgrade to (4) 5'x5' RBC
CR 166
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
N
Texas Water Development Board
0 250 500 Feet
FIGURE 6-4. RECOMMENDED IMPROVEMENTS
SMITH BRANCH
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
FM 1460
S AUSTIN AVE
Raise Road 1.0'
MADISON OAKS AVE
Raise Road 1.5'
MADISON OAKS AVE
EXIT 259 NB
S IH 35 NB
S AUSTIN AVE
Smith West Fork
IH 35
S IH 35 PKWY NB
S IH 35 SB
EXIT 259 SB
IH 35 SB FR
COOPERATIVE WAY
SWEAD DR
EXIT 258
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
N
Texas Water Development Board
0 250 500 Feet
FIGURE 6-4. RECOMMENDED IMPROVEMENTS
SMITH BRANCH
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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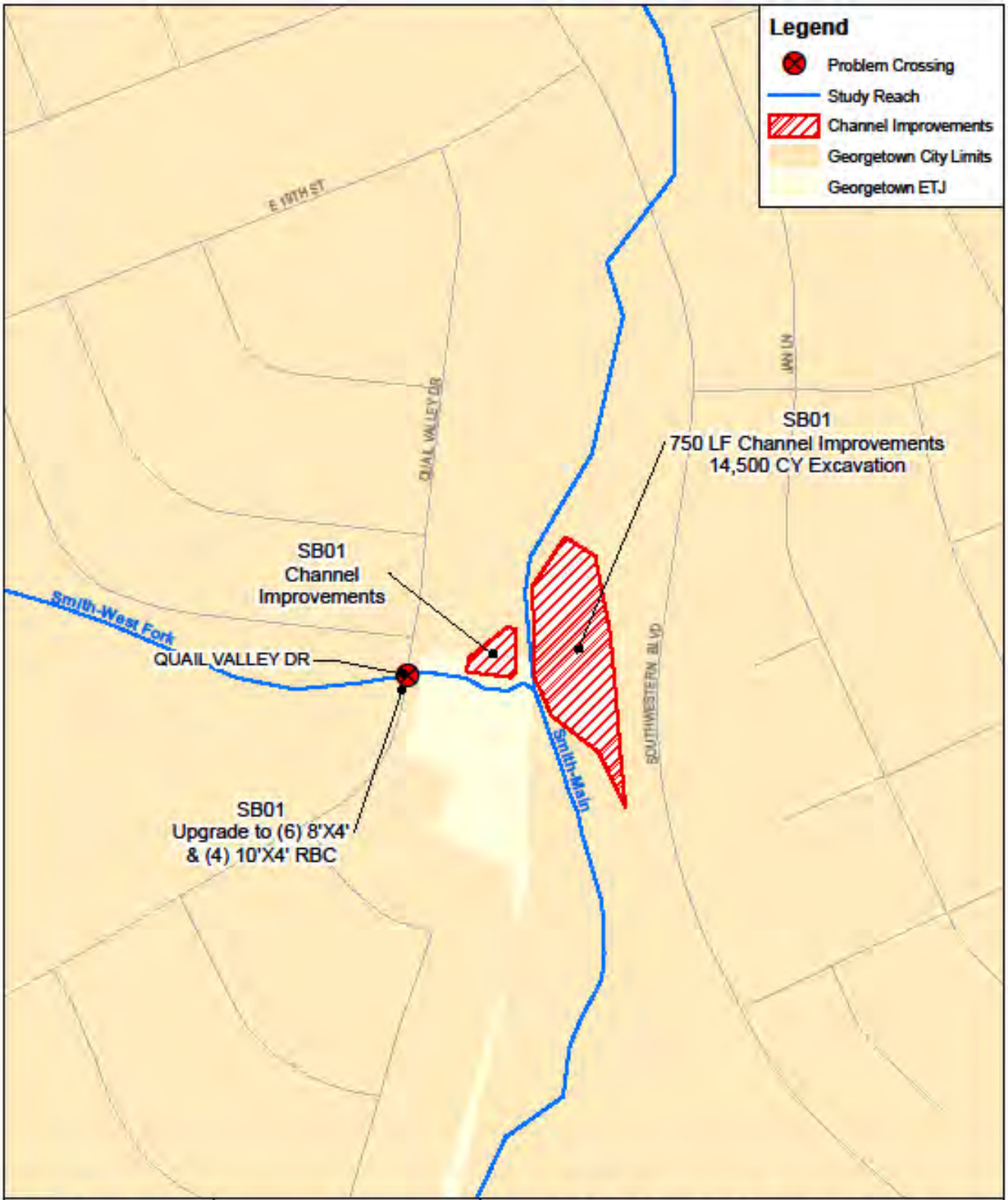

FIGURE 6-4. RECOMMENDED IMPROVEMENTS SMITH BRANCH SB01

TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

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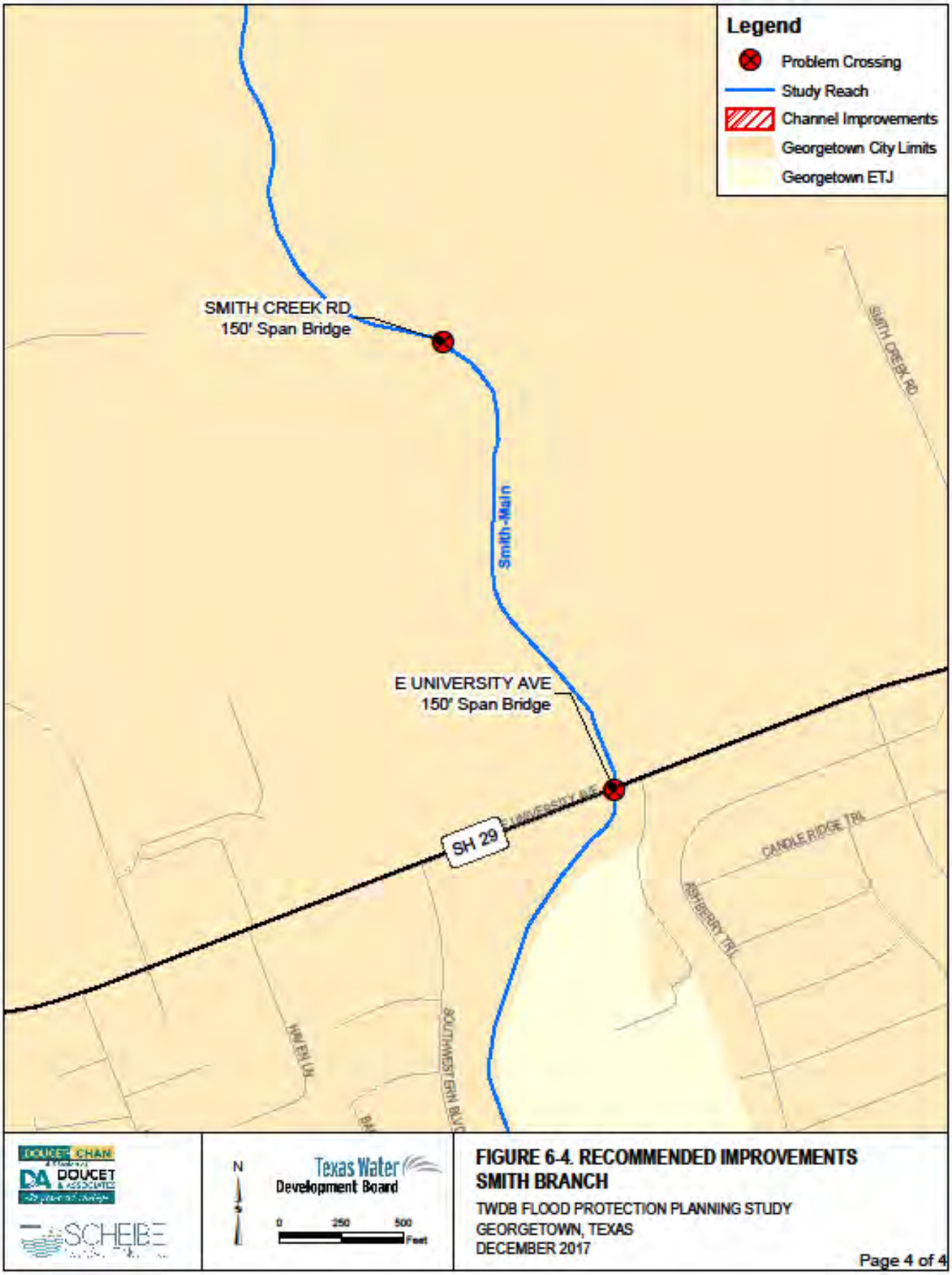

FIGURE 6-4. RECOMMENDED IMPROVEMENTS
SMITH BRANCH
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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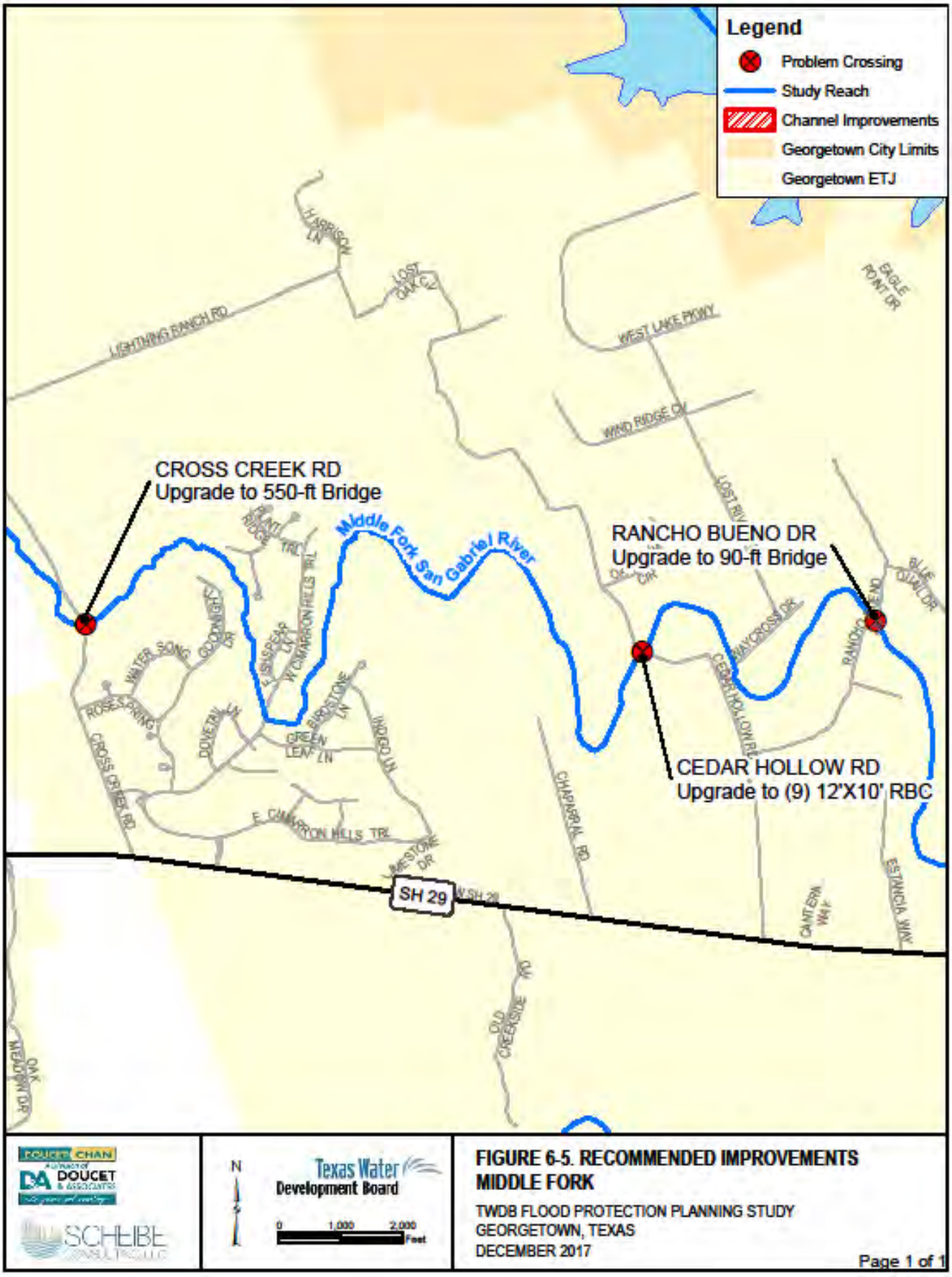
Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
CROSS CREEK RD
Upgrade to 550-ft Bridge
RANCHO BUENO DR
Upgrade to 90-ft Bridge
CEDAR HOLLOW RD
Upgrade to (9) 12'X10' RBC
Middle Fork San Gabriel River
SH 29
LIGHTNING RANCH RD
WEST LAKE PKWY
WIND RIDGE CV
LOST RIV
CHAPARRAL RD
CROSS CREEK RD
E CIMARRON HILLS TRL
ESTANCIA WAY
CANTERA WAY
OLD CREEKSIDE CV
OAK MEADOW DR
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
N
Texas Water Development Board
0 1,000 2,000 Feet
FIGURE 6-5. RECOMMENDED IMPROVEMENTS
MIDDLE FORK
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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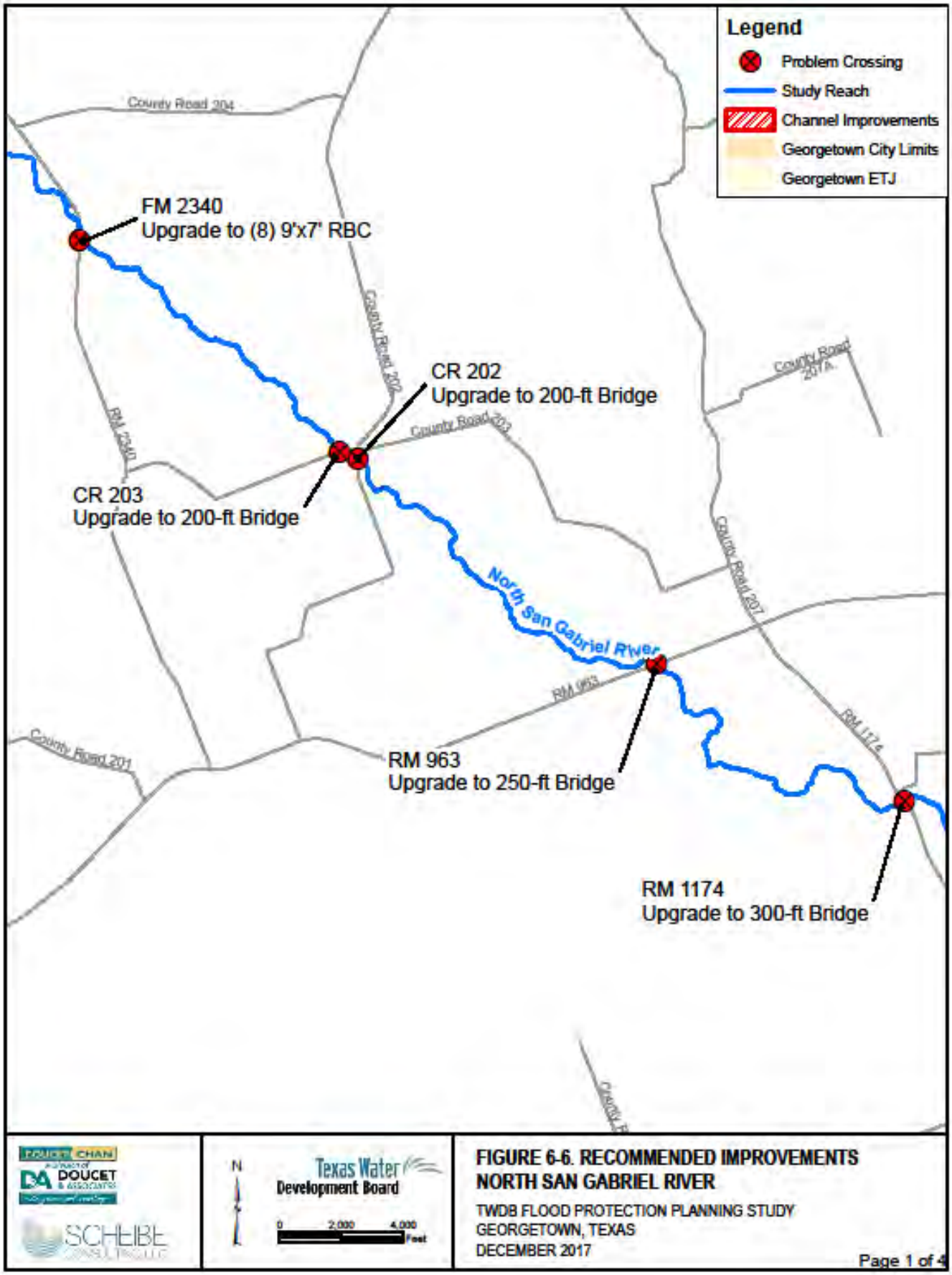
Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
County Road 204
FM 2340
Upgrade to (8) 9'x7' RBC
County Road 202
CR 202
Upgrade to 200-ft Bridge
County Road 203
County Road 207A
RM 2340
CR 203
Upgrade to 200-ft Bridge
North San Gabriel River
County Road 207
RM 963
RM 963
Upgrade to 250-ft Bridge
RM 1174
County Road 201
RM 1174
Upgrade to 300-ft Bridge
N
Texas Water Development Board
0 2,000 4,000 Feet
FIGURE 6-6. RECOMMENDED IMPROVEMENTS
NORTH SAN GABRIEL RIVER
TWDB FLOOD PROTECTION PLANNING STUDY
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DECEMBER 2017
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Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
CR 200
Upgrade to 300-ft Bridge
FM 243
Upgrade to 300-ft Bridge
North San Gabriel River
County Road 212
County Road 214
County Road 282
County Road 272
RM 243
Burnet
Williamson
Shady Grove
N
Texas Water Development Board
0 2,000 4,000 Feet
FIGURE 6-6. RECOMMENDED IMPROVEMENTS
NORTH SAN GABRIEL RIVER
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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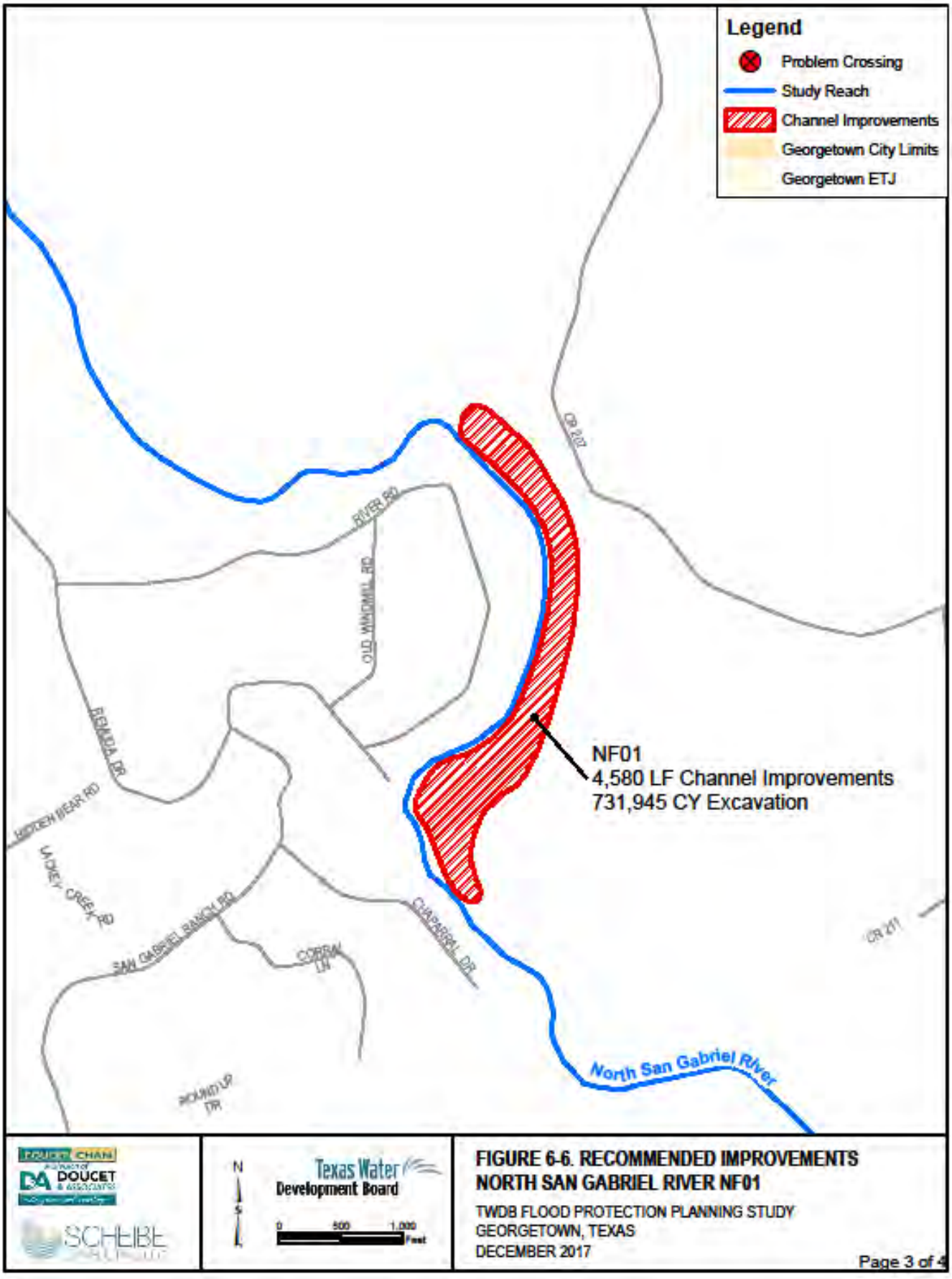
Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
NF01
4,580 LF Channel Improvements
731,945 CY Excavation
RIVER RD
OLD WADDELL RD
RAMADA DR
HIDDEN BEAR RD
LADKEY CREEK RD
SAN GABRIEL RANCH RD
CORRAL LN
CHAPARRAL DR
ROUND UP DR
CR 207
CR 211
North San Gabriel River
Texas Water Development Board
0 500 1,000 Feet
FIGURE 6-6. RECOMMENDED IMPROVEMENTS
NORTH SAN GABRIEL RIVER NF01
TWDB FLOOD PROTECTION PLANNING STUDY
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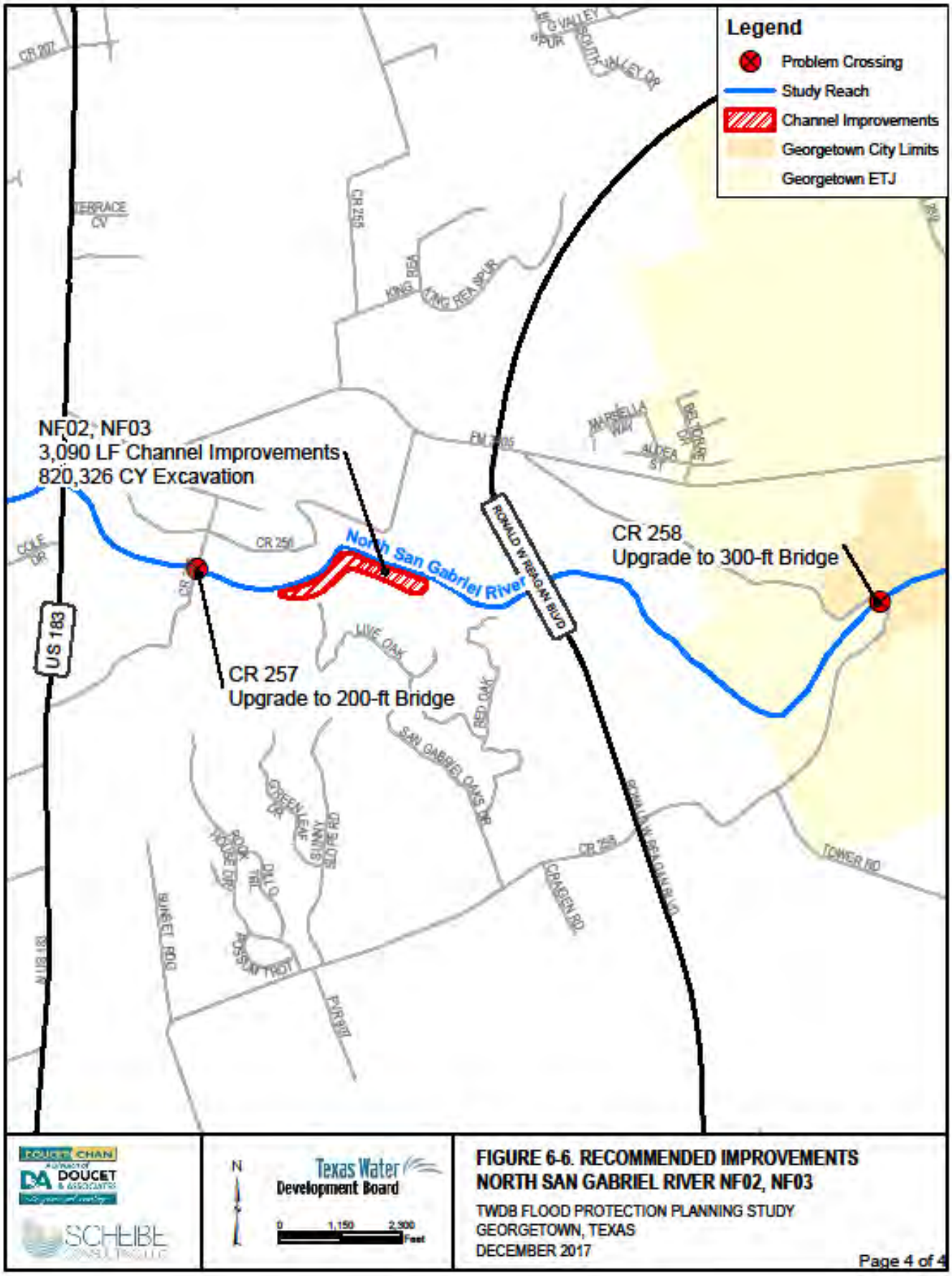
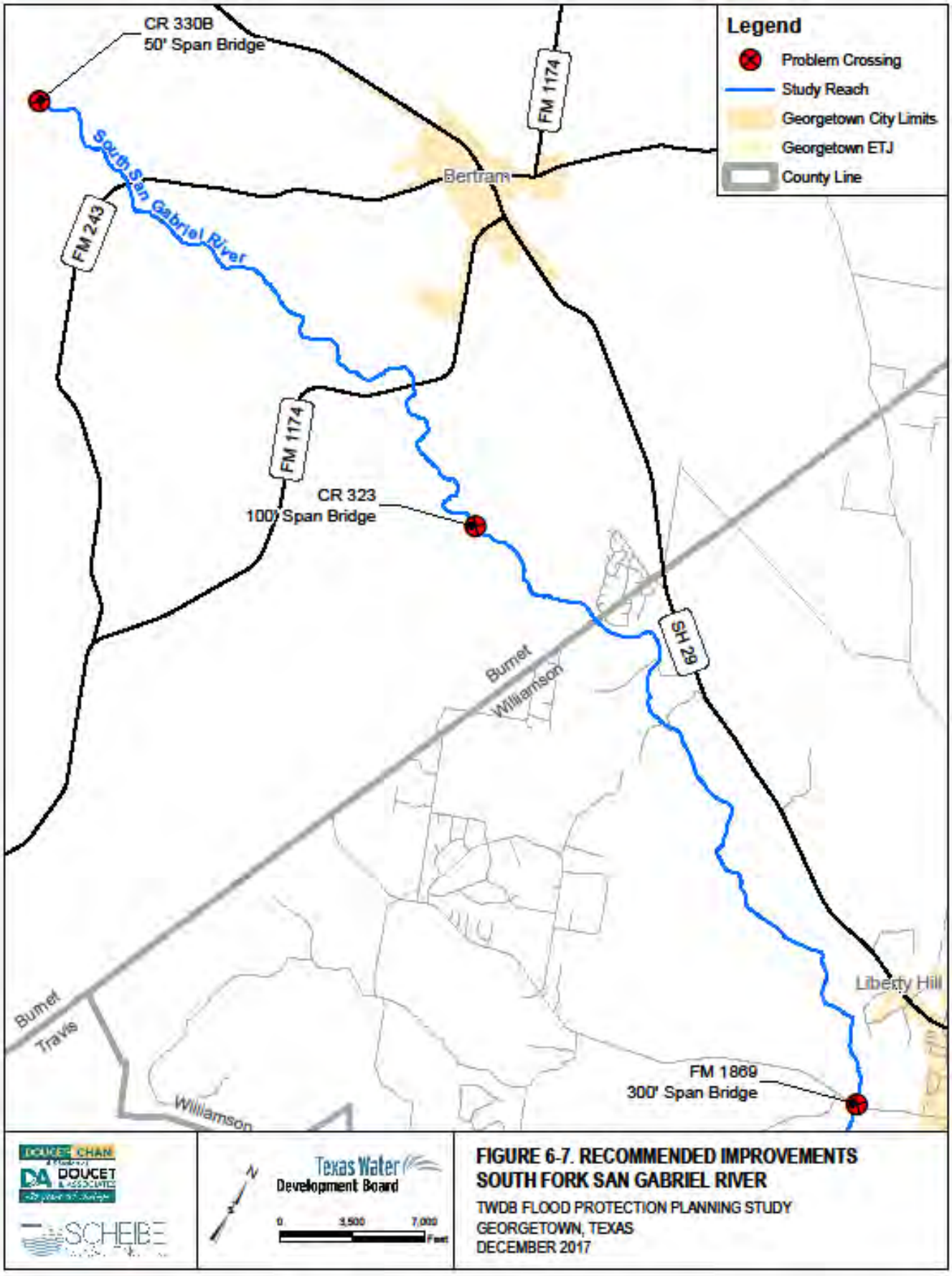
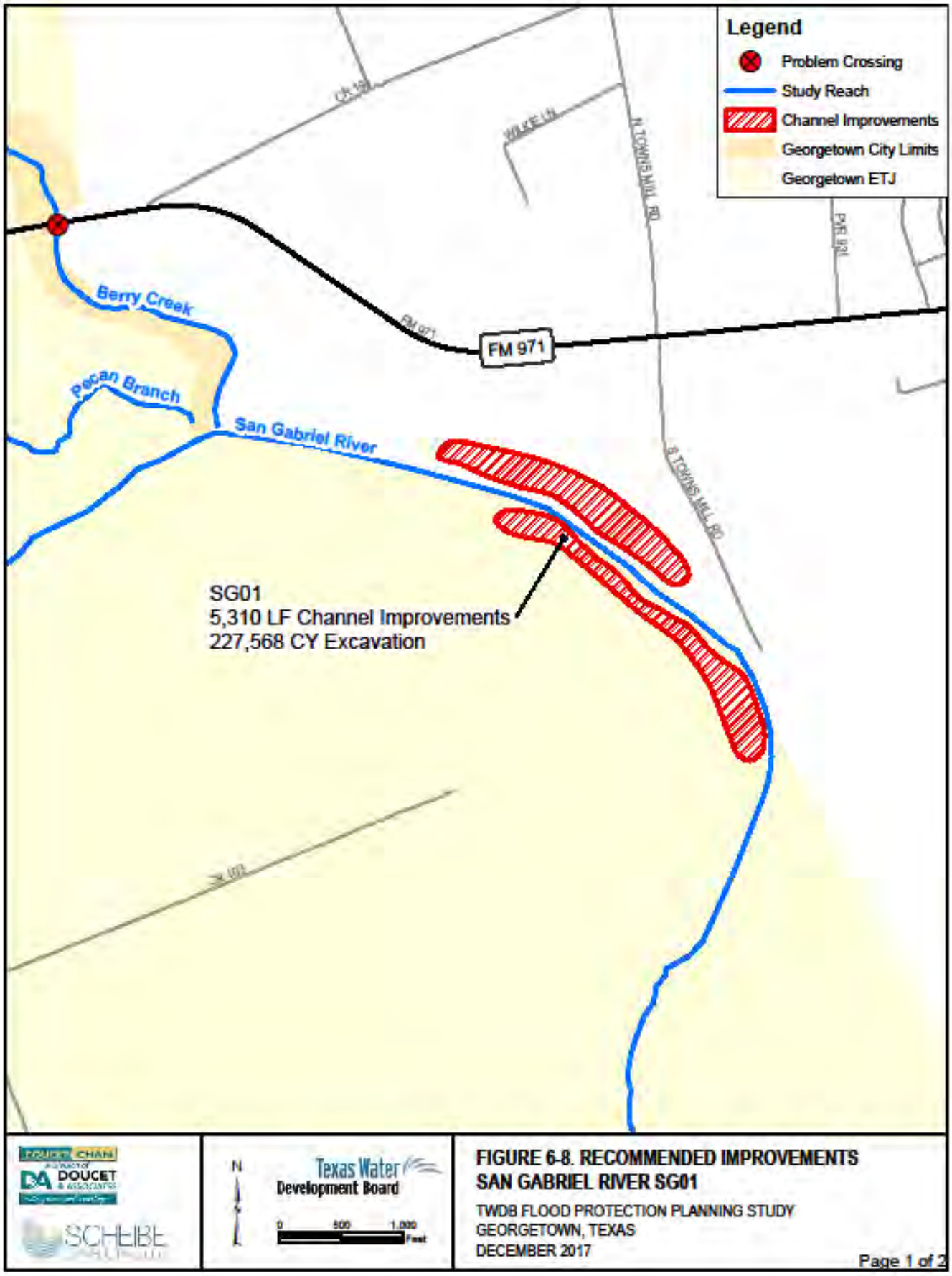
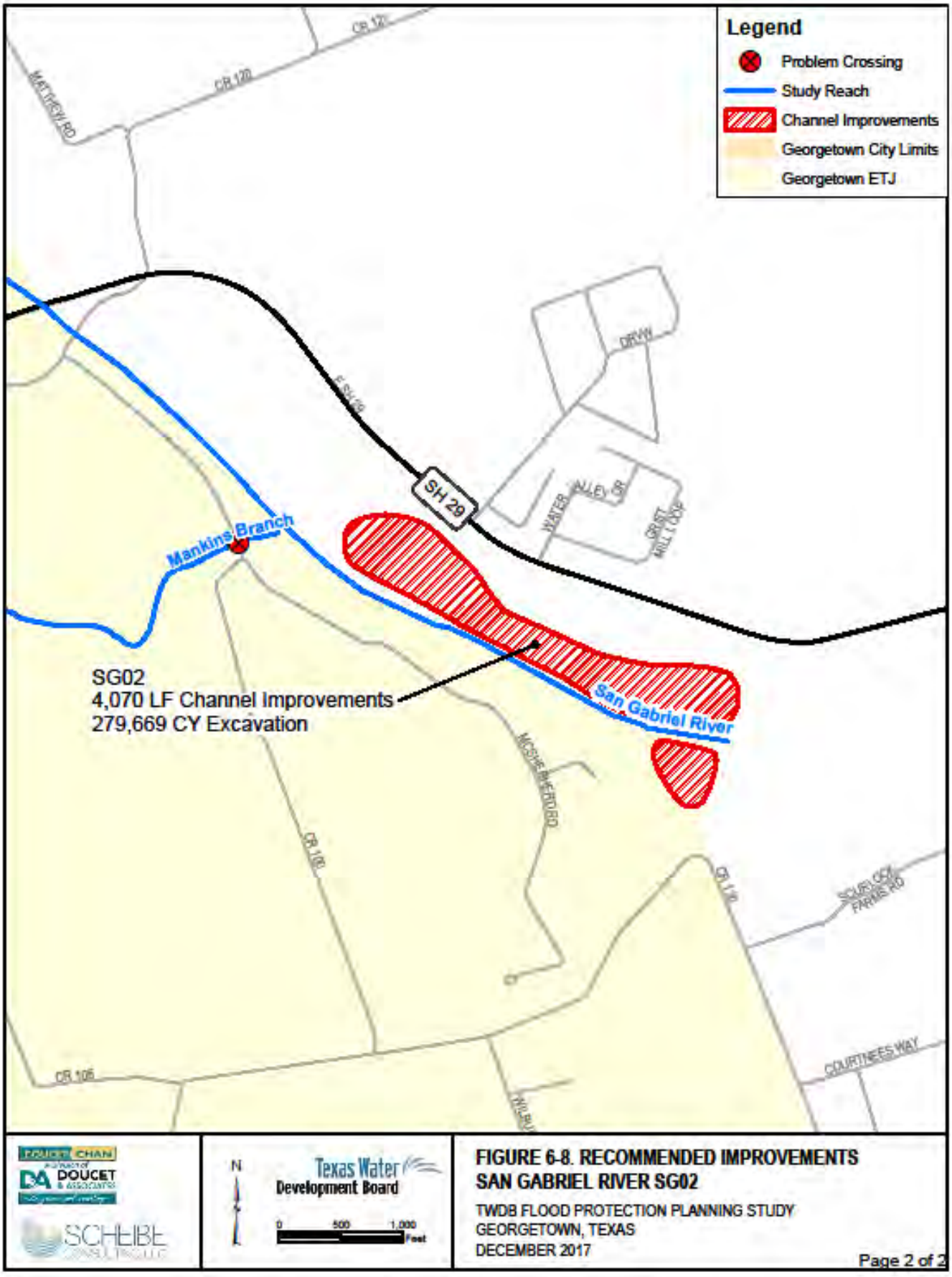


FIGURE 6-6. RECOMMENDED IMPROVEMENTS
NORTH SAN GABRIEL RIVER NF02, NF03
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Problem Crossing
Study Reach
Georgetown City Limits
Georgetown ETJ
County Line
CR 330B
50' Span Bridge
South San Gabriel River
FM 1174
Bertram
FM 243
FM 1174
CR 323
100' Span Bridge
SH 29
Burnet
Williamson
Burnet
Travis
Williamson
Liberty Hill
FM 1869
300' Span Bridge
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
Texas Water Development Board
0
3,500
7,000
Feet
FIGURE 6-7. RECOMMENDED IMPROVEMENTS
SOUTH FORK SAN GABRIEL RIVER
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
CR 152
WILKE LN
N TOWNS MILL RD
PVR 972
Berry Creek
FM 971
FM 971
Pecan Branch
San Gabriel River
S TOWNS MILL RD
SG01
5,310 LF Channel Improvements
227,568 CY Excavation
CR 151
N
Texas Water Development Board
0
500
1,000
Feet
FIGURE 6-8. RECOMMENDED IMPROVEMENTS
SAN GABRIEL RIVER SG01
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
Page 1 of 2


Legend
Problem Crossing
Study Reach
Channel Improvements
Georgetown City Limits
Georgetown ETJ
SH 29
Mankins Branch
San Gabriel River
SG02
4,070 LF Channel Improvements
279,669 CY Excavation
CR 120
CR 100
CR 106
MATTHEW RD
DRVW
WATER VALLEY DR
GRIST MILL LOOP
MOSHE PIVERTO RD
SCURLOCK FARMS RD
COURTNEES WAY
N
Texas Water Development Board
0 500 1,000 Feet
FIGURE 6-8. RECOMMENDED IMPROVEMENTS
SAN GABRIEL RIVER SG02
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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7.0 Prioritization of Recommended Flood Hazard Mitigation Improvements

The flood hazard mitigation projects presented in Section 6 provide protection from flooding for many affected individuals and their property as well as for public safety associated with road crossings over streams. The reality of public infrastructure improvement funding is that there are limited funds available and that not all the identified/recommended projects can be funded within a reasonable time period. Therefore, a prioritization process was developed and utilized to assist participating project sponsors in determining a practical way of selecting flood hazard mitigation projects to build over the next planning horizon or two. Additional detail of the prioritization process employed in this study is presented in Appendix C along with results obtained applying the process to the individual projects identified from the floodplain modeling and mapping efforts discussed in previous sections within this report.

The initial part of the prioritization process was to identify the major concerns as well as their respective importance associated with flood hazard mitigation management for flooded problem areas as well as for road crossings over streams. The major concerns identified to be addressed by the proposed flood hazard mitigation improvements for flooded problem areas (building/structures - e.g. residences, commercial buildings, offices, etc.) were:

- Public Safety, including consideration of impassibility of evacuation routes and overall benefits to the transportation system of the area;
- Flood Significance, including consideration of number of structures flooded during the 100-year Existing Conditions event and frequency of structure flooding;
- Dependence on Other Projects, including consideration of dependence on other projects to be fully effective;
- Environment, including consideration of environmental impacts of the proposed improvements;
- Easement/O&M, easement and O&M costs and requirements associated with project
- Benefit/Cost Ratio, including consideration of the ratio of benefits (flood damage reduction) and project costs.

The major concerns identified to be addressed by the proposed flood hazard mitigation improvements for road crossing flooding were:

- Public Safety, includes roadway classification (arterial, collector, or local) and whether an alternative route is readily available;
- Flood Significance, including consideration of number of structures flooded due to inadequacy of conveyance and the frequency of the flooding;
- Dependence on Other Project, including consideration of dependence on other projects to be fully effective;

- Environment, including consideration of the environmental impact of the proposed roadway improvement;
- Project Cost, including consideration of the total cost of the project including construction, engineering fees, and administrative fees.

To refine the prioritization process, representatives from the major stakeholders participated in the prioritization process during the Working Meeting in November of 2017. That meeting included representatives from the City of Georgetown, Williamson County, and the City of Leander.

As outlined in Appendix C, the second part of the prioritization process involved developing a flood severity index matrix for flooded problem areas (see Table C-4) as well as separate flood severity index risk index for flooded road crossings (see Table C-5). Using these two flood severity matrices, an overall (total) flood severity index value was developed for each identified project area. These project index values then allowed for individual projects to be ranked against one another and grouped by jurisdiction as shown in Table 7-1.

In recent meetings with the City of Georgetown, the City requested that projects located within their city limits and ETJ be further divided into Tier 1 and Tier II sets of projects. Tier I projects are the highest ranked projects within Georgetown's city limits and ETJ that total approximately $20 million in estimated implementation costs, almost equally split between problem areas and roadway crossings, without considering costs for easements or rights-of-way. This level of project implementation could possibly be accomplished in an upcoming planning horizon as directed by the Georgetown City Council and City staff leaders. Additionally, a Tier II level of projects was also developed that includes the next highest ranked projects beyond Tier I projects that total approximately $30 million in estimated costs excluding easement and rights-of-way costs. The Tier I and Tier II projects are specifically identified in Table 7-1.

Williamson County has one road crossing project identified in Table 7-1 but several road crossing projects located in Georgetown's ETJ may, in fact, be under Williamson County's jurisdictional control. Recommendations in Table 7-1 also include one project for the City of Leander, three for the City of Liberty Hill, and ten for Burnet County. Again, additional detail is in Appendix C.

This prioritization process has a subjective, qualitative ranking of the projects and is not intended to define the specific order in which projects are ultimately funded. Instead, it can be used as a tool to help the various jurisdictions in their own prioritization process. Actual prioritization and funding of projects will be determined by the Stakeholders and affected communities.

Table 7-1 Flood Hazard Mitigation Improvements Prioritization Summary

City of Georgetown & ETJ					
Priority	**Watershed**	**Description**	**Severity Index**	**Type of Project**	**Total Cost**
Tier I					
1	Smith	SB01 - West Fork Confluence	76	Channel	$ 1,885,000
2	Pecan	PB04 - Canyon Rd	76	Channel	$ 815,000
3	Berry	BC02 - Dove Hollow/Dawson Trail	64	Channel	$ 2,310,000
4	Berry	BC03 - Painted Bunting Ln	59	Channel	$ 3,648,000
5	Berry	BC01 - Independence Creek Ln	56	Channel	$ 934,000
6	Berry	Live Oak Trails	57	Roadway	$ 4,613,000
7	Pecan	N Austin Ave	55	Roadway	$ 4,040,000
8	Smith	CR 166	55	Roadway	$ 660,000
9	Smith	SB02 - Rabbit Hollow Subdivision	54	Channel	$ 765,000
10	Pecan	PB03 - Serenada Subdivision	54	Channel	$ 410,000
					$ 20,080,000
Tier II					
1	Pecan	FM 971	55	Roadway	$ 8,272,000
2	Pecan	Serenada Dr	53	Roadway	$ 2,028,000
3	Smith	University / Hwy 29	50	Roadway	$ 2,750,000
4	Pecan	Esperada Dr	49	Roadway	$ 2,771,000
5	Berry	FM 971	45	Roadway	$ 14,961,000
					$ 30,782,000
All Other Improvement Projects					
1	Berry	CR 234	45	Roadway	$ 8,150,000
2	Berry	CR 143	45	Roadway	$ 12,774,000
3	Berry	CR 245	45	Roadway	$ 16,312,000
4	Berry	CR 241	45	Roadway	$ 14,331,000
5	Pecan	PB01 - Golden Oaks Subdivision	45	Channel	$ 8,900,000
6	Mankins	McShepherd Road / CR 100	45	Roadway	$ 4,657,000
7	Middle Fork	Rancho Bueno Drive	45	Roadway	$ 4,165,000
8	Smith	Smith Creek Rd	45	Roadway	$ 8,306,000
9	Mankins	Bell Gin Rd / CR 104	45	Roadway	$ 1,067,000

Table 7-1 Flood Hazard Mitigation Improvements Prioritization Summary (continued)

City of Georgetown & ETJ					
Priority	**Watershed**	**Description**	**Severity Index**	**Type of Project**	**Total Cost**
10	Mankins	Hutto Road	45	Roadway	$ 1,538,000
11	Pecan	W Sequoia Spur	45	Roadway	$ 1,303,000
12	Pecan	W Shady Hollow Dr	45	Roadway	$ 1,850,000
13	Pecan	W Golden Oaks Rd	45	Roadway	$ 2,454,000
14	Smith	Madison Oaks Ave	45	Roadway	$ 668,000
15	Berry	BC05 - Trail Rider Way	41	Channel	$ 4,116,000
16	San Gabriel	SG02 - McShepherd Road	40	Channel	$ 8,306,000
17	Pecan	PB05 - Lonnie Thomas Dr	39	Channel	$ 295,000
18	Berry	BC04 - Crystal Springs Dr	37	Channel	$ 4,016,000
19	Berry	CR 245	35	Roadway	$ 9,667,000
20	Middle Fork	Cedar Hollow Rd	35	Roadway	$ 5,931,000
21	Middle Fork	Cross Creek Rd	35	Roadway	$ 9,166,000
22	San Gabriel	SG01 - CR 103	35	Channel	$ 1,067,000
23	Pecan	CR 151	35	Roadway	$ 6,051,000
24	Pecan	CR 152	35	Roadway	$ 4,815,000
25	Pecan	PB02 - IH 35	34	Channel	$ 10,825,000
26	Smith	S Austin Ave	30	Roadway	$ 3,083,000
27	Pecan	NE Inner Loop	30	Roadway	$ 3,572,000
28	Berry	Andice Rd / RM 2338	30	Roadway	$ 2,473,000
29	Berry	CR 152	25	Roadway	$ 9,345,000
30	Berry	CR 152	25	Roadway	$ 1,913,000
31	North Fork	CR 258	10	Roadway	$ 6,745,000

Williamson County					
Priority	**Watershed**	**Description**	**Severity Index**	**Type of Project**	**Total Cost**
1	South Fork	FM 1869	55	Roadway	$ 4,920,000

Table 7-1 Flood Hazard Mitigation Improvements Prioritization Summary (continued)

City of Leander & ETJ					
Priority	**Watershed**	**Description**	**Severity Index**	**Type of Project**	**Total Cost**
1	South Fork	SFSG01 - High Gabriel / S. San Gabriel Ranches	33	Channel	$ 800,000

City of Liberty Hill					
Priority	**Watershed**	**Description**	**Severity Index**	**Type of Project**	**Total Cost**
1	North Fork	CR 257	73	Roadway	$ 3,174,000
2	North Fork	NF01 - River Road	30	Channel	$ 21,773,000
3	North Fork	NF02, NF 03 - CR 257	27	Channel	$ 22,275,000

Burnet County					
Priority	**Watershed**	**Description**	**Severity Index**	**Type of Project**	**Total Cost**
1	North Fork	FM 2340	55	Roadway	$ 3,623,000
2	South Fork	CR 330B	55	Roadway	$ 2,629,000
3	North Fork	CR 203	45	Roadway	$ 6,860,000
4	South Fork	CR 323	45	Roadway	$ 3,909,000
5	North Fork	RM 1174	40	Roadway	$ 4,551,000
7	North Fork	CR 202	38	Roadway	$ 7,209,000
8	North Fork	CR 200	35	Roadway	$ 6,406,000
9	North Fork	FM 243	35	Roadway	$ 10,581,000
10	North Fork	RM 963	30	Roadway	$ 4,257,000
11	North Fork	CR 258	20	Roadway	$ 6,745,000

APPENDIX A
HYDROLOGY

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A.1.0 Background

Hydrologic analyses were performed for the study areas identified in the two Georgetown-San Gabriel Flood Protection Planning Study grant applications to the Texas Water Development Board (TWDB) (Figure A-1) to estimate peak storm flows that would occur for 5, 10, 25, 50, 100, and 500-year (20, 10, 4, 2, 1, and 0.2 percent annual chance exceedance) storm events for existing and future watershed conditions. The hydrologic analysis consisted of the following steps:

- Watershed boundaries were delineated
- Curve numbers were established for each watershed
- Flow paths and associated lag times were determined for each watershed
- Routing parameters were estimated for each flow path
- Large detention structures were researched and analyzed
- Precipitation was estimated
- Hydrologic models were calibrated based upon historical storm events; and
- Final hydrologic models were developed for each study area

The USACE HEC-HMS software version 4.2 was used for the hydrologic analyses. Detailed descriptions of the steps, assumptions, and results of the analyses are presented in this Appendix. Summaries of pertinent data, calculations, tables, and figures are located at the end of this Appendix. An overview of the project area is provided in Figure A-1.

A.2.0 Data Sources

Table A-1 lists the sources used in the hydrologic analysis, as well as the specific calculation(s) for which each source was used.

A.3.0 Watershed Delineation

A.3.1 Method Overview

Watershed boundaries were delineated for each study area based upon Light Detection and Ranging (LiDAR) ground elevation information from three available sources, including the 2015 City of Georgetown 50cm LiDAR for City of Georgetown and ETJ area, the 2007 CAPCOG 140cm LiDAR for Williamson County area outside of the Georgetown LiDAR, and the 2011 StratMap Bell/Burnet/McLennan 50cm LiDAR for Burnet County area. ESRI's ArcMap program and the Corp of Engineers HEC-GeoHMS program were utilized to delineate the subbasin boundaries for use in hydrologic analysis. Subbasin sizes were generally delineated based upon geography and land topography as follows to ensure consistency in subbasin rainfall-runoff modeling within the HEC-HMS models:

- Subbasins for rural areas were sized to be close to 5 square miles, but not to exceed 8 square miles; and
- Subbasins for urban areas were sized to be close to 0.5 square miles, but not less than 0.25 square miles.

A.3.2 Watershed Delineation – Berry Creek Watershed Study Area

Hydrologic subbasins for the Berry Creek Study Area were delineated as described above, utilizing the Georgetown LiDAR and the CAPCOG LiDAR. The watershed consisted of 125.4 square miles and was delineated into 55 subbasins as shown in Figure A-2.

A.3.3 Watershed Delineation – Mankins Branch Watershed Study Area

Hydrologic subbasins for the Mankins Branch Study Area were delineated as described above, utilizing the Georgetown LiDAR. The watershed consisted of 13.2 square miles and was delineated into 16 subbasins as shown in Figure A-3.

A.3.4 Watershed Delineation – Pecan Branch Watershed Study Area

Hydrologic subbasins for the Pecan Branch Study Area were delineated as described above, utilizing the Georgetown LiDAR. The watershed consisted of 7.3 square miles and was delineated into 17 subbasins as shown in Figure A-4.

A.3.5 Watershed Delineation – Smith Branch Watershed Study Area

Hydrologic subbasins for the Smith Branch Study Area were delineated as described above, utilizing the Georgetown LiDAR. The watershed consisted of 9.2 square miles and was delineated into 23 subbasins as shown in Figure A-5.

A.3.6 Watershed Delineation – Middle Fork San Gabriel River Watershed Study Area

Hydrologic subbasins for the Middle Fork San Gabriel River Study Area were delineated as described above, utilizing the Georgetown LiDAR and the CAPCOG LiDAR. The watershed consisted of 16.9 square miles and was delineated into 25 subbasins as shown in Figure A-6.

A.3.7 Watershed Delineation – North Fork San Gabriel River Watershed Study Area

Hydrologic subbasins for the North Fork San Gabriel River Study Area were delineated as described above, utilizing the Georgetown LiDAR, the CAPCOG LiDAR, and the Burnet County LiDAR. The watershed consisted of 251.0 square miles and was delineated into 62 subbasins as shown in Figure A-7.

A.3.8 Watershed Delineation – South Fork San Gabriel River Watershed Study Area

Hydrologic subbasins for the South Fork San Gabriel River Study Area were delineated as described above, utilizing the Georgetown LiDAR and the CAPCOG LiDAR. The watershed consisted of 134.5 square miles and was delineated into 94 subbasins as shown in Figure A-8.

A.3.9 Watershed Delineation – San Gabriel River Watershed Study Area

Hydrologic subbasins for the San Gabriel River Study Area were delineated as described above, utilizing the Georgetown LiDAR and the CAPCOG LiDAR. A significant portion of the San Gabriel River Study Area is defined by the study areas detailed above. These detailed studies were incorporated in the San Gabriel River Study Area. The watershed consisted of 575.9 square miles and was delineated into 315 subbasins as shown in Figure A-9.

A.4.0 Curve Number Estimation

A.4.1 Method Overview

The volume of design storm rainfall estimated to become runoff was determined using the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) program and employing the Soil Conservation Service (SCS) Curve Number Method. This curve number index method represents the effect of soil type, land use/land cover, hydrologic condition, and antecedent soil moisture in estimating runoff volume from event rainfall volumes. This method requires the user to input the SCS Curve Number, percent impervious cover, and initial abstraction to fully develop runoff volumes in watershed subbasins. SCS Type II Curve Numbers were assigned based on the combination of hydrologic soil groups (HSGs) and land use cover description according to Table 2-2a of the Natural Resources Conservation Service (NRCS, formerly SCS) TR-55 "Urban Hydrology for Small Watersheds" as described below. The cover description selected for each land use type represents pervious areas only, since impervious coverage was input separately in the model (no nesting of imperviousness in Curve Number). Table A-3 provides the pervious Curve Number values utilized in this study. The Curve Numbers were then modified for climate index based upon Figure 4 of the Climatic Influence of NRCS Curve Number Literature Review (TxDOT Report No. TX/00/2104-1, 1983 Hailey and McGill). The following formula was developed based upon the watershed location on Figure 4:

AMC I + 0.46*(AMC II-AMC I)
AMC I = dry antecedent moisture conditions Curve Number
AMC II = normal antecedent moisture conditions Curve Number

The existing conditions percent impervious cover values were based upon the City of Georgetown's zoning districts for inside Georgetown's ETJ, Leander's ETJ, and estimated impervious cover values for agricultural areas. For areas within the City of Georgetown's jurisdiction, the future developed conditions were based upon the City of Georgetown's Future Land Use shapefile with assumed impervious cover values provided by the City of Georgetown. To obtain future development conditions impervious cover values for areas outside of the City of Georgetown's ETJ, the existing conditions impervious cover values were adjusted to reflect significant increase in impervious cover due to infill development. To estimate future impervious cover values, it was assumed that presently developed areas had a 5% increase in impervious cover while all presently undeveloped areas (i.e. agriculture, open space, crop land, woody areas, pasture) increased by assuming 50% of the undeveloped area would develop into low density residential area (20% impervious cover). When entering the Curve Number parameters into the HEC-HMS model, the impervious cover values were input separately from the undeveloped conditions Curve Numbers used.

The initial abstraction parameter defines the ability of the watershed to retain storm precipitation before runoff occurs. The study used the default initial abstraction of 0.2 times the potential maximum retention which is calculated from the respective Curve Numbers.

HSGs were determined using the soil type shapefile for Texas downloaded from the USDA's Soil Survey Geographic Database (SSURGO). The SSURGO soil shapefile delineates soil according to soil types, which are correlated in the database to an HSG. A summary of the soil types and the

associated HSGs are included in Table A-2. HSG classifies soils into four types: A, B, C, or D which are described below.

- Group A: Soils having a low runoff potential and a high infiltration rate even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission.

- Group B: Soils having a moderate infiltration rate when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

- Group C: Soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission.

- Group D: Soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. The soils have a very low rate of water transmission.

Undeveloped land use types were determined using ESRI's World Imagery. Polygons were delineated according to the land use cover categories provided by the City of Georgetown and the TR-55 manual. Table A-4 provided the land use categories and associated impervious cover values.

Curve Numbers were then assigned according to the undeveloped land use and soil for the area. An area-weighted average Curve Number for each subbasin was calculated using the following equation:

CN_{avg} = Sum (Area * CN) / Total Area

A.4.2 Curve Number Estimation – Berry Creek Watershed Study Area

Curve Numbers for the Berry Creek Study Area were estimated as described above. The results of the Curve Number estimation are provided in Table A-5. A map of the soil types is provided on Figure A-10. A map showing the existing conditions land use categories is provided on Figure A-11 while the map showing the future development conditions land use categories is provided on Figure A-12.

A.4.3 Curve Number Estimation – Mankins Branch Watershed Study Area

Curve Numbers for the Mankins Branch Study Area were estimated as described above. The results of the Curve Number estimation are provided in Table A-6. A map of the soil types is provided on Figure A-13. A map showing the existing conditions land use categories is provided on Figure A-14 while the map showing the future development conditions land use categories is provided on Figure A-15.

A.4.4 Curve Number Estimation – Pecan Branch Watershed Study Area

Curve Numbers for the Pecan Branch Study Area were estimated as described above. The results of the Curve Number estimation are provided in Table A-7. A map of the soil types is provided on Figure A-16. A map showing the existing conditions land use categories is provided on Figure A-17 while the map showing the future development conditions land use categories is provided on Figure A-18.

A.4.5 Curve Number Estimation – Smith Branch Watershed Study Area

Curve Numbers for the Smith Branch Study Area were estimated as described above. The results of the Curve Number estimation are provided in Table A-8. A map of the soil types is provided on Figure A-19. A map showing the existing conditions land use categories is provided on Figure A-20 while the map showing the future development conditions land use categories is provided on Figure A-21.

A.4.6 Curve Number Estimation – Middle Fork San Gabriel River Watershed Study Area

Curve Numbers for the Middle Fork San Gabriel River Study Area were estimated as described above. The results of the Curve Number estimation are provided in Table A-9. A map of the soil types is provided on Figure A-22. A map showing the existing conditions land use categories is provided on Figure A-23 while the map showing the future development conditions land use categories is provided on Figure A-24.

A.4.7 Curve Number Estimation – North Fork San Gabriel River Watershed Study Area

Curve Numbers for the North Fork San Gabriel River Study Area were estimated as described above. The results of the Curve Number estimation are provided in Table A-10. A map of the soil types is provided on Figure A-25. A map showing the existing conditions land use categories is provided on Figure A-26 while the map showing the future development conditions land use categories is provided on Figure A-27.

A.4.8 Curve Number Estimation – South Fork San Gabriel River Watershed Study Area

Curve Numbers for the South Fork San Gabriel River Study Area were estimated as described above. The results of the Curve Number estimation are provided in Table A-11. A map of the soil types is provided on Figure A-28. A map showing the existing conditions land use categories is provided on Figure A-29 while the map showing the future development conditions land use categories is provided on Figure A-30.

A.4.9 Curve Number Estimation – San Gabriel River Watershed Study Area

Curve Numbers for the San Gabriel River Study Area were estimated as described above. The results of the Curve Number estimation are provided in Table A-12. A map of the soil types is provided on Figure A-31. A map showing the existing conditions land use categories is provided on Figure A-32 while the map showing the future development conditions land use categories is provided on Figure A-33.

A.5.0 Lag Time Estimation

A.5.1 Method Overview

The lag time for each modeled watershed was calculated using the SCS method for calculating Unit Hydrograph lag time (T_{lag}) which is related to the time of concentration. The methodology for the lag time calculation is shown below:

$$T_{lag} = 0.6 * T_c$$

Time of concentration (T_c) is the time it takes for runoff to travel from the most hydraulically distant point in the watershed to the discharge point. This route is called the Flow Path.

The Flow Path was derived utilizing the most recent LiDAR topographic data available and ESRI's World Imagery for potential obstructions. A polyline in ArcView was drawn to connect this point to the watershed outlet, while following the path of decreasing elevation as water would flow.

T_c is a summation of travel time for three parameters, sheet flow, shallow concentrated flow, and channel flow.

Sheet flow is flow over land surface at very shallow depths, before flow concentrates into swales or channels. The equation for sheet flow is based upon Manning's kinematic solution and is provided below:

$$T_{Sheet} = \frac{0.007(n*L)^{0.8}}{(P_2)^{0.5}\, s^{0.4}} \quad \text{[Eq. 3-3 from TR-55 manual]}$$

where: T_{sheet} = sheet flow travel time (hr)
n = Manning's overland flow roughness coefficient
L = flow length (ft)
P_2 = 2-year, 24-hour rainfall depth in inches (this study used 3.4 inches based upon the City of Austin's Rainfall depth for a 2-year, 24-hour rainfall)
s = land slope (ft/ft)

After a maximum of approximately 300 feet, sheet flow usually turns to shallow concentrated flow. In this study, the maximum sheet flow lengths were assumed to be 200 feet in rural areas and 100 feet in urban areas. Based upon Appendix F of the TR-55 manual, the average velocity for shallow concentrated flow can be estimated as:

$V = 16.1345 * s^{0.5}$ for flow over unpaved surfaces
$V = 20.3282 * s^{0.5}$ for flow over paved surfaces

where: V = average velocity (ft/s)
s = land slope (ft/ft)

The shallow concentrate flow travel time is derived dividing the the flow distance by the average velocity.

$T_{shallow} = L/(3600*V)$ [Eq. 3-1 from TR-55 manual]

where: $T_{shallow}$ = shallow concentrated flow (hr)

L = flow length (ft)
V = average velocity (ft/s)

Channel flow begins where well-defined stream banks form. The study used available LiDAR topographic data and ESRI's World Imagery to determine where this occurs. Channel input parameters such as slope, depth, and bottom widths were estimated from LiDAR topographic data. The average velocity for channel flow developed from the Manning's equation is provided below:

$V = (1.49/n) * R_h^{2/3} * S_e^{1/2}$ [Eq. 3-4 from TR-55 manual]

where: V = average velocity (ft/s)
n = Manning's channel flow roughness coefficient
R_h = hydraulic radius of the channel (ft)
S_e = channel bottom slope (ft/ft)

The channel flow travel time is derived dividing the flow distance by the average velocity.

$T_{channel} = L/(3600*V)$ [Eq. 3-1 from TR-55 manual]

where: $T_{channel}$ = channel flow (hr)
L = flow length (ft)
V = average velocity (ft/s)

For future developed conditions, the exact flow routes and drainage specifics are unknown. A general assumption that subbasin lag times would be reduced by 20% was made to reflect the expected changes to the lag times due to increased development in the watershed.

A.5.2 Lag Time Estimation – Berry Creek Watershed Study Area

Lag times for the Berry Creek Study Area subbasins were estimated using the method described above and are summarized in Table A-13.

A.5.3 Lag Time Estimation – Mankins Branch Watershed Study Area

Lag times for the Mankins Branch Study Area subbasins were estimated using the method described above and are summarized in Table A-14.

A.5.4 Lag Time Estimation – Pecan Branch Watershed Study Area

Lag times for Pecan Branch Study Area subbasins were estimated using the method described above and are summarized in Table A-15.

A.5.5 Lag Time Estimation – Smith Branch Watershed Study Area

Lag times for Smith Branch Study Area subbasins were estimated using the method described above and are summarized in Table A-16.

A.5.6 Lag Time Estimation – Middle Fork San Gabriel River Watershed Study Area

Lag times for the Middle Fork San Gabriel Area subbasins were estimated using the method described above and are summarized in Table A-17.

A.5.7 Lag Time Estimation – North Fork San Gabriel River Watershed Study Area

Lag times for the North Fork San Gabriel Area subbasins were estimated using the method described above and are summarized in Table A-18.

A.5.8 Lag Time Estimation – South Fork San Gabriel River Watershed Study Area

Lag times for the South Fork San Gabriel Area subbasins were estimated using the method described above and are summarized in Table A-19.

A.5.9 Lag Time Estimation – San Gabriel River Watershed Study Area

Lag times for the San Gabriel Area subbasins downstream of the North/South Fork San Gabriel River confluence were estimated using the method described above and are summarized in Table A-20.

A.6.0 Hydrologic Routing

A.6.1 Method Overview

Hydrologic routing is a method used to describe the movement and change of a hydrograph as it travels downstream through a channel or reservoir. The peak flow will be attenuated in a channel from junction to junction (a reach). The study utilized two standard methods for hydrologic routing, Muskingum-Cunge and Modified Puls. The Muskingum-Cunge routing method calculates the reach storage based upon the channel's cross-section geometry, length of the channel, slope, and roughness coefficients. Modified Puls routing method is based upon reach storage-discharge functions to determine the peak flow attenuation for the reach.

Since the Muskingum-Cunge method does not require a known storage function, but rather channel characteristics, it is the method used for all reaches not within a studied stream. Available LiDAR topographic data was used to develop the cross-section geometry and calculate the slope. ESRI's World Imagery was utilized to estimate the channel roughness coefficients.

Modified Puls method was used for a more refined analysis of storage along studied streams. The storage-discharge rating curve for each reach within a studied stream section was developed from information extracted from HEC-RAS. Each reach may have multiple subreaches. The number of subreaches may also be used to calibrate the model. Increasing the number of subreaches reduces the peak flow attenuation in the reach. The formula for the number of subreaches is based upon the wave celerity in the channel and the simulation time step.

$$No._{subreaches} = \frac{L}{C*t}$$

where: $No._{subreaches}$ = number of subreaches
L = reach length
C = wave celerity
t = simulation time step

The simulation time step in the hydrologic model for this study was 1 minute (60 seconds). Wave celerity was calculated using the average channel velocity for the reach.

$$C = \frac{5 * V}{3}$$

where: C = wave celerity
V = average channel velocity for a reach

A.6.2 Hydrologic Routing – Berry Creek Watershed Study Area

Routing for the Berry Creek Study Area was estimated using the method described above with a few adjustments. The number of subreaches were reduced to 1 for the immediate reaches upstream of the Sun City detention pond for calibration as this will closely resemble routing through a reservoir or detention facility. Modified Puls routing inputs for the Berry Creek Study Area are provided in Table A-21 and Munkingum-Cunge routing inputs are provided in Table A-29.

A.6.3 Hydrologic Routing – Mankins Branch Watershed Study Area

Routing for the Mankins Branch Study Area was estimated using the method described above. Modified Puls routing inputs for the Mankins Branch Study Area are provided in Table A-22 and Munkingum-Cunge routing inputs are provided in Table A-30.

A.6.4 Hydrologic Routing – Pecan Branch Watershed Study Area

Routing for the Pecan Branch Study Area was estimated using the method described above. Modified Puls routing inputs for the Pecan Branch Study Area are provided in Table A-23 and Munkingum-Cunge routing inputs are provided in Table A-31.

A.6.5 Hydrologic Routing – Smith Branch Watershed Study Area

Routing for the Smith Branch Study Area was estimated using the method described above. Modified Puls routing inputs for the Smith Branch Study Area are provided in Table A-24 and Munkingum-Cunge routing inputs are provided in Table A-32.

A.6.6 Hydrologic Routing – Middle Fork San Gabriel River Watershed Study Area

Routing for the Middle Fork San Gabriel River Study Area was estimated using the method described above. Modified Puls routing inputs for the Middle Fork San Gabriel River Study Area are provided in Table A-25 and Munkingum-Cunge routing inputs are provided in Table A-33.

A.6.7 Hydrologic Routing – North Fork San Gabriel River Watershed Study Area

Routing for the North Fork San Gabriel River Study Area was estimated using the method described above. Modified Puls routing inputs for the North Fork San Gabriel River Study Area are provided in Table A-26 and Munkingum-Cunge routing inputs are provided in Table A-34.

A.6.8 Hydrologic Routing – South Fork San Gabriel River Watershed Study Area

Routing for the South Fork San Gabriel River Study Area was estimated using the method described above. Modified Puls routing inputs for the South Fork San Gabriel River Study Area are provided in Table A-27 and Munkingum-Cunge routing inputs are provided in Table A-35.

A.6.9 Hydrologic Routing –San Gabriel River Watershed Study Area

Routing for the San Gabriel River Study Area was estimated using the method described above. Modified Puls routing inputs for the San Gabriel River Study Area are provided in Table A-28 and Munkingum-Cunge routing inputs are provided in Table A-36.

A.7.0 Modeling of Significant Detention Structures

A.7.1 Method Overview

A stage-storage-discharge rating curve was developed for each significant detention structure. Rating curves consists of a stage elevation (ft) versus a corresponding reservoir storage (ac-ft) and a facility discharge (cfs). The rating curve is defined by the components of the dam, the storage basin, the embankment height, and the outflow structures.

A significant detention structure is defined as a regional detention facility or a large-scale storm water impoundment facility that has more than 10 acres in surface area.

A.7.2 Significant Detention Structures – Berry Creek Watershed Study Area

Sun City regional pond is a significant detention facility within the Berry Creek Study Area. It is an in-line pond that was modeled as a reach in the hydrologic model. The storage capacity of the pond was measured using the Modified Puls method as described in section A.6.

A.7.3 Significant Detention Structures – Mankins Branch Watershed Study Area

There are no existing significant detention facilities in the Mankins Branch Study Area.

A.7.4 Significant Detention Structures – Pecan Branch Watershed Study Area

There are no existing significant detention facilities in the Pecan Branch Study Area.

A.7.5 Significant Detention Structures – Smith Branch Watershed Study Area

There are no existing significant detention facilities in the Smith Branch Study Area.

A.7.6 Significant Detention Structures – Middle Fork San Gabriel River Watershed Study Area

There are no existing significant detention facilities in the Middle Fork San Gabriel River Study Area.

A.7.7 Significant Detention Structures – North Fork San Gabriel River Watershed Study Area

Lake Georgetown is a significant detention facility in the North Fork San Gabriel River Study Area. The US Army Corps of Engineers (Corp) regulates releases from the facility. The stage-storage-discharge rating curve is based upon information provided by the Corp.

A.7.8 Significant Detention Structures – South Fork San Gabriel River Watershed Study Area

There are no existing significant detention facilities in the South Fork San Gabriel River Study Area.

A.7.9 Significant Detention Structures –San Gabriel River Watershed Study Area

There are no existing significant detention facilities in the San Gabriel River Study Area.

A.8.0 Estimation of Rainfall

A.8.1 Method Overview

This study estimated design storm precipitation utilizing the "SCS Storm" method (available in HEC-HMS). The rainfall depth was derived using USGS SIR 2004-5041, *Atlas of Depth Duration Frequency of Precipitation Annual Maxima for Texas.* The rainfall totals are provided in Table A-37.

Areal reduction of design storm rainfall was applied to watersheds greater than 10 sq. mi. since the possibility the amount of rainfall for a specified storm event would cover the complete watershed area decreases as the areal extent of the rainfall increases. The study followed the area-depth reduction curve in Figure 15 from U.S. Department of Commerce's Technical Paper No. 40, 1961. The areal reduction factor was applied to the rainfall depth for each storm event and every increment of 10 square miles of drainage area in the watershed. A table based upon the area-depth curve is provided below:

Area (Sq. Mi.)	Areal Reduction Factor
0	100
10	98.7
20	97.6
30	96.6
40	95.7
50	95
60	94.6
70	94.2
80	93.9
90	93.6
100	93.24
125	92.7
150	92.3
200	91.9
250	91.6
300	91.4
350	91.1
400	91.1
>400	91.1

A.9.0 Assembly of Hydrologic Models

A.9.1 Method Overview

Hydrologic models were developed for each of the eight study areas. These basin models described watershed physiography utilizing the following elements:

- Subbasin characteristics
- Flow diversions
- Junctions
- Routing reachs; and
- Storage facilities

Two scenarios were developed for each study area, existing conditions and future developed conditions. The specific approaches and assumptions used to model the various elements can be found in the individual study area descriptions.

A.9.2 Hydrologic Model – Berry Creek Watershed Study Area

The Berry Creek Study Area HEC-HMS model consists of 55 subbasins, 34 reaches, and 52 junctions. The Berry Creek Study Area HEC-HMS model schematic is shown on Figure A-43. Additionally, Table A-38 provides a listing the model elements, existing conditions 100-year flow results, and the future developed conditions 100-year flow results.

A.9.3 Hydrologic Model – Mankins Branch Watershed Study Area

The Mankins Branch Study Area HEC-HMS model consists of 16 subbasins, 9 reaches, and 13 junctions. The Mankins Branch Study Area HEC-HMS model schematic is shown on Figure A-44. Additionally, Table A-39 provides a listing the model elements, existing conditions 100-year flow results, and the future developed conditions 100-year flow results.

A.9.4 Hydrologic Model – Pecan Branch Watershed Study Area

The Pecan Branch Study Area HEC-HMS model consists of 17 subbasins, 15 reaches, 18 junctions, and 2 diversions. The Pecan Branch Study Area HEC-HMS model schematic is shown on Figure A-45. Additionally, Table A-40 provides a listing the model elements, existing conditions 100-year flow results, and the future developed conditions 100-year flow results.

A.9.5 Hydrologic Model – Smith Branch Watershed Study Area

The Smith Branch Study Area HEC-HMS model consists of 23 subbasins, 18 reaches, and 23 junctions. The Smith Branch Study Area HEC-HMS model schematic is shown on Figure A-46. Additionally, Table A-41 provides a listing the model elements, existing conditions 100-year flow results, and the future developed conditions 100-year flow results.

A.9.6 Hydrologic Model – Middle Fork San Gabriel Watershed Study Area

The Middle Fork San Gabriel Study Area HEC-HMS model consists of 25 subbasins, 14 reaches, and 21 junctions. The Middle Fork San Gabriel Study Area HEC-HMS model schematic is shown on Figure A-47. Additionally, Table A-42 provides a listing the model elements, existing conditions 100-year flow results, and the future developed conditions 100-year flow results.

A.9.7 Hydrologic Model – North Fork San Gabriel Watershed Study Area

The North Fork San Gabriel Study Area HEC-HMS model consists of 62 subbasins, 45 reaches, and 56 junctions. The North Fork San Gabriel Study Area HEC-HMS model schematic is shown on Figure A-48. Additionally, Table A-43 provides a listing the model elements, existing conditions 100-year flow results, and the future developed conditions 100-year flow results.

A.9.8 Hydrologic Model – South Fork San Gabriel Watershed Study Area

The South Fork San Gabriel Study Area HEC-HMS model consists of 94 subbasins, 80 reaches, and 95 junctions. The South Fork San Gabriel Study Area HEC-HMS model schematic is shown on Figure A-49. Additionally, Table A-44 provides a listing the model elements, existing conditions 100-year flow results, and the future developed conditions 100-year flow results.

A.9.9 Hydrologic Model –San Gabriel Watershed Study Area

The San Gabriel Study Area HEC-HMS model consists of 340 subbasins, 149 reaches, and 294 junctions. The San Gabriel Study Area HEC-HMS model schematic is shown on Figure A-50. Additionally, Table A-45 provides a listing the model elements, existing conditions 100-year flow results, and the future developed conditions 100-year flow results.

A.10.0 Model Calibration

Hydrologic validations were conducted to simulate peak discharges and hydrograph trends. Calibration of model parameters used to estimate runoff volume and timing based upon a significant historic event can enhance model accuracy. The June 2007 and September 2010 (Hermine) storm events were utilized in model calibration. The calibration models confirmed the use of the AMC I.5 CN values as stated in Section A.4.

For the June 2007 and September 2010 storm events, Vieux & Associates, Inc. (Vieux) processed radar and rain gauge data for the study. Rainfall radar data from the National Weather Service was adjusted to local rainfall gauges within the vicinity of the study and with available rainfall information. Based upon this information, Vieux developed individual rainfall hyetographs for each subbasin for both the June 2007 and September 2010 storm events. Copy of the Vieux report is available upon request.

Hydrologic calibration models were developed utilizing the Vieux hyetographs. The calculated flows were compared with available USGS gage peak flow results for each storm event. Hydraulic calibration models were developed utilizing the calculated flows from the hydrologic calibration models. The peak water surface elevations were compared with reported flood elevations for each storm event.

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TABLES

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Table A-1 Data Sources Utilized in Hydrologic Analysis

Source	Used For
Burnet County 2011 LiDAR topography	Watershed Delineation Lag Time
CAPCOG 2006 LiDAR topography	Watershed Delineation Lag Time
City of Austin, 2017. City of Austin Drainage Criteria Manual	Precipitation
City of Georgetown 2015 LiDAR topography	Watershed Delineation Lag Time
City of Georgetown Future Land Use	Impervious Cover
City of Georgetown Zoning Profile	Impervious Cover
ESRI ArcView, Version 10.5 (2016)	Watershed Delineation Curve Number Lag Time
ESRI World Imagery	Watershed Delineation Curve Number Lag Time
US Army Corps of Engineers (USACE), 2015. Hydrologic Engineering Center's Hydraulic Modeling System (HEC-HMS), V. 4.1	HEC-HMS
USACE, March 2000. HEC-HMS Technical Reference Manual.	HEC-HMS
USDA Soil Conservation Service, Engineering Division, Technical Release 55 (TR-55), June 1986. Urban Hydrology for Small Watersheds	Curve Number Lag Time
USGS Rainfall Gage and Stream Flow data	HEC-HMS Calibration
U.S. Department of Agriculture (USDA) National Resource Conservation Commission (NRCS), 2004. Soil Survey Geographic Database (SSURGO) Soil Data for Burnet County, Texas	Curve Number
U.S. Department of Agriculture (USDA) National Resource Conservation Commission (NRCS), 2004. Soil Survey Geographic Database (SSURGO) Soil Data for Williamson County, Texas	Curve Number
Vieux and Associates, 2017. GARR dataset	HEC-HMS Calibration
Vieux and Associates, 2017. Radar Rainfall Analysis of San Gabriel, TX between June 26-28, 2007.	HEC-HMS Calibration
Vieux and Associates, 2017. Radar Rainfall Analysis of San Gabriel, TX between September 7-9, 2010.	HEC-HMS Calibration

Table A-2 Hydrologic Soil Groups in the Study Area

Soil Type	Soil Abbreviation	HSG
Aledo association, undulating	1	D
Altoga silty clay loam, 3 to 5 percent slopes, eroded	AgC2	B
Altoga silty clay loam, 5 to 8 percent slopes, eroded	AgD2	B
Anhalt clay, 0 to 1 percent slopes	2	D
Anhalt clay, 1 to 3 percent slopes	3	D
Austin-Whitewright complex, 1 to 5 percent slopes, eroded	AwC2	C
Austin silty clay, 0 to 1 percent slopes	AuA	C
Austin silty clay, 1 to 3 percent slopes	AuB	C
Bolar clay loam, 1 to 3 percent slopes	4	C
Bolar clay loam, 3 to 5 percent slopes	5	C
Brackett-Real association, hilly	7	D
Brackett-Rock outcrop complex, 1 to 12 percent slopes	BlD	D
Brackett-Rock outcrop complex, 16 to 30 percent slopes	BkG	D
Brackett association, undulating	6	D
Brackett clay loam, 1 to 5 percent slopes	BkC	D
Brackett gravelly clay loam, 3 to 16 percent slopes	BkE	D
Branyon clay, 0 to 1 percent slopes	BrA	D
Branyon clay, 1 to 3 percent slopes	BrB	D
Castephen silty clay, 1 to 3 percent slopes	CaB	D
Castephen silty clay, 3 to 5 percent slopes	CaC	D
Crawford clay, 0 to 1 percent slopes	CfA	D
Crawford clay, 1 to 3 percent slopes	CfB	D
Dams	DAM	D
Denton silty clay, 0 to 1 percent slopes	DnA	D
Denton silty clay, 1 to 3 percent slopes	DnB	D
Denton silty clay, 3 to 5 percent slopes	DnC	D
Doss silty clay, 1 to 5 percent slopes	DoC	D
Eckrant-Rock outcrop association, hilly	12	D
Eckrant-Rock outcrop complex, hilly	ErG	N/A
Eckrant-Rock outcrop complex, rolling	ErE	D
Eckrant association, undulating	11	D
Eckrant cobbly clay, 1 to 8 percent slopes	EaD	D
Eckrant extremely stony clay, 0 to 3 percent slopes	EeB	D
Eddy very gravelly clay loam, 0 to 3 percent slopes	EyB	D
Eddy very gravelly clay loam, 3 to 8 percent slopes	EyD	D
Fairlie clay, 0 to 1 percent slopes	FaA	D
Fairlie clay, 1 to 2 percent slopes	FaB	D
Ferris-Heiden complex, 5 to 20 percent slopes, severely eroded	FhE	D

Table A-2 Hydrologic Soil Groups in the Study Area (continued)

Soil Type	Soil Abbreviation	HSG
Georgetown clay loam, 0 to 2 percent slopes	GeB	D
Georgetown stony clay loam, 1 to 3 percent slopes	GsB	D
Heiden clay, 1 to 3 percent slopes	HeB	D
Heiden clay, 3 to 5 percent slopes, eroded	HeC2	D
Heiden clay, 5 to 8 percent slopes, eroded	HeD2	D
Heiden extremely stony clay, 3 to 12 percent slopes	HsE	D
Hensley association, undulating	17	D
Hensley loam, 1 to 3 percent slopes	15	D
Hensley loam, 3 to 5 percent slopes	16	D
Houston Black clay, 0 to 1 percent slopes	HuA	D
Houston Black clay, 1 to 3 percent slopes	HuB	D
Houston Black clay, 3 to 5 percent slopes, eroded	HuC2	D
Krum clay, 1 to 3 percent slopes	24	C
Krum clay, 3 to 5 percent slopes	25	C
Krum silty clay, 0 to 1 percent slopes	KsA	C
Krum silty clay, 1 to 3 percent slopes	KsB	C
Lewisville clay loam, 0 to 1 percent slopes	26	B
Lewisville clay loam, 1 to 3 percent slopes	27	B
Luckenbach clay loam, 1 to 3 percent slopes	29	C
Oakalla loam, occasionally flooded	31	B
Oakalla silty clay loam, occasionally flooded	Oa	B
Oakalla soils, channeled	Oc	B
Oakalla soils, frequently flooded	Of	B
Pedernales fine sandy loam, 1 to 3 percent slopes	35	C
Pedernales fine sandy loam, 3 to 5 percent slopes	36	C
Purves association, undulating	38	D
Purves gravelly clay, 1 to 3 percent slopes	37	D
Quarry	QU	N/A
Queeny clay loam, 1 to 5 percent slopes	QuC	D
Riverwash, frequently flooded	RW	A
Sunev silty clay loam, 0 to 1 percent slopes	SuA	B
Sunev silty clay loam, 1 to 3 percent slopes	SuB	B
Tarpley association, undulating	42	D
Tarpley clay, 1 to 3 percent slopes	41	D
Tarrant and Speck soils, 0 to 2 percent slopes	TcA	D
Tarrant soils, 5 to 18 percent slopes	TaD	D
Tinn clay, frequently flooded	Tn	D
Water	W	N/A
Whitewright silty clay loam, 1 to 5 percent slopes	WhC	D

Table A-3 Runoff Curve Numbers

Hydrologic Soil Group		A	B	C	D
Pasture, grassland, or range - continuous forage for grazing.	Fair	49	69	79	84
Row Crops - Contoured (C)	Good	65	75	82	86
Wood	Fair	36	60	73	79

Table A-4 Land Use Categories for Impervious Cover

Land Use Categories	
Agricultural / Rural Residential	ARR
Community Commercial	CC
Employment Center	EC
High Density Residential	HDR
Institutional	INST
Low Density Residential	LDR
Mining	M
Mixed Use Community	MUC
Mixed Use Neighborhood Center	MUNC
Moderate Density Residential	MDR
Parks, Recreation, Protected Open Space	OS
Pasture	P
Regional Commercial	RC
Right of Way	ROW
Row Crop	ROCR
Rural Residential	RR
Specialty Area Mixed Use	SMUA
Wood	W

Table A-5 CN Number Summary – Berry Creek

Watershed Name	Watershed Area (mi^2)	Weighted Curve Number	Existing Impervious Cover	Future Developed Impervious Cover
72	4.47	74	3.13%	11.57%
73	4.35	76	3.13%	11.56%
74	4.08	76	3.19%	11.59%
75	4.29	76	3.12%	11.56%
76	6.35	76	3.28%	11.64%
80	7.19	76	3.26%	11.71%
81	5.48	75	3.07%	11.51%
82	2.51	76	3.24%	11.62%
84	1.91	76	3.16%	11.58%
87	1.57	76	3.10%	11.55%
89	4.62	76	3.34%	11.67%
90	2.71	76	3.33%	11.66%
91	2.72	76	3.19%	11.60%
92	3.61	75	3.29%	11.64%
93	0.59	76	3.61%	11.81%
98	2.44	76	3.44%	13.40%
101	2.63	76	3.38%	11.69%
102	2.43	76	3.27%	17.42%
103	1.61	74	3.40%	11.74%
106	1.72	75	3.37%	28.91%
107	2.09	76	3.17%	19.81%
110	1.97	75	3.47%	13.68%
111	1.02	75	3.24%	14.50%
112	1.80	74	14.31%	41.80%
113	3.53	74	3.21%	29.37%
114	3.73	75	3.06%	12.05%
116	1.80	76	3.01%	21.25%
119	3.87	75	28.59%	35.64%
120	3.54	76	6.37%	29.21%
123	1.63	72	5.84%	33.36%
124	1.38	75	7.35%	22.72%
125	1.00	76	22.46%	44.97%
126	0.55	74	24.09%	30.51%
127	2.47	73	3.86%	17.67%
128	1.83	76	24.93%	44.09%

Table A-5 CN Number Summary – Berry Creek (continued)

Watershed Name	Watershed Area (mi^2)	Weighted Curve Number	Existing Impervious Cover	Future Developed Impervious Cover
129	5.08	75	25.69%	36.76%
130	0.67	69	5.29%	49.18%
131	0.89	73	8.10%	48.88%
133	1.29	69	4.22%	18.68%
134	1.80	73	3.09%	11.55%
135	1.71	75	19.35%	38.15%
136	3.18	73	3.00%	11.50%
138	0.40	67	3.71%	11.86%
142	1.35	71	3.49%	11.74%
149	0.44	67	22.51%	47.30%
154	0.41	68	3.97%	24.19%
159	0.23	71	12.14%	56.33%
164	0.50	73	4.78%	52.75%
179	0.20	67	11.12%	39.50%
184	0.90	75	18.98%	47.15%
189	0.49	75	19.66%	42.86%
190	1.07	74	3.68%	47.61%
195	0.77	76	3.00%	54.16%
204	3.57	75	3.09%	11.55%
212	1.00	75	30.04%	39.07%

Table A-6 CN Number Summary – Mankins Branch

Watershed Name	Watershed Area (mi^2)	Weighted Curve Number	Existing Impervious Cover	Future Developed Impervious Cover
34	0.13	61	3.93%	11.97%
39	0.82	72	30.24%	44.21%
40	0.68	73	6.18%	36.60%
41	0.64	69	12.08%	29.02%
42	1.05	73	9.97%	51.36%
43	0.87	71	3.48%	49.66%
49	1.17	71	3.09%	12.95%
50	1.08	70	5.45%	45.64%
52	1.51	69	3.17%	17.22%
53	0.74	72	3.54%	21.92%
54	0.29	72	3.19%	11.59%
55	0.56	71	3.24%	11.62%
56	0.78	72	3.00%	27.74%
57	0.56	75	5.13%	20.17%
60	0.90	73	3.10%	11.55%
66	1.45	74	5.69%	21.49%

Table A-7 CN Number Summary – Pecan Branch

Watershed Name	Watershed Area (mi^2)	Existing Conditions Weighted Curve Number	Existing Conditions Impervious Cover	Future Developed Weighted Curve Number	Future Developed Impervious Cover
01	0.42	73.61	24.76%	71.64	44.79%
02	0.46	74.2	23.44%	72.45	38.53%
03	0.46	75	21.18%	75.01	23.28%
04	0.46	75.79	18.83%	75.63	19.75%
05	0.39	74.26	24.12%	72.53	37.97%
06	0.76	70.96	42.65%	70.76	49.47%
07	0.27	75.25	9.21%	71.63	36.92%
08	0.28	72.25	34.34%	71.27	44.79%
09	0.68	73.24	24.32%	70.99	42.65%
10	0.33	73.07	22.57%	70.65	46.80%
11	0.56	72.67	22.10%	70.08	49.76%
12	0.48	72.28	19.95%	69.94	41.37%
13	0.38	69.44	16.05%	65.33	50.29%
14	0.28	73.13	16.59%	70.9	36.99%
15	0.35	71.68	6.95%	66.59	54.07%
16	0.26	71.13	16.68%	69.41	32.42%
17	0.52	68.69	3.71%	68.69	3.71%

Table A-8 CN Number Summary – Smith Branch

Watershed Name	Watershed Area (mi^2)	Existing Conditions Weighted Curve Number	Existing Conditions Impervious Cover	Future Developed Weighted Curve Number	Future Developed Impervious Cover
01	0.54	71.72	37.76%	70.65	52.36%
02	0.68	74.75	17.67%	70.96	56.87%
03	0.57	75.63	6.41%	70.31	57.41%
04	0.35	72.61	32.76%	71.13	53.67%
05	0.53	72.12	31.93%	69.86	57.03%
06	0.36	70.21	38.76%	69.3	50.18%
07	0.36	74.07	3.01%	68.71	54.61%
08	0.41	71.79	11.88%	67.75	46.41%
09	0.27	68.32	31.25%	66.59	50.91%
10	0.27	72.88	28.24%	72.37	36.22%
11	0.26	72.42	17.48%	69.03	39.97%
12	0.33	74.47	10.30%	70.85	45.88%
13	0.45	71.71	38.78%	71.57	43.08%
14	0.50	74.97	5.72%	71.12	46.24%
15	0.56	72.41	12.81%	68.61	50.82%
16	0.37	71.17	40.14%	71.17	44.36%
17	0.62	74.2	13.67%	71.13	42.73%
18	0.26	71.94	28.04%	71.39	32.83%
19	0.30	70.41	23.41%	69.85	28.89%
20	0.33	70.21	34.16%	69.22	47.12%
21	0.26	69.22	5.76%	65.15	30.56%
22	0.26	68.56	20.90%	65.94	38.89%
23	0.37	71.79	3.33%	65.22	45.83%

Table A-9 CN Number Summary – Middle Fork San Gabriel River

Watershed Name	Watershed Area (mi^2)	Weighted Curve Number	Existing Impervious Cover	Future Developed Impervious Cover
53	0.74	76	8.14%	14.07%
55	0.85	76	4.73%	13.10%
56	1.37	76	4.30%	12.15%
57	0.76	76	4.45%	14.55%
58	0.52	76	14.98%	19.20%
59	0.39	76	3.74%	11.87%
62	0.91	73	11.17%	34.85%
64	1.66	75	9.30%	18.30%
65	0.76	76	17.82%	20.57%
66	0.47	73	15.10%	26.91%
68	0.72	76	16.18%	23.51%
69	0.26	76	5.00%	48.13%
73	0.39	76	5.00%	52.75%
74	0.48	73	5.65%	38.18%
75	1.02	76	7.04%	13.52%
76	0.82	75	18.54%	22.20%
79	0.56	74	5.00%	48.10%
81	0.65	76	4.17%	12.09%
82	0.28	76	18.18%	37.99%
83	0.86	75	8.12%	16.00%
88	0.35	76	11.31%	19.16%
89	0.29	76	15.01%	33.54%
90	0.44	76	17.92%	23.67%
92	1.03	74	14.90%	38.39%
95	0.35	74	10.63%	44.62%

Table A-10 CN Number Summary – North Fork San Gabriel River

Watershed Name	Watershed Area (mi^2)	Weighted Curve Number	Existing Impervious Cover	Future Developed Impervious Cover
379	6.46	73	3.91%	11.95%
390	6.59	73	4.07%	12.04%
399	5.89	74	2.87%	11.43%
400	3.50	74	3.26%	11.63%
401	6.21	73	4.58%	12.29%
412	5.24	73	1.81%	10.90%
417	2.73	76	0.91%	10.45%
423	7.09	74	1.68%	10.84%
443	6.23	72	1.47%	10.73%
445	5.64	73	5.10%	12.55%
454	3.47	74	2.94%	11.47%
455	5.34	71	2.84%	11.42%
467	2.57	76	2.84%	11.42%
475	4.08	72	5.17%	12.58%
477	6.52	74	3.94%	11.97%
478	4.03	72	3.00%	11.50%
489	5.31	71	6.58%	13.29%
497	2.67	72	1.95%	10.97%
498	4.38	75	1.56%	10.78%
508	3.66	71	2.75%	11.38%
522	9.22	74	4.79%	12.40%
532	6.21	73	3.20%	11.60%
533	4.31	75	2.92%	11.46%
540	4.11	75	3.04%	11.52%
544	2.05	72	2.31%	11.16%
554	3.73	73	1.63%	10.82%
555	5.12	73	2.16%	11.08%
565	5.54	72	1.77%	10.89%
566	4.67	74	9.01%	14.50%
574	2.64	75	3.87%	11.94%
588	6.58	73	4.65%	12.88%
597	3.19	73	7.11%	13.56%
598	2.94	74	5.33%	12.66%
599	6.24	73	3.34%	11.67%
605	2.39	72	7.69%	13.84%
606	1.71	76	9.15%	14.57%
610	7.71	73	12.36%	19.71%

Table A-10 CN Number Summary – North Fork San Gabriel River (continued)

Watershed Name	Watershed Area (mi^2)	Weighted Curve Number	Existing Impervious Cover	Future Developed Impervious Cover
616	1.74	70	2.75%	11.37%
621	2.19	76	3.00%	11.50%
632	2.68	76	6.02%	13.01%
643	4.58	72	5.65%	12.82%
651	1.78	72	8.26%	14.13%
653	6.25	74	3.55%	11.80%
654	1.02	76	3.00%	11.49%
657	3.11	75	9.31%	13.78%
658	5.93	74	8.43%	14.22%
660	0.96	76	3.00%	11.50%
661	3.46	72	9.03%	14.41%
663	0.84	68	3.77%	11.88%
665	0.75	76	3.86%	11.93%
673	2.62	75	17.64%	18.82%
674	2.24	74	6.86%	13.43%
675	1.37	76	2.76%	10.60%
676	2.20	70	8.32%	14.16%
690	2.84	76	9.70%	15.39%
691	9.60	79	24.24%	25.46%
698	2.02	73	11.52%	15.76%
703	4.27	75	5.84%	12.72%
709	6.39	73	9.73%	12.81%
727	3.67	74	16.89%	19.32%
747	1.57	72	2.17%	7.43%
750	0.93	71	32.57%	35.30%

Table A-11 CN Number Summary – South Fork San Gabriel River

Watershed Name	Watershed Area (mi^2)	Existing Conditions Weighted Curve Number	Existing Conditions Impervious Cover	Future Developed Weighted Curve Number	Future Developed Impervious Cover
01	5.37	73.28	4.75%	73.83	12.48%
02	1.60	72.03	4.68%	72.79	12.66%
03	1.02	72.32	3.46%	73.22	11.73%
04	0.93	72.1	2.94%	73.12	11.47%
05	2.48	72.57	2.11%	73.69	11.06%
06	1.46	73.79	2.96%	74.16	11.48%
07	1.64	73.34	5.08%	73.87	12.54%
08	1.34	68.15	2.64%	69.83	11.32%
09	2.21	72.58	5.60%	72.96	13.53%
10	0.72	69.27	3.07%	69.27	11.54%
11	4.75	72.91	3.03%	73.57	11.52%
12	1.73	74.08	3.26%	74.14	11.63%
13	1.82	71.84	2.91%	71.88	11.45%
14	3.60	73.33	3.44%	73.71	11.76%
15	1.43	72.22	3.44%	72.39	11.72%
16	4.11	73.52	2.37%	74.35	11.27%
17	1.87	71.27	1.39%	73.23	10.70%
18	1.61	73.78	3.33%	74.18	11.66%
19	0.40	69.41	4.02%	69.42	12.01%
20	2.43	71.6	8.20%	72.17	16.25%
21	1.11	73.47	2.23%	74.46	11.22%
22	1.57	73.45	2.16%	73.85	11.08%
23	1.19	71.11	13.10%	71.41	20.22%
24	0.45	73.81	3.51%	73.81	11.75%
25	0.71	68.35	1.53%	68.35	12.52%
26	4.86	74.64	8.17%	74.79	14.66%
27	1.00	75.79	2.01%	75.79	11.01%
28	0.47	71.78	2.21%	71.78	11.10%
29	0.42	75.79	1.10%	75.79	10.55%
30	0.50	71.89	2.12%	71.89	11.06%
31	0.80	75.79	1.50%	75.79	10.91%
32	1.58	72.86	2.11%	72.56	11.63%
33	0.96	75.79	0.59%	75.79	10.56%
34	0.25	72.07	2.50%	70.65	12.03%
35	0.84	74.97	3.61%	75.51	12.37%

Table A-11 CN Number Summary – South Fork San Gabriel River (continued)

Watershed Name	Watershed Area (mi^2)	Existing Conditions Weighted Curve Number	Existing Conditions Impervious Cover	Future Developed Weighted Curve Number	Future Developed Impervious Cover
36	0.45	68.05	0.53%	67.9	10.43%
37	0.44	73.73	15.94%	73.9	21.33%
38	0.29	66.33	1.24%	68.34	10.62%
39	0.47	72.48	25.44%	72.71	30.32%
40	0.36	67.49	5.14%	68.5	12.57%
41	0.51	73.33	22.99%	73.33	28.56%
42	0.39	71.75	15.27%	71.75	18.08%
43	3.15	75.54	8.78%	75.68	15.27%
44	2.71	75.29	2.24%	75.37	11.12%
45	2.34	73.92	1.51%	74.72	10.75%
46	0.67	75.04	6.03%	74.94	13.41%
47	3.01	73.92	1.69%	74.8	10.84%
48	3.31	75.11	9.06%	75.15	14.82%
49	2.63	74.29	5.42%	75.02	12.71%
50	3.87	73.79	3.30%	74.09	11.67%
51	0.57	72.33	10.98%	72.33	17.33%
52	1.35	73.96	4.04%	74.24	12.06%
53	0.25	74.71	22.23%	74.71	23.26%
54	0.50	69.76	8.31%	69.76	15.74%
55	0.27	75.2	15.16%	75.2	19.98%
56	0.38	71.6	30.74%	71.6	36.30%
57	1.63	73.44	2.96%	73.44	11.48%
58	0.49	73.84	5.00%	73.84	12.69%
59	0.40	73.09	26.57%	73.09	32.01%
60	0.75	73.67	17.95%	73.67	23.21%
61	0.32	71.48	39.24%	71.48	45.06%
62	0.73	73.16	8.86%	73.16	15.78%
63	2.31	72.95	4.46%	72.91	12.91%
64	1.94	75.28	6.85%	75.54	13.43%
65	2.11	74.7	4.14%	75.25	12.07%
66	2.21	75	11.41%	75.16	15.90%
67	1.18	69.11	6.32%	70.21	13.20%
68	2.07	73.65	11.98%	74.17	16.90%
69	0.89	74.58	11.39%	74.64	19.03%
70	1.53	74.32	17.46%	74.3	25.75%

Table A-11 CN Number Summary – South Fork San Gabriel River (continued)

Watershed Name	Watershed Area (mi^2)	Existing Conditions Weighted Curve Number	Existing Conditions Impervious Cover	Future Developed Weighted Curve Number	Future Developed Impervious Cover
71	0.69	63.75	38.89%	64.15	44.56%
72	0.33	72.9	17.64%	73.38	23.72%
73	0.89	73.89	10.80%	74.22	19.32%
74	1.08	68.5	7.00%	68.43	17.80%
75	1.24	71.92	2.72%	73.22	11.57%
76	1.56	71.25	13.30%	71.98	20.64%
77	1.32	67.43	8.43%	68.27	16.46%
78	1.28	70.7	29.07%	70.97	35.72%
79	0.85	73.29	10.12%	73.75	15.14%
80	4.18	70.68	5.14%	70.68	17.30%
81	2.09	74.57	3.34%	74.78	13.45%
82	0.37	70.33	4.05%	70.91	18.08%
83	1.14	72.39	1.42%	75.23	17.02%
84	2.63	75.3	2.97%	74.12	19.63%
85	1.20	76.9	8.78%	74.65	23.63%
86	1.51	71.17	31.61%	70.29	45.77%
87	0.58	70.63	52.41%	70.41	58.47%
88	0.50	69.92	56.49%	69.67	63.10%
89	0.36	65.83	60.22%	65.57	66.18%
90	0.26	74.76	17.81%	72.3	47.42%
91	2.04	71.24	11.48%	71.66	19.09%
92	2.13	66.35	4.53%	68.92	13.58%
93	0.43	72.12	30.88%	72.12	35.67%
94	0.18	72	48.73%	71.4	59.00%

Table A-12 CN Number Summary – San Gabriel River

Watershed Name	Watershed Area (mi^2)	Weighted Curve Number	Existing Impervious Cover	Future Developed Impervious Cover
36	1.32	74	3.00%	11.50%
37	1.22	74	3.00%	11.50%
38	2.44	73	3.44%	11.72%
39	1.11	72	5.87%	12.93%
40	0.46	69	3.00%	11.50%
41	1.32	66	1.89%	7.25%
42	1.33	70	3.00%	11.48%
43	0.32	61	1.42%	5.45%
44	0.25	65	1.79%	6.87%
45	0.51	65	1.84%	7.04%
48	0.36	72	3.00%	11.50%
49	0.91	71	3.05%	11.50%
50	0.31	71	3.07%	11.56%
52	0.16	63	22.53%	25.45%
53	0.46	68	2.35%	8.98%
54	0.25	71	2.83%	10.85%
56	0.75	73	31.63%	35.14%
57	1.18	68	2.59%	9.30%
58	0.76	67	13.32%	19.12%
59	0.52	63	22.49%	23.88%
64	0.37	73	2.83%	10.56%
67	0.55	65	3.42%	11.71%
68	1.44	69	4.81%	12.41%

Table A-13 Lag Time Summary – Berry Creek

Watershed		SHEET				SHALLOW				CHANNEL			Total Lag Time		
	Length	Length	N-value	Slope	T	Length	Slope	Velocity	T	Length	Velocity	T	T_{lag}	Existing T_{lag}	Future T_{lag}
	(ft)	(ft)		(ft/ft)	(hr)	(ft)		(ft/s)	(hr)	(ft)	(ft/s)	(hr)	(hr)	(min)	(min)
72	17609	200	0.3	0.009	0.66	7621	0.009	1.52	1.39	9788	2.90	0.94	1.79	107.44	85.95
73	15812	200	0.3	0.011	0.61	4062	0.015	1.96	0.58	11550	2.24	1.43	1.57	94.38	75.51
74	20804	200	0.3	0.007	0.73	3887	0.013	1.84	0.59	16717	2.40	1.93	1.95	116.87	93.50
75	24837	200	0.3	0.011	0.61	4379	0.010	1.62	0.75	20258	3.72	1.51	1.73	103.66	82.93
76	27515	200	0.3	0.021	0.47	5955	0.015	1.96	0.85	21360	3.06	1.94	1.95	117.28	93.83
80	34857	200	0.3	0.009	0.67	1313	0.037	3.12	0.12	33344	4.61	0.81	1.69	101.17	80.93
81	22630	200	0.3	0.010	0.64	2303	0.013	1.83	0.35	20127	2.88	1.94	1.76	105.66	84.53
82	16875	200	0.3	0.016	0.52	5382	0.010	1.63	0.92	11293	2.77	1.13	1.54	92.63	74.11
84	13939	200	0.3	0.006	0.77	2949	0.028	2.68	0.31	10790	2.07	1.44	1.51	90.86	72.69
87	11582	200	0.3	0.016	0.52	2799	0.013	1.86	0.42	8583	3.93	0.61	0.93	55.66	44.52
89	25323	200	0.3	0.013	0.57	1105	0.024	2.48	0.12	24018	4.06	1.65	1.40	84.24	67.39
90	18221	200	0.3	0.034	0.39	5067	0.014	1.91	0.74	12954	3.00	1.20	1.39	83.67	66.93
91	18979	200	0.3	0.010	0.64	1665	0.038	3.16	0.15	17114	3.29	1.45	1.34	80.39	64.32
92	21899	200	0.3	0.029	0.41	7766	0.012	1.78	1.21	13933	4.83	0.31	1.49	89.50	71.60
93	8223	200	0.3	0.013	0.56	3392	0.020	2.26	0.42	4631	4.35	0.30	0.77	45.93	36.74
98	15271	200	0.3	0.017	0.51	2437	0.019	2.25	0.30	12634	2.98	1.18	1.19	71.69	57.35
101	19839	200	0.3	0.002	1.20	1387	0.034	2.96	0.13	18252	5.02	1.01	1.40	84.15	67.32
102	20411	200	0.3	0.012	0.60	2139	0.013	1.87	0.32	18072	3.27	1.53	1.47	88.18	70.54
103	15030	200	0.3	0.014	0.55	5369	0.016	2.04	0.73	9461	5.24	0.50	1.07	64.20	51.36
106	16030	200	0.3	0.015	0.54	6688	0.016	2.05	0.90	9142	3.24	0.78	1.34	80.28	64.22
107	15150	200	0.3	0.016	0.52	6478	0.014	1.91	0.94	8472	2.20	1.07	1.52	91.14	72.91
110	15328	200	0.3	0.010	0.63	9709	0.017	2.09	1.29	5419	4.21	0.36	1.37	82.03	65.63
111	10482	200	0.3	0.025	0.44	3352	0.002	0.69	1.34	6930	5.20	0.37	1.29	77.38	61.90
112	12291	200	0.3	0.025	0.44	1822	0.022	2.39	0.21	10269	3.40	0.84	0.90	53.95	43.16
113	19803	200	0.3	0.009	0.67	3836	0.016	2.02	0.53	15767	2.90	1.52	1.63	97.64	78.12
114	19797	200	0.3	0.010	0.64	4854	0.016	2.06	0.66	14743	2.10	1.95	1.95	116.95	93.56
116	12658	200	0.3	0.021	0.47	5731	0.009	1.54	1.03	6727	5.24	0.36	1.12	66.93	53.55
119	26970	200	0.3	0.018	0.51	5476	0.013	1.87	0.81	21294	6.80	0.93	1.35	80.91	64.73
120	15951	200	0.3	0.017	0.51	711	0.021	2.34	0.08	15040	3.61	1.17	1.06	63.35	50.68
123	20356	200	0.3	0.019	0.49	6915	0.010	1.65	1.16	13241	3.30	1.12	1.66	99.86	79.88
124	12521	200	0.3	0.021	0.47	2462	0.024	2.48	0.28	9859	2.21	1.24	1.19	71.66	57.33
125	9607	200	0.3	0.001	1.40	2338	0.016	2.02	0.32	7069	3.56	0.55	1.36	81.82	65.46
126	4759	100	0.2	0.007	0.31	3816	0.023	2.45	0.43	843	2.88	0.08	0.49	29.56	23.65
127	18841	200	0.3	0.014	0.56	4486	0.017	2.07	0.60	14155	3.13	1.26	1.45	87.12	69.70
128	11701	200	0.3	0.020	0.48	4112	0.014	1.92	0.59	7389	5.04	0.41	0.89	53.35	42.68

Table A-13 Lag Time Summary – Berry Creek (continued)

Watershed		SHEET				SHALLOW				CHANNEL			Total Lag Time		
	Length	Length	N-value	Slope	T	Length	Slope	Velocity	T	Length	Velocity	T	T_{lag}	Existing T_{lag}	Future T_{lag}
	(ft)	(ft)		(ft/ft)	(hr)	(ft)		(ft/s)	(hr)	(ft)	(ft/s)	(hr)	(hr)	(min)	(min)
129	30791	200	0.3	0.011	0.61	5707	0.015	1.98	0.80	24884	4.65	1.49	1.74	104.21	83.37
130	5305	200	0.3	0.020	0.48	4422	0.013	1.81	0.68	683	4.98	0.04	0.72	42.98	34.39
131	10309	200	0.3	0.029	0.41	5164	0.014	1.92	0.75	4945	3.87	0.35	0.91	54.49	43.59
133	11224	200	0.3	0.011	0.61	3339	0.017	2.08	0.45	7685	5.04	0.42	0.89	53.36	42.68
134	20791	200	0.3	0.013	0.57	9832	0.013	1.83	1.49	10759	2.54	1.18	1.94	116.45	93.16
135	16034	100	0.3	0.003	0.58	3989	0.024	2.12	0.53	11945	7.10	0.50	0.97	58.04	46.43
136	25430	200	0.3	0.027	0.42	4633	0.019	2.22	0.58	20597	4.63	1.23	1.34	80.58	64.46
138	6459	200	0.3	0.008	0.68	3338	0.012	1.73	0.54	2921	7.86	0.10	0.79	47.60	38.08
142	16887	200	0.3	0.023	0.45	3262	0.014	1.89	0.48	13425	3.42	1.27	1.32	79.45	63.56
149	10262	80	0.15	0.035	0.09	5537	0.015	1.98	0.90	4645	3.86	0.33	0.79	47.53	38.03
154	7875	200	0.3	0.025	0.44	4049	0.008	1.48	0.76	3626	2.75	0.37	0.94	56.36	45.09
159	5034	200	0.3	0.003	1.10	3334	0.014	1.94	0.48	1500	5.29	0.08	0.99	59.61	47.69
164	6442	200	0.3	0.021	0.47	5718	0.018	2.17	0.73	524	1.33	0.11	0.79	47.23	37.78
179	5698	200	0.3	0.014	0.56	429	0.017	2.14	0.06	5069	6.64	0.51	0.68	40.63	32.51
184	14212	200	0.3	0.033	0.39	9250	0.010	1.61	1.59	4762	11.57	0.11	1.26	75.56	60.45
189	9803	100	0.3	0.015	0.31	4125	0.018	2.17	0.53	5578	5.22	0.30	0.68	40.77	32.62
190	13144	200	0.3	0.008	0.69	4455	0.019	2.24	0.55	8489	3.73	0.63	1.13	67.51	54.01
195	10927	200	0.3	0.010	0.63	6741	0.013	1.85	1.01	3986	7.10	0.16	1.08	64.87	51.89
204	14458	200	0.3	0.014	0.55	1070	0.008	1.46	0.20	13188	2.80	1.31	1.24	74.35	59.48
212	9853	200	0.3	0.019	0.49	3731	0.016	2.07	0.50	5922	4.58	0.36	0.81	48.66	38.93

*For flowpaths with multiple segments per flow type (sheet, shallow concentrated, channel), average velocities were calculated.

Table A-14 Lag Time Summary – Mankins Branch

Watershed		SHEET				SHALLOW				CHANNEL			Total Lag Time		
	Length	Length	N-value	Slope	T	Length	Slope	Velocity	T	Length	Velocity	T	T_{lag}	Existing T_{lag}	Future T_{lag}
	(ft)	(ft)		(ft/ft)	(hr)	(ft)		(ft/s)	(hr)	(ft)	(ft/s)	(hr)	(hr)	(min)	(min)
34	4184	200	0.3	0.004	0.89	3704	0.016	2.02	0.51	280	4.71	0.02	0.85	50.99	40.80
39	9880	200	0.3	0.011	0.60	1282	0.007	1.36	0.26	8398	1.85	1.26	1.28	76.56	61.24
40	8070	200	0.3	0.051	0.33	450	0.013	1.89	0.07	7420	4.94	0.53	0.56	33.36	26.69
41	6047	200	0.3	0.035	0.38	779	0.025	2.55	0.08	5068	6.75	0.23	0.42	25.13	20.11
42	13662	200	0.3	0.020	0.48	3293	0.017	2.10	0.44	10169	2.57	1.11	1.22	72.95	58.36
43	12954	200	0.3	0.008	0.70	2045	0.011	1.69	0.34	10709	2.32	0.40	0.86	51.54	41.23
49	14916	200	0.3	0.007	0.73	2226	0.011	1.69	0.37	12490	3.21	1.36	1.47	88.41	70.73
50	12378	200	0.3	0.009	0.66	1427	0.023	2.47	0.16	10751	5.25	0.57	0.83	49.83	39.87
52	26119	200	0.3	0.009	0.65	10232	0.013	1.87	0.15	15687	6.49	0.89	1.02	60.91	48.73
53	10795	200	0.3	0.004	0.93	3093	0.019	2.21	0.39	7502	5.09	0.63	1.17	70.17	56.13
54	6369	200	0.3	0.027	0.43	2357	0.025	2.53	0.26	3812	5.17	0.20	0.53	32.10	25.68
55	8739	200	0.3	0.037	0.37	896	0.032	2.87	0.09	7643	4.52	0.47	0.56	33.65	26.92
56	9603	200	0.3	0.012	0.58	632	0.019	2.24	0.08	8771	2.33	1.10	1.06	63.50	50.80
57	7588	200	0.3	0.002	1.25	4565	0.019	2.23	0.57	2823	4.63	0.17	1.19	71.47	57.18
60	10017	200	0.3	0.035	0.38	2111	0.024	2.48	0.24	7706	2.98	0.72	0.80	48.17	38.53
66	10790	200	0.3	0.011	0.61	920	0.028	2.55	0.03	9670	2.72	1.05	1.01	60.82	48.66

Table A-15 Lag Time Summary – Pecan Branch

Watershed		SHEET				SHALLOW				CHANNEL			Total Lag Time		
	Length	Length	N-value	Slope	T	Length	Slope	Velocity	T	Length	Velocity	T	T_{lag}	Existing T_{lag}	Future T_{lag}
	(ft)	(ft)		(ft/ft)	(hr)	(ft)		(ft/s)	(hr)	(ft)	(ft/s)	(hr)	(hr)	(min)	(min)
01	6169	200	0.2	0.010	0.46	2699	0.011	1.7	0.44	3270.66	4.61	0.20	1.10	39.65	31.72
02	6365	100	0.02	0.012	0.04	143	0.011	2.2	0.02	6122.30	2.86	0.59	0.65	23.47	18.77
03	7362	200	0.2	0.014	0.40	3577	0.015	1.9	0.52	3585.12	3.54	0.28	1.20	43.36	34.69
04	7202	100	0.2	0.014	0.23	2160	0.018	2.2	0.28	4941.87	3.52	0.39	0.90	32.31	25.85
05	5712	100	0.02	0.010	0.04	3311	0.018	2.7	0.34	2300.71	3.96	0.16	0.54	19.56	15.65
06	9235	100	0.02	0.033	0.03	2983	0.014	2.4	0.35	6151.86	4.75	0.36	0.73	26.31	21.05
07	6411	100	0.02	0.017	0.03	2949	0.021	3.0	0.28	3361.31	3.98	0.23	0.55	19.64	15.71
08	5291	200	0.2	0.015	0.39	3474	0.008	1.4	0.69	1616.84	6.74	0.07	1.15	41.31	33.05
09	9903	200	0.2	0.009	0.47	3628	0.013	1.8	0.56	6075.63	3.21	0.53	1.56	56.03	44.82
10	5274	100	0.02	0.012	0.04	488	0.017	2.7	0.05	4685.89	5.47	0.24	0.33	11.76	9.41
11	5549	200	0.2	0.005	0.61	2489	0.006	1.2	0.60	2859.78	2.86	0.28	1.49	53.5	42.8
12	6651	200	0.2	0.017	0.37	725	0.013	1.8	0.11	5725.49	3.02	0.53	1.01	36.33	29.06
13	6289	200	0.2	0.008	0.50	3512	0.011	1.7	0.57	2577.80	4.15	0.17	1.24	44.77	35.82
14	4904	200	0.2	0.037	0.27	1652	0.023	2.4	0.19	3051.88	3.55	0.24	0.70	25.15	20.12
15	11550	200	0.2	0.016	0.38	1698	0.009	1.5	0.31	9651.24	5.35	0.50	1.19	42.95	34.36
16	5756	200	0.2	0.005	0.61	1689	0.026	2.6	0.18	3867.07	3.97	0.27	1.06	38.06	30.45
17	13466	200	0.2	0.020	0.34	2119	0.022	2.4	0.25	11147.05	4.63	0.67	1.26	45.23	36.19

*For flowpaths with multiple segments per flow type (sheet, shallow concentrated, channel), average velocities were calculated.

Table A-16 Lag Time Summary – Smith Branch

Watershed		SHEET				SHALLOW				CHANNEL			Total Lag Time		
	Length	Length	N-value	Slope	T	Length	Slope	Velocity	T	Length	Velocity	T	T_{lag}	Existing T_{lag}	Future T_{lag}
	(ft)	(ft)		(ft/ft)	(hr)	(ft)		(ft/s)	(hr)	(ft)	(ft/s)	(hr)	(hr)	(min)	(min)
01	7705	200	0.2	0.011	0.44	3978	0.016	2.1	0.54	3527	6.92	0.14	1.12	40.18	32.1
02	9230	200	0.2	0.021	0.34	6761	0.010	1.6	1.17	2269	17.00	0.04	1.55	55.82	44.7
03	10966	200	0.2	0.031	0.29	3108	0.034	3.0	0.29	7658	2.13	1.00	1.58	56.76	45.4
04	6159	200	0.2	0.013	0.41	4352	0.011	1.7	0.71	1607	2.46	0.18	1.30	46.92	37.5
05	12120	100	0.2	0.019	0.20	531	0.014	1.9	0.08	11488	5.02	0.64	0.92	33.05	26.4
06	6391	200	0.2	0.023	0.33	2033	0.048	3.6	0.16	4157	1.52	0.76	1.25	44.87	35.9
07	5644	200	0.2	0.019	0.35	258	0.047	3.6	0.02	5186	3.72	0.39	0.76	27.22	21.8
08	7966	200	0.2	0.036	0.27	1506	0.034	3.0	0.14	6260	6.65	0.26	0.67	24.22	19.4
09	6058	200	0.2	0.008	0.49	733	0.036	3.1	0.07	5125	4.78	0.30	0.86	30.89	24.7
10	3780	200	0.2	0.006	0.56	2255	0.014	1.9	0.33	1325	4.27	0.09	0.98	35.12	28.1
11	3909	200	0.2	0.016	0.37	3662	0.011	1.7	0.60	47	29.47	0.00	0.97	35.04	28
12	6484	200	0.2	0.020	0.35	1508	0.051	3.6	0.12	4776	4.88	0.27	0.73	26.43	21.1
13	5468	53.95	0.2	0.023	0.11	659	0.003	1.0	0.18	4755	3.02	0.44	0.73	26.44	21.2
14	7307	200	0.2	0.012	0.42	1947	0.039	3.2	0.17	5160	7.72	0.19	0.77	27.84	22.3
15	8898	200	0.2	0.014	0.40	4397	0.020	2.3	0.53	4300	7.48	0.16	1.09	39.19	31.4
16	8182	82.97	0.2	0.010	0.22	2686	0.008	1.2	0.62	5413	5.81	0.26	1.10	39.71	31.8
17	6477	200	0.2	0.019	0.35	2627	0.028	2.7	0.27	3650	3.97	0.26	0.88	31.58	25.3
18	7010	100	0.02	0.014	0.04	1488	0.016	2.6	0.16	5422	5.77	0.26	0.46	16.42	13.1
19	4887	100	0.02	0.022	0.03	1953	0.034	3.8	0.14	2834	6.59	0.12	0.29	10.53	8.4
20	4798	200	0.2	0.013	0.41	1832	0.022	2.4	0.21	2767	9.36	0.08	0.70	25.3	20.2
21	6213	200	0.2	0.026	0.31	1777	0.013	1.8	0.27	4236	7.25	0.16	0.75	26.93	21.5
22	8110	100	0.02	0.020	0.03	2235	0.009	1.95	0.32	5775	6.85	0.23	0.58	21.03	16.8
23	8140	200	0.2	0.061	0.22	4461	0.023	2.45	0.51	3479	6.55	0.15	0.87	31.46	25.2

*For flowpaths with multiple segments per flow type (sheet, shallow concentrated, channel), average velocities were calculated.

Table A-17 Lag Time Summary – Middle Fork San Gabriel River

Watershed		SHEET				SHALLOW				CHANNEL			Total Lag Time		
	Length	Length	N-value	Slope	T	Length	Slope	Velocity	T	Length	Velocity	T	T_{lag}	Existing T_{lag}	Future T_{lag}
	(ft)	(ft)		(ft/ft)	(hr)	(ft)		(ft/s)	(hr)	(ft)	(ft/s)	(hr)	(hr)	(min)	(min)
53	6345	200	0.3	0.005	0.82	4064	0.013	1.85	0.61	2081	3.19	0.18	0.97	58.00	46.40
55	9702	200	0.3	0.011	0.61	2500	0.038	3.13	0.22	7002	1.97	0.99	1.09	65.47	52.38
56	15716	200	0.3	0.002	1.18	3335	0.010	1.63	0.57	12181	3.40	1.05	1.67	100.45	80.36
57	12018	200	0.3	0.015	0.54	4339	0.021	2.34	0.51	7479	2.23	0.98	1.22	73.22	58.57
58	6332	200	0.3	0.035	0.38	850	0.060	3.94	0.06	5282	3.51	0.42	0.52	30.97	24.78
59	8075	200	0.3	0.017	0.51	3512	0.013	1.83	0.53	4363	1.59	0.76	1.08	65.02	52.01
62	10661	200	0.3	0.012	0.34	811	0.040	3.22	0.07	9650	4.24	0.63	0.63	37.64	30.12
64	13428	200	0.3	0.013	0.57	709	0.010	1.61	0.12	12519	3.15	1.17	1.12	67.18	53.74
65	8924	200	0.3	0.008	0.71	1522	0.029	2.73	0.15	7202	4.41	0.45	0.79	47.40	37.92
66	8907	200	0.3	0.003	1.03	2940	0.036	3.05	0.27	5767	2.74	0.65	1.17	70.29	56.23
68	9742	200	0.3	0.010	0.63	3717	0.030	2.82	0.37	5825	1.24	1.31	1.38	83.07	66.46
69	4513	200	0.3	0.002	1.30	3991	0.034	2.96	0.37	322	3.41	0.03	1.02	61.05	48.84
73	6939	200	0.3	0.028	0.42	1044	0.032	2.86	0.10	5695	3.72	0.44	0.57	34.42	27.53
74	5469	200	0.3	0.028	0.42	1283	0.039	3.17	0.11	3986	1.45	2.58	1.87	111.98	89.59
75	19274	200	0.3	0.003	1.01	6652	0.008	1.46	1.27	12422	2.53	1.40	2.20	132.28	105.82
76	11161	200	0.3	0.008	0.70	2943	0.031	2.77	0.32	8018	2.48	1.30	1.39	83.37	66.69
79	5761	200	0.3	0.039	0.37	513	0.049	3.58	0.04	5048	2.60	1.85	1.35	81.15	64.92
81	7373	200	0.3	0.001	1.36	5207	0.010	1.65	0.88	1966	2.16	0.25	1.50	89.72	71.78
82	5374	200	0.3	0.060	0.31	1840	0.024	2.51	0.20	3334	5.03	0.18	0.42	25.11	20.09
83	13322	200	0.3	0.004	0.94	1392	0.005	1.18	0.33	11730	2.63	1.24	1.50	90.01	72.01
88	5788	200	0.3	0.010	0.63	1979	0.008	1.44	0.38	3609	6.53	1.07	0.71	42.42	33.94
89	5516	200	0.3	0.006	0.80	643	0.014	1.91	0.09	4673	9.05	0.36	0.62	37.32	29.86
90	7396	200	0.3	0.018	0.50	4738	0.010	1.62	0.81	2458	3.38	0.20	0.91	54.64	43.71
92	9126	200	0.3	0.012	0.58	1548	0.025	2.54	0.17	7378	3.32	0.62	0.82	49.40	39.52
95	6047	200	0.3	0.016	0.53	758	0.040	3.21	0.07	5089	3.85	0.37	0.58	34.61	27.68

Table A-18 Lag Time Summary – North Fork San Gabriel River

Watershed		SHEET				SHALLOW				CHANNEL			Total Lag Time		
	Length	Length	N-value	Slope	T	Length	Slope	Velocity	T	Length	Velocity	T	T_{lag}	Existing T_{lag}	Future T_{lag}
	(ft)	(ft)		(ft/ft)	(hr)	(ft)		(ft/s)	(hr)	(ft)	(ft/s)	(hr)	(hr)	(min)	(min)
379	33574	200	0.3	0.017	0.51	2378	0.020	2.28	0.29	30996	2.88	2.99	2.28	136.55	109.24
390	35693	200	0.3	0.010	0.63	2956	0.015	2.01	0.41	32537	4.43	2.04	1.85	110.79	88.63
399	26625	200	0.3	0.007	0.75	5038	0.010	1.63	0.86	21387	2.76	2.15	2.26	135.56	108.45
400	27499	200	0.3	0.020	0.48	7556	0.008	1.48	1.42	19743	4.39	1.25	1.89	113.19	90.55
401	33255	200	0.3	0.018	0.50	3109	0.018	2.16	0.40	29946	3.15	2.64	2.12	127.41	101.92
412	31215	200	0.3	0.009	0.66	5347	0.014	1.90	0.78	25668	3.01	2.38	2.29	137.54	110.03
417	23837	200	0.3	0.004	0.91	1113	0.013	1.85	0.17	22524	4.77	1.31	1.43	85.87	68.70
423	35636	200	0.3	0.002	1.24	7900	0.009	1.49	1.47	27536	3.50	2.19	2.94	176.48	141.19
443	23945	200	0.3	0.001	1.39	2638	0.021	2.33	0.31	21107	5.64	1.22	1.75	105.17	84.14
445	24613	200	0.3	0.011	0.61	2719	0.018	2.15	0.35	21694	2.66	2.37	2.00	119.99	95.99
454	14418	200	0.3	0.017	0.51	2264	0.020	2.27	0.28	11954	5.04	0.66	0.87	51.97	41.58
455	32113	200	0.3	0.006	0.77	2197	0.019	2.25	0.27	29716	4.56	1.82	1.71	102.90	82.32
467	20631	200	0.3	0.015	0.54	1912	0.016	2.04	0.26	18519	2.75	1.87	1.61	96.40	77.12
475	34200	200	0.3	0.006	0.80	4485	0.009	1.51	0.82	29515	3.97	2.15	2.26	135.88	108.70
477	28673	200	0.3	0.007	0.73	3629	0.015	2.00	0.50	24844	2.62	2.64	2.32	139.38	111.50
478	26395	200	0.3	0.016	0.52	3581	0.015	2.00	0.50	22614	3.05	2.07	1.86	111.41	89.13
489	27152	200	0.3	0.028	0.42	3024	0.020	2.27	0.37	23928	3.51	2.07	1.72	103.04	82.44
497	18489	200	0.3	0.011	0.60	4315	0.016	2.05	0.58	13974	3.18	1.22	1.44	86.57	69.26
498	20293	200	0.3	0.006	0.76	1375	0.021	2.35	0.16	18718	2.89	1.80	1.63	98.01	78.41
508	29176	200	0.3	0.012	0.59	1816	0.028	2.68	0.19	27160	4.31	1.94	1.63	97.93	78.34
522	31695	200	0.3	0.002	1.17	1816	0.033	2.95	0.17	29679	3.58	2.30	2.19	131.29	105.03
532	28917	200	0.3	0.010	0.64	4491	0.024	2.51	0.50	24226	3.20	2.10	1.94	116.62	93.30
533	31995	200	0.3	0.011	0.61	8276	0.009	1.54	1.49	23519	4.98	1.31	2.05	122.86	98.29
540	25732	200	0.3	0.005	0.83	6725	0.015	2.00	0.94	18807	2.45	2.13	2.34	140.41	112.33
544	19664	200	0.3	0.005	0.83	4755	0.011	1.72	0.77	14709	5.31	0.77	0.93	55.54	44.43
554	28237	200	0.3	0.014	0.55	3100	0.011	1.71	0.50	24937	4.20	1.65	1.62	97.37	77.89
555	28624	200	0.3	0.022	0.46	3284	0.020	2.26	0.40	25140	5.88	1.19	1.23	73.82	59.05
565	29758	200	0.3	0.017	0.51	1348	0.033	2.93	0.13	28210	5.61	1.40	1.22	73.46	58.77
566	23181	200	0.3	0.008	0.70	2412	0.023	2.43	0.28	20569	5.43	1.05	1.22	73.05	58.44
574	26715	200	0.3	0.009	0.65	5459	0.015	1.98	0.77	21056	3.61	1.62	1.82	109.35	87.48
588	30561	200	0.3	0.011	0.62	6641	0.011	1.71	1.08	23720	3.97	1.66	2.02	121.13	96.91
597	23140	200	0.3	0.031	0.40	2707	0.026	2.60	0.29	20233	4.17	1.35	1.23	73.53	58.82
598	23385	200	0.2	0.016	0.52	2802	0.013	1.81	0.43	20383	4.13	1.37	1.39	83.61	66.89
599	27968	200	0.3	0.021	0.47	2659	0.018	2.16	0.34	25109	4.56	1.53	1.41	84.44	67.56
605	22191	200	0.3	0.013	0.56	5178	0.022	2.39	0.60	16813	4.20	1.21	1.42	85.45	68.36

Table A-18 Lag Time Summary – North Fork San Gabriel River (continued)

Watershed		SHEET				SHALLOW				CHANNEL			Total Lag Time		
	Length	Length	N-value	Slope	T	Length	Slope	Velocity	T	Length	Velocity	T	T_{lag}	Existing T_{lag}	Future T_{lag}
	(ft)	(ft)		(ft/ft)	(hr)	(ft)		(ft/s)	(hr)	(ft)	(ft/s)	(hr)	(hr)	(min)	(min)
606	20221	200	0.3	0.010	0.65	5117	0.014	1.90	0.75	14904	3.58	1.23	1.57	94.40	75.52
610	27326	200	0.3	0.013	0.56	2375	0.013	1.84	0.36	24751	3.33	2.08	1.80	107.96	86.37
616	15856	200	0.3	0.019	0.49	2600	0.067	4.19	0.17	13056	3.87	0.96	0.97	58.49	46.79
621	16315	200	0.3	0.029	0.42	4136	0.016	2.06	0.56	11979	2.64	1.26	1.34	80.43	64.34
632	19374	200	0.3	0.013	0.57	2849	0.020	2.27	0.35	16325	4.55	1.00	1.15	68.84	55.07
643	24538	200	0.3	0.010	0.64	7173	0.014	1.89	1.05	17165	4.74	1.03	1.63	97.98	78.38
651	20415	200	0.3	0.911	0.60	2548	0.017	2.08	0.34	17667	3.41	1.47	1.45	86.77	69.41
653	28561	200	0.3	0.003	0.98	2668	0.013	1.86	0.40	25693	4.62	1.57	1.77	106.39	85.11
654	15575	200	0.3	0.007	0.72	3474	0.010	1.60	0.60	11901	5.31	0.65	1.18	71.08	56.86
657	27756	200	0.3	0.011	0.60	2016	0.028	2.72	0.21	25540	4.21	1.76	1.54	92.38	73.90
658	32995	200	0.3	0.002	1.14	3803	0.010	1.65	0.64	28992	4.76	1.69	2.09	125.13	100.10
660	11981	200	0.3	0.006	0.80	3057	0.011	1.65	0.51	8724	3.79	0.64	1.17	70.49	56.39
661	31434	200	0.3	0.011	0.61	3234	0.014	2.42	0.37	28000	4.92	1.64	1.58	94.63	75.71
663	10784	200	0.3	0.036	0.38	3177	0.021	2.34	0.38	7407	5.33	0.39	0.69	41.29	33.03
665	13150	200	0.3	0.014	0.55	1923	0.020	2.30	0.23	11027	5.17	0.59	0.82	49.48	39.58
673	20697	200	0.3	0.008	0.69	1632	0.020	2.29	0.20	18865	4.19	1.25	1.28	77.06	61.65
674	18119	200	0.3	0.005	0.83	2039	0.025	2.56	0.22	15880	4.24	1.04	1.25	75.27	60.22
675	14734	200	0.3	0.026	0.43	1660	0.025	2.54	0.18	12874	3.73	0.99	0.96	57.84	46.28
676	15420	200	0.3	0.018	0.50	3411	0.022	2.42	0.39	11809	4.18	0.90	1.08	64.61	51.68
690	22453	200	0.3	0.006	0.76	1930	0.019	2.23	0.24	20323	5.91	0.96	1.18	70.59	56.47
691	27288	200	0.3	0.011	0.62	2336	0.026	3.27	0.20	24752	7.03	1.01	1.10	65.83	52.66
698	15249	200	0.3	0.008	0.70	2967	0.036	3.04	0.27	12082	4.16	0.86	1.10	65.94	52.75
703	22033	200	0.3	0.026	0.43	5388	0.012	1.74	0.86	16445	4.13	1.16	1.47	88.01	70.41
709	26197	200	0.3	0.030	0.41	7814	0.032	1.58	1.78	18183	3.92	1.71	2.34	140.46	112.37
727	22596	200	0.3	0.006	0.80	4200	0.023	2.43	0.48	18196	3.89	1.42	1.62	97.21	77.77
747	11675	200	0.3	0.008	0.69	1039	0.032	2.90	0.10	10436	4.59	0.82	0.97	57.96	46.37
750	5429	200	0.3	0.018	0.50	746	0.013	1.78	0.12	4483	6.63	0.41	0.62	37.04	29.63

Table A-19 Lag Time Summary – South Fork San Gabriel River

Watershed		SHEET				SHALLOW				CHANNEL			Total Lag Time		
	Length	Length	N-value	Slope	T	Length	Slope	Velocity	T	Length	Velocity	T	T_{lag}	Existing T_{lag}	Future T_{lag}
	(ft)	(ft)		(ft/ft)	(hr)	(ft)		(ft/s)	(hr)	(ft)	(ft/s)	(hr)	(hr)	(min)	(min)
01	25841	200	0.41	0.43	68.47	2405	2.06	2.32	17.25	23236	3.88	99.76	3.09	111.3	89
02	23458	200	0.41	0.67	57.26	3739	2.07	2.33	26.73	19519	3.49	93.19	2.95	106.3	85
03	14858	200	0.24	1.47	27.28	368	2.57	2.60	2.36	14290	2.70	88.24	1.96	70.7	56.6
04	11526	200	0.41	1.52	41.30	999	3.51	3.04	5.49	10327	2.39	72.05	1.98	71.3	57
05	17489	200	0.41	1.33	43.52	2505	1.50	1.99	21.02	14784	4.31	57.15	2.03	73	58.4
06	14152	200	0.41	1.21	45.24	2123	2.64	2.63	13.44	11829	5.99	32.93	1.53	55	44
07	19170	200	0.24	1.18	29.79	1879	1.97	2.27	13.77	17091	4.53	62.89	1.77	63.9	51.1
08	13342	200	0.24	0.47	42.98	4215	1.57	2.03	34.65	8927	3.97	37.46	1.92	69.1	55.2
09	17953	200	0.41	0.90	50.93	1279	2.13	2.36	9.03	16474	4.12	66.70	2.11	76	60.8
10	8895	200	0.24	1.81	25.06	1645	1.23	1.80	15.26	7051	6.01	19.57	1.00	35.9	28.7
11	22343	200	0.24	1.42	27.64	1695	2.27	2.44	11.56	20449	4.20	81.09	2.01	72.2	57.7
12	16944	200	0.41	1.76	38.92	3362	3.03	2.82	19.88	13383	3.54	63.06	2.03	73.1	58.5
13	14486	200	0.24	1.64	26.10	1203	1.69	2.10	9.53	13083	3.97	54.87	1.51	54.3	43.4
14	22920	200	0.41	1.26	44.51	5608	1.30	1.85	50.52	17111	6.70	42.58	2.29	82.6	66.1
15	13574	200	0.24	1.82	25.05	919	3.59	3.07	4.99	12455	6.10	34.05	1.07	38.5	30.8
16	20527	200	0.24	0.96	32.35	3747	1.83	2.19	28.53	16580	6.41	43.09	1.73	62.4	49.9
17	17347	200	0.41	0.50	64.59	4127	1.50	1.99	34.65	13020	7.68	28.26	2.12	76.5	61.2
18	13962	200	0.41	0.83	52.61	1403	2.73	2.67	8.74	12359	4.18	49.24	1.84	66.4	53.1
19	4908	200	0.41	0.75	54.83	906	5.06	3.64	4.15	3802	6.88	9.22	1.14	40.9	32.7
20	27191	100	0.24	0.60	22.43	229	1.06	2.12	1.80	26862	3.29	135.90	2.67	96.1	76.9
21	11012	200	0.41	1.55	41.02	1102	1.87	2.22	8.28	9710	4.98	32.51	1.36	49.1	39.3
22	13444	200	0.24	0.98	32.02	2793	1.76	2.15	21.67	10452	3.13	55.68	1.82	65.6	52.5
23	11871	200	0.41	0.97	49.45	2309	1.75	2.14	17.98	9362	4.85	32.16	1.66	59.8	47.8
24	5717	200	0.41	1.82	38.44	779	3.82	3.16	4.10	4738	3.31	23.83	1.11	39.8	31.9
25	10998	200	0.41	2.29	35.07	2598	2.14	2.37	18.28	8200	5.87	23.29	1.28	46	36.8
26	25662	200	0.41	2.99	31.48	4158	1.97	2.27	30.46	21305	4.54	78.13	2.33	84	67.2
27	9135	200	0.41	2.29	35.04	1072	1.55	2.02	8.84	7863	3.35	39.13	1.38	49.8	39.8
28	6190	200	0.24	1.21	29.43	2484	2.57	2.60	15.93	3505	3.72	15.72	1.02	36.6	29.3
29	6164	200	0.24	1.26	29.03	3021	1.74	2.14	23.53	2943	4.37	11.22	1.06	38.3	30.6
30	6787	200	0.24	5.00	16.70	307	1.75	2.14	2.39	6280	4.91	21.30	0.67	24.2	19.4
31	9134	200	0.41	0.51	63.98	1215	2.15	2.38	8.52	7719	4.17	30.84	1.72	62	49.6
32	13291	200	0.41	1.93	37.55	1367	3.85	3.18	7.17	11725	5.56	35.15	1.33	47.9	38.3
33	9237	200	0.41	0.29	79.66	1476	1.75	2.15	11.46	7561	2.78	45.34	2.27	81.9	65.5
34	7295	200	0.41	2.21	35.52	391	2.40	2.51	2.60	6704	3.54	31.54	1.16	41.8	33.4
35	8292	200	0.24	1.65	26.05	1307	1.11	1.71	12.77	6785	3.79	29.81	1.14	41.2	32.9
36	6622	200	0.24	3.46	19.35	1253	2.35	2.49	8.40	5169	4.55	18.95	0.78	28	22.4

Table A-19 Lag Time Summary – South Fork San Gabriel River (continued)

Watershed		SHEET				SHALLOW				CHANNEL			Total Lag Time		
	Length	Length	N-value	Slope	T	Length	Slope	Velocity	T	Length	Velocity	T	T_{lag}	Existing T_{lag}	Future T_{lag}
	(ft)	(ft)		(ft/ft)	(hr)	(ft)		(ft/s)	(hr)	(ft)	(ft/s)	(hr)	(hr)	(min)	(min)
37	6882	200	0.41	1.43	42.34	1307	1.16	1.74	12.49	5375	6.97	12.85	1.13	40.6	32.5
38	3848	200	0.24	2.43	22.31	236	3.76	3.14	1.25	3412	5.89	9.66	0.55	19.9	15.9
39	7666	200	0.41	1.13	46.51	1221	1.22	1.79	11.40	6245	3.09	33.73	1.53	55	44
40	4112	200	0.24	1.80	25.12	371	2.32	2.47	2.51	3541	6.34	9.31	0.62	22.2	17.7
41	5688	200	0.41	0.26	83.90	1091	2.12	2.36	7.70	4397	3.70	19.82	1.86	66.9	53.5
42	4824	200	0.24	0.97	32.14	1467	1.14	2.20	11.12	3157	4.83	10.89	0.90	32.5	26
43	29898	200	0.41	1.01	48.58	3917	0.98	1.60	40.73	25781	3.90	110.15	3.32	119.7	95.7
44	19531	200	0.41	1.59	40.55	3152	2.58	2.60	20.17	16179	4.39	61.38	2.04	73.3	58.6
45	16885	200	0.41	1.23	45.00	2187	3.01	2.81	12.97	14498	4.12	58.71	1.94	70	56
46	8740	200	0.41	1.21	45.21	1435	1.36	1.89	12.68	7106	5.30	22.34	1.34	48.1	38.5
47	18340	200	0.41	5.01	25.62	2082	3.11	2.86	12.15	16059	5.71	46.86	1.41	50.8	40.6
48	17061	200	0.41	1.27	44.43	1917	2.42	2.52	12.68	14943	5.48	45.47	1.71	61.5	49.2
49	19702	200	0.24	1.99	24.13	2129	2.55	2.58	13.73	17373	4.72	61.33	1.65	59.5	47.6
50	23711	200	0.41	2.33	34.78	2267	2.04	2.31	16.33	21244	5.77	61.34	1.87	67.5	54
51	6333	200	0.24	2.10	23.64	1803	1.92	2.25	13.37	4330	5.79	12.47	0.82	29.7	23.8
52	11847	200	0.41	0.81	53.20	2907	2.28	2.45	19.82	8739	4.82	30.21	1.72	61.9	49.6
53	3615	200	0.24	0.64	38.02	536	1.25	2.30	3.88	2878	3.95	12.15	0.90	32.4	25.9
54	4961	200	0.15	1.23	20.07	295	2.40	2.51	1.95	4467	3.94	18.91	0.68	24.6	19.6
55	3916	200	0.41	1.44	42.22	1239	1.18	1.76	11.72	2477	3.23	12.78	1.11	40	32
56	7824	100	0.15	1.89	9.72	1416	2.02	2.93	8.05	6309	5.02	20.94	0.65	23.2	18.6
57	10636	200	0.41	1.52	41.34	1278	2.78	2.70	7.89	9158	4.76	32.03	1.35	48.8	39
58	7002	200	0.41	6.93	22.50	1034	4.12	3.29	5.24	5768	5.62	17.12	0.75	26.9	21.5
59	5103	200	0.41	0.56	61.61	1472	1.65	2.08	11.78	3432	4.33	13.22	1.44	52	41.6
60	9506	100	0.15	2.35	8.91	1354	1.80	2.18	10.38	8051	5.59	24.00	0.72	26	20.8
61	2844	200	0.15	1.49	18.60	1516	2.24	3.08	8.20	1128	4.56	4.13	0.52	18.6	14.8
62	6115	200	0.41	1.09	47.16	3217	1.52	1.99	26.88	2698	5.69	7.91	1.37	49.2	39.3
63	18503	100	0.24	1.11	17.54	1622	1.50	1.98	13.62	16780	4.18	66.95	1.64	58.9	47.1
64	17740	200	0.41	0.47	65.91	2316	1.04	1.65	23.35	15225	4.81	52.79	2.37	85.2	68.2
65	13693	200	0.24	1.24	29.22	922	2.45	2.53	6.07	12570	3.87	54.10	1.49	53.6	42.9
66	15337	200	0.41	0.11	119.20	1294	2.17	2.39	9.03	13843	4.97	46.44	2.91	104.8	83.8
67	8477	200	0.41	1.52	41.26	1843	2.63	2.63	11.69	6435	6.54	16.39	1.16	41.6	33.3
68	16416	200	0.24	0.73	36.04	661	1.98	2.28	4.83	15555	4.15	62.42	1.72	62	49.6
69	8613	200	0.41	0.67	57.33	2103	1.47	1.96	17.85	6310	2.35	44.80	2.00	72	57.6
70	16024	200	0.24	1.00	31.78	3643	1.89	2.23	27.24	12181	5.48	37.03	1.60	57.6	46.1
71	9063	100	0.41	0.54	35.95	31	2.71	3.39	0.15	8932	6.32	23.54	0.99	35.8	28.6
72	3432	200	0.41	0.95	49.90	1541	1.52	2.00	12.87	1691	4.95	5.69	1.14	41.1	32.9

Table A-19 Lag Time Summary – South Fork San Gabriel River (continued)

Watershed		SHEET				SHALLOW				CHANNEL			Total Lag Time		
	Length	Length	N-value	Slope	T	Length	Slope	Velocity	T	Length	Velocity	T	T_{lag}	Existing T_{lag}	Future T_{lag}
	(ft)	(ft)		(ft/ft)	(hr)	(ft)		(ft/s)	(hr)	(ft)	(ft/s)	(hr)	(hr)	(min)	(min)
73	11531	200	0.41	3.17	30.78	306	11.84	5.57	0.91	11026	4.87	37.75	1.16	41.7	33.3
74	11686	200	0.24	1.84	24.94	98	3.80	3.16	0.52	11388	7.15	26.55	0.87	31.2	25
75	13199	200	0.24	0.70	36.61	601	3.17	2.89	3.47	12398	4.16	49.65	1.50	53.8	43.1
76	10626	200	0.41	2.95	31.68	617	6.67	4.18	2.46	9809	4.94	33.08	1.12	40.3	32.3
77	12645	200	0.41	1.90	37.75	281	11.35	5.46	0.86	12206	5.10	39.92	1.31	47.1	37.7
78	10319	200	0.41	0.95	49.74	1030	3.69	3.11	5.51	9089	6.39	23.70	1.32	47.4	37.9
79	7536	200	0.24	0.95	32.41	1134	7.69	4.49	4.20	6202	6.85	15.09	0.86	31	24.8
80	22717	200	0.24	1.28	28.83	628	5.76	3.89	2.69	21889	6.50	56.14	1.46	52.6	42.1
81	20298	200	0.41	1.47	41.81	905	4.21	3.33	4.54	19193	4.91	65.12	1.86	66.9	53.5
82	7448	200	0.41	0.81	53.04	3703	4.73	3.52	17.52	3544	5.60	10.55	1.35	48.7	38.9
83	13247	200	0.41	1.69	39.56	957	4.11	3.28	4.86	12090	4.03	49.97	1.57	56.6	45.3
84	12652	200	0.41	1.04	48.01	777	5.50	3.80	3.41	11675	6.81	28.55	1.33	48	38.4
85	13067	200	0.41	3.24	30.49	2358	1.19	1.76	22.28	10509	5.38	32.54	1.42	51.2	40.9
86	10202	200	0.41	1.49	41.56	495	3.02	2.81	2.93	9507	5.89	26.89	1.19	42.8	34.3
87	6548	100	0.24	1.53	15.40	124	1.91	2.24	0.92	6324	5.04	20.92	0.62	22.3	17.9
88	6778	100	0.15	0.33	19.63	53	0.56	1.54	0.57	6625	6.54	16.89	0.62	22.3	17.8
89	5959	100	0.15	0.31	20.13	82	2.35	2.48	0.55	5776	7.84	12.29	0.55	19.8	15.8
90	3460	200	0.24	1.66	25.99	1101	1.41	1.92	9.53	2159	8.69	4.14	0.66	23.8	19
91	16498	100	0.41	1.05	27.54	292	1.64	2.07	2.35	16106	3.85	69.81	1.66	59.8	47.9
92	14668	200	0.24	0.89	33.40	339	8.68	4.77	1.18	14129	5.35	43.99	1.31	47.1	37.7
93	5025	100	0.24	2.83	12.06	1365	2.76	2.69	8.45	3560	4.24	14.01	0.58	20.7	16.6
94	4558	200	0.24	0.81	34.55	1156	1.11	1.71	11.28	3202	2.54	21.03	1.11	40.1	32.1

*For flowpaths with multiple segments per flow type (sheet, shallow concentrated, channel), average velocities were calculated.

Table A-20 Lag Time Summary – San Gabriel River

Watershed		SHEET				SHALLOW				CHANNEL			Total Lag Time		
	Length	Length	N-value	Slope	T	Length	Slope	Velocity	T	Length	Velocity	T	T_{lag}	Existing T_{lag}	Future T_{lag}
	(ft)	(ft)		(ft/ft)	(hr)	(ft)		(ft/s)	(hr)	(ft)	(ft/s)	(hr)	(hr)	(min)	(min)
36	14886	200	0.3	0.024	0.44	2262	0.017	2.13	0.30	12424	4.93	0.70	0.86	51.79	41.43
37	14453	200	0.3	0.009	0.66	2080	0.026	2.58	0.22	12173	5.20	0.65	0.92	55.24	44.19
38	24242	200	0.3	0.060	0.31	1643	0.043	3.33	0.14	22399	6.16	1.01	0.87	52.48	41.98
39	11782	200	0.3	0.025	0.44	1605	0.019	2.23	0.20	9977	3.89	0.71	0.81	48.58	38.87
40	7533	200	0.3	0.011	0.60	929	0.024	2.51	0.10	6404	4.21	0.42	0.68	40.55	32.44
41	13964	200	0.3	0.019	0.49	3672	0.014	1.93	0.53	10092	7.00	0.40	0.85	51.17	40.93
42	17095	200	0.3	0.007	0.72	1541	0.010	1.65	0.26	15354	4.82	0.89	1.12	66.96	53.57
43	6574	200	0.3	0.008	0.68	2016	0.031	2.85	0.20	4358	7.00	0.17	0.63	37.87	30.30
44	7456	200	0.3	0.043	0.35	2122	0.021	2.36	0.25	5134	3.23	0.44	0.63	37.60	30.08
45	5266	200	0.3	0.021	0.47	864	0.004	1.00	0.24	4202	5.59	0.21	0.55	33.17	26.53
48	6090	200	0.3	0.016	0.52	1656	0.014	1.89	0.24	4234	3.77	0.31	0.65	38.89	31.11
49	12623	200	0.3	0.019	0.49	1609	0.020	2.29	0.20	10814	4.62	0.66	0.81	48.48	38.79
50	6302	200	0.3	0.015	0.54	1690	0.025	2.54	0.18	4412	3.10	0.40	0.67	40.20	32.16
52	2644	200	0.3	0.027	0.43	875	0.065	4.10	0.06	1569	7.00	0.06	0.33	19.78	15.82
53	6049	200	0.3	0.014	0.56	556	0.004	0.98	0.16	5293	4.65	0.37	0.65	39.09	31.27
54	6140	200	0.3	0.020	0.48	773	0.046	3.46	0.06	5167	4.48	0.32	0.52	30.91	24.73
56	8439	200	0.3	0.011	0.61	1821	0.008	1.45	0.35	6418	4.40	0.40	0.82	49.05	39.24
57	10121	200	0.3	0.025	0.44	2547	0.024	2.51	0.28	7374	6.99	0.29	0.61	36.58	29.27
58	6858	200	0.3	0.016	0.52	470	0.009	1.54	0.08	6188	5.40	0.33	0.56	33.68	26.94
59	5952	200	0.3	0.013	0.57	942	0.030	2.81	0.09	4810	7.00	0.19	0.51	30.67	24.54
64	5668	200	0.3	0.011	0.61	1422	0.032	2.87	0.14	4046	4.00	0.28	0.62	37.16	29.73
67	7717	200	0.3	0.009	0.66	1452	0.005	1.13	0.36	6065	6.44	0.27	0.77	46.29	37.03
68	13322	200	0.3	0.019	0.49	1194	0.023	2.45	0.14	11928	6.00	0.55	0.71	42.34	33.87

Table A-21 Modified Puls Routing Inputs – Berry Creek

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-5	Junction-4	Junction-5	46.5 99.5 215.3 530.4 1166.2 1970.8 2639.6 3233.9 3777 4275.9	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	1
Reach-6	Junction-6	Junction-7	13.1 30.9 83.2 169.8 357.9 602.9 805.5 984.8 1141.3 1284.7	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	3
Reach-7	Junction-7	Junction-8	87.8 198.6 471.6 1027.2 2299.7 3980.1 5348.3 6544.0 7626.9 8653.1	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	7
Reach-8	Junction-9	Junction-10	47.2 93.4 191.4 397.5 1061.9 2037.1 2808.9 3441.1 4073.5 4617.7	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	4
Reach-9	Junction-11	Junction-12	80.2 149.3 264.9 489.8 1177.2 2256.6 3223.7 3971.5 4682.8 5314.6	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	1
Reach-10	Junction-14	Junction-15	28.1 61.3 116.0 255.5 309.2 515.9 922.4 1076.2 1183.0 1314.5 1418.2 1579.5	1000 2500 5000 10000 12773 17291 24128 32273 39584 50000 58903 75000	1

Table A-21 Modified Puls Routing Inputs – Berry Creek (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-12	Junction-35	Junction-36	12.9 28.8 56.8 111.2 246 411.8 547.7 669.6 782.9 889	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	2
Reach-11	Junction-36	Junction-37	105.9 232.5 430.6 793.1 1801.2 3170.1 4307.5 5315.6 6242.1 7110.2	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	11
Reach-13a	Junction-15	DelWebb	58 105 176.9 300 653.7 1278.3 1756.1 2149.6 2527.4 2911.8	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	1
Reach-13b	DelWebb	Junction-16	103.7 185.4 304.9 536.1 1190.8 2333.9 3409.8 4374.5 5244.8 6053.4	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	8
Reach-14	Junction-17	Junction-18	54.7 99.5 169.5 305.8 646.2 1233 1703.9 2143.1 2532.8 2889.9	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	5
Reach-15	Junction-18	Junction-19	7.9 13.7 22 39 105.5 202.7 286.2 353.9 410.9 465.4	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	1

Table A-21 Modified Puls Routing Inputs – Berry Creek (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-16	Junction-20	Junction-21	59.2 94 144 240.3 536.7 1087.4 1730.8 2007.5 2302.9 2774	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	3
Reach-17	Junction-22	Junction-23	25.3 49.9 85.9 150.9 349.5 916.4 1715.3 2168.7 2628.7 3652	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	2
Reach-18	Junction-23	Junction-24	10 20 36.1 64.7 192.7 640.5 1155.6 1372.2 1594.8 2099.2	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	1
Reach-19	Junction-24	Junction-25	8.6 15.9 26.9 45.5 127.5 287.4 460.6 558.7 661.4 897.6	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	1
Reach-20	Junction-25	Junction-26	28.9 58.9 100.3 188.6 486.2 1064.6 1474.1 1853.6 2187.2 2502.8	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	3
Reach-21	Junction-27	Junction-28	28.3 55.2 96.1 179.7 401.8 846.7 1379.8 1761.1 2101.4 2425.3	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	3

Table A-21 Modified Puls Routing Inputs – Berry Creek (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-23	Junction-39	Junction-40	107.4 215.1 394.4 697.4 1451 2427.8 3198.6 3886 4482.9 5039.1	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	8
Reach-24	Junction-41	Junction-42	8.9 19.8 33.7 61 128.4 221.1 295.5 358.3 414.8 466.6	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	1
Reach-26	Junction-42	Junction-43	36.8 98.8 194.1 349.6 688.7 1148.9 1543.5 1893.7 2207.9 2495.8	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	5
Reach-27	Junction-43	Junction-44	35.2 76 152.3 310.6 742.6 1316.7 1799.7 2209.5 2572.3 2903.1	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	5
Reach-28	Junction-45	Junction-46	38.6 81.6 146.4 260 897.7 1414.9 1735 2233.4 2510.5 2758.5	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	5
Reach-29	Junction-47	Junction-48	51.4 103.7 195.7 384 965.6 1851.6 2464.1 3090.6 3633.1 4141.6	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	7

Table A-21 Modified Puls Routing Inputs – Berry Creek (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-30	Junction-49	Junction-50	16.3 32.6 59.7 117.9 304.2 737.7 1042.2 1323.7 1579.2 1819.6	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	2
Reach-22	Junction-29	Junction-30	63.9 125.7 222.8 418 1223.6 2273.9 3103.3 3856 4602.9 5296.6	1000 2500 5000 10000 25000 50000 75000 100000 125000 150000	5

Table A-22 Modified Puls Routing Inputs – Mankins Branch

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-1	Junction-7	Junction-8	4.48 7.73 34.17 54.4 72.31 105.42	500 1000 5000 7500 10000 15000	3
Reach-2	Junction-8	Junction-9	9.76 16.43 56.89 77.67 97.11 134.48	500 1000 5000 7500 10000 15000	2
Reach-3	Junction-9	Junction-10	10.61 17.84 71.05 113.65 156.9 232.89	500 1000 5000 7500 10000 15000	4
Reach-4	Junction-1	Junction-2	23.1 41.5 192 279.4 352.7 490.9 619.9 751.4 869.5	500 1000 5000 7500 10000 15000 20000 25000 30000	8
Reach-5	Junction-3	Junction-4	38.5 61.4 199.2 310.7 436.2 673.6 893.9 1118 1318.6	500 1000 5000 7500 10000 15000 20000 25000 30000	9
Reach-9	Junction-5	Junction-6	5.1 8.1 23.6 30.4 36.5 47.2 59.6 77.6 155.8	500 1000 5000 7500 10000 15000 20000 25000 30000	1

Table A-23 Modified Puls Routing Inputs – Pecan Branch

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-1	01	Junction-1A	1.1	10	9
			5.55	100	
			21.46	500	
			37.91	1000	
			63.3	2000	
			124.95	5000	
			208.99	10000	
			301.56	16000	
			357.67	20000	
			438.64	26000	
Reach-2	Junction-1	Junction-2	0.97	10	7
			4.82	100	
			15.14	500	
			27.24	1000	
			49.21	2000	
			106.65	5000	
			184.93	10000	
			269.84	16000	
			315.64	20000	
			386.99	26000	
Reach-3	Junction-2	Junction-3	0.48	10	4
			2.31	100	
			6.78	500	
			10.99	1000	
			18.88	2000	
			44.01	5000	
			81.58	10000	
			127.26	16000	
			155.44	20000	
			197.01	26000	
Reach-4	Junction-3	Junction-4	1.51	10	7
			9.23	100	
			27.59	500	
			44.24	1000	
			64.58	2000	
			117.45	5000	
			198.98	10000	
			285.11	16000	
			341.93	20000	
			422.55	26000	
Reach-5	Junction-4	Junction-5	0.34	10	3
			1.67	100	
			5.02	500	
			8.39	1000	
			14.37	2000	
			30.52	5000	
			56.59	10000	
			82.78	16000	
			98.54	20000	
			122.15	26000	
Reach-7	Junction-5	Junction-6	0.72	10	6
			3.82	100	
			14.8	500	
			23.22	1000	
			35.28	2000	
			64.84	5000	
			115.11	10000	
			169.75	16000	
			202.67	20000	
			250.48	26000	

Table A-23 Modified Puls Routing Inputs – Pecan Branch (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-8	Junction-6	Junction-7	1.87 6.22 18.92 29.62 47.95 112.9 187.55 272.58 315.8 373.92	10 100 500 1000 2000 5000 10000 16000 20000 26000	9
Reach-9	Junction-7	Junction-8	2.9 7.22 21.48 32.11 59.55 235.68 331.31 438.17 473.4 520.77	10 100 500 1000 2000 5000 10000 16000 20000 26000	4
Reach-11	Junction-8	Junction-9	0.69 2.37 8.35 19.91 74.18 254.19 351.04 470.46 509.52 561.53	10 100 500 1000 2000 5000 10000 16000 20000 26000	4
Reach-12	Junction-9	Junction-10	3.99 14.97 36.24 55.63 88.52 179.77 283.31 389 452.78 541.36	10 100 500 1000 2000 5000 10000 16000 20000 26000	12
Reach-13	Junction-10	Junction-11A	1.21 7.78 23.1 39.41 71.1 146.65 241.77 343.28 405.21 494.81	10 100 500 1000 2000 5000 10000 16000 20000 26000	10
Reach-14	Junction-11	Junction-12A	2.51 16.12 38.67 61.06 99.83 178.97 260.77 340.77 388.64 455.26	10 100 500 1000 2000 5000 10000 16000 20000 26000	13

Table A-23 Modified Puls Routing Inputs – Pecan Branch (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-15	Junction-12	Junction-13	3.31	10	32
			17.88	100	
			59.6	500	
			101.03	1000	
			172.2	2000	
			368.42	5000	
			662.98	10000	
			932.07	16000	
			1088.99	20000	
			1313.59	26000	

Table A-24 Modified Puls Routing Inputs – Smith Branch

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-03	03	Junction-1	0.74 3.12 9.63 16.23 27.98 60.9 111.29 157.4 185.75 226.86	10 100 500 1000 2000 5000 10000 16000 20000 26000	2
Reach-02	Junction-1	Junction-2a	1.8 4.61 13.45 27.25 120.64 262.25 327.13 597.82 742.09 951.55	10 100 500 1000 2000 5000 10000 16000 20000 26000	3
Reach-04	Junction-2	Junction-16	0.7 5.03 23.23 35.49 61.71 84.72 104.65 120.02 138.92 158.26	10 100 500 1000 2000 5000 10000 16000 20000 26000	1
Reach-05	Junction-16	Junction-3a	0.97 3.03 11.25 18.47 31.11 58.22 102.09 140.33 162.82 193.43	10 100 500 1000 2000 5000 10000 16000 20000 26000	1
Reach-07	Junction-3	Junction-4	1.35 3.89 11.77 19.1 29.06 70.66 121.89 162.35 184.76 216.95	10 100 500 1000 2000 5000 10000 16000 20000 26000	1
Reach-08	Junction-4	Junction-5	0.98 9.02 18.85 31.13 53.62 122.97 230.34 312.49 359.37 424.05	10 100 500 1000 2000 5000 10000 16000 20000 26000	1

Table A-24 Modified Puls Routing Inputs – Smith Branch (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-09	Junction-5	Junction-6a	0.92	10	1
			5.02	100	
			14.93	500	
			25.91	1000	
			44.45	2000	
			88.12	5000	
			146.86	10000	
			209.83	16000	
			249.79	20000	
			308.05	26000	
Reach-10	Junction-6	Junction-8	0.39	10	1
			1.79	100	
			4.85	500	
			7.52	1000	
			11.97	2000	
			22.44	5000	
			35.01	10000	
			52.45	16000	
			66.08	20000	
			82.49	26000	
Reach-12	Junction-8	Junction-9a	1.28	10	3
			6.04	100	
			20.03	500	
			31.6	1000	
			52.01	2000	
			115.05	5000	
			218.2	10000	
			307.79	16000	
			357.98	20000	
			438.68	26000	
Reach-13	Junction-9	Junction-11a	1.06	10	3
			5.18	100	
			15.83	500	
			26.54	1000	
			52.08	2000	
			132.52	5000	
			250.53	10000	
			356.93	16000	
			410.67	20000	
			492.49	26000	
Reach-16	Junction-11	OUTFALL	0.75	10	2
			3.75	100	
			11.64	500	
			19.28	1000	
			32.82	2000	
			67.14	5000	
			119.94	10000	
			181.46	16000	
			224.87	20000	
			283	26000	
Reach-18	Junction-17	Junction-12a	1.07	10	4
			6.9	100	
			23.62	500	
			42.23	1000	
			70.36	2000	
			137.94	5000	
			234.15	10000	
			321.45	16000	
			373.99	20000	
			448.74	26000	

Table A-24 Modified Puls Routing Inputs – Smith Branch (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-19	Junction-12	Junction-13	0.26	10	1
			1.57	100	
			13.21	500	
			20.01	1000	
			25.96	2000	
			64.63	5000	
			107.95	10000	
			143.93	16000	
			165.44	20000	
			195.02	26000	
Reach-20	Junction-13	Junction-14a	1.05	10	2
			4.66	100	
			20.65	500	
			34.53	1000	
			62.4	2000	
			200.71	5000	
			519.3	10000	
			674.27	16000	
			751.31	20000	
			855.62	26000	
Reach-21	Junction-14	Junction-15	0.55	10	2
			3.03	100	
			16.2	500	
			30.13	1000	
			45.58	2000	
			87.58	5000	
			139.23	10000	
			197.92	16000	
			237.11	20000	
			294.54	26000	
Reach-22	Junction-15	Junction-6	0.21	10	1
			1.3	100	
			4.77	500	
			7.71	1000	
			14.38	2000	
			33.25	5000	
			61.46	10000	
			93.5	16000	
			114.38	20000	
			144.41	26000	

Table A-25 Modified Puls Routing Inputs – Middle Fork San Gabriel River

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-2	Junction-2	Junction-3	0 50.9 93 167.9 290.4 372.4 536.6 685.7	0 1000 2000 4000 7500 10000 15000 20000	7
Reach-7	Junction-4	Junction-5	0 66.6 109.3 190.3 328.4 430.7 614.9 815.4	0 1000 2000 4000 7500 10000 15000 20000	6
Reach-8	Junction-6	Junction-7	0 33.3 53.9 91.3 152.2 194.2 276.4 353.9	0 1000 2000 4000 7500 10000 15000 20000	3
Reach-6	Junction-7	Junction-8	0 34.1 55.9 95.1 165 216.5 312.5 409.5	0 1000 2000 4000 7500 10000 15000 20000	4
Reach-10	Junction-9	Junction-10	0 67.8 109.3 178.1 287.6 357.7 508.1 669.4	0 1000 2000 4000 7500 10000 15000 20000	7
Reach-11	Junction-11	Junction-12	0 61.7 95.7 156.3 253.7 314.8 423.7 524	0 1000 2000 4000 7500 10000 15000 20000	6
Reach-12	Junction-12	Junction-13	0 29.2 46.4 74.3 116.8 146.7 202.2 254.6	0 1000 2000 4000 7500 10000 15000 20000	3
Reach-14	Junction-14	Junction-15	0 37.6 57.5 89.6 139.3 172.4 235.3 294.8	0 1000 2000 4000 7500 10000 15000 20000	3

Table A-25 Modified Puls Routing Inputs – Middle Fork San Gabriel River (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
Reach-3	Junction-15	Junction-16	0 27.3 46 80.2 131.1 166.9 249.2 353.2	0 1000 2000 4000 7500 10000 15000 20000	4
Reach-15	Junction-17	Junction-18	0 31.7 50.6 80.7 126.1 156.9 221.2 288.4	0 1000 2000 4000 7500 10000 15000 20000	5
Reach-16	Junction-19	Junction-20	0 59.5 89 137.3 209.1 256.3 348.1 440.8	0 1000 2000 4000 7500 10000 15000 20000	6

Table A-26 Modified Puls Routing Inputs – North Fork San Gabriel River

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R230	J907	J1	0 153.6 597.1 1189.7 2638.9 4463.9 6031.5 7392.2 8634.1 9804.1	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	19
R460	J784	J826	0 90.9 329.3 632.5 1785.2 2475.7 3316.6 4077.1 4772.6 5424.1	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	11
R720	J826	J2	0 168.7 629.5 1242.4 2924.7 5118 6985.4 8678.6 10233 11690	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	21
R860	J807	J3	0 80.8 290.6 563.1 1437.6 2432 3238.9 3948.6 4600.5 5224.3	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	10
R970	J774	J932	0 53.8 168.7 302.5 890.7 1596.1 2217.2 2733.7 3206.2 3640.3	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	5
R1060	J932	J935	0 64.7 201.5 363.3 1019.2 1881.5 2628 3283.6 3881.9 4437	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	7

Table A-26 Modified Puls Routing Inputs – North Fork San Gabriel River (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R7680	J935	J810	0 43 131.2 233.3 640.5 1197.4 1641.6 2031.2 2390.9 2724.4	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	4
R1140	J810	J4	0 81.4 261.6 504.1 1342.1 2408.2 3228.5 3959.8 4650 5278.2	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	9
R1300	J857	J783	0 7.3 22 45.4 134.8 225.2 300.4 366.2 436.2 508.2	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	1
R1650	J783	J5	0 80.9 269.3 490.6 1168.6 1980.6 2684.4 3201.9 3738.5 4233.1	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	9
R1960	J840	J913	0 113.5 386 658.6 1573.5 3465.5 4973.9 6002.7 7251.1 8480.8	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	11
R2400	J913	J877	0 24.3 82.4 140.6 298.1 663.2 951.6 1212.3 1450.4 1680.2	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	2

Table A-26 Modified Puls Routing Inputs – North Fork San Gabriel River (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R2430	J877	J6	0 42.2 129.1 227.4 463.7 992.8 1419.3 1804.3 2154.5 2481.7	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	5
R2710	J849	J7	0 50.4 158.5 282.6 602.7 1424.2 2118.8 2712.1 3226.9 3719	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	5
R2920	J804	J829	0 35.5 110.6 192.9 383.7 849.9 1542.8 1833.9 2250.2 2677.6	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	2
R2940	J829	J8	0 10.4 33.8 54.9 107.2 205.9 303.1 407.5 496.2 583.8	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	1
R2990	J777	J795	0 28.8 88.9 150.3 292.7 536.3 827.9 1102.5 1335 1625.7	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	3
R3020	J795	J9	0 47.4 148.8 262.7 551.2 1110.4 1826.6 2611.5 3406.9 4280.3	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	5

Table A-26 Modified Puls Routing Inputs – North Fork San Gabriel River (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R3150	J789	J924	0 29.4 89.3 154.8 345 682.8 1080.7 1544.8 2042.7 2448.1	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	3
R7700	J924	J780	0 75.3 215.7 388.2 768.6 1475.7 2455.5 3478.9 4428.2 5281.1	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	8
R7550	J780	J882	0 13.9 42 77.1 166.8 367.5 621.1 827.5 998.9 1150.4	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	2
R7720	J882	J1113	0 3.7 12 21.5 46.6 109.5 180.8 229. 267.3 299.9	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	1
R7560	J1113	J10	0 15.5 43.2 72.8 146.6 275.6 465.7 644.5 795.7 932.5	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	2
R7570	J792	J846	0 75.5 210.6 340.8 657.4 1161.8 1601 2089.4 2568.6 3029.3	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	8

Table A-26 Modified Puls Routing Inputs – North Fork San Gabriel River (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R7600	J846	J910	0 63.6 213.9 360.5 734.3 2170.8 3010.3 3804.1 4533.1 5221.1	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	26
R3640	Lake Georgetown	J860	0 11997 12480 12940 14083 15732 17302 18720 20081 21432	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	7
R4000	J860	J900	0 86.6 274. 461.80 914.9 1522.5 2112.6 2728.4 3434.6 4102	0 1000 5000 10000 25000 50000 75000 100000 125000 150000	10

Table A-27 Modified Puls Routing Inputs – South Fork San Gabriel River

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R001	001	J001	1.22	10	8
			4.96	100	
			41.8	1000	
			162.63	5000	
			264.71	10000	
			499.91	25000	
			804.39	50000	
			1047.21	75000	
			1256.6	100000	
			1955.69	200000	
R002.1	J001	J003	0.35	10	3
			1.85	100	
			12.49	1000	
			54.12	5000	
			105.31	10000	
			206.08	25000	
			307.89	50000	
			390.57	75000	
			462.88	100000	
			700.3	200000	
R005	J003	J004	0.38	10	4
			1.98	100	
			12.5	1000	
			50.27	5000	
			96.22	10000	
			199.27	25000	
			327.45	50000	
			429.57	75000	
			520.06	100000	
			840.03	200000	
R006	J004	J006	0.12	10	1
			0.61	100	
			3.11	1000	
			14.8	5000	
			32.37	10000	
			62.9	25000	
			103.62	50000	
			140.14	75000	
			173.09	100000	
			276.66	200000	
R008	J006	J007	3.62	10	8
			11.05	100	
			47.07	1000	
			168.27	5000	
			287.3	10000	
			631.04	25000	
			1075.09	50000	
			1408.65	75000	
			1726.57	100000	
			2815.07	200000	
R009	J008	J009	4.05	10	8
			10.99	100	
			45.26	1000	
			152.6	5000	
			267.55	10000	
			619.1	25000	
			1077.44	50000	
			1435.58	75000	
			1742.77	100000	
			2823.88	200000	

Table A-27 Modified Puls Routing Inputs – South Fork San Gabriel River (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R010	J009	J010	0.95 4.41 23.37 74.72 129.73 296.02 491.79 655.86 799.65 1271.56	10 100 1000 5000 10000 25000 50000 75000 100000 200000	5
R011	J010	J011	1.53 9.5 50.77 183.45 314.79 658.65 1100.49 1461.83 1785.08 2840.16	10 100 1000 5000 10000 25000 50000 75000 100000 200000	10
R016	J011.2	J015	0.45 2.25 9.2 34.58 59.44 132.7 247.37 354.9 448.44 837.9	10 100 1000 5000 10000 25000 50000 75000 100000 200000	1
R017	J015	J016	1.56 6.05 28.26 93.64 168.62 360.53 671.02 910.53 1125.9 1831.61	10 100 1000 5000 10000 25000 50000 75000 100000 200000	4
R018	J016.2	J017	0.63 2.87 13.47 44.17 77.95 184.57 317.3 493.57 649.38 1153.57	10 100 1000 5000 10000 25000 50000 75000 100000 200000	2
R019	J017	J018	3.07 5.54 19.41 57.68 95.53 225.31 365.85 601.97 792.43 1346.18	10 100 1000 5000 10000 25000 50000 75000 100000 200000	2

Table A-27 Modified Puls Routing Inputs – South Fork San Gabriel River(continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R020	J018	J020	0.92	10	2
			2.59	100	
			13.84	1000	
			44.19	5000	
			81.76	10000	
			220.58	25000	
			358.73	50000	
			459.66	75000	
			553.33	100000	
			927.32	200000	
R022	J020	J021	6.59	10	6
			10.93	100	
			37.38	1000	
			115.66	5000	
			200.1	10000	
			455.82	25000	
			807.88	50000	
			1168.41	75000	
			1487.03	100000	
			2562.93	200000	
R024	J023	J024	11.94	10	2
			14.08	100	
			23.63	1000	
			49.32	5000	
			83.59	10000	
			188.16	25000	
			334.63	50000	
			456.33	75000	
			596.56	100000	
			1038.58	200000	
R026	J026	J027	2.78	10	2
			4.29	100	
			14.18	1000	
			40.04	5000	
			66.26	10000	
			155.79	25000	
			319.22	50000	
			451.46	75000	
			548.63	100000	
			858.7	200000	
R027	J027.2	J029	8.01	10	6
			16.42	100	
			54.81	1000	
			147.42	5000	
			241.98	10000	
			520.57	25000	
			1108.26	50000	
			1601.65	75000	
			2031.91	100000	
			3385.25	200000	
R029	J029.2	J031	1.81	10	1
			2.92	100	
			7.21	1000	
			21.13	5000	
			38.5	10000	
			93.32	25000	
			159.89	50000	
			206.41	75000	
			248.37	100000	
			426.14	200000	

Table A-27 Modified Puls Routing Inputs – South Fork San Gabriel River (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R031	J031	J032	0.37	10	1
			1.85	100	
			10.49	1000	
			31.53	5000	
			62.7	10000	
			155.15	25000	
			316.63	50000	
			447.25	75000	
			560.43	100000	
			1000.42	200000	
R032	J032	J034	0.51	10	2
			2.68	100	
			14.51	1000	
			46.61	5000	
			78.67	10000	
			163.29	25000	
			317.25	50000	
			452.03	75000	
			571.68	100000	
			1001.07	200000	
R034	J034	J036	0.47	10	2
			2.67	100	
			14.61	1000	
			52.79	5000	
			89.91	10000	
			195.73	25000	
			348.29	50000	
			510.44	75000	
			664.22	100000	
			1172.82	200000	
R036	J036	J038	0.53	10	2
			2.48	100	
			12.01	1000	
			40.58	5000	
			73.06	10000	
			172.58	25000	
			330.2	50000	
			459.46	75000	
			573.17	100000	
			941.62	200000	
R038	J038	J045	0.73	10	4
			4.38	100	
			21.65	1000	
			67.67	5000	
			119.26	10000	
			268.5	25000	
			612.44	50000	
			854.94	75000	
			1038.61	100000	
			1619.06	200000	
R045	J045.2	J046	0.41	10	2
			2.41	100	
			13.54	1000	
			43.89	5000	
			72.05	10000	
			147.89	25000	
			261.37	50000	
			378.37	75000	
			466.06	100000	
			781.62	200000	

Table A-27 Modified Puls Routing Inputs – South Fork San Gabriel River(continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R046	J046	J048	1.53	10	4
			7.6	100	
			32.81	1000	
			100.85	5000	
			169.78	10000	
			377.06	25000	
			643.71	50000	
			875.16	75000	
			1082.28	100000	
			1764.72	200000	
R048	J048	J050	0.32	10	1
			1.71	100	
			6.66	1000	
			23.01	5000	
			41.82	10000	
			95.73	25000	
			207.23	50000	
			304.27	75000	
			390.13	100000	
			665.37	200000	
R050	J050	J051	0.92	10	2
			4.07	100	
			19.53	1000	
			68.72	5000	
			118.09	10000	
			236.28	25000	
			489.52	50000	
			714.88	75000	
			920.2	100000	
			1597.59	200000	
R051	J051	J052	1.22	10	3
			7.12	100	
			27.27	1000	
			79.05	5000	
			130.22	10000	
			284.77	25000	
			491.3	50000	
			671.47	75000	
			802.67	100000	
			1244.55	200000	
R052	J052	J054	0.12	10	1
			0.84	100	
			3.96	1000	
			12.81	5000	
			21.84	10000	
			44.77	25000	
			83.32	50000	
			119.89	75000	
			139.73	100000	
			226.91	200000	
R054	J054	J056	0.79	10	3
			4.65	100	
			22.42	1000	
			68.85	5000	
			113.38	10000	
			235.16	25000	
			451.58	50000	
			658.69	75000	
			794.62	100000	
			1247.02	200000	

Table A-27 Modified Puls Routing Inputs – South Fork San Gabriel River (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R056	J056	J058	2.28 14.21 71.49 231.2 413.62 877.86 1512.28 2137.97 2776.79 5041.53	10 100 1000 5000 10000 25000 50000 75000 100000 200000	8
R058	J058.2	J059	2.12 10.48 45.23 133.05 226.97 458.56 814.1 1189.71 1583.29 2772.99	10 100 1000 5000 10000 25000 50000 75000 100000 200000	5
R059	J059.2	J063	1.58 6.91 30.5 95.2 154.28 310.63 542.28 789.06 1232.3 2169.3	10 100 1000 5000 10000 25000 50000 75000 100000 200000	4
R063	J063.2	J064	5.82 11.66 37.07 100.4 157.64 313.13 580.05 881.97 1284.07 2617.59	10 100 1000 5000 10000 25000 50000 75000 100000 200000	3
R064	J064.2	J092	0.98 5.89 27.25 85.89 141.71 288.04 516.8 825.95 1172.89 2320.15	10 100 1000 5000 10000 25000 50000 75000 100000 200000	3
R064.1	J092	J065	2.1 10.36 44.48 134.15 224.69 469.88 830.01 1220.78 1820.11 3449.83	10 100 1000 5000 10000 25000 50000 75000 100000 200000	5

Table A-27 Modified Puls Routing Inputs – South Fork San Gabriel River (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R065	J065	J066	2.86	10	7
			13.69	100	
			71.13	1000	
			204.52	5000	
			329.93	10000	
			637.09	25000	
			1054.23	50000	
			1477.81	75000	
			2015.8	100000	
			4069.09	200000	
R066	J066.2	J067	0.24	10	1
			1.1	100	
			5.89	1000	
			18.78	5000	
			31.61	10000	
			65.55	25000	
			115.72	50000	
			168.57	75000	
			232.37	100000	
			515.67	200000	
R067	J067	J068	4.93	10	13
			26.45	100	
			119.66	1000	
			360.59	5000	
			597.75	10000	
			1267.4	25000	
			2296.19	50000	
			3506.13	75000	
			4697.36	100000	
			8594.57	200000	
R068	J068.2	J069	1.15	10	3
			5.52	100	
			25.2	1000	
			73.25	5000	
			119.77	10000	
			285.25	25000	
			594.04	50000	
			897.18	75000	
			1207.22	100000	
			2311.85	200000	
R069	J069.2	J070	3.25	10	8
			16.7	100	
			77.53	1000	
			233.82	5000	
			388.88	10000	
			788.06	25000	
			1522.36	50000	
			2354.26	75000	
			3047.93	100000	
			6106.95	200000	
R070	J070.2	J071	2.14	10	8
			12.77	100	
			62.55	1000	
			187.89	5000	
			310.4	10000	
			634.72	25000	
			1180.74	50000	
			1849.73	75000	
			2480.54	100000	
			5321.89	200000	

Table A-27 Modified Puls Routing Inputs – South Fork San Gabriel River (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R071	J071	J072	0.88	10	3
			5.29	100	
			25.9	1000	
			78.78	5000	
			134.92	10000	
			280.4	25000	
			479.73	50000	
			658.65	75000	
			828.4	100000	
			1744.14	200000	
R072	J072	J090	0.58	10	2
			3	100	
			14.23	1000	
			43.91	5000	
			71.79	10000	
			150.09	25000	
			250.44	50000	
			339.26	75000	
			433.45	100000	
			808.85	200000	
R072.1	J090	J094	0.67	10	2
			3.92	100	
			21.53	1000	
			62.82	5000	
			100.74	10000	
			186.64	25000	
			297.34	50000	
			402.04	75000	
			504.36	100000	
			1000.51	200000	
R072.2	J094	J073	2.89	10	1
			4.48	100	
			11.53	1000	
			33.51	5000	
			58.17	10000	
			119.5	25000	
			193.77	50000	
			297.25	75000	
			356.98	100000	
			579.79	200000	
R073	J073	OUTFALL	0.42	10	1
			2.14	100	
			8.19	1000	
			32.19	5000	
			64.6	10000	
			135.21	25000	
			207.51	50000	
			282.41	75000	
			364.32	100000	
			651.66	200000	

Table A-28 Modified Puls Routing Inputs – San Gabriel River

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R290	SF-SG	SGJ199	73.6 159.6 251.4 472.5 832.1 1234.8 1711.0 2290.1 3188.9	1000 5000 10000 25000 50000 75000 100000 125000 150000	3
R180	SGJ199	SGJ202	24.1 68.7 114.8 229.6 376.7 506.0 654.7 838.9 1089.9	1000 5000 10000 25000 50000 75000 100000 125000 150000	2
R220	SGJ202	S-SG	38.1 128.5 227.4 490.6 928.1 1419.1 1949.7 2502.9 3153.7	1000 5000 10000 25000 50000 75000 100000 125000 150000	4
R170	S-SG	SGJ10	19.1 89.1 184.3 371.7 650.7 944.9 1197.2 1410.1 1665.9	1000 5000 10000 25000 50000 75000 100000 125000 150000	2
R110	SGJ10	B-SG	122.5 382 684.7 1538.9 2873.7 4214.2 5418 6578.5 7597.7	1000 5000 10000 25000 50000 75000 100000 125000 150000	9
R70	B-SG	SGJ228	49.7 158.2 261.1 544.1 991.1 1462.3 2181.6 2893.3 3572.3 4051.1 4500	1000 5000 10000 25000 50000 75000 100000 125000 150000 175000 195152.6	4
R80	SGJ228	SGJ225	2 6.80 10.4 21.1 37.6 58.9 79 100.3 127.8 167.17 200	1000 5000 10000 25000 50000 75000 100000 125000 150000 175000 226720.5	1

Table A-28 Modified Puls Routing Inputs – San Gabriel River (continued)

Reach Name	From Element	To Element	Storage-Discharge Function		Subreaches
			Ac-Ft	CFS	
R150	SGJ225	SGJ256	14.7 49.9 87.1 190 361.3 566.2 827.9 1114.5 1512 1998.7 2500	1000 5000 10000 25000 50000 75000 100000 125000 150000 175000 239127.8	2
R240	SGJ256	SGJ205	38.9 115.1 188.5 378.6 735.1 1095.6 1521.6 2045.1 2743 3542.5 4000	1000 5000 10000 25000 50000 75000 100000 125000 150000 175000 215044.2	1
R310	SGJ205	SGJ193	42.1 126.9 198.6 398.3 766.5 1143.9 1590.3 2225.7 2900.4 3522.7 4000	1000 5000 10000 25000 50000 75000 100000 125000 150000 175000 209780.3	4
R360	SGJ193	SGJ267	5.4 16.9 27.3 52.3 96.1 144.6 196.5 246.9 311.1 364.2 450	10000 50000 100000 250000 500000 750000 1000000 1250000 1500000 1750000 2213078	1
R330	SGJ267	SGJ188	26.5 71.9 133.1 283.9 548.5 783.3 1002.5 1231.9 1511.5 1773 2500	1000 5000 10000 25000 50000 75000 100000 125000 150000 175000 250159.4	2

Table A-29 Muskingum-Cunge Inputs – Berry Creek

Reach Name	From Element	To Element	Length (ft)	Slope (ft/ft)	Channel Manning's n	Shape	Trapezoid		Eight Point	
							Bottom Width (ft)	Side Slope (xH:1V)	X	Y
Reach-31	204	Junction-1	13024	0.0034	0.045	Trapezoid	13	3	N/A	N/A
Reach-1	Junction-1	Junction-2	9873	0.0033	0.04	Trapezoid	30	7	N/A	N/A
Reach-32	Junction-2	Junction-3	13619	0.0032	0.04	Trapezoid	29	5	N/A	N/A
Reach-2	Junction-3	Junction-4	18199	0.0034	0.04	Trapezoid	43	2.75	N/A	N/A
Reach-3	Junction-32	Junction-33	16932	0.0048	0.045	Trapezoid	27	5.5	N/A	N/A
Reach-4	Junction-33	Junction-4	5781	0.0042	0.04	Trapezoid	33	3	N/A	N/A
Reach-25	Junction-51	Junction-52	11588	0.0060	0.04	Trapezoid	58	3	N/A	N/A
Reach-33	136	Junction-31	985	0.0004	0.04	Trapezoid	12	1	N/A	N/A

Table A-30 Muskingum-Cunge Inputs – Mankins Branch

Reach Name	From Element	To Element	Length (ft)	Slope (ft/ft)	Channel Manning's n	Shape	Trapezoid		Eight Point	
							Bottom Width (ft)	Side Slope (xH:1V)	X	Y
Reach-7	Junction-12	Junction-13	3917	0.0106	0.04	Trapezoid	19	3	N/A	N/A
Reach-6	Junction-11	Junction-13	8028	0.0087	0.04	Trapezoid	19	2.6	N/A	N/A
Reach-8	Junction-13	Junction-5	6785	0.0068	0.04	Trapezoid	17	2.5	N/A	N/A

Table A-31 Muskingum-Cunge Inputs – Pecan Branch

Reach Name	From Element	To Element	Length (ft)	Slope (ft/ft)	Channel Manning's n	Shape	Trapezoid		Eight Point	
							Bottom Width (ft)	Side Slope (xH:1V)	X	Y
Reach-6	06	Junction-5	132	0.1187	0.04	Trapezoid	20	3	N/A	N/A
Reach-10	10	Junction-8	1761	0.0651	0.04	Trapezoid	10	10	N/A	N/A

Table A-32 Muskingum-Cunge Inputs – Smith Branch

Reach Name	From Element	To Element	Length (ft)	Slope (ft/ft)	Channel Manning's n	Shape	Trapezoid		Eight Point	
							Bottom Width (ft)	Side Slope (xH:1V)	X	Y
Reach-01	01	Junction-02	1823	0.0077	0.04	Trapezoid	20	10	N/A	N/A
Reach-17	07	Junction-12	4040	0.0472	0.04	Trapezoid	25	10	N/A	N/A

Table A-33 Muskingum-Cunge Inputs – Middle Fork San Gabriel River

Reach Name	From Element	To Element	Length (ft)	Slope (ft/ft)	Channel Manning's n	Shape	Trapezoid		Eight Point	
							Bottom Width (ft)	Side Slope (xH:1V)	X	Y
Reach-1	Junction-1	Junction-2	7989	0.0033	0.045	Trapezoid	30	4	N/A	N/A
Reach-5	81	Junction-21	11174	0.0050	0.045	Trapezoid	26	3	N/A	N/A
Reach-4	Junction-21	Junction-4	10009	0.0033	0.04	Trapezoid	31	6	N/A	N/A

Table A-34 Muskingum-Cunge Inputs – North Fork San Gabriel River

Reach Name	From Element	To Element	Length (ft)	Slope (ft/ft)	Channel Manning's n	Shape	Manning's n		Eight Point	
							L.B. Manning's n	R.B. Manning's n	X	Y
R540	J894	J832	13444	0.0057	0.045	Eight Point	0.24	0.24	0.0 293.77 306.79 338.37 352.28 368.66 384.25 568.88	1293.9 1292.0 1288.3 1283.9 1283.9 1288.4 1291.4 1299.1
R620	J832	J874	16063	0.0046	0.045	Eight Point	0.24	0.2	0.0 172.53 289.62 305.68 320.02 330.40 348.23 600.47	1228.8 1222.5 1217.4 1213.8 1213.8 1217.9 1227.5 1228.9
R1500	J871	J798	19352	0.0042	0.045	Eight Point	0.24	0.24	0.0 296.17 318.41 327.41 346.42 373.98 394.53 828.71	1271.1 1265.8 1262.3 1261.9 1261.9 1264.4 1268.4 1279.0
R1890	J798	J801	14211	0.0036	0.045	Eight Point	0.3	0.4	0.0 204.61 234.46 241.80 250.74 263.55 275.00 571.64	1246.9 1241.9 1235.1 1233.9 1234.1 1236.6 1240.1 1252.8
R1820	J801	J818	6013	0.0029	0.045	Eight Point	0.24	0.2	0.0 66.060 122.18 127.62 149.38 154.05 246.92 450.10	1195.2 1183.3 1175.4 1173.9 1174.1 1176.0 1187.2 1189.4
R1790	J818	J904	12421	0.0028	0.045	Eight Point	0.4	0.3	0.0 102.22 181.79 201.76 231.18 260.48 333.33 434.12	1162.3 1160.6 1155.5 1147.5 1147.7 1155.0 1160.6 1162.3
R1450	J904	J852	18767	0.0026	0.045	Eight Point	0.4	0.4	0.0 235.12 250.13 262.55 285.12 298.04 420.01 468.70	1113.5 1106.7 1101.1 1094.8 1094.6 1102.3 1110.9 1121.8
R1520	J852	J774	20934	0.0030	0.045	Eight Point	0.4	0.35	0.0 70.320 219.69 236.10 270.30 284.81 291.04 400.56	1064.7 1055.9 1052.7 1045.6 1045.6 1053.2 1059.3 1065.7

Table A-34 Muskingum-Cunge Inputs – North Fork San Gabriel River (continued)

Reach Name	From Element	To Element	Length (ft)	Slope (ft/ft)	Channel Manning's n	Shape	Manning's n		Eight Point	
							L.B. Manning's n	R.B. Manning's n	X	Y
R2390	J843	J877	18173	0.0060	0.045	Eight Point	0.4	0.4	0.0 212.17 304.56 320.40 329.39 353.96 511.08 956.67	1003.4 994.75 983.43 978.90 978.90 981.14 986.35 991.99
R2310	J929	J885	17958	0.0047	0.045	Eight Point	0.24	0.24	0.0 12.000 25.510 38.360 66.400 77.530 172.65 353.69	1067.3 1062.7 1048.4 1040.2 1039.6 1046.4 1047.9 1054.3
R2530	J885	J837	16695	0.0039	0.045	Eight Point	0.4	0.4	0.0 222.37 238.73 252.34 268.42 324.98 336.47 393.15	1020.9 1019.1 1014.7 1010.1 1010.2 1014.5 1025.8 1032.1
R2580	J837	J849	19311	0.0043	0.045	Eight Point	0.24	0.24	0.0 159.29 297.21 304.83 333.25 345.22 622.87 797.95	947.97 940.68 927.17 924.51 923.56 931.04 842.36 946.56
R3130	J863	J1113	19584	0.0060	0.045	Eight Point	0.4	0.24	0.0 75.290 95.900 106.52 113.70 145.60 276.71 694.18	854.90 841.83 823.54 819.22 818.76 824.37 831.82 835.44
R2900	J868	J813	11421	0.0058	0.045	Eight Point	0.4	0.4	0.0 56.890 291.78 301.06 307.17 313.34 370.00 704.42	875.41 686.01 852.41 848.02 848.09 832.25 854.35 865.06
R3000	J813	J1103	1586	0.0074	0.045	Eight Point	0.2	0.4	0.0 288.00 445.65 453.84 467.08 471.89 587.87 852.93	842.02 839.26 836.44 831.76 831.12 832.57 837.46 851.06
R3010	J823	J1103	9566	0.0076	0.045	Eight Point	0.3	0.4	0.0 133.00 146.00 153.00 161.00 170.00 287.00 509.00	887.19 875.77 868.94 866.71 866.82 867.46 877.22 881.02

Table A-34 Muskingum-Cunge Inputs – North Fork San Gabriel River (continued)

Reach Name	From Element	To Element	Length (ft)	Slope (ft/ft)	Channel Manning's n	Shape	Manning's n		Eight Point	
							L.B. Manning's n	R.B. Manning's n	X	Y
R3140	J1103	J792	3735	0.0096	0.045	Eight Point	0.24	0.24	0.0 138.16 174.59 208.80 229.49 257.97 285.71 599.23	830.09 822.44 816.93 807.82 807.99 816.03 821.49 832.87

Table A-35 Muskingum-Cunge Inputs – South Fork San Gabriel River

Reach Name	From Element	To Element	Length (ft)	Slope (ft/ft)	Channel Manning's n	Shape	Trapezoid		Eight Point	
							Bottom Width (ft)	Side Slope (xH:1V)	X	Y
R012	J012.1	J012.2	8918	0.0074	0.08	Trapezoid	5	5.3	N/A	N/A
R013	J012.2	J014	10835	0.0054	0.08	Trapezoid	14.5	2.89	N/A	N/A
R014	J013	J014	10058	0.0057	0.08	Trapezoid	10	5.61	N/A	N/A
R015	J014	J011.2	2884	0.0054	0.08	Trapezoid	14.5	3.9	N/A	N/A
R004	J002	J003	643	0.0241	0.08	Trapezoid	7.5	10.8	N/A	N/A
R007	J005	J006	907	0.0166	0.08	Trapezoid	0.5	4.4	N/A	N/A
R091	J091	J091B	5749	0.0080	0.065	Trapezoid	20	6	N/A	N/A
R021	J019	J020	3165	0.0225	0.08	Trapezoid	3.5	3.1	N/A	N/A
R023	J022	J023	3081	0.0162	0.08	Trapezoid	6.5	1.92	N/A	N/A
R025	J025	J026	3525	0.0171	0.08	Trapezoid	3.5	5.6	N/A	N/A
R089	031	J027.2	2733	0.0120	0.07	Trapezoid	2	5	N/A	N/A
R028	J028	J029.2	6257	0.0108	0.08	Trapezoid	4	5.2	N/A	N/A
R030	J030	J031	3654	0.0120	0.08	Trapezoid	5	7.4	N/A	N/A
R033	J033	J034	3894	0.0186	0.08	Trapezoid	5.5	2.15	N/A	N/A
R035	J035	J036	3359	0.0217	0.08	Trapezoid	3.5	2.39	N/A	N/A
R037	J037	J038	4378	0.0178	0.08	Trapezoid	4	10.2	N/A	N/A
R039	J039	J040	3696	0.0081	0.08	Trapezoid	4.5	2.3	N/A	N/A
R040	J040	J041	12017	0.0030	0.08	Trapezoid	8.5	2.06	N/A	N/A
R041	J041	J042	1272	0.0252	0.08	Trapezoid	4	4.01	N/A	N/A
R042	J042	J043	17968	0.0043	0.08	Trapezoid	8	2.8	N/A	N/A
R043	J043	J044	634	0.0026	0.08	Trapezoid	13	1.96	N/A	N/A
R044	J044	J045.2	1915	0.0063	0.08	Trapezoid	13.5	1.26	N/A	N/A
R047	J047	J047.1	4724	0.0148	0.08	Trapezoid	3.5	6.8	N/A	N/A
R047.1	J047.1	J048	3706	0.0148	0.08	Trapezoid	3.5	6.8	N/A	N/A
R049	J049	J050	7170	0.0164	0.08	Trapezoid	6	6.4	N/A	N/A
R053	J053	J054	7492	0.0155	0.08	Trapezoid	8.5	3.1	N/A	N/A
R055	J055	J056	5528	0.0182	0.08	Trapezoid	8	3.2	N/A	N/A
R057	J057	J058.2	10000	0.0085	0.08	Trapezoid	5	2.43	N/A	N/A
R060	J060	J062	13501	0.0078	0.08	Trapezoid	5	5.7	N/A	N/A
R061	J061	J062	10660	0.0099	0.08	Trapezoid	8	6.3	N/A	N/A
R062	J062	J063.2	1474	0.0209	0.08	Trapezoid	8.5	4.2	N/A	N/A
R090	090	J090	1313	0.0256	0.08	Trapezoid	15	2.5	N/A	N/A
R094	094	J094	1333	0.0511	0.08	Trapezoid	15	2.5	N/A	N/A

Table A-36 Muskingum-Cunge Inputs – San Gabriel River

Reach Name	From Element	To Element	Length (ft)	Slope (ft/ft)	Channel Manning's n	Shape	Manning's n		Eight Point	
							L.B. Manning's n	R.B. Manning's n	X	Y
R40	SGJ245	SGJ241	9801	0.0069	0.045	Eight Point	0.24	0.2	0.00 205.73 256.80 273.57 280.33 287.13 339.24 586.39	638.63 633.85 630.38 623.93 622.97 623.40 634.10 642.40
R90	SGJ241	SGJ225	3915	0.0050	0.045	Eight Point	0.4	0.25	0.00 186.41 199.97 209.69 224.31 250.28 309.74 438.02	622.15 625.24 602.28 601.83 601.79 613.25 616.94 619.68
R140	SGJ217	SGJ256	8359	0.0098	0.045	Eight Point	0.2	0.24	0.00 95.47 104.21 113.49 117.67 134.29 169.84 323.28	637.78 623.86 618.92 618.69 618.33 625.60 630.96 635.18

Table A-37 Estimation of Rainfall Depth by Annual Exceedance Probability

Return Frequency	Total Rainfall Depth (inches) in 24 hours
5	4.7
10	5.5
25	6.7
50	8
100	9.1
500	12

Table A-38 HEC-HMS Results – Berry Creek

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
Junction-1	8.04	8286.5	9916.5
Junction-10	54.38	36319	40301.8
Junction-11	55.41	36593.2	40570.7
Junction-12	57.20	34487.5	37951.6
Junction-13	58.20	34723.8	38187.3
Junction-14	58.75	34800.6	38272.1
Junction-15	69.35	36850.5	40393.9
Junction-16	74.43	36299.4	39597.8
Junction-17	76.27	36526.1	39839.7
Junction-18	77.33	36530	39825.4
Junction-19	77.83	36564.6	39860.9
Junction-2	12.39	12294.5	14506.6
Junction-20	78.60	36656.2	39960.9
Junction-21	79.60	36580.7	39849.2
Junction-22	80.50	36468.3	39733.7
Junction-23	80.70	36220.8	39419.6
Junction-24	82.41	36083.8	39216.3
Junction-25	82.92	36090.6	39218.5
Junction-26	83.36	35972.4	39062.9
Junction-27	83.58	35990.8	39084.5
Junction-28	83.99	35935.4	39008.3
Junction-29	120.92	50068.2	54817
Junction-3	20.76	19279.5	22507.2
Junction-30	122.27	49980.3	54887.1
Junction-31	125.44	50696	55605
Junction-32	4.08	4557.9	5432.9
Junction-33	11.41	12422.2	14608.9
Junction-34	3.54	4888.4	6002.6
Junction-35	5.34	7258.2	8885.4
Junction-36	6.73	8921.8	10858.8
Junction-37	10.60	11790.1	13318.1
Junction-38	5.48	5179.8	6214.6
Junction-39	12.67	12090.7	14491.1
Junction-4	39.10	33678.2	38655.1
Junction-40	14.28	12708.5	14967.9
Junction-41	18.01	15837	18618.2
Junction-42	24.25	20799.4	24382.4
Junction-43	27.78	23377.9	27310.9
Junction-44	28.67	23476.9	27452.2
Junction-45	30.30	24173.3	28290.3
Junction-46	30.97	23917.2	28267.4
Junction-47	33.44	25004.6	29592.1
Junction-48	34.74	25063.3	29289.3
Junction-49	36.53	25908.2	30239.4
Junction-5	42.71	33285	37725.4
Junction-50	36.93	25849	29891.7
Junction-51	4.52	5195.8	6267.2
Junction-52	6.24	7101.7	8618
Junction-6	44.62	34517.1	39035.4
Junction-7	47.06	35915.3	40501.7
Junction-8	49.69	35801.3	40017.7
Junction-9	52.41	36372.8	40543
Outlet1	125.44	50696	55605
Reach-1	8.04	8232.9	9816.8
Reach-10	58.75	34401.2	37876
Reach-11	6.73	8327.7	9854.7
Reach-12	5.34	7188	8757.2
Reach-13a	69.35	35901.1	39314.9
Reach-13b	69.35	35583.8	38935.6
Reach-14	76.27	36401	39685.6
Reach-15	77.33	36513.2	39804.4
Reach-16	78.60	36478	39739.5
Reach-17	80.50	36204.1	39400.6
Reach-18	80.70	35923	39044.9
Reach-19	82.41	36048	39171.1
Reach-2	20.76	19110.1	22216.2

Table A-38 HEC-HMS Results – Berry Creek (continued)

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
Reach-20	82.92	35937.9	39025.1
Reach-21	83.58	35903.9	38974.6
Reach-22	120.92	49702.9	54606.4
Reach-23	12.67	11835.4	14035.7
Reach-24	18.01	15815.9	18585
Reach-25	4.52	5182.1	6241.7
Reach-26	24.25	20654.3	24169.3
Reach-27	27.78	23158.8	27086.2
Reach-28	30.30	23766.1	28073.5
Reach-29	33.44	24781.1	28965.3
Reach-3	4.08	4515	5357.8
Reach-30	36.53	25773.6	29806.9
Reach-31	3.57	4239.4	5009.4
Reach-32	12.39	12185.7	14310.1
Reach-33	3.18	3380.8	4028.8
Reach-4	11.41	12388.1	14548
Reach-5	39.10	31506.9	35855
Reach-6	44.62	34462.8	38959.8
Reach-7	47.06	34836.8	39072.1
Reach-8	52.41	35762.4	39757.8
Reach-9	55.41	34186	37624.2
101	2.63	2976.1	3546
102	2.43	2661.2	3226.3
103	1.61	2106.4	2501.9
106	1.72	1964.6	2465.4
107	2.09	2229	2723
110	1.97	2224	2669.3
111	1.02	1199.6	1442.3
112	1.80	2728.4	3401.7
113	3.53	3462.7	4403.7
114	3.73	3277.3	3945.1
116	1.80	2377.2	2891.5
119	3.87	4761.4	5641.2
120	3.54	4888.4	6002.6
123	1.63	1529.3	1980.6
124	1.38	1733.8	2103.7
125	1.00	1213	1495.4
126	0.55	1214.2	1381.4
127	2.47	2577.1	3154
128	1.83	2976.1	3581.7
129	5.08	5206.8	6272.2
130	0.67	1025	1402.1
131	0.89	1287.2	1687.4
133	1.29	1722.8	2113.9
134	1.80	1521.7	1837.5
135	1.71	2549	3088.3
136	3.18	3482.7	4176.9
138	0.40	548.9	655.2
142	1.34	1430	1727.3
149	0.44	666.4	856.1
154	0.41	518.4	658.1
159	0.22	291.7	420.7
164	0.51	793.6	1050.9
179	0.20	317.6	412.7
184	0.90	1132.2	1422.6
189	0.49	918.6	1108.4
190	1.07	1352.1	1792.7
195	0.77	1035.8	1369.3
204	3.57	4307.6	5130.9
212	1.00	1717.8	2010.2
72	4.47	4090.4	4920.7
73	4.35	4535.7	5418.8
74	4.08	3658.5	4385.9
75	4.29	4187.4	5011
76	6.35	5680.9	6809.6
80	7.19	7139.8	8541.1

Table A-38 HEC-HMS Results – Berry Creek (continued)

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
81	5.48	5179.8	6214.6
82	2.51	2647.4	3162.6
84	1.91	2041.4	2437.1
87	1.57	2334.8	2747
89	4.62	5215	6214.6
90	2.71	3073.8	3662.3
91	2.72	3171	3775.4
92	3.61	3835.4	4586.6
93	0.59	987.7	1151.3
98	2.44	3069.4	3658.9
DelWebb	69.35	35901.1	39314.9

*Results are after applying Areal Reduction Factors

Table A-39 HEC-HMS Results – Mankins Branch

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
Junction-1	1.35	1683.1	2093.1
Junction-10	4.06	4303.4	5479.1
Junction-11	1.45	1977.8	2398.9
Junction-12	1.46	2319.8	2725.5
Junction-13	3.94	5141.1	6182.8
Junction-2	2.43	2668.1	3277.6
Junction-3	6.49	6970.9	8756.7
Junction-4	8.00	8154.3	9805.7
Junction-5	13.10	13909.1	16618
Junction-6	13.23	14011.8	16729.9
Junction-7	1.92	2397.9	3235.6
Junction-8	2.74	3381.7	4429.7
Junction-9	3.42	3949.3	5109.9
Outlet1	13.23	14011.8	16729.9
Reach-1	1.92	2392.3	3224
Reach-2	2.74	3356.2	4379.4
Reach-3	3.42	3930.8	5063.5
Reach-4	1.35	1639.5	2012.9
Reach-5	6.49	6851.6	8534.8
Reach-6	1.45	1973.9	2392.2
Reach-7	1.46	2316.9	2720.8
Reach-8	3.94	5129.4	6162.3
Reach-9	13.10	13903.6	16604
34	0.13	142.7	174.5
39	0.82	1011.2	1231.1
40	0.68	1312.3	1624.6
41	0.64	1357.7	1618.3
42	1.05	1265.5	1682.2
43	0.87	1228	1673.1
49	1.17	1155.1	1403.2
50	1.08	1550.5	2085
52	1.51	1836.6	2263.2
53	0.74	871.1	1081.9
54	0.29	561.7	649.3
55	0.56	1022.1	1187.1
56	0.78	990.5	1253.7
57	0.56	699.8	848.5
60	0.90	1385.1	1630.2
66	1.45	1977.8	2398.9

Table A-40 HEC-HMS Results – Pecan Branch

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
BERRY	0.00	1478.8	1573.1
Diversion-1	7.35	4656.1	4833.7
Diversion-2	7.35	4131.3	4263.5
Junction-1	1.34	2087.5	2352.8
Junction-1A	0.88	1483.4	1660.8
Junction-10	5.55	5324.0	5574.0
Junction-11	6.21	5472.4	5707.6
Junction-11A	5.83	5355.2	5585.4
Junction-12	6.83	5616.4	5851.4
Junction-12A	6.47	5520.0	5750.6
Junction-13	7.35	5610.1	5836.6
Junction-2	1.80	2885.1	3201.4
Junction-3	2.19	3339.5	3660.2
Junction-4	2.46	3528.4	3836.0
Junction-5	3.22	4569.1	4888.1
Junction-6	3.50	5067.5	5452.6
Junction-7	4.18	6059.2	6635.0
Junction-8	4.5081	5796.8	6273.9
Junction-9	5.0691	5213.7	5543.6
OUTFALL	7.3492	4131.3	4263.5
Reach-1	0.4198	754.7	875.5
Reach-10	0.3268	1064.3	1202.3
Reach-11	4.5081	4901.7	5191.9
Reach-12	5.0691	5173.8	5415.2
Reach-13	5.5484	5286.4	5511.9
Reach-14	6.2124	5453.5	5682.8
Reach-15	6.8258	5505.7	5731.4
Reach-2	1.3437	2049.6	2306.7
Reach-3	1.7996	2870.1	3172.5
Reach-4	2.1919	3300.1	3611.7
Reach-5	2.4618	3521.1	3826.8
Reach-6	0.7585	1820.4	2066.1
Reach-7	3.2203	4559.4	4876.3
Reach-8	3.5003	5033.2	5426.4
Reach-9	4.1813	5677.4	6145.0
1	0.4198	789.1	929.3
2	0.4596	1141.6	1293.9
3	0.4643	835.7	955.4
4	0.4559	973.7	1091.5
5	0.3923	1062.4	1192.4
6	0.7585	1820.6	2066.4
7	0.2699	710.4	807.7
8	0.28	520.5	604.2
9	0.681	1029.3	1223.3
10	0.3268	1065.3	1204.7
11	0.561	859.5	1052.8
12	0.4793	913.9	1077.4
13	0.3845	609.1	763.8
14	0.2795	647.3	745.5
15	0.3543	578.7	741.5
16	0.2591	466.6	545.6
17	0.5234	767.1	874.9

Table A-41 HEC-HMS Results – Smith Branch

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
Junction-01	1.24	1749.5	2141.4
Junction-02	2.13	3067.5	3673.0
Junction-02a	1.59	2203.2	2648.8
Junction-03	2.94	3660.5	4427.4
Junction-03a	2.40	3144.7	3791.1
Junction-04	2.94	3548.8	4218.0
Junction-05	3.38	3575.2	4147.6
Junction-06	7.42	8203.4	9208.8
Junction-06a	3.75	3763.7	4312.2
Junction-08	7.75	8506.9	9573.3
Junction-09	8.32	8633.6	9691.6
Junction-09a	8.05	8521.5	9565.9
Junction-11	8.83	8711.5	9737.8
Junction-11a	8.58	8619.6	9642.2
Junction-12	1.72	3109.8	3645.0
Junction-12a	1.01	1787.4	2058.1
Junction-13	1.99	3368.9	3913.0
Junction-14	3.0451	4086.4	4547.9
Junction-14a	2.4881	3308.5	3609.9
Junction-15	3.6661	4863.3	5496.5
Junction-16	2.1339	2949.2	3612.2
Junction-17	0.6815	1467.9	1753.4
OUTFALL	9.1964	8838.1	9862.1
Reach-01	0.5399	1023.7	1204.7
Reach-02	1.2442	1730.1	2103.2
Reach-03	0.5655	793.8	983.3
Reach-04	2.1339	2949.2	3612.2
Reach-05	2.1339	2893.5	3488.8
Reach-07	2.9374	3548.8	4218.0
Reach-08	2.9374	3363.6	3923.5
Reach-09	3.3842	3523.1	4069.7
Reach-10	7.4205	8202.1	9206.9
Reach-12	7.754	8413.3	9446.4
Reach-13	8.3153	8514.0	9534.4
Reach-16	8.8307	8680.6	9702.0
Reach-17	0.3577	775.4	958.5
Reach-18	0.6815	1283.1	1497.5
Reach-19	1.7228	2923.3	3413.3
Reach-20	1.9865	2917.9	3224.6
Reach-21	3.0451	4050.6	4497.4
Reach-22	3.6661	4830.5	5447.4
1	0.5399	1025.2	1207.1
2	0.6787	1030.1	1282.4
3	0.5655	833.5	1055.2
4	0.3498	602.2	724.7
5	0.5325	1111.3	1327.9
6	0.3564	625.1	735.1
7	0.3577	775.6	959.1
8	0.411	932.5	1113.9
9	0.2705	554.2	660.8
10	0.271	546.0	626.1
11	0.2637	509.8	594.5
12	0.3272	741.3	880.3
13	0.4468	1064.7	1197.0
14	0.5016	1102.3	1320.6
15	0.557	994.4	1229.7
16	0.3702	709.2	813.3
17	0.621	1291.7	1522.5
18	0.264	756.2	835.2
19	0.2973	970.9	1053.4
20	0.3335	784.5	904.2
21	0.2601	519.9	604.9
22	0.2553	606.0	697.5
23	0.3657	704.6	852.1

Table A-42 HEC-HMS Results – Middle Fork San Gabriel River

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
Junction-1	2.11	2210.6	2630.9
Junction-10	11.43	8955	9840.6
Junction-11	12.19	9186.4	10061.5
Junction-12	13.21	9426.6	10281.4
Junction-13	13.57	9484.7	10339.7
Junction-14	13.83	9563.7	10417.3
Junction-15	14.39	9749.7	10588.6
Junction-16	14.87	9958.4	10766.6
Junction-17	15.27	10037.7	10851.5
Junction-18	15.74	10161.3	10958
Junction-19	16.03	10220.3	11018.4
Junction-2	3.34	3670.6	4295.5
Junction-20	16.94	10369	11165.2
Junction-21	1.95	1979.5	2310.4
Junction-3	4.11	4360.8	4997.5
Junction-4	7.08	7093.4	8238.1
Junction-5	8.74	7999.4	9019.9
Junction-6	9.08	8144.6	9162.5
Junction-7	9.61	8251.8	9253.2
Junction-8	10.33	8503.6	9446.1
Junction-9	10.61	8575.1	9521.6
Outlet1	16.94	10369	11165.2
Reach-1	2.11	2192.5	2599.4
Reach-10	10.61	8523.7	9450.3
Reach-11	12.19	9144.5	10006
Reach-12	13.21	9407.2	10257.4
Reach-14	13.83	9540.4	10388.7
Reach-15	15.27	10025.7	10835.2
Reach-16	16.03	10200.9	10992.5
Reach-2	3.34	3587.2	4161.7
Reach-3	14.39	9730.1	10553.8
Reach-4	1.95	1968.5	2291.2
Reach-5	0.65	699.9	832
Reach-6	9.61	8198.3	9179.8
Reach-7	7.08	6939.1	7983.4
Reach-8	9.08	8095	9093.5
53	0.74	1080.3	1264
55	0.85	1136.9	1345.3
56	1.37	1374.4	1640.9
57	0.76	952.8	1136.9
58	0.52	1132.2	1280.2
59	0.39	527	623.2
62	0.91	1698.8	2034.7
64	1.66	2178.7	2589
65	0.76	1297.8	1491.5
66	0.47	606.1	718.7
68	0.72	854.8	1013.9
69	0.26	360	473.4
73	0.39	772.2	996
74	0.48	428.4	550.8
75	1.02	847.5	1011.5
76	0.82	962.7	1131.5
79	0.56	633.2	842.7
81	0.65	703.2	838
82	0.28	678.8	791.2
83	0.86	927.7	1107.2
88	0.35	624.4	723.8
89	0.29	575.5	680.6
90	0.44	691.8	806.3
92	1.03	1674.2	2021.5
95	0.35	693	861.1

*Results are after applying Areal Reduction Factors

Table A-43 HEC-HMS Results – North Fork San Gabriel River

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
J1	19.26	13583.7	16092.3
J10	222.51	54922.8	57709.3
J11	246.37	56128.9	59779.4
J1103	4.92	3458.4	4020.3
J1113	219.41	54838.7	57576.5
J2	47.60	26772.8	29832.7
J3	55.18	28125.6	31034.4
J4	128.45	48104.3	51538.4
J5	135.80	48595.7	51975.7
J6	155.58	49712.5	52946.6
J7	185.42	53233.6	56437.3
J774	107.33	45494.5	49368.8
J777	198.00	53860.9	56778.4
J780	210.75	54334	57078.3
J783	133.75	48536.6	51960.3
J789	205.28	54210.3	57053.1
J792	228.80	55341.8	58483
J795	200.24	53980.9	56882.7
J798	20.10	11328.1	13286.8
J8	195.38	53690.6	56603.9
J801	25.64	12156.5	13385.1
J804	188.61	53441.1	56654
J807	51.10	27347	30407.6
J810	121.35	46901.7	50495.8
J813	3.96	2539.8	2993.7
J818	34.49	15576.8	18064.4
J823	0.96	1227.7	1457
J826	42.26	25970.6	30072.5
J829	194.54	53651	56568.9
J832	12.12	8829.4	10092.1
J837	23.49	15171.6	16876.6
J840	138.47	48818.6	52210.3
J843	6.75	5477.5	6593.8
J846	230.38	55321.2	58485.7
J849	183.65	53193	56552.7
J852	46.84	18572.2	19819
J857	131.18	48284.1	51712.5
J860	250.04	3362.9	3957.1
J863	4.38	5148.6	6090.2
J868	2.19	2551.3	3038.8
J871	9.22	7367.6	8860.9
J874	36.62	24447	27815.1
J877	153.84	49658.8	52916.4
J882	215.02	54563.2	57298
J885	14.29	10389.7	11587.9
J894	5.89	4568	5516
J9	202.43	54036.5	56874.4
J900	250.97	3616.2	4186.7
J904	38.86	17845.4	19983.5
J907	13.05	10338.8	12488.7
J910	236.77	55702.8	59134
J913	144.71	48762.5	52053.8
J924	207.29	54292.8	57108.6
J929	6.58	5458.6	6587.4
J932	111.36	45837.3	49583
J935	117.89	46874.2	50486.3
Lake Georgetown	246.37	4470.5	4495.7
Outlet1	250.97	3616.2	4186.7
R1060	111.36	45670.7	49310.9
R1140	121.35	46730.4	50224.6
R1300	131.18	48273.9	51692.3
R1450	38.8619	16171.2	17461.6
R1500	9.2204	7022.7	8232.5
R1520	46.8396	18140.4	19261.5
R1650	133.7502	48446	51816.1

Table A-43 HEC-HMS Results – North Fork San Gabriel River (continued)

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
R1790	34.4869	14688.3	16532.3
R1820	25.6385	11991	13106.9
R1890	20.098	10430.6	11573.1
R1960	138.47	48464.4	51744
R230	13.0504	10002.5	12036.8
R2310	6.5837	5330.5	6332.8
R2390	6.7476	5259.8	6151.7
R2400	144.7085	48697.6	51953.1
R2430	153.8418	49604.5	52830.8
R2530	14.2894	10201.6	11399.2
R2580	23.4874	14661.6	16113.8
R2710	183.648	53114.3	56313.8
R2900	2.1923	1881.5	2055.5
R2920	188.6127	53271.2	56223.5
R2940	194.5422	53644.1	56555
R2990	197.9986	53840.8	56738
R3000	3.9574	2532.3	2937.4
R3010	0.9644	1210.6	1423.9
R3020	200.2356	53910.8	56744.5
R3130	4.382	5036.6	5873.7
R3140	4.9218	3457.4	4018.8
R3150	205.2752	54175.4	56987.6
R3640	246.3707	696.5	810.5
R4000	250.0394	3309.5	3861.3
R460	36.6196	24085.3	27651.1
R540	5.8898	4503.4	5350.4
R620	12.1184	8473.1	9522.5
R720	42.2588	25673.2	28599.7
R7550	210.7519	54314	57043.7
R7560	219.4052	54827.4	57557.4
R7570	228.8043	55327	58468.8
R7600	230.3785	55304.8	58470.2
R7680	117.8855	46759.1	50336.9
R7700	207.2916	54215.1	56970.4
R7720	215.0232	54559.9	57292.6
R860	51.103	27159.5	30012.5
R970	107.3345	45335.7	49071.9
379	6.4602	4903.2	5923.3
390	6.5902	5808.4	6994.5
399	5.8898	4568	5516
400	3.5023	3092.9	3722.7
401	6.2095	4965	5984.9
412	5.2413	3924.9	4762.9
417	2.7316	3020.3	3613.8
423	7.0947	4530.2	5500.3
443	6.2286	5519.8	6694.7
445	5.6392	4715.2	5673.2
454	3.4651	5188.6	6114.4
455	5.3419	4731.4	5734.9
467	2.5733	2640.5	3157.4
475	4.0797	3059.3	3694.6
477	6.5207	4977	6000
478	4.0303	3450.6	4175.2
489	5.3122	4777.7	5741.7
497	2.6678	2715.3	3277.5
498	4.375	4336.2	5209.8
508	3.6636	3358.7	4068.4
522	9.2204	7367.6	8860.9
532	6.2125	5262.1	6352.7
533	4.3141	3661.5	4404.8
540	4.1079	3171.1	3820.5
544	2.052	2822	3355.7
554	3.7283	3566	4305.7
555	5.1201	5944.2	7124.8
565	5.5405	6310.6	7588.3
566	4.6651	5695.1	6725.9

Table A-43 HEC-HMS Results – North Fork San Gabriel River (continued)

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
574	2.6397	2440.8	2926.3
588	6.5837	5458.6	6587.4
597	3.1893	3780	4487.6
598	2.9445	3237.3	3860.5
599	6.2385	6631.9	7957.2
605	2.3857	2506.9	2989.2
606	1.7053	1809	2141.4
610	7.7057	7134.9	8556.4
616	1.7409	2221	2658.9
621	2.1923	2551.3	3038.8
632	2.6767	3492.5	4123.3
643	4.5779	4337.7	5207.8
651	1.7754	1850.1	2204.3
653	6.2535	5775.3	6941.7
654	1.0196	1290.7	1532.3
657	3.1063	3289.1	3886.5
658	5.9295	4967.1	5929.8
660	0.9644	1227.7	1457
661	3.4603	3405.1	4055
663	0.8407	1281.9	1514.6
665	0.7455	1198.2	1401.1
673	2.6157	3218.4	3749.1
674	2.237	2656.8	3151.7
675	1.371	1988.6	2339.4
676	2.1953	2687.9	3188.5
690	2.8443	3687	4339.2
691	9.604	14113.1	16339.8
698	2.0164	2612.6	3066.6
703	4.2713	4625.9	5503.3
709	6.3882	4859.8	5760.4
727	3.6687	3778.5	4440.3
747	1.5742	2104.6	2473.9
750	0.9263	1793.2	2041.9

*Results are after applying Areal Reduction Factors

Table A-44 HEC-HMS Results – South Fork San Gabriel River

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
J001	6.97	6068.4	7414.0
J002	1.02	1203.5	1462.1
J003	7.98	6715.5	8207.4
J004	8.91	7298.3	8885.2
J005	2.48	2879.5	3524.3
J006	11.40	9051.8	10720.6
J007	12.86	9835.8	11432.8
J008	14.50	11038.1	12761.6
J009	15.84	11915.2	13753.3
J010	20.08	15250.7	17480.7
J011	20.80	15441.7	17658.1
J011.2	41.73	35489.6	41247.6
J012.1	6.48	7682.3	9266.2
J012.2	11.91	13079.9	15623.4
J013	5.98	7347.6	8969.8
J014	20.93	21901.8	25934.0
J015	42.13	35620.4	41367.0
J016	44.57	37477.2	43536.4
J016.2	45.67	38033.2	44133.1
J017	47.24	39033.5	45110.3
J018	48.42	39615.0	45690.9
J019	0.45	786.1	913.2
J020	48.87	39813.6	45840.8
J021	49.58	39941.8	45910.5
J021.2	54.44	43034.4	48898.0
J022	1.00	1579.8	1854.4
J023	55.44	43519.0	49356.6
J024	55.91	43591.7	49446.6
J025	0.42	770.9	894.7
J026	56.33	43751.8	49604.7
J027	56.82	43814.7	49651.9
J027.2	57.62	44259.8	50076.9
J028	0.96	1089.0	1304.3
J029	59.45	44431.8	50250.6
J029.2	60.41	44763.2	50579.8
J030	0.84	1473.2	1730.9
J031	61.24	45009.4	50832.4
J032	61.69	44977.5	50788.9
J033	0.44	795.2	918.3
J034	62.42	45107.4	50889.9
J035	0.47	709.3	830.3
J036	63.25	45284.5	51031.5
J037	0.51	684.2	805.7
J038	64.15	45546.3	51272.6
J039	5.05	6167.4	7413.5
J040	8.73	10966.5	13101.2
J041	12.04	13887.7	15937.8
J042	14.67	16960.7	19426.4
J043	18.55	19525.3	21815.5
J044	21.70	21820.1	24638.2
J045	64.72	45538.9	51263.2
J045.2	86.42	57829.7	63998.0
J046	87.77	58221.3	64372.4
J047	0.25	533.1	599.6
J047.1	0.68	1332.3	1457.7
J048	88.96	58393.1	64554.8
J049	0.27	494.0	567.0
J050	89.60	58483.0	64648.4
J051	91.22	58496.9	64632.0
J052	91.72	58524.6	64656.2
J053	0.40	639.2	745.0
J054	92.87	58775.9	64913.0
J055	0.32	907.4	1018.5
J056	93.92	58923.7	65041.6
J057	4.06	4982.8	5943.0
J058	96.23	59168.0	65230.8

Table A-44 HEC-HMS Results – South Fork San Gabriel River (continued)

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
J058.2	102.50	60929.8	66863.9
J059	103.68	60984.5	66894.8
J059.2	105.76	61424.1	67326.9
J060	0.89	1112.4	1321.4
J061	0.33	588.1	684.8
J062	1.22	1489.6	1758.3
J063	106.45	61460.6	67350.1
J063.2	110.09	61506.9	67376.4
J064	111.17	61538.1	67369.1
J064.2	112.41	61748.1	67585.1
J065	116.10	62015.0	67774.1
J066	117.42	62087.8	67827.0
J066.2	118.69	62264.4	68008.7
J067	119.54	62356.8	68103.4
J068	123.72	62100.9	67754.3
J068.2	125.81	62380.1	68030.0
J069	126.18	61485.4	66766.4
J069.2	127.31	61607.6	66893.1
J070	129.94	61708.9	66958.8
J070.2	131.14	61410.2	66603.9
J071	132.65	61430.6	66588.1
J072	133.24	61456.5	66610.0
J073	134.17	61506.5	66656.0
J090	133.49	61469.0	66622.2
J091	2.21	2527.3	3042.1
J091B	4.25	4919.0	5848.1
J092	113.97	61848.6	67627.4
J094	133.67	61475.1	66626.3
OUTFALL	134.53	61526.4	66671.6
R001	5.37	4723.8	5747.7
R002.1	6.97	6057.3	7390.4
R004	1.02	1203.4	1461.8
R005	7.98	6709.3	8189.6
R006	8.91	7294.8	8872.7
R007	2.48	2878.8	3522.9
R008	11.40	9025.8	10675.7
R009	14.50	11018.0	12724.9
R010	15.84	11903.1	13730.9
R011	20.08	15198.9	17402.6
R012	6.48	7626.6	9167.0
R013	11.91	12912.2	15328.2
R014	5.98	7232.1	8765.5
R015	20.93	21826.2	25810.8
R016	41.73	35436.3	41173.3
R017	42.13	35413.5	41158.9
R018	45.67	38003.4	44034.9
R019	47.24	38943.8	45007.9
R020	48.42	39624.7	45652.0
R021	0.45	785.1	911.7
R022	48.87	39689.7	45664.0
R023	1.00	1577.5	1850.8
R024	55.44	43448.3	49301.4
R025	0.42	769.0	892.0
R026	56.33	43693.0	49524.0
R027	57.62	43880.0	49706.9
R028	0.96	1086.3	1299.5
R029	60.41	44745.0	50564.6
R030	0.84	1467.1	1721.6
R031	61.24	44883.3	50689.1
R032	61.69	44924.8	50702.3
R033	0.44	793.5	915.8
R034	62.42	45053.0	50800.5
R035	0.47	708.7	829.4
R036	63.25	45234.7	50969.0
R037	0.51	683.4	804.3
R038	64.15	45420.6	51139.3

Table A-44 HEC-HMS Results – South Fork San Gabriel River (continued)

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
R039	5.05	6151.4	7385.5
R040	8.73	10303.5	12022.4
R041	12.04	13886.3	15935.0
R042	14.67	16291.6	18467.6
R043	18.55	19461.2	21732.3
R044	21.70	21783.2	24587.3
R045	86.42	57791.9	63957.7
R046	87.77	58138.8	64287.2
R047	0.25	530.3	595.3
R047.1	0.68	1328.2	1451.5
R048	88.96	58333.5	64493.1
R049	0.27	491.7	563.2
R050	89.60	58331.5	64475.6
R051	91.22	58433.1	64558.9
R052	91.72	58518.2	64648.0
R053	0.40	637.0	741.3
R054	92.87	58703.0	64816.6
R055	0.32	899.6	1004.7
R056	93.92	58672.6	64741.1
R057	4.06	4948.0	5881.1
R058	102.50	60791.7	66689.7
R059	105.76	61354.5	67236.5
R060	0.89	1098.5	1296.8
R061	0.33	577.5	668.0
R062	1.22	1489.2	1757.8
R063	110.09	61391.5	67211.2
R064	112.41	61622.9	67389.2
R064.1	113.97	61731.8	67469.8
R065	116.10	61918.6	67650.4
R066	118.69	62253.2	67995.7
R067	119.54	61957.4	67615.0
R068	125.81	61448.0	66727.9
R069	127.31	61455.1	66701.4
R070	131.14	61299.4	66454.9
R071	132.65	61410.1	66562.6
R072	133.24	61448.8	66601.4
R072.1	133.49	61460.0	66611.1
R072.2	133.67	61467.0	66615.7
R073	134.17	61498.9	66643.5
R089	0.80	1095.3	1297.7
R090	0.26	628.7	737.7
R091	2.21	2519.9	3029.2
R094	0.18	346.9	403.5
1	5.37	4754.7	5773.8
2	1.60	1427.3	1745.9
3	1.02	1203.5	1462.1
4	0.93	1084.8	1324.5
5	2.48	2879.5	3524.3
6	1.46	2106.7	2505.9
7	1.64	2130.6	2549.7
8	1.34	1462.7	1834.8
9	2.21	2527.3	3042.1
10	0.72	1214.9	1423.1
11	4.75	5604.8	6787.0
12	1.73	2077.8	2480.2
13	1.82	2542.2	3021.2
14	3.60	3912.4	4718.6
15	1.43	2491.6	2912.7
16	4.11	5397.8	6519.6
17	1.87	2037.0	2550.4
18	1.61	2052.5	2459.4
19	0.40	637.4	749.6
20	2.43	2343.6	2850.8
21	1.11	1695.9	2032.8
22	1.57	1986.7	2385.7
23	1.19	1593.0	1898.4

Table A-44 HEC-HMS Results – South Fork San Gabriel River (continued)

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
24	0.45	786.1	913.2
25	0.71	1007.5	1212.5
26	4.86	5442.8	6479.3
27	1.00	1579.8	1854.4
28	0.47	835.3	974.0
29	0.42	770.9	894.7
30	0.50	1090.5	1247.9
31	0.80	1096.7	1299.9
32	1.58	2428.4	2854.6
33	0.96	1089.0	1304.3
34	0.25	408.3	468.2
35	0.84	1473.2	1730.9
36	0.45	833.6	971.5
37	0.44	795.2	918.3
38	0.29	618.7	748.2
39	0.47	709.3	830.3
40	0.36	756.0	886.0
41	0.51	684.2	805.7
42	0.39	768.0	870.1
43	3.15	2806.3	3355.9
44	2.71	3311.8	3953.0
45	2.34	2859.7	3465.6
46	0.67	1090.4	1270.4
47	3.01	4539.6	5440.4
48	3.31	4622.6	5427.6
49	2.63	3664.4	4374.0
50	3.87	4873.9	5832.5
51	0.57	1182.8	1349.3
52	1.35	1815.8	2159.7
53	0.25	533.1	599.6
54	0.50	1061.3	1216.3
55	0.27	494.0	567.0
56	0.38	926.0	1042.9
57	1.63	2509.9	2954.7
58	0.49	1076.7	1227.7
59	0.40	639.2	745.0
60	0.75	1725.4	1948.1
61	0.32	907.4	1018.5
62	0.73	1134.8	1329.7
63	2.31	3140.3	3726.2
64	1.94	2169.9	2585.8
65	2.12	3154.9	3742.1
66	2.21	2155.6	2559.0
67	1.18	1865.7	2230.5
68	2.07	2833.5	3350.4
69	0.89	1112.4	1321.4
70	1.53	2266.3	2671.9
71	0.69	1276.5	1489.4
72	0.33	588.1	684.8
73	0.89	1552.8	1820.2
74	1.08	1980.0	2324.5
75	1.24	1742.7	2116.6
76	1.56	2692.8	3169.7
77	1.32	1877.5	2267.9
78	1.28	2104.0	2469.6
79	0.85	1734.8	1988.3
80	4.18	5854.3	7056.5
81	2.09	2679.7	3212.3
82	0.37	538.1	659.4
83	1.14	1551.3	1975.9
84	2.63	4246.6	4998.2
85	1.20	1935.0	2231.8
86	1.51	2689.4	3177.0
87	0.58	1563.4	1757.4
88	0.50	1356.4	1531.9
89	0.36	1001.7	1130.1

Table A-44 HEC-HMS Results – South Fork San Gabriel River (continued)

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
90	0.26	629.2	739.1
91	2.04	2726.6	3257.9
92	2.13	2889.5	3651.9
93	0.43	1131.9	1265.9
94	0.18	347.1	403.5

Table A-45 HEC-HMS Results – San Gabriel River

Element Name	Area (mi^2)	Existing Conditions 100-Year Peak Discharge (cfs)	Future Developed 100-Year Peak Discharge (cfs)
B-SG	549.46	109413	113066.8
R110	414.90	67128.9	69018.5
R140	0.67	1113.4	1113.4
R150	556.12	109691.4	112840.4
R170	414.19	67192	70526.1
R180	403.71	66224.3	70907.7
R220	403.86	66191.8	70659.6
R240	558.21	109656.6	112666.5
R290	402.43	66133.2	70827.7
R310	559.38	109598.2	112356.3
R330	574.50	111359.5	114125.1
R360	573.17	111306.7	114093.5
R40	2.54	3572	3572
R70	549.46	109268	112442.4
R80	550.03	109301	112491.3
R90	6.09	7929.3	7929.3
San Gabriel	575.94	111446.2	114216
SF-SG	402.43	66179.6	71004.6
SGJ10	414.90	67241.1	70575.5
SGJ188	575.94	111446.2	114216
SGJ193	573.17	111310.1	114096.5
SGJ199	403.71	66233.7	70932.3
SGJ202	403.86	66234.8	70918.4
SGJ205	559.38	109728.2	112741
SGJ217	0.67	1121.5	1121.5
SGJ225	556.12	109748.3	112961.4
SGJ228	550.03	109301.4	112492.4
SGJ241	6.09	7986.9	7986.9
SGJ245	2.54	3730.6	3730.6
SGJ256	558.21	109827.4	112981.6
SGJ267	574.50	111393.3	114184.6
S-SG	414.19	67218	70631.9
36	1.32	1978.3	1978.3
37	1.22	1757.7	1757.7
38	2.44	3572.5	3572.5
39	1.11	1681.8	1681.8
40	0.46	715.4	715.4
41	1.32	1659.6	1659.6
42	1.33	1549.9	1549.9
43	0.32	420.7	172.6
44	0.25	366.8	366.8
45	0.51	815.9	815.9
48	0.36	611.6	611.6
49	0.91	1338.2	1338.2
50	0.31	510.4	510.4
52	0.16	345.5	348.5
53	0.46	714.4	837.9
54	0.25	474.3	474.3
56	0.75	1265.5	1275.3
57	1.18	1914.3	1914.3
58	0.76	1340.4	1563.9
59	0.52	938.5	946.1
64	0.37	664.6	764.6
67	0.55	727.5	727.5
68	1.44	2230.1	2230.1

*Results are after applying Areal Reduction Factors
**HMS model for San Gabriel includes all other study areas; however, results shown here exclude the other study area results because they are already shown in Tables A-38 to A-44

FIGURES

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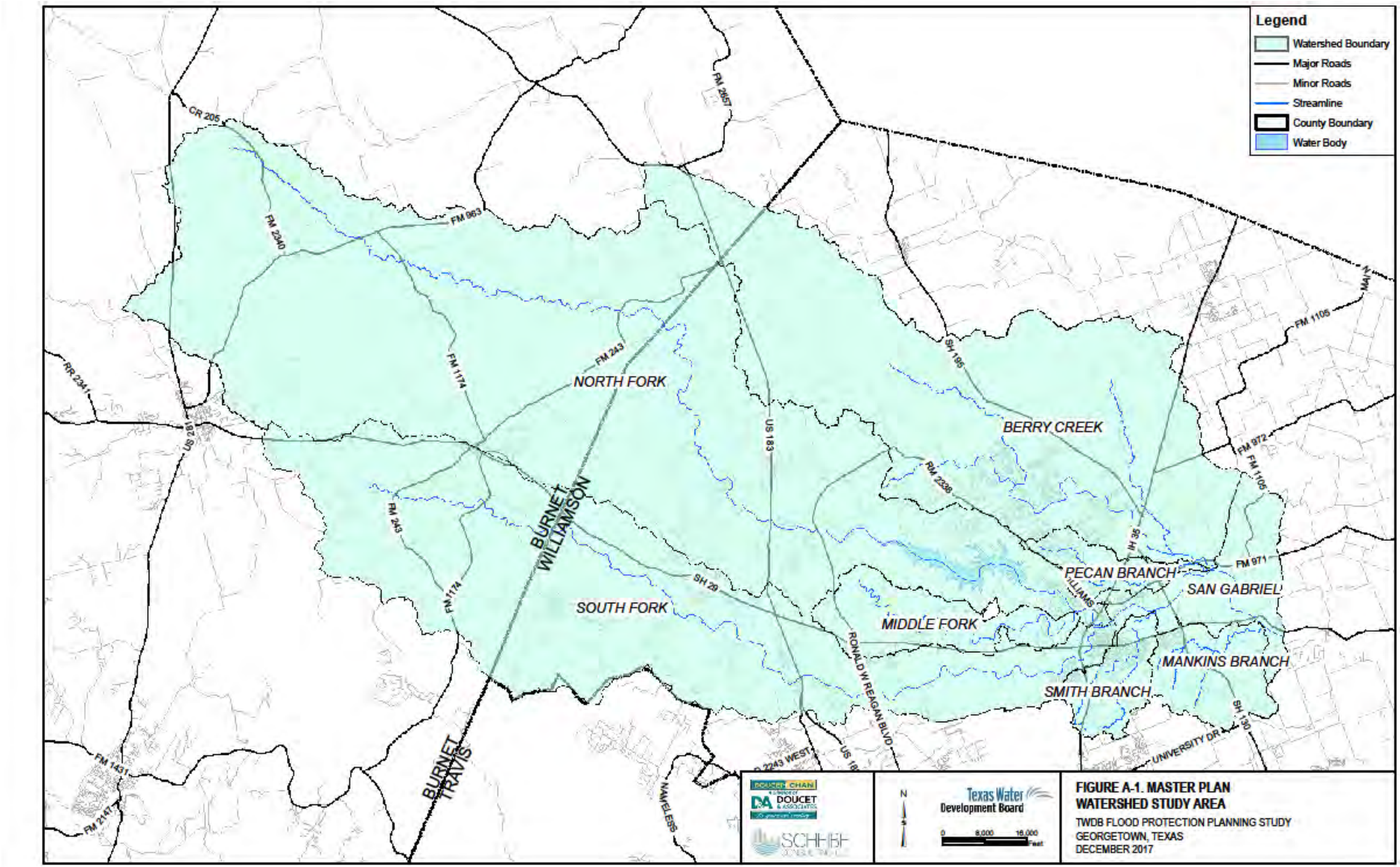
Legend
Watershed Boundary
Major Roads
Minor Roads
Streamline
County Boundary
Water Body
CR 205
FM 2657
FM 963
FM 2240
FM 1174
FM 243
NORTH FORK
US 183
SH 195
BERRY CREEK
FM 1105
MAIN
RR 2341
US 281
RM 2239
FM 972
FM 1105
BURNET
WILLIAMSON
FM 243
IH 35
FM 971
PECAN BRANCH
SAN GABRIEL
SH 29
FM 1174
SOUTH FORK
MIDDLE FORK
WILLIAMS
RONALD W REAGAN BLVD
MANKINS BRANCH
SMITH BRANCH
SH 29
UNIVERSITY DR
FM 1431
2243 WEST
US 18
BURNET
TRAVIS
NAMELESS
FM 2147
BOUCHER CHAN
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DOUCET & ASSOCIATES
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Feet
FIGURE A-1. MASTER PLAN
WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

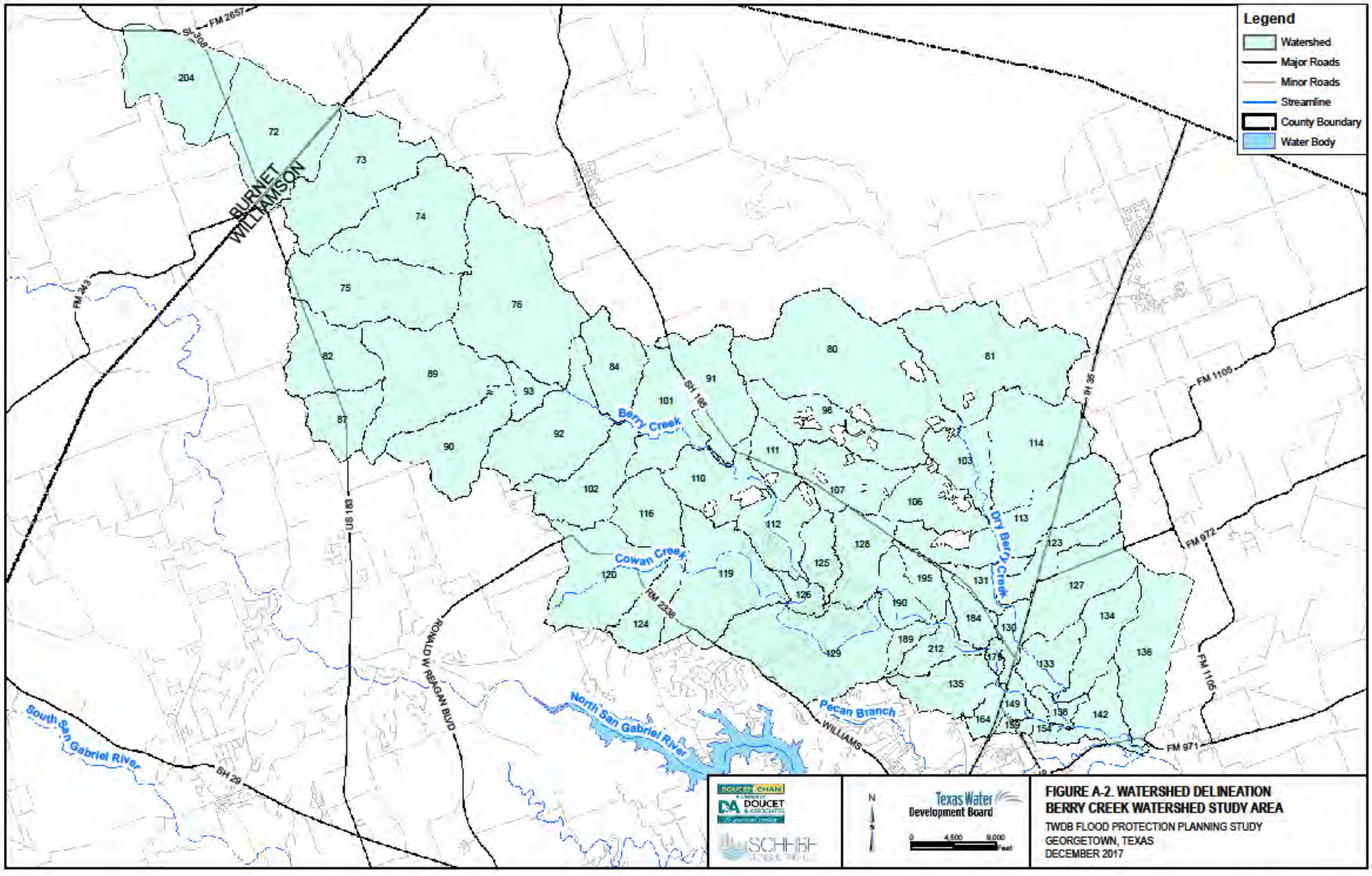
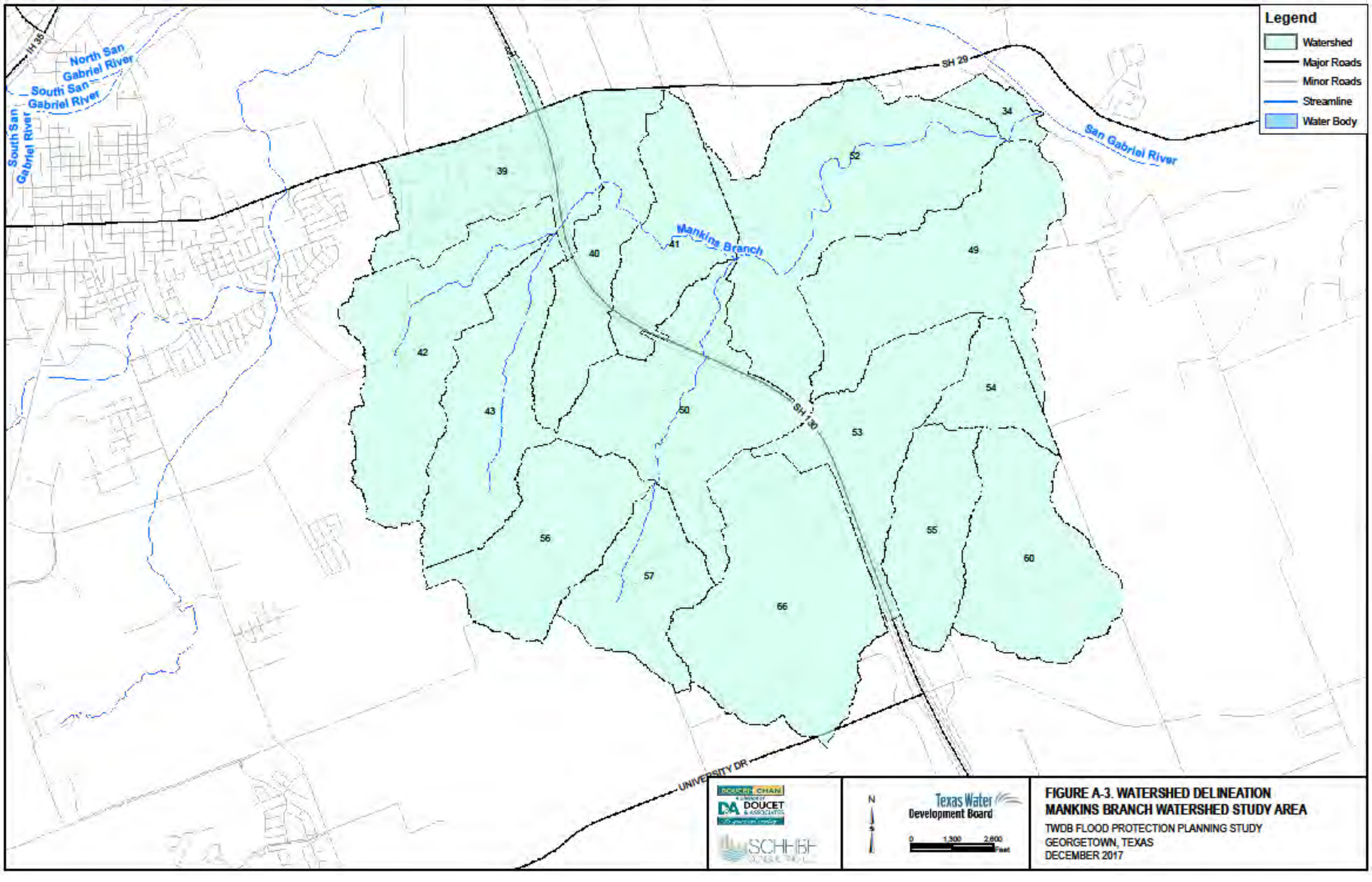
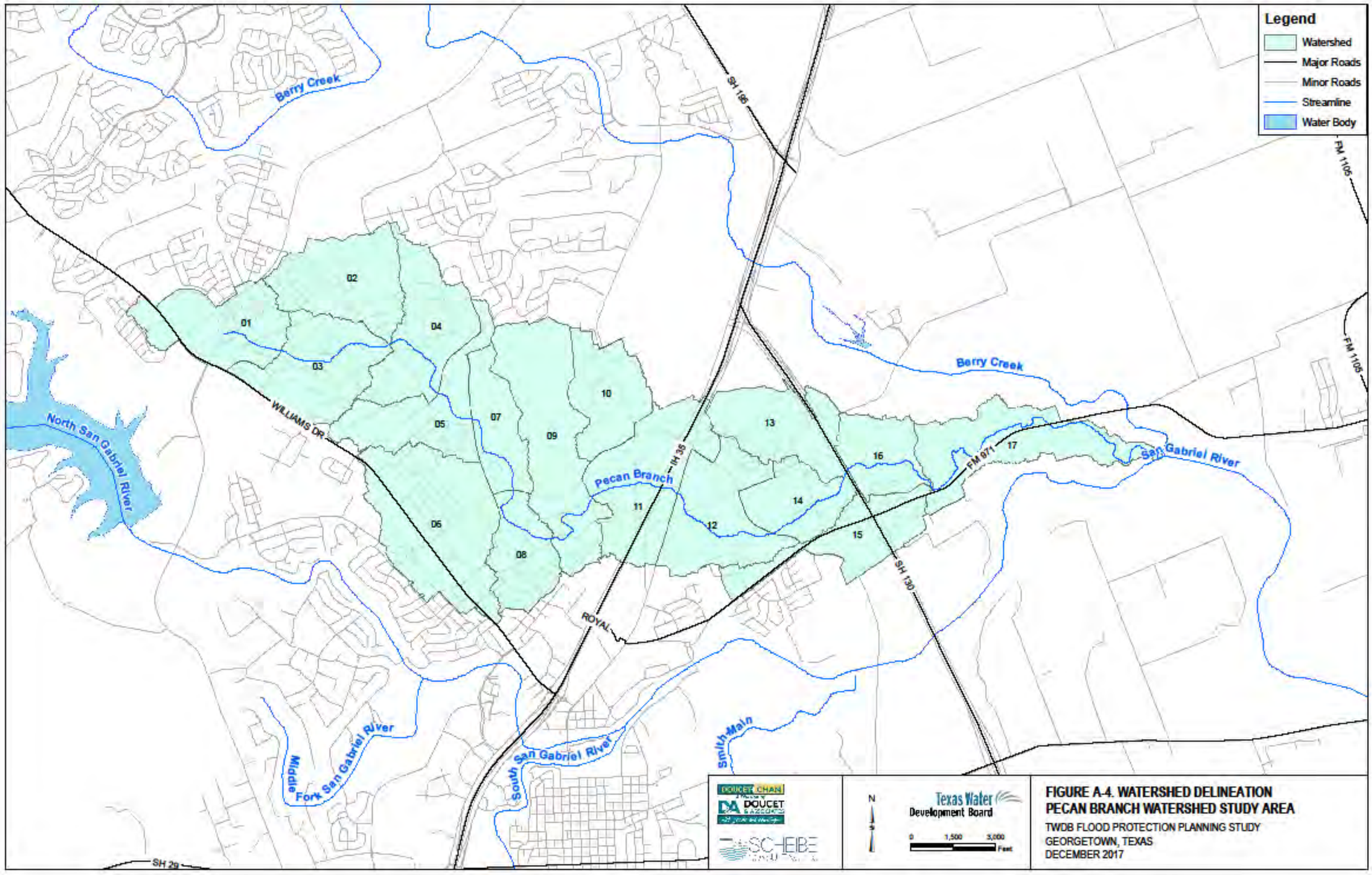
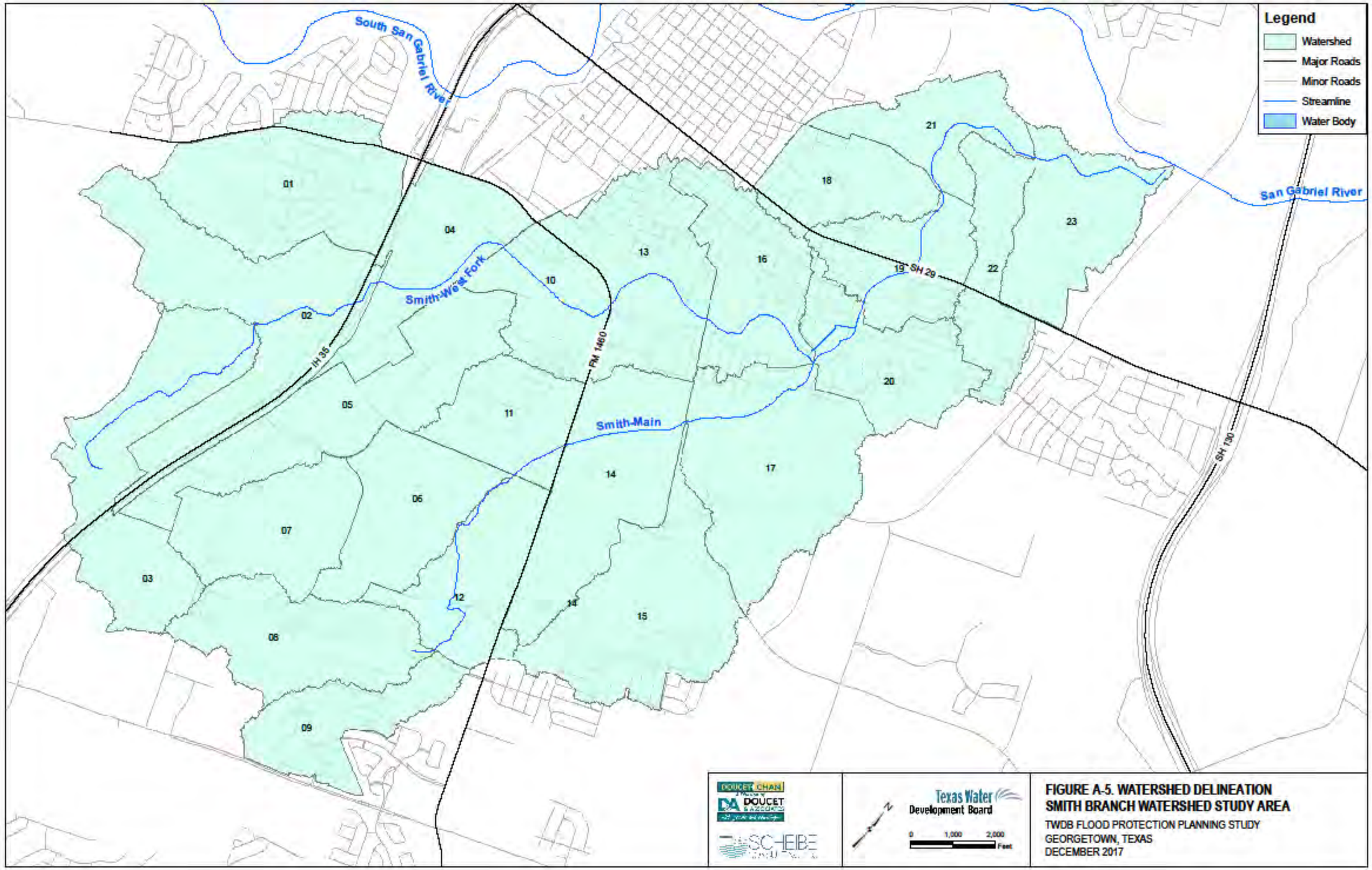


FIGURE A-2. WATERSHED DELINEATION
BERRY CREEK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Roads
Streamline
Water Body
IH 35
North San Gabriel River
South San Gabriel River
South San Gabriel River
SH 29
San Gabriel River
Manking Branch
SH 130
UNIVERSITY DR
39
40
41
42
43
50
52
34
49
54
53
55
60
56
57
66
N
0
1,300
2,600
Feet
Texas Water Development Board
FIGURE A-3. WATERSHED DELINEATION
MANKINS BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Roads
Streamline
Water Body
Berry Creek
SH 195
FM 1105
Berry Creek
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
WILLIAMS DR
IH 35
Pecan Branch
FM 971
San Gabriel River
North San Gabriel River
ROYAL
SH 130
Middle Fork San Gabriel River
South San Gabriel River
Smith Main
SH 29
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
N
Texas Water Development Board
0 1,500 3,000 Feet
FIGURE A-4. WATERSHED DELINEATION
PECAN BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Roads
Streamline
Water Body
South San Gabriel River
San Gabriel River
Smith-West Fork
Smith-Main
IH 35
RM 1460
SH 29
SH 130
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
Texas Water Development Board
0 1,000 2,000 Feet
FIGURE A-5. WATERSHED DELINEATION
SMITH BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

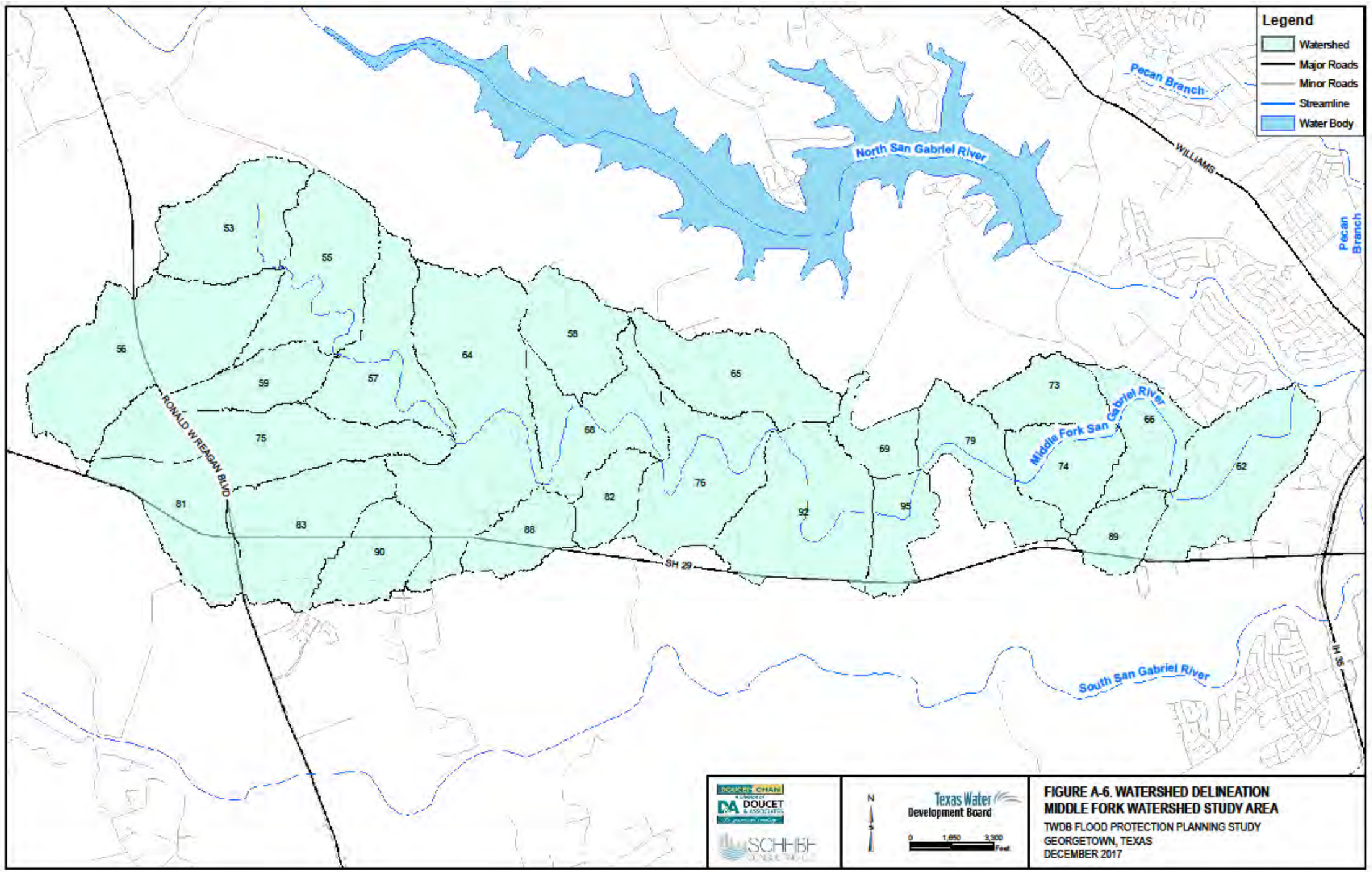


FIGURE A-6. WATERSHED DELINEATION
MIDDLE FORK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

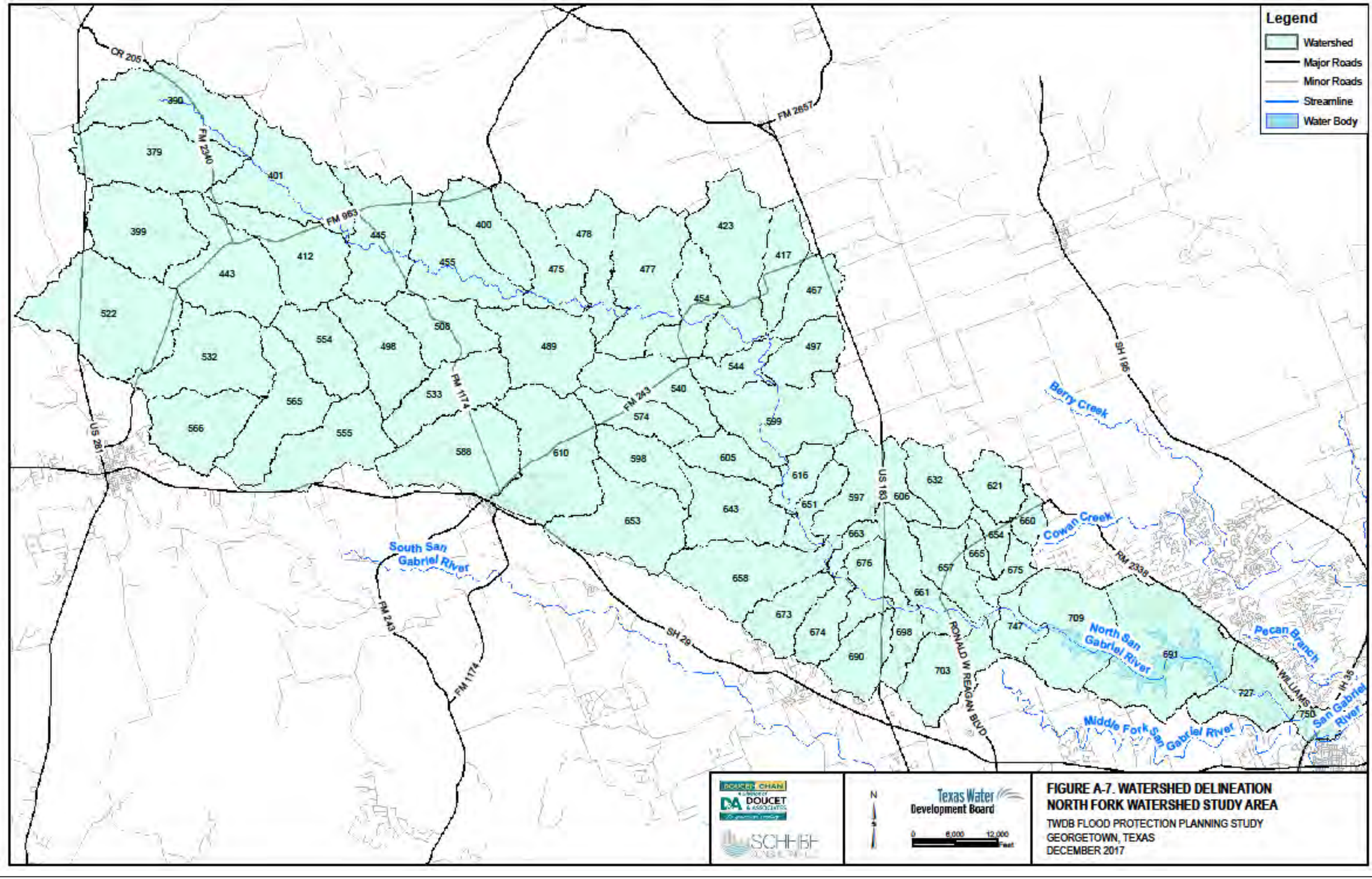
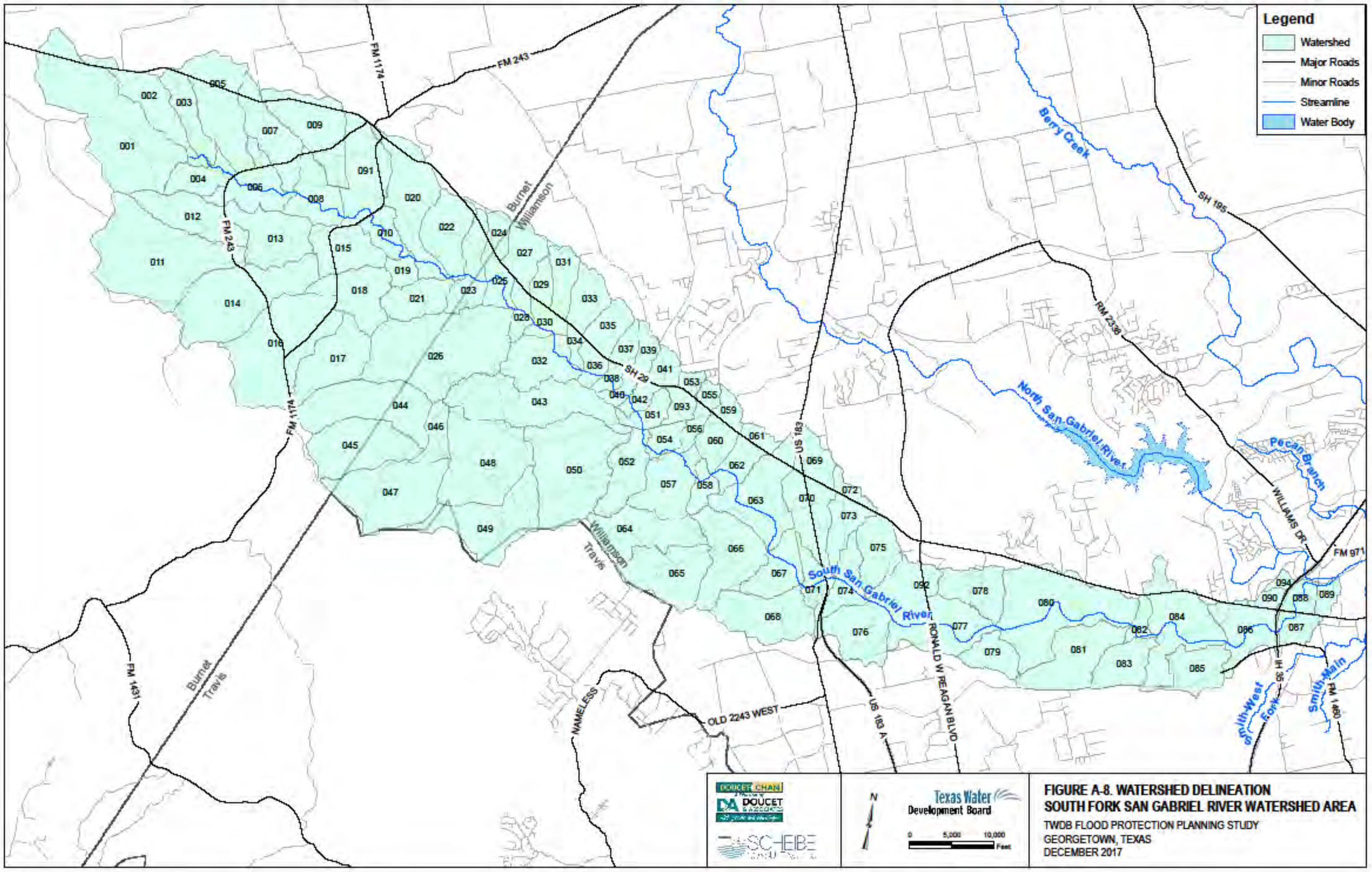


FIGURE A-7. WATERSHED DELINEATION
NORTH FORK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Roads
Streamline
Water Body
FM 1174
FM 243
Burnet
Williamson
Berry Creek
SH 195
RM 2338
North San Gabriel River
Pecan Branch
WILLIAMS DR
FM 971
US 183
SH 29
Williamson
Travis
South San Gabriel River
RONALD W REAGAN BLVD
US 183 A
OLD 2243 WEST
NAMELESS
FM 1431
IH 35
South Fork San Gabriel River
Smith Main
FM 1460
001
002
003
004
005
006
007
008
009
010
011
012
013
014
015
016
017
018
019
020
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072
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075
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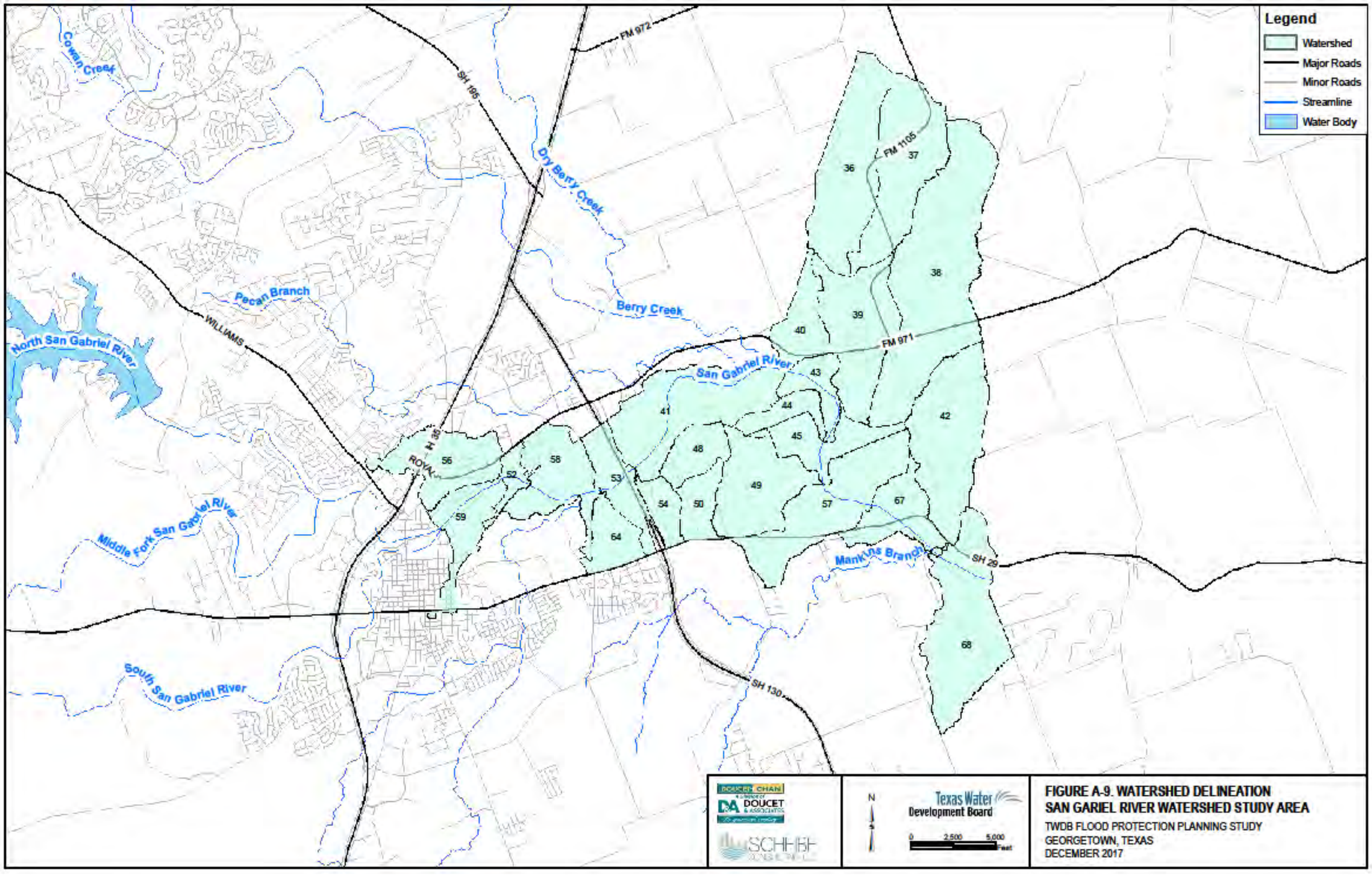
079
080
081
082
083
084
085
086
087
088
089
090
091
092
093
094
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
N
Texas Water Development Board
0 5,000 10,000 Feet
FIGURE A-8. WATERSHED DELINEATION
SOUTH FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Roads
Streamline
Water Body
Cowan Creek
SH 195
FM 972
Dry Berry Creek
FM 1105
Pecan Branch
Berry Creek
WILLIAMS
North San Gabriel River
San Gabriel River
FM 971
ROYAL
Middle Fork San Gabriel River
Mankins Branch
SH 29
South San Gabriel River
SH 130
36
37
38
39
40
41
42
43
44
45
48
49
50
52
53
54
56
57
58
59
64
67
68
N
Texas Water Development Board
0
2,500
5,000
Feet
FIGURE A-9. WATERSHED DELINEATION
SAN GARIEL RIVER WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

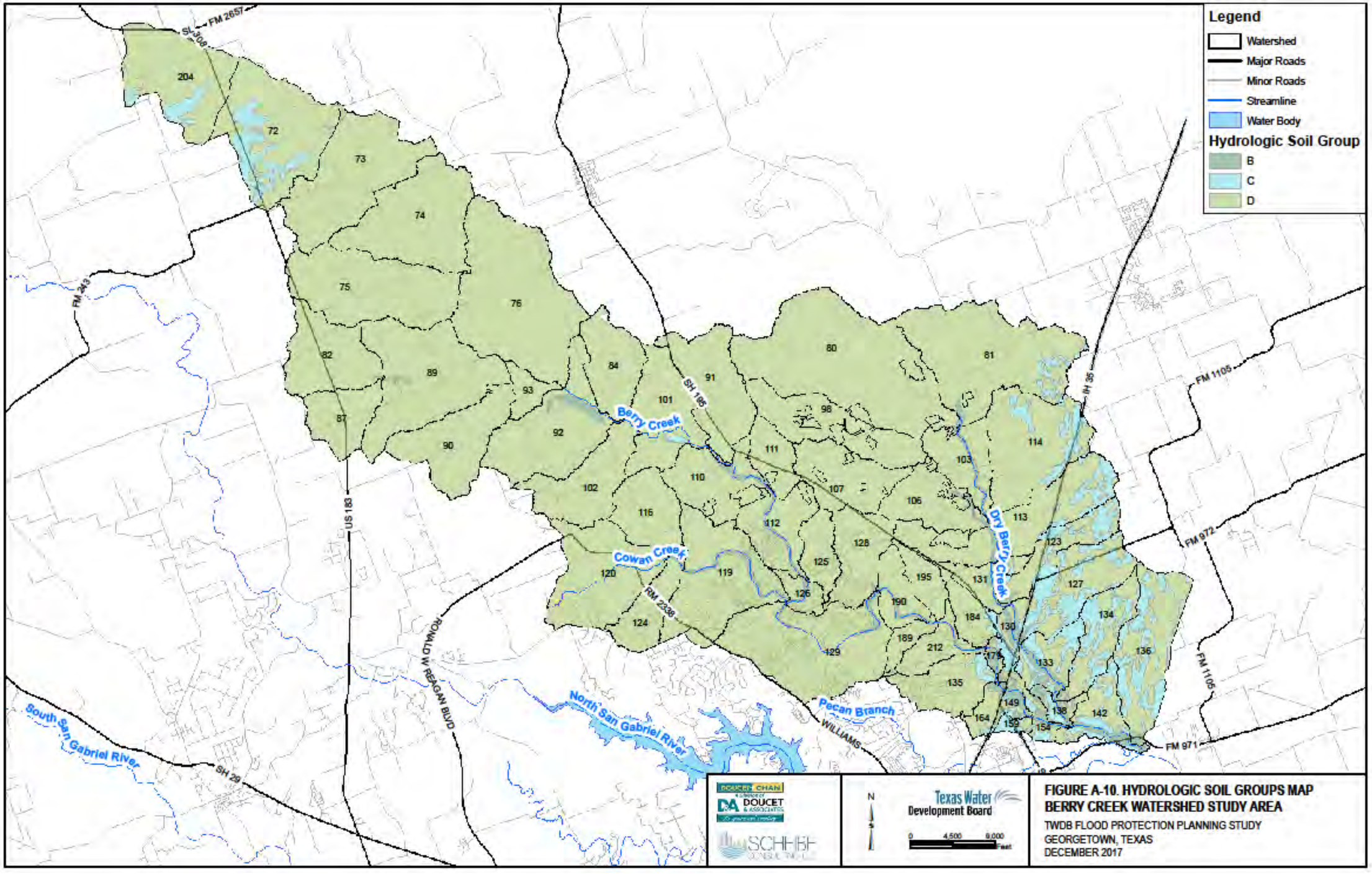


FIGURE A-10. HYDROLOGIC SOIL GROUPS MAP
BERRY CREEK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

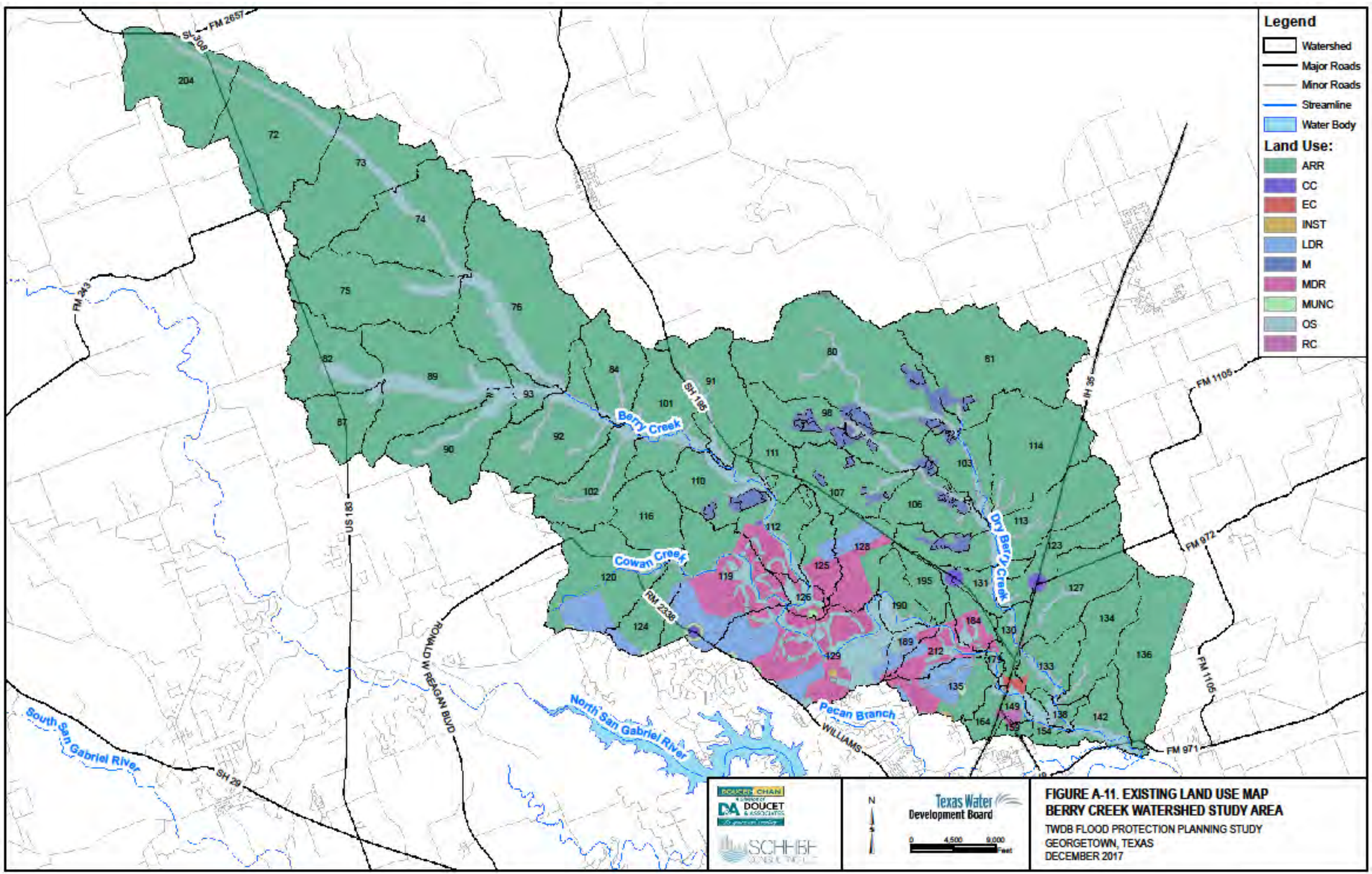


FIGURE A-11. EXISTING LAND USE MAP
BERRY CREEK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

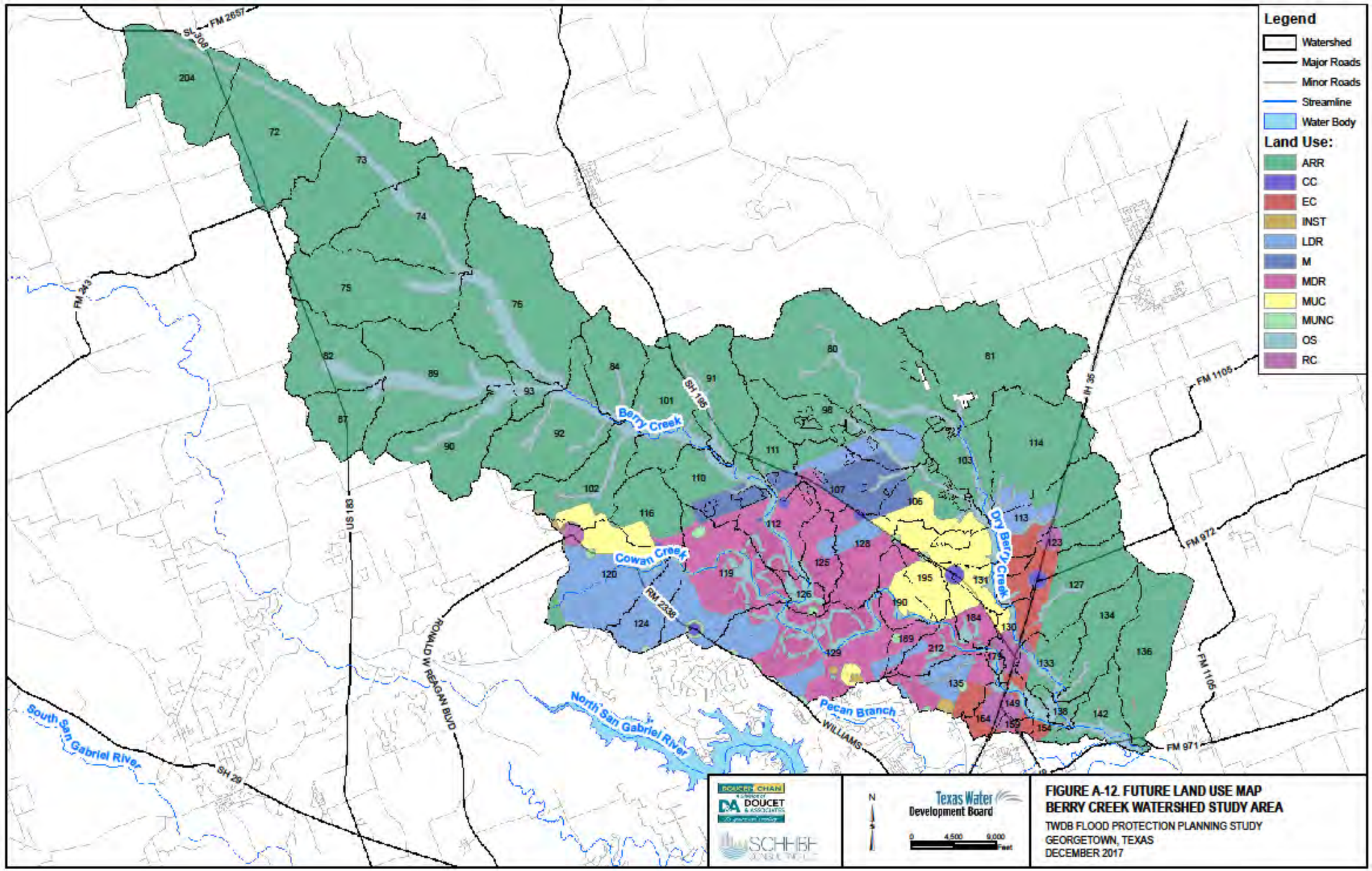
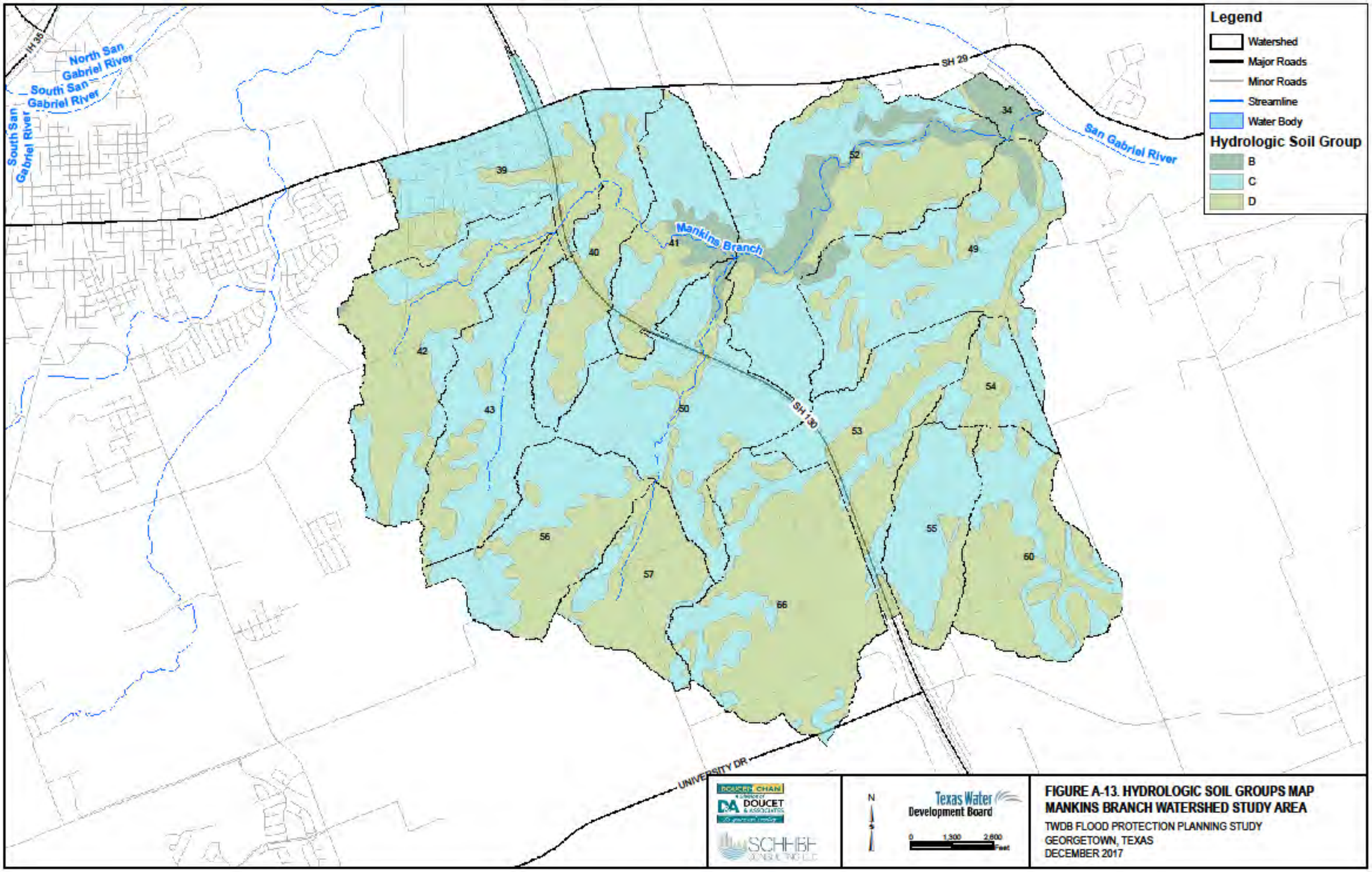


FIGURE A-12. FUTURE LAND USE MAP
BERRY CREEK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Roads
Streamline
Water Body
Hydrologic Soil Group
B
C
D
IH 35
North San Gabriel River
South San Gabriel River
South San Gabriel River
SH 29
San Gabriel River
Mankins Branch
SH 130
UNIVERSITY DR
39
40
41
42
43
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52
34
49
53
54
55
56
57
60
66
N
Texas Water Development Board
0 1,300 2,600 Feet
FIGURE A-13. HYDROLOGIC SOIL GROUPS MAP
MANKINS BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

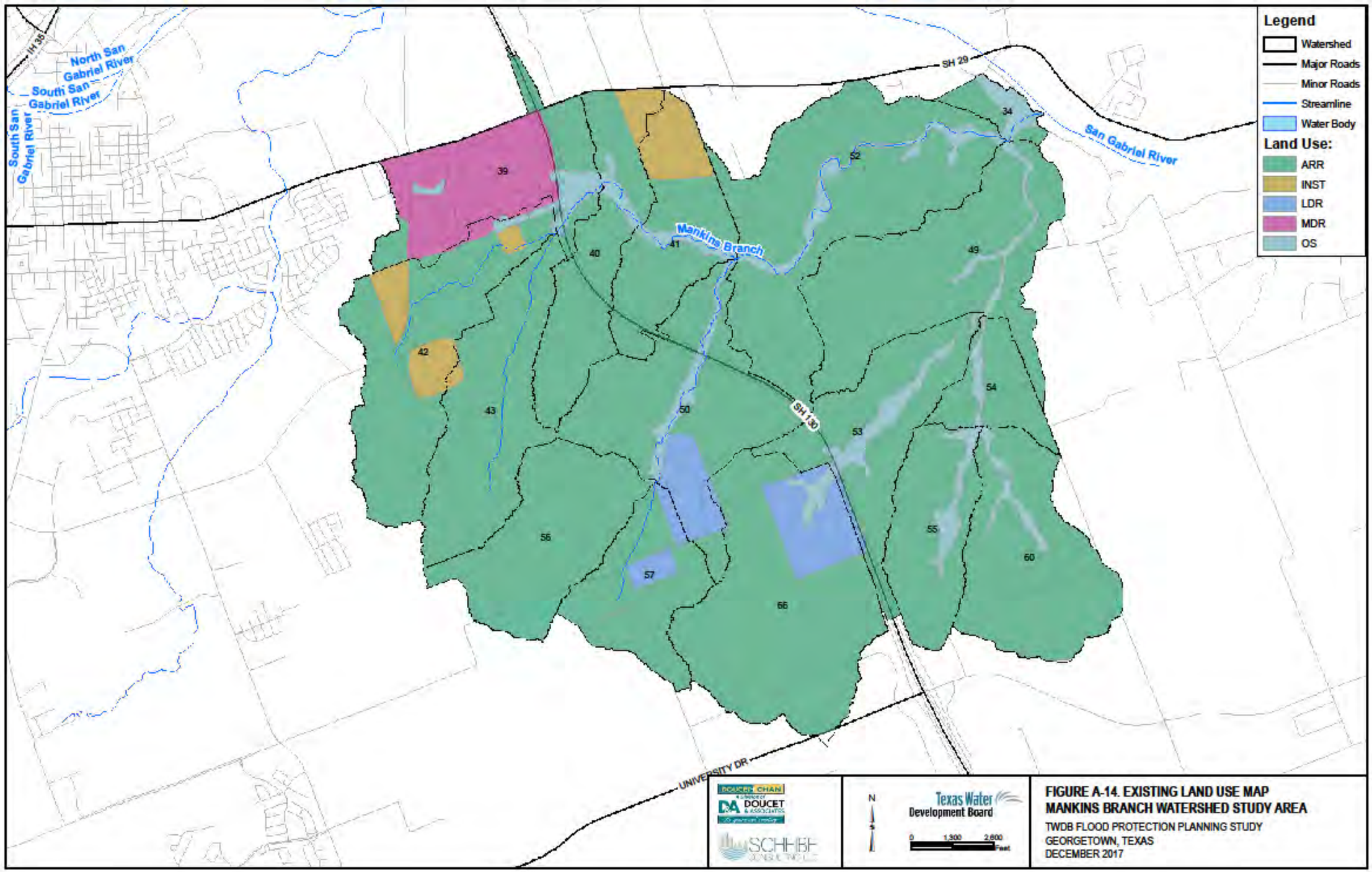
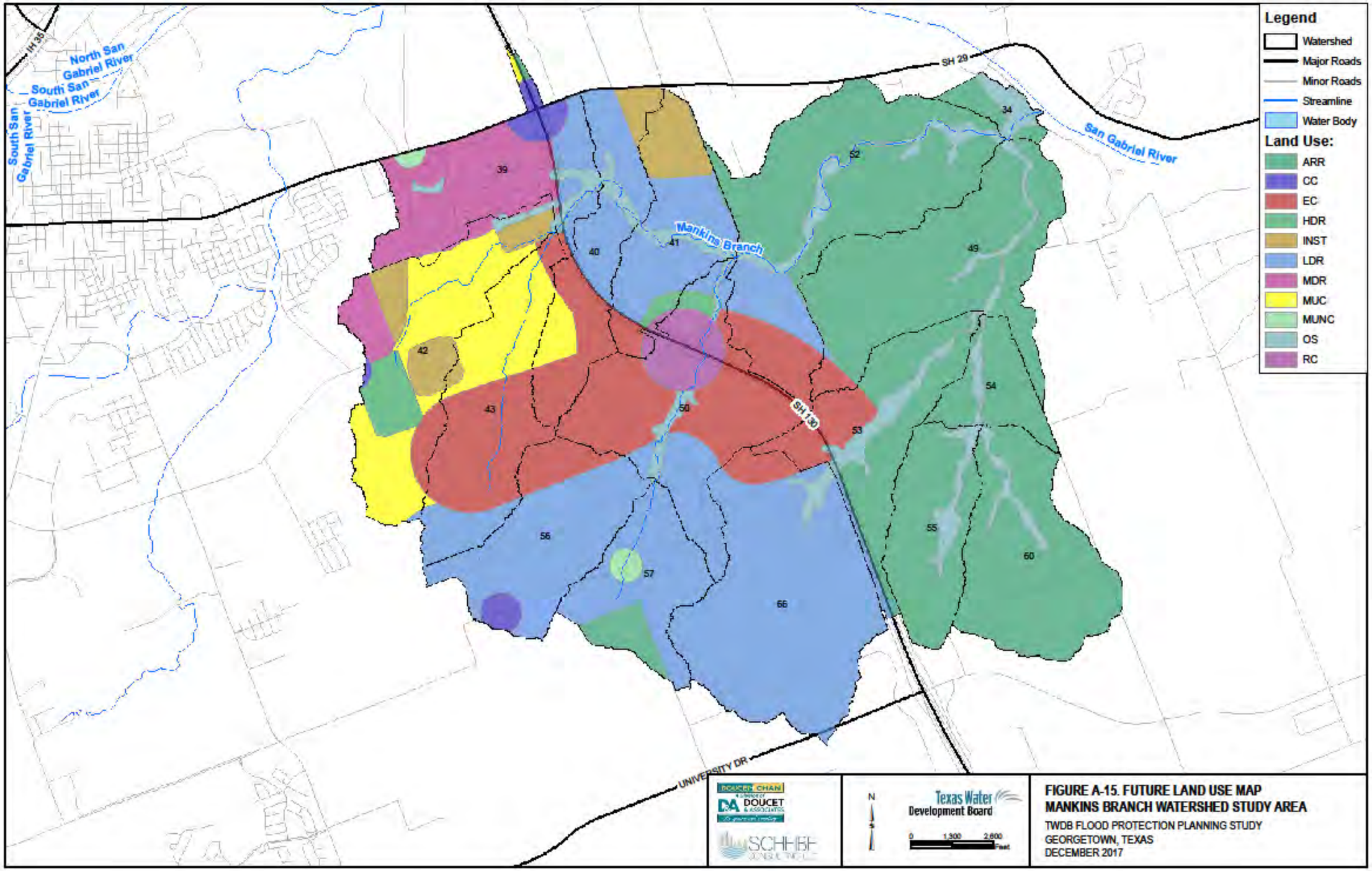
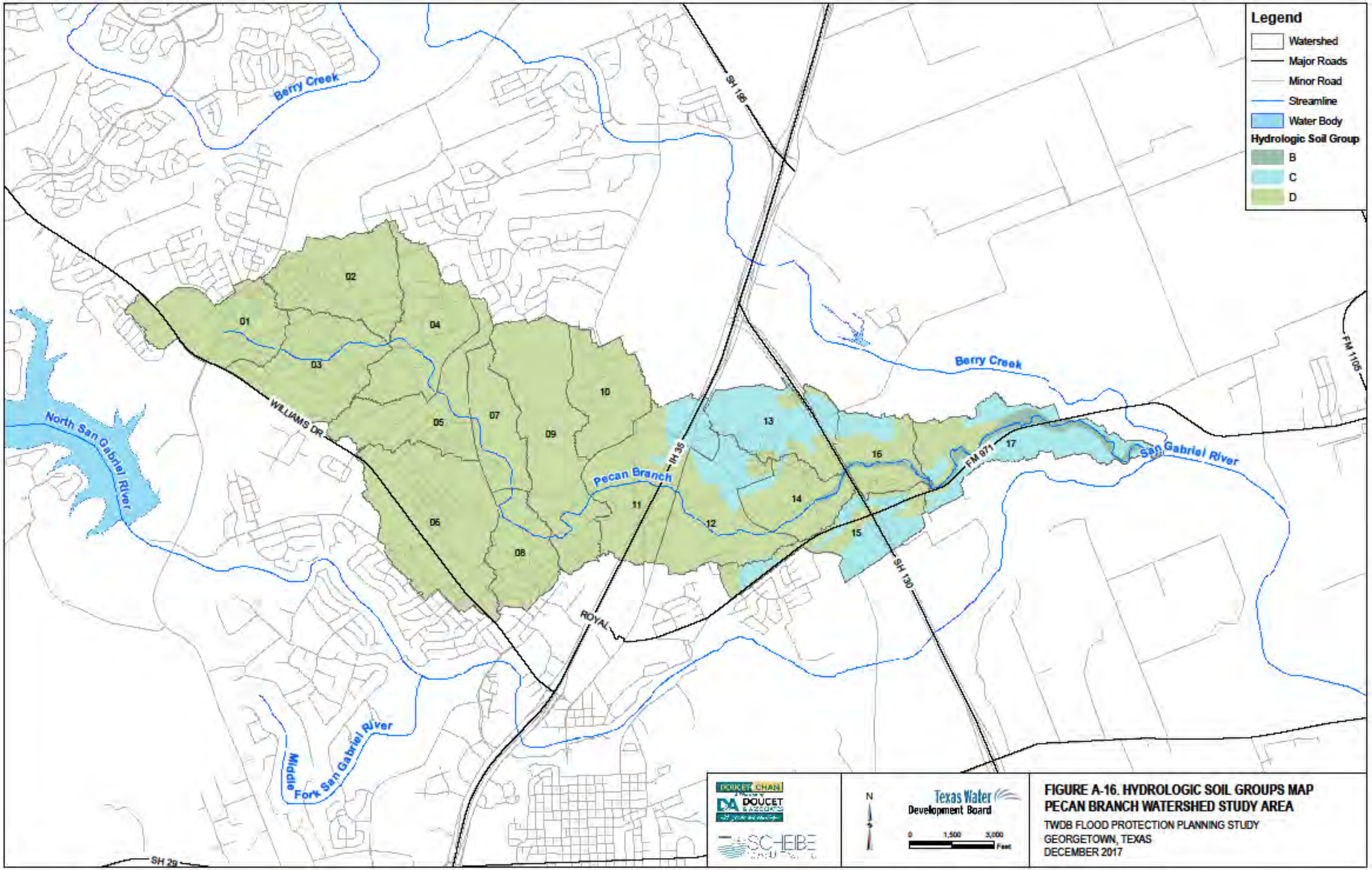


FIGURE A-14. EXISTING LAND USE MAP
MANKINS BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Roads
Streamline
Water Body
Land Use:
ARR
CC
EC
HDR
INST
LDR
MDR
MUC
MUNC
OS
RC
IH 35
North San Gabriel River
South San Gabriel River
South San Gabriel River
SH 29
San Gabriel River
Mankins Branch
SH 130
UNIVERSITY DR
39
40
41
42
43
50
52
53
54
55
56
57
60
66
49
34
N
Texas Water Development Board
0 1,300 2,600 Feet
FIGURE A-15. FUTURE LAND USE MAP
MANKINS BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Road
Streamline
Water Body
Hydrologic Soil Group
B
C
D
Berry Creek
SH 195
FM 1105
WILLIAMS DR
North San Gabriel River
Pecan Branch
IH 35
FM 971
San Gabriel River
SH 130
ROYAL
Middle Fork San Gabriel River
SH 29
01
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03
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05
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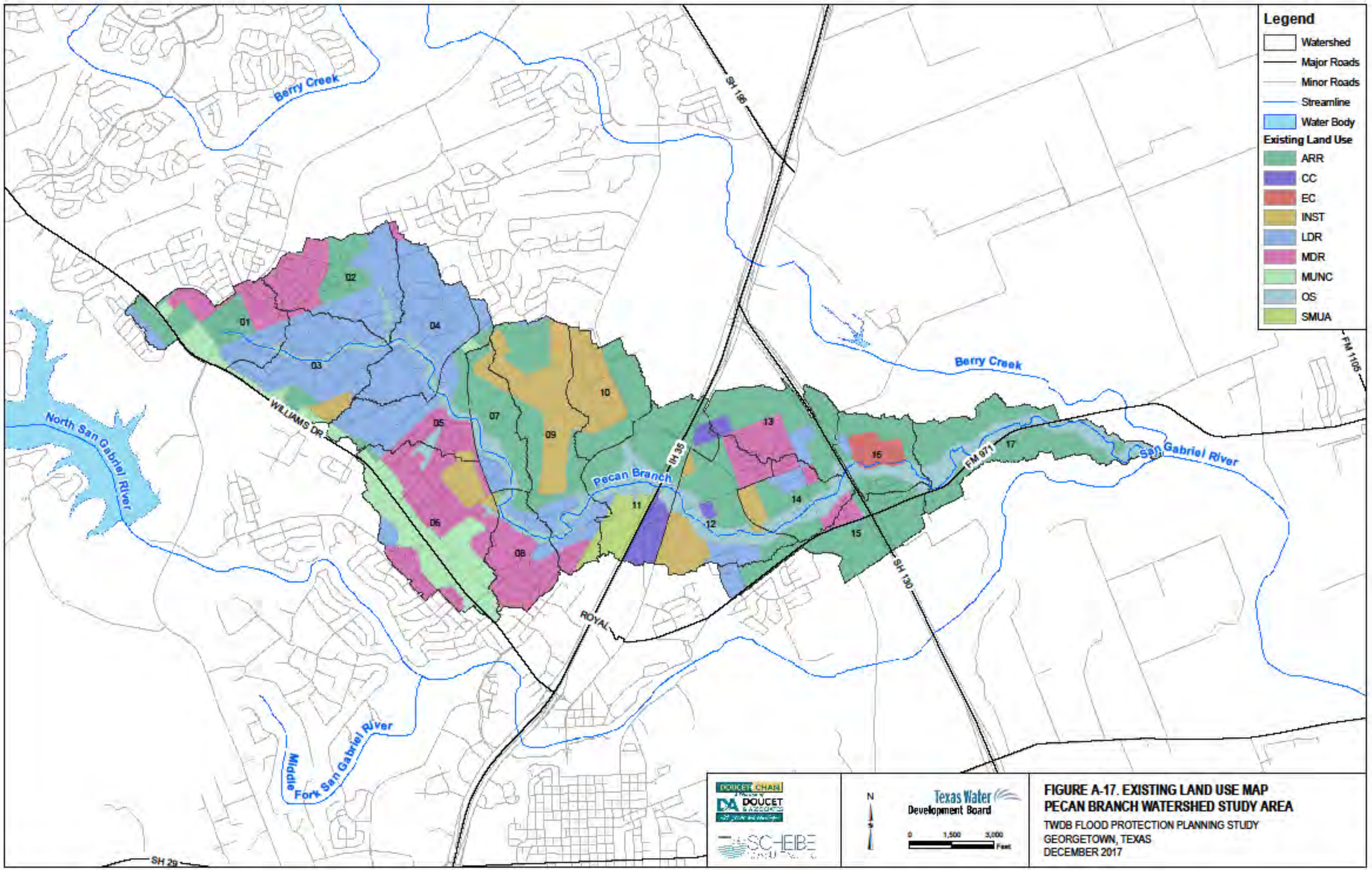
07
08
09
10
11
12
13
14
15
16
17
N
0
1,500
3,000
Feet
Texas Water Development Board
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
FIGURE A-16. HYDROLOGIC SOIL GROUPS MAP
PECAN BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Roads
Streamline
Water Body
Existing Land Use
ARR
CC
EC
INST
LDR
MDR
MUNC
OS
SMUA
Berry Creek
SH 195
FM 1105
WILLIAMS DR
North San Gabriel River
IH 35
Pecan Branch
FM 971
San Gabriel River
SH 130
ROYAL
Middle Fork San Gabriel River
SH 29
01
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11
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13
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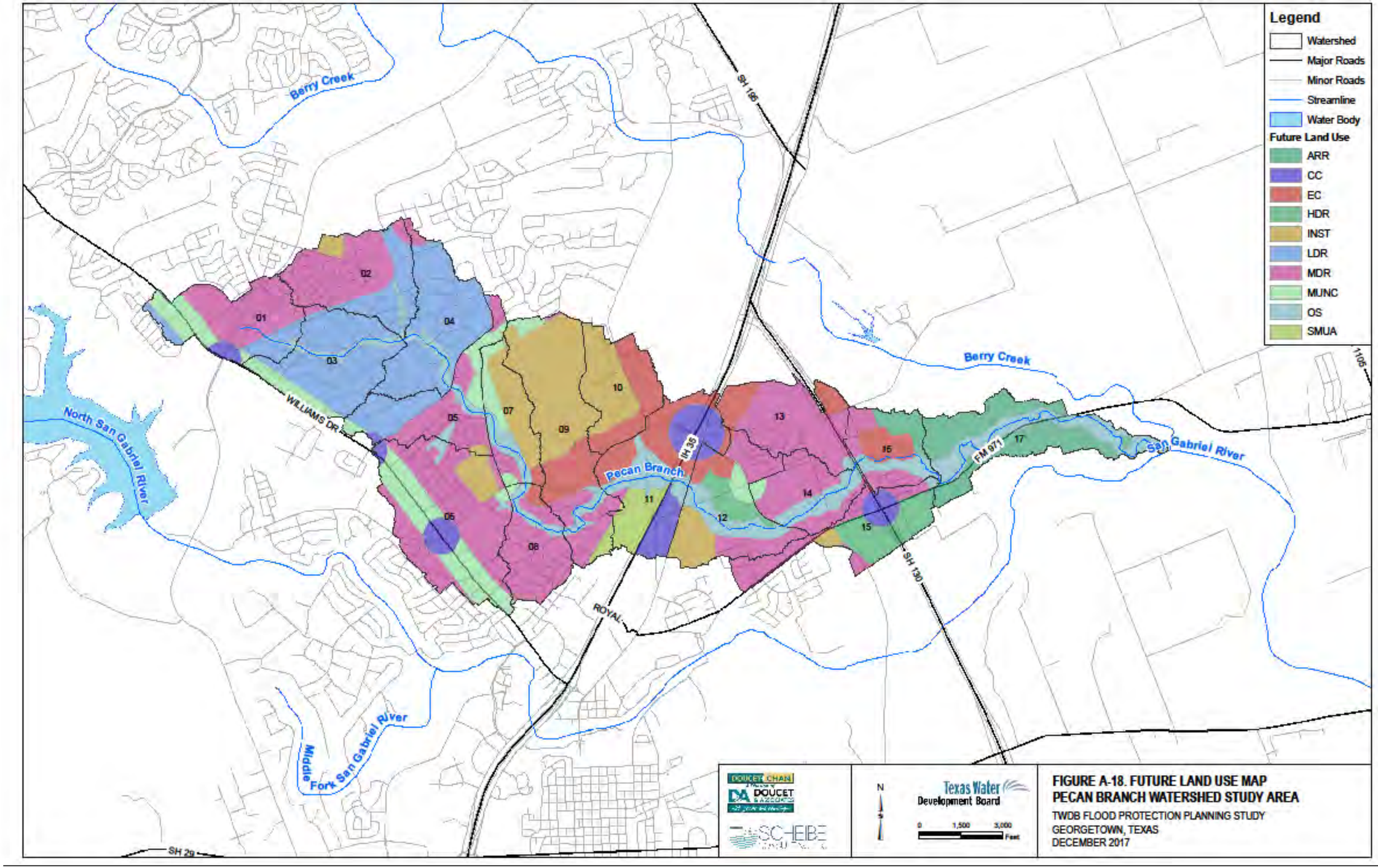
15
16
17
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
N
Texas Water Development Board
0 1,500 3,000 Feet
FIGURE A-17. EXISTING LAND USE MAP
PECAN BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Roads
Streamline
Water Body
Future Land Use
ARR
CC
EC
HDR
INST
LDR
MDR
MUNC
OS
SMUA
Berry Creek
SH 195
Berry Creek
1105
North San Gabriel River
WILLIAMS DR
IH 35
Pecan Branch
FM 971
San Gabriel River
SH 130
ROYAL
Middle Fork San Gabriel River
SH 29
01
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15
16
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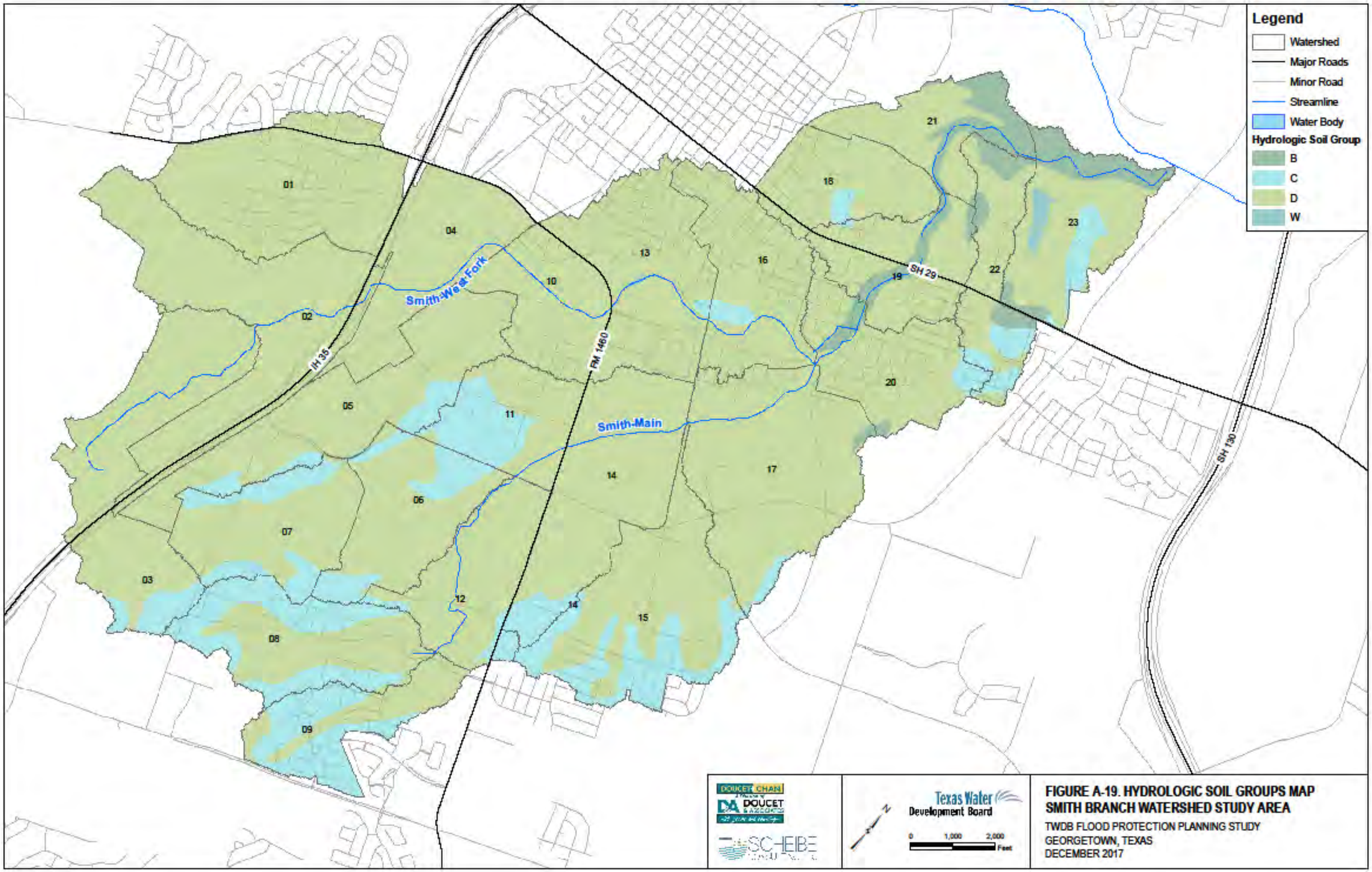
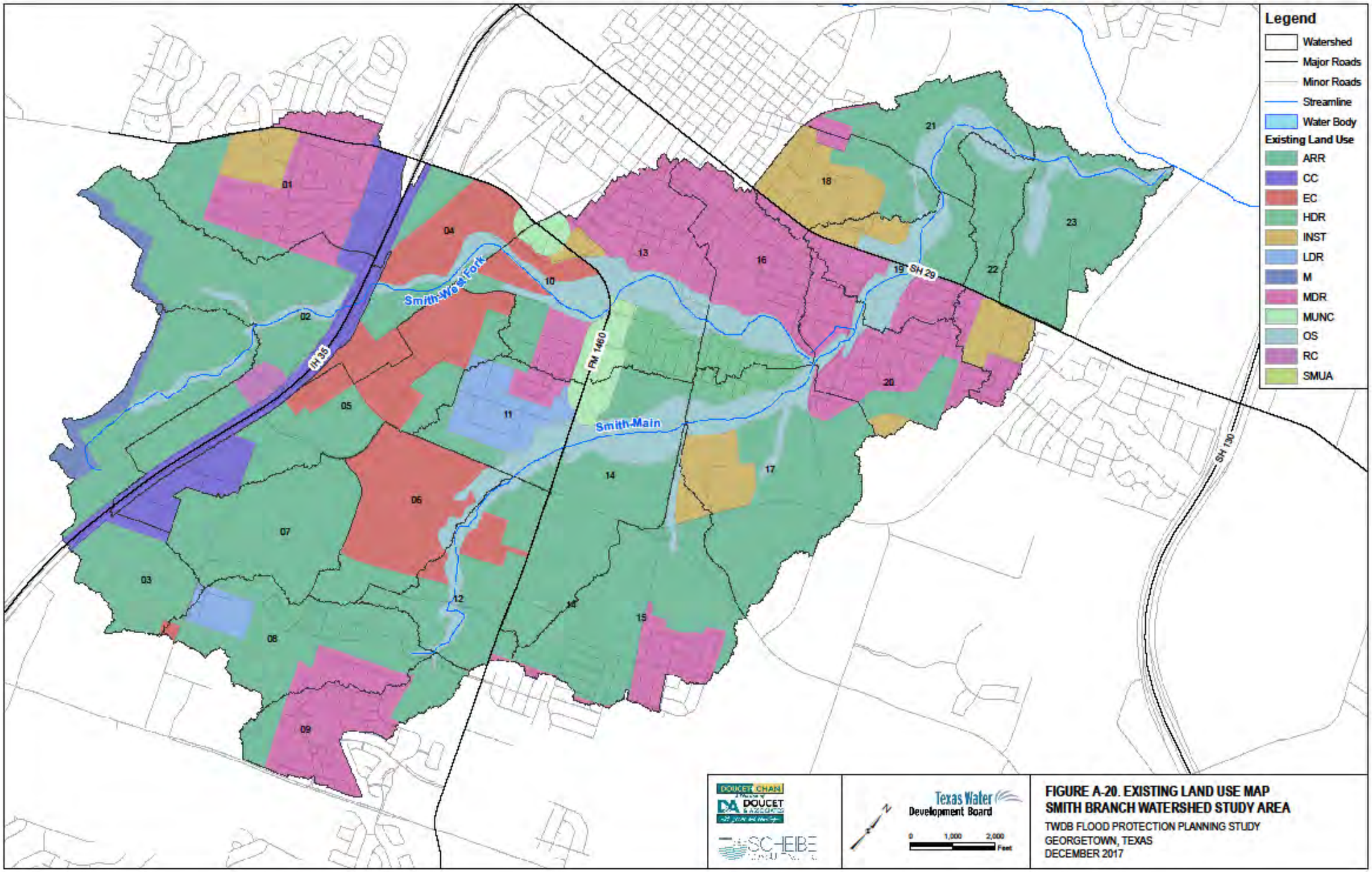
DOUCET CHAN
DOUCET
SCHEIBE
N
Texas Water Development Board
0 1,500 3,000 Feet
FIGURE A-18. FUTURE LAND USE MAP
PECAN BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Road
Streamline
Water Body
Hydrologic Soil Group
B
C
D
W
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Smith-West Fork
Smith-Main
IH 35
FM 1460
SH 29
SH 130
Texas Water Development Board
0 1,000 2,000 Feet
FIGURE A-19. HYDROLOGIC SOIL GROUPS MAP
SMITH BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Roads
Streamline
Water Body
Existing Land Use
ARR
CC
EC
HDR
INST
LDR
M
MDR
MUNC
OS
RC
SMUA
Smith-West Fork
Smith-Main
IH 35
FM 1460
SH 29
SH 130
01
02
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07
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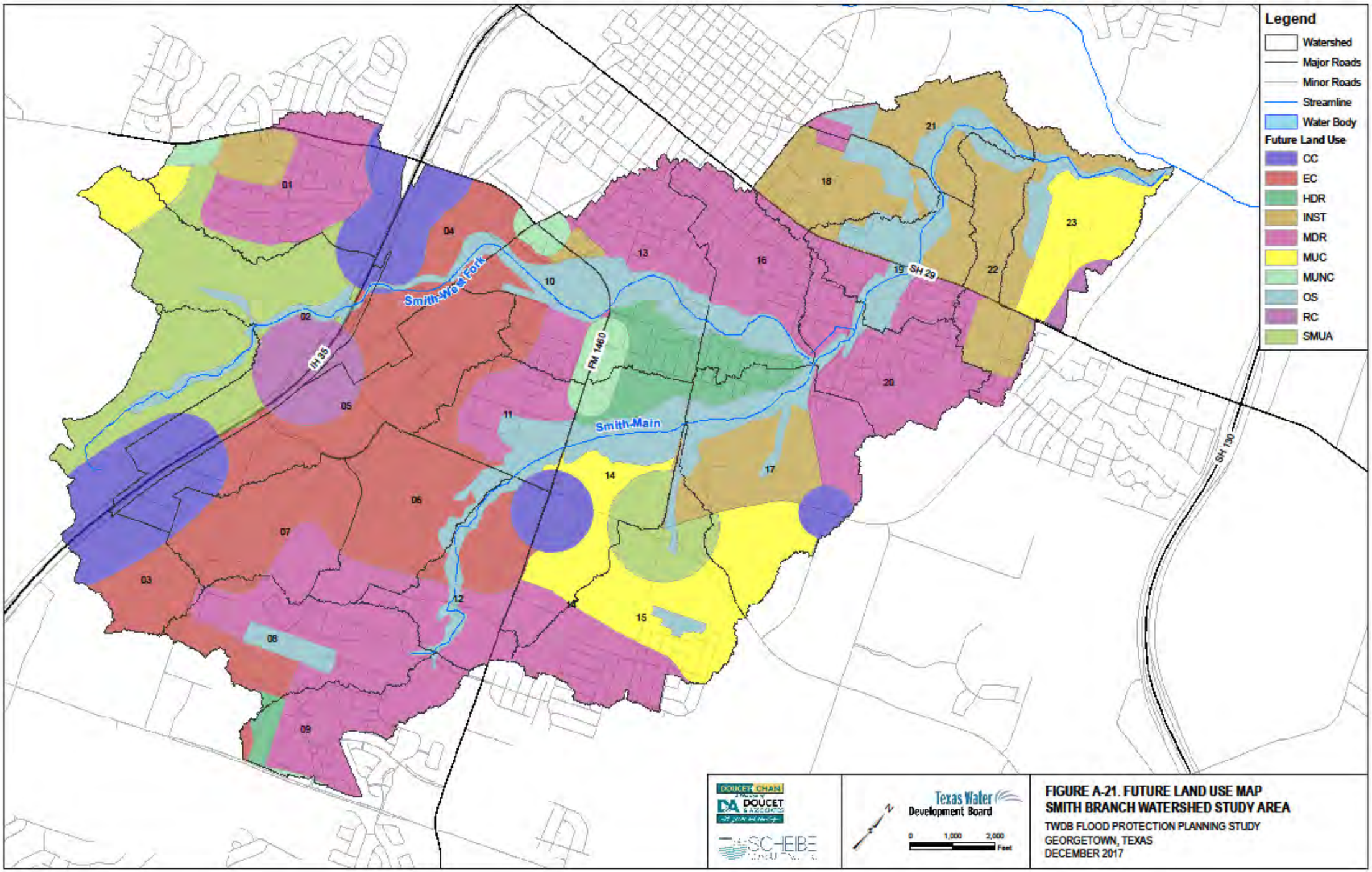
21
22
23
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
Texas Water Development Board
0 1,000 2,000 Feet
FIGURE A-20. EXISTING LAND USE MAP
SMITH BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Roads
Streamline
Water Body
Future Land Use
CC
EC
HDR
INST
MDR
MUC
MUNC
OS
RC
SMUA
Smith-West Fork
Smith-Main
IH 35
FM 1460
SH 29
SH 130
01
02
03
04
05
06
07
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09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
Texas Water Development Board
0 1,000 2,000 Feet
FIGURE A-21. FUTURE LAND USE MAP
SMITH BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

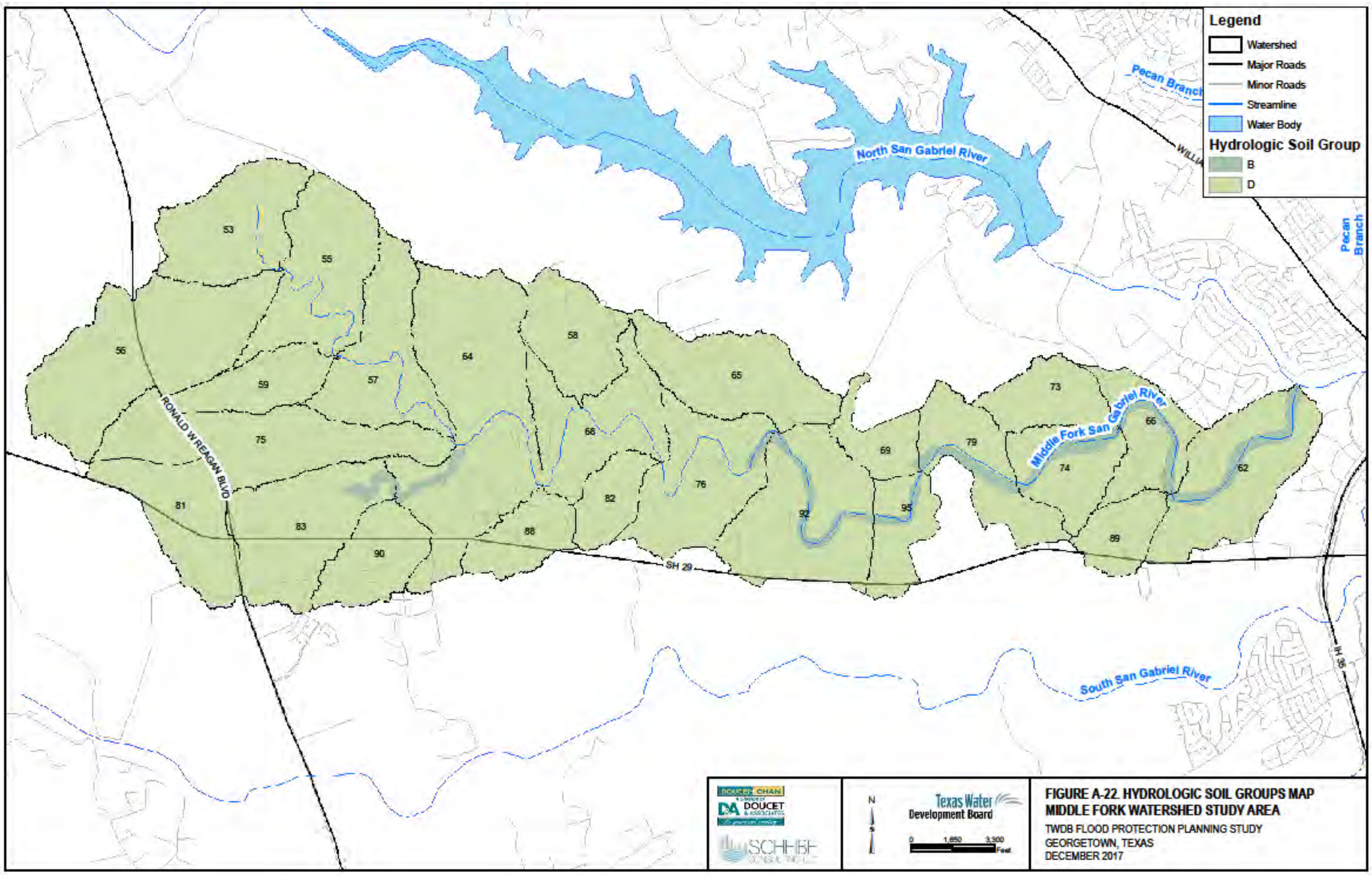


FIGURE A-22. HYDROLOGIC SOIL GROUPS MAP
MIDDLE FORK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

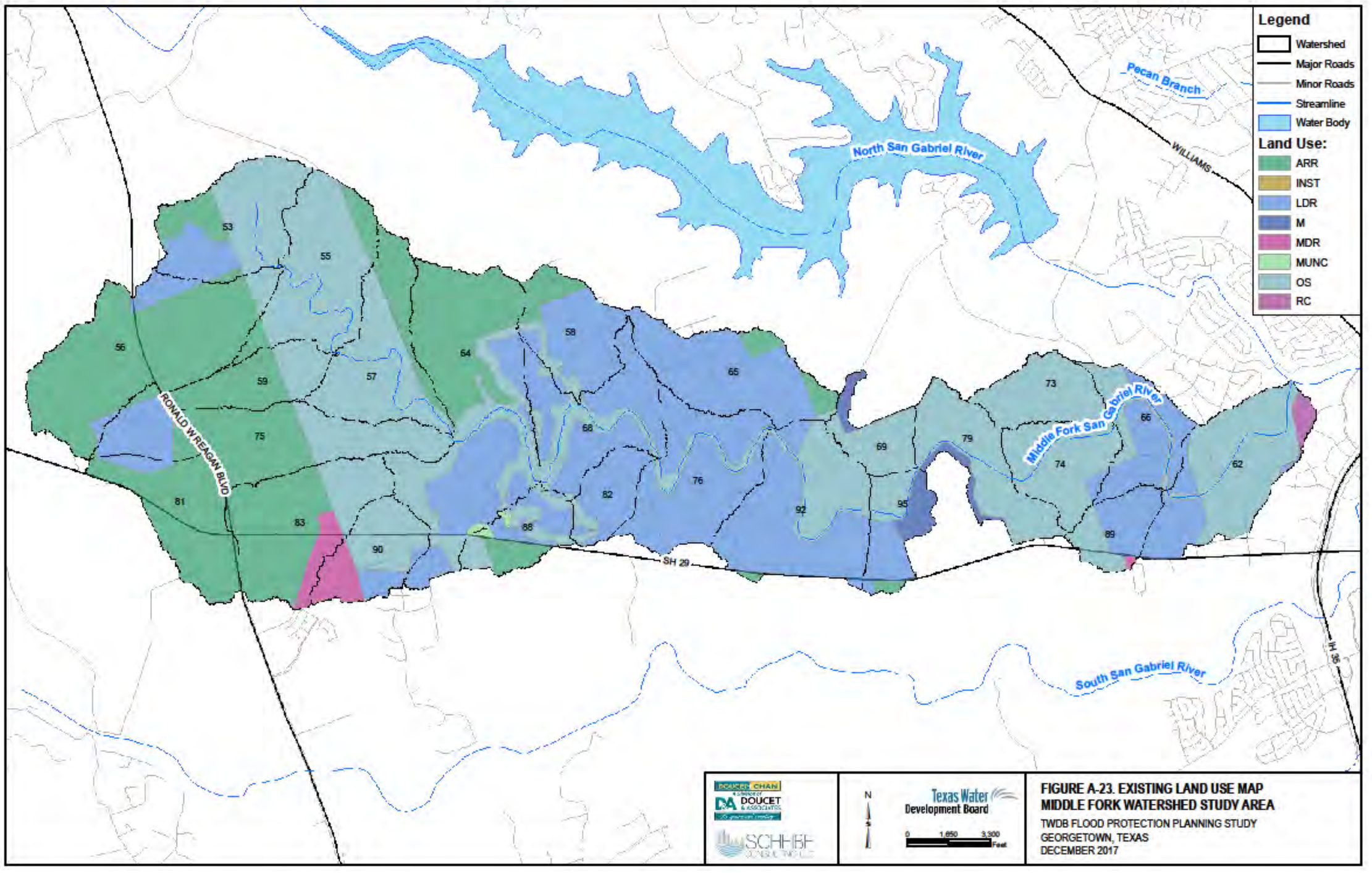


FIGURE A-23. EXISTING LAND USE MAP
MIDDLE FORK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

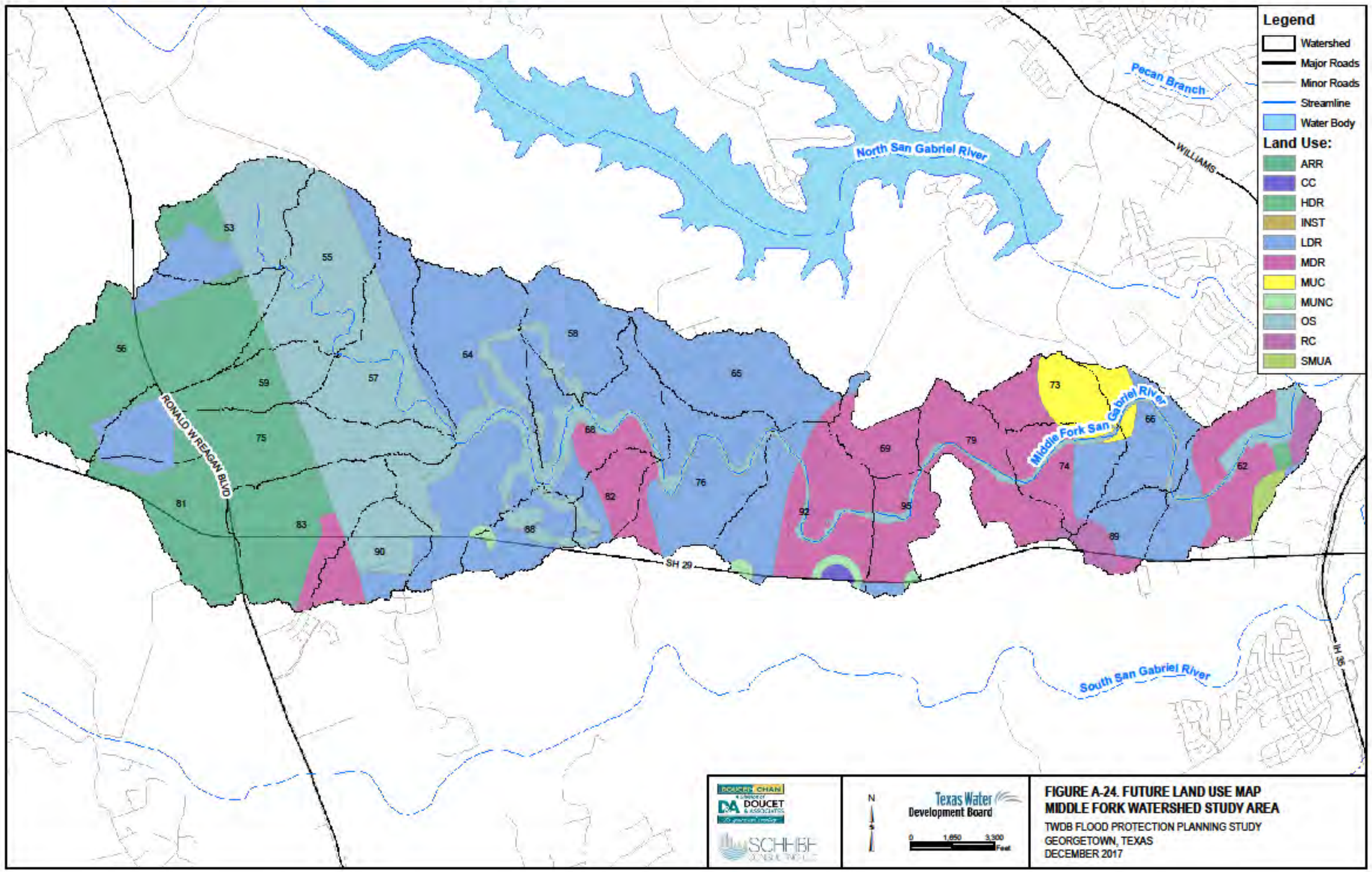
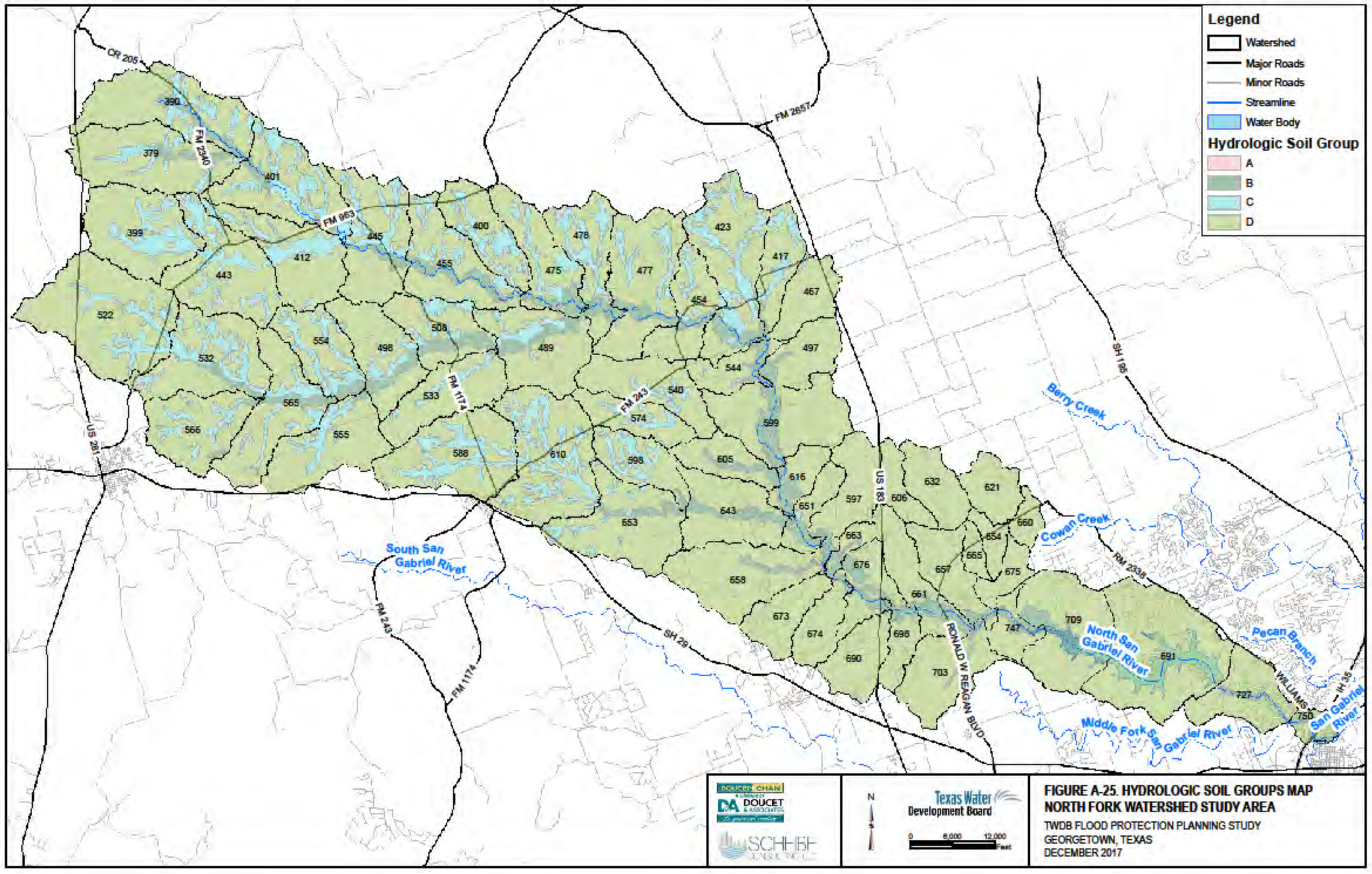


FIGURE A-24. FUTURE LAND USE MAP
MIDDLE FORK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017



DOUCET CHAN
A DIVISION OF DOUCET & ASSOCIATES
SCHNIEBE CONSULTING

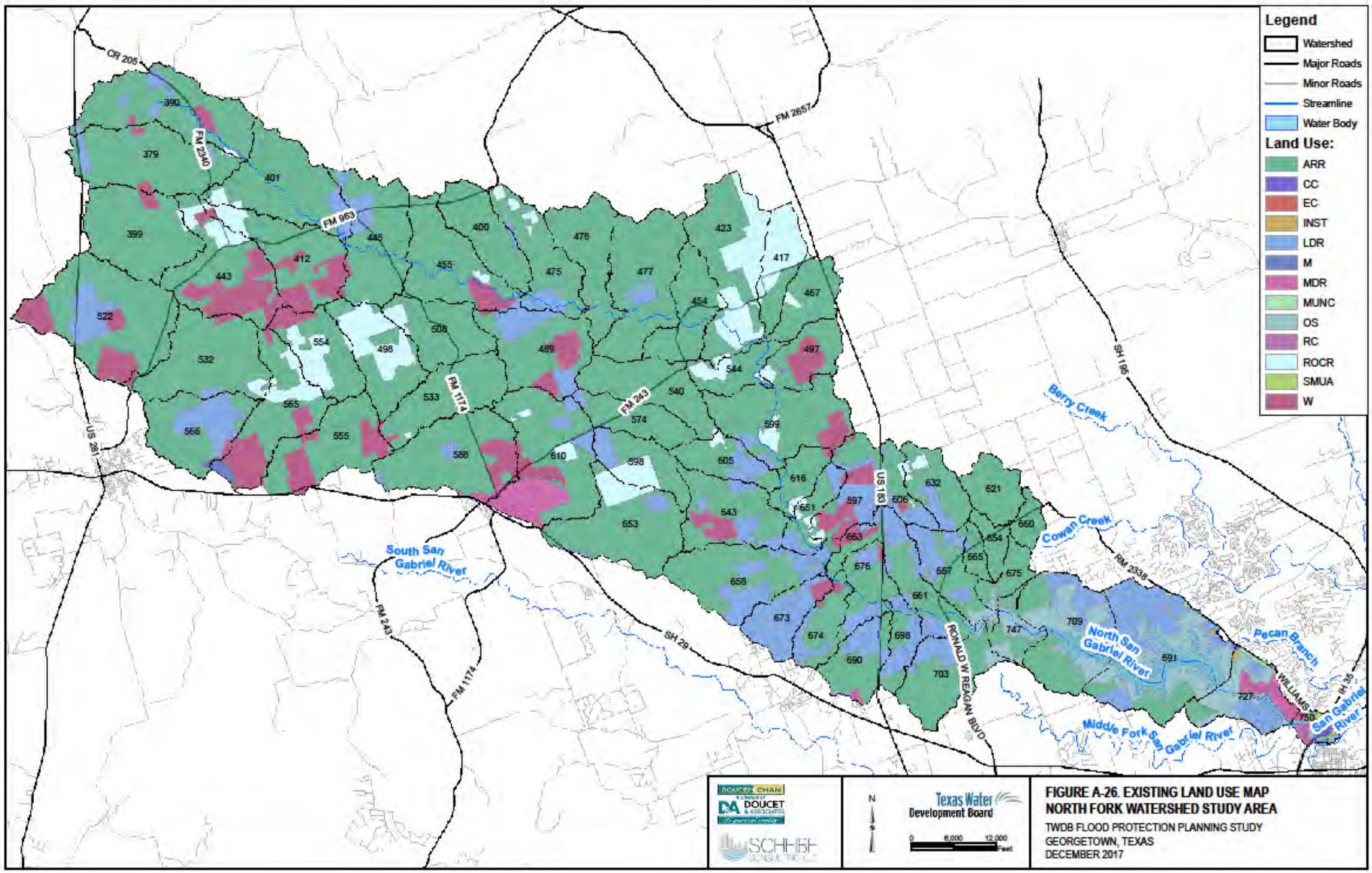
N

Texas Water Development Board

0 6,000 12,000 Feet

FIGURE A-25. HYDROLOGIC SOIL GROUPS MAP NORTH FORK WATERSHED STUDY AREA

TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017


Legend
Watershed
Major Roads
Minor Roads
Streamline
Water Body
Land Use:
ARR
CC
EC
INST
LDR
M
MDR
MUNC
OS
RC
ROCR
SMUA
W
CR 205
FM 2657
FM 2340
FM 963
US 281
FM 1174
FM 243
SH 195
Berry Creek
US 183
Cowan Creek
RM 2338
South San Gabriel River
SH 29
RONALD W REAGAN BLVD
North San Gabriel River
Pecan Branch
WILLIAMS
IH 35
San Gabriel River
Middle Fork San Gabriel River
N
Texas Water Development Board
0 6,000 12,000 Feet
FIGURE A-26. EXISTING LAND USE MAP
NORTH FORK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

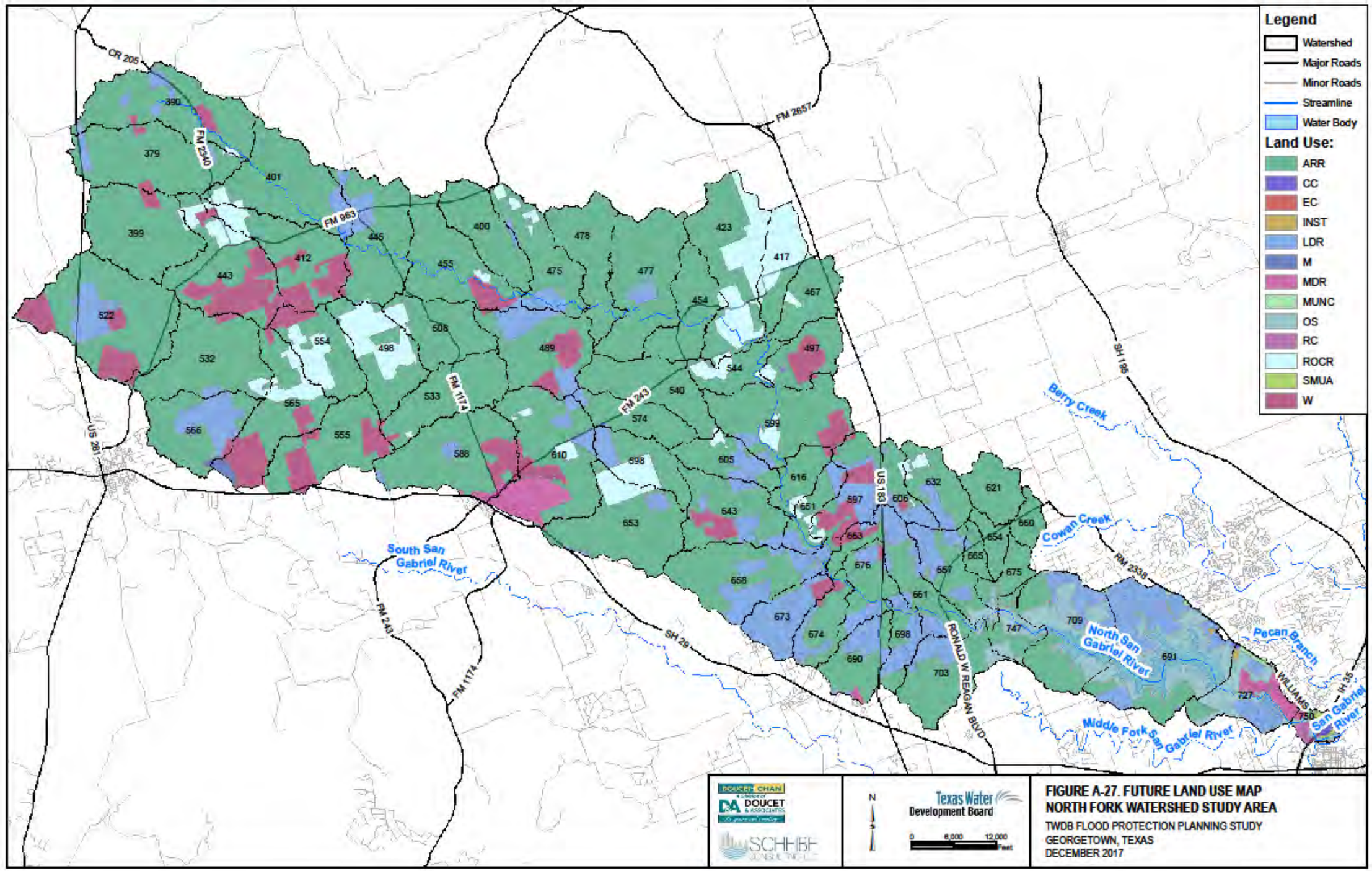


FIGURE A-27. FUTURE LAND USE MAP
NORTH FORK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

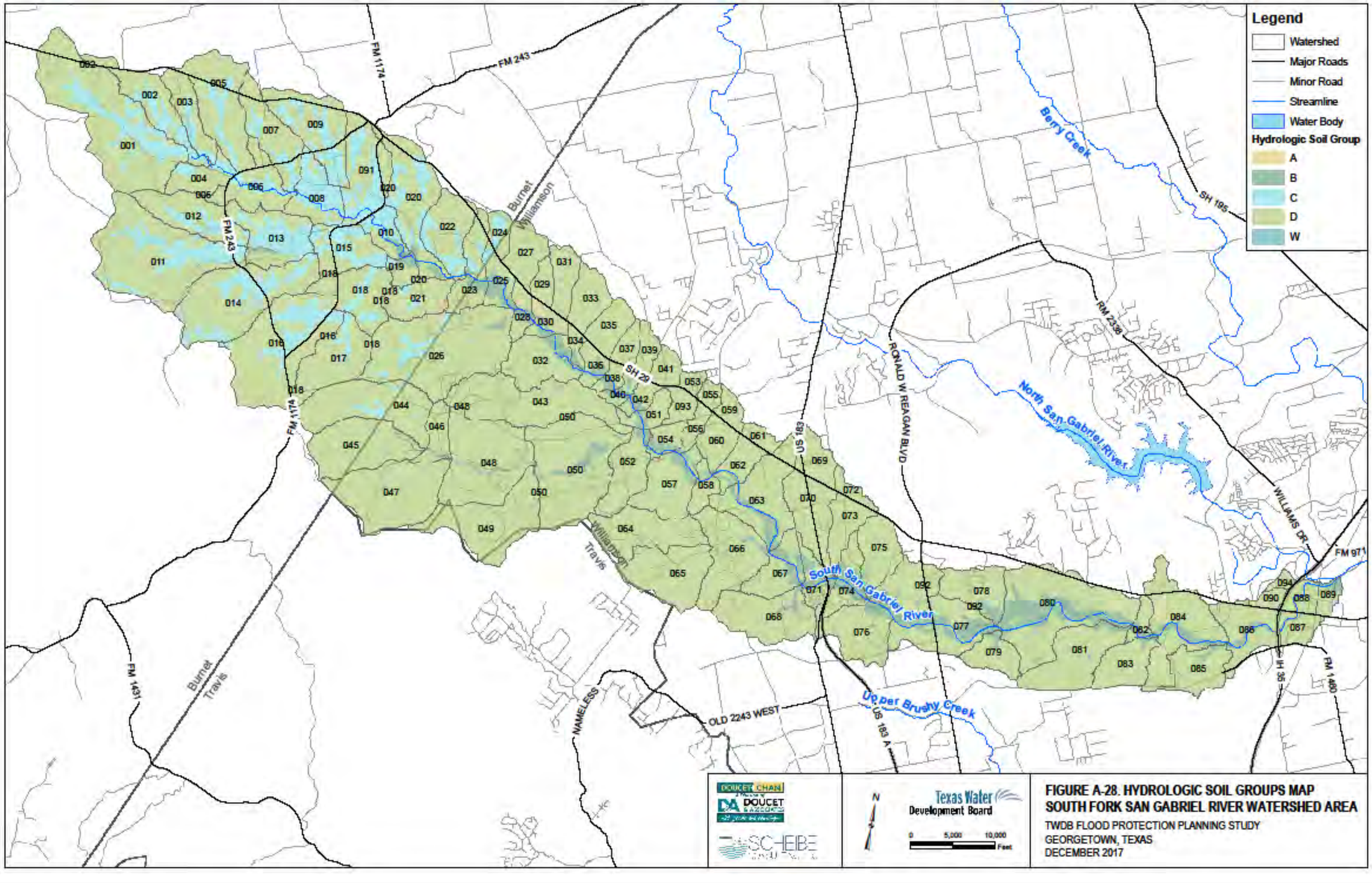

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FIGURE A-28. HYDROLOGIC SOIL GROUPS MAP
SOUTH FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

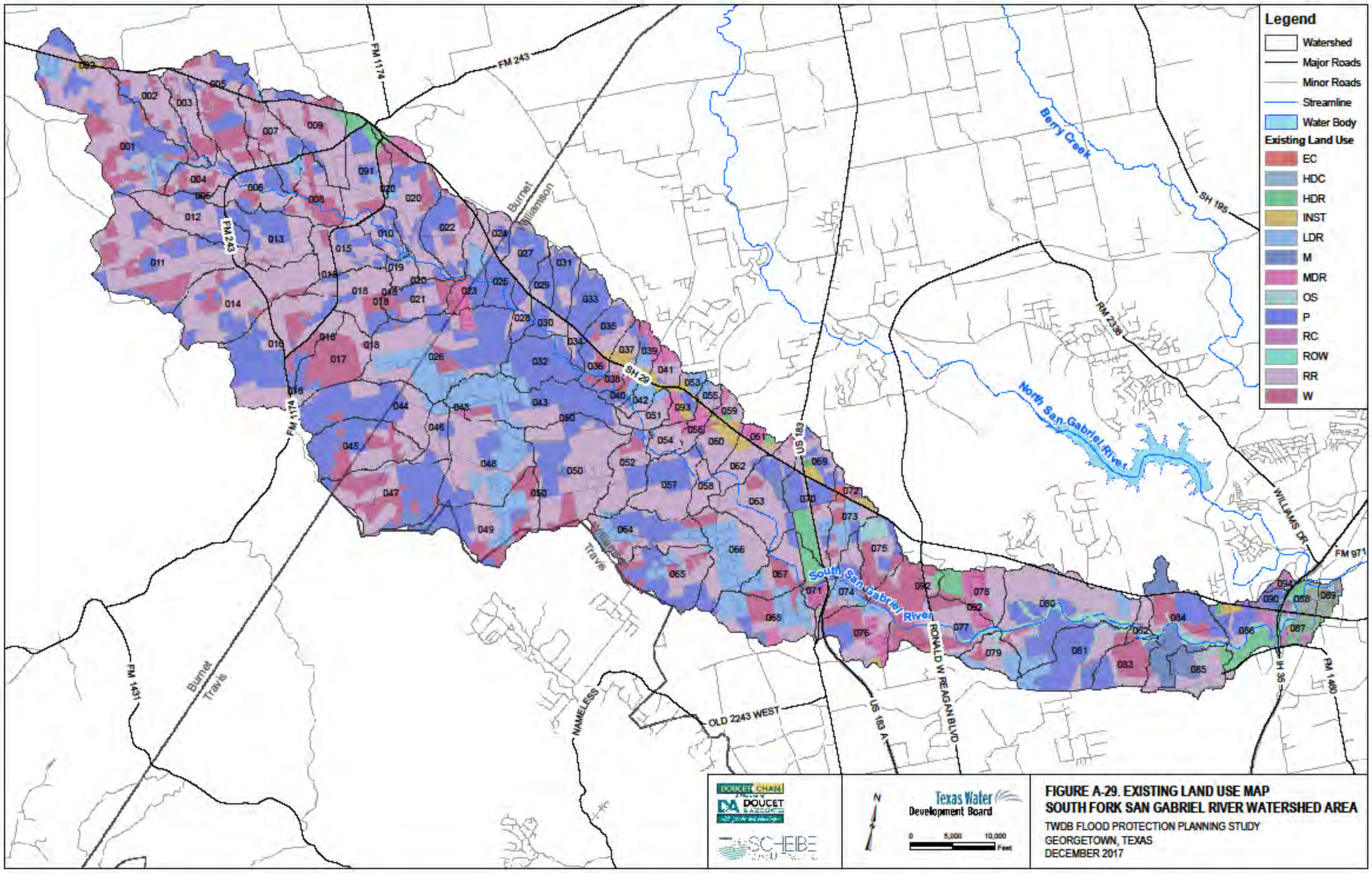
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FIGURE A-29. EXISTING LAND USE MAP
SOUTH FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

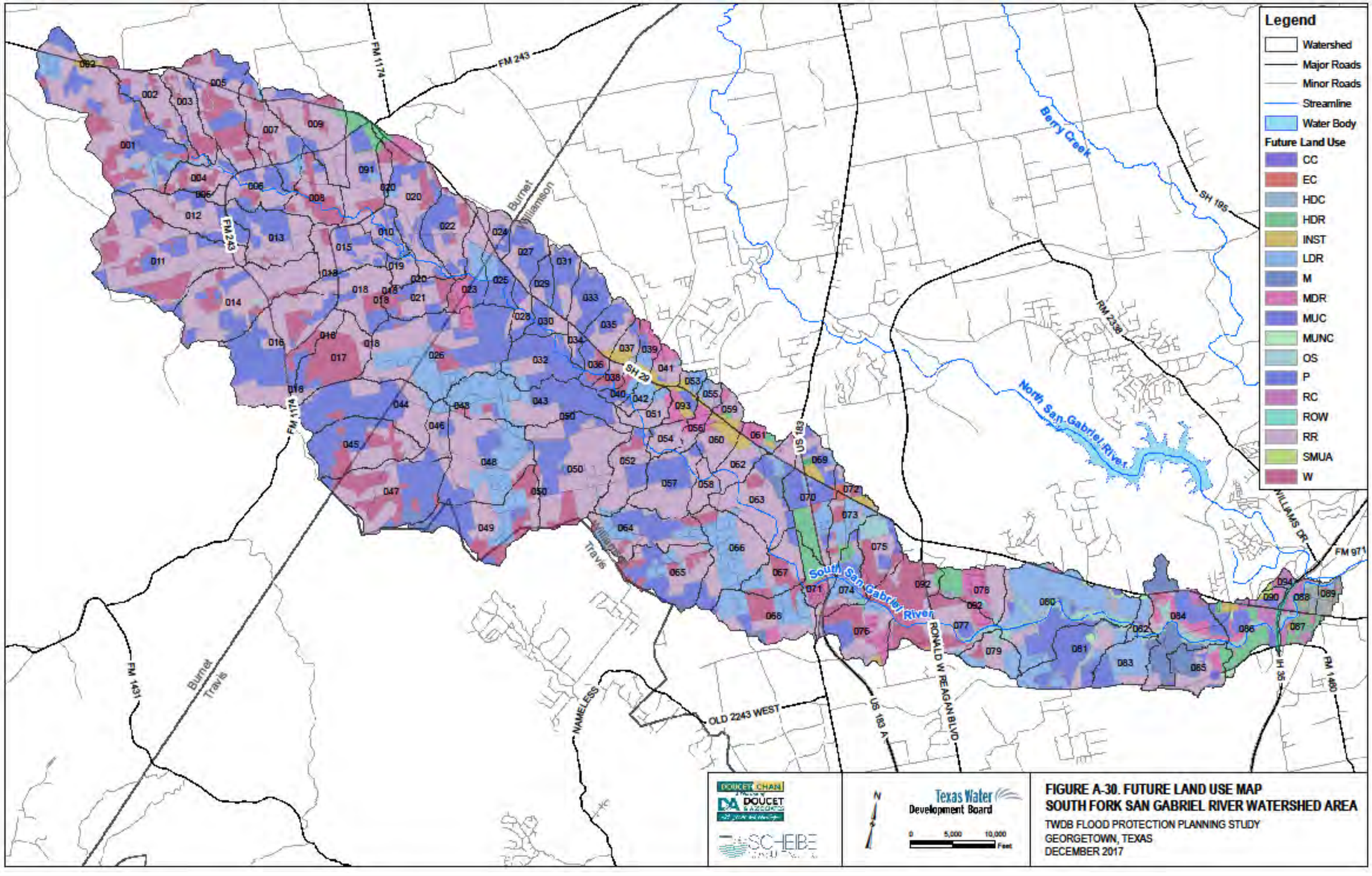
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FIGURE A-30. FUTURE LAND USE MAP
SOUTH FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

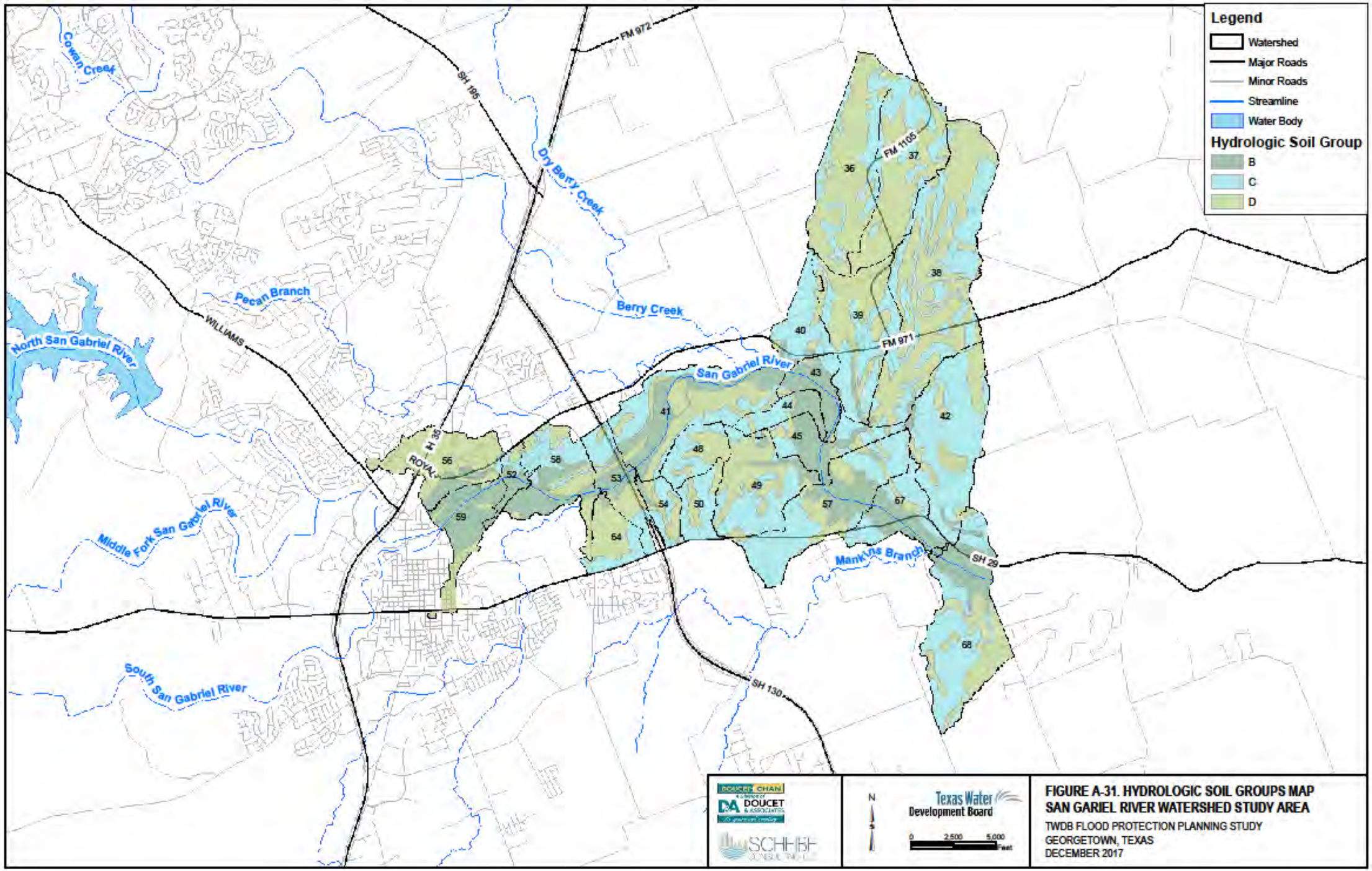
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FIGURE A-31. HYDROLOGIC SOIL GROUPS MAP
SAN GARIEL RIVER WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

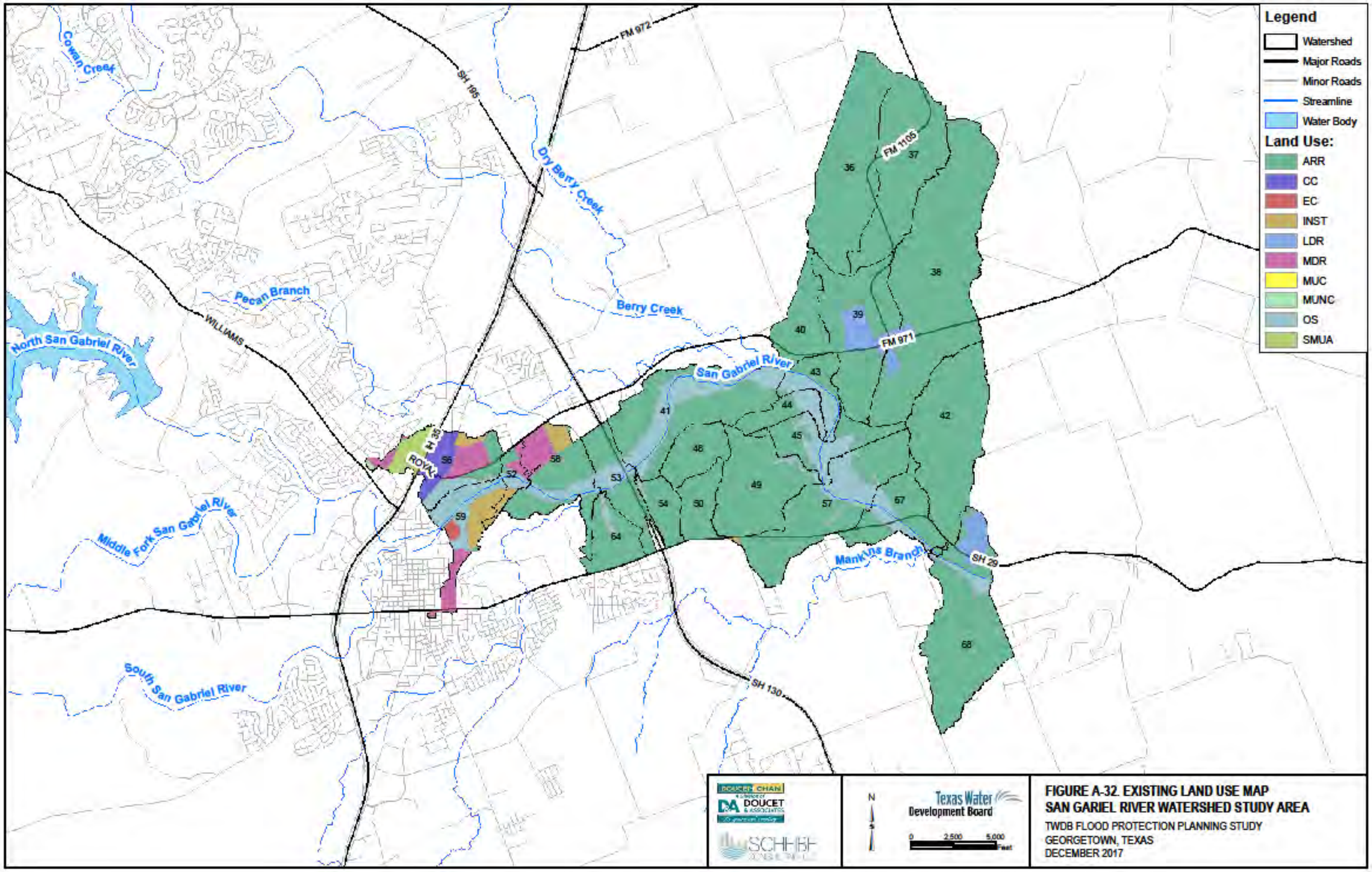
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FIGURE A-32. EXISTING LAND USE MAP
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TWDB FLOOD PROTECTION PLANNING STUDY
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DECEMBER 2017

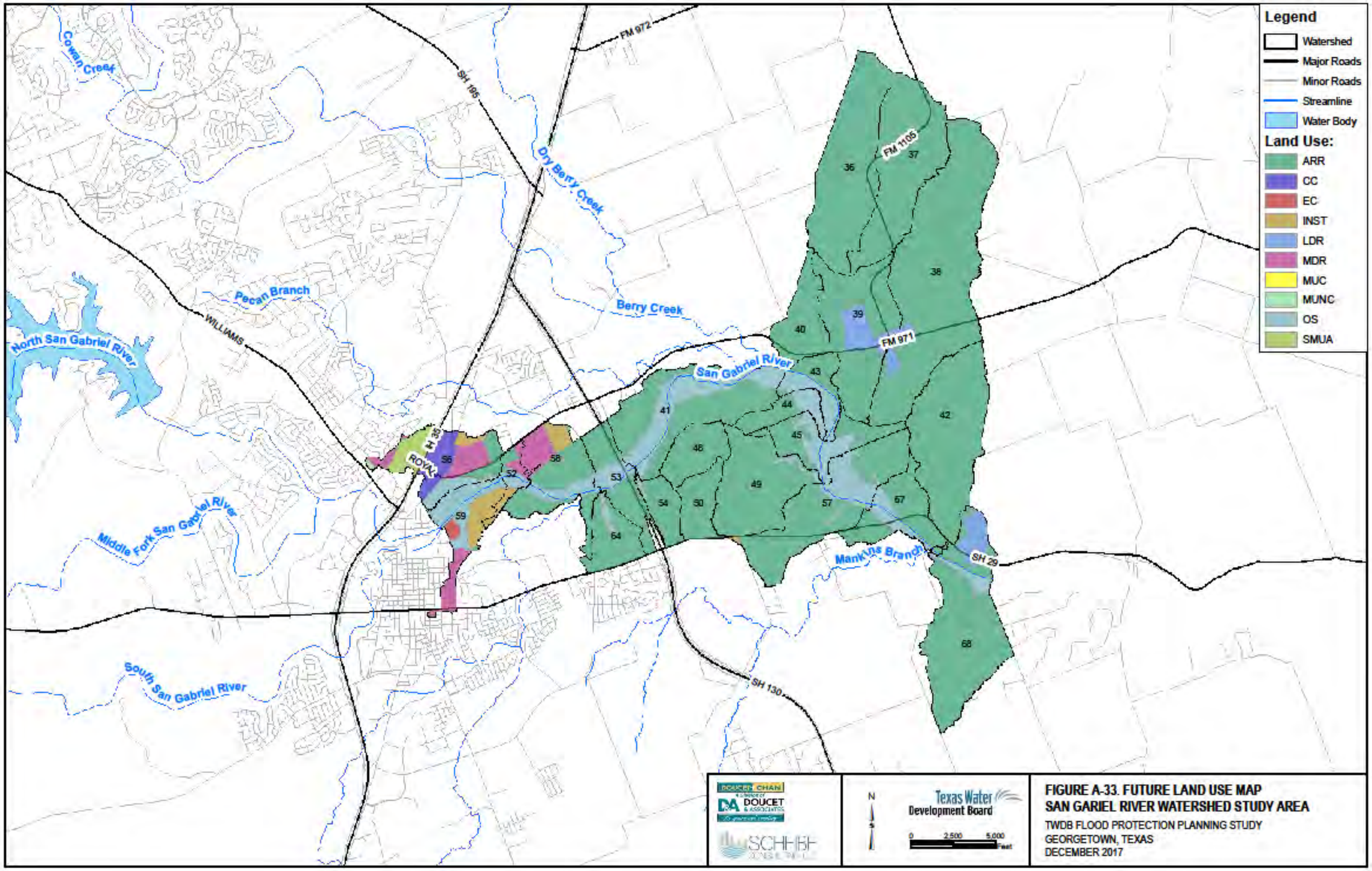
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FIGURE A-33. FUTURE LAND USE MAP
SAN GARIEL RIVER WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

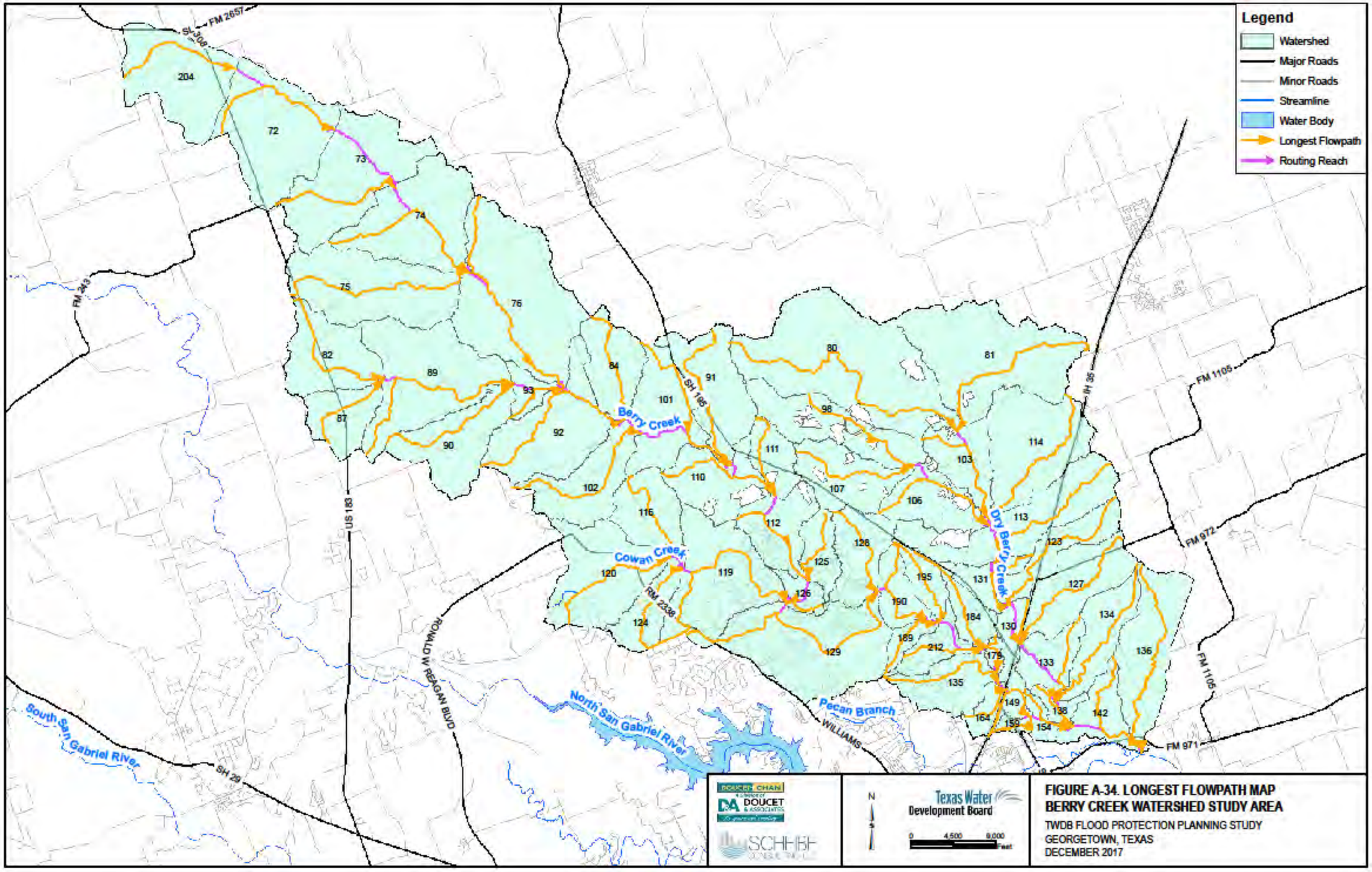
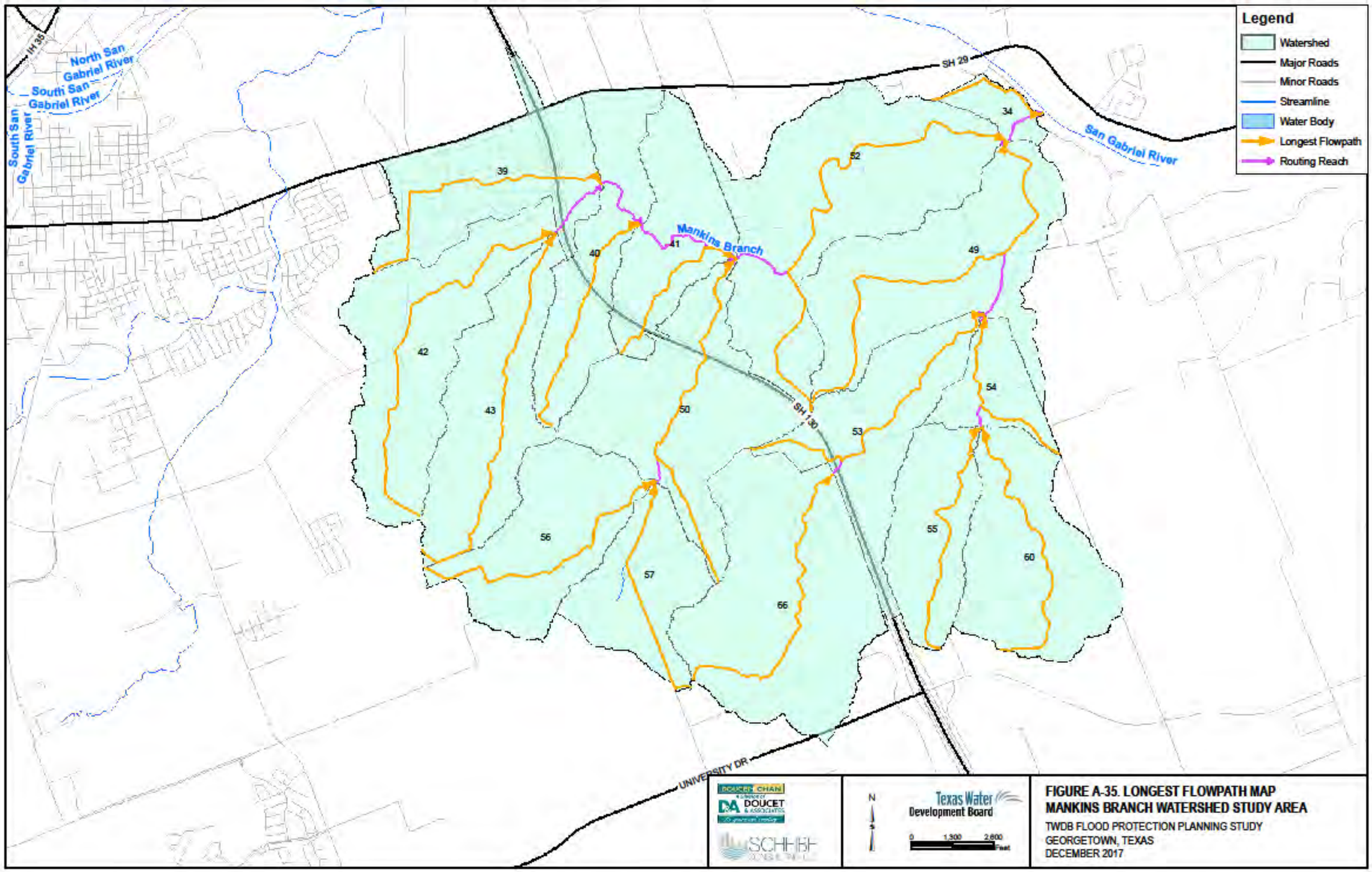


FIGURE A-34. LONGEST FLOWPATH MAP
BERRY CREEK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017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South San Gabriel River
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San Gabriel River
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FIGURE A-35. LONGEST FLOWPATH MAP
MANKINS BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

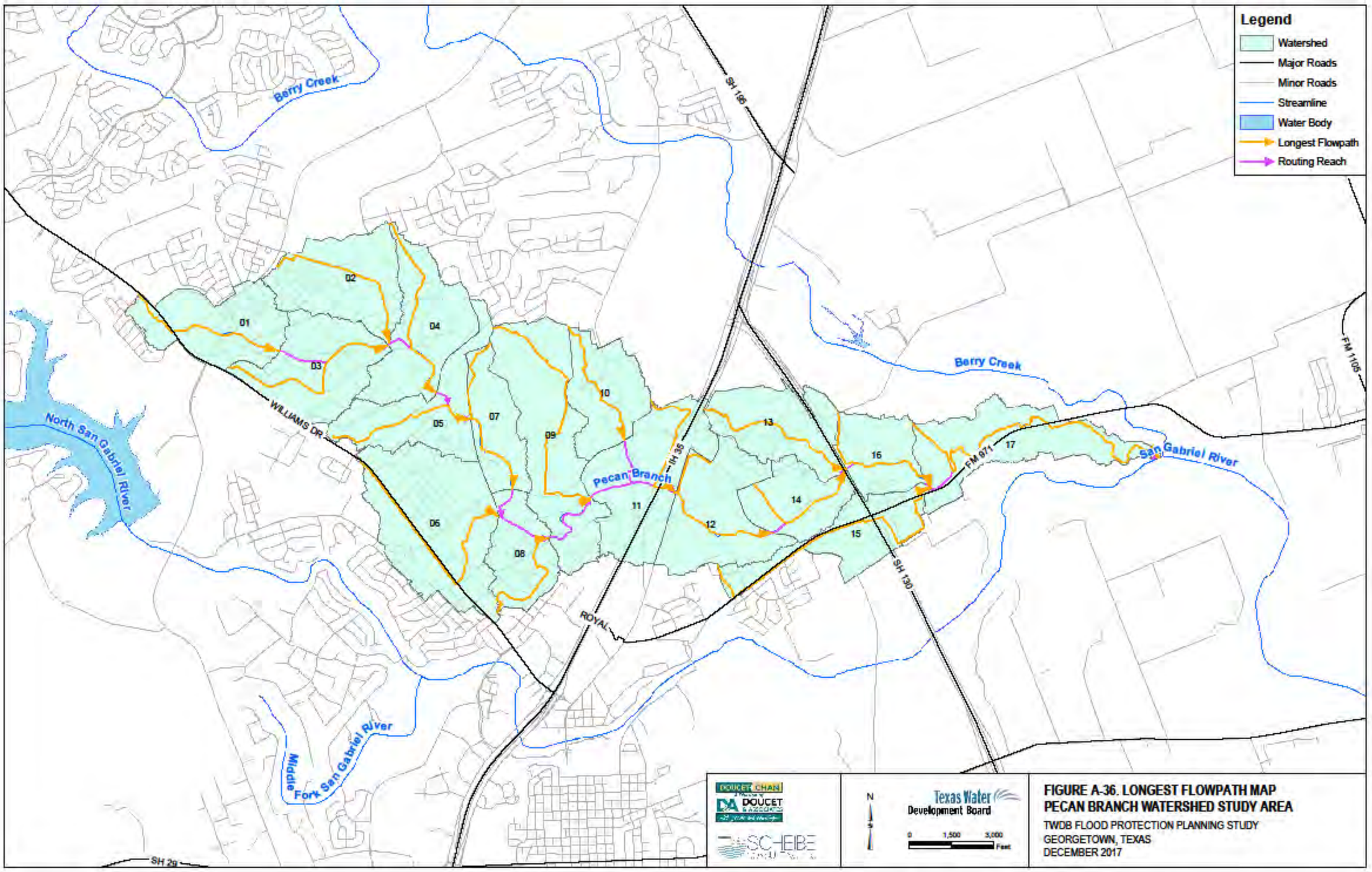
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FIGURE A-36. LONGEST FLOWPATH MAP
PECAN BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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DECEMBER 2017

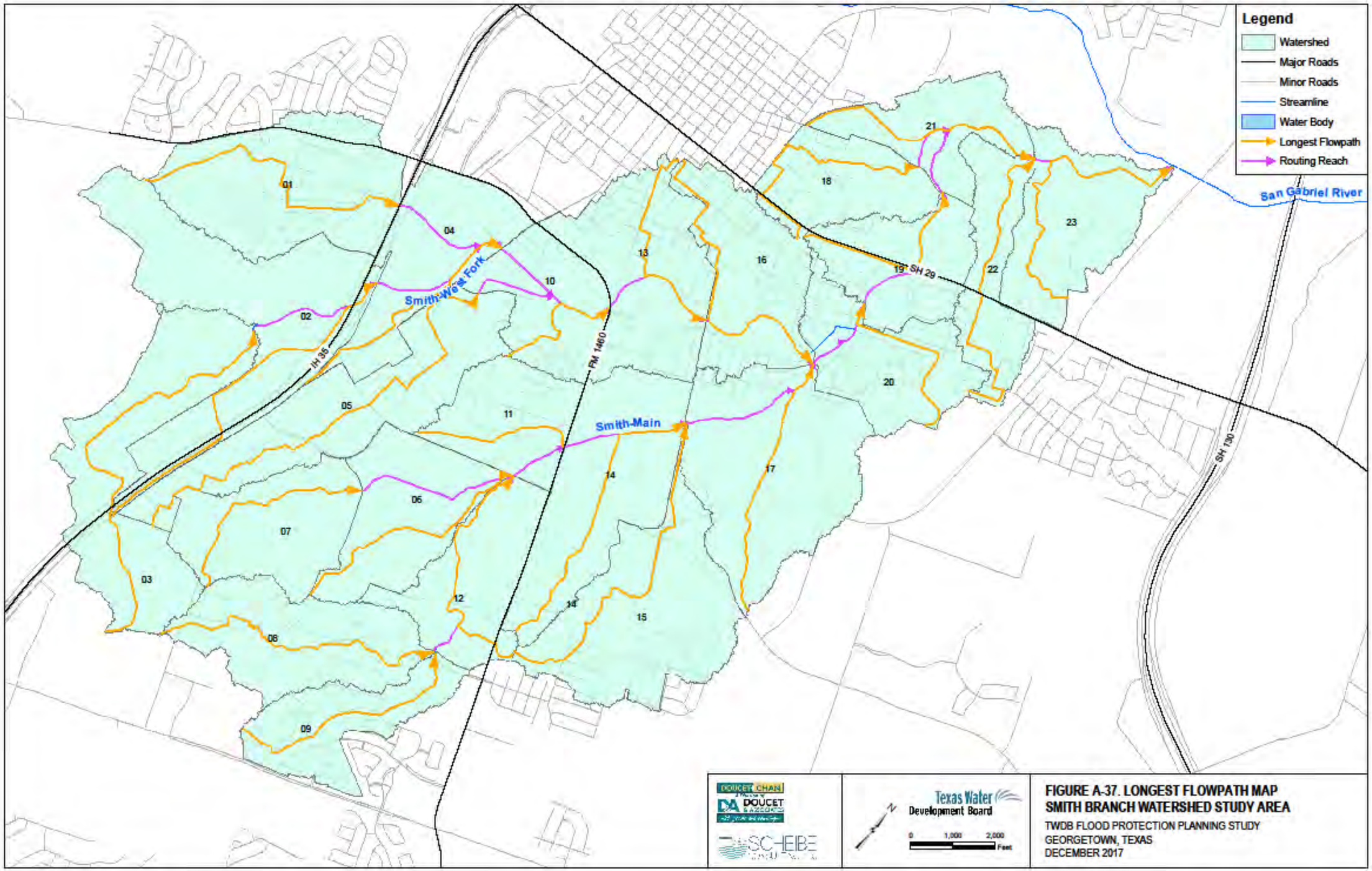
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FIGURE A-37. LONGEST FLOWPATH MAP
SMITH BRANCH WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

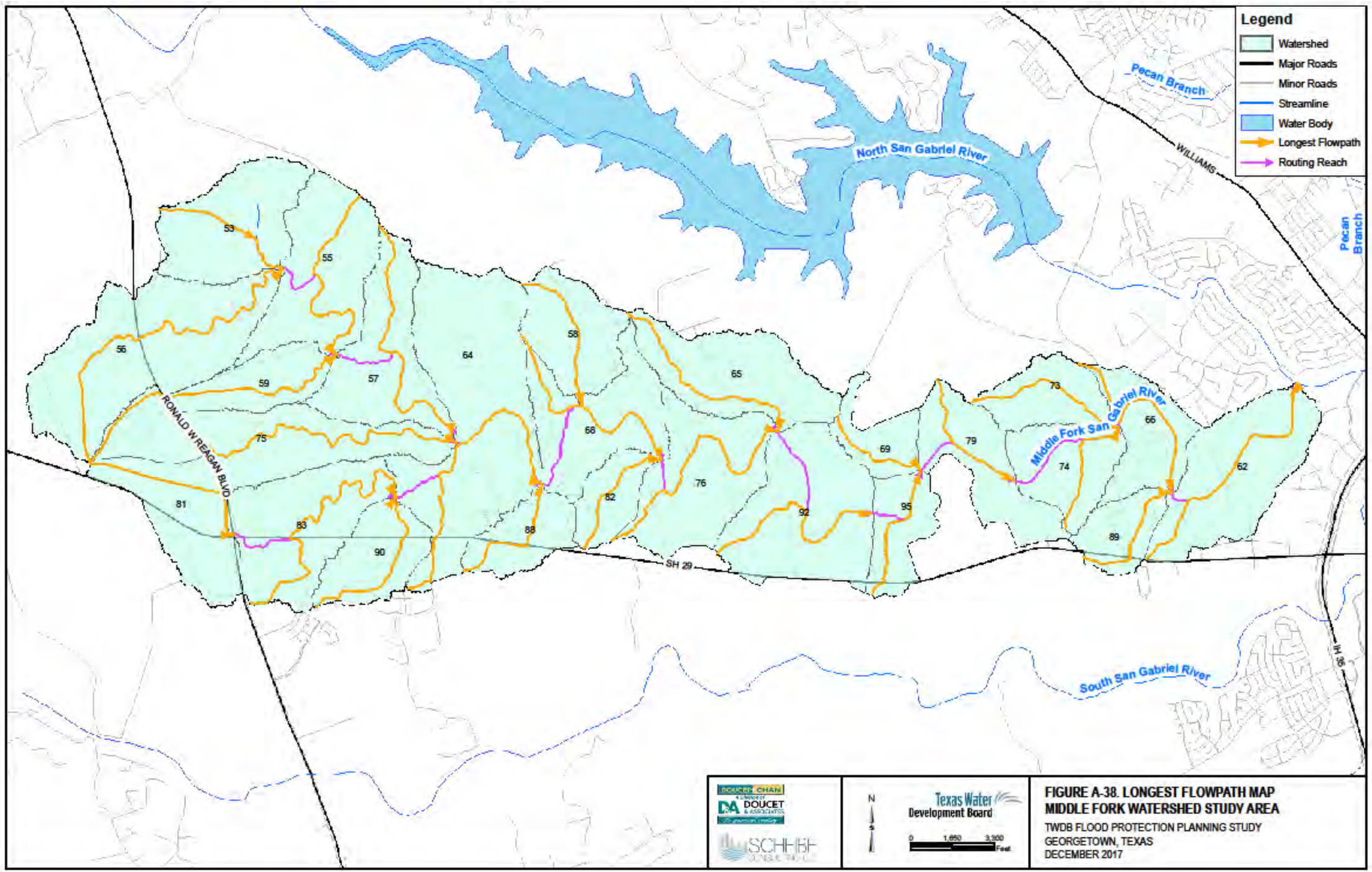

FIGURE A-38. LONGEST FLOWPATH MAP
MIDDLE FORK WATERSHED STUDY AREA
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DECEMBER 2017

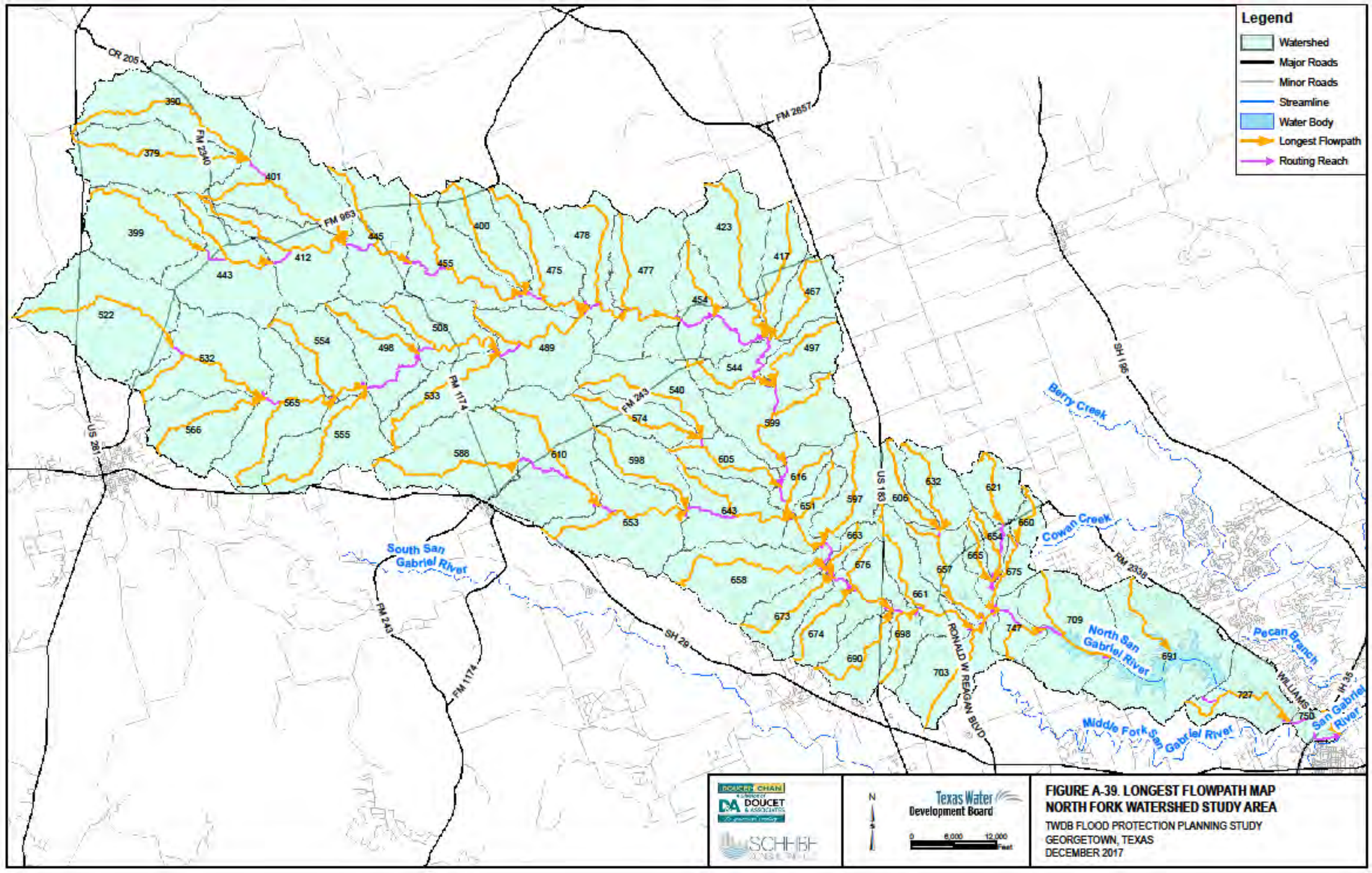

FIGURE A-39. LONGEST FLOWPATH MAP
NORTH FORK WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

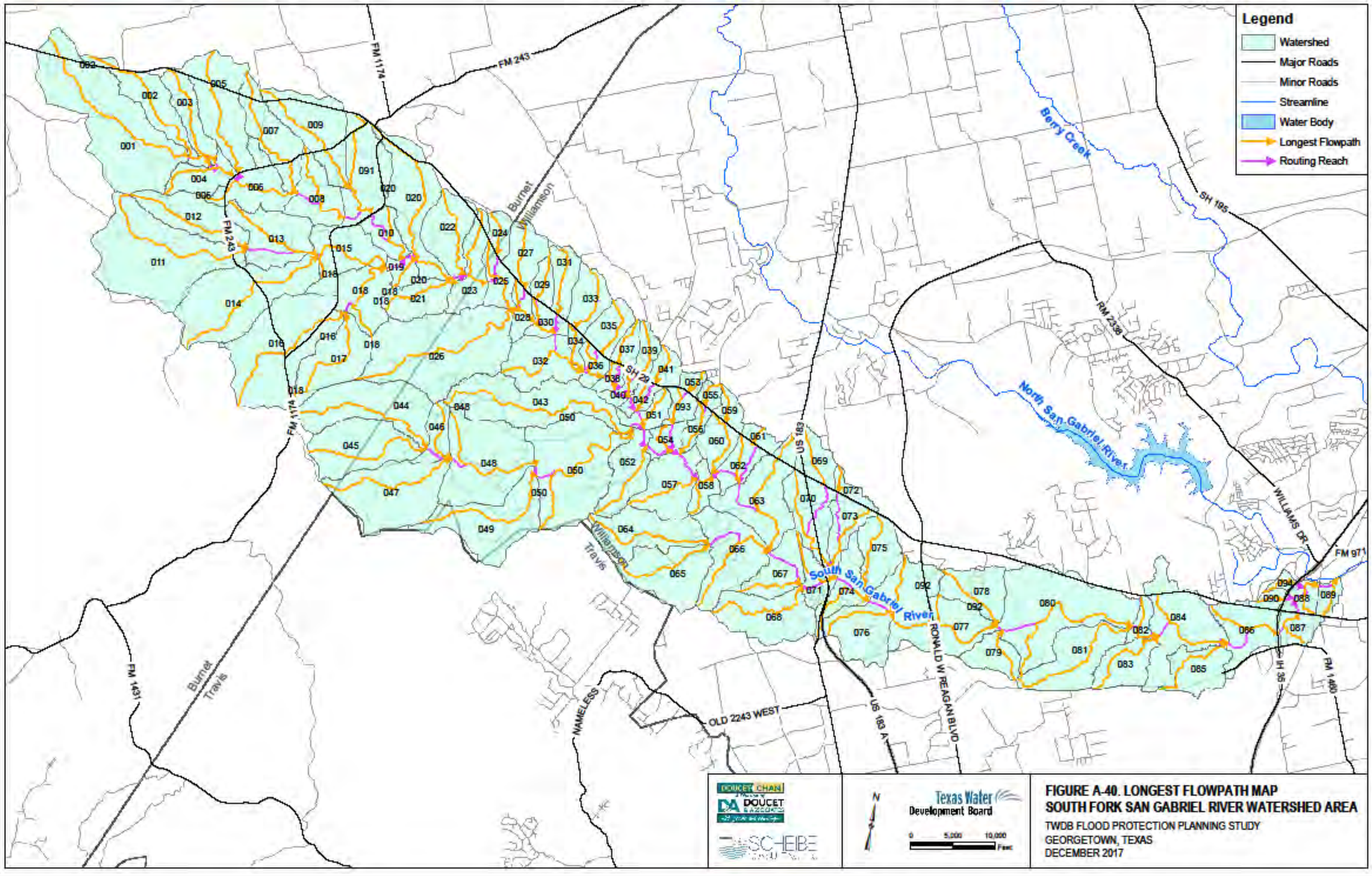
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FIGURE A-40. LONGEST FLOWPATH MAP
SOUTH FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

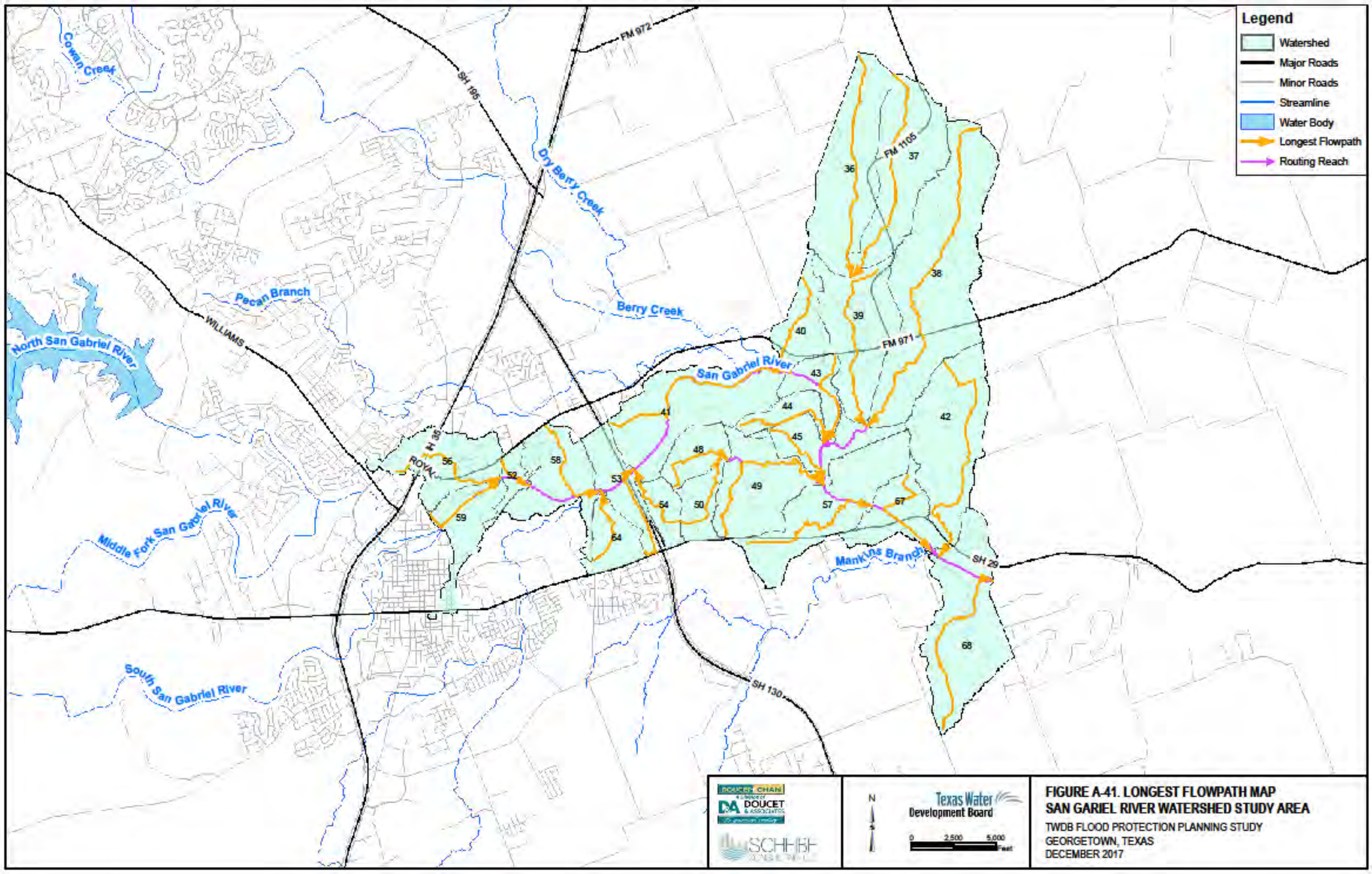
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FIGURE A-41. LONGEST FLOWPATH MAP
SAN GARIEL RIVER WATERSHED STUDY AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

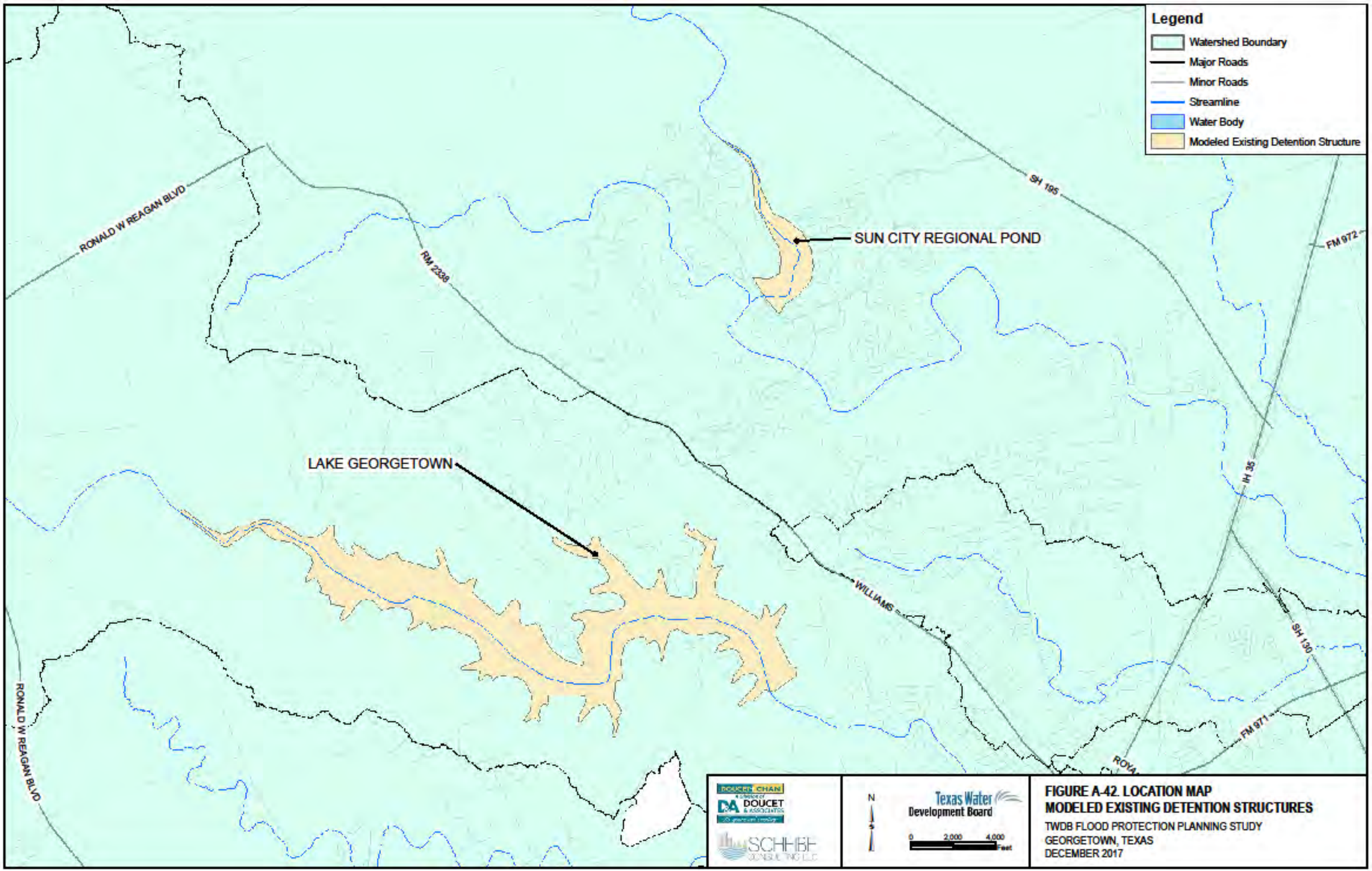


FIGURE A-42. LOCATION MAP
MODELED EXISTING DETENTION STRUCTURES
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017

Figure A-43 HEC-HMS Model Layout – Berry Creek

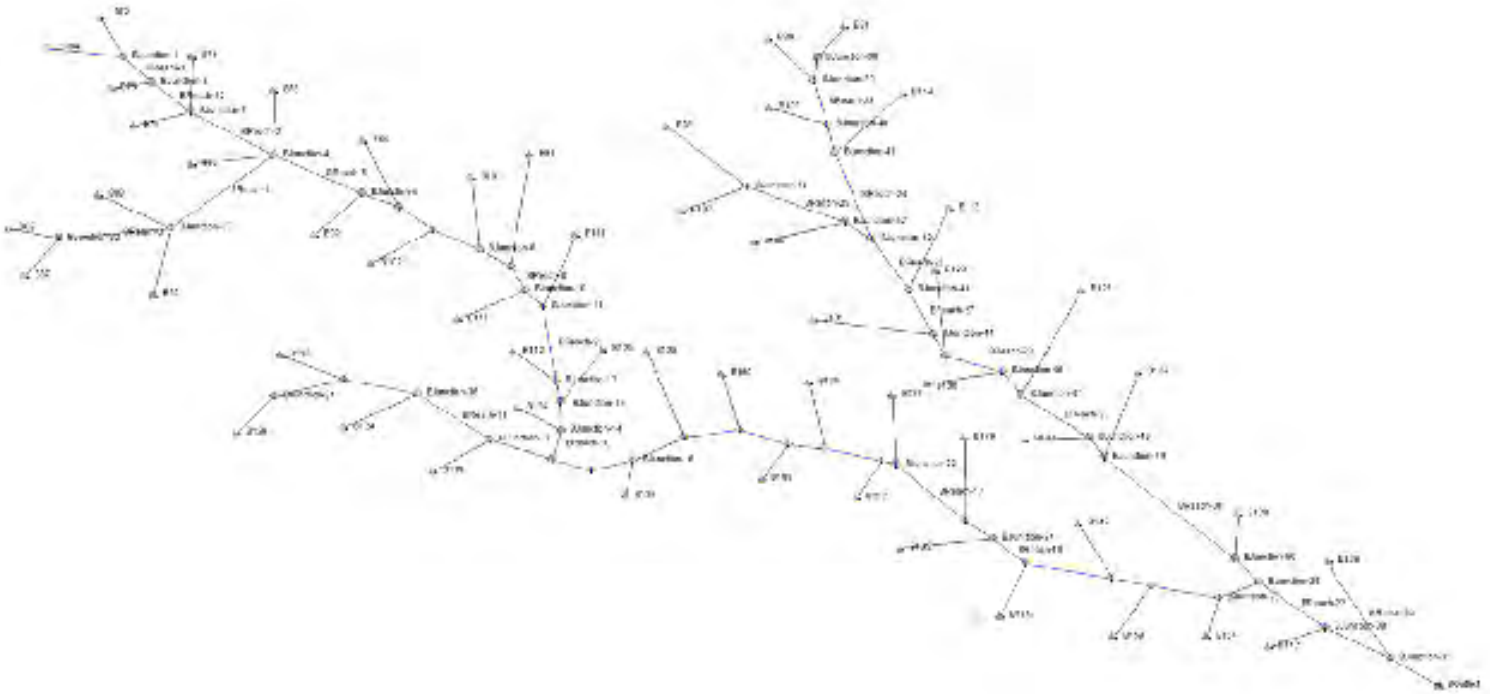


Figure A-44 HEC-HMS Model Layout – Mankins Branch

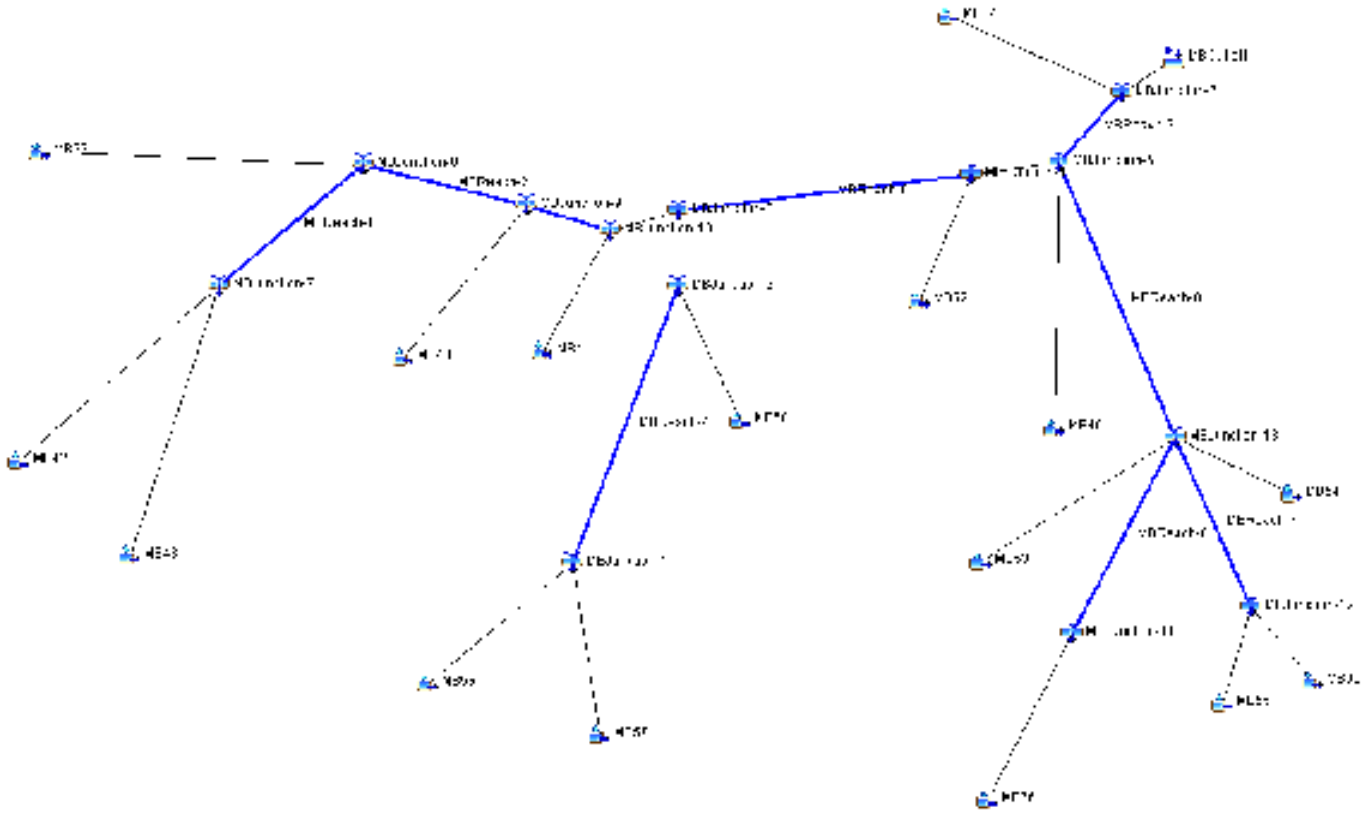


Figure A-45 HEC-HMS Model Layout – Pecan Branch

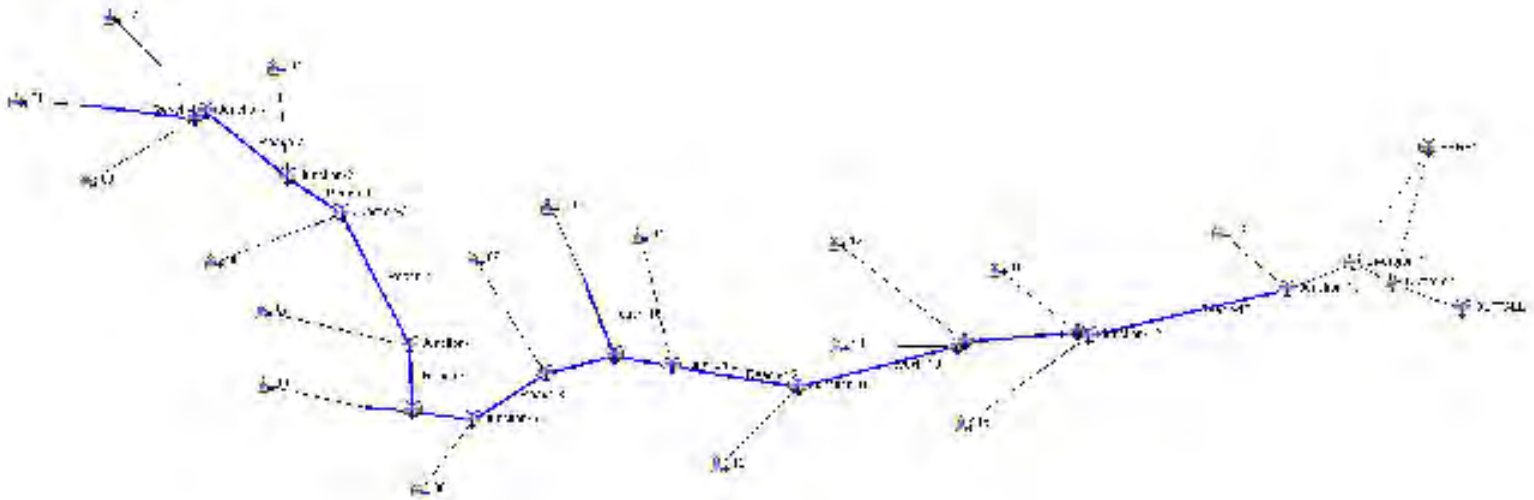


Figure A-46 HEC-HMS Model Layout – Smith Branch

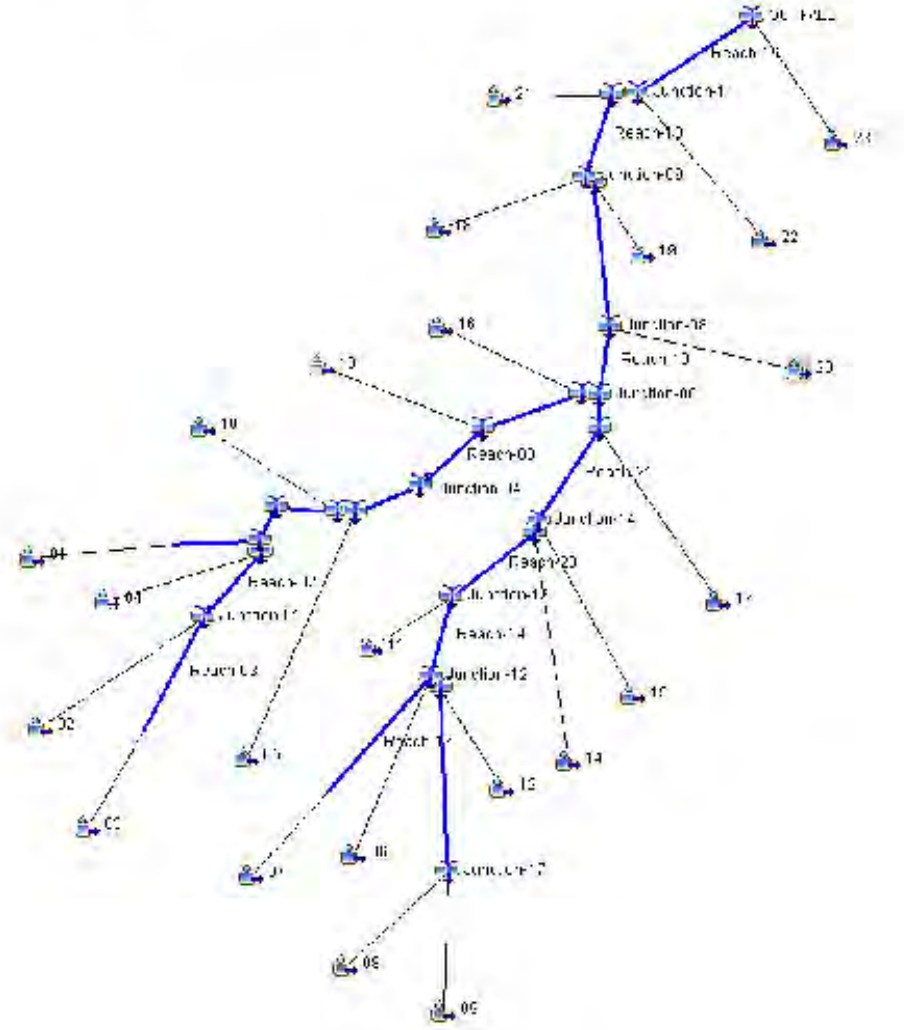


Figure A-47 HEC-HMS Model Layout – Middle Fork San Gabriel River



Figure A-48 HEC-HMS Model Layout – North Fork San Gabriel River

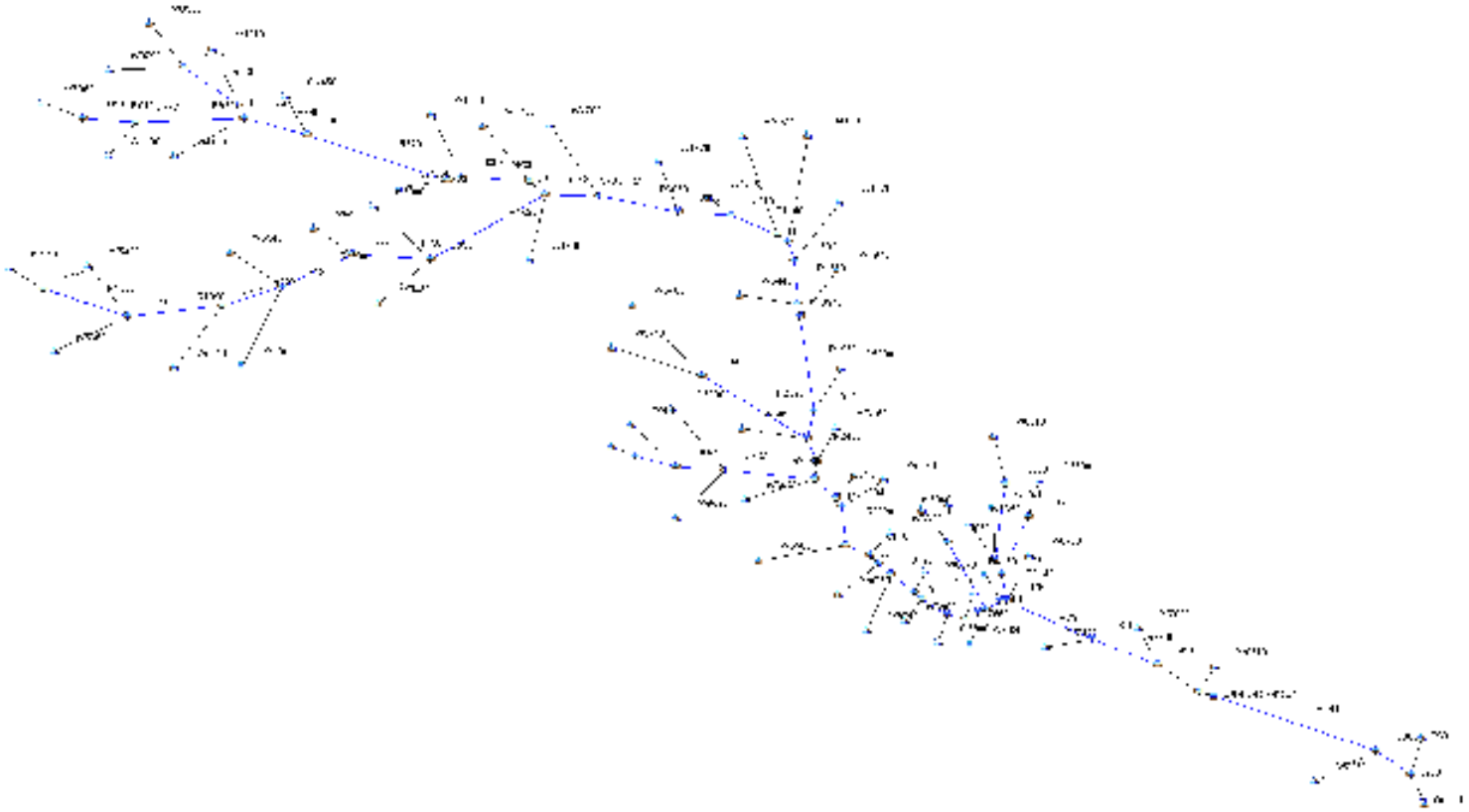


Figure A-49 HEC-HMS Model Layout – South Fork San Gabriel River

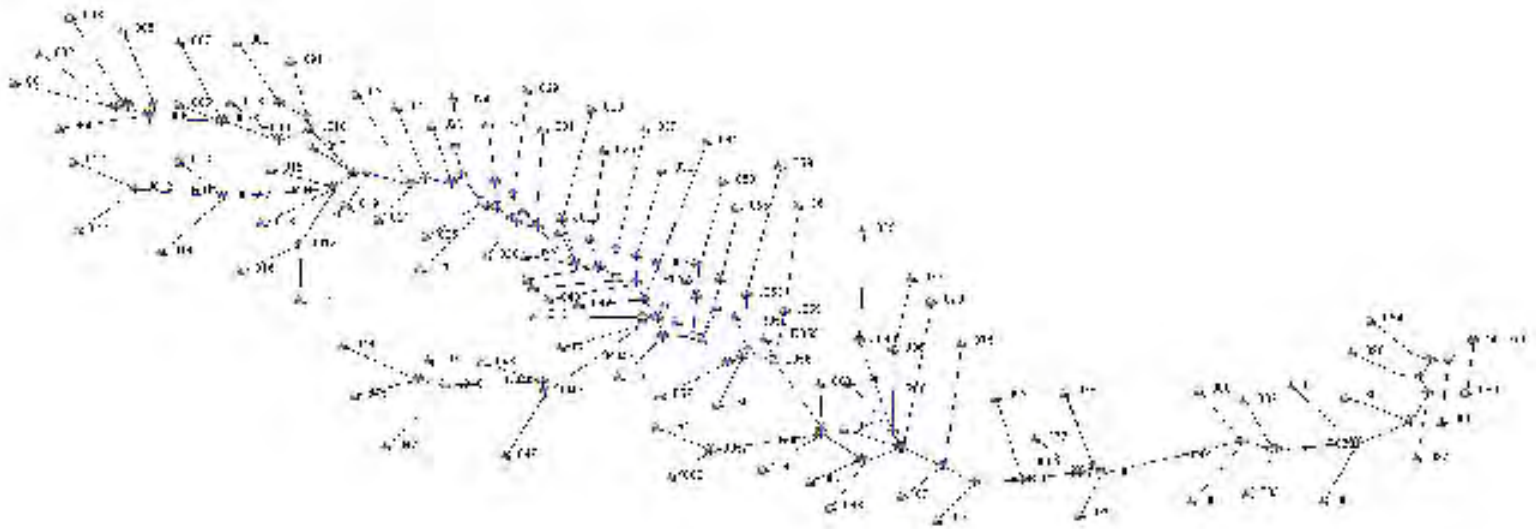
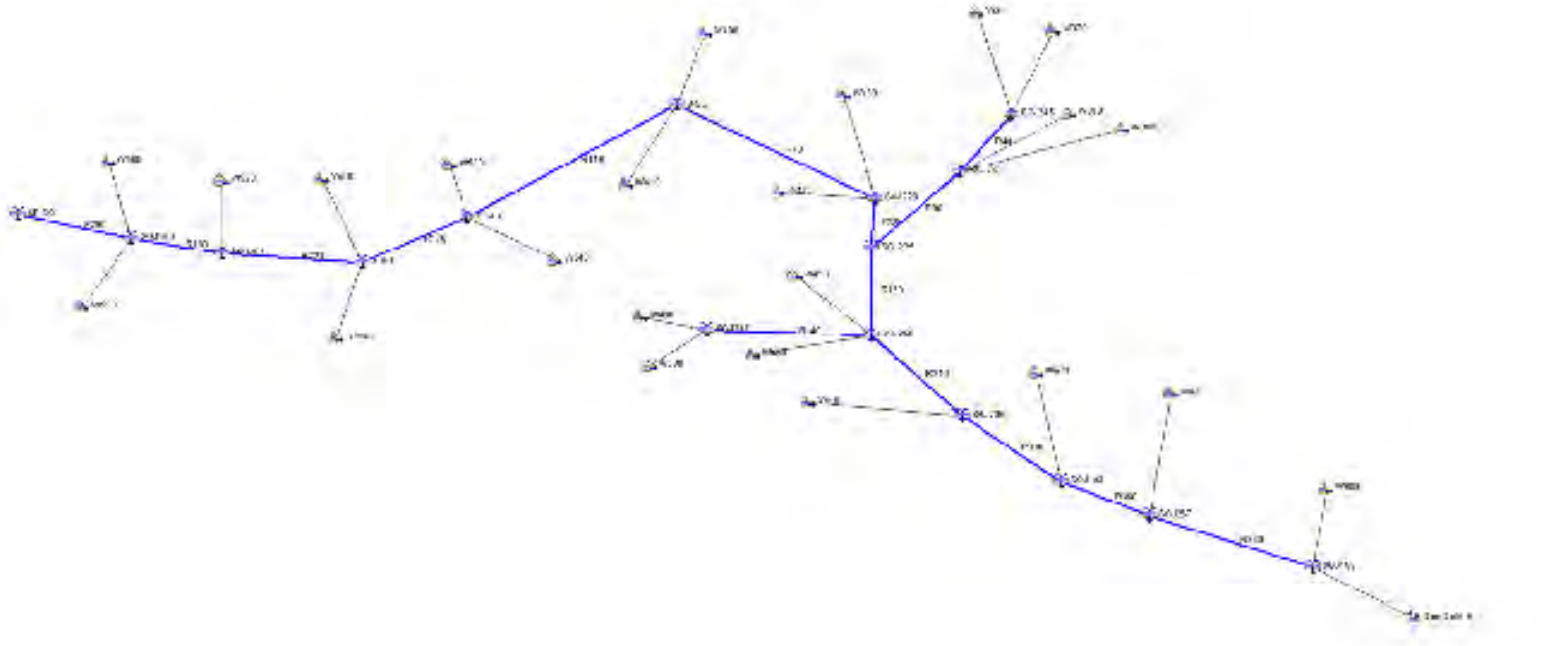


Figure A-50 HEC-HMS Model Layout – San Gabriel River



APPENDIX B
HYDRAULICS

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B.1.0 Background

Hydraulic analyses were performed for study streams within the watershed study areas to estimate maximum water surface elevations that would occur for the 5-, 10-, 25-, 50-, 100-, and 500-year (20, 10, 4, 2, 1, and 0.2 percent annual chance exceedance) storm events for existing and future watershed conditions. The hydraulic analyses also include the delineation of the existing and future conditions 100-year floodplains. USACE HEC-RAS software version 5.0.1 is used for the hydraulic analysis. All modeling is one dimensional and steady state. Table B-1 lists stream study limits as well as the length and number of structures modeled, respectively.

The sections that follow describe the development of the hydraulic models both in general terms and specifics that apply to each stream.

B.2.0 Data Sources

Table B-2 lists the sources of data used in the hydraulic analyses. The most recently flown LIDAR data was utilized within each study reach for model geometry development. New on-the-ground topographic survey data were collected as part of this study including channel cross sections at one stream mile intervals and detailed survey of culvert crossings, bridge crossings, and regional detention facilities to supplement available as-built information. Field survey data sheets are included as Attachment 1. As-built information sources for culvert and bridge crossings within each study reach are listed in Section B.4 of this appendix. All topographic data were referenced to the vertical datum NAVD 88.

B.3.0 Model Development

B.3.1 Stream Centerlines and Cross Sections

Study stream centerlines and channel cross sections were developed based on best available LiDAR topographic data. A terrain surface was developed using ESRI ArcMap for each watershed study area. Cross sections were placed along the stream centerlines to capture natural cross sections and data for hydraulically significant structures including bridges, culverts, and roads. In general, cross section spacing was no more than 1,000 feet in undeveloped areas and no more than 500 ft in developed areas. Additional cross sections were placed at significant profile inflection points, areas of rapid expansion or contraction, and at significant changes in channel or overbank cross sectional geometry or roughness. Cross section locations for each study reach are shown on Figures B-2 through B-9.

USACE HEC-GeoRAS software was used in conjunction with ESRI ArcMap to develop station-elevation data for stream centerlines and cross sections based on LiDAR data. Crossing and hydraulic structures were then added to model geometry based on best available data including field survey data, as-built information, and field measurements. Channel cross sections were also refined based on field survey data where available.

B.3.1 Parameter Estimation

Hydraulic models require several estimated parameters, including Manning's 'n' roughness coefficients for channels and overbanks, contraction and expansion coefficients, ineffective flow area limits, and others as shown in the following tables.

Manning's 'n' is a measure of the roughness of channels and overbanks. The value of 'n' varies with flow depth, alignment, amount and type of vegetation, and flow observations. For this analysis, channel and overbank surfaces were evaluated using best available aerial imagery and field reconnaissance data and corresponding roughness coefficients were assigned based on Table B-3 using experience and engineering judgement.

Contraction and expansion coefficients were applied upstream and downstream, respectively, of culverts and bridges to model the contraction and expansion of flow. In this study, contraction and expansion coefficients of cross sections bounding bridges and culverts were 0.3 and 0.5, respectively. All other cross sections used the default contraction and expansion coefficients of 0.1 and 0.3. Additional hydraulic parameters are provided in Table B-4.

Ineffective flow limits were added to cross sections to accurately model any given section's inability to convey flow, such as cross sections that bound bridges and culverts. Blocked obstructions were added within off-channel local drainage features including detention ponds and channels, since these areas were assumed to be full and unable to convey flow. Storage in the main channel and overbanks were accounted for by using Modified Puls routing within the HEC-HMS hydrologic models.

Downstream boundary conditions for each hydraulic model were based on normal depth. An energy slope was entered for each model based on the average bed slope in the vicinity of the downstream boundary. All hydraulic modeling assumed a subcritical flow regime for this study.

B.3.2 Peak Discharge Application Locations

Peak discharges within each study stream were computed by the HEC-HMS models for each watershed study area (See Appendix A). Peak flow rates computed at each hydrologic junction along the study stream were generally applied two-thirds of the distance to the next upstream junction. In cases where junctions were located at a significant tributary inflow point, the confluence peak flow was applied at the nearest cross section downstream of the confluence. Tables B-5 through B-12 provide a summary of peak existing and future conditions 100-year discharges and application locations for each study stream.

B.3.3 Road Crossings

Given the significant importance that road crossings play in a stream's hydraulic conditions, numerous crossings were field surveyed or measured. When available, as-built information on the road crossing was used. Topographic data sources are provided in Tables B-5 through B-12.

B.3.4 Special Modeling Considerations

The following sections provide details of special modeling requirements and considerations for each study stream.

B.3.4.1 Hydraulic Model – Berry Creek Watershed Study Area

The Berry Creek Watershed Study Area HEC-RAS model consists of the streams identified in Table B-1 and shown on Figure B-1. Special modeling requirements and considerations included simulation of Sun City inline detention pond and the in-line wet pond. The Sun City detention pond's control structure is modeled as bridge crossing since it is integrated with the Sun City Boulevard crossing of Berry Creek. The wet pond is modeled as an inline structure consisting of a flat-topped weir. The weir crest elevation was set to the apparent permanent pool elevation upstream of the structure based on best available LiDAR data. The channel invert at the structure was interpolated from the nearest downstream channel elevation.

B.3.4.2 Hydraulic Model – Mankins Branch Watershed Study Area

The Mankins Branch Watershed Study Area HEC-RAS model consists of the streams identified in Table B-1 and shown on Figure B-1. Special modeling requirements and considerations included simulation of a small dam that is modeled as an inline structure consisting of a flat-topped weir. The weir crest elevation was set to the apparent permanent pool elevation upstream of the structure based on best available LiDAR data. The channel invert at the structure was interpolated from the nearest downstream channel elevation.

B.3.4.3 Hydraulic Model – Pecan Branch Watershed Study Area

The Pecan Branch Watershed Study Area HEC-RAS model consists of the streams identified in Table B-1 and shown on Figure B-1. Special modeling requirements and considerations included simulation of the overtopping of the left overbank into Berry Creek in the lower reach near FM 971. An auxiliary HEC-RAS model including laterals weirs along high ground between Pecan Branch and Berry Creek within the potential overflow area. The split flow optimization tool was used to compute diversion flow rates between the two systems assuming independent storm events within each watershed (i.e., no coincident peaks). An inflow-diversion rating curve was then developed based on the auxiliary model and added to the Pecan Branch HEC-HMS hydrologic

model to adjust flow rates in the lower reach. Spillover from Pecan Branch into Berry Creek may occur in events as frequent as the 5-year event in the vicinity of FM 971; however, Berry Creek flows are generally conveyed within its banks up to the 100-year event and do not significantly influence flow rates in its lower reach.

B.3.4.4 Hydraulic Model – Smith Branch Watershed Study Area

The Smith Branch Watershed Study Area HEC-RAS model consists of the streams identified in Table B-1 and shown on Figure B-1. Special modeling requirements and considerations were limited to the West Fork of Smith Branch, and included simulation of the overtopping of the left overbank near Quail Valley Drive (including auxiliary unsteady-state and 2D modeling), simulation of overtopping of the right overbank along S. Austin Avenue (including auxiliary unsteady-state and 2D modeling), unsteady-state modeling in support of hydrologic routing calibration, and use of a levee along the railroad embankment between S. Austin Avenue and FM 1460.

B.3.4.5 Hydraulic Model – Middle Fork San Gabriel River Watershed Study Area

The Middle Fork San Gabriel River Watershed Study Area HEC-RAS model consists of the streams identified in Table B-1 and shown on Figure B-1. Special modeling requirements and considerations included simulation of several private inline check dams. They were modeled as inline structures consisting of flat-topped weirs. Weir crest elevations were set to the apparent permanent pool elevation upstream of each structure based on best available LiDAR data. Channel inverts at each structure were interpolated from the nearest upstream and downstream channel or structure field survey data.

B.3.4.6 Hydraulic Model – North Fork San Gabriel River Watershed Study Area

The North Fork San Gabriel River Watershed Study Area HEC-RAS model consists of the stream identified in Table B-1 and shown on Figure B-1. Special modeling requirements and considerations included considerations in and around Lake Georgetown. Lake Georgetown is a significant U.S. Army Corps of Engineers' reservoir located on the North Fork San Gabriel River in the northwest Georgetown area. The reservoir storage capacity, the dam, as well as its principal and emergency spillways influence flood considerations in the reservoir impoundment area as well as the downstream areas, including North Fork to the confluence with South Fork and the San Gabriel River downstream of the confluence. In developing existing and future developed watershed condition flood elevations, we developed separate approaches for three different areas of the Lake Georgetown floodplain; the impoundment area, downstream of the dam, and upstream of the lake.

For 100-year flood elevations within the Lake Georgetown impoundment area, the study compared the maximum historic lake elevation, the effective FEMA Zone A flood elevation, and the maximum flood elevation occurring when North Fork 100-year flood event flows route through the lake assuming pool elevation starts 10-feet above conservation pool elevation. Based upon Corps data, the historic maximum lake level did not occur during a significant flood event for the San Gabriel, but when the Corps impounded water in Lake Georgetown to provide flood protection in the lower Brazos River Basin. FEMA Zone A floodplains around the lake appear to indicate an elevation at or near the historic maximum lake level which is slightly higher than the emergency spillway elevation. Those levels were then compared to the runoff volume estimated to flow into

the lake during a 100-year flood event and assuming the lake's water surface elevation is 10-feet above the conservation pool elevation. The study used the existing Zone A floodplain around the Lake Georgetown impoundment area since it exceeded the study's peak 100-year flood elevation and closely matched the maximum historic lake elevation.

Immediately downstream of Lake Georgetown, the flows reflected the runoff from the surrounding area and small releases from the dam.

Upstream of Lake Georgetown, the 100-year flood elevations are based upon Lake Georgetown's maximum impoundment flood elevation. The boundary condition for the most downstream cross-section just upstream of the lake was set at the top of the spillway's elevation.

Channel cross sections were also refined based on field survey data where available. In order to maintain a consistent bed slope between surveyed cross sections, channel inverts for cross sections based on LiDAR data alone were lowered to an interpolated channel invert based on the nearest upstream and downstream channel or structure field survey data. This was done by adjusting the lowest channel cross section point for each of these cross sections.

B.3.4.7 Hydraulic Model – South Fork San Gabriel River Watershed Study Area

The South Fork San Gabriel River Watershed Study Area HEC-RAS model consists of the streams identified in Table B-1 and shown on Figure B-1. Special modeling requirements and considerations included simulation of several private inline check dams generally west of Liberty Hill. Since no field survey data were obtained for these small dams, which were several feet below the 5-year computed water surface, they were modeled as inline structures consisting of flat-topped weirs. Weir crest elevations were set to the apparent permanent pool elevation upstream of each structure based on best available LiDAR data. Channel inverts at each structure were interpolated from the nearest upstream and downstream channel or structure field survey data.

Channel cross sections were also refined based on field survey data where available. In order to maintain a consistent bed slope between surveyed cross sections, channel inverts for cross sections based on LiDAR data alone were lowered to an interpolated channel invert based on the nearest upstream and downstream channel or structure field survey data. This was done by adjusting the lowest channel cross section point for each of these cross sections.

B.3.4.8 Hydraulic Model – San Gabriel River Watershed Study Area

The San Gabriel River Watershed Study Area HEC-RAS model consists of the streams identified in Table B-1 and shown on Figure B-1.

Channel cross sections were also refined based on field survey data where available. In order to maintain a consistent bed slope between surveyed cross sections, channel inverts for cross sections based on LiDAR data alone were lowered to an interpolated channel invert based on the nearest upstream and downstream channel or structure field survey data. This was done by adjusting the lowest channel cross section point for each of these cross sections.

B.4.0 Model Results and Floodplain Mapping

This section provides detailed model results including a tabulation of maximum water surface elevation profiles and floodplain figures. Existing and future conditions 100-year floodplain limits were determined by comparing maximum computed water surface elevation profiles to watershed terrain surfaces based on best available LiDAR ground surface elevations within each study stream. The RAS Mapper tool within HEC-RAS was used to auto-delineate floodplain limits for each event. Auto-delineated floodplain limits were then exported as shapefiles to ESRI ArcMap for post-processing, which included removal of "islands" within the floodplain and areas not hydraulically connected to the floodplain generally smaller than 0.5 acres.

Figures B-2 through B-9 provide cross section locations, effective FEMA 100-year floodplain limits, existing conditions 100-year floodplain limits, and future conditions 100-year floodplain limits for each of the study streams. Tables B-5 through B-12 provide tabulations of existing and future conditions 100-year maximum computed water surface elevations at cross sections within each study stream. These tables also provide the topographic data sources used at each cross section, bridge/culvert, and inline structure.

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TABLES

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Table B-1. Studied Streams Table

Stream	Limits of Study	Length (ft)	No. Structures
Berry Creek (Main Stem)	From confl. with San Gabriel River to 2,500 ft upstream of CR 241	108,095	19
Berry Creek (Dry Berry Creek)	From confl. with Berry Creek to 4,200 ft upstream of Ronald Reagan Blvd.	43,291	9
Berry Creek (Cowan Creek)	From confl. with Berry Creek to 550 ft downstream of Young Ranch Rd.	34,654	3
Mankins Branch (Main Stem)	From confl. with San Gabriel River to 950 ft upstream of Hutto Rd.	27,799	11
Mankins Branch (Trib 2)	From confl. with Main Stem to 1700 ft upstream of Sam Houston Ave.	17,838	2
Mankins Branch (Trib 2.1)	From confl. with Trib 2 to 400 ft upstream of Rockride Ln.	7865	1
Pecan Branch	From confl. with San Gabriel River to 1,000 ft upstream of W. Sequoia Spur	48,500	31
Smith Branch (Main Stem)	From confl. with San Gabriel River to 2,300 ft upstream of CR 166	27,400	7
Smith Branch (West Fork)	From confl. with Main Stem to D/S face railroad west of IH35	22,400	10
Middle Fork San Gabriel	From confl. with San Gabriel River to 80 ft downstream of Cross Creek Ln.	69,217	10
North Fork San Gabriel	From confl. with San Gabriel River to 4600 ft upstream of FM 2340	264,538	23
South Fork San Gabriel	From confl. with San Gabriel River to 1,100 ft upstream of CR 330B	196,800	21
San Gabriel River	From 6650 ft downstream of SH 29 to confl. with South San Gabriel River	58,354	17

Table B-2. Data Sources

Source	Used For
Burnet County 2011 LiDAR topography	Cross Section Station-Elevation Data, Floodplain Mapping
CAPCOG 2006 LiDAR topography	Cross Section Station-Elevation Data, Floodplain Mapping
City of Georgetown 2015 LiDAR topography	Cross Section Station-Elevation Data, Floodplain Mapping
ESRI World Imagery	Channel & Overbank Roughness Coefficients
2015-2016 Topographic Field Survey Data	Cross Section Station-Elevation Data, Stream Invert, Bridge/Culvert Data
Various As-built Information (see Section B-5 through B-12 for sources)	Bridge/Culvert Data

Table B-3. Manning's n Roughness Coefficients for Open Channel Flow

Material	Typical Manning's n roughness coefficient	
	Minimum	**Maximum**
Channel		
Concrete	0.011	0.020
Natural stream channels Clean, straight stream Clean, winding stream Winding with weeds & pools With heavy brush and timber	0.025 0.033 0.045 0.070	0.033 0.045 0.060 0.150
Overbanks Pasture Cultivated Area Light brush Dense brush Trees Residential Areas	 0.025 0.020 0.035 0.045 0.080 0.100	 0.060 0.060 0.080 0.160 0.200 0.200

Table B-4. Miscellaneous Hydraulic Coefficients

Coefficient Type	Value or Range
Bridge pier drag coefficient for momentum equation application, Cd	1.2 to 2
Pressure and weir flow coefficient (submerged inlet and outlet), Cd	0.8
Expansion coefficients for bridge / culverts / in-line structures	0.3 to 0.5
Expansion coefficients for channels	0.3
Contraction coefficient for bridges / culverts / in-line structures	0.1 to 0.3
Contraction coefficients for channels	0.1
Weir coefficients (road deck)	2.6 to 3.0
Culvert entrance loss coefficient	0.4
Culvert exit loss coefficient	1

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Table B-5 Computed Water Surface Elevations and Topographic Data Source – Berry Creek

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Berry Creek	Berry Creek	107605	915.26	915.84	LIDAR TOPO
Berry Creek	Berry Creek	107128	914.20	914.73	LIDAR TOPO
Berry Creek	Berry Creek	106636	913.33	913.86	LIDAR TOPO
Berry Creek	Berry Creek	106149	912.39	912.93	LIDAR TOPO
Berry Creek	Berry Creek	105690	911.57	912.12	LIDAR TOPO
Berry Creek	Berry Creek	105633	911.63	912.18	LIDAR TOPO/2015-2016 FIELD SURVEY
Berry Creek	Berry Creek	105550 COUNTY RD 241			2015-2016 FIELD SURVEY
Berry Creek	Berry Creek	105480	911.19	911.86	LIDAR TOPO
Berry Creek	Berry Creek	105368	910.18	910.77	LIDAR TOPO
Berry Creek	Berry Creek	105006	908.88	909.48	LIDAR TOPO
Berry Creek	Berry Creek	104554	906.33	906.86	LIDAR TOPO
Berry Creek	Berry Creek	104065	905.45	905.91	LIDAR TOPO
Berry Creek	Berry Creek	103582	904.71	905.14	LIDAR TOPO
Berry Creek	Berry Creek	103058	903.86	904.27	LIDAR TOPO/2015-2016 FIELD SURVEY
Berry Creek	Berry Creek	103006 COUNTY RD 245			2015-2016 FIELD SURVEY
Berry Creek	Berry Creek	102912	902.24	902.75	LIDAR TOPO
Berry Creek	Berry Creek	102793	902.09	902.60	LIDAR TOPO
Berry Creek	Berry Creek	102314	901.24	901.77	LIDAR TOPO
Berry Creek	Berry Creek	101863	899.91	900.39	LIDAR TOPO
Berry Creek	Berry Creek	101386	898.24	898.64	LIDAR TOPO
Berry Creek	Berry Creek	100905	896.12	896.59	LIDAR TOPO
Berry Creek	Berry Creek	100394	895.12	895.59	LIDAR TOPO
Berry Creek	Berry Creek	99933	894.23	894.69	LIDAR TOPO
Berry Creek	Berry Creek	99432	893.02	893.47	LIDAR TOPO
Berry Creek	Berry Creek	98959	891.48	892.00	LIDAR TOPO
Berry Creek	Berry Creek	98479	890.11	890.61	LIDAR TOPO
Berry Creek	Berry Creek	97979	889.11	889.64	LIDAR TOPO
Berry Creek	Berry Creek	97464	887.81	888.34	LIDAR TOPO
Berry Creek	Berry Creek	97058	887.22	887.74	LIDAR TOPO
Berry Creek	Berry Creek	96595	886.40	886.92	LIDAR TOPO
Berry Creek	Berry Creek	96137	885.69	886.22	LIDAR TOPO
Berry Creek	Berry Creek	95634	884.43	884.97	LIDAR TOPO
Berry Creek	Berry Creek	95019	882.00	882.42	LIDAR TOPO
Berry Creek	Berry Creek	94671	881.54	881.97	LIDAR TOPO
Berry Creek	Berry Creek	94118	879.74	880.23	LIDAR TOPO
Berry Creek	Berry Creek	93636	878.70	879.22	LIDAR TOPO
Berry Creek	Berry Creek	93179	877.76	878.29	LIDAR TOPO
Berry Creek	Berry Creek	92700	876.94	877.46	LIDAR TOPO
Berry Creek	Berry Creek	92219	876.33	876.84	LIDAR TOPO
Berry Creek	Berry Creek	91704	875.22	875.76	LIDAR TOPO
Berry Creek	Berry Creek	91199	873.82	874.34	LIDAR TOPO
Berry Creek	Berry Creek	90700	873.18	873.67	LIDAR TOPO
Berry Creek	Berry Creek	90298	872.21	872.66	LIDAR TOPO
Berry Creek	Berry Creek	89830	870.85	871.30	LIDAR TOPO
Berry Creek	Berry Creek	89346	869.34	869.79	LIDAR TOPO
Berry Creek	Berry Creek	88885	868.27	868.74	LIDAR TOPO
Berry Creek	Berry Creek	88760	868.08	868.56	LIDAR TOPO
Berry Creek	Berry Creek	88716 BEAVER LN			LIDAR TOPO
Berry Creek	Berry Creek	88681	867.74	868.17	LIDAR TOPO
Berry Creek	Berry Creek	88638	867.69	868.13	LIDAR TOPO
Berry Creek	Berry Creek	88408	866.83	867.30	LIDAR TOPO
Berry Creek	Berry Creek	87940	865.90	866.38	LIDAR TOPO
Berry Creek	Berry Creek	87446	863.70	864.19	LIDAR TOPO
Berry Creek	Berry Creek	86947	862.73	863.31	LIDAR TOPO
Berry Creek	Berry Creek	86482	861.98	862.62	LIDAR TOPO
Berry Creek	Berry Creek	85998	861.27	861.97	LIDAR TOPO
Berry Creek	Berry Creek	85551	860.94	861.67	LIDAR TOPO
Berry Creek	Berry Creek	85083	860.70	861.45	LIDAR TOPO
Berry Creek	Berry Creek	84626	860.46	861.24	LIDAR TOPO
Berry Creek	Berry Creek	84143	860.26	861.05	LIDAR TOPO
Berry Creek	Berry Creek	83684	859.96	860.76	LIDAR TOPO
Berry Creek	Berry Creek	83190	859.30	860.10	LIDAR TOPO
Berry Creek	Berry Creek	82689	857.60	858.40	LIDAR TOPO
Berry Creek	Berry Creek	82209	856.00	856.69	LIDAR TOPO

Table B-5 Computed Water Surface Elevations and Topographic Data Source – Berry Creek (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Berry Creek	Berry Creek	81764	855.20	855.87	LIDAR TOPO
Berry Creek	Berry Creek	81291	854.28	854.95	LIDAR TOPO
Berry Creek	Berry Creek	80881	853.79	854.49	LIDAR TOPO
Berry Creek	Berry Creek	80415	852.63	853.27	LIDAR TOPO
Berry Creek	Berry Creek	79933	851.78	852.46	LIDAR TOPO
Berry Creek	Berry Creek	79469	850.96	851.58	LIDAR TOPO
Berry Creek	Berry Creek	79174	849.92	850.48	LIDAR TOPO
Berry Creek	Berry Creek	78709	848.40	849.04	LIDAR TOPO
Berry Creek	Berry Creek	78249	848.10	848.93	LIDAR TOPO
Berry Creek	Berry Creek	77704	847.45	848.15	LIDAR TOPO
Berry Creek	Berry Creek	77347	847.12	847.86	LIDAR TOPO
Berry Creek	Berry Creek	76869	843.89	844.76	LIDAR TOPO
Berry Creek	Berry Creek	76407	843.21	844.08	LIDAR TOPO
Berry Creek	Berry Creek	75929	841.29	842.21	LIDAR TOPO
Berry Creek	Berry Creek	75464	840.98	841.93	LIDAR TOPO
Berry Creek	Berry Creek	75002	840.61	841.53	LIDAR TOPO
Berry Creek	Berry Creek	74905	839.90	840.77	LIDAR TOPO
Berry Creek	Berry Creek	74792 RONALD REAGAN BLVD			Ronald W. Reagan Boulevard North Phase III As-builts
Berry Creek	Berry Creek	74637	838.73	839.55	LIDAR TOPO
Berry Creek	Berry Creek	74512	838.07	839.01	LIDAR TOPO
Berry Creek	Berry Creek	74062	835.92	836.59	LIDAR TOPO
Berry Creek	Berry Creek	73599	834.66	835.40	LIDAR TOPO
Berry Creek	Berry Creek	73169	834.09	834.83	LIDAR TOPO
Berry Creek	Berry Creek	72687	831.61	832.33	LIDAR TOPO
Berry Creek	Berry Creek	72222	830.94	831.68	LIDAR TOPO
Berry Creek	Berry Creek	71803	830.09	830.82	LIDAR TOPO
Berry Creek	Berry Creek	71329	829.07	829.77	LIDAR TOPO
Berry Creek	Berry Creek	70900	828.06	828.67	LIDAR TOPO
Berry Creek	Berry Creek	70391	826.90	827.46	LIDAR TOPO
Berry Creek	Berry Creek	69914	825.80	826.38	LIDAR TOPO
Berry Creek	Berry Creek	69453	824.87	825.42	LIDAR TOPO
Berry Creek	Berry Creek	68973	824.01	824.55	LIDAR TOPO
Berry Creek	Berry Creek	68494	822.79	823.35	LIDAR TOPO
Berry Creek	Berry Creek	68026	820.64	821.48	LIDAR TOPO
Berry Creek	Berry Creek	67554	819.35	819.85	LIDAR TOPO
Berry Creek	Berry Creek	67056	818.65	819.19	LIDAR TOPO
Berry Creek	Berry Creek	66570	817.95	818.48	LIDAR TOPO
Berry Creek	Berry Creek	66065	817.39	817.91	LIDAR TOPO
Berry Creek	Berry Creek	65597	817.14	817.65	LIDAR TOPO
Berry Creek	Berry Creek	65141	816.97	817.46	LIDAR TOPO
Berry Creek	Berry Creek	64665	816.84	817.32	LIDAR TOPO
Berry Creek	Berry Creek	64247	816.68	817.14	LIDAR TOPO
Berry Creek	Berry Creek	63749	816.50	816.94	LIDAR TOPO
Berry Creek	Berry Creek	63563	816.45	816.88	LIDAR TOPO
Berry Creek	Berry Creek	63101	816.44	816.88	LIDAR TOPO
Berry Creek	Berry Creek	62999	816.46	816.90	LIDAR TOPO
Berry Creek	Berry Creek	62816 SUN CITY BLVD			Sun City Georgetown - Phase 2A - Sun City Boulevard Bridge/Detention Facility
Berry Creek	Berry Creek	62717	804.49	805.18	LIDAR TOPO
Berry Creek	Berry Creek	62634	804.28	804.98	LIDAR TOPO
Berry Creek	Berry Creek	62371	804.07	804.76	LIDAR TOPO
Berry Creek	Berry Creek	62248	803.59	804.26	LIDAR TOPO
Berry Creek	Berry Creek	62046	802.84	803.50	LIDAR TOPO
Berry Creek	Berry Creek	61776	802.22	802.86	LIDAR TOPO
Berry Creek	Berry Creek	61281	801.14	801.82	LIDAR TOPO
Berry Creek	Berry Creek	60851	801.02	801.70	LIDAR TOPO
Berry Creek	Berry Creek	60351	801.01	801.71	LIDAR TOPO
Berry Creek	Berry Creek	59882	799.66	800.35	LIDAR TOPO
Berry Creek	Berry Creek	59419	798.83	799.48	LIDAR TOPO
Berry Creek	Berry Creek	58952	797.92	798.55	LIDAR TOPO
Berry Creek	Berry Creek	58465	796.37	797.17	LIDAR TOPO
Berry Creek	Berry Creek	57967	795.40	796.29	LIDAR TOPO
Berry Creek	Berry Creek	57529	793.95	794.95	LIDAR TOPO

Table B-5 Computed Water Surface Elevations and Topographic Data Source – Berry Creek (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Berry Creek	Berry Creek	57049	793.22	794.29	LIDAR TOPO
Berry Creek	Berry Creek	56566	792.45	793.60	LIDAR TOPO
Berry Creek	Berry Creek	56519 DAM			LIDAR TOPO
Berry Creek	Berry Creek	56372	792.34	793.45	LIDAR TOPO
Berry Creek	Berry Creek	56272 DEL WEBB BLVD			Sun City Georgetown - Market Trail - Segment 1
Berry Creek	Berry Creek	56192	791.14	791.98	LIDAR TOPO
Berry Creek	Berry Creek	56085	791.04	791.88	LIDAR TOPO
Berry Creek	Berry Creek	55635	789.41	790.33	LIDAR TOPO
Berry Creek	Berry Creek	55147	787.22	788.15	LIDAR TOPO
Berry Creek	Berry Creek	54684	787.09	788.07	LIDAR TOPO
Berry Creek	Berry Creek	54210	785.54	786.38	LIDAR TOPO
Berry Creek	Berry Creek	53686	783.68	784.76	LIDAR TOPO
Berry Creek	Berry Creek	53221	782.06	783.27	LIDAR TOPO
Berry Creek	Berry Creek	52739	779.02	779.60	LIDAR TOPO
Berry Creek	Berry Creek	52255	778.01	778.81	LIDAR TOPO
Berry Creek	Berry Creek	51764	776.60	777.41	LIDAR TOPO
Berry Creek	Berry Creek	51373	776.33	777.17	LIDAR TOPO
Berry Creek	Berry Creek	51025	775.55	776.38	LIDAR TOPO
Berry Creek	Berry Creek	50617	774.90	775.74	LIDAR TOPO
Berry Creek	Berry Creek	50323	774.65	775.46	LIDAR TOPO
Berry Creek	Berry Creek	49841	772.72	773.38	LIDAR TOPO
Berry Creek	Berry Creek	49345	771.69	772.28	LIDAR TOPO
Berry Creek	Berry Creek	48887	770.69	771.24	LIDAR TOPO
Berry Creek	Berry Creek	48527	769.00	769.54	LIDAR TOPO
Berry Creek	Berry Creek	48187	768.32	768.90	LIDAR TOPO
Berry Creek	Berry Creek	47773	767.63	768.15	LIDAR TOPO
Berry Creek	Berry Creek	47383	767.07	767.59	LIDAR TOPO
Berry Creek	Berry Creek	46913	766.64	767.15	LIDAR TOPO
Berry Creek	Berry Creek	46421	762.94	763.92	LIDAR TOPO
Berry Creek	Berry Creek	45923	762.73	763.60	LIDAR TOPO
Berry Creek	Berry Creek	45448	758.97	759.53	LIDAR TOPO
Berry Creek	Berry Creek	44939	758.46	759.08	LIDAR TOPO
Berry Creek	Berry Creek	44477	758.04	758.75	LIDAR TOPO
Berry Creek	Berry Creek	43987	756.89	757.72	LIDAR TOPO
Berry Creek	Berry Creek	43467	754.14	754.91	LIDAR TOPO
Berry Creek	Berry Creek	43012	752.60	753.35	LIDAR TOPO
Berry Creek	Berry Creek	42532	751.66	752.52	LIDAR TOPO
Berry Creek	Berry Creek	42059	750.42	751.32	LIDAR TOPO
Berry Creek	Berry Creek	41572	748.92	749.81	LIDAR TOPO
Berry Creek	Berry Creek	41110	747.97	748.87	LIDAR TOPO
Berry Creek	Berry Creek	40655	745.75	746.60	LIDAR TOPO
Berry Creek	Berry Creek	40168	744.79	745.56	LIDAR TOPO
Berry Creek	Berry Creek	39686	743.23	743.88	LIDAR TOPO
Berry Creek	Berry Creek	39212	741.69	742.34	LIDAR TOPO
Berry Creek	Berry Creek	38734	740.36	741.00	LIDAR TOPO
Berry Creek	Berry Creek	38261	739.54	740.33	LIDAR TOPO
Berry Creek	Berry Creek	37773	738.77	739.59	LIDAR TOPO
Berry Creek	Berry Creek	37314	737.70	738.57	LIDAR TOPO
Berry Creek	Berry Creek	36857	735.96	736.79	LIDAR TOPO
Berry Creek	Berry Creek	36394	734.24	735.23	LIDAR TOPO
Berry Creek	Berry Creek	35898	734.29	735.32	LIDAR TOPO
Berry Creek	Berry Creek	35429	733.11	734.20	LIDAR TOPO
Berry Creek	Berry Creek	35152	730.67	731.60	LIDAR TOPO
Berry Creek	Berry Creek	35102 SHELL RD			Field Measurements
Berry Creek	Berry Creek	35053	729.24	730.02	LIDAR TOPO
Berry Creek	Berry Creek	34974	727.44	728.19	LIDAR TOPO
Berry Creek	Berry Creek	34491	726.35	727.05	LIDAR TOPO
Berry Creek	Berry Creek	34022	725.11	725.97	LIDAR TOPO
Berry Creek	Berry Creek	33544	723.33	724.25	LIDAR TOPO
Berry Creek	Berry Creek	33071	721.63	722.40	LIDAR TOPO
Berry Creek	Berry Creek	32604	721.08	721.93	LIDAR TOPO
Berry Creek	Berry Creek	32120	715.55	716.49	LIDAR TOPO
Berry Creek	Berry Creek	31657	713.29	713.93	LIDAR TOPO
Berry Creek	Berry Creek	31183	712.10	712.91	LIDAR TOPO

Table B-5 Computed Water Surface Elevations and Topographic Data Source – Berry Creek (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Berry Creek	Berry Creek	30713	710.37	711.16	LIDAR TOPO
Berry Creek	Berry Creek	30254	709.51	710.38	LIDAR TOPO
Berry Creek	Berry Creek	29744	707.98	708.77	LIDAR TOPO
Berry Creek	Berry Creek	29534	706.56	707.39	LIDAR TOPO/2015-2016 FIELD SURVEY
Berry Creek	Berry Creek	29483 OAK TREE DR			2015-2016 FIELD SURVEY
Berry Creek	Berry Creek	29448	706.10	707.19	LIDAR TOPO
Berry Creek	Berry Creek	29311	705.82	706.87	LIDAR TOPO
Berry Creek	Berry Creek	29169	705.68	706.66	LIDAR TOPO
Berry Creek	Berry Creek	29117 CHAMPIONS DR			Field Measurements
Berry Creek	Berry Creek	29073	704.45	705.09	LIDAR TOPO
Berry Creek	Berry Creek	28840	704.15	704.77	LIDAR TOPO
Berry Creek	Berry Creek	28365	703.24	703.70	LIDAR TOPO
Berry Creek	Berry Creek	27897	702.60	702.99	LIDAR TOPO
Berry Creek	Berry Creek	27421	701.97	702.27	LIDAR TOPO
Berry Creek	Berry Creek	26968	701.56	701.81	LIDAR TOPO
Berry Creek	Berry Creek	26906	701.31	701.50	LIDAR TOPO
Berry Creek	Berry Creek	26856 COUNTY RD 190 / AIRPORT RD			Field Measurements
Berry Creek	Berry Creek	26794	698.48	699.03	LIDAR TOPO
Berry Creek	Berry Creek	26501	698.28	698.86	LIDAR TOPO
Berry Creek	Berry Creek	26019	698.32	698.98	LIDAR TOPO
Berry Creek	Berry Creek	25521	697.94	698.62	LIDAR TOPO
Berry Creek	Berry Creek	25035	694.96	695.77	LIDAR TOPO
Berry Creek	Berry Creek	24556	694.66	695.37	LIDAR TOPO
Berry Creek	Berry Creek	24079	693.47	693.94	LIDAR TOPO
Berry Creek	Berry Creek	23580	692.44	692.76	LIDAR TOPO
Berry Creek	Berry Creek	23130	689.41	690.19	LIDAR TOPO
Berry Creek	Berry Creek	22645	689.34	689.90	LIDAR TOPO
Berry Creek	Berry Creek	22183	688.43	689.05	LIDAR TOPO
Berry Creek	Berry Creek	21733	687.85	688.50	LIDAR TOPO
Berry Creek	Berry Creek	21239	687.51	688.22	LIDAR TOPO
Berry Creek	Berry Creek	20742	687.21	687.94	LIDAR TOPO
Berry Creek	Berry Creek	20304	686.70	687.46	LIDAR TOPO
Berry Creek	Berry Creek	19864	686.60	687.34	LIDAR TOPO
Berry Creek	Berry Creek	19765	686.23	686.94	LIDAR TOPO
Berry Creek	Berry Creek	19703 I.H. 35 SB FRONTAGE RD			TXDOT 0015-08-108 As-builts
Berry Creek	Berry Creek	19662	685.16	685.78	LIDAR TOPO
Berry Creek	Berry Creek	19621 TEXAS 130 SB			TXDOT 0015-08-114
Berry Creek	Berry Creek	19549	684.46	685.03	LIDAR TOPO
Berry Creek	Berry Creek	19502 I.H. 35 MAIN LANE NB AND SB			TXDOT 0015-08-108
Berry Creek	Berry Creek	19392	683.62	684.11	LIDAR TOPO
Berry Creek	Berry Creek	19356 TEXAS 130 NB			TXDOT 0015-08-114
Berry Creek	Berry Creek	19285	683.18	683.61	LIDAR TOPO
Berry Creek	Berry Creek	19216 I.H. 35 NB FRONTAGE RD			TXDOT 0015-08-108
Berry Creek	Berry Creek	19144	680.93	681.35	LIDAR TOPO
Berry Creek	Berry Creek	19055	681.50	682.05	LIDAR TOPO
Berry Creek	Berry Creek	18808	681.37	681.90	LIDAR TOPO
Berry Creek	Berry Creek	18366	681.00	681.55	LIDAR TOPO
Berry Creek	Berry Creek	18116	680.55	681.13	LIDAR TOPO
Berry Creek	Berry Creek	17640	677.54	677.86	LIDAR TOPO
Berry Creek	Berry Creek	17171	677.45	677.80	LIDAR TOPO
Berry Creek	Berry Creek	16705	676.37	676.81	LIDAR TOPO
Berry Creek	Berry Creek	16241	675.00	675.46	LIDAR TOPO
Berry Creek	Berry Creek	15796	673.63	674.07	LIDAR TOPO
Berry Creek	Berry Creek	15354	673.27	673.76	LIDAR TOPO
Berry Creek	Berry Creek	14873	671.65	671.99	LIDAR TOPO
Berry Creek	Berry Creek	14421	669.26	669.89	LIDAR TOPO
Berry Creek	Berry Creek	13950	668.18	668.83	LIDAR TOPO
Berry Creek	Berry Creek	13482	668.06	668.64	LIDAR TOPO
Berry Creek	Berry Creek	13039	664.78	665.03	LIDAR TOPO
Berry Creek	Berry Creek	12578	663.94	664.10	LIDAR TOPO
Berry Creek	Berry Creek	12087	662.92	662.84	LIDAR TOPO

Table B-5 Computed Water Surface Elevations and Topographic Data Source – Berry Creek (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Berry Creek	Berry Creek	12025	662.69	662.53	LIDAR TOPO/2015-2016 FIELD SURVEY
Berry Creek	Berry Creek	11992 COUNTY RD 152			2015-2016 FIELD SURVEY
Berry Creek	Berry Creek	11956	660.97	661.43	LIDAR TOPO
Berry Creek	Berry Creek	11791	660.45	660.93	LIDAR TOPO
Berry Creek	Berry Creek	11435	660.29	660.80	LIDAR TOPO
Berry Creek	Berry Creek	11010	658.29	658.77	LIDAR TOPO
Berry Creek	Berry Creek	10490	657.94	658.52	LIDAR TOPO
Berry Creek	Berry Creek	10017	657.22	657.78	LIDAR TOPO
Berry Creek	Berry Creek	9574	656.26	656.91	LIDAR TOPO
Berry Creek	Berry Creek	9238	655.41	656.08	LIDAR TOPO
Berry Creek	Berry Creek	8781	654.87	655.54	LIDAR TOPO
Berry Creek	Berry Creek	8630	653.36	654.03	LIDAR TOPO
Berry Creek	Berry Creek	8223	651.72	652.35	LIDAR TOPO
Berry Creek	Berry Creek	7791	650.67	651.30	LIDAR TOPO
Berry Creek	Berry Creek	7371	650.13	650.73	LIDAR TOPO
Berry Creek	Berry Creek	6927	646.93	647.42	LIDAR TOPO
Berry Creek	Berry Creek	6533	647.48	647.97	LIDAR TOPO
Berry Creek	Berry Creek	6154	645.32	645.84	LIDAR TOPO
Berry Creek	Berry Creek	5683	643.98	644.41	LIDAR TOPO
Berry Creek	Berry Creek	5199	641.18	641.76	LIDAR TOPO
Berry Creek	Berry Creek	4685	641.91	642.40	LIDAR TOPO
Berry Creek	Berry Creek	4296	641.41	641.90	LIDAR TOPO
Berry Creek	Berry Creek	3833	640.97	641.46	LIDAR TOPO
Berry Creek	Berry Creek	3370	640.57	641.05	LIDAR TOPO
Berry Creek	Berry Creek	2890	640.22	640.69	LIDAR TOPO
Berry Creek	Berry Creek	2761	640.10	640.55	LIDAR TOPO
Berry Creek	Berry Creek	2727	640.19	640.65	LIDAR TOPO/2015-2016 FIELD SURVEY
Berry Creek	Berry Creek	2681 FM 971			2015-2016 FIELD SURVEY
Berry Creek	Berry Creek	2616	639.87	640.37	LIDAR TOPO
Berry Creek	Berry Creek	2588	639.76	640.22	LIDAR TOPO
Berry Creek	Berry Creek	2477	639.64	640.09	LIDAR TOPO
Berry Creek	Berry Creek	2074	639.43	639.87	LIDAR TOPO
Berry Creek	Berry Creek	1608	639.08	639.50	LIDAR TOPO
Berry Creek	Berry Creek	1135	638.91	639.31	LIDAR TOPO
Berry Creek	Berry Creek	718	638.77	639.17	LIDAR TOPO
Berry Creek	Berry Creek	543	638.79	639.19	LIDAR TOPO
Berry Creek	Berry Creek	462	638.48	638.85	LIDAR TOPO/2015-2016 FIELD SURVEY
Berry Creek	Berry Creek	419 RAILROAD CROSSING			2015-2016 FIELD SURVEY
Berry Creek	Berry Creek	363	636.75	637.28	LIDAR TOPO
Berry Creek	Berry Creek	314	636.52	637.05	LIDAR TOPO
Berry Creek	Berry Creek	174	636.48	637.01	LIDAR TOPO
Berry Creek	Dry Berry Creek	42785	785.71	785.52	LIDAR TOPO
Berry Creek	Dry Berry Creek	42235	782.79	782.63	LIDAR TOPO
Berry Creek	Dry Berry Creek	41757	780.02	780.39	LIDAR TOPO
Berry Creek	Dry Berry Creek	41245	777.69	778.36	LIDAR TOPO
Berry Creek	Dry Berry Creek	41062	776.62	777.32	LIDAR TOPO
Berry Creek	Dry Berry Creek	40695	774.75	775.47	LIDAR TOPO
Berry Creek	Dry Berry Creek	40230	772.72	773.45	LIDAR TOPO
Berry Creek	Dry Berry Creek	39729	770.63	771.37	LIDAR TOPO
Berry Creek	Dry Berry Creek	39248	769.46	770.22	LIDAR TOPO
Berry Creek	Dry Berry Creek	39094	768.42	769.16	LIDAR TOPO
Berry Creek	Dry Berry Creek	39018 RONALD REAGAN BLVD			Ronald W. Reagan Boulevard North Phase IV As-builts
Berry Creek	Dry Berry Creek	38920	768.18	768.92	LIDAR TOPO
Berry Creek	Dry Berry Creek	38691	765.35	765.98	LIDAR TOPO
Berry Creek	Dry Berry Creek	38282	763.52	764.16	LIDAR TOPO
Berry Creek	Dry Berry Creek	37801	761.98	762.64	LIDAR TOPO
Berry Creek	Dry Berry Creek	37323	760.36	760.93	LIDAR TOPO
Berry Creek	Dry Berry Creek	36833	755.39	756.43	LIDAR TOPO/2015-2016 FIELD SURVEY
Berry Creek	Dry Berry Creek	36747 LIVE OAK TRL			2015-2016 FIELD SURVEY

Table B-5 Computed Water Surface Elevations and Topographic Data Source – Berry Creek (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Berry Creek	Dry Berry Creek	36677	755.85	756.47	LIDAR TOPO
Berry Creek	Dry Berry Creek	36374	755.30	755.92	LIDAR TOPO
Berry Creek	Dry Berry Creek	35886	754.19	754.82	LIDAR TOPO
Berry Creek	Dry Berry Creek	35398	751.32	751.93	LIDAR TOPO
Berry Creek	Dry Berry Creek	34924	750.24	750.72	LIDAR TOPO
Berry Creek	Dry Berry Creek	34446	748.43	748.96	LIDAR TOPO
Berry Creek	Dry Berry Creek	34273	747.11	747.56	LIDAR TOPO/2015-2016 FIELD SURVEY
Berry Creek	Dry Berry Creek	34248 COUNTY RD 234			2015-2016 FIELD SURVEY
Berry Creek	Dry Berry Creek	34213	747.17	747.64	LIDAR TOPO
Berry Creek	Dry Berry Creek	34048	746.91	747.35	LIDAR TOPO
Berry Creek	Dry Berry Creek	33588	745.64	746.10	LIDAR TOPO
Berry Creek	Dry Berry Creek	33088	744.73	745.14	LIDAR TOPO
Berry Creek	Dry Berry Creek	32637	744.02	744.44	LIDAR TOPO
Berry Creek	Dry Berry Creek	32148	743.14	743.52	LIDAR TOPO
Berry Creek	Dry Berry Creek	31543	740.78	741.09	LIDAR TOPO
Berry Creek	Dry Berry Creek	31103	739.29	739.72	LIDAR TOPO
Berry Creek	Dry Berry Creek	30667	738.52	738.99	LIDAR TOPO
Berry Creek	Dry Berry Creek	30196	737.72	738.23	LIDAR TOPO
Berry Creek	Dry Berry Creek	29611	736.97	737.50	LIDAR TOPO
Berry Creek	Dry Berry Creek	29363	736.36	736.88	LIDAR TOPO
Berry Creek	Dry Berry Creek	29010	735.77	736.29	LIDAR TOPO
Berry Creek	Dry Berry Creek	28627	735.22	735.73	LIDAR TOPO
Berry Creek	Dry Berry Creek	28118	733.96	734.44	LIDAR TOPO
Berry Creek	Dry Berry Creek	27705	732.45	732.96	LIDAR TOPO
Berry Creek	Dry Berry Creek	27396	731.45	731.94	LIDAR TOPO
Berry Creek	Dry Berry Creek	26906	730.42	730.92	LIDAR TOPO
Berry Creek	Dry Berry Creek	26755	730.10	730.61	LIDAR TOPO
Berry Creek	Dry Berry Creek	26266	729.32	729.82	LIDAR TOPO
Berry Creek	Dry Berry Creek	25761	728.31	728.79	LIDAR TOPO
Berry Creek	Dry Berry Creek	25306	727.21	727.72	LIDAR TOPO
Berry Creek	Dry Berry Creek	25224	725.83	726.39	LIDAR TOPO/2015-2016 FIELD SURVEY
Berry Creek	Dry Berry Creek	25160 COUNTY RD 143			2015-2016 FIELD SURVEY
Berry Creek	Dry Berry Creek	25100	725.93	726.41	LIDAR TOPO
Berry Creek	Dry Berry Creek	24896	725.21	725.67	LIDAR TOPO
Berry Creek	Dry Berry Creek	24397	723.63	724.20	LIDAR TOPO
Berry Creek	Dry Berry Creek	23913	722.95	723.61	LIDAR TOPO
Berry Creek	Dry Berry Creek	23507	722.10	722.80	LIDAR TOPO
Berry Creek	Dry Berry Creek	23019	721.08	721.89	LIDAR TOPO
Berry Creek	Dry Berry Creek	22555	720.29	721.04	LIDAR TOPO
Berry Creek	Dry Berry Creek	22057	717.99	718.54	LIDAR TOPO
Berry Creek	Dry Berry Creek	21588	716.34	716.81	LIDAR TOPO
Berry Creek	Dry Berry Creek	21119	714.96	715.42	LIDAR TOPO
Berry Creek	Dry Berry Creek	20651	713.48	713.94	LIDAR TOPO
Berry Creek	Dry Berry Creek	20175	712.12	712.57	LIDAR TOPO
Berry Creek	Dry Berry Creek	19712	710.98	711.39	LIDAR TOPO
Berry Creek	Dry Berry Creek	19212	709.36	709.88	LIDAR TOPO
Berry Creek	Dry Berry Creek	18737	708.19	708.92	LIDAR TOPO
Berry Creek	Dry Berry Creek	18278	707.63	708.49	LIDAR TOPO
Berry Creek	Dry Berry Creek	17761	707.18	708.04	LIDAR TOPO
Berry Creek	Dry Berry Creek	17279	706.47	707.33	LIDAR TOPO
Berry Creek	Dry Berry Creek	16823	705.70	706.60	LIDAR TOPO
Berry Creek	Dry Berry Creek	16356	704.35	705.37	LIDAR TOPO
Berry Creek	Dry Berry Creek	15860	703.10	704.26	LIDAR TOPO
Berry Creek	Dry Berry Creek	15378	702.14	703.49	LIDAR TOPO
Berry Creek	Dry Berry Creek	14902	701.61	703.18	LIDAR TOPO
Berry Creek	Dry Berry Creek	14402	701.33	702.97	LIDAR TOPO
Berry Creek	Dry Berry Creek	13929	701.14	702.83	LIDAR TOPO
Berry Creek	Dry Berry Creek	13431	701.08	702.77	LIDAR TOPO
Berry Creek	Dry Berry Creek	13350	701.00	702.72	LIDAR TOPO
Berry Creek	Dry Berry Creek	13272 I.H. 35 SB FRONTAGE RD			TXDOT 0015-08-108
Berry Creek	Dry Berry Creek	13233	700.17	702.18	LIDAR TOPO
Berry Creek	Dry Berry Creek	13135 I.H. 35 SB			TXDOT 0015-08-108
Berry Creek	Dry Berry Creek	13039	699.08	701.11	LIDAR TOPO

Table B-5 Computed Water Surface Elevations and Topographic Data Source – Berry Creek (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Berry Creek	Dry Berry Creek	12950 I.H. 35 NB			TXDOT 0015-08-108
Berry Creek	Dry Berry Creek	12850	698.08	699.57	LIDAR TOPO
Berry Creek	Dry Berry Creek	12786 I.H. 35 NB FRONTAGE RD			TXDOT 0015-08-108
Berry Creek	Dry Berry Creek	12713	693.69	694.44	LIDAR TOPO
Berry Creek	Dry Berry Creek	12559	693.04	693.82	LIDAR TOPO
Berry Creek	Dry Berry Creek	12269	692.66	693.46	LIDAR TOPO
Berry Creek	Dry Berry Creek	11839	689.57	690.31	LIDAR TOPO
Berry Creek	Dry Berry Creek	11362	689.30	689.97	LIDAR TOPO
Berry Creek	Dry Berry Creek	10908	688.02	688.69	LIDAR TOPO
Berry Creek	Dry Berry Creek	10403	686.21	686.87	LIDAR TOPO
Berry Creek	Dry Berry Creek	9912	684.42	685.30	LIDAR TOPO
Berry Creek	Dry Berry Creek	9461	682.34	682.96	LIDAR TOPO
Berry Creek	Dry Berry Creek	9000	681.87	682.52	LIDAR TOPO
Berry Creek	Dry Berry Creek	8556	679.00	679.81	LIDAR TOPO
Berry Creek	Dry Berry Creek	8071	677.51	678.21	LIDAR TOPO
Berry Creek	Dry Berry Creek	7581	675.26	675.81	LIDAR TOPO
Berry Creek	Dry Berry Creek	7133	674.33	674.96	LIDAR TOPO
Berry Creek	Dry Berry Creek	6665	673.27	673.97	LIDAR TOPO
Berry Creek	Dry Berry Creek	6178	672.17	673.05	LIDAR TOPO
Berry Creek	Dry Berry Creek	5710	672.10	672.96	LIDAR TOPO
Berry Creek	Dry Berry Creek	5222	671.89	672.74	LIDAR TOPO
Berry Creek	Dry Berry Creek	4739	671.20	672.08	LIDAR TOPO
Berry Creek	Dry Berry Creek	4259	669.30	670.14	LIDAR TOPO
Berry Creek	Dry Berry Creek	3960	667.65	668.75	LIDAR TOPO
Berry Creek	Dry Berry Creek	3648	668.25	669.35	LIDAR TOPO
Berry Creek	Dry Berry Creek	3355	666.31	666.94	LIDAR TOPO
Berry Creek	Dry Berry Creek	2854	664.23	665.26	LIDAR TOPO
Berry Creek	Dry Berry Creek	2337	662.41	663.72	LIDAR TOPO
Berry Creek	Dry Berry Creek	2251	662.67	663.84	LIDAR TOPO/2015-2016 FIELD SURVEY
Berry Creek	Dry Berry Creek	2216 COUNTY RD 152			2015-2016 FIELD SURVEY
Berry Creek	Dry Berry Creek	2161	662.53	663.21	LIDAR TOPO
Berry Creek	Dry Berry Creek	2035	662.20	662.92	LIDAR TOPO
Berry Creek	Dry Berry Creek	1786	660.44	661.53	LIDAR TOPO
Berry Creek	Dry Berry Creek	1329	657.73	658.18	LIDAR TOPO
Berry Creek	Dry Berry Creek	852	656.28	656.60	LIDAR TOPO
Berry Creek	Dry Berry Creek	326	656.42	656.63	LIDAR TOPO
Berry Creek	Cowan Creek	34278	986.41	986.50	LIDAR TOPO
Berry Creek	Cowan Creek	33861	979.05	979.22	LIDAR TOPO
Berry Creek	Cowan Creek	33434	974.54	974.66	LIDAR TOPO
Berry Creek	Cowan Creek	32941	968.00	968.09	LIDAR TOPO
Berry Creek	Cowan Creek	32486	963.21	963.33	LIDAR TOPO
Berry Creek	Cowan Creek	32061	959.15	959.27	LIDAR TOPO
Berry Creek	Cowan Creek	31559	955.08	955.19	LIDAR TOPO
Berry Creek	Cowan Creek	31091	951.94	952.13	LIDAR TOPO
Berry Creek	Cowan Creek	30625	949.45	949.65	LIDAR TOPO
Berry Creek	Cowan Creek	30116	947.32	947.51	LIDAR TOPO
Berry Creek	Cowan Creek	29670	944.11	944.30	LIDAR TOPO
Berry Creek	Cowan Creek	29167	940.64	940.81	LIDAR TOPO
Berry Creek	Cowan Creek	28702	938.19	938.34	LIDAR TOPO
Berry Creek	Cowan Creek	28217	935.22	935.35	LIDAR TOPO
Berry Creek	Cowan Creek	27752	933.04	933.21	LIDAR TOPO
Berry Creek	Cowan Creek	27305	930.40	930.61	LIDAR TOPO
Berry Creek	Cowan Creek	26798	929.20	929.47	LIDAR TOPO
Berry Creek	Cowan Creek	26324	927.71	927.95	LIDAR TOPO
Berry Creek	Cowan Creek	25827	924.20	924.50	LIDAR TOPO
Berry Creek	Cowan Creek	25342	920.71	920.88	LIDAR TOPO
Berry Creek	Cowan Creek	24862	916.14	916.52	LIDAR TOPO
Berry Creek	Cowan Creek	24385	915.88	916.27	LIDAR TOPO
Berry Creek	Cowan Creek	24375	915.71	916.10	LIDAR TOPO
Berry Creek	Cowan Creek	23885	912.99	913.44	LIDAR TOPO
Berry Creek	Cowan Creek	23458	912.51	912.99	LIDAR TOPO
Berry Creek	Cowan Creek	23337	912.54	913.02	LIDAR TOPO/2015-2016 FIELD SURVEY
Berry Creek	Cowan Creek	23202 RR 2338 / ANDICE RD			2015-2016 FIELD SURVEY

Table B-5 Computed Water Surface Elevations and Topographic Data Source – Berry Creek (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Berry Creek	Cowan Creek	23078	907.32	907.65	LIDAR TOPO
Berry Creek	Cowan Creek	22979	906.66	906.97	LIDAR TOPO
Berry Creek	Cowan Creek	22670	904.90	905.17	LIDAR TOPO
Berry Creek	Cowan Creek	22208	902.08	902.38	LIDAR TOPO
Berry Creek	Cowan Creek	21724	900.01	900.39	LIDAR TOPO
Berry Creek	Cowan Creek	21255	896.85	897.08	LIDAR TOPO
Berry Creek	Cowan Creek	20784	893.97	894.31	LIDAR TOPO
Berry Creek	Cowan Creek	20330	893.18	893.48	LIDAR TOPO
Berry Creek	Cowan Creek	20239	892.95	893.22	LIDAR TOPO/2015-2016 FIELD SURVEY
Berry Creek	Cowan Creek	20200 COUNTY RD 245			2015-2016 FIELD SURVEY
Berry Creek	Cowan Creek	20166	891.21	891.91	LIDAR TOPO
Berry Creek	Cowan Creek	20131	891.15	891.83	LIDAR TOPO
Berry Creek	Cowan Creek	19668	888.31	888.83	LIDAR TOPO
Berry Creek	Cowan Creek	19220	885.79	886.33	LIDAR TOPO
Berry Creek	Cowan Creek	18973	885.20	885.89	LIDAR TOPO
Berry Creek	Cowan Creek	18637	883.58	884.23	LIDAR TOPO
Berry Creek	Cowan Creek	18164	882.27	882.98	LIDAR TOPO
Berry Creek	Cowan Creek	17721	880.61	881.15	LIDAR TOPO
Berry Creek	Cowan Creek	17242	877.19	877.80	LIDAR TOPO
Berry Creek	Cowan Creek	16782	875.67	876.38	LIDAR TOPO
Berry Creek	Cowan Creek	16321	872.89	873.51	LIDAR TOPO
Berry Creek	Cowan Creek	15890	872.09	872.60	LIDAR TOPO
Berry Creek	Cowan Creek	15491	870.04	870.80	LIDAR TOPO
Berry Creek	Cowan Creek	15311	868.09	868.51	LIDAR TOPO
Berry Creek	Cowan Creek	15104	867.34	868.09	LIDAR TOPO
Berry Creek	Cowan Creek	14827	866.50	867.26	LIDAR TOPO
Berry Creek	Cowan Creek	14382	864.97	865.75	LIDAR TOPO
Berry Creek	Cowan Creek	13899	861.23	861.70	LIDAR TOPO
Berry Creek	Cowan Creek	13434	860.43	861.44	LIDAR TOPO
Berry Creek	Cowan Creek	12944	858.01	858.71	LIDAR TOPO
Berry Creek	Cowan Creek	12477	856.49	857.08	LIDAR TOPO
Berry Creek	Cowan Creek	11973	852.88	853.41	LIDAR TOPO
Berry Creek	Cowan Creek	11504	850.48	851.11	LIDAR TOPO
Berry Creek	Cowan Creek	10997	848.25	849.11	LIDAR TOPO
Berry Creek	Cowan Creek	10506	846.12	846.94	LIDAR TOPO
Berry Creek	Cowan Creek	9976	841.84	842.54	LIDAR TOPO
Berry Creek	Cowan Creek	9487	840.97	841.97	LIDAR TOPO
Berry Creek	Cowan Creek	9060	840.42	841.46	LIDAR TOPO
Berry Creek	Cowan Creek	8901	839.23	840.32	LIDAR TOPO
Berry Creek	Cowan Creek	8834 COOL SPRING WAY			Sun City Texas Cool Spring Way Bridge
Berry Creek	Cowan Creek	8798	836.84	837.35	LIDAR TOPO
Berry Creek	Cowan Creek	8606	836.38	836.96	LIDAR TOPO
Berry Creek	Cowan Creek	8128	833.39	833.83	LIDAR TOPO
Berry Creek	Cowan Creek	7669	831.94	832.66	LIDAR TOPO
Berry Creek	Cowan Creek	7192	830.57	831.26	LIDAR TOPO
Berry Creek	Cowan Creek	6706	828.95	829.60	LIDAR TOPO
Berry Creek	Cowan Creek	6222	827.16	827.68	LIDAR TOPO
Berry Creek	Cowan Creek	5756	824.52	825.04	LIDAR TOPO
Berry Creek	Cowan Creek	5292	822.19	822.73	LIDAR TOPO
Berry Creek	Cowan Creek	4831	819.24	819.86	LIDAR TOPO
Berry Creek	Cowan Creek	4335	816.90	817.54	LIDAR TOPO
Berry Creek	Cowan Creek	3881	815.28	815.94	LIDAR TOPO
Berry Creek	Cowan Creek	3502	813.71	814.40	LIDAR TOPO
Berry Creek	Cowan Creek	3017	809.77	810.22	LIDAR TOPO
Berry Creek	Cowan Creek	2535	806.91	807.59	LIDAR TOPO
Berry Creek	Cowan Creek	2033	805.72	806.36	LIDAR TOPO
Berry Creek	Cowan Creek	1552	802.82	803.25	LIDAR TOPO
Berry Creek	Cowan Creek	1102	802.02	802.26	LIDAR TOPO
Berry Creek	Cowan Creek	616	801.34	801.40	LIDAR TOPO
Berry Creek	Cowan Creek	291	801.24	801.28	LIDAR TOPO
Berry Creek	Cowan Creek	152	801.15	801.16	LIDAR TOPO

Table B-6 Computed Water Surface Elevations and Topographic Data Source – Mankins Branch

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Mankins Branch	1	27434	762.58	762.70	LIDAR TOPO
Mankins Branch	1	26990	762.03	762.20	LIDAR TOPO
Mankins Branch	1	26910	762.00	762.18	LIDAR TOPO/2015-2016 FIELD SURVEY
Mankins Branch	1	26857 COUNTY RD 110 / ROCKRIDE LN			2015-2016 FIELD SURVEY
Mankins Branch	1	26823	759.92	760.09	LIDAR TOPO
Mankins Branch	1	26758	759.88	760.06	LIDAR TOPO
Mankins Branch	1	26676	759.76	759.90	LIDAR TOPO
Mankins Branch	1	26599	759.75	759.88	LIDAR TOPO/2015-2016 FIELD SURVEY
Mankins Branch	1	26549 CR 104 / BELL GIN RD			2015-2016 FIELD SURVEY
Mankins Branch	1	26511	754.38	754.58	LIDAR TOPO
Mankins Branch	1	26379	753.46	753.65	LIDAR TOPO
Mankins Branch	1	26157	751.68	751.90	LIDAR TOPO
Mankins Branch	1	25680	747.98	748.18	LIDAR TOPO
Mankins Branch	1	25199	744.39	744.56	LIDAR TOPO
Mankins Branch	1	24689	741.04	741.20	LIDAR TOPO
Mankins Branch	1	24197	735.41	735.59	LIDAR TOPO
Mankins Branch	1	23842	733.60	733.91	LIDAR TOPO
Mankins Branch	1	23401	731.22	731.65	LIDAR TOPO
Mankins Branch	1	22922	726.70	727.03	LIDAR TOPO
Mankins Branch	1	22433	724.31	724.78	LIDAR TOPO
Mankins Branch	1	21976	722.03	722.44	LIDAR TOPO
Mankins Branch	1	21513	719.07	719.57	LIDAR TOPO
Mankins Branch	1	21040	715.38	715.69	LIDAR TOPO
Mankins Branch	1	20560	711.74	712.26	LIDAR TOPO
Mankins Branch	1	20037	708.88	709.41	LIDAR TOPO
Mankins Branch	1	19528	705.66	706.14	LIDAR TOPO
Mankins Branch	1	19197	703.88	704.42	LIDAR TOPO
Mankins Branch	1	19151	703.80	704.35	LIDAR TOPO
Mankins Branch	1	19039 TX 130 SB SERVICE RD			TXDOT 0440-05-004
Mankins Branch	1	18954	702.61	703.25	LIDAR TOPO
Mankins Branch	1	18865 TX 130 SB			TXDOT 0440-05-004
Mankins Branch	1	18752	699.78	700.45	LIDAR TOPO
Mankins Branch	1	18751	699.09	699.69	LIDAR TOPO
Mankins Branch	1	18631 TX 130 NB			TXDOT 0440-05-004
Mankins Branch	1	18561	697.87	698.52	LIDAR TOPO
Mankins Branch	1	18503 TX 130 NB SERVICE RD			TXDOT 0440-05-004
Mankins Branch	1	18342	697.46	698.21	LIDAR TOPO
Mankins Branch	1	18256	696.69	697.34	LIDAR TOPO
Mankins Branch	1	18043	695.05	695.47	LIDAR TOPO
Mankins Branch	1	17556	692.31	692.86	LIDAR TOPO
Mankins Branch	1	17063	688.13	688.72	LIDAR TOPO
Mankins Branch	1	16601	684.69	685.45	LIDAR TOPO
Mankins Branch	1	16531	685.08	686.08	LIDAR TOPO/2015-2016 FIELD SURVEY
Mankins Branch	1	16486 COUNTY RD 104			2015-2016 FIELD SURVEY
Mankins Branch	1	16409	683.65	684.46	LIDAR TOPO
Mankins Branch	1	16306	682.60	683.30	LIDAR TOPO
Mankins Branch	1	16012	681.62	681.91	LIDAR TOPO
Mankins Branch	1	15688	681.67	681.99	LIDAR TOPO
Mankins Branch	1	15161	677.56	678.74	LIDAR TOPO
Mankins Branch	1	15022	675.22	677.21	LIDAR TOPO/2015-2016 FIELD SURVEY
Mankins Branch	1	14869 COUNTY RD 104			2015-2016 FIELD SURVEY
Mankins Branch	1	14797	675.15	676.12	LIDAR TOPO
Mankins Branch	1	14728	674.18	675.12	LIDAR TOPO
Mankins Branch	1	14328	671.15	672.30	LIDAR TOPO
Mankins Branch	1	13832	669.92	671.06	LIDAR TOPO
Mankins Branch	1	13345	668.71	669.93	LIDAR TOPO
Mankins Branch	1	12883	665.92	667.30	LIDAR TOPO
Mankins Branch	1	12406	663.74	665.48	LIDAR TOPO
Mankins Branch	1	12332	663.60	665.44	LIDAR TOPO
Mankins Branch	1	12308			LIDAR TOPO
Mankins Branch	1	12293 PRIVATE DR	664.04	665.81	LIDAR TOPO

Table B-6 Computed Water Surface Elevations and Topographic Data Source – Mankins Branch (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Mankins Branch	1	12200	661.75	662.63	LIDAR TOPO
Mankins Branch	1	12000	662.09	663.19	LIDAR TOPO
Mankins Branch	1	11537	659.70	661.08	LIDAR TOPO
Mankins Branch	1	11076	655.11	656.90	LIDAR TOPO
Mankins Branch	1	10823	654.38	656.56	LIDAR TOPO
Mankins Branch	1	10377	654.22	656.39	LIDAR TOPO
Mankins Branch	1	10029	650.79	652.24	LIDAR TOPO
Mankins Branch	1	9576	647.83	648.33	LIDAR TOPO
Mankins Branch	1	9078	646.56	647.98	LIDAR TOPO
Mankins Branch	1	8675	645.14	646.15	LIDAR TOPO
Mankins Branch	1	8315	641.54	642.94	LIDAR TOPO
Mankins Branch	1	7961	640.93	643.00	LIDAR TOPO
Mankins Branch	1	7635	637.63	641.12	LIDAR TOPO
Mankins Branch	1	7134	635.28	640.25	LIDAR TOPO
Mankins Branch	1	7060	635.44	640.65	LIDAR TOPO
Mankins Branch	1	7032 COUNTY RD 106			Field Measurement
Mankins Branch	1	7017	633.00	634.52	LIDAR TOPO
Mankins Branch	1	6958	632.38	633.74	LIDAR TOPO
Mankins Branch	1	6823	629.56	630.92	LIDAR TOPO
Mankins Branch	1	6409	626.84	628.28	LIDAR TOPO
Mankins Branch	1	5936	622.99	624.12	LIDAR TOPO
Mankins Branch	1	5457	622.21	623.45	LIDAR TOPO
Mankins Branch	1	4990	619.28	620.37	LIDAR TOPO
Mankins Branch	1	4523	616.46	617.46	LIDAR TOPO
Mankins Branch	1	4069	613.87	614.98	LIDAR TOPO
Mankins Branch	1	3579	611.38	612.41	LIDAR TOPO
Mankins Branch	1	3116	609.39	610.73	LIDAR TOPO
Mankins Branch	1	2665	608.20	609.68	LIDAR TOPO
Mankins Branch	1	2241	605.96	607.54	LIDAR TOPO
Mankins Branch	1	1946	604.93	606.54	LIDAR TOPO
Mankins Branch	1	1471	603.94	605.57	LIDAR TOPO
Mankins Branch	1	1320	601.24	602.43	LIDAR TOPO
Mankins Branch	1	890	599.16	600.48	LIDAR TOPO
Mankins Branch	1	465	595.99	596.28	LIDAR TOPO
Mankins Branch	1	354	595.69	595.65	LIDAR TOPO/2015-2016 FIELD SURVEY
Mankins Branch	1	322 COUNTY RD 100			2015-2016 FIELD SURVEY
Mankins Branch	1	294	593.53	594.39	LIDAR TOPO
Mankins Branch	1	223	593.58	594.54	LIDAR TOPO
Mankins Branch	2	17316	795.24	795.35	LIDAR TOPO
Mankins Branch	2	17071	793.05	793.58	LIDAR TOPO
Mankins Branch	2	16667	790.58	790.39	LIDAR TOPO
Mankins Branch	2	16478	788.20	789.50	LIDAR TOPO
Mankins Branch	2	16274	787.88	789.43	LIDAR TOPO
Mankins Branch	2	16184 SAM HOUSTON AVE			S.E. Arterial 1 Phase 1 Drainage No. 5 As-builts
Mankins Branch	2	16037	784.88	785.15	LIDAR TOPO
Mankins Branch	2	15956	784.36	784.60	LIDAR TOPO
Mankins Branch	2	15563	781.35	781.63	LIDAR TOPO
Mankins Branch	2	15107	777.68	777.99	LIDAR TOPO
Mankins Branch	2	14799	775.05	775.43	LIDAR TOPO
Mankins Branch	2	14417	771.66	771.95	LIDAR TOPO
Mankins Branch	2	13960	768.89	769.22	LIDAR TOPO
Mankins Branch	2	13417	764.54	764.76	LIDAR TOPO
Mankins Branch	2	13031	761.04	761.45	LIDAR TOPO
Mankins Branch	2	12552	755.50	755.98	LIDAR TOPO
Mankins Branch	2	12097	751.86	752.20	LIDAR TOPO
Mankins Branch	2	11744	749.11	749.41	LIDAR TOPO
Mankins Branch	2	11346	745.46	745.84	LIDAR TOPO
Mankins Branch	2	10881	741.51	741.82	LIDAR TOPO
Mankins Branch	2	10405	738.25	738.60	LIDAR TOPO
Mankins Branch	2	9961	734.69	734.99	LIDAR TOPO
Mankins Branch	2	9496	731.15	731.50	LIDAR TOPO
Mankins Branch	2	9099	727.28	727.64	LIDAR TOPO
Mankins Branch	2	8796	725.08	726.93	LIDAR TOPO

Table B-6 Computed Water Surface Elevations and Topographic Data Source – Mankins Branch (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Mankins Branch	2	8706	725.02	726.87	LIDAR TOPO
Mankins Branch	2	8456 TEXAS 130			TXDOT 0440-05-004
Mankins Branch	2	7953	719.80	720.34	LIDAR TOPO
Mankins Branch	2	7693	719.13	719.69	LIDAR TOPO
Mankins Branch	2	7257	716.83	717.33	LIDAR TOPO
Mankins Branch	2	6792	713.03	713.45	LIDAR TOPO
Mankins Branch	2	6315	710.11	710.48	LIDAR TOPO
Mankins Branch	2	5964	708.06	708.41	LIDAR TOPO
Mankins Branch	2	5549	706.62	706.99	LIDAR TOPO
Mankins Branch	2	5059	703.84	704.36	LIDAR TOPO
Mankins Branch	2	4614	701.28	701.74	LIDAR TOPO
Mankins Branch	2	4292	698.45	699.20	LIDAR TOPO
Mankins Branch	2	3769	695.05	695.63	LIDAR TOPO
Mankins Branch	2	3295	692.09	692.94	LIDAR TOPO
Mankins Branch	2	2792	689.12	689.89	LIDAR TOPO
Mankins Branch	2	2287	686.09	686.67	LIDAR TOPO
Mankins Branch	2	1791	683.61	684.67	LIDAR TOPO
Mankins Branch	2	1450	682.16	683.30	LIDAR TOPO
Mankins Branch	2	954	679.73	680.85	LIDAR TOPO
Mankins Branch	2	499	676.99	677.87	LIDAR TOPO
Mankins Branch	2	48	675.69	677.14	LIDAR TOPO
Mankins Branch	2.1	7565	776.54	776.92	LIDAR TOPO
Mankins Branch	2.1	7430 ROCKRIDE LN			Georgetown Inner Loop STA 151+75 to STA 164+90 As-builts
Mankins Branch	2.1	7384	774.50	774.73	LIDAR TOPO
Mankins Branch	2.1	7149	773.63	773.81	LIDAR TOPO
Mankins Branch	2.1	6824	771.75	771.93	LIDAR TOPO
Mankins Branch	2.1	6310	769.42	769.60	LIDAR TOPO
Mankins Branch	2.1	5821	766.86	767.05	LIDAR TOPO
Mankins Branch	2.1	5381	763.63	763.94	LIDAR TOPO
Mankins Branch	2.1	4803	759.06	759.28	LIDAR TOPO
Mankins Branch	2.1	4248	753.45	753.70	LIDAR TOPO
Mankins Branch	2.1	3800	750.74	751.02	LIDAR TOPO
Mankins Branch	2.1	3320	745.87	746.11	LIDAR TOPO
Mankins Branch	2.1	2987	743.32	743.62	LIDAR TOPO
Mankins Branch	2.1	2491	740.89	741.18	LIDAR TOPO
Mankins Branch	2.1	2018	738.06	738.33	LIDAR TOPO
Mankins Branch	2.1	1584	734.22	734.69	LIDAR TOPO
Mankins Branch	2.1	1115	731.66	732.05	LIDAR TOPO
Mankins Branch	2.1	642	728.88	729.23	LIDAR TOPO
Mankins Branch	2.1	332	727.01	727.31	LIDAR TOPO
Mankins Branch	2.1	164	725.64	725.99	LIDAR TOPO
Mankins Branch	2.1	63	725.32	726.16	LIDAR TOPO

Table B-7 Computed Water Surface Elevations and Topographic Data Source – Pecan Branch

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Source
			Existing Conditions	Future Conditions	
Pecan Branch	Pecan Branch	48493	847.79	848.01	LIDAR TOPO
Pecan Branch	Pecan Branch	48000	835.43	835.64	LIDAR TOPO
Pecan Branch	Pecan Branch	47526	831.82	832.02	LIDAR TOPO
Pecan Branch	Pecan Branch	47433	831.76	831.95	2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	47419 W SEQUOIA SPUR			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	47345	827.78	828.31	LIDAR TOPO
Pecan Branch	Pecan Branch	47155	824.04	824.25	LIDAR TOPO
Pecan Branch	Pecan Branch	47000	823.35	823.67	LIDAR TOPO
Pecan Branch	Pecan Branch	46498	815.12	815.33	LIDAR TOPO
Pecan Branch	Pecan Branch	46113	813.70	814.04	LIDAR TOPO
Pecan Branch	Pecan Branch	45924	813.58	813.91	LIDAR TOPO
Pecan Branch	Pecan Branch	45887 LA PALOMA DR			JULY 2017 FIELD MEASUREMENTS
Pecan Branch	Pecan Branch	45852	809.82	810.11	LIDAR TOPO
Pecan Branch	Pecan Branch	45502	806.81	807.05	LIDAR TOPO
Pecan Branch	Pecan Branch	44983	800.69	800.98	LIDAR TOPO
Pecan Branch	Pecan Branch	44500	796.93	797.18	LIDAR TOPO
Pecan Branch	Pecan Branch	44302	796.61	796.83	LIDAR TOPO
Pecan Branch	Pecan Branch	44268 MALAGA DR			JULY 2017 FIELD MEASUREMENTS
Pecan Branch	Pecan Branch	44231	794.27	794.53	LIDAR TOPO
Pecan Branch	Pecan Branch	44121	793.84	794.06	LIDAR TOPO
Pecan Branch	Pecan Branch	43930	793.29	793.49	LIDAR TOPO
Pecan Branch	Pecan Branch	43798	793.00	793.2	2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	43788 VAL VERDE DR			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	43720	791.48	791.43	LIDAR TOPO
Pecan Branch	Pecan Branch	43502	789.63	789.85	LIDAR TOPO
Pecan Branch	Pecan Branch	43346	788.82	789	LIDAR TOPO
Pecan Branch	Pecan Branch	43207	787.86	787.49	LIDAR TOPO/2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	43193 SEVILLA DR			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	43127	786.23	786.34	LIDAR TOPO
Pecan Branch	Pecan Branch	43001	785.59	785.77	LIDAR TOPO
Pecan Branch	Pecan Branch	42514	782.45	782.65	LIDAR TOPO
Pecan Branch	Pecan Branch	42402	781.57	781.76	LIDAR TOPO
Pecan Branch	Pecan Branch	42384 PRIVATE DR			JULY 2017 FIELD MEASUREMENTS
Pecan Branch	Pecan Branch	42366	781.48	781.69	LIDAR TOPO
Pecan Branch	Pecan Branch	42084	780.45	780.67	LIDAR TOPO/2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	42074 W SEQUIOA TRL			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	42010	779.54	779.82	LIDAR TOPO
Pecan Branch	Pecan Branch	41874	778.29	778.57	LIDAR TOPO
Pecan Branch	Pecan Branch	41510	775.94	776.19	LIDAR TOPO
Pecan Branch	Pecan Branch	41339	774.65	774.89	LIDAR TOPO
Pecan Branch	Pecan Branch	41166	773.83	774.02	LIDAR TOPO
Pecan Branch	Pecan Branch	41074	773.47	773.61	LIDAR TOPO
Pecan Branch	Pecan Branch	41039 ESPARADA DR			JULY 2017 FIELD MEASUREMENTS
Pecan Branch	Pecan Branch	40994	772.97	773.2	LIDAR TOPO
Pecan Branch	Pecan Branch	40807	772.36	772.65	LIDAR TOPO
Pecan Branch	Pecan Branch	40456	771.28	771.53	LIDAR TOPO
Pecan Branch	Pecan Branch	39972	768.13	768.39	LIDAR TOPO
Pecan Branch	Pecan Branch	39497	765.78	766.14	LIDAR TOPO
Pecan Branch	Pecan Branch	39000	763.97	764.22	LIDAR TOPO
Pecan Branch	Pecan Branch	38892	763.55	763.78	2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	38878 SERENADA DR			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	38826	762.37	762.62	LIDAR TOPO
Pecan Branch	Pecan Branch	38732	761.72	761.98	LIDAR TOPO
Pecan Branch	Pecan Branch	38558	760.91	761.15	LIDAR TOPO
Pecan Branch	Pecan Branch	37989	755.97	756.23	LIDAR TOPO
Pecan Branch	Pecan Branch	37568	753.00	753.43	LIDAR TOPO
Pecan Branch	Pecan Branch	37344	752.06	752.57	LIDAR TOPO
Pecan Branch	Pecan Branch	37185	751.73	752.26	LIDAR TOPO
Pecan Branch	Pecan Branch	37120 NORTHWEST BLVD			JULY 2017 FIELD MEASUREMENTS
Pecan Branch	Pecan Branch	37086	750.44	750.73	LIDAR TOPO
Pecan Branch	Pecan Branch	37001	750.17	750.48	LIDAR TOPO
Pecan Branch	Pecan Branch	36853	749.84	750.14	LIDAR TOPO

Table B-7 Computed Water Surface Elevations and Topographic Data Source – Pecan Branch (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Source
			Existing Conditions	Future Conditions	
Pecan Branch	Pecan Branch	36454	748.13	748.4	LIDAR TOPO
Pecan Branch	Pecan Branch	36000	746.35	746.62	LIDAR TOPO
Pecan Branch	Pecan Branch	35489	745.85	746.1	LIDAR TOPO
Pecan Branch	Pecan Branch	35122	745.73	745.98	LIDAR TOPO
Pecan Branch	Pecan Branch	34909	745.36	745.6	LIDAR TOPO
Pecan Branch	Pecan Branch	34499	743.61	743.81	LIDAR TOPO
Pecan Branch	Pecan Branch	34320	743.29	743.46	LIDAR TOPO
Pecan Branch	Pecan Branch	34107	743.08	743.24	LIDAR TOPO
Pecan Branch	Pecan Branch	33941	742.98	743.13	LIDAR TOPO/2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	33919 ABANDONED			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	33849	742.28	742.67	LIDAR TOPO
Pecan Branch	Pecan Branch	33840	742.26	742.65	LIDAR TOPO
Pecan Branch	Pecan Branch	33824	742.14	742.54	LIDAR TOPO/2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	33807 LAKEWAY DR			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	33731	740.09	740.3	LIDAR TOPO
Pecan Branch	Pecan Branch	33634	739.81	740.06	LIDAR TOPO
Pecan Branch	Pecan Branch	33307	738.66	738.92	LIDAR TOPO
Pecan Branch	Pecan Branch	33047	738.04	738.3	LIDAR TOPO
Pecan Branch	Pecan Branch	32851	737.53	737.77	LIDAR TOPO
Pecan Branch	Pecan Branch	32491	736.91	737.15	LIDAR TOPO
Pecan Branch	Pecan Branch	32181	735.61	735.84	LIDAR TOPO
Pecan Branch	Pecan Branch	31916	734.59	734.84	LIDAR TOPO
Pecan Branch	Pecan Branch	31757	734.07	734.34	2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	31748 W SHADY HOLLOW			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	31702	733.95	734.23	LIDAR TOPO
Pecan Branch	Pecan Branch	31500	733.45	733.73	LIDAR TOPO
Pecan Branch	Pecan Branch	31200	732.42	732.65	LIDAR TOPO
Pecan Branch	Pecan Branch	30825	731.07	731.19	LIDAR TOPO
Pecan Branch	Pecan Branch	30712	730.83	730.93	2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	30700 W GOLDEN OAKS			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	30648	730.71	730.87	LIDAR TOPO
Pecan Branch	Pecan Branch	30505	730.20	730.33	LIDAR TOPO
Pecan Branch	Pecan Branch	30400	730.03	730.15	LIDAR TOPO
Pecan Branch	Pecan Branch	30343	729.92	730.02	LIDAR TOPO
Pecan Branch	Pecan Branch	30324 PRIVATE DR			JULY 2017 FIELD MEASUREMENTS
Pecan Branch	Pecan Branch	30305	728.69	728.9	LIDAR TOPO
Pecan Branch	Pecan Branch	30240	728.43	728.65	LIDAR TOPO
Pecan Branch	Pecan Branch	30114	728.29	728.5	LIDAR TOPO
Pecan Branch	Pecan Branch	30034	728.19	728.41	2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	30020 E GOLDEN OAKS			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	29970	728.08	728.33	LIDAR TOPO
Pecan Branch	Pecan Branch	29868	727.79	728.05	LIDAR TOPO
Pecan Branch	Pecan Branch	29507	726.71	726.97	LIDAR TOPO
Pecan Branch	Pecan Branch	28995	725.50	725.77	LIDAR TOPO
Pecan Branch	Pecan Branch	28898	725.31	725.58	LIDAR TOPO
Pecan Branch	Pecan Branch	28853 PRIVATE DR			JULY 2017 FIELD MEASUREMENTS
Pecan Branch	Pecan Branch	28823	725.27	725.54	LIDAR TOPO
Pecan Branch	Pecan Branch	28761	725.18	725.45	LIDAR TOPO
Pecan Branch	Pecan Branch	28736 PRIVATE DR			JULY 2017 FIELD MEASUREMENTS
Pecan Branch	Pecan Branch	28711	725.11	725.38	LIDAR TOPO
Pecan Branch	Pecan Branch	28491	724.68	724.94	LIDAR TOPO
Pecan Branch	Pecan Branch	28002	723.84	724.03	LIDAR TOPO
Pecan Branch	Pecan Branch	27864	723.65	723.83	LIDAR TOPO
Pecan Branch	Pecan Branch	27705	723.59	723.76	LIDAR TOPO
Pecan Branch	Pecan Branch	27605	723.47	723.62	2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	27593 E SHADY HOLLOW			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	27532	723.45	723.64	LIDAR TOPO
Pecan Branch	Pecan Branch	27342	723.32	723.48	LIDAR TOPO
Pecan Branch	Pecan Branch	26909	723.07	723.2	LIDAR TOPO
Pecan Branch	Pecan Branch	26488	722.96	723.08	LIDAR TOPO
Pecan Branch	Pecan Branch	26240	722.94	723.06	LIDAR TOPO
Pecan Branch	Pecan Branch	26127	722.93	723.05	LIDAR TOPO

Table B-7 Computed Water Surface Elevations and Topographic Data Source – Pecan Branch (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Source
			Existing Conditions	Future Conditions	
Pecan Branch	Pecan Branch	26000	722.93	723.04	LIDAR TOPO/2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	25961 AIRPORT			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	25912	722.90	723.04	LIDAR TOPO
Pecan Branch	Pecan Branch	25756	722.89	723.03	LIDAR TOPO
Pecan Branch	Pecan Branch	25574	722.89	723.03	LIDAR TOPO
Pecan Branch	Pecan Branch	25435	722.88	723.02	LIDAR TOPO
Pecan Branch	Pecan Branch	25226	722.80	722.93	LIDAR TOPO
Pecan Branch	Pecan Branch	25193	722.67	722.8	LIDAR TOPO/AS-BUILT: TxDOT 0015-08-044
Pecan Branch	Pecan Branch	25144 SB IH35			AS-BUILT: TxDOT 0015-08-044
Pecan Branch	Pecan Branch	25122	721.65	721.71	LIDAR TOPO
Pecan Branch	Pecan Branch	25076	721.77	721.84	LIDAR TOPO/AS-BUILT: TxDOT 0015-08-044
Pecan Branch	Pecan Branch	24989 ML/NB IH35			AS-BUILT: TxDOT 0015-08-044, 0015-08-116
Pecan Branch	Pecan Branch	24786	714.04	714.04	LIDAR TOPO
Pecan Branch	Pecan Branch	24631	714.03	714.03	LIDAR TOPO
Pecan Branch	Pecan Branch	24522	714.04	714.05	LIDAR TOPO
Pecan Branch	Pecan Branch	24393	713.95	713.94	LIDAR TOPO/2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	24353 N AUSTIN AVE			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	24250	710.95	711.06	LIDAR TOPO
Pecan Branch	Pecan Branch	24070	710.59	710.71	LIDAR TOPO
Pecan Branch	Pecan Branch	23785	709.69	709.79	LIDAR TOPO
Pecan Branch	Pecan Branch	23592	709.19	709.29	2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	23562 CR 151			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	23490	708.80	708.92	LIDAR TOPO
Pecan Branch	Pecan Branch	23291	707.91	708.06	LIDAR TOPO
Pecan Branch	Pecan Branch	23035	707.14	707.32	LIDAR TOPO
Pecan Branch	Pecan Branch	22714	706.27	706.43	LIDAR TOPO
Pecan Branch	Pecan Branch	22387	705.07	705.19	LIDAR TOPO
Pecan Branch	Pecan Branch	22195	704.21	704.33	LIDAR TOPO
Pecan Branch	Pecan Branch	21679	701.25	701.35	LIDAR TOPO
Pecan Branch	Pecan Branch	21407	700.16	700.27	LIDAR TOPO
Pecan Branch	Pecan Branch	21163	699.75	699.87	LIDAR TOPO
Pecan Branch	Pecan Branch	20838	699.37	699.49	LIDAR TOPO
Pecan Branch	Pecan Branch	20465	698.73	698.86	LIDAR TOPO
Pecan Branch	Pecan Branch	20361	698.07	698.18	LIDAR TOPO
Pecan Branch	Pecan Branch	20016	697.81	697.93	2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	19892 NE INNER			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	19814	695.38	695.49	LIDAR TOPO
Pecan Branch	Pecan Branch	19450	693.81	693.93	LIDAR TOPO
Pecan Branch	Pecan Branch	19153	692.70	692.81	LIDAR TOPO
Pecan Branch	Pecan Branch	18676	690.79	690.88	LIDAR TOPO
Pecan Branch	Pecan Branch	18265	689.39	689.46	LIDAR TOPO
Pecan Branch	Pecan Branch	18099	688.61	688.7	2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	18074 CR 152			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	17985	687.57	687.66	LIDAR TOPO
Pecan Branch	Pecan Branch	17765	686.36	686.49	LIDAR TOPO
Pecan Branch	Pecan Branch	17576	685.80	685.92	LIDAR TOPO
Pecan Branch	Pecan Branch	17546	685.73	685.85	LIDAR TOPO
Pecan Branch	Pecan Branch	17351	685.44	685.56	LIDAR TOPO
Pecan Branch	Pecan Branch	16987	684.99	685.1	LIDAR TOPO
Pecan Branch	Pecan Branch	16551	684.80	684.91	LIDAR TOPO
Pecan Branch	Pecan Branch	16355 SB SH 130			AS-BUILT: TxDOT 0440-05-004
Pecan Branch	Pecan Branch	16242	683.40	683.51	LIDAR TOPO
Pecan Branch	Pecan Branch	16220	683.37	683.48	LIDAR TOPO
Pecan Branch	Pecan Branch	16151 NB SH 130			AS-BUILT: TxDOT 0440-05-004
Pecan Branch	Pecan Branch	15980	683.03	683.15	LIDAR TOPO
Pecan Branch	Pecan Branch	15799	682.82	682.94	LIDAR TOPO
Pecan Branch	Pecan Branch	15750	681.49	681.49	LIDAR TOPO
Pecan Branch	Pecan Branch	15697	679.38	679.81	LIDAR TOPO
Pecan Branch	Pecan Branch	15507	678.50	678.59	LIDAR TOPO
Pecan Branch	Pecan Branch	14917	675.88	675.96	LIDAR TOPO

Table B-7 Computed Water Surface Elevations and Topographic Data Source – Pecan Branch (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Source
			Existing Conditions	Future Conditions	
Pecan Branch	Pecan Branch	14597	674.94	675	LIDAR TOPO
Pecan Branch	Pecan Branch	14342	673.87	673.92	LIDAR TOPO
Pecan Branch	Pecan Branch	14043	671.60	671.66	LIDAR TOPO
Pecan Branch	Pecan Branch	13843	670.60	670.68	LIDAR TOPO
Pecan Branch	Pecan Branch	13487	669.95	670.04	LIDAR TOPO
Pecan Branch	Pecan Branch	13048	667.93	667.99	LIDAR TOPO
Pecan Branch	Pecan Branch	12714	666.41	666.47	LIDAR TOPO
Pecan Branch	Pecan Branch	11996	664.17	664.25	LIDAR TOPO
Pecan Branch	Pecan Branch	11474	662.38	662.45	LIDAR TOPO
Pecan Branch	Pecan Branch	11155	661.43	661.5	LIDAR TOPO
Pecan Branch	Pecan Branch	10702	659.94	660.01	LIDAR TOPO
Pecan Branch	Pecan Branch	10475	659.45	659.54	LIDAR TOPO
Pecan Branch	Pecan Branch	9998	658.60	658.7	LIDAR TOPO
Pecan Branch	Pecan Branch	9548	658.08	658.19	LIDAR TOPO
Pecan Branch	Pecan Branch	8984	657.34	657.46	LIDAR TOPO
Pecan Branch	Pecan Branch	8519	656.30	656.43	LIDAR TOPO
Pecan Branch	Pecan Branch	7988	654.62	654.75	LIDAR TOPO
Pecan Branch	Pecan Branch	7486	653.12	653.25	LIDAR TOPO
Pecan Branch	Pecan Branch	6995	651.27	651.38	LIDAR TOPO
Pecan Branch	Pecan Branch	6546	649.52	649.61	LIDAR TOPO
Pecan Branch	Pecan Branch	5956	647.35	647.42	LIDAR TOPO
Pecan Branch	Pecan Branch	5520	647.20	647.27	LIDAR TOPO/2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	5470 FM 971			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	5370	646.27	646.36	LIDAR TOPO
Pecan Branch	Pecan Branch	5044	645.04	645.12	LIDAR TOPO
Pecan Branch	Pecan Branch	4921	644.46	644.55	LIDAR TOPO
Pecan Branch	Pecan Branch	4479	642.95	643.05	LIDAR TOPO
Pecan Branch	Pecan Branch	3904	641.96	642.05	LIDAR TOPO
Pecan Branch	Pecan Branch	3497	641.58	641.66	LIDAR TOPO
Pecan Branch	Pecan Branch	3052	641.27	641.36	LIDAR TOPO
Pecan Branch	Pecan Branch	2919	641.26	641.34	LIDAR TOPO
Pecan Branch	Pecan Branch	2709	640.87	640.93	LIDAR TOPO/2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	2671 RAILROAD			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	2621	637.70	637.8	LIDAR TOPO
Pecan Branch	Pecan Branch	2616	637.70	637.81	LIDAR TOPO/2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	2600 PRIVATE DR			2015-2016 FIELD SURVEY
Pecan Branch	Pecan Branch	2564	637.24	637.32	LIDAR TOPO
Pecan Branch	Pecan Branch	2321	636.48	636.54	LIDAR TOPO
Pecan Branch	Pecan Branch	2009	635.56	635.63	LIDAR TOPO
Pecan Branch	Pecan Branch	1506	633.64	633.78	LIDAR TOPO
Pecan Branch	Pecan Branch	1016	632.02	632.21	LIDAR TOPO
Pecan Branch	Pecan Branch	497	630.91	631.11	LIDAR TOPO

Table B-8 Computed Water Surface Elevations and Topographic Data Source – Smith Branch

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Smith-West Fork	1	22395	824.11	824.41	LIDAR TOPO
Smith-West Fork	1	22014	821.91	822.06	LIDAR TOPO
Smith-West Fork	1	21398	817.68	817.88	LIDAR TOPO
Smith-West Fork	1	20777	812.24	812.45	LIDAR TOPO
Smith-West Fork	1	20251	807.68	807.84	LIDAR TOPO
Smith-West Fork	1	19952	805.98	806.2	LIDAR TOPO
Smith-West Fork	1	19356	803.40	803.6	LIDAR TOPO
Smith-West Fork	1	18945	801.32	801.51	LIDAR TOPO
Smith-West Fork	1	18442	798.63	798.81	LIDAR TOPO
Smith-West Fork	1	17894	795.71	795.87	LIDAR TOPO
Smith-West Fork	1	17402	792.93	793.14	LIDAR TOPO
Smith-West Fork	1	16918	789.06	789.26	LIDAR TOPO
Smith-West Fork	1	16360	784.39	784.8	LIDAR TOPO
Smith-West Fork	1	16036	782.91	783.51	LIDAR TOPO
Smith-West Fork	1	15807	782.47	783.15	LIDAR TOPO
Smith-West Fork	1	15443	781.11	782.23	LIDAR TOPO
Smith-West Fork	1	15289	780.57	781.98	LIDAR TOPO
Smith-West Fork	1	15223	780.07	781.85	LIDAR TOPO
Smith-West Fork	1	15040	778.01	781.67	LIDAR TOPO
Smith-West Fork	1	14942	777.86	781.66	LIDAR TOPO
Smith-West Fork	1	14879	777.81	781.66	LIDAR TOPO
Smith-West Fork	1	14690	777.68	781.64	LIDAR TOPO
Smith-West Fork	1	14267	777.69	781.64	LIDAR TOPO
Smith-West Fork	1	14148 SB IH35 FR			AS-BUILT: TxDOT 0015-09-102
Smith-West Fork	1	14098	777.68	781.63	LIDAR TOPO
Smith-West Fork	1	14079	777.46	781.44	LIDAR TOPO
Smith-West Fork	1	13936 IH35 ML			AS-BUILT: TxDOT 0015-08-044
Smith-West Fork	1	13770	768.90	771.67	LIDAR TOPO
Smith-West Fork	1	13636	768.70	771.69	LIDAR TOPO
Smith-West Fork	1	13341	769.00	771.82	LIDAR TOPO
Smith-West Fork	1	13250 NB IH35 FR			AS-BUILT: TxDOT 0015-09-160
Smith-West Fork	1	13200	769.11	771.93	LIDAR TOPO
Smith-West Fork	1	13182	768.98	771.93	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-West Fork	1	13115 RAILROAD			2015-2016 FIELD SURVEY
Smith-West Fork	1	13100	762.92	763.41	LIDAR TOPO
Smith-West Fork	1	12935	761.82	762.29	LIDAR TOPO
Smith-West Fork	1	12589	759.99	760.33	LIDAR TOPO
Smith-West Fork	1	12277	758.93	759.23	LIDAR TOPO
Smith-West Fork	1	11766	755.80	756.09	LIDAR TOPO
Smith-West Fork	1	11402	751.54	751.76	LIDAR TOPO
Smith-West Fork	1	11261	751.79	752.08	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-West Fork	1	11209 MADISON OAKS AVE			2015-2016 FIELD SURVEY
Smith-West Fork	1	11131	751.30	751.56	LIDAR TOPO
Smith-West Fork	1	11021	751.29	751.55	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-West Fork	1	11020			2015-2016 FIELD SURVEY
Smith-West Fork	1	10566	751.28	751.54	LIDAR TOPO
Smith-West Fork	1	10161	751.25	751.5	LIDAR TOPO
Smith-West Fork	1	9937	751.19	751.44	LIDAR TOPO
Smith-West Fork	1	9746	750.92	751.13	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-West Fork	1	9696 S AUSTIN AVE			2015-2016 FIELD SURVEY
Smith-West Fork	1	9646	748.95	749.23	LIDAR TOPO
Smith-West Fork	1	9104	747.68	747.85	LIDAR TOPO
Smith-West Fork	1	8723	747.07	746.83	LIDAR TOPO
Smith-West Fork	1	8479	745.42	746.13	LIDAR TOPO
Smith-West Fork	1	8351	745.84	746.07	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-West Fork	1	8320			2015-2016 FIELD SURVEY
Smith-West Fork	1	8290	744.64	744.89	LIDAR TOPO
Smith-West Fork	1	7884	744.12	744.37	LIDAR TOPO
Smith-West Fork	1	7583	743.43	743.83	LIDAR TOPO
Smith-West Fork	1	7326	743.01	743.68	LIDAR TOPO
Smith-West Fork	1	6807	742.90	743.65	LIDAR TOPO

Table B-8 Computed Water Surface Elevations and Topographic Data Source – Smith Branch (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Smith-West Fork	1	6538	742.53	743.65	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-West Fork	1	6465 N FM 1460			2015-2016 FIELD SURVEY
Smith-West Fork	1	6326	740.09	740.35	LIDAR TOPO
Smith-West Fork	1	5921	738.52	738.85	LIDAR TOPO
Smith-West Fork	1	5657	737.62	737.91	LIDAR TOPO
Smith-West Fork	1	5217	736.60	736.87	LIDAR TOPO
Smith-West Fork	1	4821	733.02	733.26	LIDAR TOPO
Smith-West Fork	1	4460	730.09	730.43	LIDAR TOPO
Smith-West Fork	1	4033	729.51	729.94	LIDAR TOPO
Smith-West Fork	1	3706	729.03	729.51	LIDAR TOPO
Smith-West Fork	1	3443	728.70	729.16	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-West Fork	1	3392 MAPLE ST			2015-2016 FIELD SURVEY
Smith-West Fork	1	3341	727.32	727.54	LIDAR TOPO
Smith-West Fork	1	2900	725.71	725.88	LIDAR TOPO
Smith-West Fork	1	2309	723.32	723.53	LIDAR TOPO
Smith-West Fork	1	1575	721.07	721.27	LIDAR TOPO
Smith-West Fork	1	988	718.87	719.15	LIDAR TOPO
Smith-West Fork	1	980			LIDAR TOPO
Smith-West Fork	1	832	718.17	718.51	LIDAR TOPO
Smith-West Fork	1	675	717.43	717.78	LIDAR TOPO
Smith-West Fork	1	365	717.07	717.41	LIDAR TOPO
Smith-West Fork	1	294	717.04	717.38	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-West Fork	1	258 QUAIL VALLEY			2015-2016 FIELD SURVEY
Smith-West Fork	1	228	716.70	717.14	LIDAR TOPO
Smith-West Fork	1	138	716.66	717.09	LIDAR TOPO
Smith-Main	2	14111	812.80	813.22	LIDAR TOPO
Smith-Main	2	13772	807.39	807.69	LIDAR TOPO
Smith-Main	2	13473	804.36	804.71	LIDAR TOPO
Smith-Main	2	13002	798.07	798.35	LIDAR TOPO
Smith-Main	2	12633	793.96	794.12	LIDAR TOPO
Smith-Main	2	12318	792.08	792.26	LIDAR TOPO
Smith-Main	2	11836	789.95	790.19	LIDAR TOPO
Smith-Main	2	11769	790.04	790.26	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-Main	2	11742 CR 166			2015-2016 FIELD SURVEY
Smith-Main	2	11715	787.82	788.12	LIDAR TOPO
Smith-Main	2	11638	786.83	787.26	LIDAR TOPO
Smith-Main	2	11183	781.00	781.1	LIDAR TOPO
Smith-Main	2	10668	776.23	776.51	LIDAR TOPO
Smith-Main	2	10114	771.41	771.41	LIDAR TOPO
Smith-Main	2	9513	767.34	767.66	LIDAR TOPO
Smith-Main	2	9018	762.90	762.67	LIDAR TOPO
Smith-Main	2	8614	760.23	760.74	LIDAR TOPO
Smith-Main	2	8270	759.26	758.26	LIDAR TOPO
Smith-Main	2	8003	756.76	757.87	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-Main	2	7945 SE INNER LOOP			2015-2016 FIELD SURVEY
Smith-Main	2	7882	756.05	756.26	LIDAR TOPO
Smith-Main	2	7619	755.46	755.61	LIDAR TOPO
Smith-Main	2	7438	754.55	754.65	LIDAR TOPO
Smith-Main	2	7257	752.42	752.57	LIDAR TOPO
Smith-Main	2	7077	751.67	751.92	LIDAR TOPO
Smith-Main	2	6925	751.18	751.6	LIDAR TOPO
Smith-Main	2	6773	751.10	751.53	LIDAR TOPO
Smith-Main	2	6622	751.06	751.5	LIDAR TOPO
Smith-Main	2	6594	751.06	751.5	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-Main	2	6548 S FM 1460			2015-2016 FIELD SURVEY
Smith-Main	2	6484	746.66	746.92	LIDAR TOPO
Smith-Main	2	6178	745.29	745.64	LIDAR TOPO
Smith-Main	2	5960 S FM 1460 (NEW)			FINAL PLANS: TxDOT 221-02-017 2014
Smith-Main	2	5713	744.06	744.21	LIDAR TOPO

Table B-8 Computed Water Surface Elevations and Topographic Data Source – Smith Branch (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Smith-Main	2	5201	741.17	741.32	LIDAR TOPO
Smith-Main	2	4985	739.85	739.89	LIDAR TOPO
Smith-Main	2	4529	737.44	737.65	LIDAR TOPO
Smith-Main	2	4066	736.68	737.05	LIDAR TOPO
Smith-Main	2	3703	736.30	736.7	LIDAR TOPO
Smith-Main	2	3627	733.51	733.78	LIDAR TOPO
Smith-Main	2	3558	732.91	733.03	LIDAR TOPO
Smith-Main	2	3061	729.56	729.71	LIDAR TOPO
Smith-Main	2	2636	728.14	728.32	LIDAR TOPO
Smith-Main	2	2168	726.06	726.22	LIDAR TOPO
Smith-Main	2	1727	723.41	723.57	LIDAR TOPO
Smith-Main	2	1190	720.52	720.72	LIDAR TOPO
Smith-Main	2	717	718.24	718.58	LIDAR TOPO
Smith-Main	2	165	716.66	717.03	LIDAR TOPO
Smith-Main	1	13223	715.42	715.87	LIDAR TOPO
Smith-Main	1	12776	712.88	713	LIDAR TOPO
Smith-Main	1	12566	712.25	712.19	LIDAR TOPO
Smith-Main	1	12388	711.97	711.81	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-Main	1	12341 SOUTHWESTERN BLV			2015-2016 FIELD SURVEY
Smith-Main	1	12294	710.89	711.37	LIDAR TOPO
Smith-Main	1	12142	709.95	710.32	LIDAR TOPO
Smith-Main	Quail_Valley	1285	716.40	716.59	LIDAR TOPO
Smith-Main	Quail_Valley	1028	716.20	716.35	LIDAR TOPO
Smith-Main	Quail_Valley	726	713.97	714.09	LIDAR TOPO
Smith-Main	Quail_Valley	506	712.26	712.61	LIDAR TOPO
Smith-Main	Quail_Valley	398	712.26	712.61	LIDAR TOPO
Smith-Main	Quail_Valley	248	712.26	712.61	LIDAR TOPO
Smith-Main	1a	11911	707.79	708.2	LIDAR TOPO
Smith-Main	1a	11420	705.80	706.11	LIDAR TOPO
Smith-Main	1a	10884	704.24	704.63	LIDAR TOPO
Smith-Main	1a	10411	703.78	704.16	LIDAR TOPO
Smith-Main	1a	9900	702.84	703.33	LIDAR TOPO
Smith-Main	1a	9816	702.97	703.42	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-Main	1a	9774 UNIV. / HWY 29			2015-2016 FIELD SURVEY
Smith-Main	1a	9716	699.55	699.79	LIDAR TOPO
Smith-Main	1a	9464	698.60	698.84	LIDAR TOPO
Smith-Main	1a	9240	697.85	698.08	LIDAR TOPO
Smith-Main	1a	8795	695.93	696.17	LIDAR TOPO
Smith-Main	1a	8308	692.58	692.71	LIDAR TOPO
Smith-Main	1a	7883	690.33	690.7	LIDAR TOPO
Smith-Main	1a	7750	690.20	690.57	LIDAR TOPO/2015-2016 FIELD SURVEY
Smith-Main	1a	7708 SMITH CREEK			2015-2016 FIELD SURVEY
Smith-Main	1a	7679	690.16	690.52	LIDAR TOPO
Smith-Main	1a	7307	688.08	688.31	LIDAR TOPO
Smith-Main	1a	6991	685.75	686.02	LIDAR TOPO
Smith-Main	1a	6516	683.62	683.97	LIDAR TOPO
Smith-Main	1a	5981	680.85	681.23	LIDAR TOPO
Smith-Main	1a	5448	678.12	678.35	LIDAR TOPO
Smith-Main	1a	4999	676.87	677.09	LIDAR TOPO
Smith-Main	1a	4583	675.53	675.82	LIDAR TOPO
Smith-Main	1a	3967	673.65	674.08	LIDAR TOPO
Smith-Main	1a	3592	670.95	671.34	LIDAR TOPO
Smith-Main	1a	2988	669.18	669.83	LIDAR TOPO
Smith-Main	1a	2551	668.28	668.95	LIDAR TOPO
Smith-Main	1a	1993	664.63	665.23	LIDAR TOPO
Smith-Main	1a	1559	661.38	661.97	LIDAR TOPO
Smith-Main	1a	943	659.28	659.92	LIDAR TOPO
Smith-Main	1a	494	656.93	657.57	LIDAR TOPO

Table B-9 Computed Water Surface Elevations and Topographic Data Source – Middle Fork San Gabriel River

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Middle Fork	Middle Fork	68236	950	950.28	LIDAR TOPO
Middle Fork	Middle Fork	67844	947.85	948.15	LIDAR TOPO
Middle Fork	Middle Fork	67356	945.45	945.88	LIDAR TOPO
Middle Fork	Middle Fork	66891	943.75	944.36	LIDAR TOPO
Middle Fork	Middle Fork	66459	942.06	942.76	LIDAR TOPO
Middle Fork	Middle Fork	66024	939.16	939.71	LIDAR TOPO
Middle Fork	Middle Fork	65564	938.12	938.57	LIDAR TOPO
Middle Fork	Middle Fork	65063	937.27	937.64	LIDAR TOPO
Middle Fork	Middle Fork	64595	936.38	936.55	LIDAR TOPO
Middle Fork	Middle Fork	64146	933.4	934.05	LIDAR TOPO
Middle Fork	Middle Fork	63636	931.08	931.41	LIDAR TOPO
Middle Fork	Middle Fork	63164	929.45	929.77	LIDAR TOPO
Middle Fork	Middle Fork	62791	928.86	929.19	LIDAR TOPO
Middle Fork	Middle Fork	62370	926.69	926.99	LIDAR TOPO
Middle Fork	Middle Fork	61979	925.84	926.24	LIDAR TOPO
Middle Fork	Middle Fork	61499	923.65	923.98	LIDAR TOPO
Middle Fork	Middle Fork	61023	921.17	921.42	LIDAR TOPO
Middle Fork	Middle Fork	60540	921.15	921.4	LIDAR TOPO
Middle Fork	Middle Fork	60163	920.95	921.17	LIDAR TOPO
Middle Fork	Middle Fork	60075	920.91	921.12	LIDAR TOPO/2015-2016 FIELD SURVEY
Middle Fork	Middle Fork	60038 CROSS CREEK RD			2015-2016 FIELD SURVEY
Middle Fork	Middle Fork	60017	920.06	920.34	LIDAR TOPO
Middle Fork	Middle Fork	59935	919.21	919.66	LIDAR TOPO
Middle Fork	Middle Fork	59729	918.91	919.35	LIDAR TOPO
Middle Fork	Middle Fork	59266	917.82	918.25	LIDAR TOPO
Middle Fork	Middle Fork	58794	916.08	916.64	LIDAR TOPO
Middle Fork	Middle Fork	58364	915.07	915.74	LIDAR TOPO
Middle Fork	Middle Fork	57930	914.2	914.94	LIDAR TOPO
Middle Fork	Middle Fork	57536	913.55	914.31	LIDAR TOPO
Middle Fork	Middle Fork	57039	912.34	913.09	LIDAR TOPO
Middle Fork	Middle Fork	56519	911.4	912.16	LIDAR TOPO
Middle Fork	Middle Fork	56087	910.81	911.57	LIDAR TOPO
Middle Fork	Middle Fork	55621	908.72	909.18	LIDAR TOPO
Middle Fork	Middle Fork	55161	908.49	909.12	LIDAR TOPO
Middle Fork	Middle Fork	54770	908.04	908.71	LIDAR TOPO
Middle Fork	Middle Fork	54378	906.93	907.65	LIDAR TOPO
Middle Fork	Middle Fork	54262	907.01	907.75	LIDAR TOPO
Middle Fork	Middle Fork	54176 CIMARRON HILLS TRL			Cimarron Hills Phase II, Section 2 As-builts
Middle Fork	Middle Fork	54121	906.42	907.01	LIDAR TOPO
Middle Fork	Middle Fork	54023	906.39	906.99	LIDAR TOPO
Middle Fork	Middle Fork	53836	905.99	906.59	LIDAR TOPO
Middle Fork	Middle Fork	53363	902.58	902.82	LIDAR TOPO
Middle Fork	Middle Fork	52913	902.41	902.9	LIDAR TOPO
Middle Fork	Middle Fork	52446	901.47	901.94	LIDAR TOPO
Middle Fork	Middle Fork	51978	900.81	901.26	LIDAR TOPO
Middle Fork	Middle Fork	51698	899.69	900.08	LIDAR TOPO
Middle Fork	Middle Fork	51379	899.11	899.51	LIDAR TOPO
Middle Fork	Middle Fork	50875	896.52	897	LIDAR TOPO
Middle Fork	Middle Fork	50456	895.99	896.49	LIDAR TOPO
Middle Fork	Middle Fork	49988	894.49	894.97	LIDAR TOPO
Middle Fork	Middle Fork	49646	893.47	893.98	LIDAR TOPO
Middle Fork	Middle Fork	49444	892.83	893.37	LIDAR TOPO
Middle Fork	Middle Fork	48970	890.96	891.51	LIDAR TOPO
Middle Fork	Middle Fork	48501	889.8	890.54	LIDAR TOPO
Middle Fork	Middle Fork	48098	889.16	889.89	LIDAR TOPO
Middle Fork	Middle Fork	47600	885.13	885.35	LIDAR TOPO
Middle Fork	Middle Fork	47080	885.51	886.15	LIDAR TOPO
Middle Fork	Middle Fork	46612	882.94	883.41	LIDAR TOPO
Middle Fork	Middle Fork	46179	882.07	882.58	LIDAR TOPO
Middle Fork	Middle Fork	45753	881.31	881.83	LIDAR TOPO
Middle Fork	Middle Fork	45283	880.19	880.68	LIDAR TOPO
Middle Fork	Middle Fork	44845	879.33	879.86	LIDAR TOPO
Middle Fork	Middle Fork	44380	877.66	878.15	LIDAR TOPO
Middle Fork	Middle Fork	43949	876.54	877.04	LIDAR TOPO

Table B-9 Computed Water Surface Elevations and Topographic Data Source – Middle Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Middle Fork	Middle Fork	43438	875.25	875.86	LIDAR TOPO
Middle Fork	Middle Fork	42992	874.27	874.95	LIDAR TOPO
Middle Fork	Middle Fork	42532	872.58	872.96	LIDAR TOPO
Middle Fork	Middle Fork	42134	872.68	873.18	LIDAR TOPO
Middle Fork	Middle Fork	41721	871.46	871.94	LIDAR TOPO
Middle Fork	Middle Fork	41370	871.52	872.01	LIDAR TOPO
Middle Fork	Middle Fork	41299	871.31	871.78	2015-2016 FIELD SURVEY
Middle Fork	Middle Fork	41263 CEDAR HOLLOW RD			2015-2016 FIELD SURVEY
Middle Fork	Middle Fork	41217	871.44	871.93	LIDAR TOPO
Middle Fork	Middle Fork	41028	871.29	871.78	LIDAR TOPO
Middle Fork	Middle Fork	40621	871.01	871.49	LIDAR TOPO
Middle Fork	Middle Fork	40189	869.24	869.58	LIDAR TOPO
Middle Fork	Middle Fork	39802	866.73	867.14	LIDAR TOPO
Middle Fork	Middle Fork	39348	865.83	866.11	LIDAR TOPO
Middle Fork	Middle Fork	38890	865.41	865.62	LIDAR TOPO
Middle Fork	Middle Fork	38826	865.34	865.55	LIDAR TOPO
Middle Fork	Middle Fork	38769 WAY CROSS DR			FIELD MEASUREMENT
Middle Fork	Middle Fork	38713	863.11	863.36	LIDAR TOPO
Middle Fork	Middle Fork	38300	861.17	861.56	LIDAR TOPO
Middle Fork	Middle Fork	37813	858.93	859.26	LIDAR TOPO
Middle Fork	Middle Fork	37346	857.56	857.91	LIDAR TOPO
Middle Fork	Middle Fork	36928	856.58	856.94	LIDAR TOPO
Middle Fork	Middle Fork	36474	855.32	855.72	LIDAR TOPO
Middle Fork	Middle Fork	35996	854.39	854.84	LIDAR TOPO
Middle Fork	Middle Fork	35679	853.49	853.89	LIDAR TOPO
Middle Fork	Middle Fork	35369	852.79	853.09	LIDAR TOPO
Middle Fork	Middle Fork	35086	852.24	852.49	LIDAR TOPO
Middle Fork	Middle Fork	35006	852.17	852.41	2015-2016 FIELD SURVEY
Middle Fork	Middle Fork	34965 RANCHO BUENO DR			2015-2016 FIELD SURVEY
Middle Fork	Middle Fork	34921	849.95	850.38	LIDAR TOPO
Middle Fork	Middle Fork	34678	849.55	850	LIDAR TOPO
Middle Fork	Middle Fork	34304	847.28	847.69	LIDAR TOPO
Middle Fork	Middle Fork	33927	845.72	846.18	LIDAR TOPO
Middle Fork	Middle Fork	33456	844.42	844.86	LIDAR TOPO
Middle Fork	Middle Fork	32946	843.32	843.73	LIDAR TOPO
Middle Fork	Middle Fork	32469	842.58	842.98	LIDAR TOPO
Middle Fork	Middle Fork	32032	841.02	841.45	LIDAR TOPO
Middle Fork	Middle Fork	31582	840.7	841.14	LIDAR TOPO
Middle Fork	Middle Fork	31066	839.94	840.38	LIDAR TOPO
Middle Fork	Middle Fork	30604	837.72	838.03	LIDAR TOPO
Middle Fork	Middle Fork	30132	836.36	836.55	LIDAR TOPO
Middle Fork	Middle Fork	29729	836.33	836.56	LIDAR TOPO
Middle Fork	Middle Fork	29662 DAM			LIDAR TOPO
Middle Fork	Middle Fork	29220	830.35	830.6	LIDAR TOPO
Middle Fork	Middle Fork	28708	827.83	828.19	LIDAR TOPO
Middle Fork	Middle Fork	28275	825.1	825.36	LIDAR TOPO
Middle Fork	Middle Fork	28025	824.56	824.81	LIDAR TOPO
Middle Fork	Middle Fork	27690	822.33	822.57	LIDAR TOPO
Middle Fork	Middle Fork	27392	820.67	820.88	LIDAR TOPO
Middle Fork	Middle Fork	27036	818.63	818.88	LIDAR TOPO
Middle Fork	Middle Fork	26543	816.55	816.92	LIDAR TOPO
Middle Fork	Middle Fork	26077	815.77	816.19	LIDAR TOPO
Middle Fork	Middle Fork	25826	815.75	816.17	LIDAR TOPO
Middle Fork	Middle Fork	25536	812.91	813.18	LIDAR TOPO
Middle Fork	Middle Fork	25081	813.1	813.41	LIDAR TOPO
Middle Fork	Middle Fork	24605	811.76	812.01	LIDAR TOPO
Middle Fork	Middle Fork	24072	811.13	811.38	LIDAR TOPO
Middle Fork	Middle Fork	23607	810.69	810.94	LIDAR TOPO
Middle Fork	Middle Fork	23094	810.08	810.32	LIDAR TOPO
Middle Fork	Middle Fork	22673	809.06	809.27	LIDAR TOPO
Middle Fork	Middle Fork	22657 DAM			LIDAR TOPO
Middle Fork	Middle Fork	22429	799.69	800.08	LIDAR TOPO
Middle Fork	Middle Fork	22168	798.23	798.59	LIDAR TOPO
Middle Fork	Middle Fork	21743	797.13	797.49	LIDAR TOPO
Middle Fork	Middle Fork	21261	793.63	793.91	LIDAR TOPO

Table B-9 Computed Water Surface Elevations and Topographic Data Source – Middle Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
Middle Fork	Middle Fork	20776	791.16	791.42	LIDAR TOPO
Middle Fork	Middle Fork	20298	788.47	788.67	LIDAR TOPO
Middle Fork	Middle Fork	19813	786.01	786.38	LIDAR TOPO
Middle Fork	Middle Fork	19332	784.71	785.08	LIDAR TOPO
Middle Fork	Middle Fork	18894	783.17	783.52	LIDAR TOPO
Middle Fork	Middle Fork	18395	780.74	780.99	LIDAR TOPO
Middle Fork	Middle Fork	17912	777.95	778.25	LIDAR TOPO
Middle Fork	Middle Fork	17475	776.76	777.08	LIDAR TOPO
Middle Fork	Middle Fork	17039	774.93	775.21	LIDAR TOPO
Middle Fork	Middle Fork	16602	771.93	772.26	LIDAR TOPO
Middle Fork	Middle Fork	16082	770.84	771.16	LIDAR TOPO
Middle Fork	Middle Fork	15629	768.77	769.04	LIDAR TOPO
Middle Fork	Middle Fork	15200	766.85	767.23	LIDAR TOPO
Middle Fork	Middle Fork	14719	765.36	765.87	LIDAR TOPO
Middle Fork	Middle Fork	14223	764.59	765.19	LIDAR TOPO
Middle Fork	Middle Fork	14056	764.3	764.89	LIDAR TOPO
Middle Fork	Middle Fork	13968 D B WOOD RD			FIELD MEASUREMENT
Middle Fork	Middle Fork	13857	760.65	760.89	LIDAR TOPO
Middle Fork	Middle Fork	13556	759.51	759.77	LIDAR TOPO
Middle Fork	Middle Fork	13281	758.25	758.57	LIDAR TOPO
Middle Fork	Middle Fork	13102	757.53	757.86	LIDAR TOPO
Middle Fork	Middle Fork	12730	754.85	755.14	LIDAR TOPO
Middle Fork	Middle Fork	12339	753.52	753.83	LIDAR TOPO
Middle Fork	Middle Fork	11866	750.4	750.66	LIDAR TOPO
Middle Fork	Middle Fork	11436	748.77	749.04	LIDAR TOPO
Middle Fork	Middle Fork	10999	747.02	747.28	LIDAR TOPO
Middle Fork	Middle Fork	10606	743.24	743.54	LIDAR TOPO
Middle Fork	Middle Fork	10185	741.62	741.92	LIDAR TOPO
Middle Fork	Middle Fork	9723	738.67	738.95	LIDAR TOPO
Middle Fork	Middle Fork	9258	737.02	737.32	LIDAR TOPO
Middle Fork	Middle Fork	8790	735.3	735.58	LIDAR TOPO
Middle Fork	Middle Fork	8282	733.65	733.97	LIDAR TOPO
Middle Fork	Middle Fork	7771	730.17	730.43	LIDAR TOPO
Middle Fork	Middle Fork	7331	727.4	727.66	LIDAR TOPO
Middle Fork	Middle Fork	7083	727.07	727.41	LIDAR TOPO
Middle Fork	Middle Fork	6769	725.7	726.02	LIDAR TOPO
Middle Fork	Middle Fork	6371	722.96	723.21	LIDAR TOPO
Middle Fork	Middle Fork	5874	720.3	720.6	LIDAR TOPO
Middle Fork	Middle Fork	5386	718.48	718.81	LIDAR TOPO
Middle Fork	Middle Fork	4997	718.19	718.53	LIDAR TOPO
Middle Fork	Middle Fork	4526	717.26	717.6	LIDAR TOPO
Middle Fork	Middle Fork	4039	713.76	713.81	LIDAR TOPO
Middle Fork	Middle Fork	3956	713.65	713.68	LIDAR TOPO
Middle Fork	Middle Fork	3942 DAM			LIDAR TOPO
Middle Fork	Middle Fork	3539	710.77	711.09	LIDAR TOPO
Middle Fork	Middle Fork	3232	707.88	708.13	LIDAR TOPO
Middle Fork	Middle Fork	2910	707.35	707.65	LIDAR TOPO
Middle Fork	Middle Fork	2629	706.27	706.6	LIDAR TOPO
Middle Fork	Middle Fork	2154	705.41	705.74	LIDAR TOPO
Middle Fork	Middle Fork	1689	703.52	703.77	LIDAR TOPO
Middle Fork	Middle Fork	1212	702.86	703.1	LIDAR TOPO
Middle Fork	Middle Fork	827	702.4	702.62	LIDAR TOPO
Middle Fork	Middle Fork	362	701.22	701.45	LIDAR TOPO
Middle Fork	Middle Fork	286	699.61	699.65	LIDAR TOPO
Middle Fork	Middle Fork	277 DAM			LIDAR TOPO
Middle Fork	Middle Fork	88	695.97	696.38	LIDAR TOPO

Table B-10 Computed Water Surface Elevations and Topographic Data Source – North Fork San Gabriel River

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
North Fork	North Fork	322253	1350.75	1351.14	LIDAR TOPO
North Fork	North Fork	321743	1348.75	1349.07	LIDAR TOPO
North Fork	North Fork	321276	1344.98	1345.42	LIDAR TOPO
North Fork	North Fork	320772	1342.67	1343.15	LIDAR TOPO
North Fork	North Fork	320258	1340.94	1341.47	LIDAR TOPO
North Fork	North Fork	319722	1337.01	1337.30	LIDAR TOPO
North Fork	North Fork	319260	1334.32	1334.72	LIDAR TOPO
North Fork	North Fork	318695	1332.10	1332.49	LIDAR TOPO
North Fork	North Fork	318225	1329.77	1330.33	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	318168 FM 2340			2015-2016 FIELD SURVEY
North Fork	North Fork	318126	1329.77	1330.29	LIDAR TOPO
North Fork	North Fork	317935	1328.90	1329.41	LIDAR TOPO
North Fork	North Fork	317611	1327.20	1327.69	LIDAR TOPO
North Fork	North Fork	317117	1324.59	1325.13	LIDAR TOPO
North Fork	North Fork	316647	1321.32	1321.74	LIDAR TOPO
North Fork	North Fork	316184	1318.40	1318.72	LIDAR TOPO
North Fork	North Fork	315663	1316.03	1316.33	LIDAR TOPO
North Fork	North Fork	315160	1312.26	1312.55	LIDAR TOPO
North Fork	North Fork	314660	1309.73	1310.15	LIDAR TOPO
North Fork	North Fork	314188	1307.14	1307.60	LIDAR TOPO
North Fork	North Fork	313661	1304.13	1304.54	LIDAR TOPO
North Fork	North Fork	313176	1301.49	1301.87	LIDAR TOPO
North Fork	North Fork	312693	1298.65	1299.03	LIDAR TOPO
North Fork	North Fork	312234	1295.78	1296.02	LIDAR TOPO
North Fork	North Fork	311722	1292.41	1292.65	LIDAR TOPO
North Fork	North Fork	311203	1289.26	1289.53	LIDAR TOPO
North Fork	North Fork	310708	1287.79	1288.09	LIDAR TOPO
North Fork	North Fork	310221	1285.47	1285.78	LIDAR TOPO
North Fork	North Fork	309731	1282.67	1283.02	LIDAR TOPO
North Fork	North Fork	309163	1280.55	1280.93	LIDAR TOPO
North Fork	North Fork	308679	1278.40	1278.79	LIDAR TOPO
North Fork	North Fork	308192	1275.73	1276.17	LIDAR TOPO
North Fork	North Fork	307754	1273.59	1274.23	LIDAR TOPO
North Fork	North Fork	307217	1270.14	1270.63	LIDAR TOPO
North Fork	North Fork	306753	1267.73	1268.29	LIDAR TOPO
North Fork	North Fork	306291	1266.73	1267.25	LIDAR TOPO
North Fork	North Fork	305798	1263.68	1264.26	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	305742 COUNTY RD 203			2015-2016 FIELD SURVEY
North Fork	North Fork	305705	1262.60	1263.41	LIDAR TOPO
North Fork	North Fork	305366	1259.27	1259.55	LIDAR TOPO
North Fork	North Fork	305068	1258.31	1258.94	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	305024 COUNTY RD 202			2015-2016 FIELD SURVEY
North Fork	North Fork	304993	1258.12	1258.78	LIDAR TOPO
North Fork	North Fork	304508	1257.03	1257.72	LIDAR TOPO
North Fork	North Fork	304172	1254.13	1254.76	LIDAR TOPO
North Fork	North Fork	303900	1252.20	1252.78	LIDAR TOPO
North Fork	North Fork	303398	1250.13	1250.84	LIDAR TOPO
North Fork	North Fork	302981	1247.71	1248.41	LIDAR TOPO
North Fork	North Fork	302449	1245.33	1245.93	LIDAR TOPO
North Fork	North Fork	301936	1242.61	1243.14	LIDAR TOPO
North Fork	North Fork	301462	1240.75	1241.24	LIDAR TOPO
North Fork	North Fork	300973	1239.01	1239.58	LIDAR TOPO
North Fork	North Fork	300482	1237.12	1237.63	LIDAR TOPO
North Fork	North Fork	300039	1235.97	1236.32	LIDAR TOPO
North Fork	North Fork	299536	1233.01	1233.80	LIDAR TOPO
North Fork	North Fork	299083	1231.13	1231.85	LIDAR TOPO
North Fork	North Fork	298599	1229.32	1230.03	LIDAR TOPO
North Fork	North Fork	298103	1227.57	1228.36	LIDAR TOPO
North Fork	North Fork	297617	1226.21	1226.99	LIDAR TOPO
North Fork	North Fork	297114	1223.88	1224.47	LIDAR TOPO
North Fork	North Fork	296643	1221.94	1222.64	LIDAR TOPO
North Fork	North Fork	296157	1220.58	1221.29	LIDAR TOPO

Table B-10 Computed Water Surface Elevations and Topographic Data Source – North Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
North Fork	North Fork	295663	1218.76	1219.47	LIDAR TOPO
North Fork	North Fork	295261	1218.00	1218.64	LIDAR TOPO
North Fork	North Fork	294796	1216.03	1216.64	LIDAR TOPO
North Fork	North Fork	294322	1213.34	1214.06	LIDAR TOPO
North Fork	North Fork	293835	1211.75	1212.52	LIDAR TOPO
North Fork	North Fork	293353	1208.95	1209.78	LIDAR TOPO
North Fork	North Fork	292883	1207.17	1207.73	LIDAR TOPO
North Fork	North Fork	292420	1205.18	1205.80	LIDAR TOPO
North Fork	North Fork	291929	1203.30	1203.89	LIDAR TOPO
North Fork	North Fork	291042	1200.89	1201.24	LIDAR TOPO
North Fork	North Fork	290884	1200.75	1201.07	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	290833 FM 963			2015-2016 FIELD SURVEY
North Fork	North Fork	290782	1198.00	1198.54	LIDAR TOPO
North Fork	North Fork	290486	1196.88	1197.38	LIDAR TOPO
North Fork	North Fork	289983	1194.78	1195.31	LIDAR TOPO
North Fork	North Fork	289484	1192.25	1192.74	LIDAR TOPO
North Fork	North Fork	288982	1189.18	1189.86	LIDAR TOPO
North Fork	North Fork	288556	1186.84	1187.57	LIDAR TOPO
North Fork	North Fork	287974	1186.04	1186.83	LIDAR TOPO
North Fork	North Fork	287482	1184.13	1184.91	LIDAR TOPO
North Fork	North Fork	286992	1182.41	1183.15	LIDAR TOPO
North Fork	North Fork	286478	1181.09	1181.83	LIDAR TOPO
North Fork	North Fork	286164	1180.70	1181.42	LIDAR TOPO
North Fork	North Fork	285915	1180.67	1181.40	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	285707	1180.33	1181.08	LIDAR TOPO
North Fork	North Fork	285421	1179.29	1180.04	LIDAR TOPO
North Fork	North Fork	285008	1177.56	1178.26	LIDAR TOPO
North Fork	North Fork	284466	1176.01	1176.65	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	284435 PRIVATE DR			2015-2016 FIELD SURVEY
North Fork	North Fork	284392	1175.66	1176.28	LIDAR TOPO
North Fork	North Fork	284067	1174.69	1175.31	LIDAR TOPO
North Fork	North Fork	283561	1172.36	1172.99	LIDAR TOPO
North Fork	North Fork	283143	1171.67	1172.26	LIDAR TOPO
North Fork	North Fork	282607	1170.98	1171.59	LIDAR TOPO
North Fork	North Fork	282039	1169.10	1169.83	LIDAR TOPO
North Fork	North Fork	281517	1168.19	1168.89	LIDAR TOPO
North Fork	North Fork	281040	1167.05	1167.67	LIDAR TOPO
North Fork	North Fork	280487	1165.80	1166.39	LIDAR TOPO
North Fork	North Fork	280103	1164.84	1165.42	LIDAR TOPO
North Fork	North Fork	279684	1163.30	1163.76	LIDAR TOPO
North Fork	North Fork	279187	1161.83	1162.29	LIDAR TOPO
North Fork	North Fork	278711	1160.56	1161.08	LIDAR TOPO
North Fork	North Fork	278189	1159.72	1160.21	LIDAR TOPO
North Fork	North Fork	277625	1158.83	1159.22	LIDAR TOPO
North Fork	North Fork	277207	1158.72	1159.10	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	277136 FM 1174			2015-2016 FIELD SURVEY
North Fork	North Fork	277069	1156.43	1156.96	LIDAR TOPO
North Fork	North Fork	276326	1155.31	1155.86	LIDAR TOPO
North Fork	North Fork	275814	1153.07	1153.85	LIDAR TOPO
North Fork	North Fork	275326	1151.09	1151.68	LIDAR TOPO
North Fork	North Fork	274868	1150.50	1151.17	LIDAR TOPO
North Fork	North Fork	274312	1148.85	1149.56	LIDAR TOPO
North Fork	North Fork	273843	1148.25	1148.95	LIDAR TOPO
North Fork	North Fork	273343	1146.69	1147.34	LIDAR TOPO
North Fork	North Fork	272811	1145.65	1146.28	LIDAR TOPO
North Fork	North Fork	272321	1143.99	1144.61	LIDAR TOPO
North Fork	North Fork	271849	1142.64	1143.26	LIDAR TOPO
North Fork	North Fork	271342	1141.53	1142.18	LIDAR TOPO
North Fork	North Fork	270836	1140.12	1140.82	LIDAR TOPO
North Fork	North Fork	270339	1139.23	1139.94	LIDAR TOPO
North Fork	North Fork	269847	1137.78	1138.53	LIDAR TOPO

Table B-10 Computed Water Surface Elevations and Topographic Data Source – North Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
North Fork	North Fork	269488	1135.88	1136.77	LIDAR TOPO
North Fork	North Fork	268776	1134.89	1135.81	LIDAR TOPO
North Fork	North Fork	268340	1133.97	1134.90	LIDAR TOPO
North Fork	North Fork	267835	1133.13	1134.10	LIDAR TOPO
North Fork	North Fork	267310	1132.45	1133.43	LIDAR TOPO
North Fork	North Fork	266801	1131.15	1132.08	LIDAR TOPO
North Fork	North Fork	266308	1129.16	1129.99	LIDAR TOPO
North Fork	North Fork	265810	1126.66	1127.45	LIDAR TOPO
North Fork	North Fork	265392	1125.46	1126.20	LIDAR TOPO
North Fork	North Fork	264795	1123.89	1124.60	LIDAR TOPO
North Fork	North Fork	264384	1122.79	1123.51	LIDAR TOPO
North Fork	North Fork	263825	1122.06	1122.83	LIDAR TOPO
North Fork	North Fork	263276	1121.37	1122.10	LIDAR TOPO
North Fork	North Fork	262803	1120.06	1120.71	LIDAR TOPO
North Fork	North Fork	262370	1118.90	1119.58	LIDAR TOPO
North Fork	North Fork	261966	1118.19	1118.89	LIDAR TOPO
North Fork	North Fork	261457	1117.65	1118.36	LIDAR TOPO
North Fork	North Fork	260869	1115.70	1116.46	LIDAR TOPO
North Fork	North Fork	260380	1113.37	1114.03	LIDAR TOPO
North Fork	North Fork	259892	1111.79	1112.41	LIDAR TOPO
North Fork	North Fork	259373	1109.64	1110.20	LIDAR TOPO
North Fork	North Fork	258867	1108.40	1108.92	LIDAR TOPO
North Fork	North Fork	258355	1106.97	1107.34	LIDAR TOPO
North Fork	North Fork	257914	1105.31	1105.69	LIDAR TOPO
North Fork	North Fork	257412	1104.04	1104.49	LIDAR TOPO
North Fork	North Fork	256874	1103.36	1103.85	LIDAR TOPO
North Fork	North Fork	256427	1102.76	1103.32	LIDAR TOPO
North Fork	North Fork	255964	1102.24	1102.87	LIDAR TOPO
North Fork	North Fork	255464	1101.71	1102.36	LIDAR TOPO
North Fork	North Fork	254932	1100.61	1101.26	LIDAR TOPO
North Fork	North Fork	254431	1098.86	1099.55	LIDAR TOPO
North Fork	North Fork	253982	1097.43	1098.10	LIDAR TOPO
North Fork	North Fork	253522	1096.26	1096.95	LIDAR TOPO
North Fork	North Fork	253024	1094.52	1095.21	LIDAR TOPO
North Fork	North Fork	252530	1094.06	1094.74	LIDAR TOPO
North Fork	North Fork	251999	1092.63	1093.31	LIDAR TOPO
North Fork	North Fork	251489	1090.56	1091.22	LIDAR TOPO
North Fork	North Fork	251000	1089.34	1090.00	LIDAR TOPO
North Fork	North Fork	250502	1087.94	1088.65	LIDAR TOPO
North Fork	North Fork	250024	1087.02	1087.75	LIDAR TOPO
North Fork	North Fork	249506	1086.15	1086.86	LIDAR TOPO
North Fork	North Fork	248997	1084.67	1085.41	LIDAR TOPO
North Fork	North Fork	248470	1084.21	1084.90	LIDAR TOPO
North Fork	North Fork	247988	1082.00	1082.60	LIDAR TOPO
North Fork	North Fork	247489	1080.60	1081.19	LIDAR TOPO
North Fork	North Fork	246990	1079.89	1080.52	LIDAR TOPO
North Fork	North Fork	246420	1078.68	1079.30	LIDAR TOPO
North Fork	North Fork	246062	1077.83	1078.46	LIDAR TOPO
North Fork	North Fork	245971	1077.16	1077.75	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	245927 COUNTY RD 200			2015-2016 FIELD SURVEY
North Fork	North Fork	245900	1076.83	1077.45	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	245875 FOOTBRIDGE			LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	245857	1076.88	1077.50	LIDAR TOPO
North Fork	North Fork	245608	1074.79	1075.33	LIDAR TOPO
North Fork	North Fork	245016	1073.15	1073.62	LIDAR TOPO
North Fork	North Fork	244488	1071.52	1072.06	LIDAR TOPO
North Fork	North Fork	243982	1069.71	1070.20	LIDAR TOPO
North Fork	North Fork	243459	1069.20	1069.67	LIDAR TOPO
North Fork	North Fork	242942	1068.32	1068.77	LIDAR TOPO
North Fork	North Fork	242429	1066.88	1067.32	LIDAR TOPO
North Fork	North Fork	241964	1065.21	1065.67	LIDAR TOPO
North Fork	North Fork	241450	1064.16	1064.61	LIDAR TOPO
North Fork	North Fork	240940	1062.82	1063.28	LIDAR TOPO

Table B-10 Computed Water Surface Elevations and Topographic Data Source – North Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
North Fork	North Fork	240477	1062.04	1062.51	LIDAR TOPO
North Fork	North Fork	239905	1060.10	1060.50	LIDAR TOPO
North Fork	North Fork	239398	1058.88	1059.22	LIDAR TOPO
North Fork	North Fork	239014	1058.48	1058.82	LIDAR TOPO
North Fork	North Fork	238375	1055.84	1056.34	LIDAR TOPO
North Fork	North Fork	237908	1055.27	1055.66	LIDAR TOPO
North Fork	North Fork	237428	1054.60	1055.03	LIDAR TOPO
North Fork	North Fork	236948	1053.96	1054.41	LIDAR TOPO
North Fork	North Fork	236444	1053.41	1053.85	LIDAR TOPO
North Fork	North Fork	235940	1053.22	1053.65	LIDAR TOPO
North Fork	North Fork	235484	1051.97	1052.33	LIDAR TOPO
North Fork	North Fork	234960	1050.75	1051.07	LIDAR TOPO
North Fork	North Fork	234474	1049.08	1049.53	LIDAR TOPO
North Fork	North Fork	233958	1047.80	1048.36	LIDAR TOPO
North Fork	North Fork	233434	1047.28	1047.84	LIDAR TOPO
North Fork	North Fork	232835	1046.93	1047.51	LIDAR TOPO
North Fork	North Fork	232436	1046.32	1046.89	LIDAR TOPO
North Fork	North Fork	231948	1045.79	1046.39	LIDAR TOPO
North Fork	North Fork	231448	1044.96	1045.54	LIDAR TOPO
North Fork	North Fork	230980	1043.73	1044.28	LIDAR TOPO
North Fork	North Fork	230458	1043.39	1043.95	LIDAR TOPO
North Fork	North Fork	230002	1042.06	1042.70	LIDAR TOPO
North Fork	North Fork	229456	1041.46	1042.11	LIDAR TOPO
North Fork	North Fork	228944	1039.53	1040.05	LIDAR TOPO
North Fork	North Fork	228451	1037.43	1037.97	LIDAR TOPO
North Fork	North Fork	227982	1036.37	1036.87	LIDAR TOPO
North Fork	North Fork	227477	1036.61	1037.12	LIDAR TOPO
North Fork	North Fork	226976	1034.67	1035.11	LIDAR TOPO
North Fork	North Fork	226514	1033.65	1034.11	LIDAR TOPO
North Fork	North Fork	226006	1032.56	1032.99	LIDAR TOPO
North Fork	North Fork	225515	1031.74	1032.18	LIDAR TOPO
North Fork	North Fork	225036	1030.66	1031.13	LIDAR TOPO
North Fork	North Fork	224558	1030.21	1030.71	LIDAR TOPO
North Fork	North Fork	224082	1029.54	1030.07	LIDAR TOPO
North Fork	North Fork	223568	1028.70	1029.28	LIDAR TOPO
North Fork	North Fork	223067	1027.76	1028.32	LIDAR TOPO
North Fork	North Fork	222556	1026.41	1026.98	LIDAR TOPO
North Fork	North Fork	222031	1025.19	1025.74	LIDAR TOPO
North Fork	North Fork	221541	1024.02	1024.59	LIDAR TOPO
North Fork	North Fork	221025	1023.93	1024.47	LIDAR TOPO
North Fork	North Fork	220516	1023.09	1023.64	LIDAR TOPO
North Fork	North Fork	220032	1021.69	1022.13	LIDAR TOPO
North Fork	North Fork	219518	1020.33	1020.83	LIDAR TOPO
North Fork	North Fork	219019	1019.76	1020.25	LIDAR TOPO
North Fork	North Fork	218520	1018.67	1019.10	LIDAR TOPO
North Fork	North Fork	218009	1017.80	1018.23	LIDAR TOPO
North Fork	North Fork	217488	1017.16	1017.57	LIDAR TOPO
North Fork	North Fork	217023	1016.98	1017.39	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	216901 FM 243			2015-2016 FIELD SURVEY
North Fork	North Fork	216800	1015.83	1016.39	LIDAR TOPO
North Fork	North Fork	216443	1014.58	1015.14	LIDAR TOPO
North Fork	North Fork	215952	1013.85	1014.39	LIDAR TOPO
North Fork	North Fork	215426	1013.39	1013.90	LIDAR TOPO
North Fork	North Fork	214916	1011.18	1011.61	LIDAR TOPO
North Fork	North Fork	214394	1009.76	1010.21	LIDAR TOPO
North Fork	North Fork	213871	1008.95	1009.38	LIDAR TOPO
North Fork	North Fork	213341	1007.42	1007.88	LIDAR TOPO
North Fork	North Fork	212843	1006.87	1007.32	LIDAR TOPO
North Fork	North Fork	212322	1006.26	1006.68	LIDAR TOPO
North Fork	North Fork	211804	1005.44	1005.83	LIDAR TOPO
North Fork	North Fork	211319	1004.21	1004.65	LIDAR TOPO
North Fork	North Fork	210843	1004.07	1004.49	LIDAR TOPO
North Fork	North Fork	210303	1003.32	1003.70	LIDAR TOPO
North Fork	North Fork	209803	1002.47	1002.85	LIDAR TOPO

Table B-10 Computed Water Surface Elevations and Topographic Data Source – North Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
North Fork	North Fork	209302	1001.21	1001.59	LIDAR TOPO
North Fork	North Fork	208791	999.78	1000.11	LIDAR TOPO
North Fork	North Fork	208288	998.33	998.67	LIDAR TOPO
North Fork	North Fork	207807	997.50	997.83	LIDAR TOPO
North Fork	North Fork	207318	996.11	996.49	LIDAR TOPO
North Fork	North Fork	206790	995.45	995.81	LIDAR TOPO
North Fork	North Fork	206240	994.73	995.09	LIDAR TOPO
North Fork	North Fork	205737	993.97	994.32	LIDAR TOPO
North Fork	North Fork	205234	992.19	992.54	LIDAR TOPO
North Fork	North Fork	204742	991.25	991.61	LIDAR TOPO
North Fork	North Fork	204254	990.04	990.38	LIDAR TOPO
North Fork	North Fork	203761	989.30	989.64	LIDAR TOPO
North Fork	North Fork	203223	988.49	988.85	2015-2016 FIELD SURVEY
North Fork	North Fork	202749	987.66	988.05	LIDAR TOPO
North Fork	North Fork	202280	987.02	987.42	LIDAR TOPO
North Fork	North Fork	201770	986.30	986.71	LIDAR TOPO
North Fork	North Fork	201239	985.73	986.13	LIDAR TOPO
North Fork	North Fork	200754	984.83	985.24	LIDAR TOPO
North Fork	North Fork	200135	983.16	983.56	LIDAR TOPO
North Fork	North Fork	199740	982.43	982.83	LIDAR TOPO
North Fork	North Fork	199257	981.73	982.14	LIDAR TOPO
North Fork	North Fork	198781	980.87	981.28	LIDAR TOPO
North Fork	North Fork	198257	979.84	980.26	LIDAR TOPO
North Fork	North Fork	197765	978.96	979.38	2015-2016 FIELD SURVEY
North Fork	North Fork	197296	978.05	978.44	LIDAR TOPO
North Fork	North Fork	196791	976.93	977.30	LIDAR TOPO
North Fork	North Fork	196313	975.83	976.18	LIDAR TOPO
North Fork	North Fork	195784	974.27	974.65	LIDAR TOPO
North Fork	North Fork	195298	973.27	973.63	LIDAR TOPO
North Fork	North Fork	194813	972.86	973.23	LIDAR TOPO
North Fork	North Fork	194341	972.59	972.97	LIDAR TOPO
North Fork	North Fork	193813	971.90	972.27	LIDAR TOPO
North Fork	North Fork	193331	970.86	971.24	LIDAR TOPO
North Fork	North Fork	192992	969.27	969.68	LIDAR TOPO
North Fork	North Fork	192846	968.30	968.65	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	192787 PRIVATE DR			2015-2016 FIELD SURVEY
North Fork	North Fork	192715	968.47	968.83	LIDAR TOPO
North Fork	North Fork	192305	968.59	968.97	2015-2016 FIELD SURVEY
North Fork	North Fork	191968	968.05	968.46	LIDAR TOPO
North Fork	North Fork	191503	967.57	968.00	LIDAR TOPO
North Fork	North Fork	190991	967.23	967.66	LIDAR TOPO
North Fork	North Fork	190481	966.65	967.07	LIDAR TOPO
North Fork	North Fork	189943	964.99	965.41	LIDAR TOPO
North Fork	North Fork	189507	963.70	964.09	LIDAR TOPO
North Fork	North Fork	188971	963.01	963.38	LIDAR TOPO
North Fork	North Fork	188468	962.08	962.51	LIDAR TOPO
North Fork	North Fork	187950	960.95	961.33	LIDAR TOPO
North Fork	North Fork	187400	960.84	961.21	LIDAR TOPO
North Fork	North Fork	186718	959.50	959.90	2015-2016 FIELD SURVEY
North Fork	North Fork	186383	959.08	959.44	LIDAR TOPO
North Fork	North Fork	186001	958.36	958.67	LIDAR TOPO
North Fork	North Fork	185461	957.63	957.90	LIDAR TOPO
North Fork	North Fork	184977	956.96	957.21	LIDAR TOPO
North Fork	North Fork	184500	955.58	956.82	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	184428 COUNTY RD 236			2015-2016 FIELD SURVEY
North Fork	North Fork	184371	953.50	953.84	LIDAR TOPO
North Fork	North Fork	183854	952.55	952.89	LIDAR TOPO
North Fork	North Fork	183233	951.28	951.63	LIDAR TOPO
North Fork	North Fork	182719	950.09	950.46	LIDAR TOPO
North Fork	North Fork	182263	949.66	950.03	LIDAR TOPO
North Fork	North Fork	181710	949.28	949.66	LIDAR TOPO
North Fork	North Fork	181215	948.34	948.71	2015-2016 FIELD SURVEY
North Fork	North Fork	180698	947.43	947.81	LIDAR TOPO

Table B-10 Computed Water Surface Elevations and Topographic Data Source – North Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
North Fork	North Fork	180214	946.99	947.38	LIDAR TOPO
North Fork	North Fork	179692	946.38	946.74	LIDAR TOPO
North Fork	North Fork	179202	945.26	945.58	LIDAR TOPO
North Fork	North Fork	178689	943.38	943.77	LIDAR TOPO
North Fork	North Fork	178185	942.90	943.25	LIDAR TOPO
North Fork	North Fork	177654	942.18	942.52	LIDAR TOPO
North Fork	North Fork	177149	939.47	939.55	LIDAR TOPO
North Fork	North Fork	176646	938.49	939.13	LIDAR TOPO
North Fork	North Fork	176152	937.85	938.51	LIDAR TOPO
North Fork	North Fork	175620	937.54	938.23	2015-2016 FIELD SURVEY
North Fork	North Fork	175116	932.93	933.11	LIDAR TOPO
North Fork	North Fork	174603	933.89	934.37	LIDAR TOPO
North Fork	North Fork	174118	932.90	933.35	LIDAR TOPO
North Fork	North Fork	173559	932.60	933.06	LIDAR TOPO
North Fork	North Fork	173008	931.86	932.45	LIDAR TOPO
North Fork	North Fork	172553	931.49	932.08	LIDAR TOPO
North Fork	North Fork	172035	930.83	931.44	LIDAR TOPO
North Fork	North Fork	171489	930.06	930.64	LIDAR TOPO
North Fork	North Fork	171002	928.34	928.91	LIDAR TOPO
North Fork	North Fork	170624	926.24	926.69	2015-2016 FIELD SURVEY
North Fork	North Fork	170125	924.88	925.40	LIDAR TOPO
North Fork	North Fork	169578	925.08	925.59	LIDAR TOPO
North Fork	North Fork	169013	921.71	922.18	LIDAR TOPO
North Fork	North Fork	168542	922.39	922.90	LIDAR TOPO
North Fork	North Fork	168041	921.15	921.59	LIDAR TOPO
North Fork	North Fork	167531	919.82	920.28	LIDAR TOPO
North Fork	North Fork	167052	918.71	919.15	LIDAR TOPO
North Fork	North Fork	166626	917.16	917.67	LIDAR TOPO
North Fork	North Fork	166137	915.36	915.91	LIDAR TOPO
North Fork	North Fork	165689	915.11	915.70	LIDAR TOPO
North Fork	North Fork	165125	914.92	915.52	LIDAR TOPO
North Fork	North Fork	164787	912.30	912.76	2015-2016 FIELD SURVEY
North Fork	North Fork	164648	911.79	912.29	LIDAR TOPO
North Fork	North Fork	164142	912.05	912.62	LIDAR TOPO
North Fork	North Fork	163601	911.22	911.74	LIDAR TOPO
North Fork	North Fork	163155	908.79	909.24	LIDAR TOPO
North Fork	North Fork	162611	907.63	908.07	LIDAR TOPO
North Fork	North Fork	162072	907.34	907.79	LIDAR TOPO
North Fork	North Fork	161606	906.67	907.12	LIDAR TOPO
North Fork	North Fork	161124	905.27	905.74	LIDAR TOPO
North Fork	North Fork	160646	904.02	904.42	LIDAR TOPO
North Fork	North Fork	160159	903.62	904.04	LIDAR TOPO
North Fork	North Fork	159690	903.00	903.40	2015-2016 FIELD SURVEY
North Fork	North Fork	159683	901.96	902.42	LIDAR TOPO
North Fork	North Fork	159185	901.17	901.66	LIDAR TOPO
North Fork	North Fork	158701	899.82	900.38	LIDAR TOPO
North Fork	North Fork	158217	899.01	899.61	LIDAR TOPO
North Fork	North Fork	157620	898.45	899.07	LIDAR TOPO
North Fork	North Fork	157002	897.24	897.88	2015-2016 FIELD SURVEY
North Fork	North Fork	156628	896.80	897.47	LIDAR TOPO
North Fork	North Fork	156211	896.77	897.45	LIDAR TOPO
North Fork	North Fork	155725	894.82	895.55	LIDAR TOPO
North Fork	North Fork	155225	893.75	894.54	LIDAR TOPO
North Fork	North Fork	154743	894.18	894.96	LIDAR TOPO
North Fork	North Fork	154257	889.87	890.41	2015-2016 FIELD SURVEY
North Fork	North Fork	153772	890.14	890.85	LIDAR TOPO
North Fork	North Fork	153220	889.60	890.36	LIDAR TOPO
North Fork	North Fork	152770	889.13	889.95	LIDAR TOPO
North Fork	North Fork	152272	888.57	889.44	LIDAR TOPO
North Fork	North Fork	151774	886.02	886.78	LIDAR TOPO
North Fork	North Fork	151312	884.20	885.09	LIDAR TOPO
North Fork	North Fork	150840	877.34	877.59	LIDAR TOPO
North Fork	North Fork	150392	881.20	881.81	LIDAR TOPO
North Fork	North Fork	149847	880.59	881.25	LIDAR TOPO
North Fork	North Fork	149376	879.52	880.13	LIDAR TOPO

Table B-10 Computed Water Surface Elevations and Topographic Data Source – North Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
North Fork	North Fork	148841	878.64	879.25	2015-2016 FIELD SURVEY
North Fork	North Fork	148360	877.95	878.60	LIDAR TOPO
North Fork	North Fork	147924	877.81	878.46	LIDAR TOPO
North Fork	North Fork	147389	876.91	877.57	LIDAR TOPO
North Fork	North Fork	146933	875.60	876.23	LIDAR TOPO
North Fork	North Fork	146427	875.44	876.09	LIDAR TOPO
North Fork	North Fork	145944	873.03	873.60	LIDAR TOPO
North Fork	North Fork	145454	872.48	873.07	LIDAR TOPO
North Fork	North Fork	144959	871.69	872.30	LIDAR TOPO
North Fork	North Fork	144454	870.13	870.66	LIDAR TOPO
North Fork	North Fork	143962	870.16	870.73	LIDAR TOPO
North Fork	North Fork	143443	867.61	868.10	2015-2016 FIELD SURVEY
North Fork	North Fork	142948	867.79	868.37	LIDAR TOPO
North Fork	North Fork	142467	867.38	867.94	LIDAR TOPO
North Fork	North Fork	142006	866.73	867.29	LIDAR TOPO
North Fork	North Fork	141508	865.97	866.54	LIDAR TOPO
North Fork	North Fork	141065	864.44	865.02	LIDAR TOPO
North Fork	North Fork	140548	863.38	863.97	LIDAR TOPO
North Fork	North Fork	140076	861.44	862.12	LIDAR TOPO
North Fork	North Fork	139756	861.26	861.87	LIDAR TOPO
North Fork	North Fork	139273	861.84	862.50	LIDAR TOPO
North Fork	North Fork	139087	860.70	861.32	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	138964 N HIGHWAY 183			2015-2016 FIELD SURVEY
North Fork	North Fork	138865	859.98	860.57	LIDAR TOPO
North Fork	North Fork	138151	859.26	859.87	2015-2016 FIELD SURVEY
North Fork	North Fork	137656	858.11	858.68	LIDAR TOPO
North Fork	North Fork	137287	856.92	857.47	LIDAR TOPO
North Fork	North Fork	136775	856.04	856.58	LIDAR TOPO
North Fork	North Fork	136371	854.77	855.26	LIDAR TOPO
North Fork	North Fork	136056	855.30	855.83	2015-2016 FIELD SURVEY
North Fork	North Fork	135794	855.10	855.64	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	135723 COUNTY RD 257			2015-2016 FIELD SURVEY
North Fork	North Fork	135651	853.32	853.96	LIDAR TOPO
North Fork	North Fork	135132	851.94	852.58	LIDAR TOPO
North Fork	North Fork	134648	849.86	850.33	LIDAR TOPO
North Fork	North Fork	134180	848.07	848.54	LIDAR TOPO
North Fork	North Fork	133713	847.30	847.78	LIDAR TOPO
North Fork	North Fork	133223	847.60	848.12	LIDAR TOPO
North Fork	North Fork	132739	847.57	848.11	2015-2016 FIELD SURVEY
North Fork	North Fork	132252	845.84	846.35	LIDAR TOPO
North Fork	North Fork	131773	844.20	844.70	LIDAR TOPO
North Fork	North Fork	131288	842.80	843.21	LIDAR TOPO
North Fork	North Fork	130840	843.07	843.55	LIDAR TOPO
North Fork	North Fork	130357	842.07	842.49	LIDAR TOPO
North Fork	North Fork	129883	841.66	842.09	LIDAR TOPO
North Fork	North Fork	129361	840.97	841.39	LIDAR TOPO
North Fork	North Fork	128885	840.21	840.65	LIDAR TOPO
North Fork	North Fork	128412	839.77	840.20	LIDAR TOPO
North Fork	North Fork	128308 RONALD W REAGAN BLVD			Williamson County Parmer Lane As-builts
North Fork	North Fork	128194	838.80	839.19	LIDAR TOPO
North Fork	North Fork	127839	837.63	838.10	LIDAR TOPO
North Fork	North Fork	127090	836.31	836.80	2015-2016 FIELD SURVEY
North Fork	North Fork	126639	835.38	835.88	LIDAR TOPO
North Fork	North Fork	125891	833.04	833.48	LIDAR TOPO
North Fork	North Fork	125453	832.10	832.53	LIDAR TOPO
North Fork	North Fork	124857	831.32	831.78	LIDAR TOPO
North Fork	North Fork	124406	830.12	830.59	LIDAR TOPO
North Fork	North Fork	123939	828.79	829.24	LIDAR TOPO
North Fork	North Fork	123455	828.01	828.46	LIDAR TOPO
North Fork	North Fork	123028	827.85	828.33	LIDAR TOPO
North Fork	North Fork	122431	827.43	827.94	2015-2016 FIELD SURVEY
North Fork	North Fork	122094	826.05	826.52	LIDAR TOPO

Table B-10 Computed Water Surface Elevations and Topographic Data Source – North Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
North Fork	North Fork	121641	825.49	825.94	LIDAR TOPO
North Fork	North Fork	121120	824.32	824.80	LIDAR TOPO
North Fork	North Fork	120623	823.42	823.91	LIDAR TOPO
North Fork	North Fork	120106	821.60	822.07	LIDAR TOPO
North Fork	North Fork	119643	821.09	821.58	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	119539 COUNTY RD 258			2015-2016 FIELD SURVEY
North Fork	North Fork	119446	820.59	821.08	LIDAR TOPO
North Fork	North Fork	119108	819.72	820.19	LIDAR TOPO
North Fork	North Fork	118640	818.91	819.41	LIDAR TOPO
North Fork	North Fork	118134	817.99	818.43	LIDAR TOPO
North Fork	North Fork	117638	817.24	817.68	LIDAR TOPO
North Fork	North Fork	117284	816.67	817.09	LIDAR TOPO
North Fork	North Fork	116813	816.29	816.70	2015-2016 FIELD SURVEY
North Fork	North Fork	116350	815.18	815.56	LIDAR TOPO
North Fork	North Fork	115867	814.12	814.43	LIDAR TOPO
North Fork	North Fork	115297	813.57	813.84	LIDAR TOPO
North Fork	North Fork	114744	813.11	813.36	LIDAR TOPO
North Fork	North Fork	114257	813.24	813.50	LIDAR TOPO
North Fork	North Fork	113815	812.78	813.00	LIDAR TOPO
North Fork	North Fork	113330	812.56	812.77	LIDAR TOPO
North Fork	North Fork	112850	812.31	812.50	LIDAR TOPO
North Fork	North Fork	112340	812.22	812.41	LIDAR TOPO
North Fork	North Fork	111929	812.24	812.43	LIDAR TOPO
North Fork	North Fork	111422	812.15	812.33	2015-2016 FIELD SURVEY
North Fork	North Fork	110957	812.02	812.19	LIDAR TOPO
North Fork	North Fork	110504	812.05	812.23	LIDAR TOPO
North Fork	North Fork	109982	811.88	812.04	LIDAR TOPO
North Fork	North Fork	109518	811.90	812.07	LIDAR TOPO
North Fork	North Fork	109039	811.75	811.90	LIDAR TOPO
North Fork	North Fork	108546	811.70	811.84	LIDAR TOPO
North Fork	North Fork	108037	811.66	811.80	LIDAR TOPO
North Fork	North Fork	107591	811.62	811.75	LIDAR TOPO
North Fork	North Fork	107112	811.57	811.70	LIDAR TOPO
North Fork	North Fork	106740	811.57	811.71	2015-2016 FIELD SURVEY
North Fork	North Fork	106679	811.53	811.65	LIDAR TOPO
North Fork	North Fork	106228	811.50	811.63	LIDAR TOPO
North Fork	North Fork	105836	811.50	811.62	LIDAR TOPO
North Fork	North Fork	105352	811.49	811.62	LIDAR TOPO
North Fork	North Fork	104838	811.50	811.63	LIDAR TOPO
North Fork	North Fork	104302	811.49	811.62	LIDAR TOPO
North Fork	North Fork	103847	811.48	811.61	LIDAR TOPO
North Fork	North Fork	103373	811.44	811.56	LIDAR TOPO
North Fork	North Fork	102906	811.46	811.58	LIDAR TOPO
North Fork	North Fork	102452	811.46	811.58	LIDAR TOPO
North Fork	North Fork	101982	811.46	811.58	LIDAR TOPO
North Fork	North Fork	101575	811.46	811.58	LIDAR TOPO
North Fork	North Fork	101080	811.46	811.58	LIDAR TOPO
North Fork	North Fork	100737	811.46	811.58	LIDAR TOPO
North Fork	North Fork	100187	811.46	811.58	LIDAR TOPO
North Fork	North Fork	99656	811.46	811.58	LIDAR TOPO
North Fork	North Fork	99119	811.46	811.58	LIDAR TOPO
North Fork	North Fork	98652	811.45	811.57	LIDAR TOPO
North Fork	North Fork	98177	811.45	811.57	LIDAR TOPO
North Fork	North Fork	97664	811.45	811.57	LIDAR TOPO
North Fork	North Fork	76012 DAM			LIDAR TOPO
North Fork	North Fork	71322	732.65	712.03	LIDAR TOPO
North Fork	North Fork	71076	729.85	711.10	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	70782 D B WOOD RD			2015-2016 FIELD SURVEY
North Fork	North Fork	70556	731.12	711.00	LIDAR TOPO
North Fork	North Fork	69916	728.58	709.26	LIDAR TOPO
North Fork	North Fork	69397	727.33	707.88	2015-2016 FIELD SURVEY
North Fork	North Fork	68873	727.23	706.95	LIDAR TOPO
North Fork	North Fork	68376	726.14	705.80	LIDAR TOPO

Table B-10 Computed Water Surface Elevations and Topographic Data Source – North Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
North Fork	North Fork	67856	724.90	704.42	LIDAR TOPO
North Fork	North Fork	67359	723.81	703.58	LIDAR TOPO
North Fork	North Fork	66856	721.96	702.66	LIDAR TOPO
North Fork	North Fork	66322	719.64	701.79	LIDAR TOPO
North Fork	North Fork	65834	719.31	701.00	LIDAR TOPO
North Fork	North Fork	65341	718.54	700.03	LIDAR TOPO
North Fork	North Fork	64857	715.82	699.20	LIDAR TOPO
North Fork	North Fork	64810 DAM			LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	64742	717.11	698.91	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	64706 FOOTBRIDGE			LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	64669	716.64	698.83	LIDAR TOPO
North Fork	North Fork	64565	715.16	698.61	LIDAR TOPO
North Fork	North Fork	64316	713.55	698.08	LIDAR TOPO
North Fork	North Fork	64076	713.69	697.63	2015-2016 FIELD SURVEY
North Fork	North Fork	63543	706.20	697.01	LIDAR TOPO
North Fork	North Fork	63049	696.09	696.70	LIDAR TOPO
North Fork	North Fork	62557	695.70	696.30	LIDAR TOPO
North Fork	North Fork	62039	695.17	695.74	LIDAR TOPO
North Fork	North Fork	61530	694.58	695.12	LIDAR TOPO
North Fork	North Fork	61081	693.90	694.41	LIDAR TOPO
North Fork	North Fork	60508	693.09	693.58	LIDAR TOPO
North Fork	North Fork	59996	692.76	693.22	LIDAR TOPO
North Fork	North Fork	59494	692.65	693.09	LIDAR TOPO
North Fork	North Fork	59446 DAM			LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	59398	692.54	692.97	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	59348 COUNTRY CLUB RD			LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	59302	692.50	692.91	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	59272 FOOTPATH			LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	59238	688.09	688.69	LIDAR TOPO
North Fork	North Fork	59101	687.75	688.36	LIDAR TOPO
North Fork	North Fork	58596	687.00	687.66	2015-2016 FIELD SURVEY
North Fork	North Fork	58109	686.41	687.10	LIDAR TOPO
North Fork	North Fork	57587	685.69	686.44	LIDAR TOPO
North Fork	North Fork	57113	685.28	686.07	LIDAR TOPO
North Fork	North Fork	57064 FOOTPATH			LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	57019	685.19	685.98	LIDAR TOPO
North Fork	North Fork	56610	684.96	685.76	LIDAR TOPO
North Fork	North Fork	56134	684.72	685.53	LIDAR TOPO
North Fork	North Fork	55661	684.66	685.46	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	55512 RIVERY BLVD			2015-2016 FIELD SURVEY
North Fork	North Fork	55406	684.59	685.40	LIDAR TOPO
North Fork	North Fork	55084	684.47	685.26	LIDAR TOPO
North Fork	North Fork	54575	684.30	685.06	LIDAR TOPO
North Fork	North Fork	54130	684.26	685.01	LIDAR TOPO
North Fork	North Fork	53670	684.21	684.95	2015-2016 FIELD SURVEY
North Fork	North Fork	53207	684.17	684.91	LIDAR TOPO
North Fork	North Fork	52654	684.13	684.87	LIDAR TOPO
North Fork	North Fork	52542 I.H. 35 SB FRONTAGE RD			TXDOT 0015-08-091 As-builts
North Fork	North Fork	52452	684.12	684.85	LIDAR TOPO
North Fork	North Fork	52331 I.H. 35 SB			TXDOT 0015-08-044 As-builts
North Fork	North Fork	52276	684.11	684.84	LIDAR TOPO
North Fork	North Fork	52208 I.H. 35 NB			TXDOT 0015-08-044 As-builts
North Fork	North Fork	52115	684.10	684.83	LIDAR TOPO
North Fork	North Fork	52035 I.H. 35 NB FRONTAGE RD			TXDOT 0015-08-100 As-builts
North Fork	North Fork	51982	684.09	684.82	LIDAR TOPO
North Fork	North Fork	51736	684.08	684.80	LIDAR TOPO

Table B-10 Computed Water Surface Elevations and Topographic Data Source – North Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
North Fork	North Fork	51317	684.06	684.79	LIDAR TOPO
North Fork	North Fork	50856	684.05	684.77	LIDAR TOPO
North Fork	North Fork	50352	684.04	684.76	LIDAR TOPO/2015-2016 FIELD SURVEY
North Fork	North Fork	50282 AUSTIN AVE			2015-2016 FIELD SURVEY
North Fork	North Fork	50191	684.03	684.76	LIDAR TOPO
North Fork	North Fork	49728	684.02	684.74	LIDAR TOPO
North Fork	North Fork	49299	684.01	684.73	2015-2016 FIELD SURVEY
North Fork	North Fork	48745	684.01	684.73	LIDAR TOPO
North Fork	North Fork	48333	682.61	683.25	LIDAR TOPO

Table B-11 Computed Water Surface Elevations and Topographic Data Source – South Fork San Gabriel River

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
SSG	SSG	196830	1273.50	1273.89	LIDAR TOPO
SSG	SSG	196199	1270.91	1271.36	LIDAR TOPO
SSG	SSG	195697	1268.34	1268.61	2015-2016 FIELD SURVEY
SSG	SSG	195620 CR 330B			2015-2016 FIELD SURVEY
SSG	SSG	195455	1266.29	1266.63	LIDAR TOPO
SSG	SSG	194340	1259.16	1259.44	LIDAR TOPO
SSG	SSG	193199	1252.33	1252.62	LIDAR TOPO
SSG	SSG	192270	1246.29	1246.59	LIDAR TOPO
SSG	SSG	192105	1244.60	1245.4	2015-2016 FIELD SURVEY
SSG	SSG	192089 CR 330A			2015-2016 FIELD SURVEY
SSG	SSG	192004	1244.99	1245.78	LIDAR TOPO
SSG	SSG	191831	1243.34	1244.15	LIDAR TOPO
SSG	SSG	191195	1237.45	1238.06	LIDAR TOPO
SSG	SSG	190216	1233.00	1233.54	LIDAR TOPO
SSG	SSG	189190	1227.17	1227.62	LIDAR TOPO
SSG	SSG	188680	1225.04	1225.4	LIDAR TOPO
SSG	SSG	188532	1224.05	1224.38	LIDAR TOPO
SSG	SSG	188462	1224.08	1224.37	2015-2016 FIELD SURVEY
SSG	SSG	188425 FM 243			2015-2016 FIELD SURVEY
SSG	SSG	188372	1222.61	1223.03	LIDAR TOPO
SSG	SSG	187818	1218.89	1219.28	LIDAR TOPO
SSG	SSG	187193	1215.28	1215.62	LIDAR TOPO
SSG	SSG	186190	1208.53	1208.97	LIDAR TOPO
SSG	SSG	185122	1200.61	1201.54	LIDAR TOPO
SSG	SSG	184081	1193.50	1194.05	LIDAR TOPO
SSG	SSG	183187	1190.07	1191.01	LIDAR TOPO
SSG	SSG	182503	1183.70	1183.7	LIDAR TOPO
SSG	SSG	182325 PRIVATE LWC			LIDAR TOPO
SSG	SSG	182218	1183.82	1184.73	LIDAR TOPO
SSG	SSG	181891	1181.45	1182.29	LIDAR TOPO
SSG	SSG	181185	1179.07	1179.94	LIDAR TOPO
SSG	SSG	180648	1176.99	1177.84	LIDAR TOPO
SSG	SSG	179970	1172.82	1173.35	LIDAR TOPO
SSG	SSG	179109	1166.14	1166.99	LIDAR TOPO
SSG	SSG	178187	1159.57	1160.2	LIDAR TOPO
SSG	SSG	177183	1157.15	1157.53	LIDAR TOPO
SSG	SSG	176501	1154.21	1154.94	LIDAR TOPO
SSG	SSG	175794	1151.16	1151.86	LIDAR TOPO
SSG	SSG	175181	1148.06	1148.76	LIDAR TOPO
SSG	SSG	174178	1142.63	1143.17	LIDAR TOPO
SSG	SSG	173176	1138.27	1138.94	LIDAR TOPO
SSG	SSG	172306	1134.16	1134.42	2015-2016 FIELD SURVEY
SSG	SSG	172293 N WILSON LN			2015-2016 FIELD SURVEY
SSG	SSG	172271	1132.09	1132.64	LIDAR TOPO
SSG	SSG	171175	1126.89	1127.61	LIDAR TOPO
SSG	SSG	170174	1123.81	1124.41	LIDAR TOPO
SSG	SSG	169175	1120.85	1121.5	LIDAR TOPO
SSG	SSG	168252	1120.32	1120.99	LIDAR TOPO
SSG	SSG	168106	1120.31	1120.97	2015-2016 FIELD SURVEY
SSG	SSG	168068 RM 1174			2015-2016 FIELD SURVEY
SSG	SSG	168017	1114.95	1115.47	LIDAR TOPO
SSG	SSG	167546	1112.55	1113.02	LIDAR TOPO
SSG	SSG	166972	1111.56	1112.06	LIDAR TOPO
SSG	SSG	166172	1107.55	1107.96	LIDAR TOPO
SSG	SSG	165167	1105.04	1105.64	LIDAR TOPO
SSG	SSG	164160	1102.86	1103.7	LIDAR TOPO
SSG	SSG	163169	1099.51	1100.25	LIDAR TOPO
SSG	SSG	162167	1096.35	1096.95	LIDAR TOPO
SSG	SSG	161162	1093.75	1094.62	LIDAR TOPO
SSG	SSG	160162	1092.61	1093.69	LIDAR TOPO
SSG	SSG	159154	1089.52	1090.74	LIDAR TOPO
SSG	SSG	158453	1087.24	1088.38	LIDAR TOPO
SSG	SSG	158074	1085.50	1086.1	LIDAR TOPO
SSG	SSG	157717	1085.02	1085.59	2015-2016 FIELD SURVEY
SSG	SSG	157654 CR 323			2015-2016 FIELD SURVEY

Table B-11 Computed Water Surface Elevations and Topographic Data Source – South Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
SSG	SSG	157596	1084.43	1084.99	LIDAR TOPO
SSG	SSG	157268	1083.20	1083.97	LIDAR TOPO
SSG	SSG	156923	1082.22	1082.77	LIDAR TOPO
SSG	SSG	156158	1080.11	1080.98	LIDAR TOPO
SSG	SSG	155152	1071.55	1072.66	LIDAR TOPO
SSG	SSG	154189 PRIVATE LWC			LIDAR TOPO
SSG	SSG	154130	1071.68	1072.62	LIDAR TOPO
SSG	SSG	153158	1069.95	1070.83	LIDAR TOPO
SSG	SSG	151756	1064.11	1065.09	LIDAR TOPO
SSG	SSG	151151	1063.39	1064.48	LIDAR TOPO
SSG	SSG	150156	1055.33	1056.66	LIDAR TOPO
SSG	SSG	149207 PRIVATE LWC			LIDAR TOPO
SSG	SSG	149160	1055.47	1055.45	LIDAR TOPO
SSG	SSG	148732 PRIVATE DAM			LIDAR TOPO
SSG	SSG	148701	1056.58	1057.43	LIDAR TOPO
SSG	SSG	148525	1055.45	1055.35	LIDAR TOPO
SSG	SSG	148150	1052.25	1053.18	LIDAR TOPO
SSG	SSG	147151	1049.33	1049.82	LIDAR TOPO
SSG	SSG	146152	1047.04	1047.46	LIDAR TOPO
SSG	SSG	145148	1044.70	1045.35	LIDAR TOPO
SSG	SSG	144839	1042.17	1042.46	LIDAR TOPO
SSG	SSG	144633 PRIVATE LWC			LIDAR TOPO
SSG	SSG	144544	1042.27	1043.24	LIDAR TOPO
SSG	SSG	143798	1040.79	1041.65	LIDAR TOPO
SSG	SSG	143142	1039.86	1040.75	LIDAR TOPO
SSG	SSG	142190	1036.16	1036.91	LIDAR TOPO
SSG	SSG	141222	1033.07	1034.13	LIDAR TOPO
SSG	SSG	140751 PRIVATE LWC			LIDAR TOPO
SSG	SSG	140673	1032.58	1033.57	LIDAR TOPO
SSG	SSG	140501 PRIVATE LWC			LIDAR TOPO
SSG	SSG	140445	1032.66	1033.67	LIDAR TOPO
SSG	SSG	140142	1030.95	1032.07	LIDAR TOPO
SSG	SSG	139233	1027.65	1028.45	LIDAR TOPO
SSG	SSG	138566	1026.12	1026.69	2015-2016 FIELD SURVEY
SSG	SSG	138430 W ENO RIVER RANC			2015-2016 FIELD SURVEY
SSG	SSG	138315	1026.57	1027.26	LIDAR TOPO
SSG	SSG	138013	1025.95	1026.75	LIDAR TOPO
SSG	SSG	137139	1020.49	1021.08	LIDAR TOPO
SSG	SSG	136264 PRIVATE DAM			LIDAR TOPO
SSG	SSG	136239	1018.62	1019.34	LIDAR TOPO
SSG	SSG	135320 PRIVATE DAM			LIDAR TOPO
SSG	SSG	135283	1015.73	1017.21	LIDAR TOPO
SSG	SSG	135223 PRIVATE LWC			LIDAR TOPO
SSG	SSG	135183	1016.30	1017.91	LIDAR TOPO
SSG	SSG	135056 PRIVATE DAM			LIDAR TOPO
SSG	SSG	135028	1015.66	1017.43	LIDAR TOPO
SSG	SSG	134755 PRIVATE DAM			LIDAR TOPO
SSG	SSG	134733	1012.24	1012.97	LIDAR TOPO
SSG	SSG	134160 PRIVATE DAM			LIDAR TOPO
SSG	SSG	134140	1013.48	1014.26	LIDAR TOPO
SSG	SSG	133135	1011.10	1012.25	LIDAR TOPO
SSG	SSG	132134	1007.92	1008.88	LIDAR TOPO
SSG	SSG	131136	1005.66	1006.51	LIDAR TOPO
SSG	SSG	130486	1004.96	1006	LIDAR TOPO
SSG	SSG	130348	1004.65	1005.64	2015-2016 FIELD SURVEY
SSG	SSG	130282 E RIVER RANCH			2015-2016 FIELD SURVEY
SSG	SSG	130242	1004.57	1005.49	LIDAR TOPO
SSG	SSG	130054	1003.57	1004.44	LIDAR TOPO
SSG	SSG	129132	1001.54	1002.27	LIDAR TOPO
SSG	SSG	128777	1000.80	1001.48	2015-2016 FIELD SURVEY
SSG	SSG	128760 PRIVATE DAM			2015-2016 FIELD SURVEY
SSG	SSG	128728	1001.05	1001.76	2015-2016 FIELD SURVEY
SSG	SSG	128693 PRIVATE LWC			2015-2016 FIELD SURVEY
SSG	SSG	128638	1000.51	1001.2	LIDAR TOPO
SSG	SSG	128341	999.68	1000.16	2015-2016 FIELD SURVEY

Table B-11 Computed Water Surface Elevations and Topographic Data Source – South Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
SSG	SSG	128299 PRIVATE DAM			2015-2016 FIELD SURVEY
SSG	SSG	128256	999.77	1000.3	LIDAR TOPO
SSG	SSG	127897	998.82	999.47	LIDAR TOPO
SSG	SSG	127133	996.14	996.98	LIDAR TOPO
SSG	SSG	126269	995.02	995.8	2015-2016 FIELD SURVEY
SSG	SSG	126202 SW LIBERTY HILL			2015-2016 FIELD SURVEY
SSG	SSG	126140	994.31	995.12	LIDAR TOPO
SSG	SSG	125127	991.15	992.32	LIDAR TOPO
SSG	SSG	124125	987.96	988.85	LIDAR TOPO
SSG	SSG	123123	986.54	987.42	LIDAR TOPO
SSG	SSG	122125	983.81	984.59	LIDAR TOPO
SSG	SSG	121121	982.38	983.18	LIDAR TOPO
SSG	SSG	120124	980.63	981.54	LIDAR TOPO
SSG	SSG	118690	976.90	977.53	LIDAR TOPO
SSG	SSG	117838	975.84	976.45	LIDAR TOPO
SSG	SSG	117401	975.69	976.31	LIDAR TOPO
SSG	SSG	117160	974.74	975.22	2015-2016 FIELD SURVEY
SSG	SSG	117106 FM 1869			2015-2016 FIELD SURVEY
SSG	SSG	116992	971.66	972.1	LIDAR TOPO
SSG	SSG	116269	970.58	971.19	LIDAR TOPO
SSG	SSG	115290	968.46	969.11	LIDAR TOPO
SSG	SSG	114059	965.26	965.81	LIDAR TOPO
SSG	SSG	113113	964.25	964.82	LIDAR TOPO
SSG	SSG	112093	962.44	963.03	LIDAR TOPO
SSG	SSG	111128	959.85	960.47	LIDAR TOPO
SSG	SSG	110112	956.55	957.22	LIDAR TOPO
SSG	SSG	109112	954.43	955.08	LIDAR TOPO
SSG	SSG	108113	952.76	953.43	LIDAR TOPO
SSG	SSG	107112	949.57	950.34	LIDAR TOPO
SSG	SSG	106092	949.64	950.34	LIDAR TOPO
SSG	SSG	105105	945.06	945.59	LIDAR TOPO
SSG	SSG	104559	945.21	946.2	2015-2016 FIELD SURVEY
SSG	SSG	104526 CR 279 LWC			2015-2016 FIELD SURVEY
SSG	SSG	104479	945.28	946.23	LIDAR TOPO
SSG	SSG	104338	945.20	946.14	LIDAR TOPO
SSG	SSG	104210	945.50	946.47	2015-2016 FIELD SURVEY
SSG	SSG	104157 CR 279 BRIDGE			2015-2016 FIELD SURVEY
SSG	SSG	104092	943.59	944.36	LIDAR TOPO
SSG	SSG	103695	943.31	944.08	LIDAR TOPO
SSG	SSG	102858	942.02	942.83	LIDAR TOPO
SSG	SSG	102102	939.92	941.08	LIDAR TOPO
SSG	SSG	101103	931.66	932.42	LIDAR TOPO
SSG	SSG	100099	931.04	931.97	LIDAR TOPO
SSG	SSG	99099	929.53	930.43	LIDAR TOPO
SSG	SSG	98095	928.07	928.94	LIDAR TOPO
SSG	SSG	97096	924.56	925.46	LIDAR TOPO
SSG	SSG	95857	920.60	921.48	LIDAR TOPO
SSG	SSG	95117	918.37	919.16	LIDAR TOPO
SSG	SSG	94092	916.17	916.85	LIDAR TOPO
SSG	SSG	93125	912.91	913.93	LIDAR TOPO
SSG	SSG	92063	911.34	912.39	LIDAR TOPO
SSG	SSG	91087	909.49	910.49	LIDAR TOPO
SSG	SSG	90090	907.90	908.83	LIDAR TOPO
SSG	SSG	89387	906.24	907.38	LIDAR TOPO
SSG	SSG	88459	904.70	905.82	LIDAR TOPO
SSG	SSG	87087	901.62	902.89	LIDAR TOPO
SSG	SSG	86423	900.56	901.86	LIDAR TOPO
SSG	SSG	86026	900.20	901.51	LIDAR TOPO
SSG	SSG	85919 RAILROAD			LIDAR TOPO/2017 AERIAL IMAGERY
SSG	SSG	85772	896.16	897.24	LIDAR TOPO
SSG	SSG	85445	895.03	896.17	2015-2016 FIELD SURVEY
SSG	SSG	85371 INDIAN TRL			2015-2016 FIELD SURVEY
SSG	SSG	85337	895.53	896.69	LIDAR TOPO
SSG	SSG	85042	895.31	896.47	LIDAR TOPO
SSG	SSG	84083	891.78	892.72	LIDAR TOPO

Table B-11 Computed Water Surface Elevations and Topographic Data Source – South Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
SSG	SSG	83080	889.92	890.87	LIDAR TOPO
SSG	SSG	82077	887.06	888.15	LIDAR TOPO
SSG	SSG	81080	884.17	885.21	LIDAR TOPO
SSG	SSG	79894	881.42	882.52	LIDAR TOPO
SSG	SSG	79405.7	880.65	881.76	2015-2016 FIELD SURVEY
SSG	SSG	79370 ABANDONED BRIDGE			2015-2016 FIELD SURVEY
SSG	SSG	79333.26	880.63	881.75	LIDAR TOPO
SSG	SSG	79328.09	880.74	881.84	LIDAR TOPO
SSG	SSG	79226 HWY 183 SB			2015-2016 FIELD SURVEY
SSG	SSG	79127	880.05	881.11	2015-2016 FIELD SURVEY
SSG	SSG	79000	879.61	880.69	2015-2016 FIELD SURVEY
SSG	SSG	78923 HWY 183 NB			2015-2016 FIELD SURVEY
SSG	SSG	78847	878.82	879.82	LIDAR TOPO
SSG	SSG	77951	875.87	877.11	LIDAR TOPO
SSG	SSG	77073	874.65	875.92	LIDAR TOPO
SSG	SSG	76417	868.98	869.69	LIDAR TOPO
SSG	SSG	75717	867.10	867.52	2015-2016 FIELD SURVEY
SSG	SSG	75683 DAM E OF 183			2015-2016 FIELD SURVEY
SSG	SSG	75642	867.96	868.73	LIDAR TOPO
SSG	SSG	75078	866.62	867.31	LIDAR TOPO
SSG	SSG	74075	864.64	865.7	LIDAR TOPO
SSG	SSG	73075	862.36	863.26	LIDAR TOPO
SSG	SSG	72071	860.43	861.38	LIDAR TOPO
SSG	SSG	71092	856.57	857.43	LIDAR TOPO
SSG	SSG	70072	854.09	855.2	LIDAR TOPO
SSG	SSG	69067	851.81	852.9	LIDAR TOPO
SSG	SSG	68068	847.08	848.05	LIDAR TOPO
SSG	SSG	67057	846.67	847.68	LIDAR TOPO
SSG	SSG	66054	843.09	844.25	LIDAR TOPO
SSG	SSG	65063	841.04	842.32	LIDAR TOPO
SSG	SSG	64495	840.82	842.12	LIDAR TOPO
SSG	SSG	64366 SB RONALD REGAN			AS-BUILT: WILCO 81-21122-001
SSG	SSG	64332	840.47	841.75	LIDAR TOPO
SSG	SSG	64319	840.42	841.72	LIDAR TOPO
SSG	SSG	64268 NB RONALD REGAN			AS-BUILT: WILCO 81-21122-001
SSG	SSG	64145	839.73	840.95	LIDAR TOPO
SSG	SSG	63042	836.43	837.62	LIDAR TOPO
SSG	SSG	62472	835.13	836.3	LIDAR TOPO
SSG	SSG	62060	834.24	835.41	LIDAR TOPO
SSG	SSG	61060	831.81	832.97	LIDAR TOPO
SSG	SSG	60060	828.60	829.74	LIDAR TOPO
SSG	SSG	59056	826.73	827.87	LIDAR TOPO
SSG	SSG	58059	824.41	825.53	LIDAR TOPO
SSG	SSG	57054	822.16	823.47	LIDAR TOPO
SSG	SSG	56056	819.51	820.67	LIDAR TOPO
SSG	SSG	54904	818.11	819.38	LIDAR TOPO
SSG	SSG	54050	816.75	818.03	LIDAR TOPO
SSG	SSG	53050	812.48	813.7	LIDAR TOPO
SSG	SSG	52050	809.29	810.4	LIDAR TOPO
SSG	SSG	51049	806.59	807.69	LIDAR TOPO
SSG	SSG	50044	804.49	805.72	LIDAR TOPO
SSG	SSG	49033	802.22	803.08	LIDAR TOPO
SSG	SSG	48043	799.70	800.65	LIDAR TOPO
SSG	SSG	47043	798.71	799.72	LIDAR TOPO
SSG	SSG	46039	797.67	798.7	LIDAR TOPO
SSG	SSG	45029	794.93	795.74	LIDAR TOPO
SSG	SSG	44136	793.94	794.72	LIDAR TOPO
SSG	SSG	43873	793.81	794.74	LIDAR TOPO
SSG	SSG	43042	787.97	788.91	LIDAR TOPO
SSG	SSG	42128	786.31	786.97	LIDAR TOPO
SSG	SSG	41039	784.58	785.36	LIDAR TOPO
SSG	SSG	40030	781.54	782.54	LIDAR TOPO
SSG	SSG	39027	779.32	779.89	LIDAR TOPO
SSG	SSG	38036	778.31	779.12	LIDAR TOPO
SSG	SSG	37033	774.14	774.79	LIDAR TOPO

Table B-11 Computed Water Surface Elevations and Topographic Data Source – South Fork San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
SSG	SSG	36035	768.88	769.6	LIDAR TOPO
SSG	SSG	35032	768.05	768.7	LIDAR TOPO
SSG	SSG	34041	767.17	767.86	LIDAR TOPO
SSG	SSG	33031	764.47	765.37	LIDAR TOPO
SSG	SSG	32029	764.24	765.05	LIDAR TOPO
SSG	SSG	31028	762.96	763.78	LIDAR TOPO
SSG	SSG	30023	760.36	761.45	LIDAR TOPO
SSG	SSG	28996	756.86	757.22	LIDAR TOPO
SSG	SSG	28008	755.73	755.92	LIDAR TOPO
SSG	SSG	27025	748.45	749.96	LIDAR TOPO
SSG	SSG	26024	749.06	749.84	LIDAR TOPO
SSG	SSG	25022	746.28	747.19	LIDAR TOPO
SSG	SSG	24019	743.54	744.26	LIDAR TOPO
SSG	SSG	22927	740.67	741.71	LIDAR TOPO
SSG	SSG	22020	737.05	737.95	LIDAR TOPO
SSG	SSG	21059	735.77	736.78	LIDAR TOPO
SSG	SSG	20016	734.57	735.63	LIDAR TOPO
SSG	SSG	19069	732.96	734.1	LIDAR TOPO
SSG	SSG	18016	730.72	731.83	LIDAR TOPO
SSG	SSG	17015	729.75	730.9	LIDAR TOPO
SSG	SSG	16091	728.54	729.84	LIDAR TOPO
SSG	SSG	15013	726.66	727.99	LIDAR TOPO
SSG	SSG	14054	725.31	726.67	LIDAR TOPO
SSG	SSG	13194	724.86	726.22	LIDAR TOPO
SSG	SSG	12994	724.48	725.84	LIDAR TOPO
SSG	SSG	12906 SB IH35 FR			AS-BUILT: TxDOT 0015-09-119
SSG	SSG	12844	723.95	725.33	LIDAR TOPO
SSG	SSG	12829	723.95	725.33	LIDAR TOPO
SSG	SSG	12733 IH35 ML			AS-BUILT: TxDOT 0015-19-124
SSG	SSG	12643	722.23	723.62	LIDAR TOPO
SSG	SSG	12608	722.09	723.48	LIDAR TOPO
SSG	SSG	12557 NB IH35 FR			AS-BUILT: TxDOT 0015-08-128
SSG	SSG	12451	720.59	721.9	LIDAR TOPO
SSG	SSG	12003	719.04	720.3	LIDAR TOPO
SSG	SSG	11008	717.47	718.64	LIDAR TOPO
SSG	SSG	10007	714.72	715.94	LIDAR TOPO
SSG	SSG	9148	712.79	713.96	LIDAR TOPO
SSG	SSG	9035	713.05	714.26	LIDAR TOPO/2015-2016 FIELD SURVEY
SSG	SSG	8964 HWY 29			2015-2016 FIELD SURVEY
SSG	SSG	8895	710.55	711.63	LIDAR TOPO
SSG	SSG	8487	709.87	710.96	LIDAR TOPO
SSG	SSG	8388	709.73	710.81	LIDAR TOPO
SSG	SSG	8005	709.23	710.33	LIDAR TOPO
SSG	SSG	7002	707.69	708.88	LIDAR TOPO
SSG	SSG	6020	704.03	705.06	LIDAR TOPO
SSG	SSG	5009	700.90	701.77	LIDAR TOPO
SSG	SSG	4376	699.72	700.66	LIDAR TOPO
SSG	SSG	4005	695.29	696.14	LIDAR TOPO
SSG	SSG	3004	693.49	694.34	LIDAR TOPO/2015-2016 FIELD SURVEY
SSG	SSG	2988 LWC			2015-2016 FIELD SURVEY
SSG	SSG	2939	693.71	694.6	LIDAR TOPO
SSG	SSG	2792	693.65	694.56	LIDAR TOPO
SSG	SSG	2699	693.61	694.5	LIDAR TOPO/2015-2016 FIELD SURVEY
SSG	SSG	2629 AUSTIN AVE			2015-2016 FIELD SURVEY
SSG	SSG	2556	692.95	693.79	LIDAR TOPO
SSG	SSG	2371	692.56	693.43	LIDAR TOPO
SSG	SSG	2001	691.46	692.24	LIDAR TOPO
SSG	SSG	1397	690.43	691.21	LIDAR TOPO
SSG	SSG	1007	690.53	691.35	LIDAR TOPO

Table B-12 Computed Water Surface Elevations and Topographic Data Source – San Gabriel River

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
San Gabriel River	San Gabriel River	48018 FOOTBRIDGE			LIDAR TOPO
San Gabriel River	San Gabriel River	47973	681.86	682.51	LIDAR TOPO
San Gabriel River	San Gabriel River	47665	681.42	682.07	LIDAR TOPO
San Gabriel River	San Gabriel River	47177	680.50	681.17	2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	46713	679.66	680.35	LIDAR TOPO
San Gabriel River	San Gabriel River	46319	678.68	679.38	LIDAR TOPO
San Gabriel River	San Gabriel River	45747	677.30	678.00	LIDAR TOPO
San Gabriel River	San Gabriel River	45370	676.95	677.68	LIDAR TOPO/2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	45220 DAM			2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	45066	676.19	676.89	LIDAR TOPO/2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	45013 FOOTBRIDGE			2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	44944	675.48	676.16	LIDAR TOPO
San Gabriel River	San Gabriel River	44763	675.32	676.00	LIDAR TOPO
San Gabriel River	San Gabriel River	44722 COLLEGE ST			WILCO 0914-05-136 As-builts
San Gabriel River	San Gabriel River	44656	675.06	675.76	LIDAR TOPO
San Gabriel River	San Gabriel River	44401	674.11	674.92	LIDAR TOPO
San Gabriel River	San Gabriel River	43899	673.47	674.26	LIDAR TOPO
San Gabriel River	San Gabriel River	43493	673.10	673.91	LIDAR TOPO
San Gabriel River	San Gabriel River	42910	672.11	672.85	LIDAR TOPO
San Gabriel River	San Gabriel River	42346	671.24	671.98	LIDAR TOPO
San Gabriel River	San Gabriel River	42278	670.70	671.42	2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	41964	669.59	670.28	LIDAR TOPO/2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	41885 RAILROAD			2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	41778	668.97	669.59	LIDAR TOPO
San Gabriel River	San Gabriel River	41457	667.72	668.26	LIDAR TOPO
San Gabriel River	San Gabriel River	40929	667.01	667.52	LIDAR TOPO
San Gabriel River	San Gabriel River	40439	665.96	666.41	LIDAR TOPO
San Gabriel River	San Gabriel River	39943	665.37	665.81	LIDAR TOPO
San Gabriel River	San Gabriel River	39454	665.23	665.65	LIDAR TOPO
San Gabriel River	San Gabriel River	38973	664.22	664.57	LIDAR TOPO
San Gabriel River	San Gabriel River	38527	663.69	664.38	LIDAR TOPO
San Gabriel River	San Gabriel River	37920	663.47	664.01	LIDAR TOPO
San Gabriel River	San Gabriel River	37521	662.58	663.14	LIDAR TOPO
San Gabriel River	San Gabriel River	37417 GEORGETOWN INNER LOOP			Georgetown Inner Loop Extension As-builts
San Gabriel River	San Gabriel River	37311	662.08	662.62	LIDAR TOPO
San Gabriel River	San Gabriel River	36926	661.28	661.84	2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	36647	660.76	661.33	LIDAR TOPO
San Gabriel River	San Gabriel River	35987	660.53	661.13	LIDAR TOPO
San Gabriel River	San Gabriel River	35728	660.45	661.06	LIDAR TOPO
San Gabriel River	San Gabriel River	35261	658.87	659.49	LIDAR TOPO
San Gabriel River	San Gabriel River	35116 TEXAS 130 SB			TXDOT 0440-05-004 As-builts
San Gabriel River	San Gabriel River	35016	657.77	658.35	LIDAR TOPO
San Gabriel River	San Gabriel River	34924 TEXAS 130 NB			TXDOT 0440-05-004 As-builts
San Gabriel River	San Gabriel River	34770	657.31	657.88	LIDAR TOPO
San Gabriel River	San Gabriel River	34250	653.73	654.15	LIDAR TOPO
San Gabriel River	San Gabriel River	33774	653.94	654.43	LIDAR TOPO
San Gabriel River	San Gabriel River	33294	652.55	653.00	LIDAR TOPO
San Gabriel River	San Gabriel River	32814	651.81	652.28	LIDAR TOPO
San Gabriel River	San Gabriel River	32340	652.00	652.47	LIDAR TOPO
San Gabriel River	San Gabriel River	31656	651.29	651.76	LIDAR TOPO
San Gabriel River	San Gabriel River	31380	650.50	650.98	LIDAR TOPO
San Gabriel River	San Gabriel River	31028	648.64	649.17	2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	30905	646.59	647.04	LIDAR TOPO
San Gabriel River	San Gabriel River	30444	645.32	645.76	LIDAR TOPO
San Gabriel River	San Gabriel River	29968	644.53	644.96	LIDAR TOPO
San Gabriel River	San Gabriel River	29492	644.43	644.86	LIDAR TOPO
San Gabriel River	San Gabriel River	28980	644.26	644.72	LIDAR TOPO
San Gabriel River	San Gabriel River	28497	644.18	644.63	LIDAR TOPO
San Gabriel River	San Gabriel River	28050	643.98	644.43	LIDAR TOPO
San Gabriel River	San Gabriel River	27509	643.84	644.28	LIDAR TOPO
San Gabriel River	San Gabriel River	26927	643.49	643.91	LIDAR TOPO

Table B-12 Computed Water Surface Elevations and Topographic Data Source – San Gabriel River (continued)

River	Reach	Cross Section	100-Year Water Surface Elevation (ft NAVD88)		Topographic Data Source
			Existing Conditions	Future Conditions	
San Gabriel River	San Gabriel River	26449	643.03	643.44	2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	25997	642.79	643.21	LIDAR TOPO
San Gabriel River	San Gabriel River	25521	642.24	642.66	LIDAR TOPO
San Gabriel River	San Gabriel River	25051	641.75	642.17	LIDAR TOPO
San Gabriel River	San Gabriel River	24586	641.46	641.86	LIDAR TOPO
San Gabriel River	San Gabriel River	24116	640.49	640.90	LIDAR TOPO
San Gabriel River	San Gabriel River	23626	640.30	640.70	LIDAR TOPO
San Gabriel River	San Gabriel River	23185	640.63	641.03	LIDAR TOPO
San Gabriel River	San Gabriel River	22649	639.69	640.11	LIDAR TOPO
San Gabriel River	San Gabriel River	22108	638.27	638.73	LIDAR TOPO
San Gabriel River	San Gabriel River	21640	637.13	637.53	LIDAR TOPO
San Gabriel River	San Gabriel River	21217	636.74	637.13	2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	20679	636.03	636.43	LIDAR TOPO
San Gabriel River	San Gabriel River	20183	635.68	636.10	LIDAR TOPO
San Gabriel River	San Gabriel River	19733	635.11	635.55	LIDAR TOPO
San Gabriel River	San Gabriel River	19190	634.69	635.13	LIDAR TOPO
San Gabriel River	San Gabriel River	18683	634.38	634.82	LIDAR TOPO
San Gabriel River	San Gabriel River	18177	633.40	633.85	LIDAR TOPO
San Gabriel River	San Gabriel River	17820	633.25	633.69	LIDAR TOPO
San Gabriel River	San Gabriel River	17269	631.28	631.67	LIDAR TOPO
San Gabriel River	San Gabriel River	16788	630.76	631.25	LIDAR TOPO
San Gabriel River	San Gabriel River	16251	627.48	627.83	LIDAR TOPO
San Gabriel River	San Gabriel River	15948	626.63	627.11	2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	15350	624.96	625.16	LIDAR TOPO
San Gabriel River	San Gabriel River	14854	625.74	626.02	LIDAR TOPO
San Gabriel River	San Gabriel River	14409	623.75	624.01	LIDAR TOPO
San Gabriel River	San Gabriel River	14140	624.14	624.41	LIDAR TOPO
San Gabriel River	San Gabriel River	13686	622.46	622.71	LIDAR TOPO
San Gabriel River	San Gabriel River	13205	622.44	622.72	LIDAR TOPO
San Gabriel River	San Gabriel River	12711	622.17	622.45	LIDAR TOPO
San Gabriel River	San Gabriel River	12247	621.65	621.94	LIDAR TOPO
San Gabriel River	San Gabriel River	11809	620.50	620.82	LIDAR TOPO
San Gabriel River	San Gabriel River	11296	621.32	621.62	LIDAR TOPO
San Gabriel River	San Gabriel River	10657	620.81	621.11	LIDAR TOPO
San Gabriel River	San Gabriel River	10484	620.21	620.52	2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	10140	619.78	620.08	LIDAR TOPO
San Gabriel River	San Gabriel River	9774	619.18	619.46	LIDAR TOPO
San Gabriel River	San Gabriel River	9353	618.38	618.63	LIDAR TOPO
San Gabriel River	San Gabriel River	8782	616.58	616.93	LIDAR TOPO
San Gabriel River	San Gabriel River	8339	616.55	616.89	LIDAR TOPO
San Gabriel River	San Gabriel River	7869	615.77	616.15	LIDAR TOPO
San Gabriel River	San Gabriel River	7396	614.87	615.27	LIDAR TOPO
San Gabriel River	San Gabriel River	6995	613.94	614.48	LIDAR TOPO
San Gabriel River	San Gabriel River	6868	613.89	614.36	LIDAR TOPO/2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	6759 SH 29			2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	6645	613.32	613.64	LIDAR TOPO
San Gabriel River	San Gabriel River	6474	612.76	613.10	LIDAR TOPO/2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	6414 COUNTY RD 100			2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	6353	612.74	613.01	LIDAR TOPO
San Gabriel River	San Gabriel River	5833	612.22	612.51	LIDAR TOPO
San Gabriel River	San Gabriel River	5428	611.81	612.09	2015-2016 FIELD SURVEY
San Gabriel River	San Gabriel River	5041	611.12	611.40	LIDAR TOPO
San Gabriel River	San Gabriel River	4596	610.90	611.21	LIDAR TOPO
San Gabriel River	San Gabriel River	4019	609.80	610.09	LIDAR TOPO
San Gabriel River	San Gabriel River	3417	607.85	608.13	LIDAR TOPO
San Gabriel River	San Gabriel River	3081	606.76	607.06	LIDAR TOPO
San Gabriel River	San Gabriel River	2654	606.53	606.86	LIDAR TOPO
San Gabriel River	San Gabriel River	2195	603.60	603.82	LIDAR TOPO
San Gabriel River	San Gabriel River	1705	602.60	602.81	LIDAR TOPO
San Gabriel River	San Gabriel River	1272	600.99	601.22	LIDAR TOPO
San Gabriel River	San Gabriel River	632	600.81	601.04	LIDAR TOPO
San Gabriel River	San Gabriel River	156	598.76	598.99	LIDAR TOPO

FIGURES

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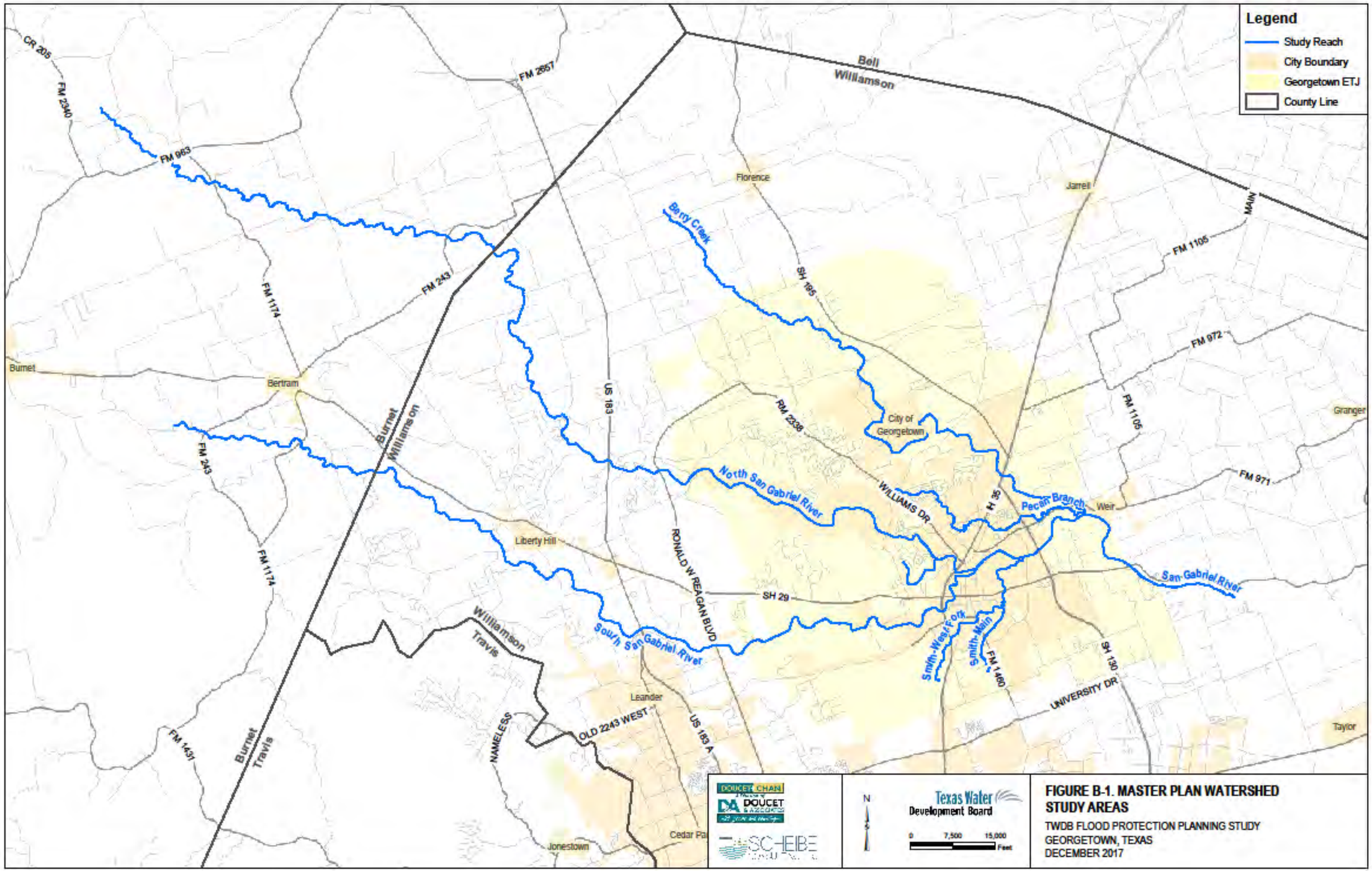
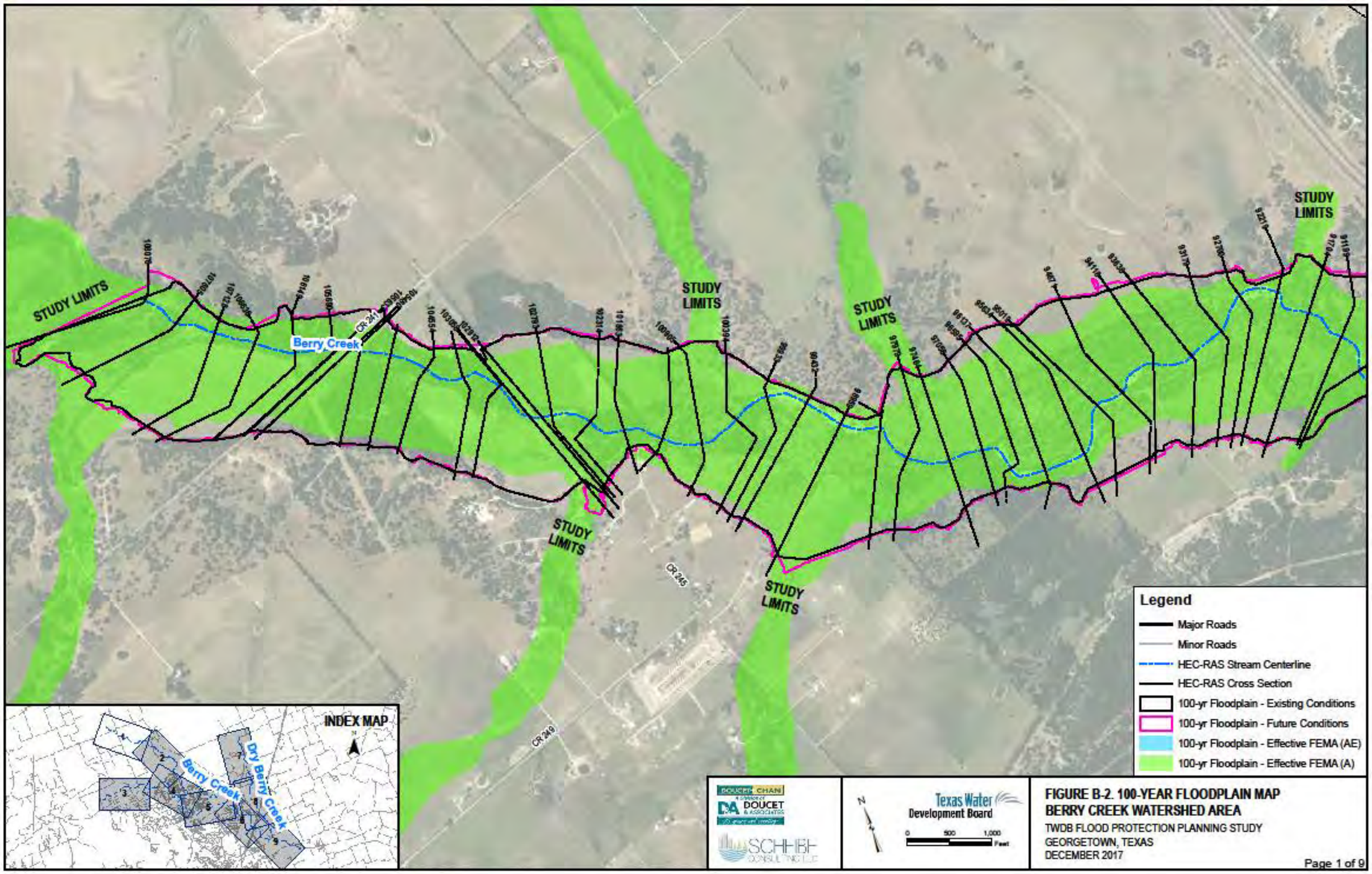


FIGURE B-1. MASTER PLAN WATERSHED STUDY AREAS
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017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STUDY LIMITS
STUDY LIMITS
STUDY LIMITS
STUDY LIMITS
STUDY LIMITS
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CR 245
CR 249
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100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
DOUCET, CHAN
DOUCET & ASSOCIATES
SCHNIEB CONSULTING LLC
Texas Water Development Board
0 500 1,000 Feet
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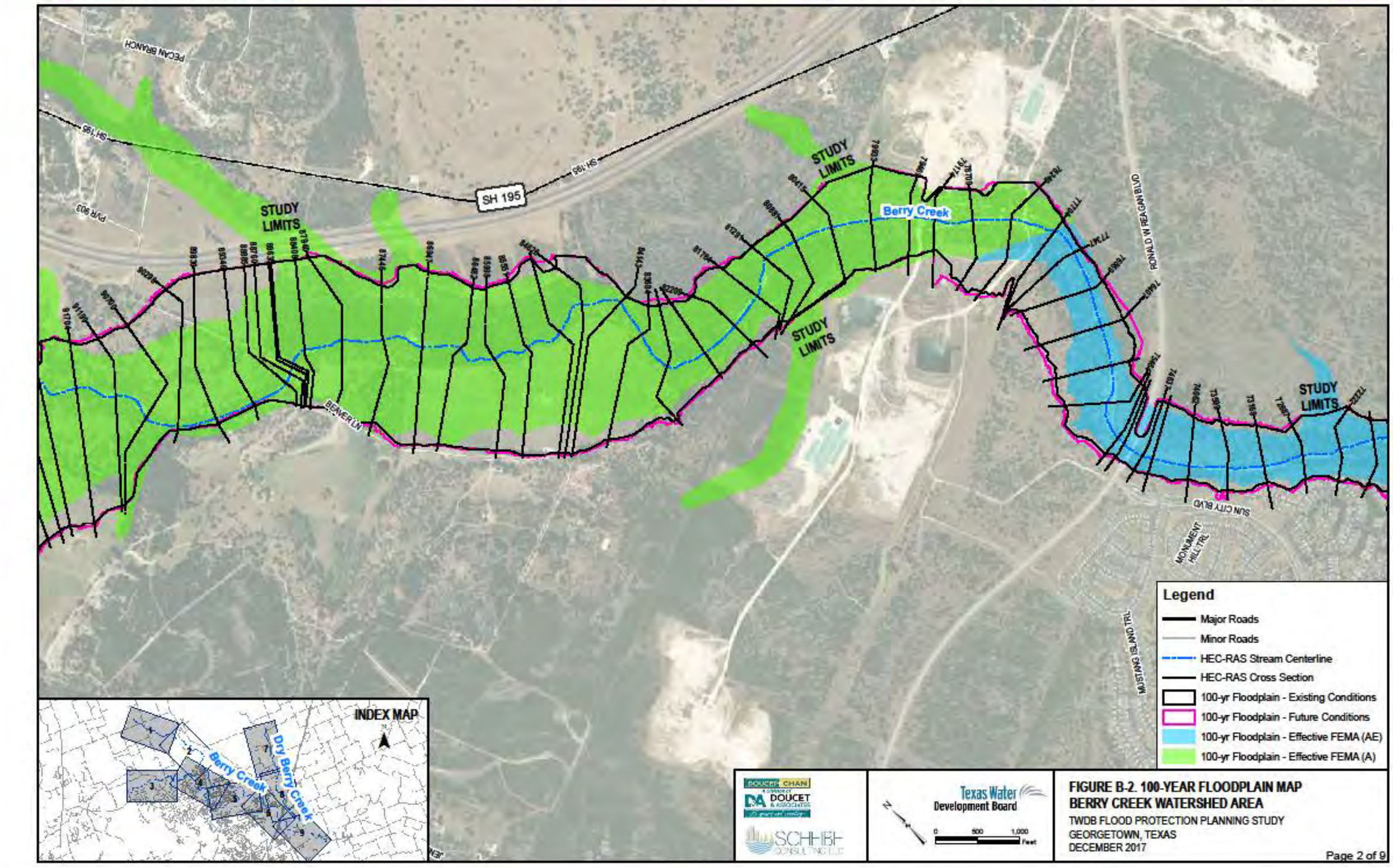
PECAN BRANCH
SH 195
SH 195
PVR 903
STUDY LIMITS
STUDY LIMITS
STUDY LIMITS
STUDY LIMITS
Berry Creek
RONALD W REAGAN BLVD
BEAVER LN
SUN CITY BLVD
MONUMENT HILL TRL
MUSTANG ISLAND TRL
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100-yr Floodplain - Effective FEMA (A)
DOUCET, CHAN
DOUCET & ASSOCIATES
SCHIEBE CONSULTING LLC
Texas Water Development Board
0 500 1,000 Feet
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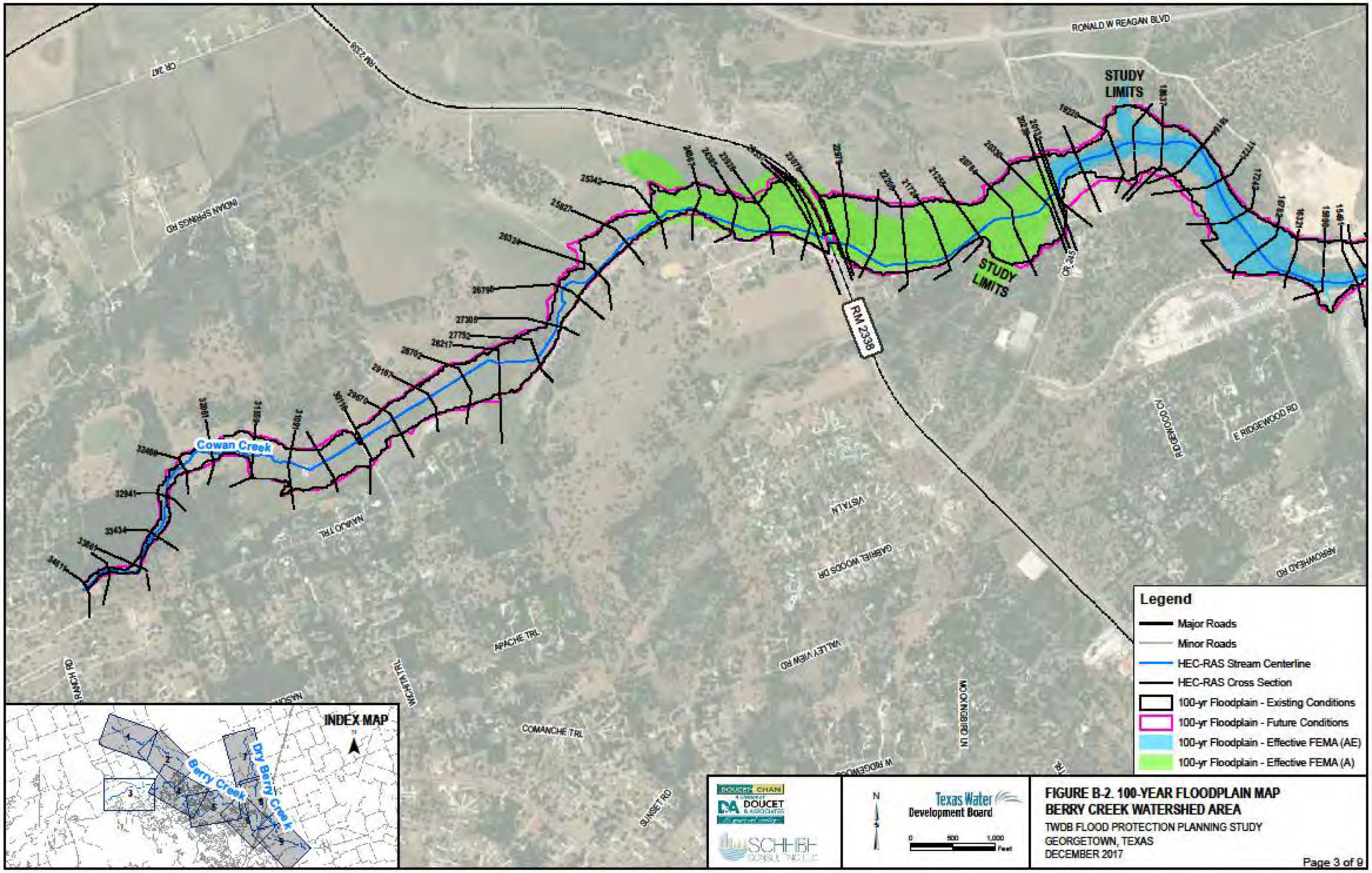
RONALD W REAGAN BLVD
STUDY LIMITS
STUDY LIMITS
RM 2338
Cowan Creek
INDIAN SPRINGS RD
NAVAJO TRL
APACHE TRL
COMANCHE TRL
VALLEY VIEW RD
GABRIEL WOODS DR
VISTA LN
RIDGEWOOD CV
E RIDGEWOOD RD
ARROWHEAD RD
MOCKINGBIRD LN
SUNSET RD
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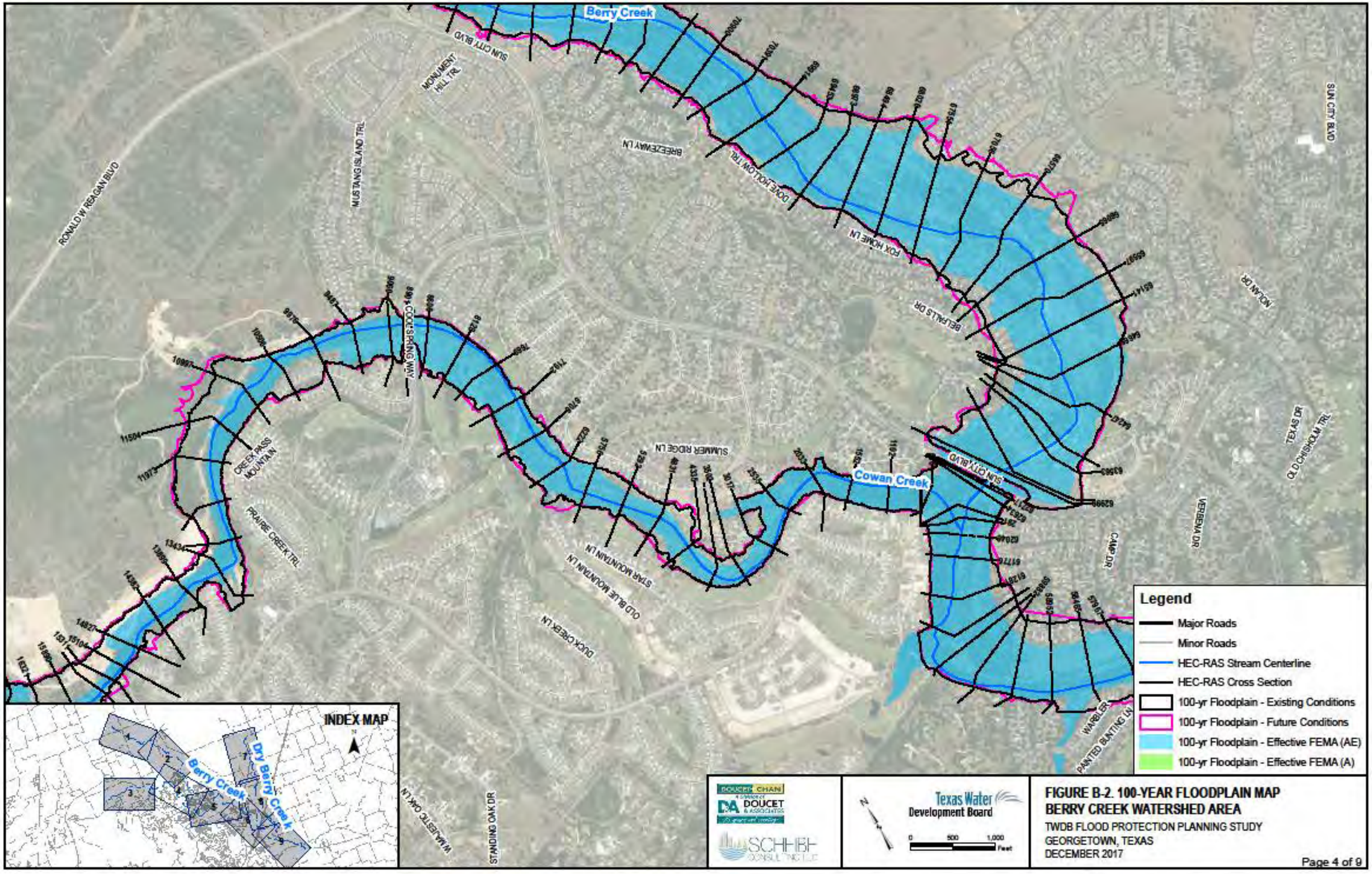
Berry Creek
Cowan Creek
Dry Berry Creek
RONALD W. REAGAN BLVD
MUSTANG ISLAND TRL
MONUMENT HILL TRL
SUN CITY BLVD
BREEZEWAY LN
DOVE HOLLOW TRL
FOX HOME LN
BELFALLS DR
NORMAN DR
COOPERSHING WAY
CREEK PASS MOUNTAIN
PRAIRIE CREEK TRL
SUMMER RIDGE LN
STAR MOUNTAIN LN
OLD BLUE MOUNTAIN LN
DUCK CREEK LN
TEXAS DR
OLD CHISHOLM TRL
MERIDEN DR
CAMEO DR
WARBLER
PAINTED BUNTING LN
WAMBESTO OAK LN
STANDING OAK DR
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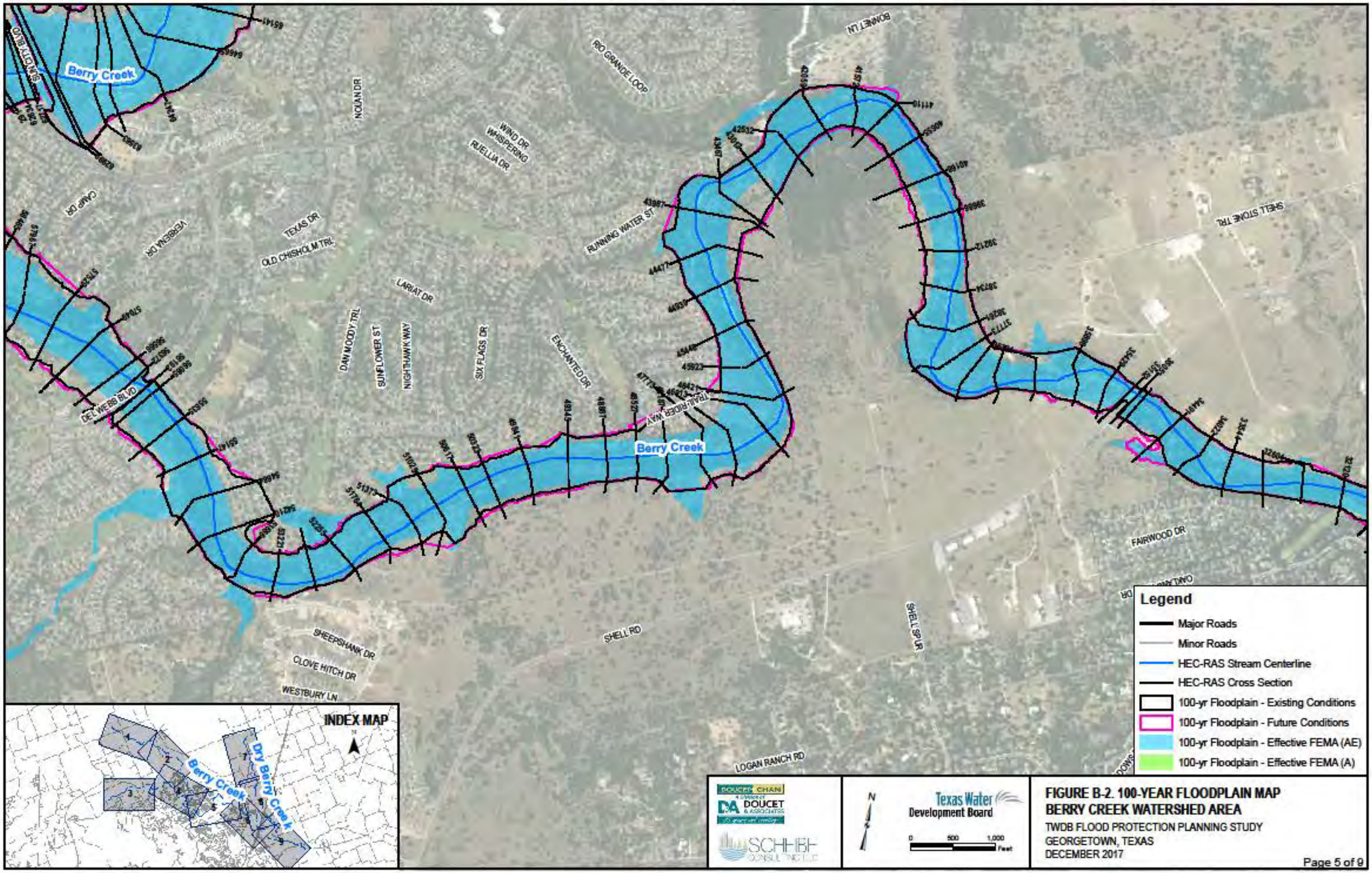
Berry Creek
RIO GRANDE LOOP
NOLAN DR
WIND DR
WHISPERING
RUELLIA DR
BONNET LN
RUNNING WATER ST
SHELL STONE TRL
TEXAS DR
OLD CHISHOLM TRL
LARIAT DR
DAN WOODY TRL
SUNFLOWER ST
NIGHTHAWK WAY
SIX FLAGS DR
ENCHANTED DR
DEL WEBB BLVD
TRAIL RIDGE WAY
SHEEPSHANK DR
CLOVE HITCH DR
WESTBURY LN
SHELL RD
SHELL SPUR
FAIRWOOD DR
LOGAN RANCH RD
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BERRY CREEK WATERSHED AREA
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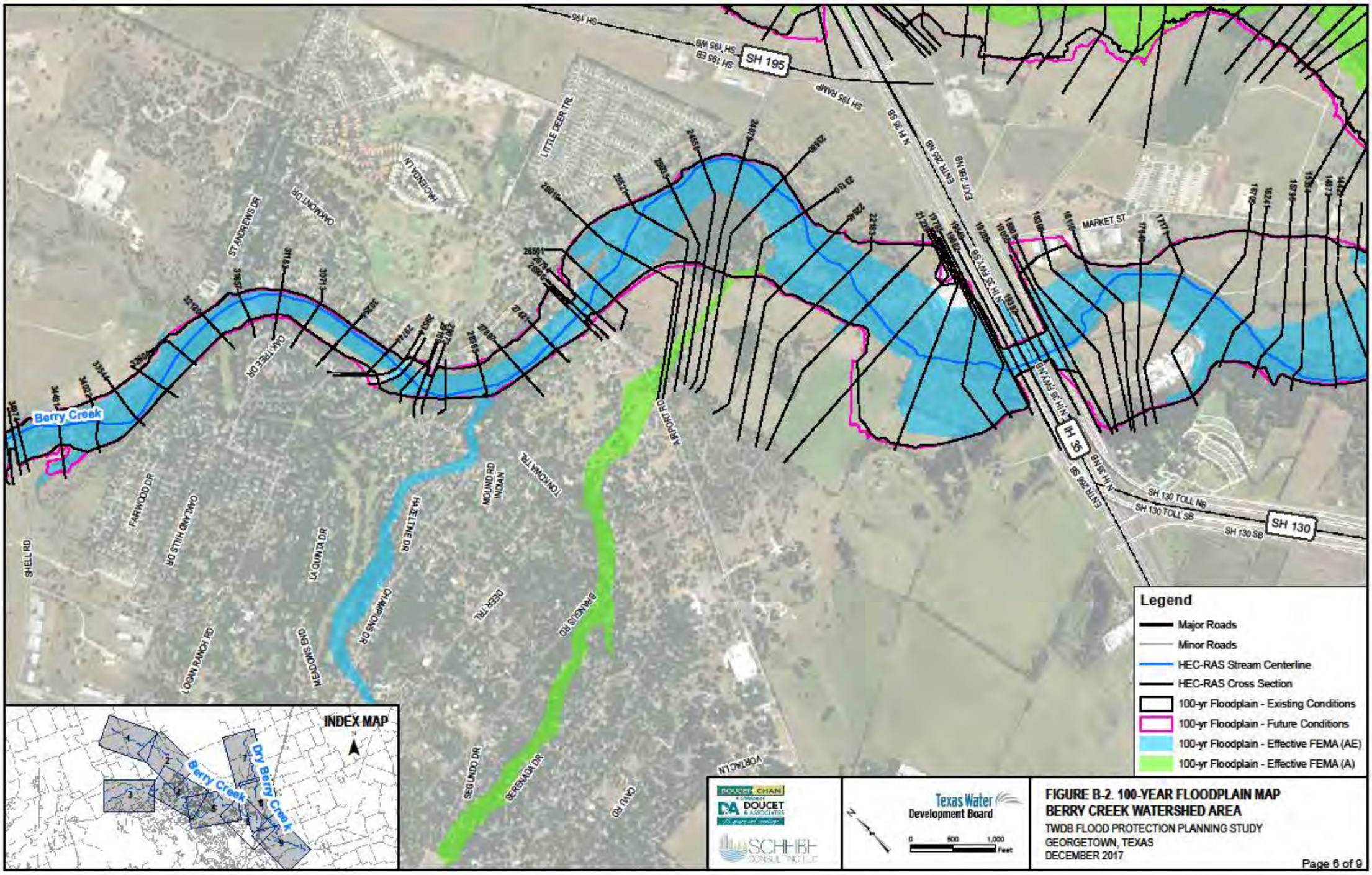
SH 195
SH 195 EB
SH 195 WB
SH 195 RAMP
LITTLE DEER TRL
HACIENDA LN
OAKMONT DR
ST ANDREWS DR
OAK TREE DR
Berry Creek
AIRPORT RD
MARKET ST
IH 35
SH 130 TOLL NB
SH 130 TOLL SB
SH 130 SB
SH 130
FAIRWOOD DR
OAKLAND HILLS DR
SHELL RD
LA QUINTA DR
HAZELTINE DR
MOUND RD
INDIAN
TONKOWA TRL
CHAMPIONS DR
DEER TRL
BRANGUS RD
LOGAN RANCH RD
MEADOWS END
SEGUNDO DR
SERENADA DR
CAVU RD
VORTAC LN
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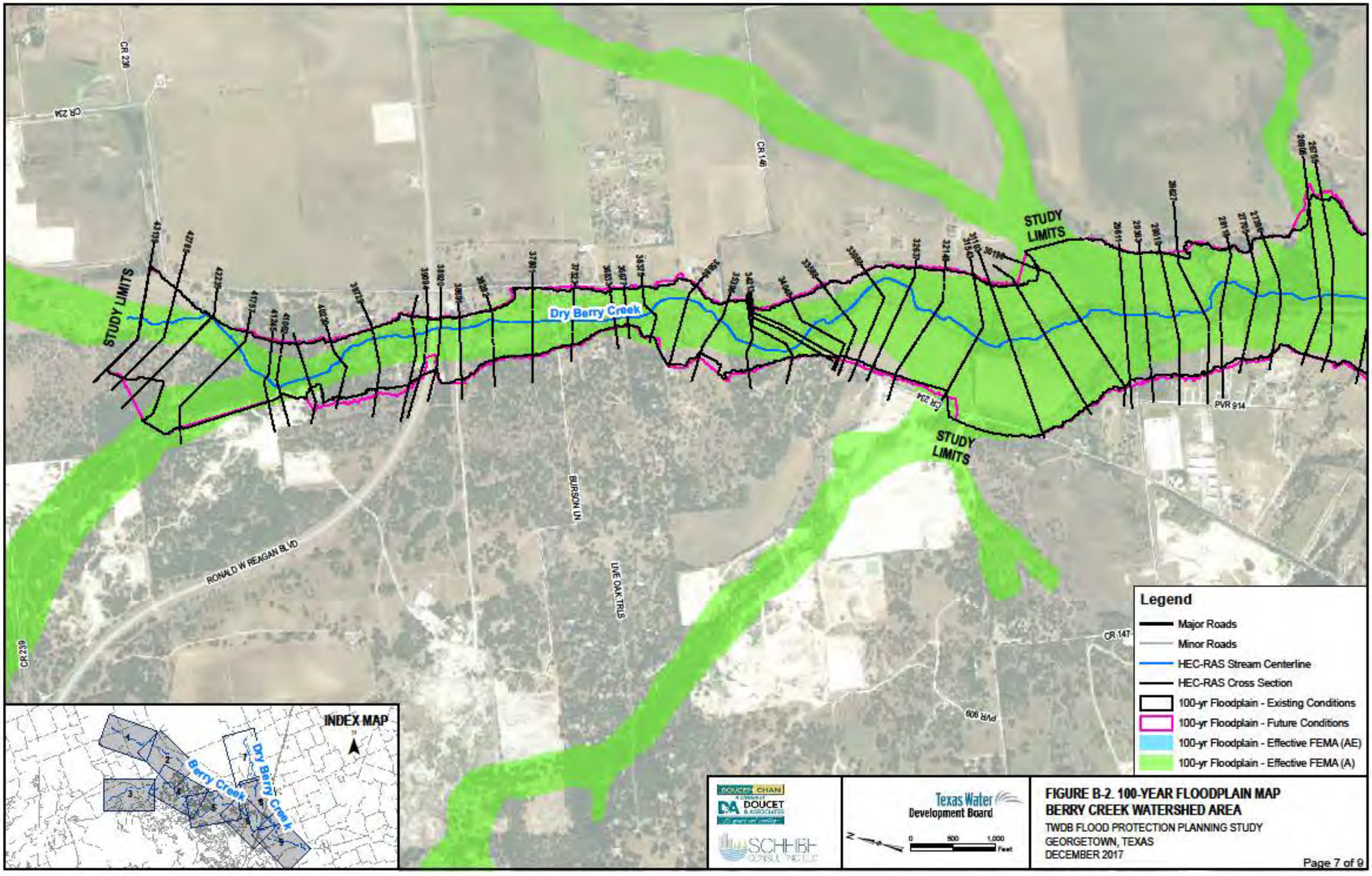
STUDY LIMITS
Dry Berry Creek
STUDY LIMITS
STUDY LIMITS
CR 236
CR 234
CR 146
CR 234
BURSON LN
LIVE OAK TRLS
RONALD W REAGAN BLVD
CR 239
CR 147
PVR 914
PVR 909
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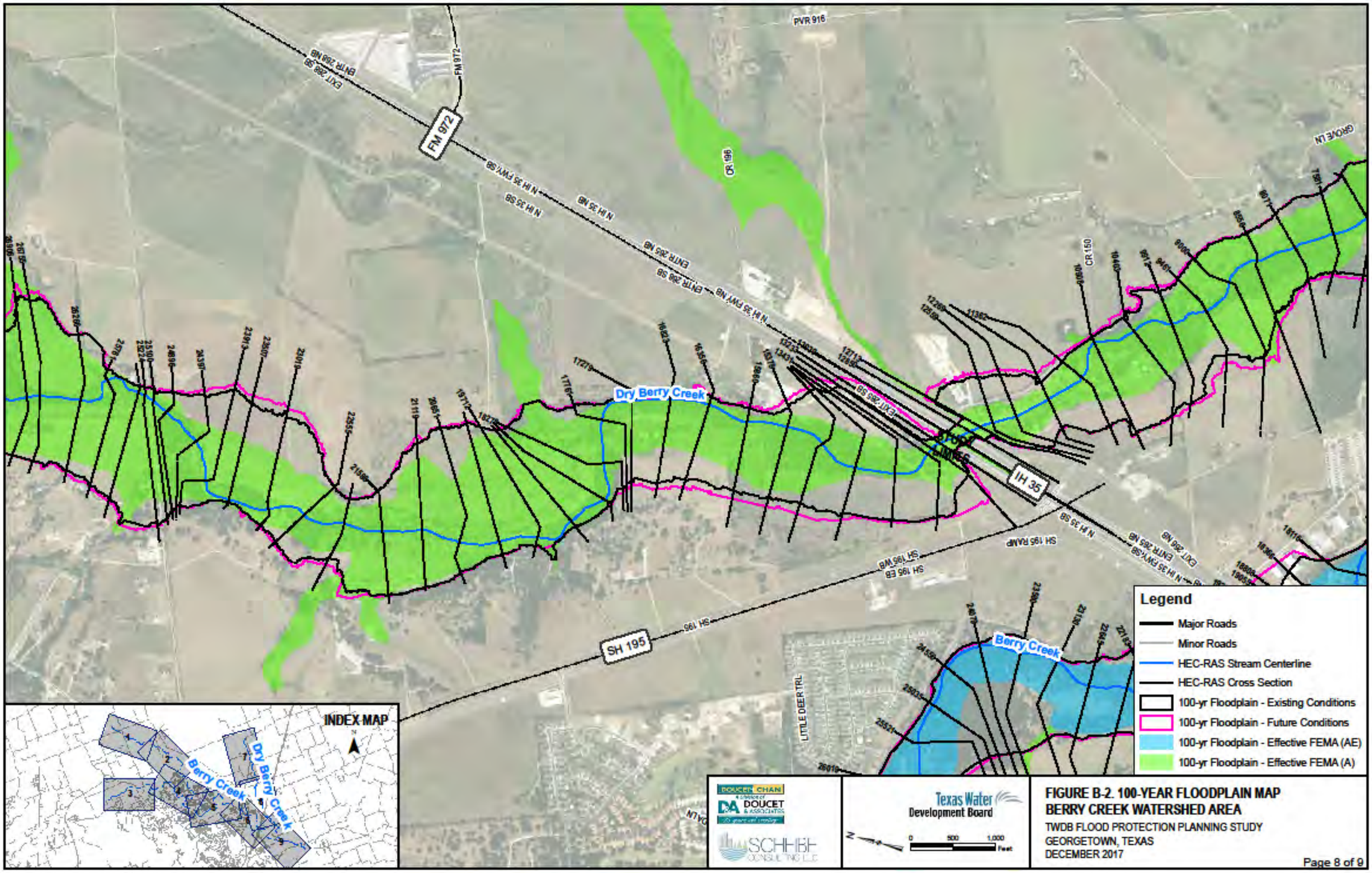

FIGURE B-2. 100-YEAR FLOODPLAIN MAP
BERRY CREEK WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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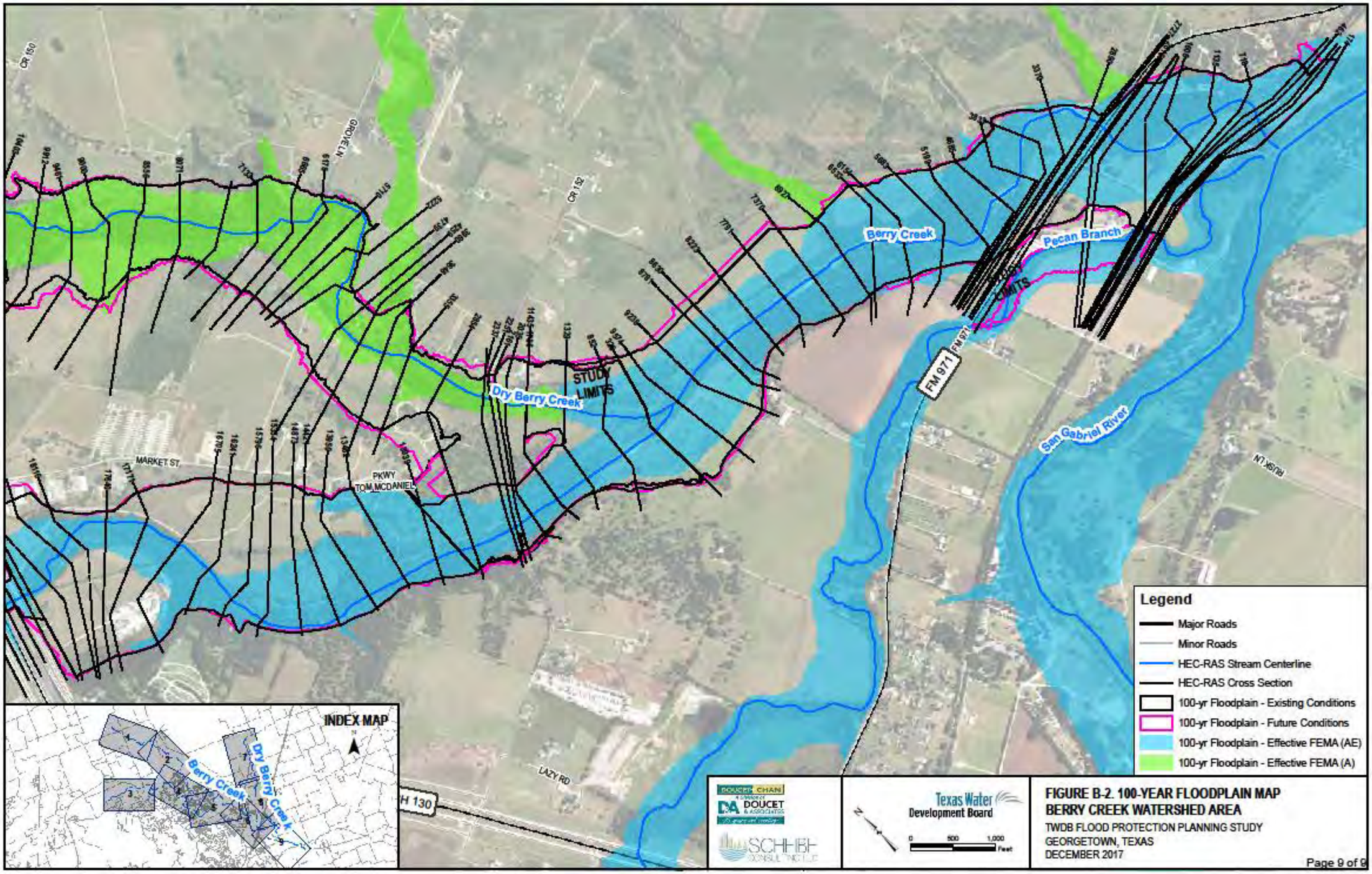
CR 150
GEORGETOWN
CR 152
Berry Creek
Pecan Branch
STUDY LIMITS
FM 971
Dry Berry Creek
San Gabriel River
MARKET ST
PKWY TOM MCDANIEL
LAZY RD
H 130
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BERRY CREEK WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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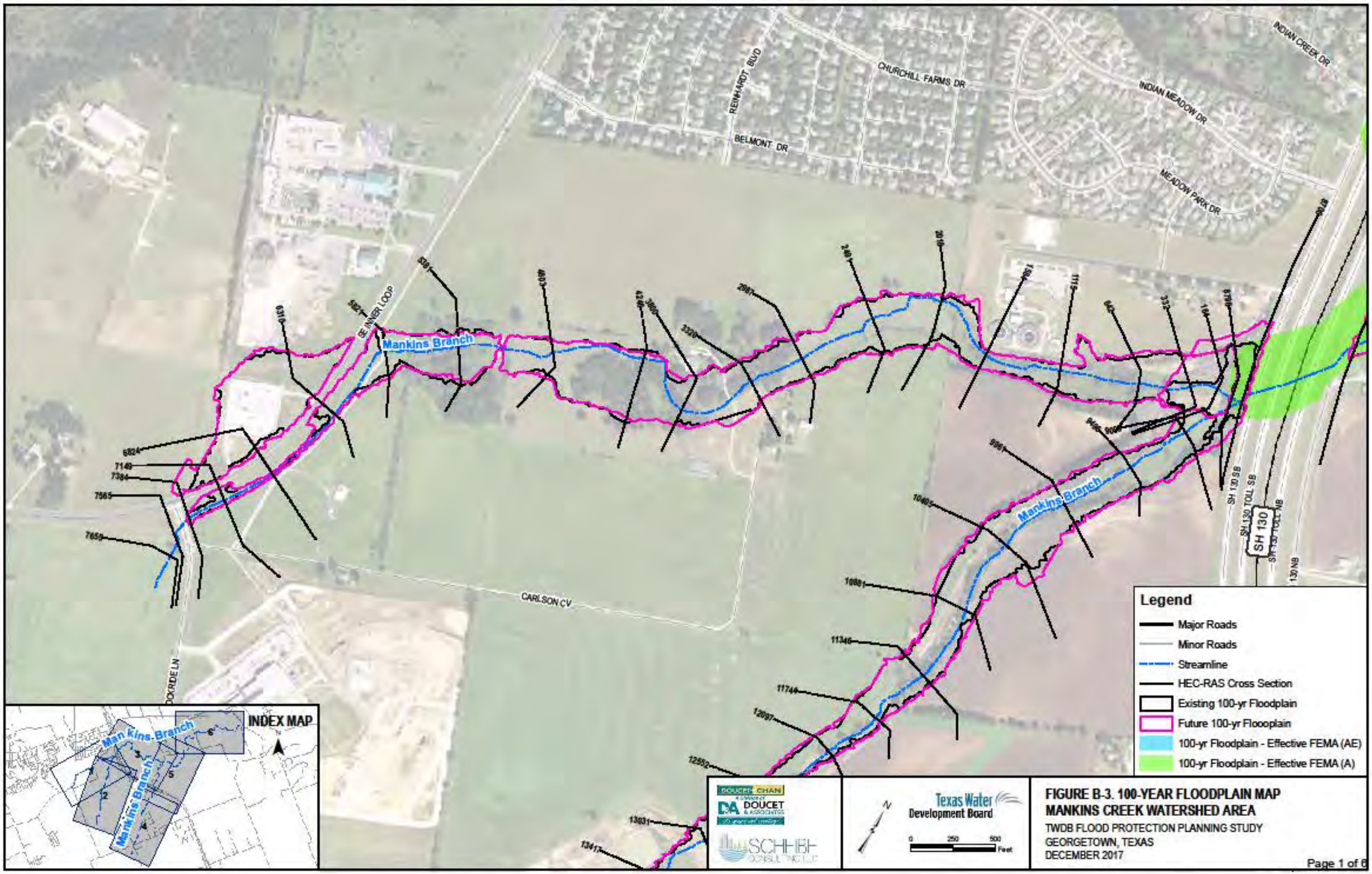
REINHARDT BLVD
CHURCHILL FARMS DR
INDIAN CREEK DR
INDIAN MEADOW DR
BELMONT DR
MEADOW PARK DR
SE INNER LOOP
Mankins Branch
CARLSON CV
DOXRIDE LN
SH 130 TOLL SB
SH 130
SH 130 TOLL NB
130 NB
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Future 100-yr Floooplain
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIB CONSULTING LLC
Texas Water Development Board
0 250 500 Feet
FIGURE B-3. 100-YEAR FLOODPLAIN MAP
MANKINS CREEK WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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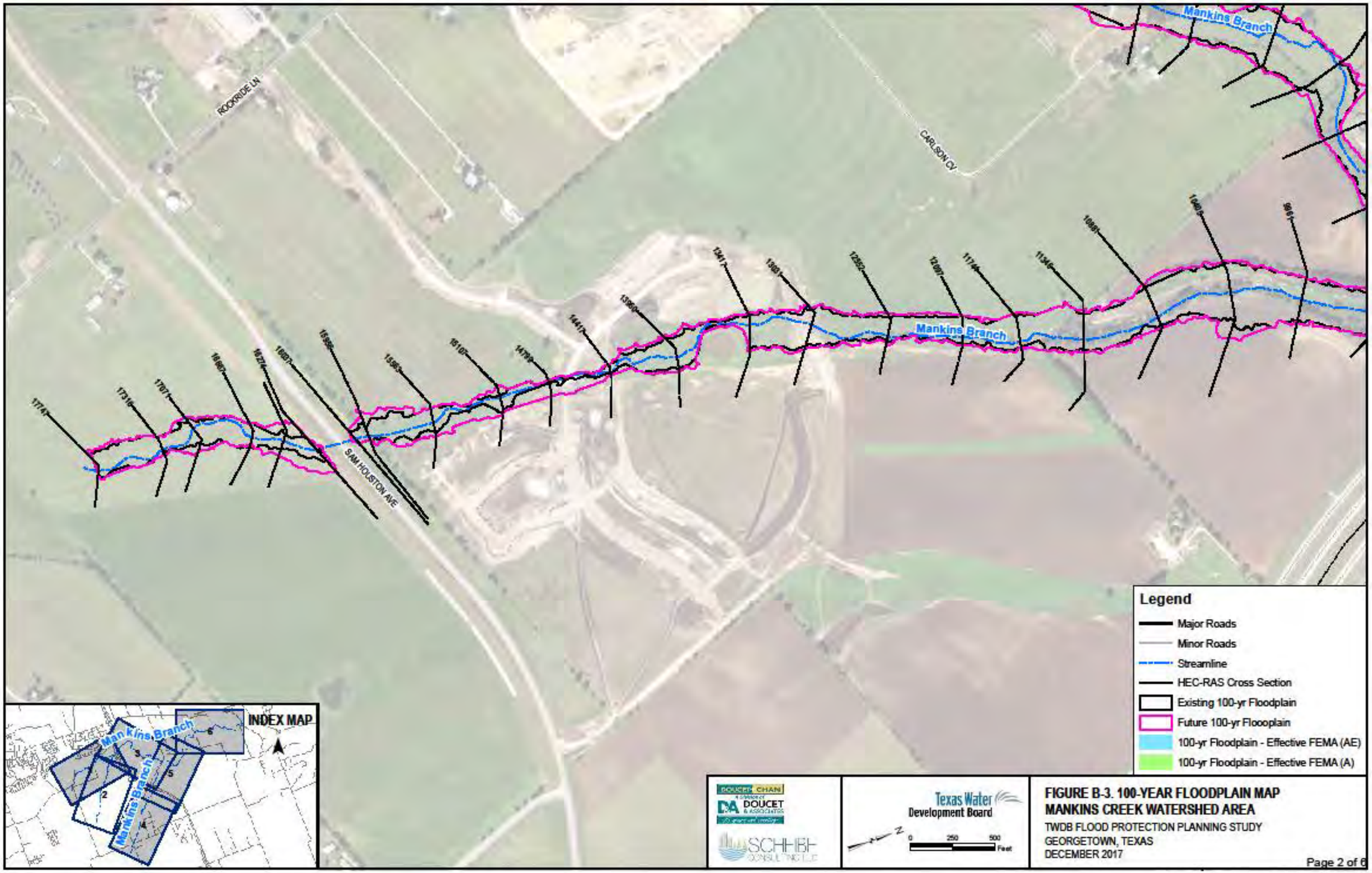
Mankins Branch
ROCKRIDGE LN
CARLSON CV
Mankins Branch
SAM HOUSTON AVE
INDEX MAP
Mankins Branch
Mankins Branch
Legend
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Future 100-yr Floooplain
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100-yr Floodplain - Effective FEMA (A)
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIB CONSULTING LLC
Texas Water Development Board
0 250 500 Feet
FIGURE B-3. 100-YEAR FLOODPLAIN MAP
MANKINS CREEK WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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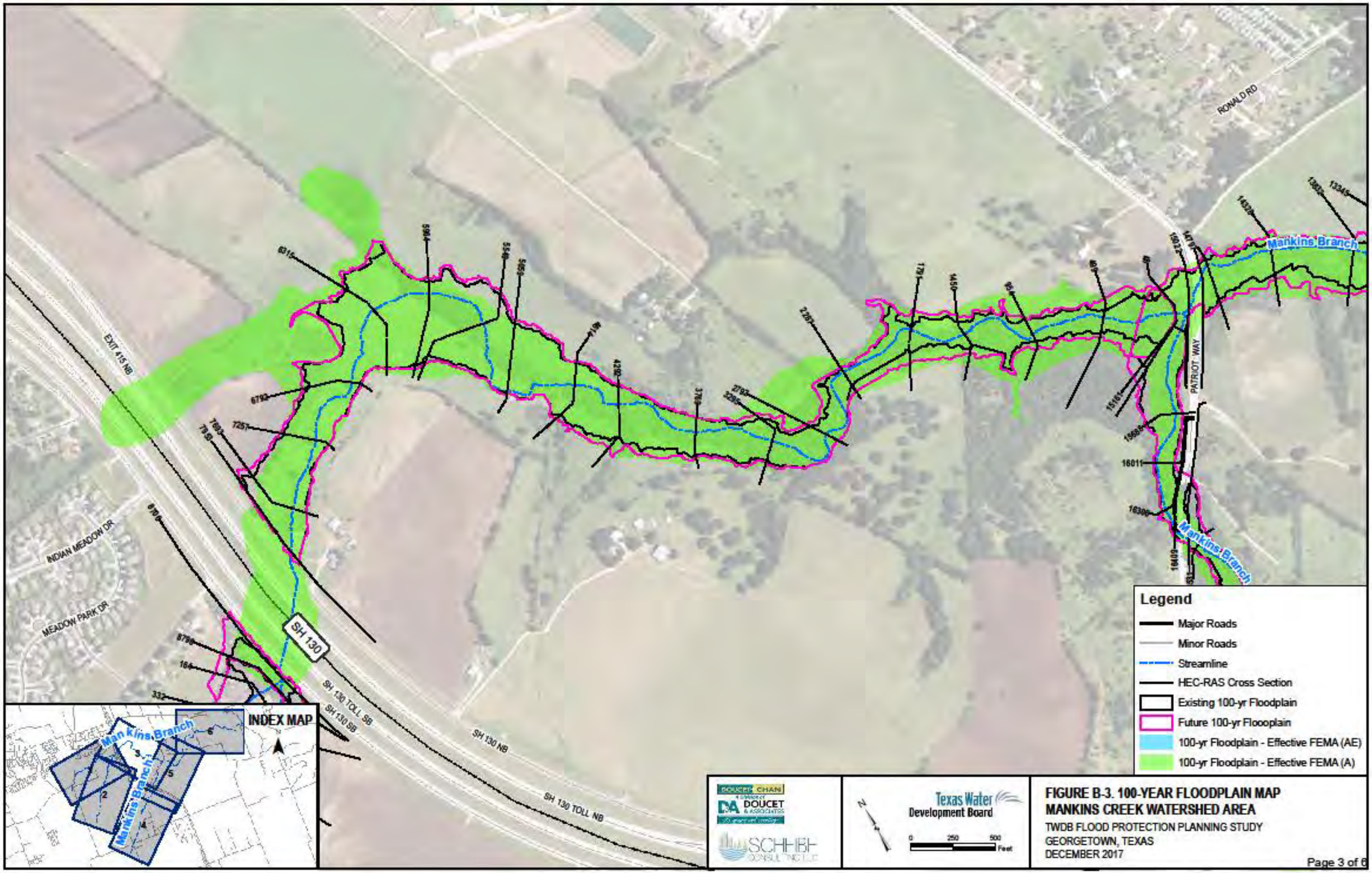
Mankins Branch
RONALD RD
PATRIOT WAY
EXIT 415 NB
INDIAN MEADOW DR
MEADOW PARK DR
SH 130
SH 130 TOLL SB
SH 130 SB
SH 130 NB
SH 130 TOLL NB
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100-yr Floodplain - Effective FEMA (A)
Texas Water Development Board
0 250 500 Feet
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MANKINS CREEK WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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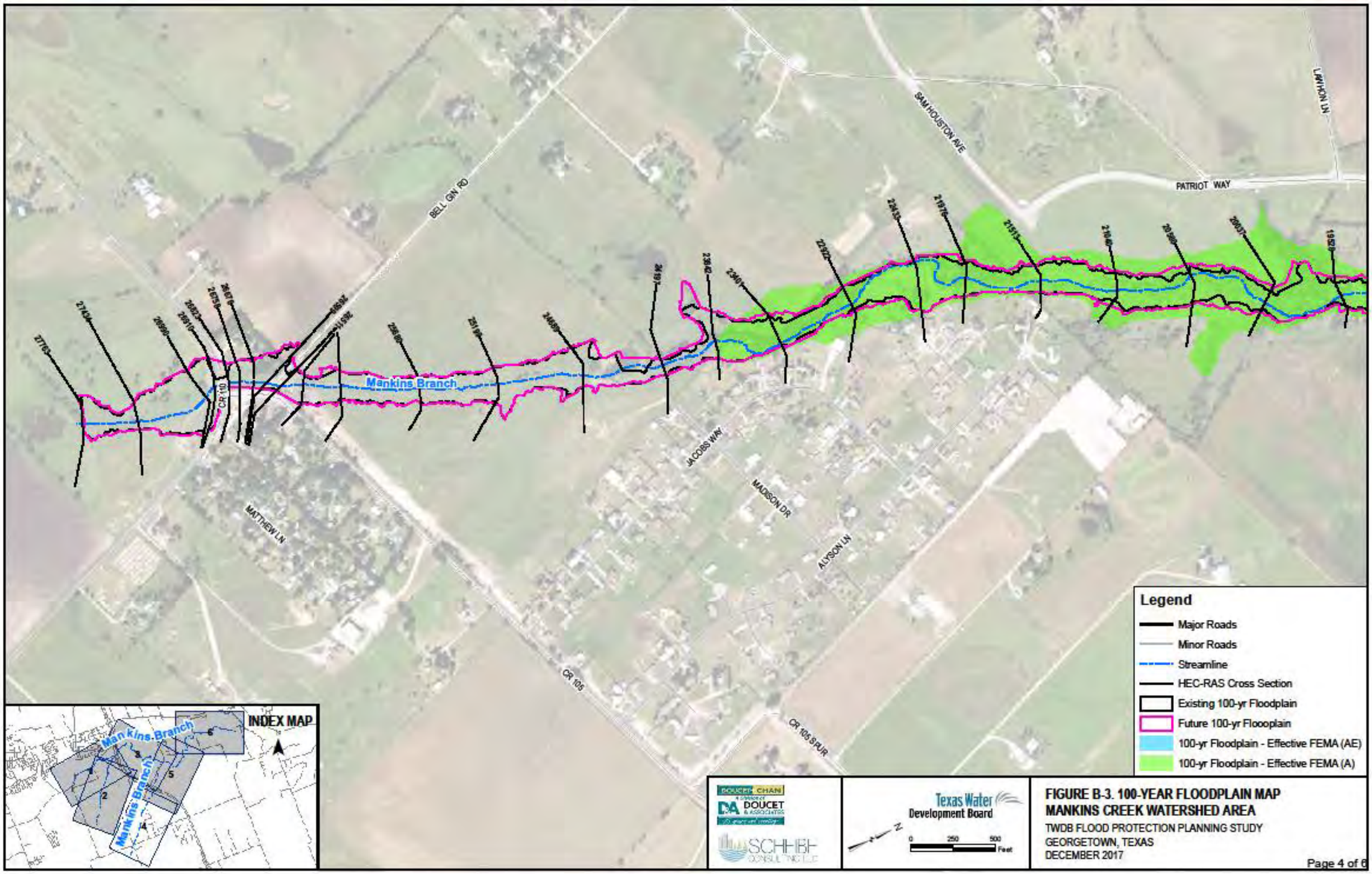
BELL GIN RD
SAM HOUSTON AVE
PATRIOT WAY
LAWHON LN
Mankins Branch
CR 110
JACOBS WAY
MADISON DR
ALYSON LN
MATTHEW LN
CR 105
CR 105 SPUR
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100-yr Floodplain - Effective FEMA (A)
Texas Water Development Board
0 250 500 Feet
FIGURE B-3. 100-YEAR FLOODPLAIN MAP
MANKINS CREEK WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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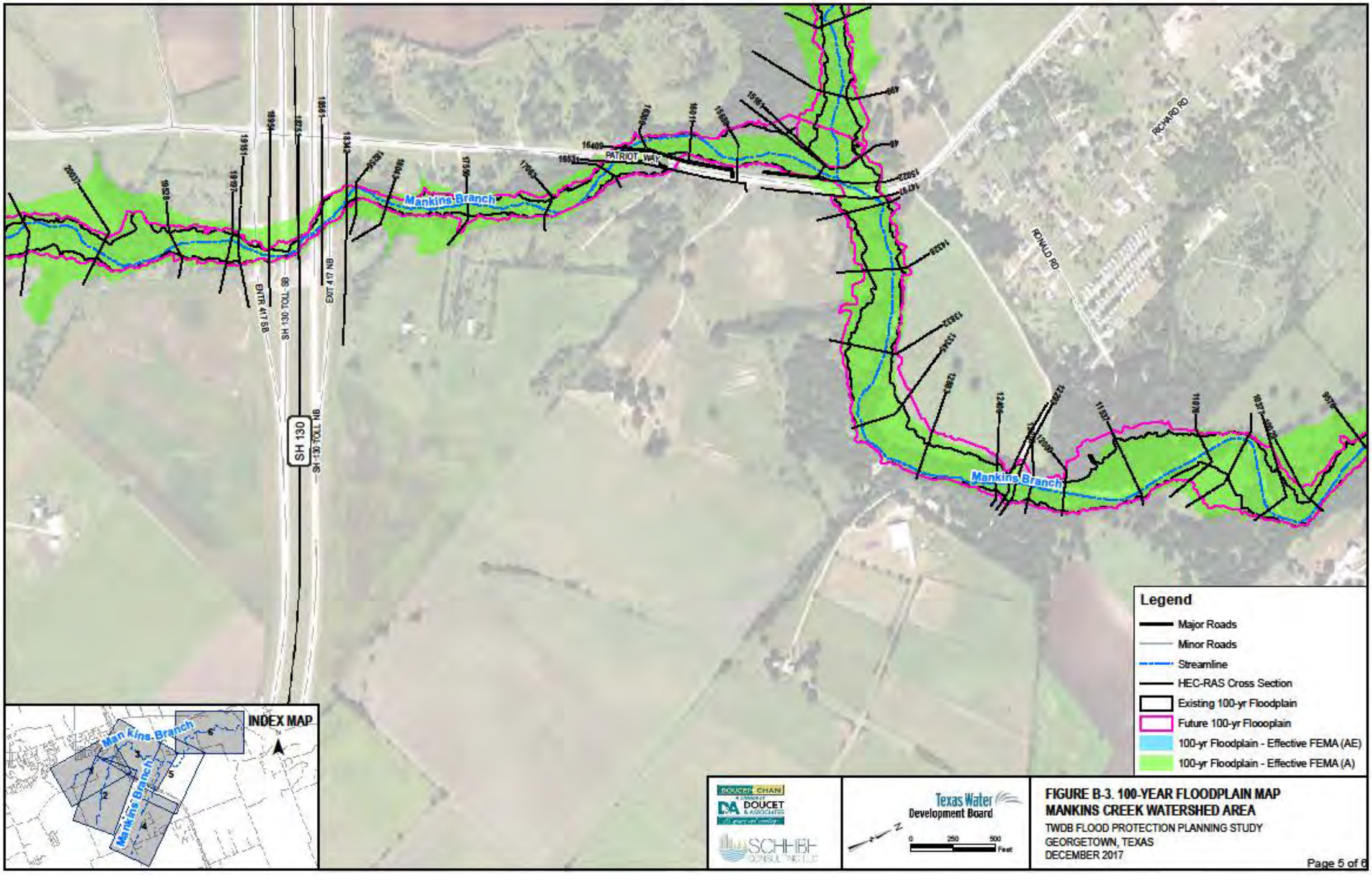
Mankins Branch
PATRIOT WAY
RICHARD RD
RONALD RD
SH 130
SH 130 TOLL NB
SH 130 TOLL SB
EXIT 417 NB
ENTR 417 SB
Mankins Branch
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Mankins Branch
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2
3
4
5
6
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HEC-RAS Cross Section
Existing 100-yr Floodplain
Future 100-yr Floooplain
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
DOUCET CHAN
DOUCET & ASSOCIATES
SCHIEB CONSULTING LLC
Texas Water Development Board
0 250 500 Feet
FIGURE B-3. 100-YEAR FLOODPLAIN MAP
MANKINS CREEK WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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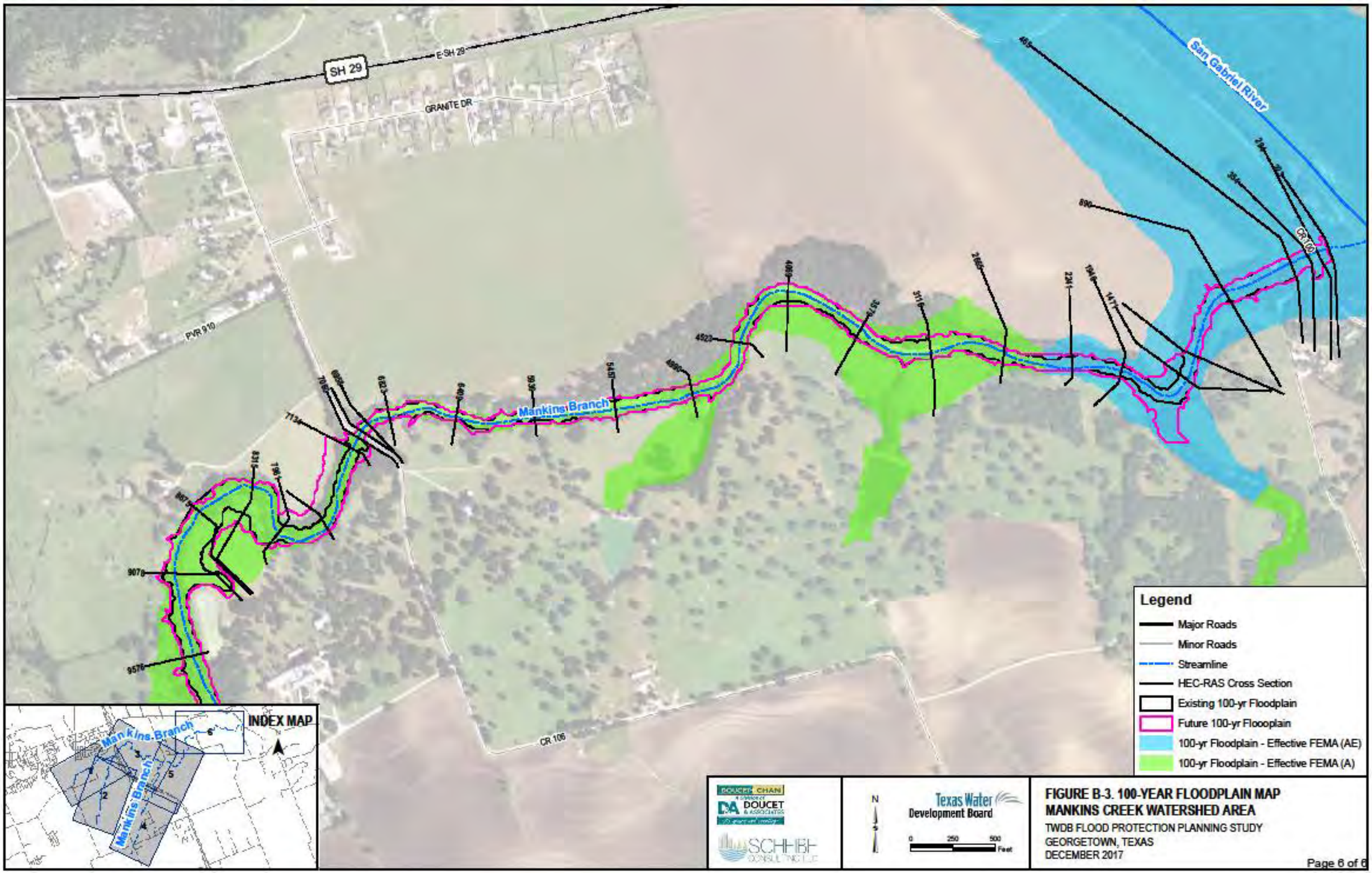
SH 29
E-SH 29
GRANITE DR
PVR 910
San Gabriel River
CR 106
Mankins Branch
INDEX MAP
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Major Roads
Minor Roads
Streamline
HEC-RAS Cross Section
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Future 100-yr Floooplain
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
Texas Water Development Board
0 250 500 Feet
FIGURE B-3. 100-YEAR FLOODPLAIN MAP
MANKINS CREEK WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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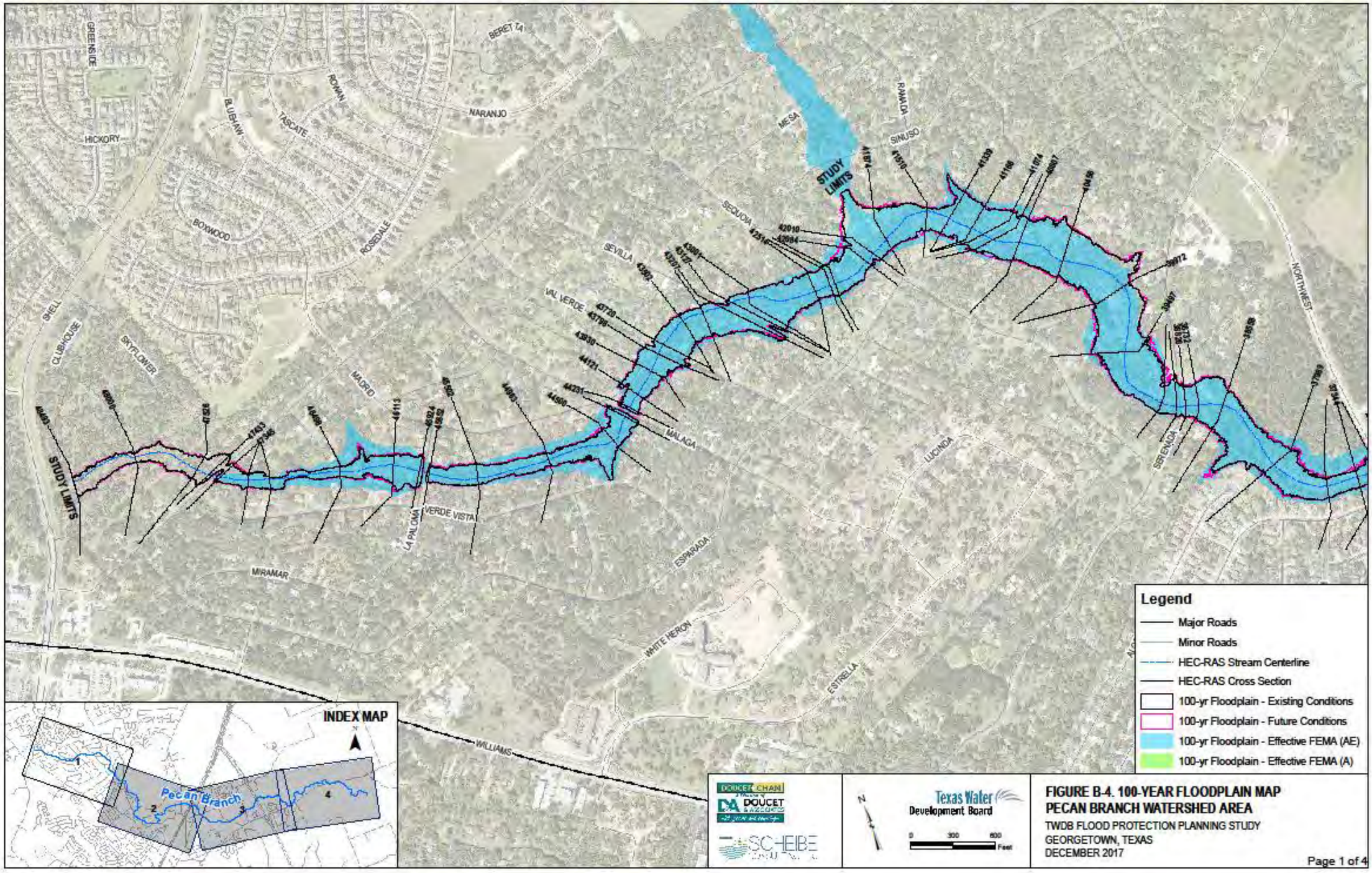
STUDY LIMITS
STUDY LIMITS
GREENSIDE
HICKORY
BLUEHAW
TASCATE
ROWAN
BERET
NARANJO
BOXWOOD
ROSEDALE
SHELL
CLUBHOUSE
SKYFLOWER
MADRID
MESA
RAMADA
SINUSO
SEQUOIA
SEVILLA
VAL VERDE
MALAGA
LA PALOMA
VERDE VISTA
MIRAMAR
ESPARADA
WHITE HERON
ESTRELLA
LUCINDA
SERENADA
NORTHWEST
WILLIAMS
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100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
Texas Water Development Board
0 300 600 Feet
FIGURE B-4. 100-YEAR FLOODPLAIN MAP
PECAN BRANCH WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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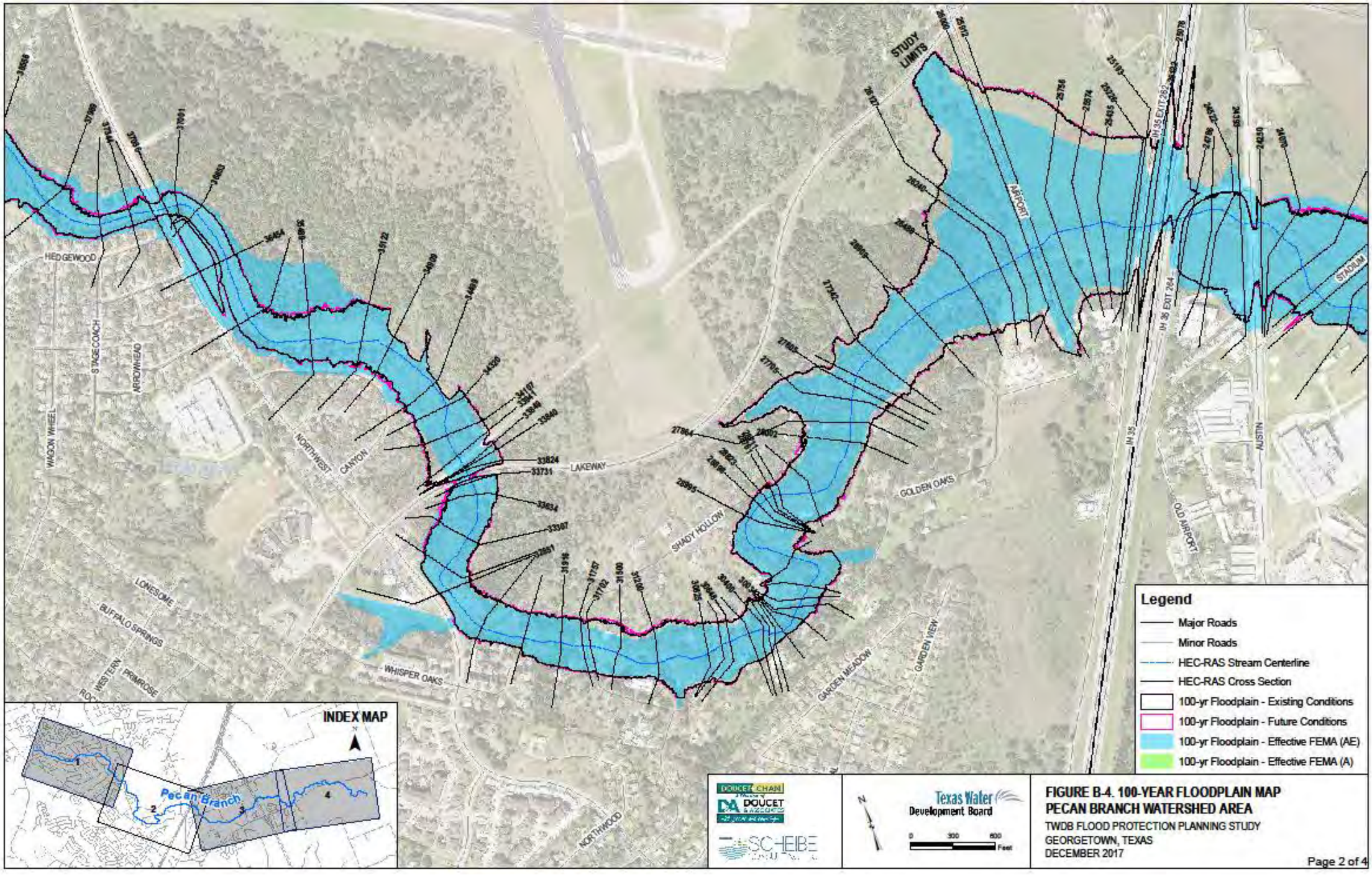
STUDY LIMITS
AIRPORT
IH 35 EXIT 282
IH 35 EXIT 284
STADIUM
HEDGEWOOD
STAGECOACH
ARROWHEAD
WAGON WHEEL
NORTHWEST CANYON
LAKEWAY
SHADY HOLLOW
GOLDEN OAKS
IH 35
AUSTIN
OLD AIRPORT
LONESOME
BUFFALO SPRINGS
WESTERN PRIMROSE
WHISPER OAKS
GARDEN MEADOW
GARDEN VIEW
NORTHWOOD
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HEC-RAS Cross Section
100-yr Floodplain - Existing Conditions
100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
DOUCET CHAIN
DOUCET & ASSOCIATES
SCHEIBE
Texas Water Development Board
0 300 600 Feet
FIGURE B-4. 100-YEAR FLOODPLAIN MAP
PECAN BRANCH WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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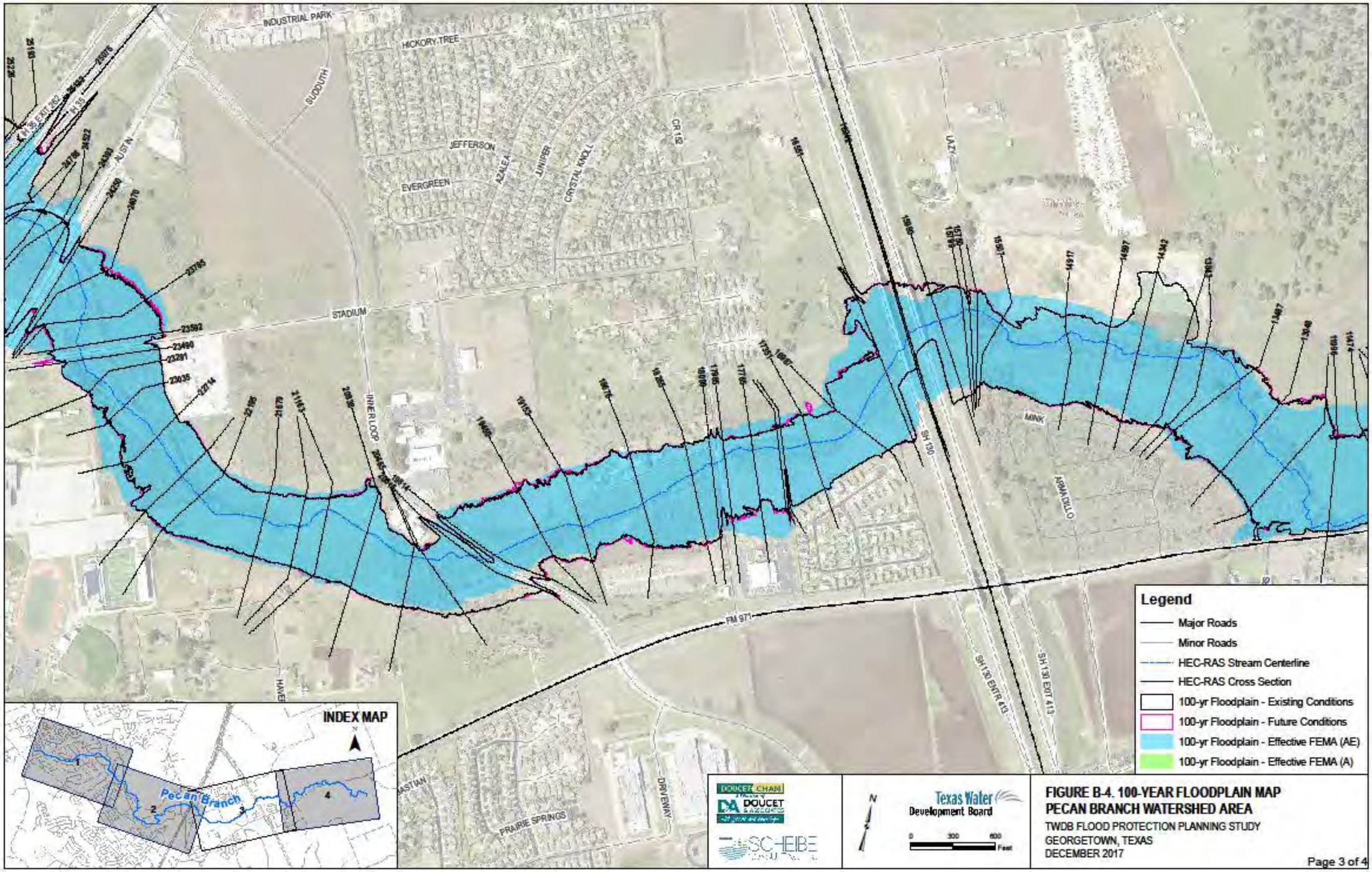
INDUSTRIAL PARK
HICKORY TREE
SUDDUTH
JEFFERSON
EVERGREEN
AZALEA
JUNIPER
CRYSTAL KNOLL
CR 152
AUSTIN
LAZY
STADIUM
INNER LOOP
MINK
ARMADILLO
SH 130
FM 971
SH 130 ENTR 413
SH 130 EXIT 413
HAVEN
PRAIRIE SPRINGS
DRIVEWAY
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100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
Texas Water Development Board
0 300 600 Feet
FIGURE B-4. 100-YEAR FLOODPLAIN MAP
PECAN BRANCH WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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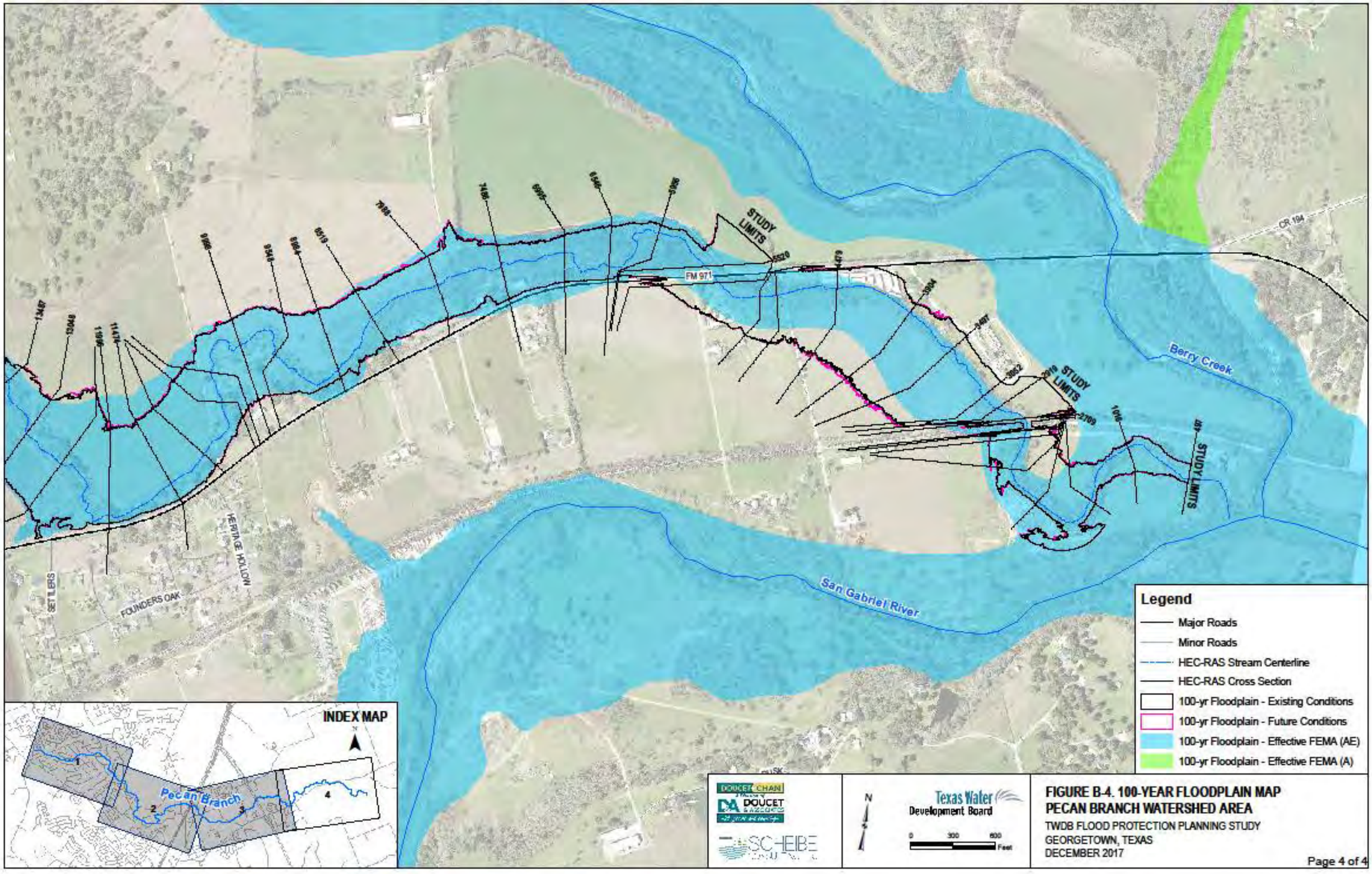
STUDY LIMITS
FM 971
CR 194
Berry Creek
STUDY LIMITS
STUDY LIMITS
San Gabriel River
Pecan Branch
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SETTLERS
FOUNDERS OAK
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100-yr Floodplain - Future Conditions
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100-yr Floodplain - Effective FEMA (A)
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
Texas Water Development Board
0 300 600 Feet
FIGURE B-4. 100-YEAR FLOODPLAIN MAP
PECAN BRANCH WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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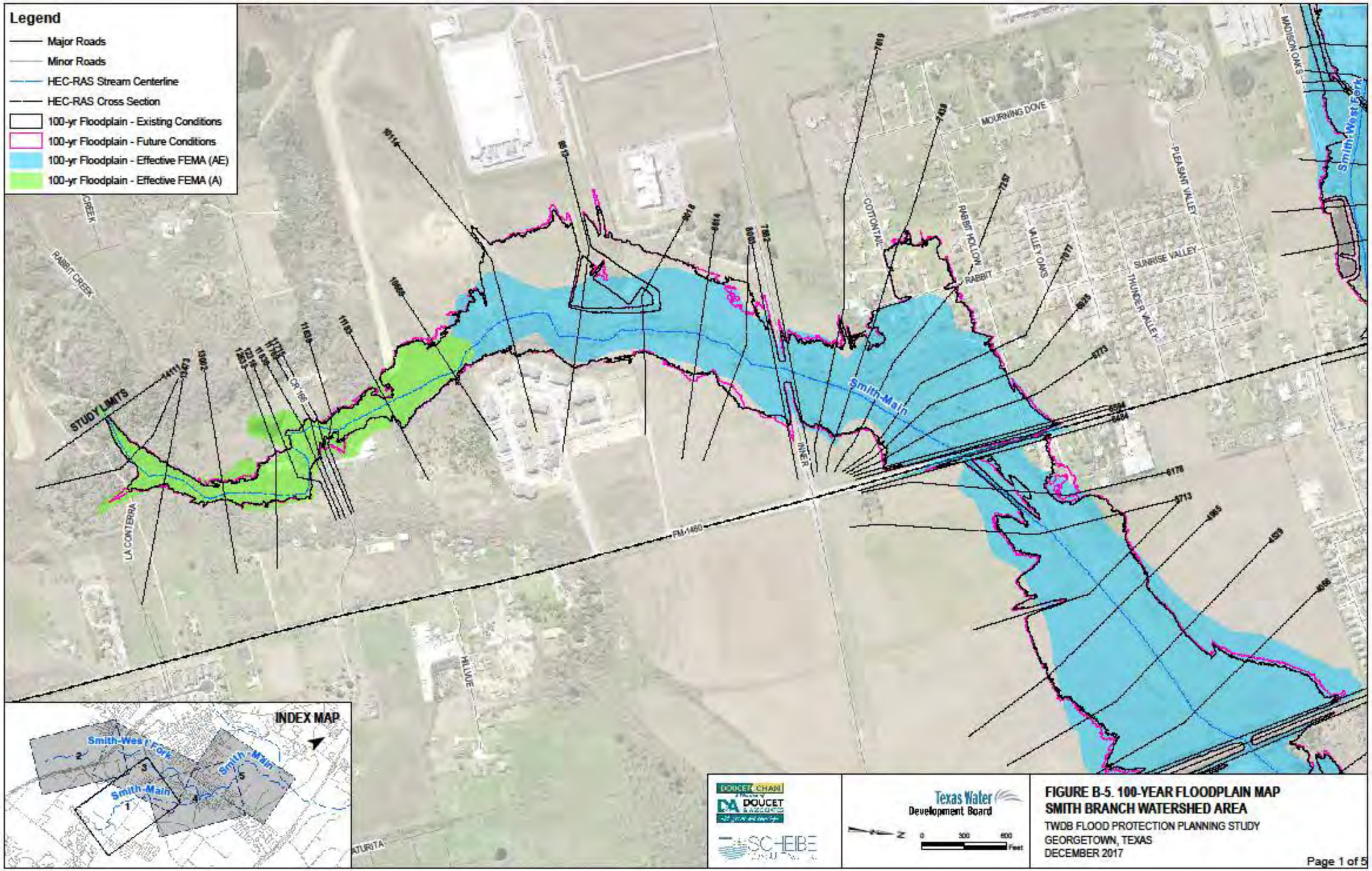
Legend
Major Roads
Minor Roads
HEC-RAS Stream Centerline
HEC-RAS Cross Section
100-yr Floodplain - Existing Conditions
100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
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RABBIT CREEK
LA CONTERRA
CR 166
FM-1460
HILLVIEW
MOURNING DOVE
COTTONTAIL
RABBIT HOLLOW
VALLEY OAKS
SUNRISE VALLEY
PLEASANT VALLEY
THUNDER VALLEY
MADISON OAKS
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Smith-West Fork
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0 300 600 Feet
FIGURE B-5. 100-YEAR FLOODPLAIN MAP
SMITH BRANCH WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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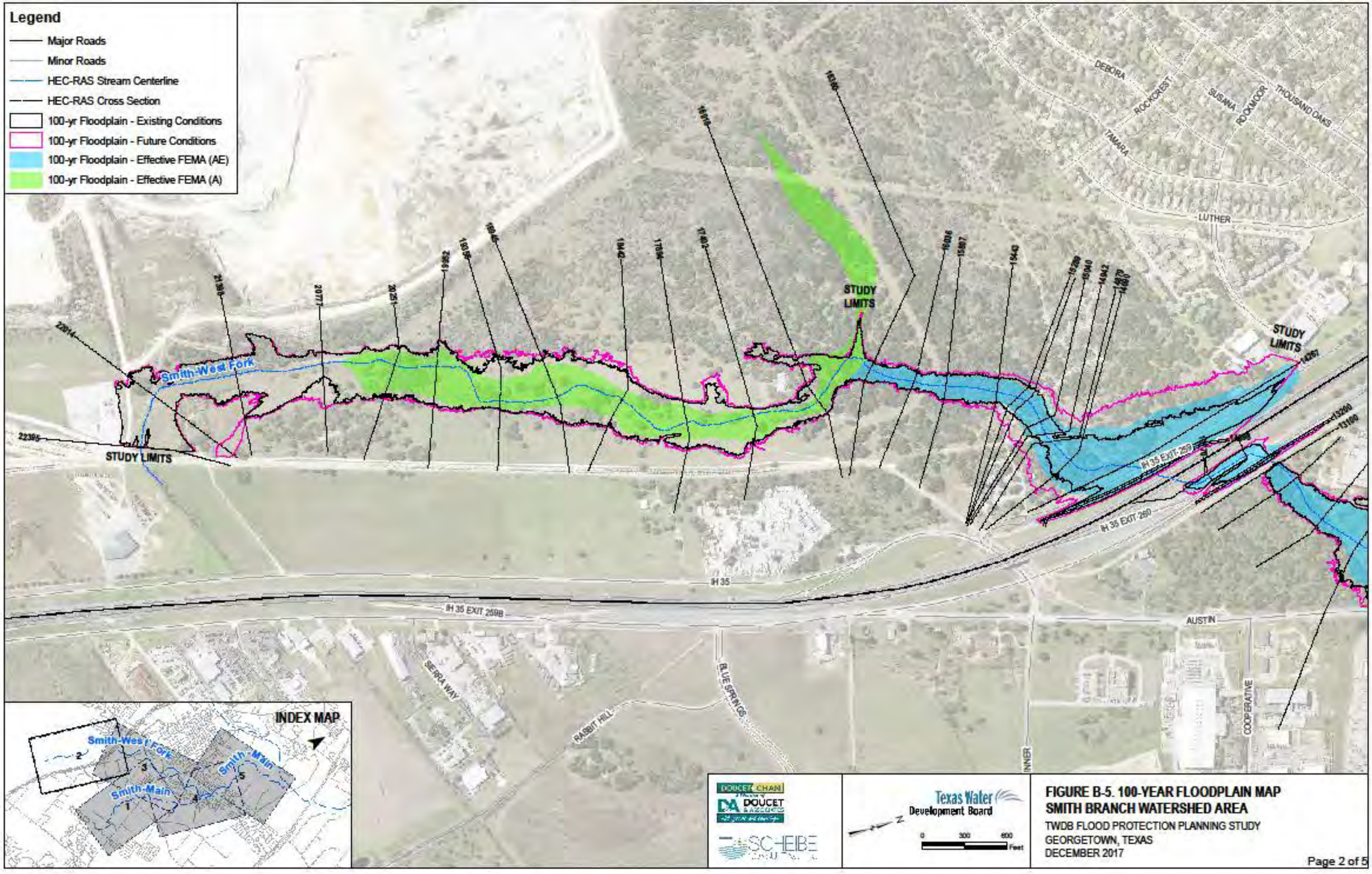
Legend
Major Roads
Minor Roads
HEC-RAS Stream Centerline
HEC-RAS Cross Section
100-yr Floodplain - Existing Conditions
100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
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STUDY LIMITS
STUDY LIMITS
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ROCKCREST
SUSANA
ROCKMOOR
THOUSAND OAKS
TAMARA
LUTHER
IH 35
IH 35 EXIT 259B
IH 35 EXIT 259
AUSTIN
SIERRA WAY
RABBIT HILL
BLUE SPRINGS
COOPERATIVE
INNER
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Smith-Main
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
Texas Water Development Board
0 300 600 Feet
FIGURE B-5. 100-YEAR FLOODPLAIN MAP
SMITH BRANCH WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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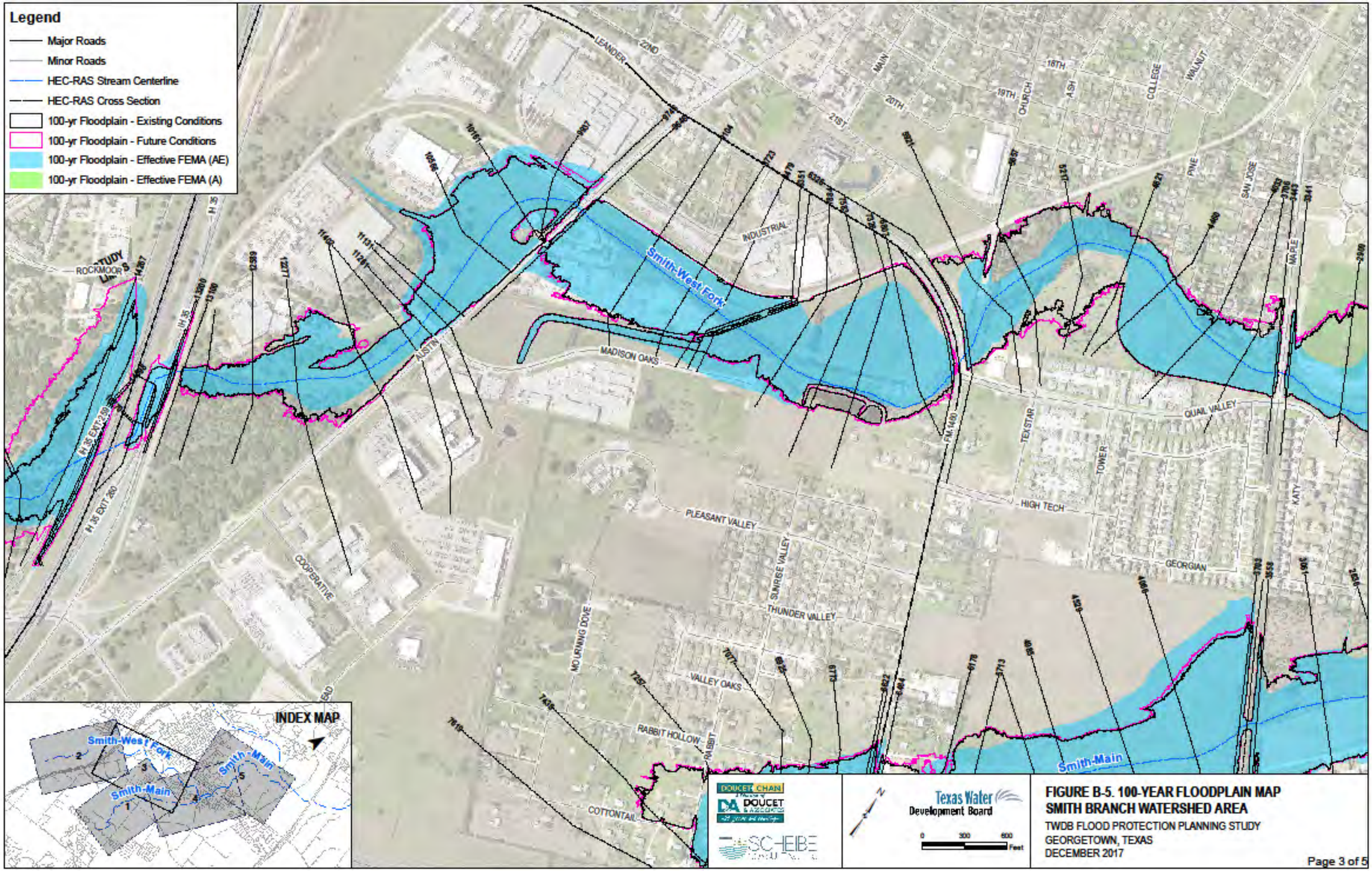
Legend
Major Roads
Minor Roads
HEC-RAS Stream Centerline
HEC-RAS Cross Section
100-yr Floodplain - Existing Conditions
100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
Smith-West Fork
Smith-Main
LEANDER
22ND
MAIN
18TH
19TH
20TH
21ST
CHURCH
ASH
COLLEGE
WALNUT
PINE
SAN JOSE
MAPLE
INDUSTRIAL
AUSTIN
MADISON OAKS
ROCKMOOR
I H 35
I H 35 EXT 259
COOPERATIVE
QUAIL VALLEY
TEXSTAR
TOWER
FM 1460
HIGH TECH
GEORGIAN
KATY
PLEASANT VALLEY
SUNRISE VALLEY
THUNDER VALLEY
MOURNING DOVE
VALLEY OAKS
RABBIT HOLLOW
RABBIT
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DOUCET & ASSOCIATES
SCHEIBE
Texas Water Development Board
0 300 600 Feet
FIGURE B-5. 100-YEAR FLOODPLAIN MAP
SMITH BRANCH WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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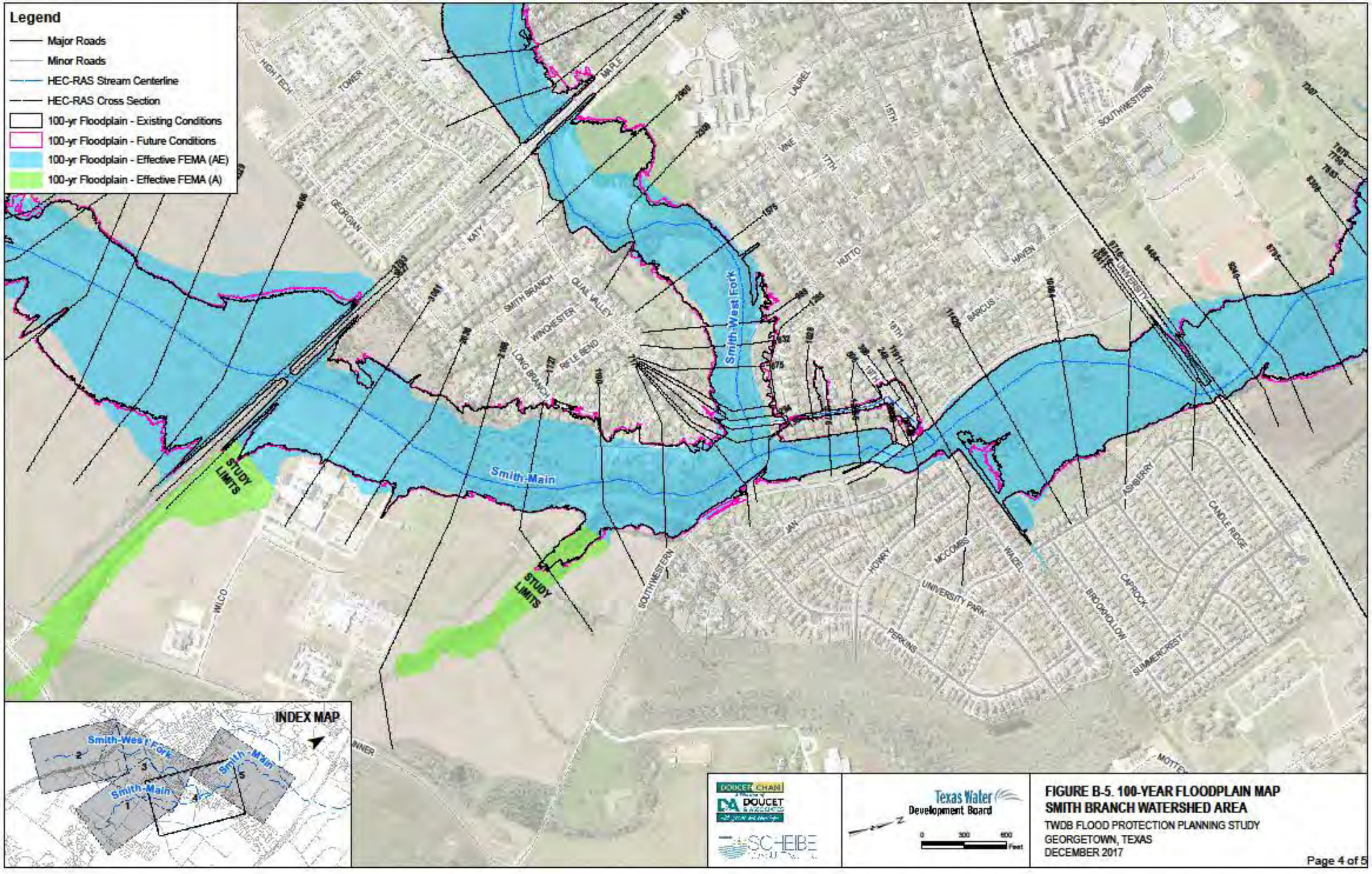
Legend
Major Roads
Minor Roads
HEC-RAS Stream Centerline
HEC-RAS Cross Section
100-yr Floodplain - Existing Conditions
100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
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0 300 600 Feet
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SMITH BRANCH WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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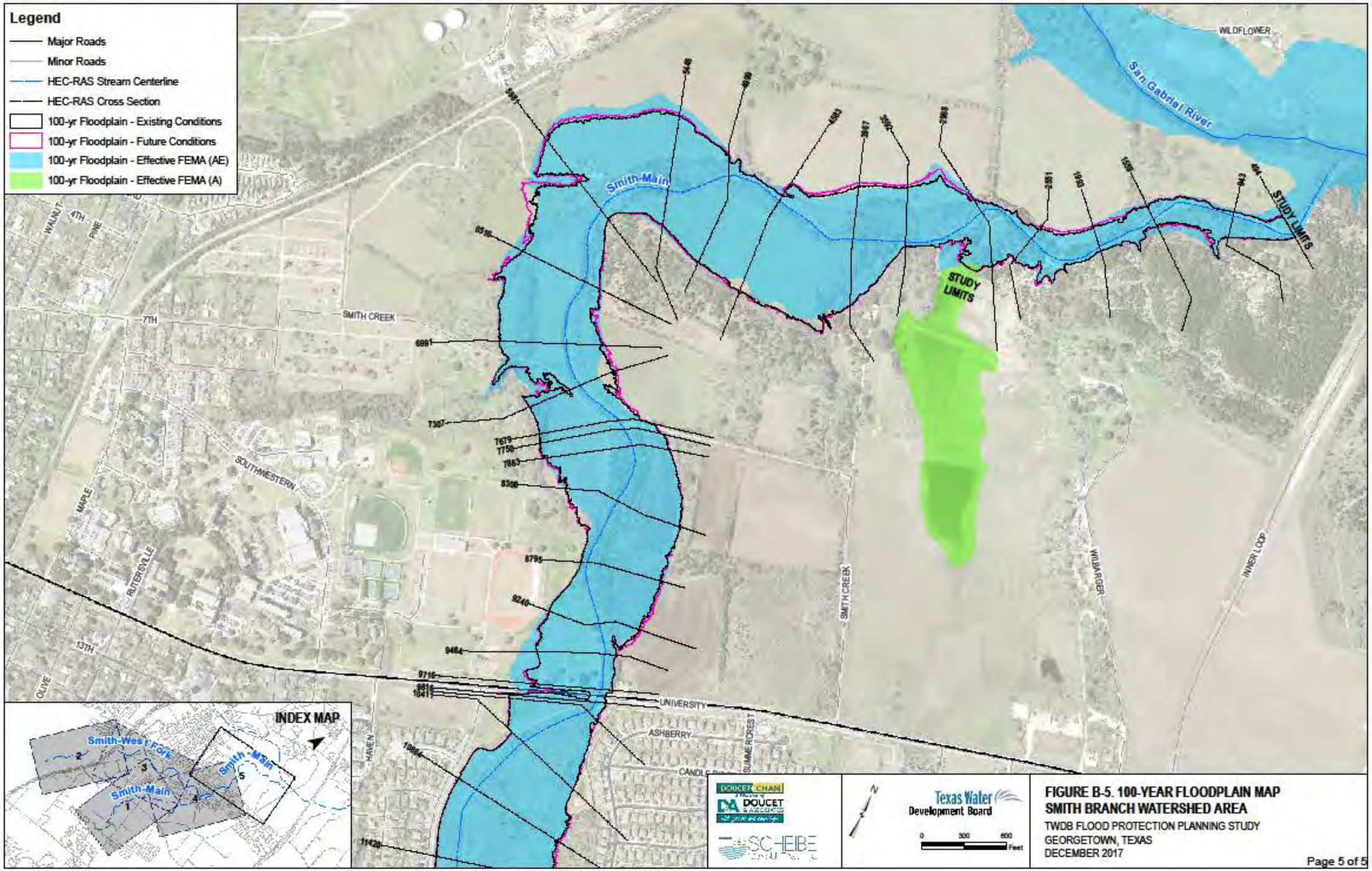
Legend
Major Roads
Minor Roads
HEC-RAS Stream Centerline
HEC-RAS Cross Section
100-yr Floodplain - Existing Conditions
100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
Smith-Main
San Gabriel River
WILDFLOWER
STUDY LIMITS
STUDY LIMITS
SMITH CREEK
SMITH CREEK
WALNUT
4TH
PINE
7TH
SOUTHWESTERN
MAPLE
RUTERSVILLE
13TH
OLIVE
HAVEN
UNIVERSITY
ASHBERRY
SUMMERFOREST
WILBARGER
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Smith-Main
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0 300 600 Feet
FIGURE B-5. 100-YEAR FLOODPLAIN MAP
SMITH BRANCH WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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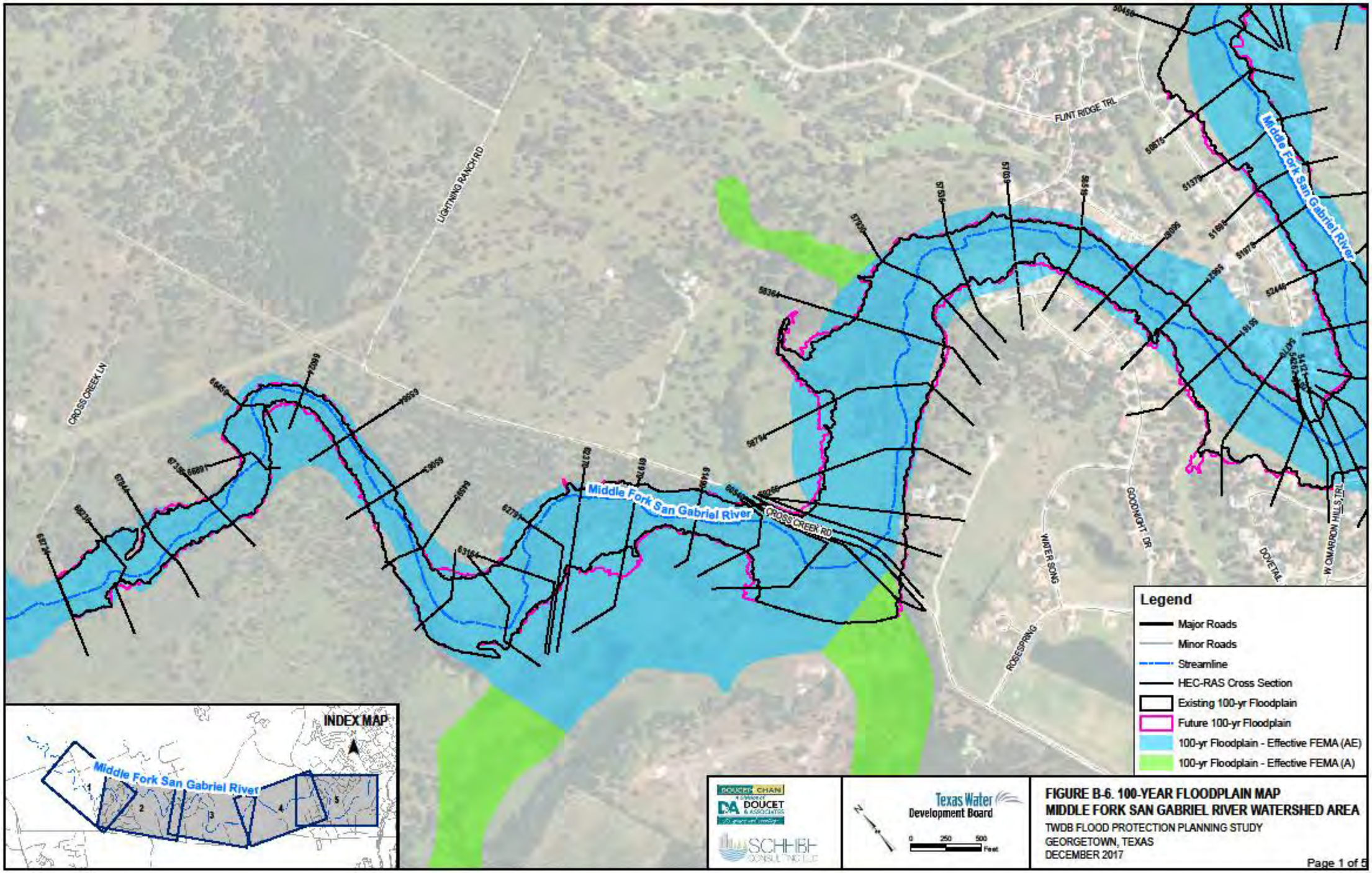
FLINT RIDGE TRL
LIGHTNING RANCH RD
CROSS CREEK LN
Middle Fork San Gabriel River
CROSS CREEK RD
GOODNIGHT DR
W CIMARRON HILLS TRL
WIDER BEND
ROSESPRING
DOVETAIL
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Streamline
HEC-RAS Cross Section
Existing 100-yr Floodplain
Future 100-yr Floodplain
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
DOUCET CHAN
DOUCET & ASSOCIATES
SCHIEBE CONSULTING LLC
Texas Water Development Board
0 250 500 Feet
FIGURE B-6. 100-YEAR FLOODPLAIN MAP
MIDDLE FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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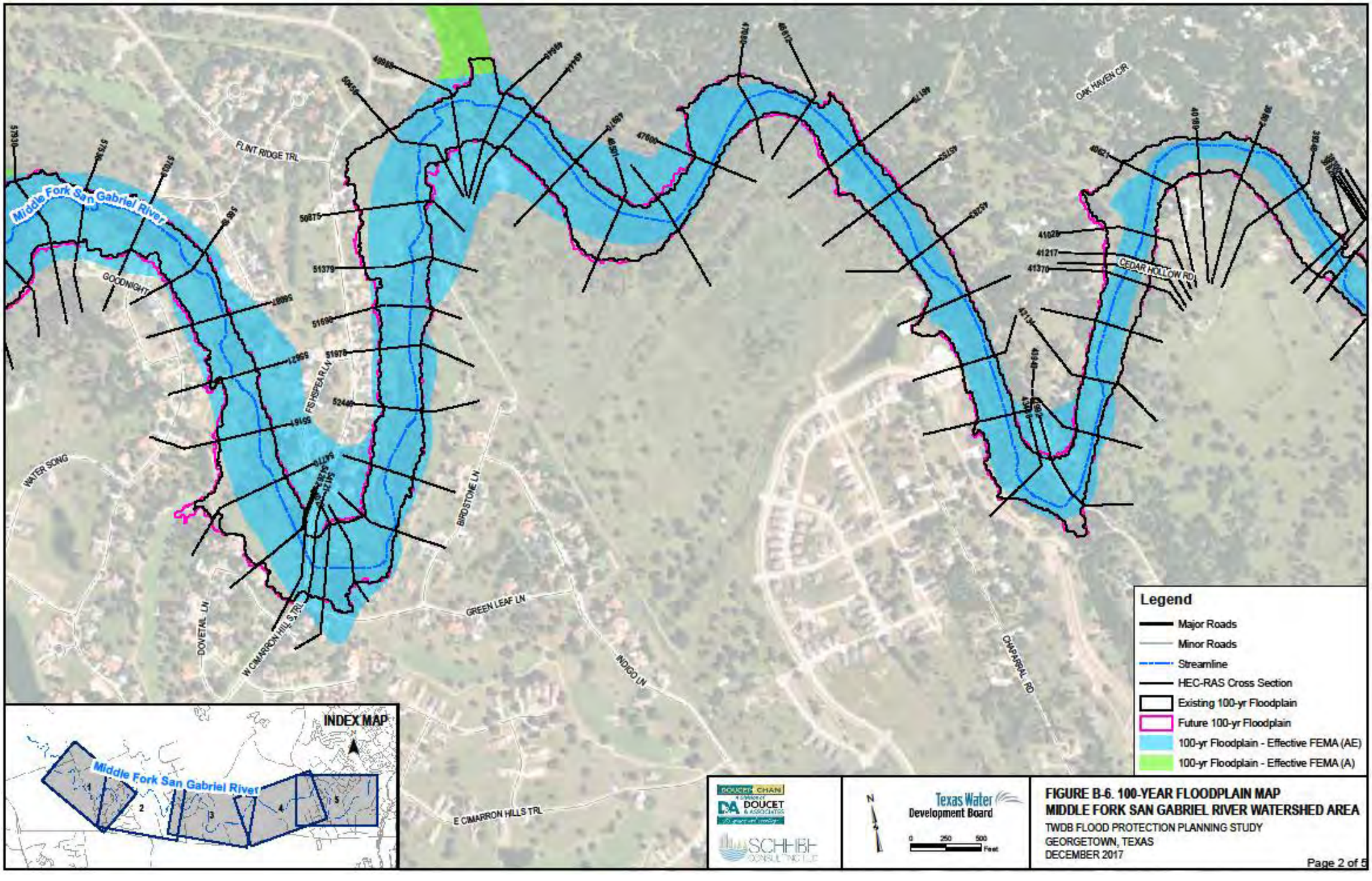
Middle Fork San Gabriel River
FLINT RIDGE TRL
GOODNIGHT
FISHSPEAR PLY
WATER SONG
BIRDSTONE LN
DOVETAIL LN
W CIMARRON HILLS TRL
GREEN LEAF LN
INDIGO LN
E CIMARRON HILLS TRL
OAK HAVEN CIR
CEDAR HOLLOW RD
CHAPARRAL RD
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HEC-RAS Cross Section
Existing 100-yr Floodplain
Future 100-yr Floodplain
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIB CONSULTING LLC
Texas Water Development Board
0 250 500 Feet
FIGURE B-6. 100-YEAR FLOODPLAIN MAP
MIDDLE FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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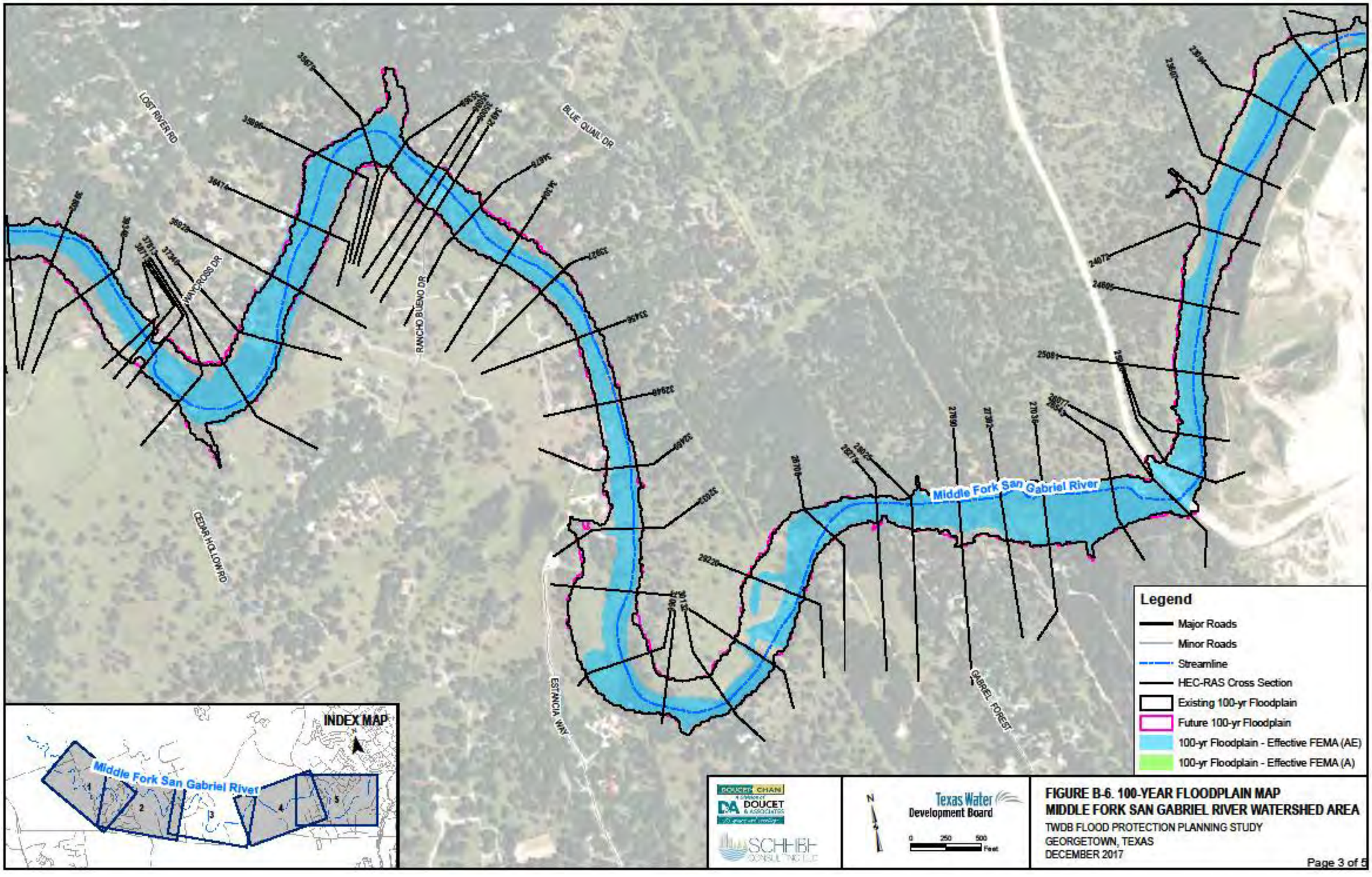
LOST RIVER RD
BLUE QUAIL DR
RANCHO BUENO DR
WAYCROSS DR
CEDAR HOLLOW RD
ESTANCIA WAY
GABRIEL FOREST
Middle Fork San Gabriel River
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4
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Minor Roads
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Future 100-yr Floodplain
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
DOUCET CHAN
DOUCET & ASSOCIATES
SCHNIEB CONSULTING LLC
N
Texas Water Development Board
0 250 500 Feet
FIGURE B-6. 100-YEAR FLOODPLAIN MAP
MIDDLE FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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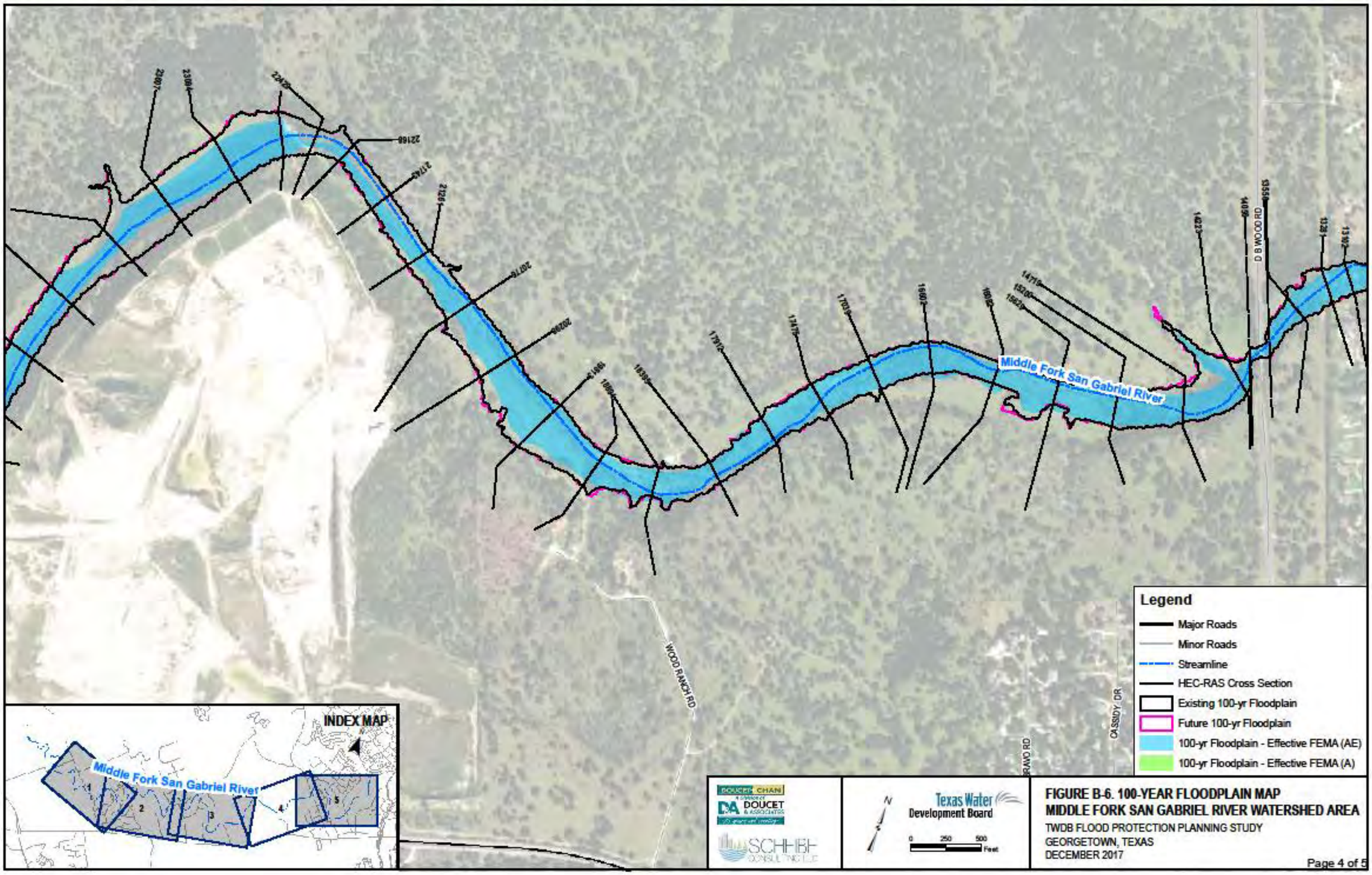
Middle Fork San Gabriel River
WOOD RANCH RD
CASSIDY DR
BRAVO RD
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Future 100-yr Floodplain
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
Texas Water Development Board
0 250 500 Feet
FIGURE B-6. 100-YEAR FLOODPLAIN MAP
MIDDLE FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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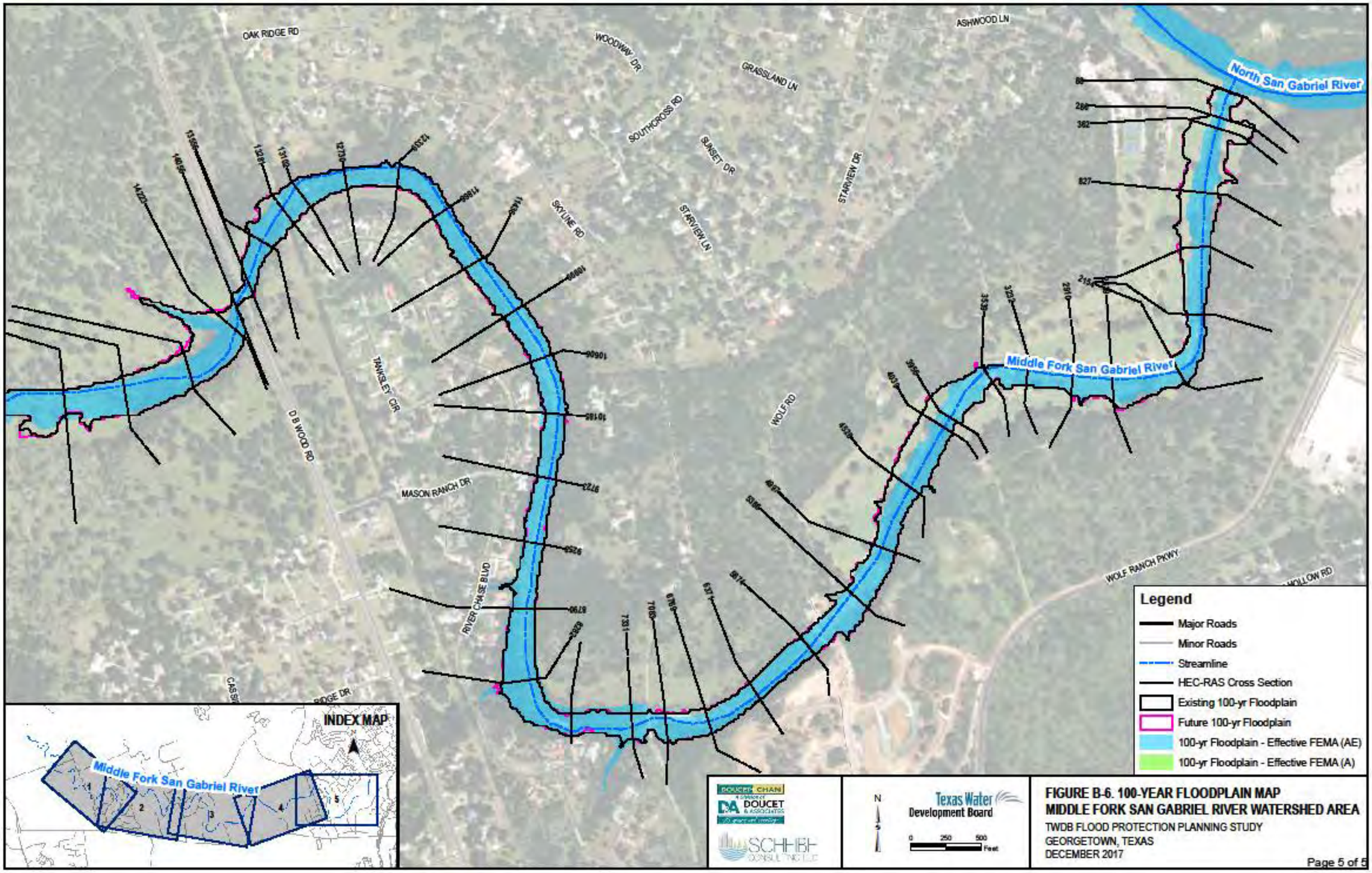
OAK RIDGE RD
WOODWAY DR
GRASSLAND LN
ASHWOOD LN
SOUTHCROSS RD
SUNSET DR
STARVIEW DR
STARVIEW LN
SKYLINE RD
TRAWSLEY CIR
D B WOOD RD
WOLF RD
MASON RANCH DR
RIVER CHASE BLVD
WOLF RANCH PKWY
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Minor Roads
Streamline
HEC-RAS Cross Section
Existing 100-yr Floodplain
Future 100-yr Floodplain
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
DOUCET CHAN
DOUCET & ASSOCIATES
SCHIEBE CONSULTING LLC
N
Texas Water Development Board
0 250 500 Feet
FIGURE B-6. 100-YEAR FLOODPLAIN MAP
MIDDLE FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
DECEMBER 2017
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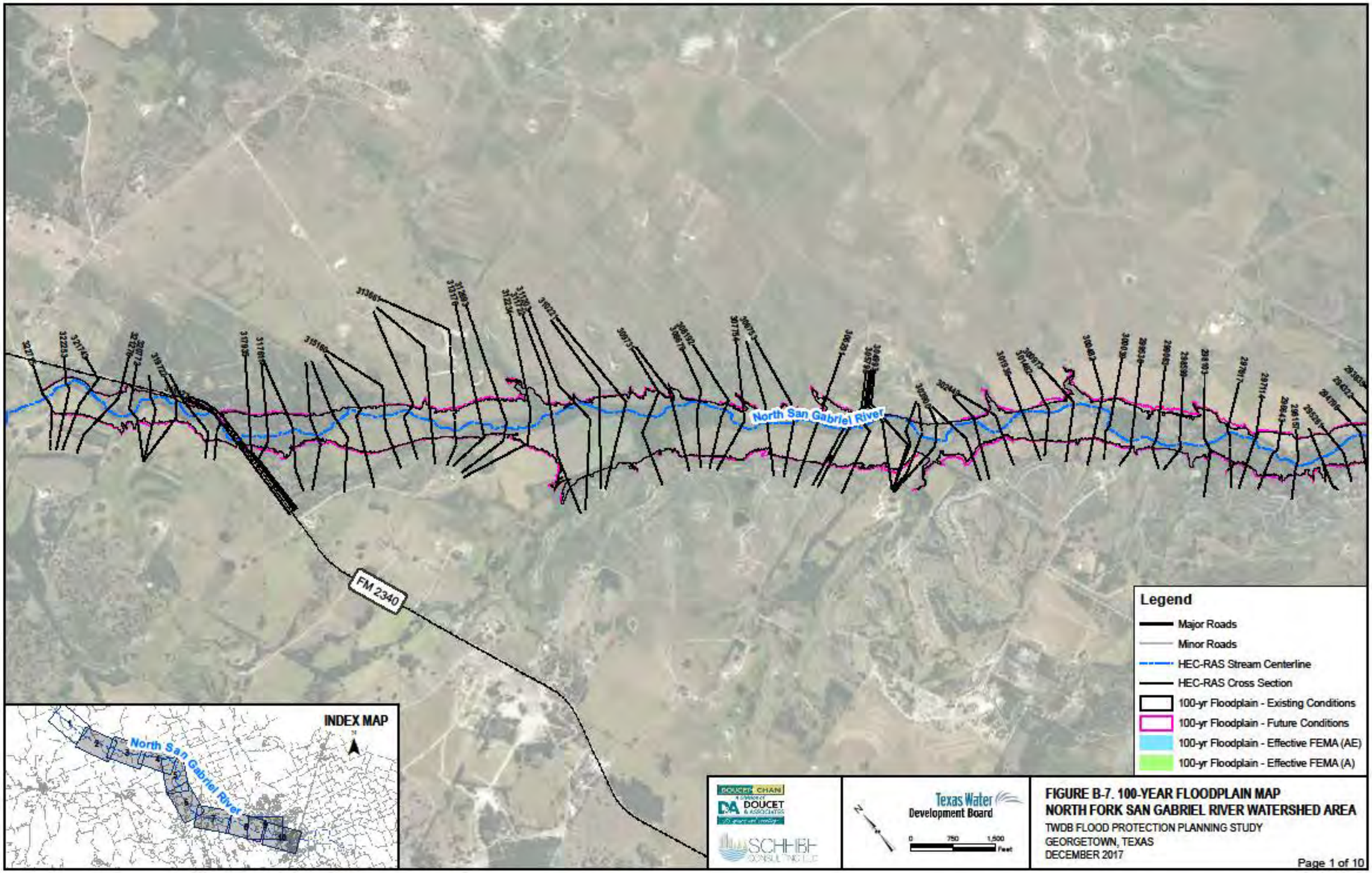
North San Gabriel River
FM 2340
INDEX MAP
North San Gabriel River
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Major Roads
Minor Roads
HEC-RAS Stream Centerline
HEC-RAS Cross Section
100-yr Floodplain - Existing Conditions
100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
Texas Water Development Board
0 750 1,500 Feet
FIGURE B-7. 100-YEAR FLOODPLAIN MAP
NORTH FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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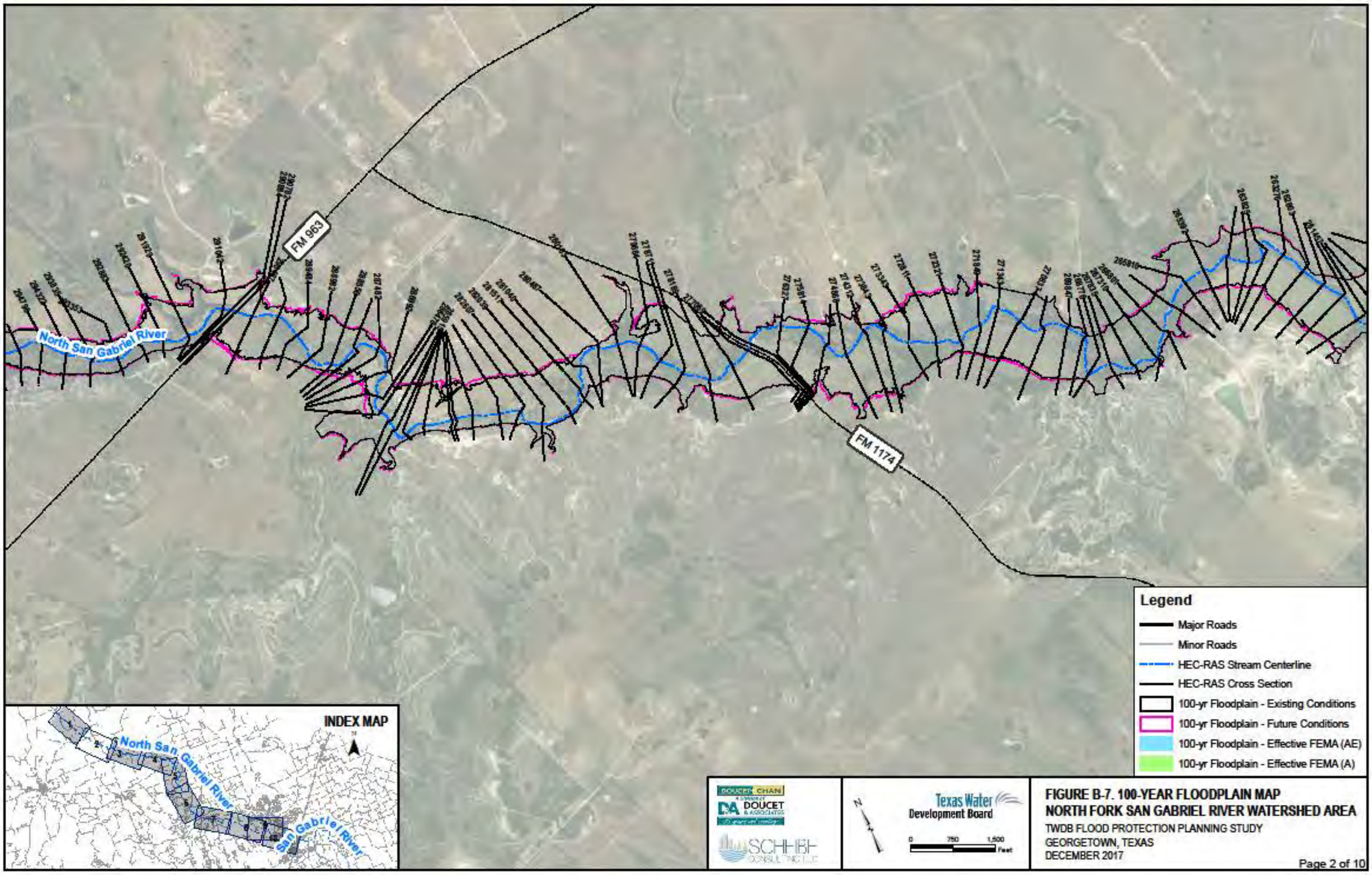
FM 963
FM 1174
North San Gabriel River
INDEX MAP
North San Gabriel River
San Gabriel River
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HEC-RAS Stream Centerline
HEC-RAS Cross Section
100-yr Floodplain - Existing Conditions
100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIB CONSULTING LLC
Texas Water Development Board
0 750 1,500 Feet
FIGURE B-7. 100-YEAR FLOODPLAIN MAP
NORTH FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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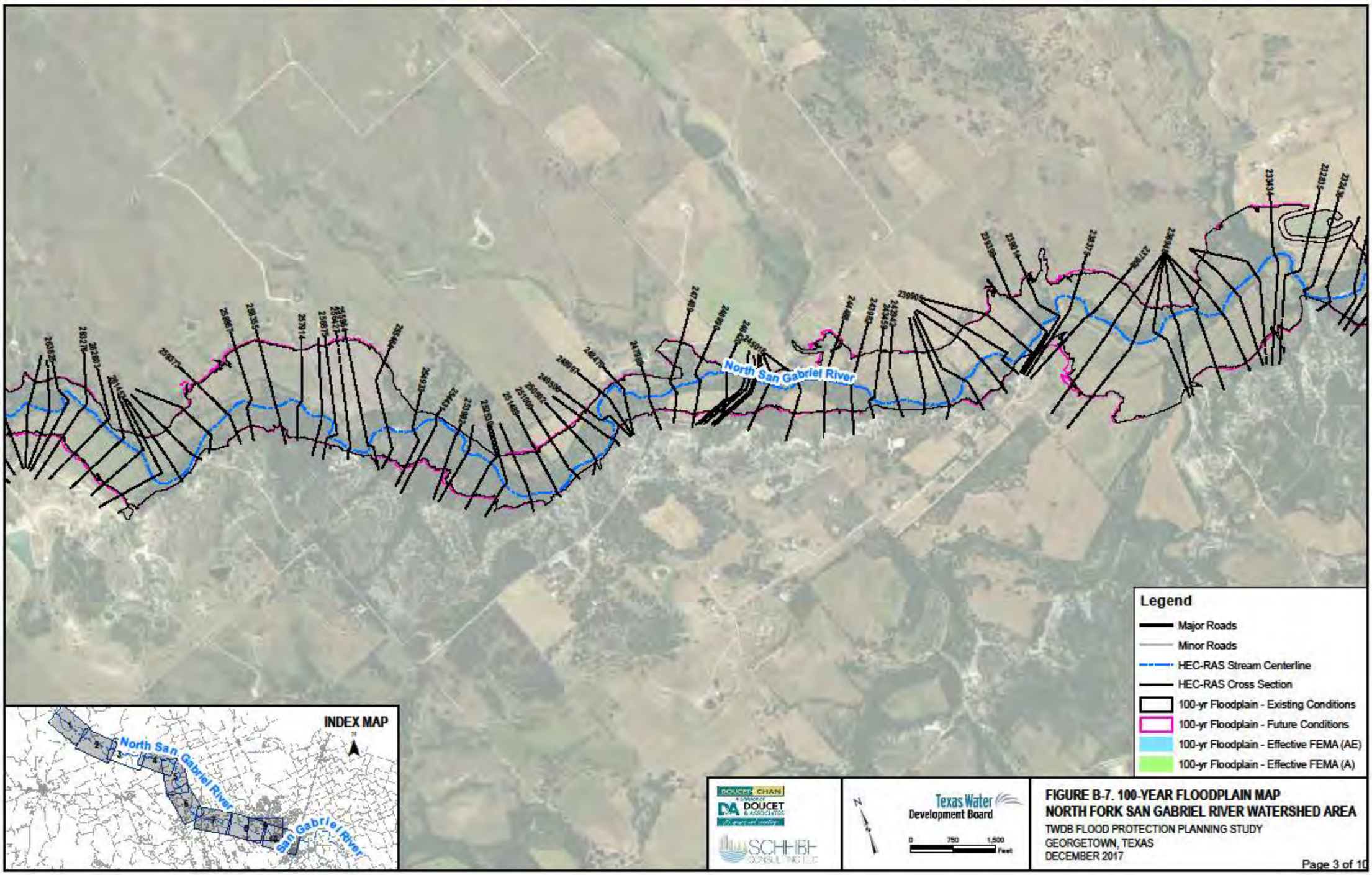
North San Gabriel River
INDEX MAP
North San Gabriel River
San Gabriel River
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Major Roads
Minor Roads
HEC-RAS Stream Centerline
HEC-RAS Cross Section
100-yr Floodplain - Existing Conditions
100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
DOUCET CHAN
DOUCET & ASSOCIATES
SCHIEBE CONSULTING LLC
Texas Water Development Board
0 750 1,500 Feet
FIGURE B-7. 100-YEAR FLOODPLAIN MAP
NORTH FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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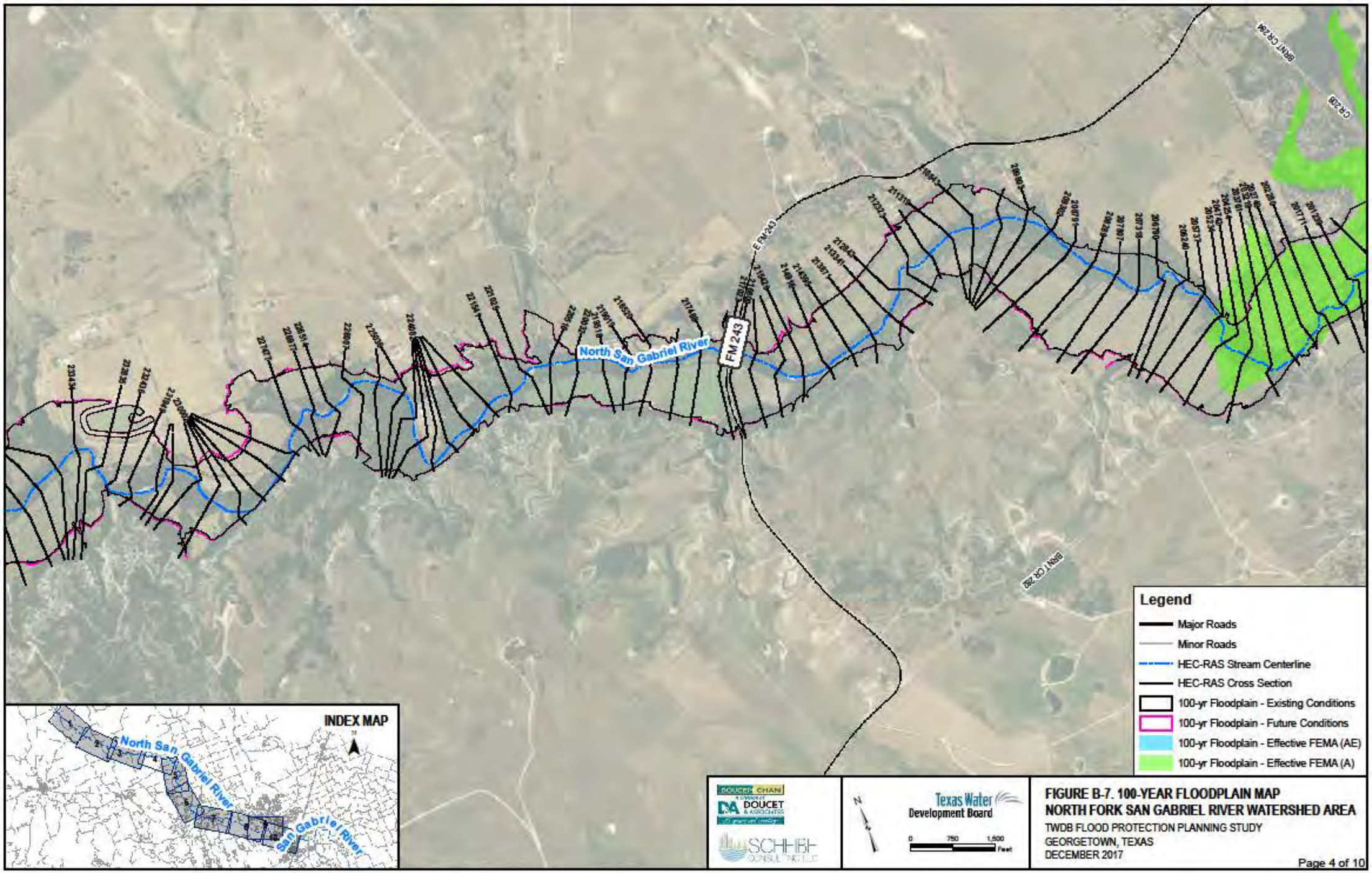
North San Gabriel River
FM 243
E FM243
BENT CR 236
CR 236
INDEX MAP
North San Gabriel River
San Gabriel River
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Major Roads
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HEC-RAS Stream Centerline
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100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
Texas Water Development Board
0 750 1,500 Feet
FIGURE B-7. 100-YEAR FLOODPLAIN MAP
NORTH FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
GEORGETOWN, TEXAS
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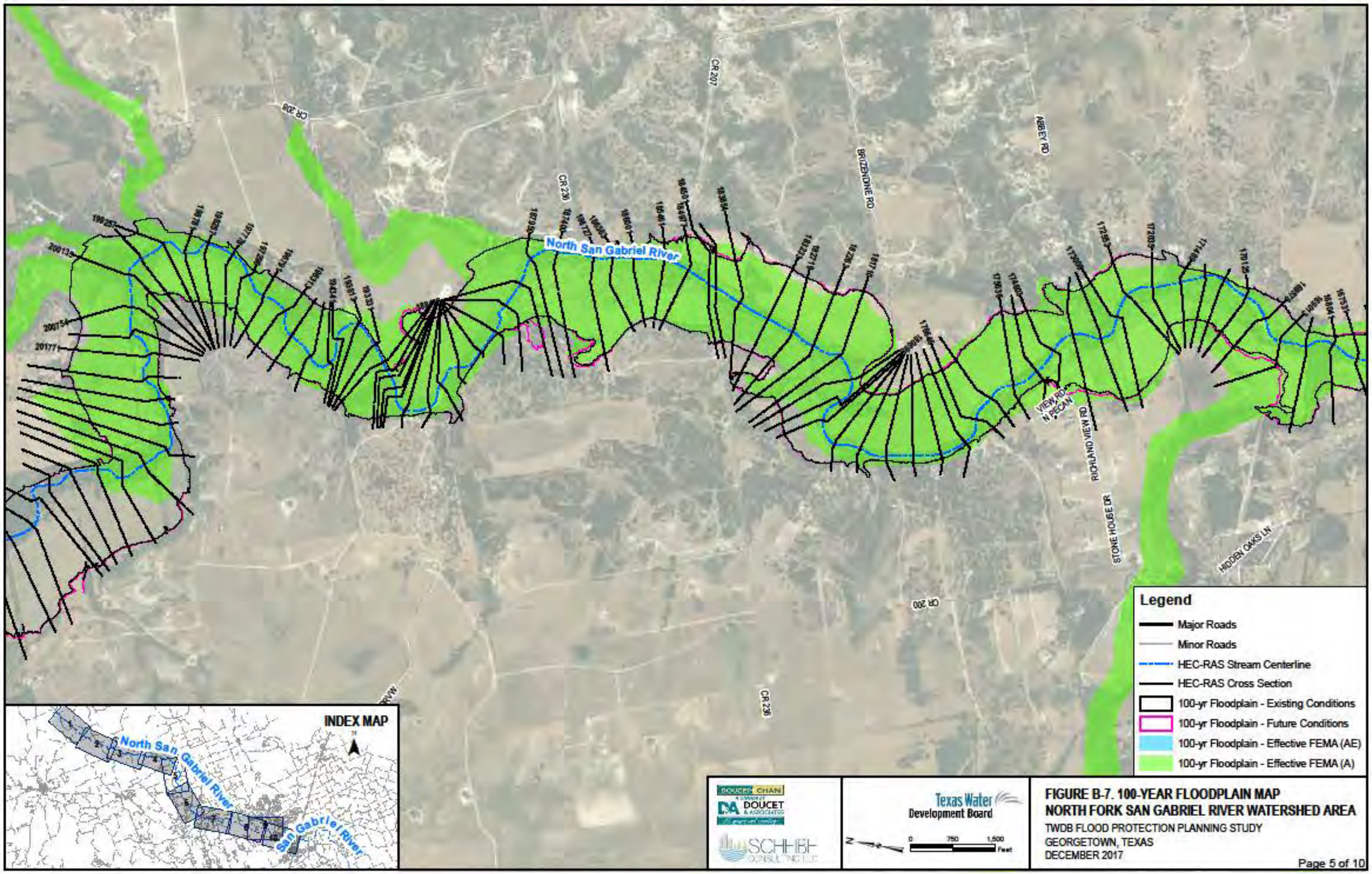
North San Gabriel River
CR 207
CR 236
CR 238
CR 200
BRIZENDINE RD
ABBEY RD
VIEW RD
N PECAN
RICHLAND VIEW RD
STONE HOUSE DR
HIDDEN OAKS LN
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100-yr Floodplain - Existing Conditions
100-yr Floodplain - Future Conditions
100-yr Floodplain - Effective FEMA (AE)
100-yr Floodplain - Effective FEMA (A)
DOUCET, CHAN
DOUCET & ASSOCIATES
SCHEIB CONSULTING LLC
Texas Water Development Board
0 750 1,500 Feet
FIGURE B-7. 100-YEAR FLOODPLAIN MAP
NORTH FORK SAN GABRIEL RIVER WATERSHED AREA
TWDB FLOOD PROTECTION PLANNING STUDY
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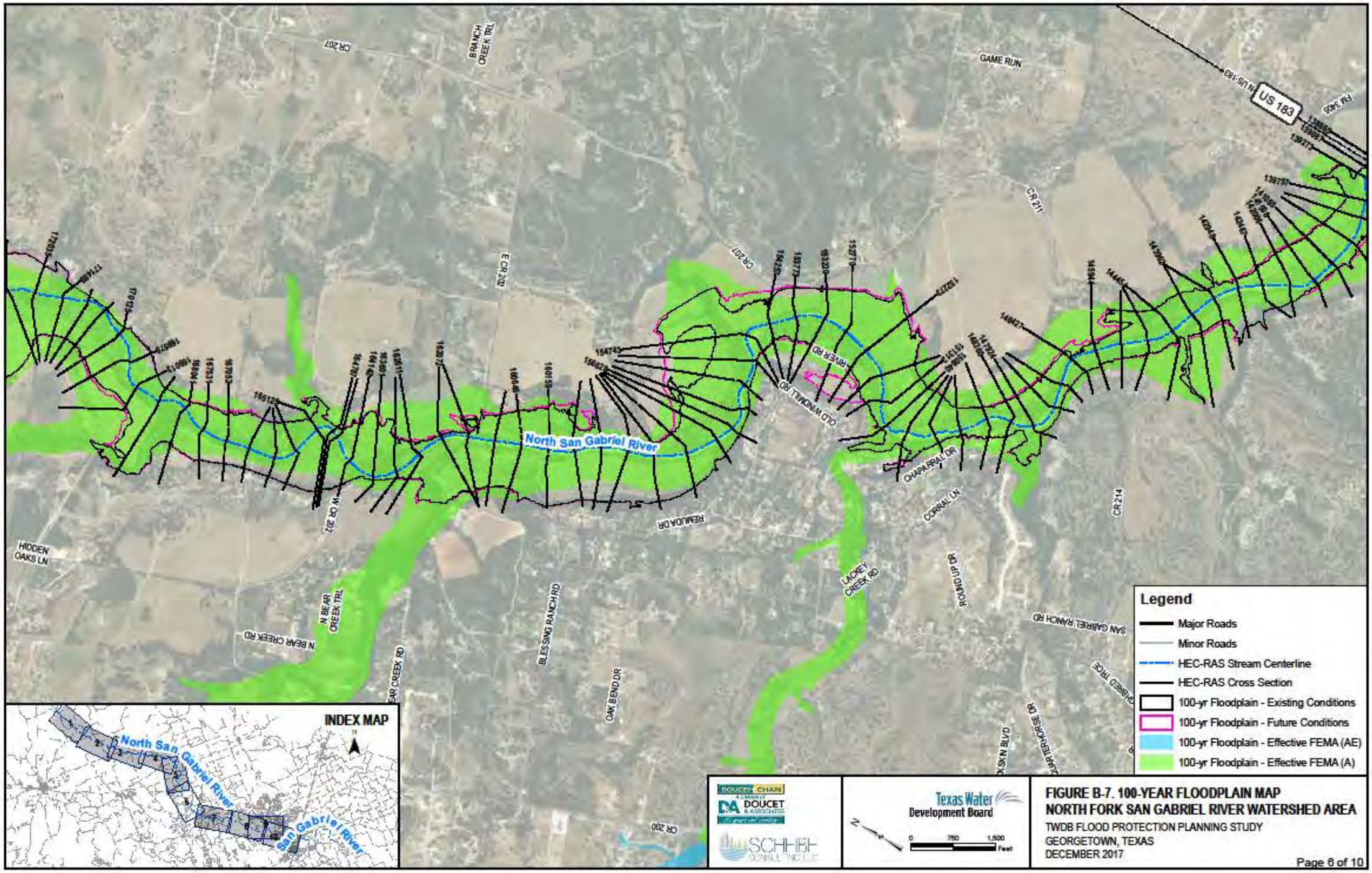
North San Gabriel River
US 183
GAME RUN
CR 207
BRANCH CREEK TRL
E CR 202
W CR 202
CR 211
CR 214
CR 200
OLD WINDMILL RD
RIVER RD
CHAPARRAL DR
CORRAL LN
REMUDA DR
LACKEY CREEK RD
ROUND UP DR
SAN GABRIEL RANCH RD
HIDDEN OAKS LN
N BEAR CREEK TRL
N BEAR CREEK RD
BLESSING RANCH RD
OAK BEND DR
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100-yr Floodplain - Effective FEMA (A)
Texas Water Development Board
0 750 1,500 Feet
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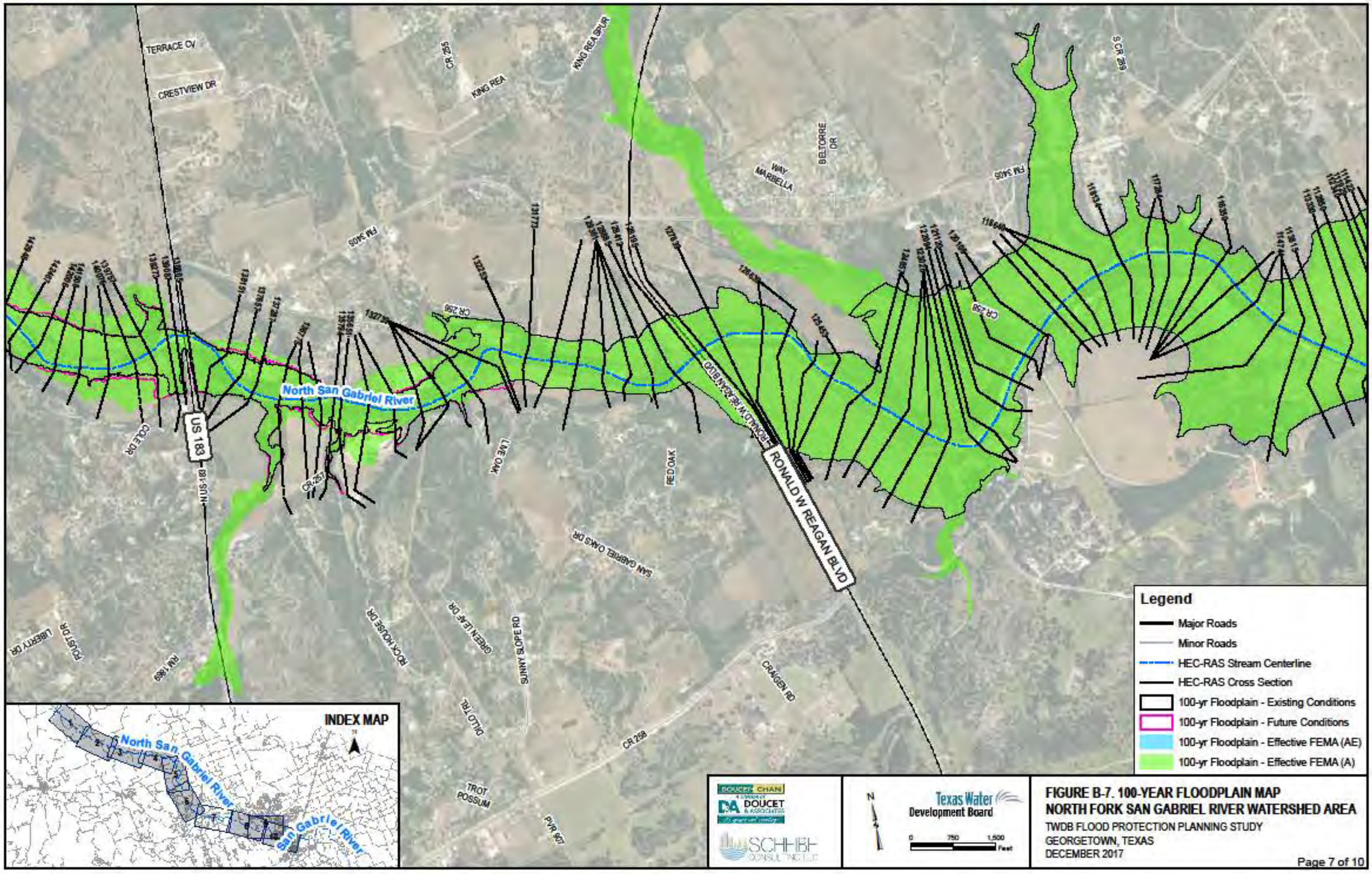
TERRACE CV
CRESTVIEW DR
CR 255
KING REA
KING REA SPUR
WAY MARBELLA
BELTORRE DR
FM 3405
S CR 259
CR 258
US 183
N US-183
North San Gabriel River
COLE DR
CR 257
LAKE OAK
RED OAK
RONALD W REAGAN BLVD
SAN GABRIEL OAKS DR
ROCK HOUSE DR
GREEN LEAF DR
SUNNY SLOPE RD
DILLO TRL
CRAGEN RD
CR 256
TROT
POSSUM
PVR 907
LIBERTY DR
RUST DR
RM 1869
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DOUCET CHAN
DOUCET & ASSOCIATES
SCHIEF CONSULTING LLC
Texas Water Development Board
0 750 1,500 Feet
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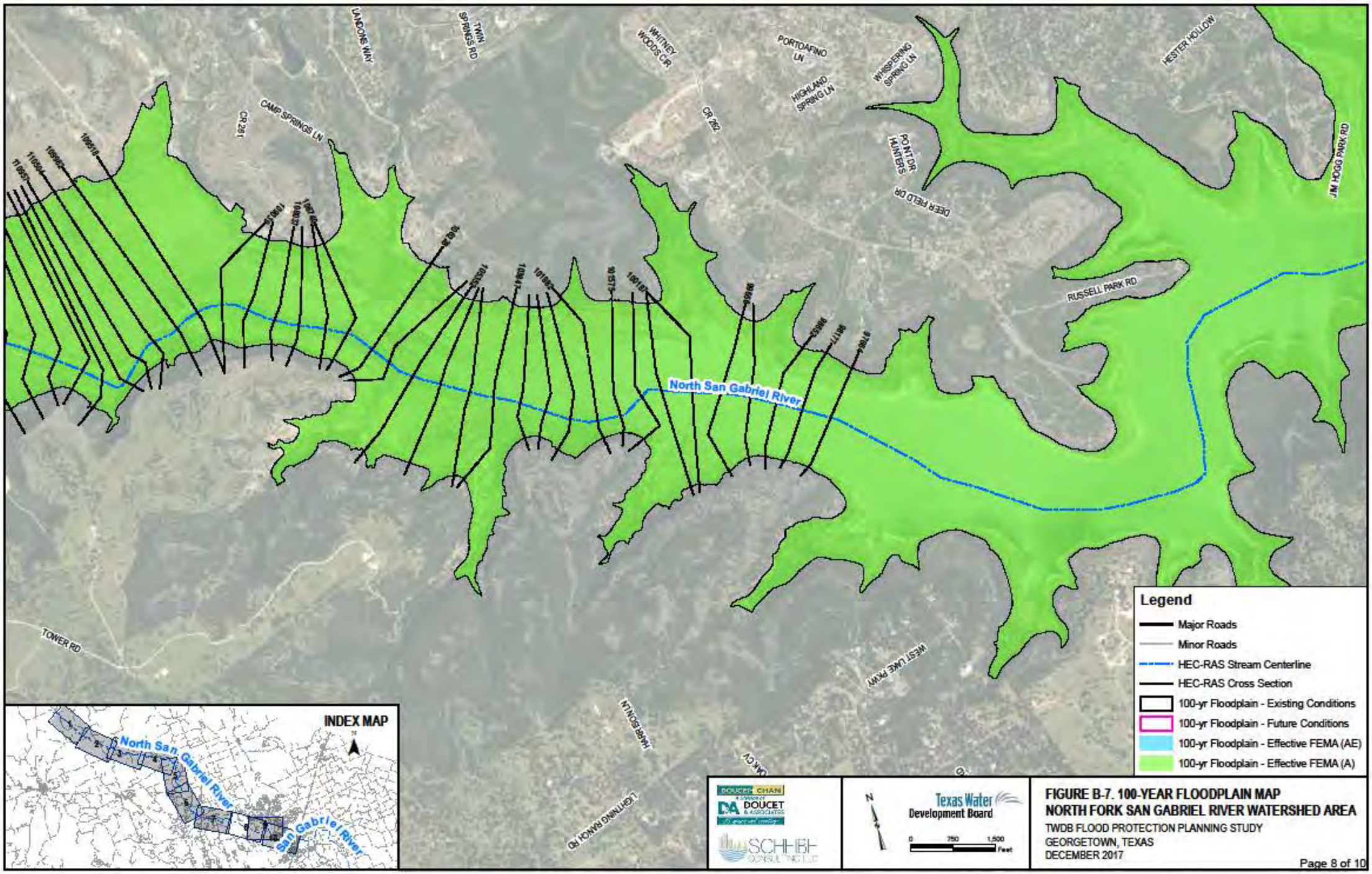
CAMP SPRINGS LN
CR 261
LANDONS WAY
TWIN SPRINGS RD
WHITNEY WOODS CIR
PORTOAFINO LN
HIGHLAND SPRING LN
CR 262
WHISPERING SPRING LN
HESTER HOLLOW
POINT DR HUNTERS
DEER FIELD DR
J.M. HOGG PARK RD
RUSSELL PARK RD
North San Gabriel River
TOWER RD
MABE BEND LN
LIGHTNING RANCH RD
WEST LAKE PKWY
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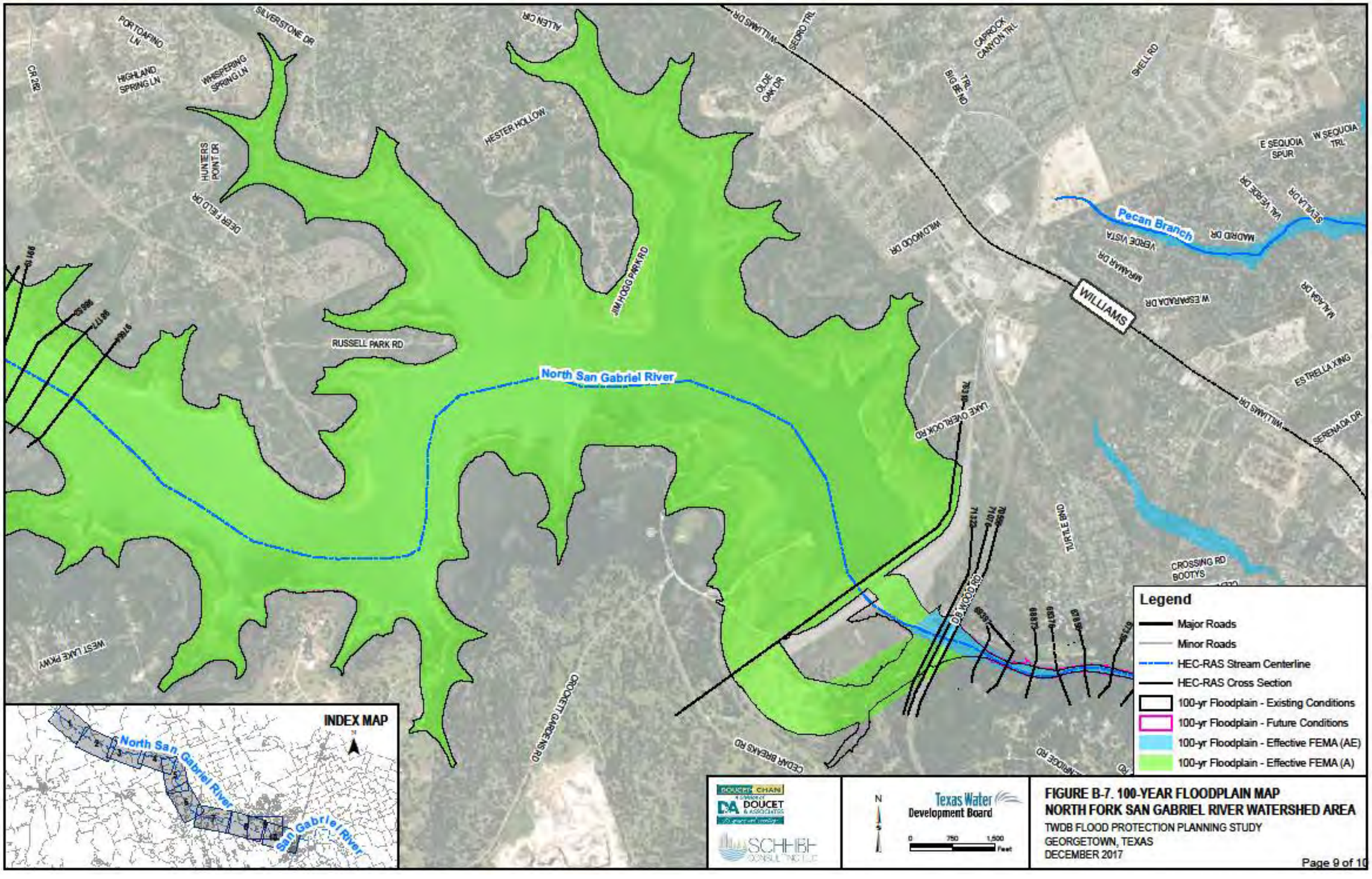
PORTOAFINO LN
SILVERSTONE DR
ALLEN CIR
WILLIAMS DR
SEDRO TRL
CAPROCK CANYON TRL
SHELL RD
HIGHLAND SPRING LN
WHISPERING SPRING LN
CR 282
HESTER HOLLOW
OLDE OAK DR
BIG BEND TRL
E SEQUOIA SPUR
W SEQUOIA TRL
HUNTERS POINT DR
DEER FIELD DR
JIM HOGG PARK RD
WILDWOOD DR
Pecan Branch
VERDE VISTA
MIRAMAR DR
MADRID DR
VAL VERDE DR
SEVILLA DR
WILLIAMS
W ESPARADA DR
MALACA DR
RUSSELL PARK RD
North San Gabriel River
LAKE OVERLOOK RD
ES TRELLA XING
WILLIAMS DR
SERENADA DR
TURTLE BND
CROSSING RD
BOOTYS
WEST LAKE PKWY
CROCKETT GARDENS RD
CEDAR BREAKS RD
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DOUCET & ASSOCIATES
SCHIEF CONSULTING LLC
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0 750 1,500 Feet
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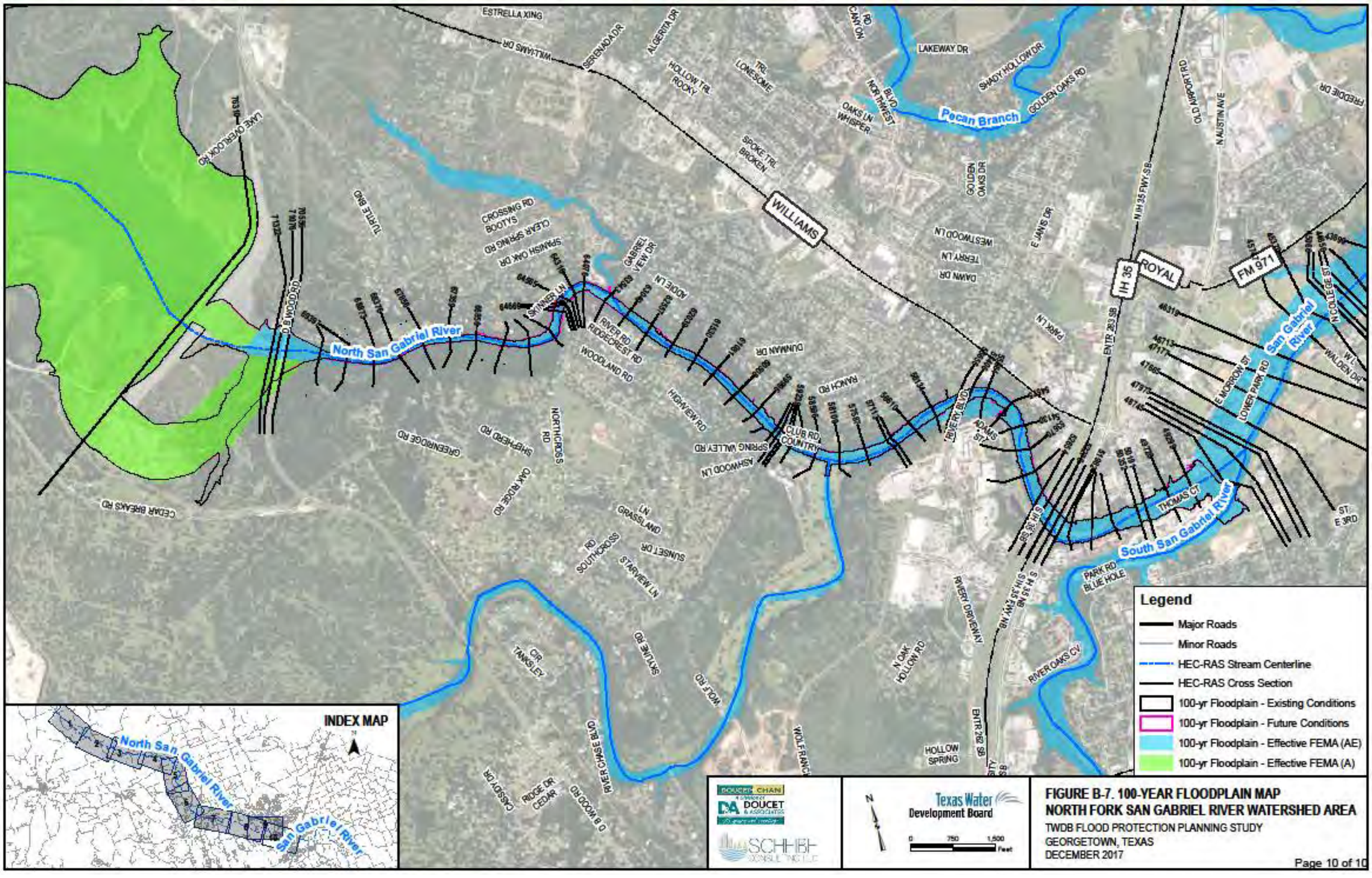
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WILLIAMS DR
SERENADA DR
ALGERITA DR
HOLLOW TRL ROCKY
TRL LONESOME
CANYON RD
LAKEWAY DR
SHADY HOLLOW DR
GOLDEN OAKS RD
OAKS LN WHISPER
BLVD NORTHWEST
Pecan Branch
SPOKE TRL BROKEN
WILLIAMS
GOLDEN OAKS DR
WESTWOOD LN
TERRY LN
DAWN DR
E JAMES DR
PARK LN
OLD MORGAN RD
N AUSTIN AVE
FREDDIE DR
N COLLEGE ST
WALDEN DR
IH 35
ROYAL
FM 971
N IH 35 FWY SB
ENTR IH 35 SB
LAKE OVERLOOK RD
TURTLE BND
CROSSING RD BOOTYS
CLEAR SPRING RD
SPANISH OAK DR
GABRIEL VIEW DR
SKINNER LN
NOOLE LN
RIVER RD
RIDGECREST RD
WOODLAND RD
North San Gabriel River
DUNMAN DR
RANCH RD
HIGHVIEW RD
CLUB RD COUNTRY
SPRING VALLEY RD
ASHWOOD LN
RIVERY BLVD
ADAMS ST
THOMAS CT
San Gabriel River
LOWER PARK RD
E MORROW ST
E 3RD ST
S IH 35 SB
S IH 35 FWY NB
PARK RD BLUE HOLE
South San Gabriel River
RIVERY DRIVEWAY
N OAK HOLLOW RD
RIVER OAKS CV
ENTR IH 35 SB
HOLLOW SPRING
WOLF RANCH
WOLF RD
SKYLINE RD
CIR TANKSLEY
RIVERCHASE BLVD
CASSIDY DR
RIDGE DR CEDAR
D B WOOD RD
CEDAR BREAKS RD
GREENRIDGE RD
SHEPHERD RD
NORTHCROSS RD
OAK RIDGE RD
GRASSLAND LN
SUNSET DR
SOUTHCROSS RD
STARVIEW LN
ASHWOOD LN
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0 750 1,500 Feet
FIGURE B-7. 100-YEAR FLOODPLAIN MAP
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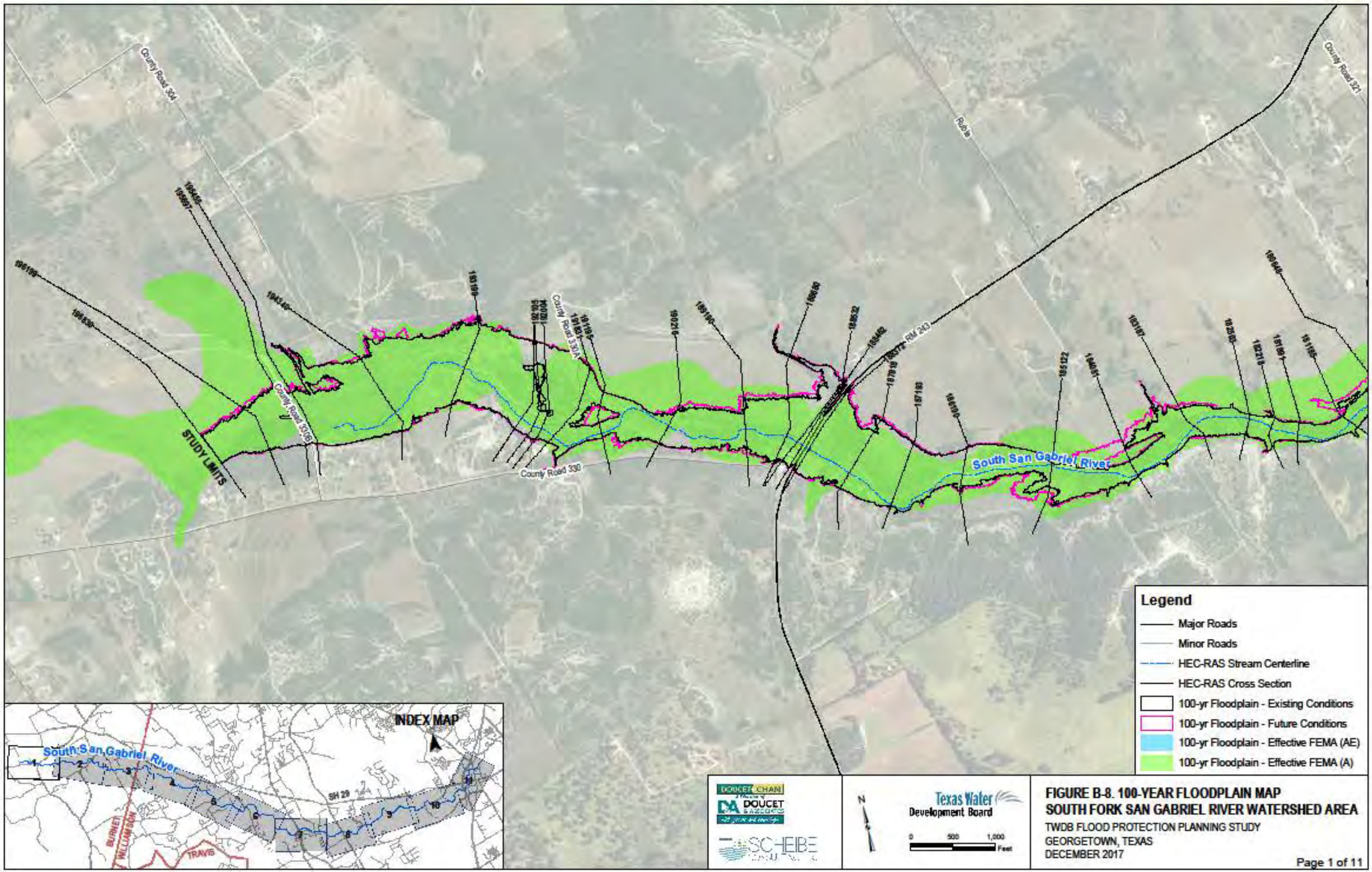
County Road 304
County Road 321
Ruble
County Road 330A
County Road 330
County Road 330B
RM 243
STUDY LIMITS
South San Gabriel River
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WILLIAMSON
TRAVIS
DOUCET CHAN
DOUCET
SCHEIBE
Texas Water Development Board
0 500 1,000 Feet
FIGURE B-8. 100-YEAR FLOODPLAIN MAP
SOUTH FORK SAN GABRIEL RIVER WATERSHED AREA
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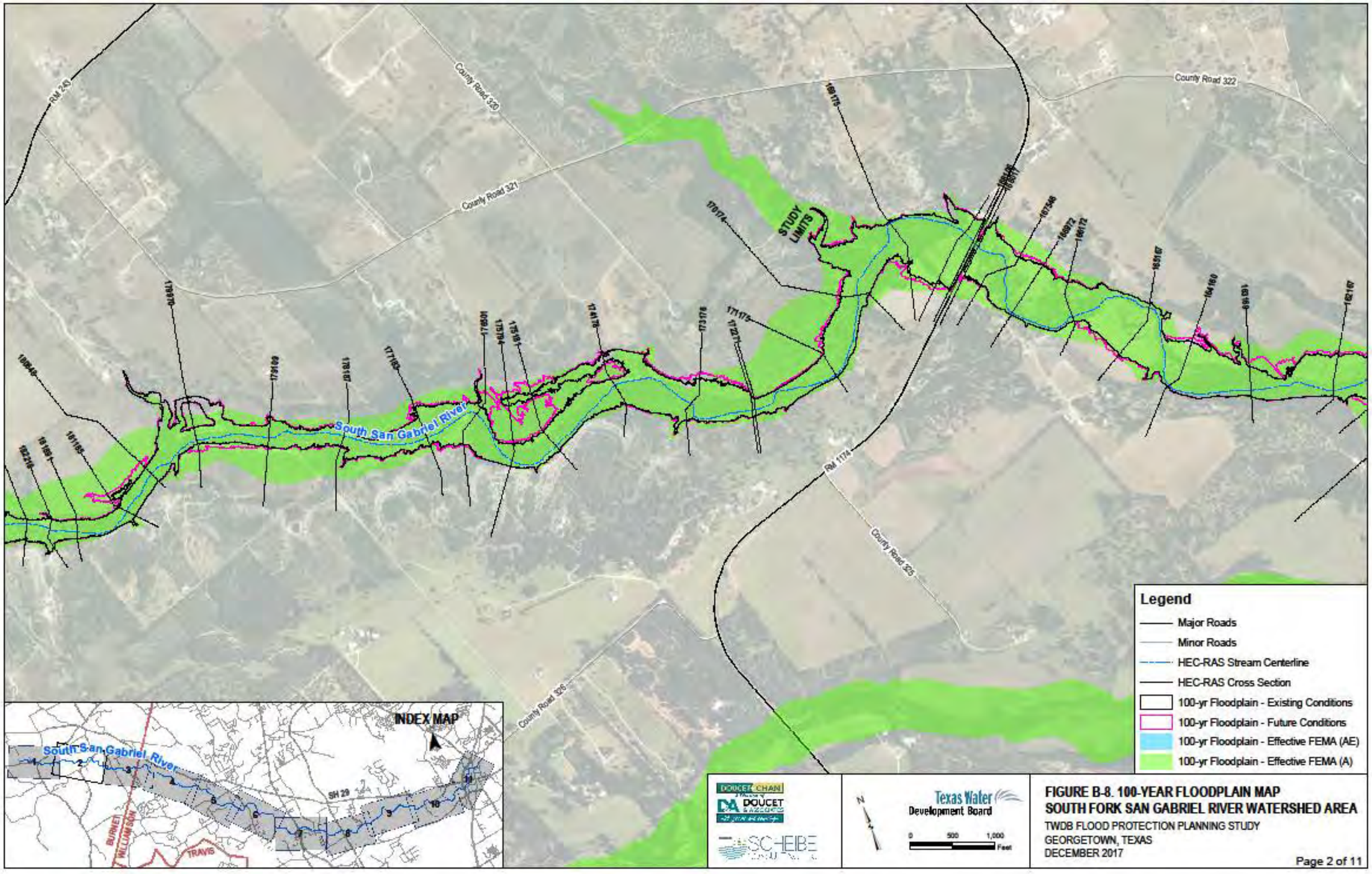
RM 243
County Road 320
County Road 321
County Road 322
STUDY LIMITS
South San Gabriel River
RM 1174
County Road 305
County Road 306
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DOUCET CHAN
DOUCET & ASSOCIATES
SCHEIBE
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0 500 1,000 Feet
FIGURE B-8. 100-YEAR FLOODPLAIN MAP
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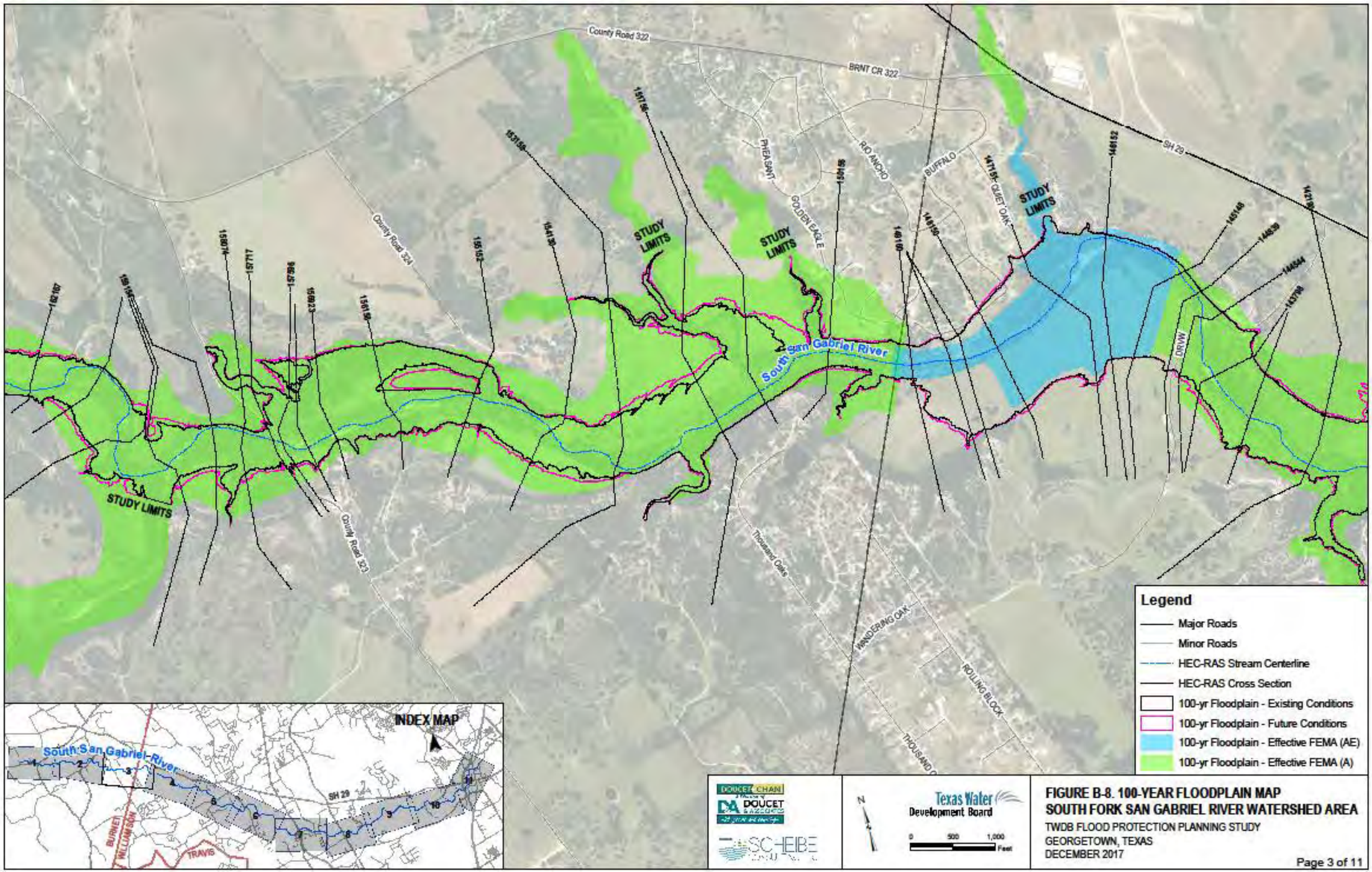
County Road 322
BRNT CR 322
SH 29
County Road 324
County Road 323
PHEASANT
GOLDEN EAGLE
RIO ANCHO
BUFFALO
QUIET OAK
STUDY LIMITS
STUDY LIMITS
STUDY LIMITS
STUDY LIMITS
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DRVW
Thousand Oaks
WANDERING OAK
ROLLING BLOCK
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100-yr Floodplain - Effective FEMA (A)
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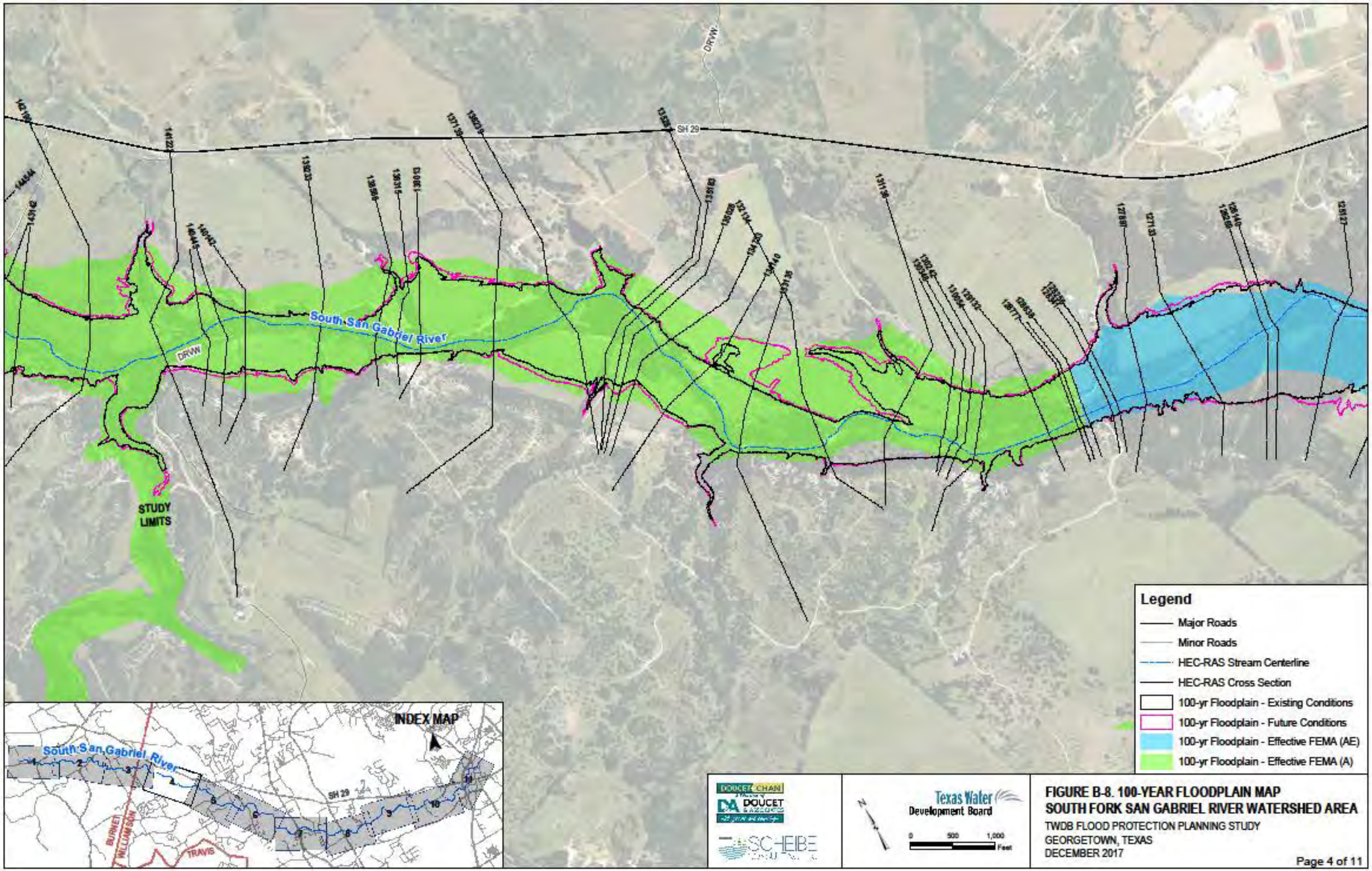
SH 29
South San Gabriel River
DRW
STUDY LIMITS
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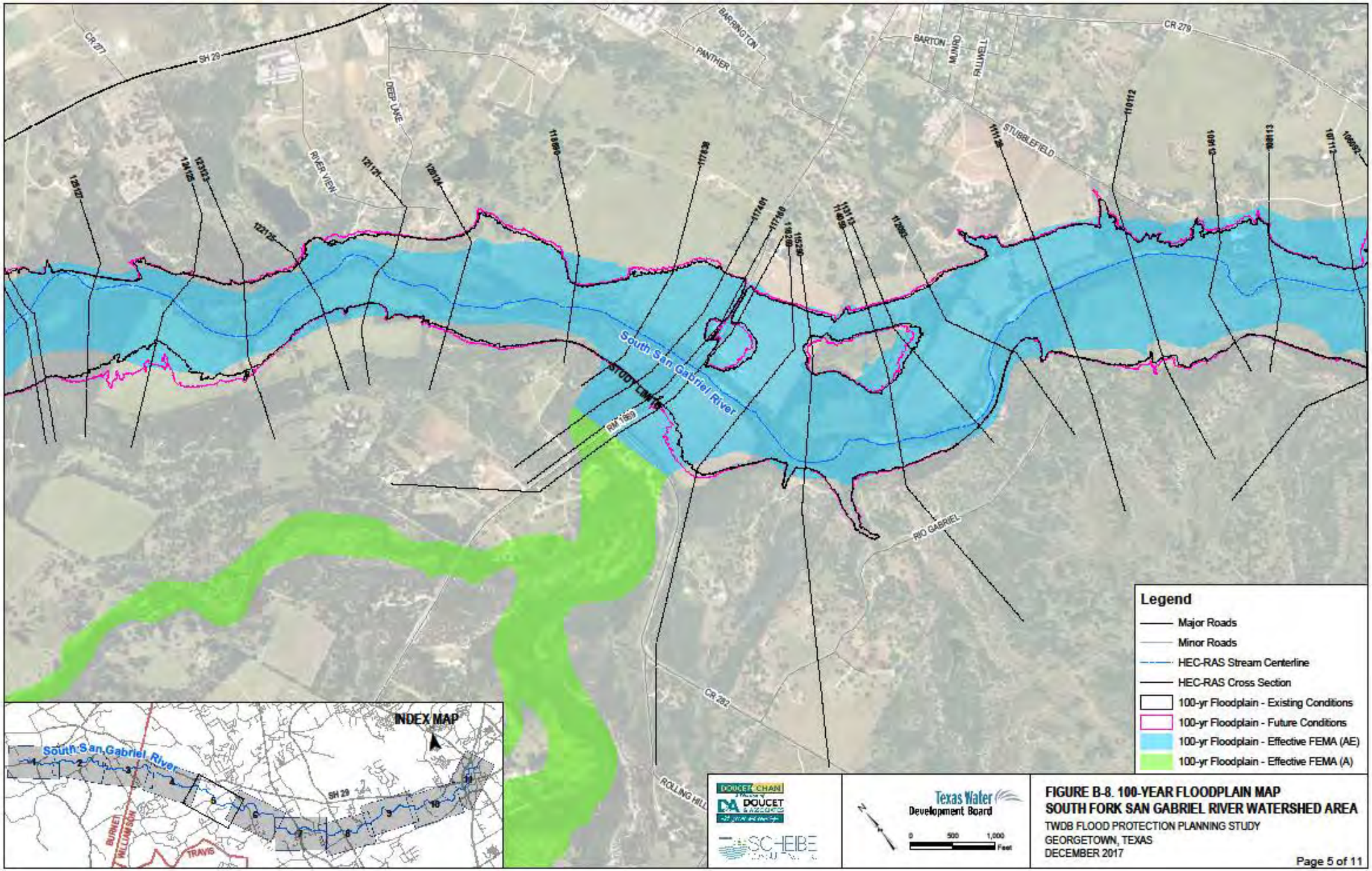
CR 277
SH 29
DEEP LAKE
RIVER VIEW
BARRINGTON
PANTHER
BARTON
MUNRO
TIMMELL
CR 279
STUBBLEFIELD
South San Gabriel River
STODT LANE
RM 1869
RIO GABRIEL
CR 282
ROLLING HILL
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DOUCET & ASSOCIATES
SCHEIBE
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0 500 1,000 Feet
FIGURE B-8. 100-YEAR FLOODPLAIN MAP
SOUTH FORK SAN GABRIEL RIVER WATERSHED AREA
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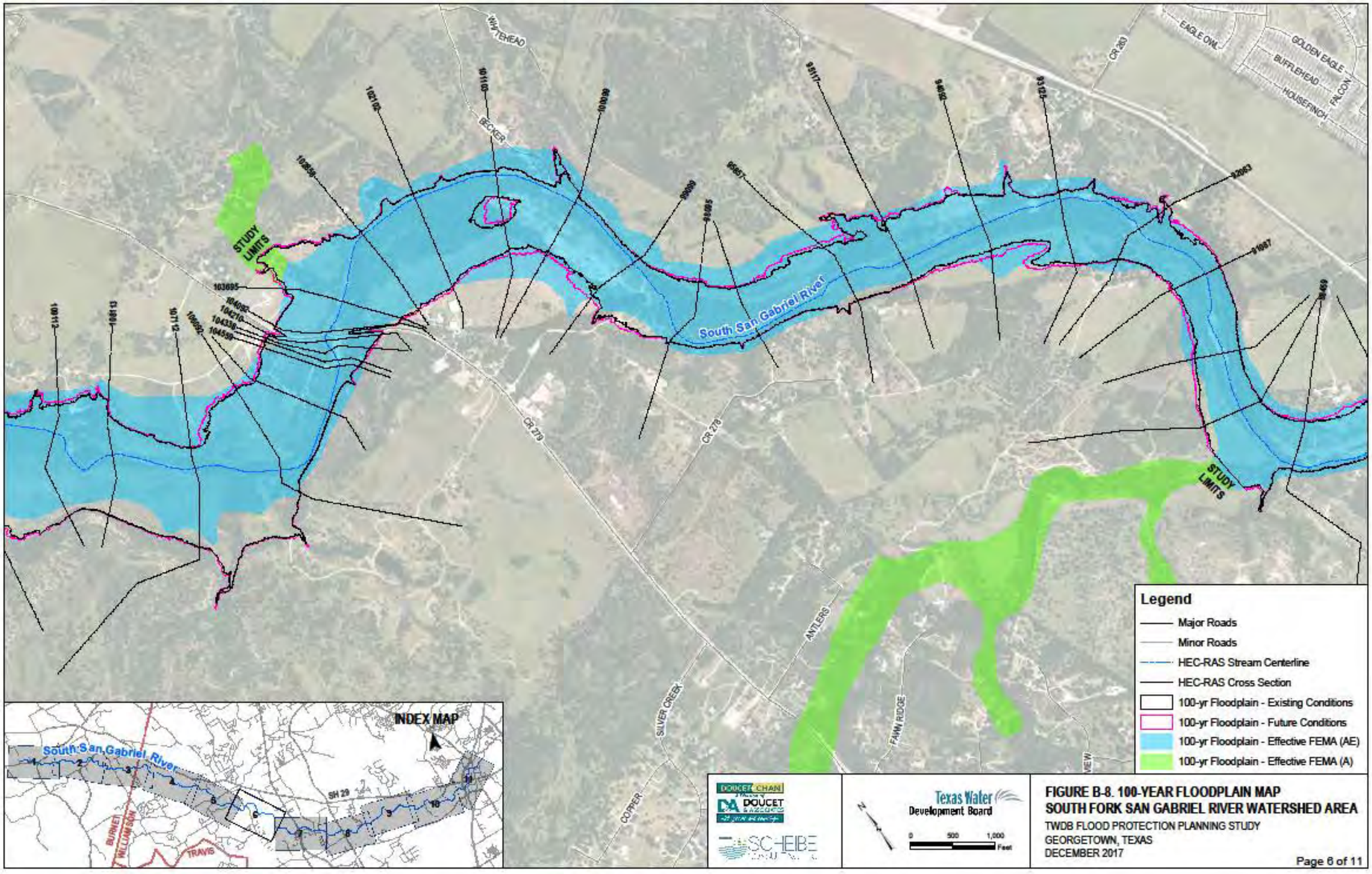
STUDY LIMITS
South San Gabriel River
BECKER
CR 279
CR 278
CR 283
EAGLE OWL
GOLDEN EAGLE
BUFFLEHEAD
FALCON
HOUSEFINCH
SILVER CREEK
ANTLERS
FAWN RIDGE
COPPER
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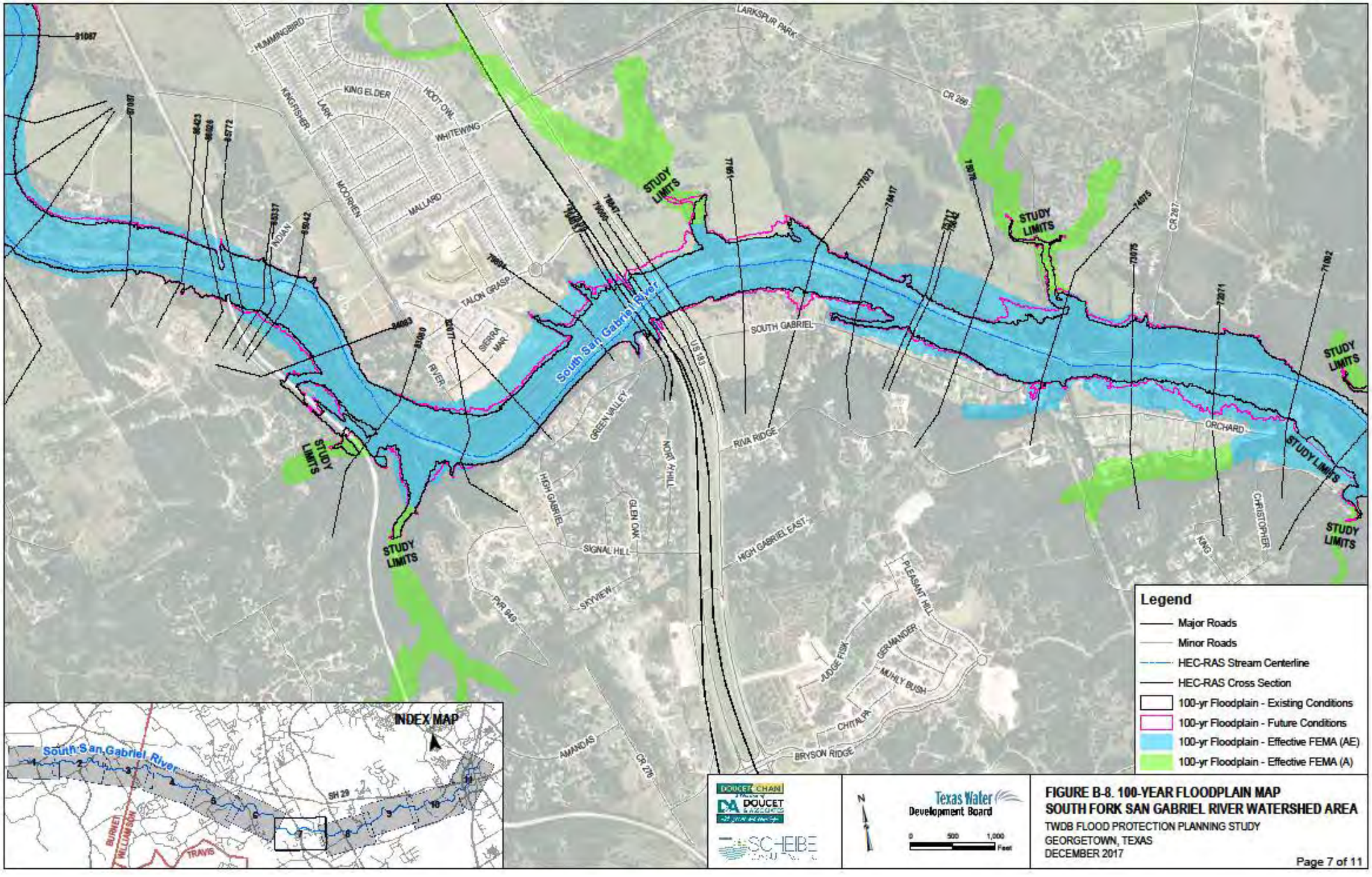
STUDY LIMITS
South San Gabriel River
LARKSPUR PARK
CR 286
CR 287
SOUTH GABRIEL
RIVA RIDGE
HIGH GABRIEL EAST
ORCHARD
BRYSON RIDGE
SIGNAL HILL
SKYVIEW
PVR 949
AMANDAS
CR 276
HUMMINGBIRD
KINGFISHER
LARK
KING ELDER
HOOT OWL
WHITEWING
MOORHEN
MALLARD
INDIAN
TALON GRASP
SIERRA MAR
RIVER
US 183
GREEN VALLEY
HIGH GABRIEL
GLEN OAK
MOON HILL
PLEASANT HILL
GERMANDER
MUHLY BUSH
JUDGE FISK
CHITALPA
CHRISTOPHER
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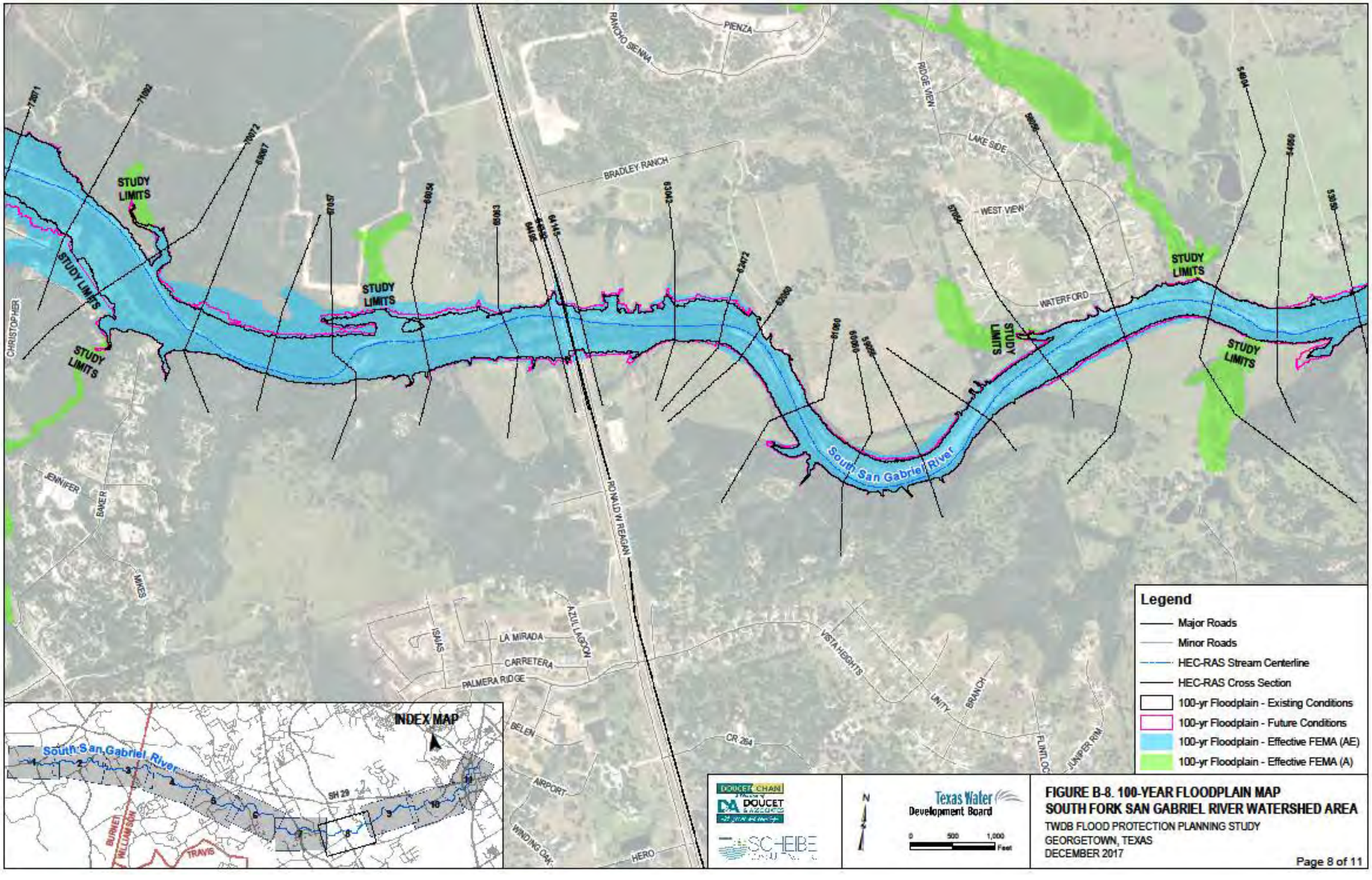
RANCHO SIENNA
PIENZA
RIDGE VIEW
LAKE SIDE
BRADLEY RANCH
WEST VIEW
WATERFORD
STUDY LIMITS
CHRISTOPHER
JENNIFER
BAKER
MIKES
ISAIAS
LA MIRADA
AZUL LAGOON
CARRETERA
PALMERA RIDGE
RONALD W REAGAN
BELEN
AIRPORT
WINDING OAK
HERO
CR 264
VISTA HEIGHTS
UNITY
BRANCH
FUNTLOC
JUNIPER RIM
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DOUCET & ASSOCIATES
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0 500 1,000 Feet
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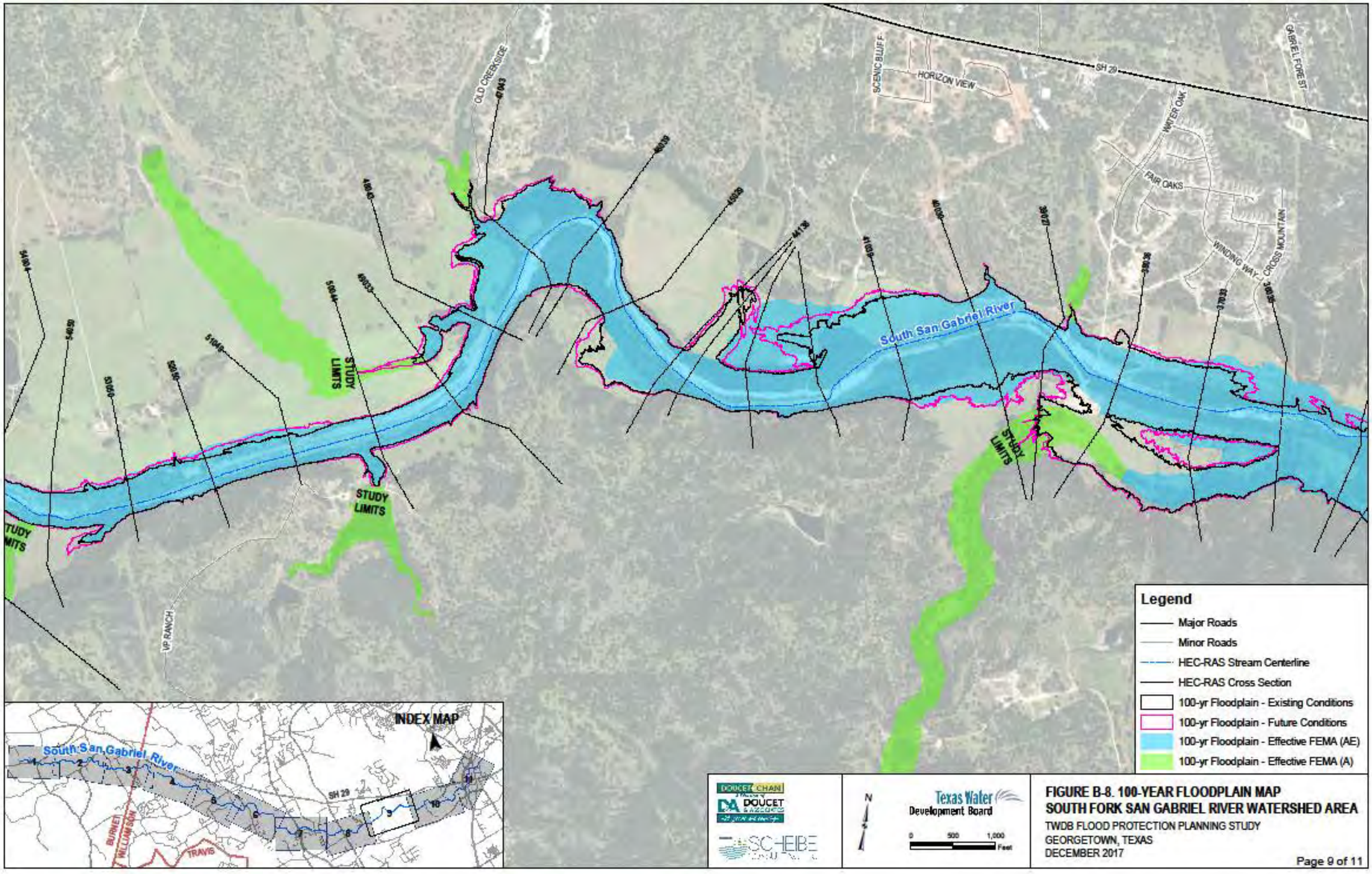
OLD CREEKSIDE
SCENIC BLUFF
HORIZON VIEW
SH 29
GABRIEL FOREST
WATER OAK
FAIR OAKS
WINDING WAY
CROSS MOUNTAIN
South San Gabriel River
STUDY LIMITS
STUDY LIMITS
STUDY LIMITS
STUDY LIMITS
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DOUCET & ASSOCIATES
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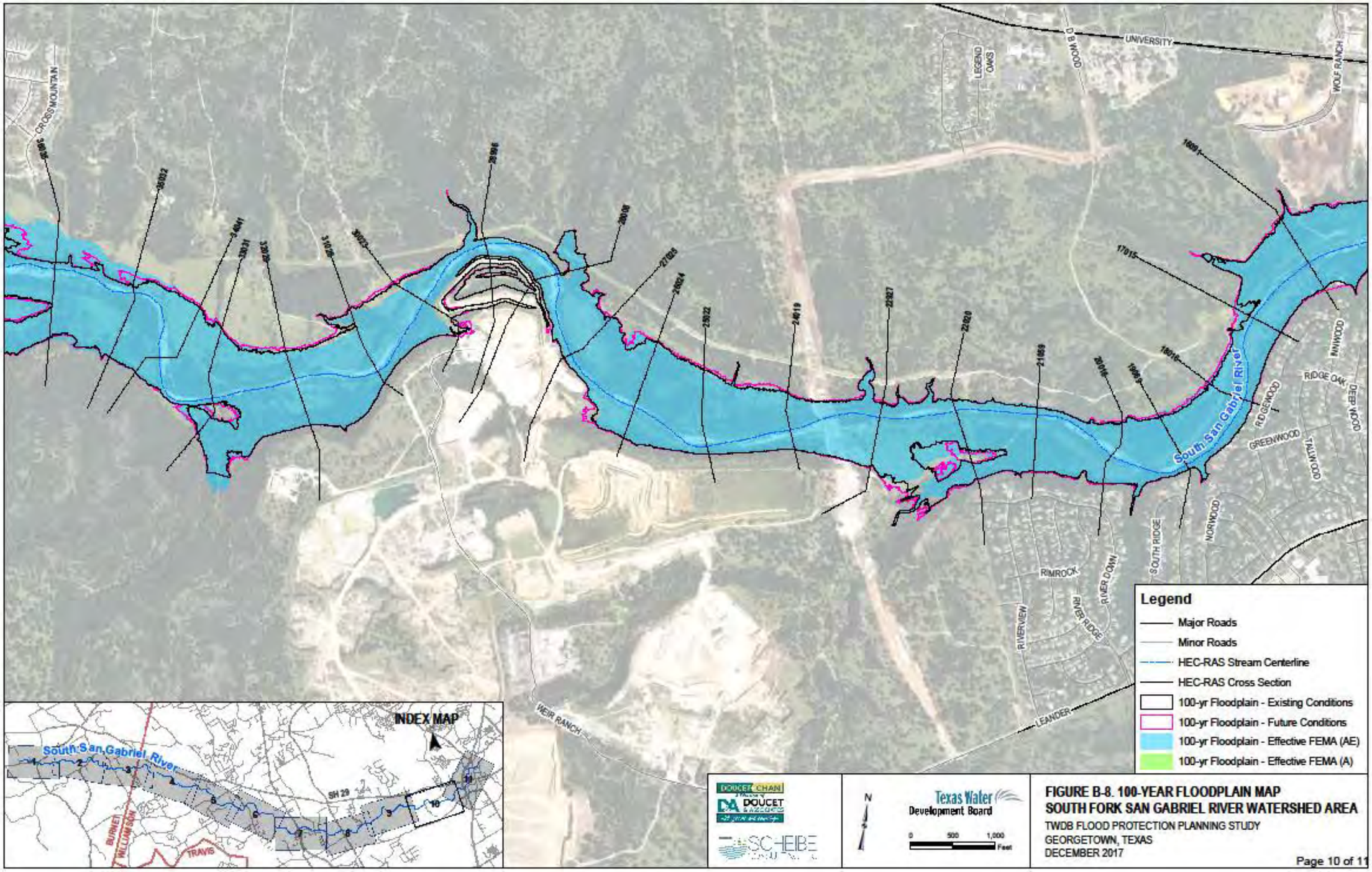
UNIVERSITY
LEGEND OAKS
DOOM B D
WOLF RANCH
CROSS MOUNTAIN
INWOOD
RIDGE OAK
RIDGEWOOD
GREENWOOD
TALLWOOD
DEER WOOD
NORWOOD
SOUTH RIDGE
RIMROCK
RIVER DOWN
RIVER RIDGE
RIVERVIEW
LEANDER
WEIR RANCH
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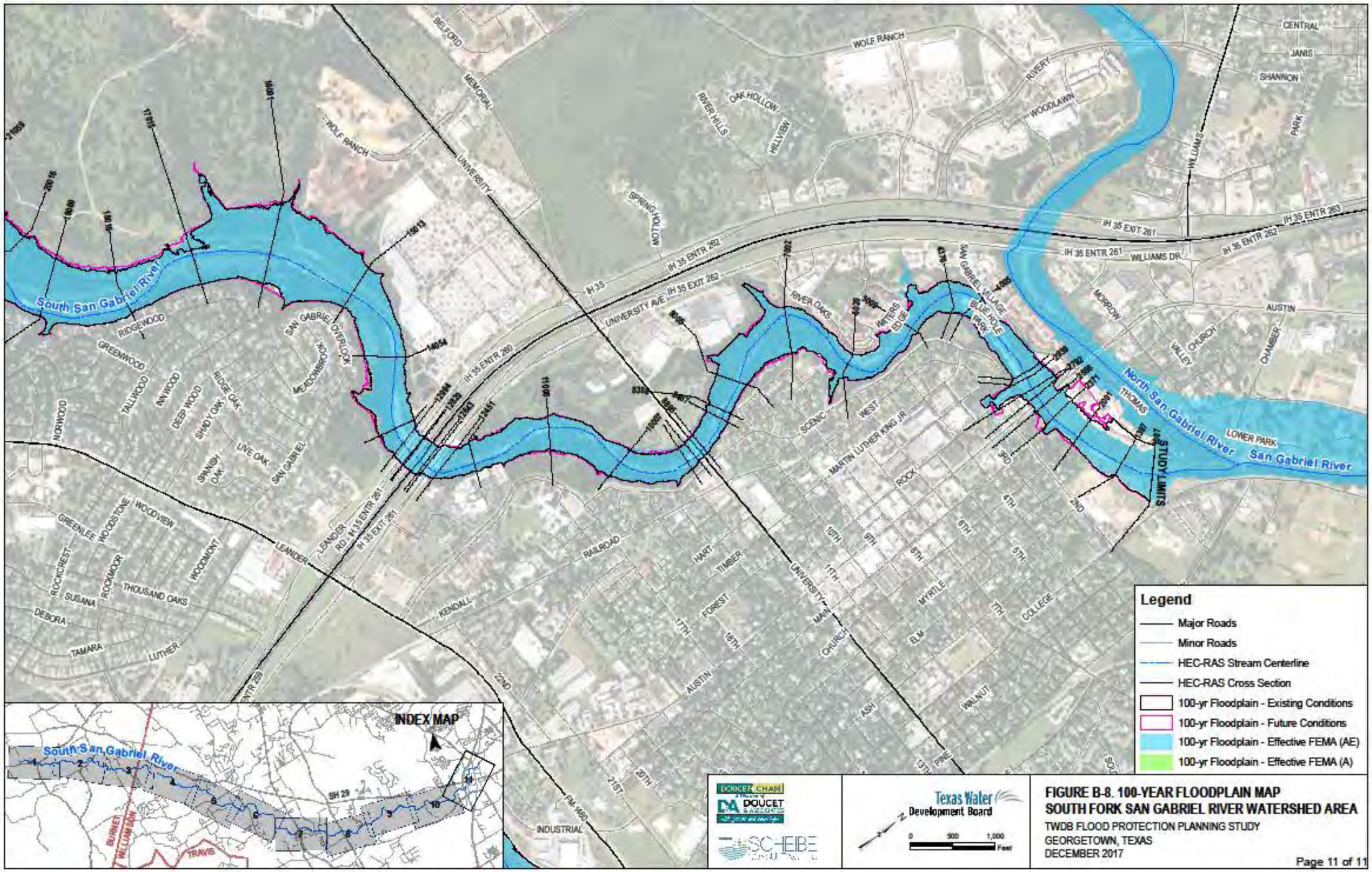

FIGURE B-8. 100-YEAR FLOODPLAIN MAP
SOUTH FORK SAN GABRIEL RIVER WATERSHED AREA
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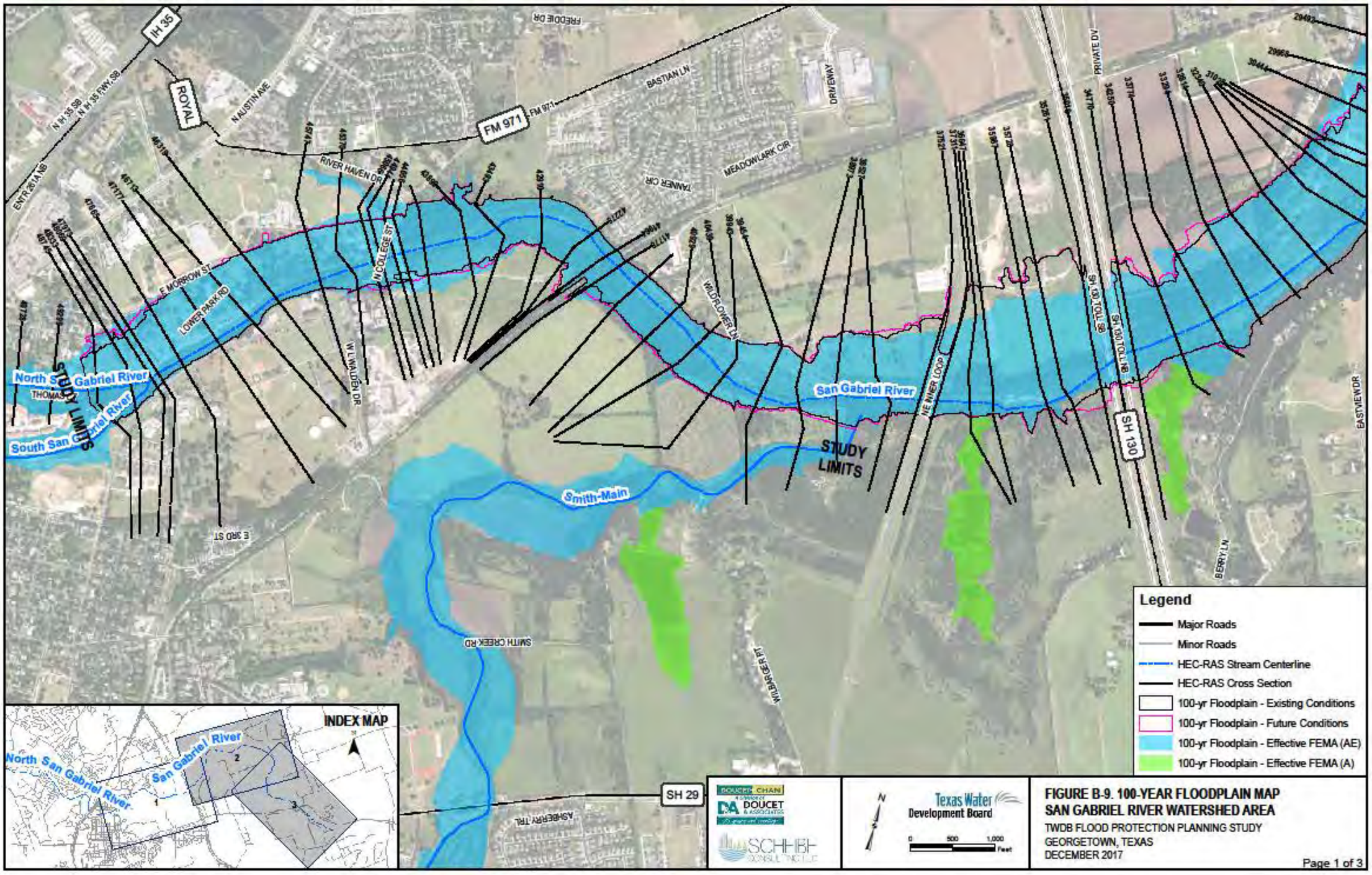
IH 35
ROYAL
FM 971
N AUSTIN AVE
BASTIAN LN
DRIVEWAY
PRIVATE DV
MEADOWLARK CIR
TANNER CIR
RIVER HAVEN DR
N COLLEGE ST
E MORROW ST
LOWER PARK RD
W LIVALDEN DR
WILDFLOWER LN
NE RIVER LOOP
SH 130 TOLL SB
SH 130 TOLL NB
EASTVIEW DR
BERRY LN
North San Gabriel River
South San Gabriel River
San Gabriel River
Smith-Main
STUDY LIMITS
SMITH CREEK RD
WIBERG PL
ASHBERRY TRL
SH 29
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TWDB FLOOD PROTECTION PLANNING STUDY
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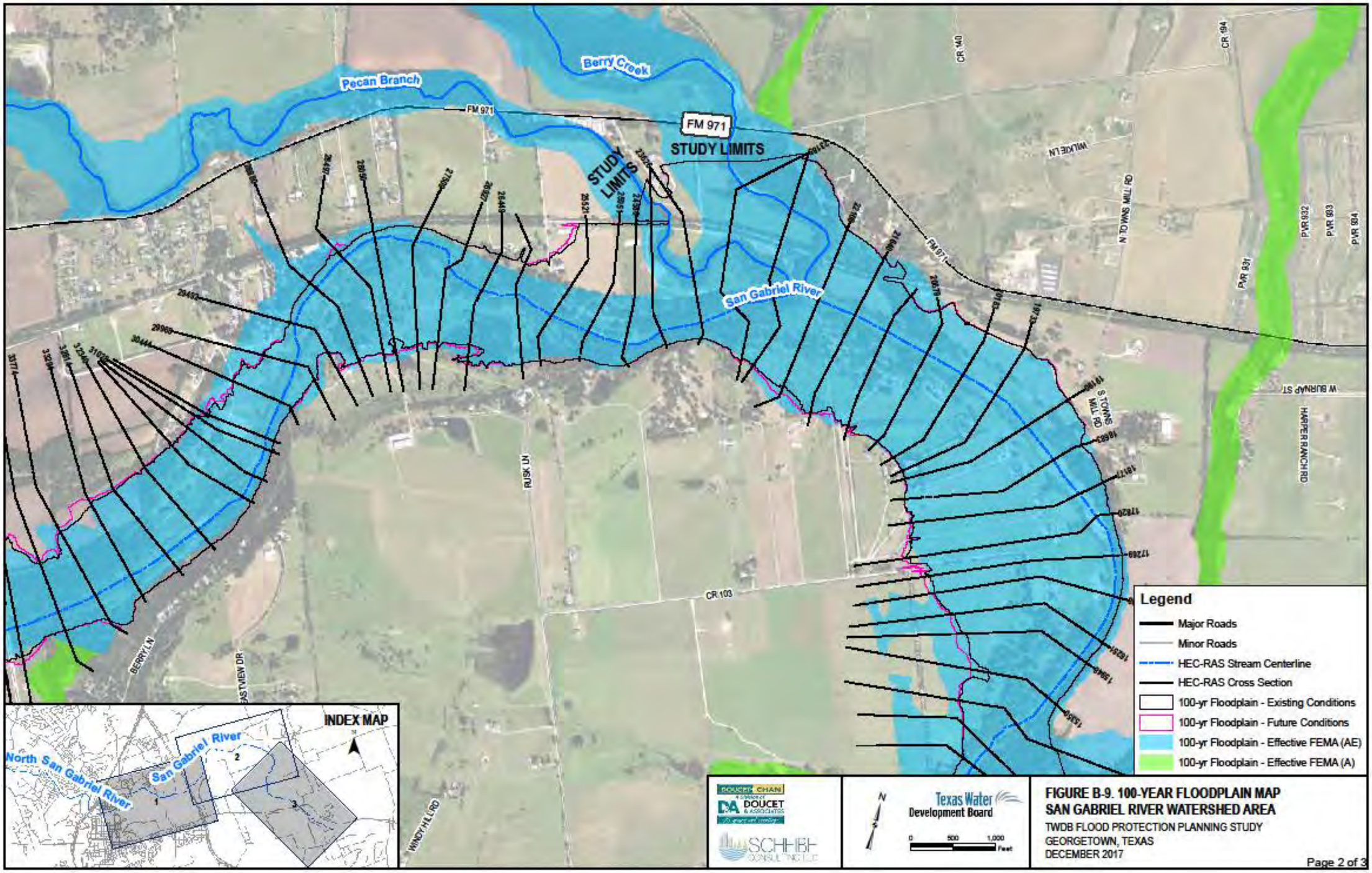
Pecan Branch
Berry Creek
FM 971
STUDY LIMITS
STUDY LIMITS
San Gabriel River
CR 140
CR 194
CR 103
RUSK LN
BERRY LN
EASTVIEW DR
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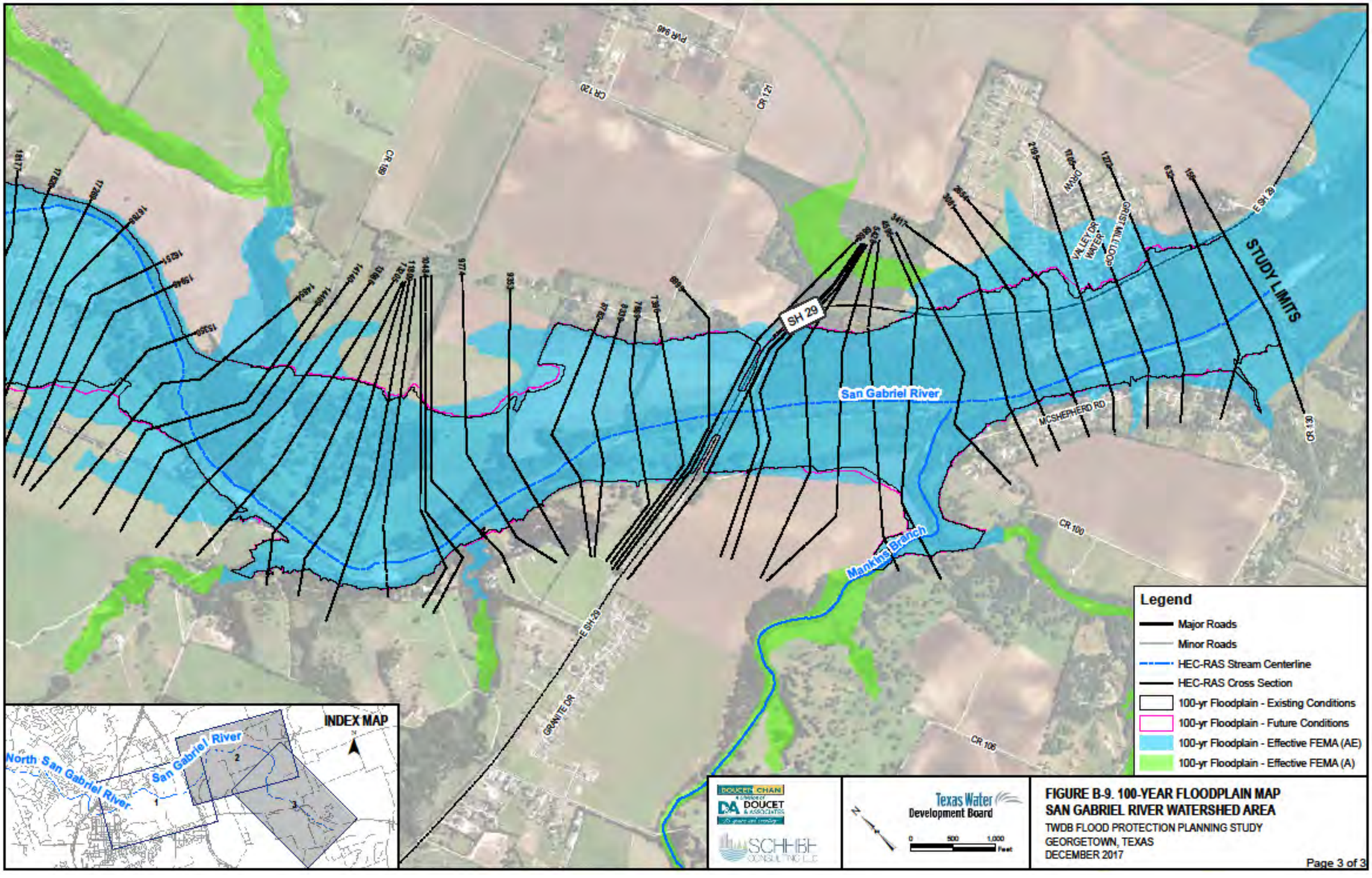
STUDY LIMITS
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APPENDIX C
PROJECT ALTERNATIVES EVALUATION AND SELECTION

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C.1.0 Background

An assessment was performed to identify and prioritize mitigation alternatives to address flood hazards within the study areas identified in the two Georgetown-San Gabriel Flood Protection Study (FPPS) grant applications to the Texas Water Development Board (TWDB). The assessment of the flood mitigation alternatives consisted of the following primary steps:

- Flood hazard areas, including flooded residential and commercial structures (Problem Areas) and flooded roadway crossings that were identified using the FPPS floodplain modeling and mapping efforts (see Appendices A and B);
- Flood Problem areas were assessed to define the extent of structural flooding and to develop flood hazard mitigation improvements to lower the existing conditions 100-year flood elevation to be at least one foot below a defined structures' Finished Floor Elevations (FFEs);
- Flooded roadway crossings were assigned an initial flood severity index to identify road crossings that were candidates for further assessment, the depth and frequency of road crossing flooding was determined, and flood hazard mitigation improvements were developed to prevent overtopping of the crossings and their roadway approaches, based upon the hydrologic and hydraulic design criteria of the governing jurisdiction;
- Opinions of probable cost were developed for each flood hazard mitigation improvement, including construction cost, contingency cost, and engineering/permitting/administrative cost;
- The proposed flood hazard mitigation improvements were sorted by overall priority into Tier I (highest priority) and Tier II (lower priority) for the City of Georgetown & ETJ. The Tier I improvement projects were then ranked from highest to lowest priority. Only Tier I was applied to all other jurisdictions due to the small number of projects remaining in those jurisdictions.

Detailed descriptions of the methods, assumptions and results of the assessment and prioritization of the flood hazard mitigation improvements are presented in this Appendix C Report. Summaries of pertinent data and tables are located at the end of this appendix. Figures of the Problems Areas, flooded road crossings, and proposed flood hazard mitigation improvements are presented in Chapter 6 of the Main Report.

C.2.0 Identification of Flood Hazard Areas

Flood hazard areas were identified for flooded residential and commercial structures and for flooded roadways crossing the studied streams. This section discusses the process for identification of the flood hazard areas.

C.2.1 Problem Areas

Problems Areas are defined as containing at least 5 residential and/or commercial structures within an area shown to flood during the existing conditions 100-year event floodplain. The process for defining the Problem Areas included the following steps:

- Identification of building footprints of existing structures located partially or completely within the existing conditions 100-year event, using the HEC-RAS models developed for this FPPS (see Appendix B Report) and floodplain mapping;
- Grouping of a minimum of 5 structure footprints within the existing conditions 100-year floodplain to define each Problem Area;
- Assignment of Finished Floor Elevation (FFE) to each flooded structure footprint assuming the FFE to be 6 inches above the highest LiDAR mapping elevation within the structure's footprint indicative of highest adjacent grade;
- Assessment of frequency of flooding of each structure's footprint for existing conditions 5-year through the 500-year events, using the mapped floodplains from the HEC-RAS model developed for this FPPS (see Appendix B Report) to define the severity of flooding within that Problem Area (see Section C.5.0 for discussion of Flood Severity Index).

Problem areas are discussed and mapped as provided in Section 5 of the Main Report. Table C-3 summarizes the flooded structures within each Problem Area.

C.2.2 Flooded Roadway Crossings

Flooded road crossings are defined as stream road crossings, including roadway approaches, whose depth of flooding at the design flood event exceeds that governmental jurisdiction's criteria, as follows:

- City of Georgetown Incorporated Limits and Extraterritorial Jurisdiction (ETJ): 6-inch maximum depth of inundation under existing conditions 100-year event. However, due to the hydraulic modeling assumption of debris blocking the crossing's railings, it was assumed that any inundation of the crossing under existing conditions 100-year event (25-year storm with less than 12-inch inundation for "local" roadways) would not comply with the City of Georgetown's hydraulic design criteria;
- All other Study Areas outside City of Georgetown Jurisdiction (Williamson County, City of Leander, City of Liberty Hill, Burnet County): convey the existing conditions 25-year event without overtopping the crossing or roadway approaches.

The process for defining the flooded roadway crossings included the following steps:

- Assess depth and frequency of flooding of each existing road crossing, for the existing conditions 5-year through 100-year events, and define the most frequent (smallest) flood event that overtops each road crossing;
- Assign a Flood Severity Index for each flooded road crossing to determine the road crossings that were candidates for further assessments for flood hazard improvement (see Section C.5.0 for discussion of Flood Severity Index).

Table C-2 summarizes the flooding condition of each existing road crossing and its severity index.

C.3.0 Flood Hazard Mitigation Improvement Concept Designs

After the flood hazard areas were defined (see Section C.2.0), flood hazard mitigation improvements were assessed for each flood hazard area. This section discusses the process for assessing flood hazard mitigation improvements.

C.3.1 Problem Areas

C.3.1.1 Methodology

The two primary goals of developing flood hazard mitigation improvements for the Problem Areas are:

- Wherever possible, lower the existing conditions 100-year event water surface elevations (WSELs) along the Problem Area such that the resulting 100-year WSELs are at least one foot lower than the assumed Finished Floor Elevations (FFEs) of the flooded structures within the Problem Areas; and/or
- Raise ground levels (construct berms/levees) between the flood event within the stream channels and the structures to physically prevent floodwaters from reaching and flooding the structures.

The primary flood hazard mitigation improvement strategies considered for Problem Area flood hazard mitigation included the following:

- Channel widening: where the existing channel lacked the ability to fully convey the existing conditions 100-year event such that the threshold limits were not exceeded, channel excavation was used to provide additional conveyance. The additional conveyance was accomplished by excavating sections of the main channel, primarily downstream and/or adjacent to the identified flooded structures. HEC-RAS hydraulic model cross-section data was modified to simulate channel excavation and provide additional conveyance within the channel to lower the WSEL to the desired levels;
- Protective berms: In some situations, berms were used to contain or limit flooding along with the channel excavation improvements. The berms were used in cases where channel excavation did not provide sufficient flood protection for structures along the channel. Berm design was a basic design consisting of 3:1 side slopes, 3-foot top width, and a height of approximately 3-4 feet above the existing conditions 100-year WSEL. Outside of the berms (structure side), small swales were used to convey local runoff downstream and back to the main channel.
- Detention ponds: In some situations, a detention pond was used upstream of the problem area to reduce existing conditions 100-year event peak flows within the channel in order to reduce the WSEL at the structures. HEC-HMS hydrologic modeling was used to size the detention structures.
- Improved channel maintenance: In some situations, improved channel maintenance was employed and modeled hydraulically by assuming improved maintenance reduces flow impedance within the channels (i.e. lowering Manning's "n" friction values), thereby lowering the existing conditions 100-year event WSELs.

In the case of channel improvements (widening and improved maintenance), flow conditions were reviewed to assess whether the channel improvements resulted in higher peak flow rates downstream of the proposed channel improvements. This assessment would need to be updated when/if final improvements are proposed for an area.

C.3.1.2 Results

The dimensions and characteristics of the proposed flood hazard mitigation improvements for each Problem Area are summarized in Table C-3. Locations of the proposed Problem Area improvements are shown on the Chapter 6 figures of the Main Report.

C.3.2 Flooded Road Crossings

C.3.2.1 Methodology

The primary goal of developing flood hazard mitigation improvements for the flooded road crossings was to improve the crossing structure and/or roadway approach to meet hydraulic design criteria at the hydraulic design event (see Section C.2.2 for discussion of hydraulic design criteria). The primary flood hazard mitigation improvement strategies considered for road crossing flood hazard mitigation included the following:

- Expansion of existing bridge opening lengths to provide added capacity without raising the existing bridge deck level where practical;
- Raising flooded approach road grades where the crossing structure is not flooded but the roadway approach is flooded;
- Replacement of existing crossing structures with new box culverts or clear-span bridges and construction of new roadway approaches at raised grades.

The HEC-RAS hydraulic model with existing road crossing configurations (used in the assessment of flooding of the existing road crossings) was modified using a combination of the mitigation strategies discussed above to develop crossing configurations that complied with the governmental jurisdiction's hydrological and hydraulic design criteria. Flooded roadway crossings that were considered "local" with an alternate emergency access route were excluded from the final list of flooded crossings.

C.3.2.2 Results

The dimensions and characteristics of the proposed flood hazard mitigation improvements for each flooded road crossing are shown in Table C-2. Locations of the proposed road crossing improvements are shown on the Chapter 6 figures of the Main Report.

C.4.0 Flood Hazard Mitigation Improvement Cost Estimations

After the flood hazard mitigation improvements were assessed (see Section C.3.0), a conceptual opinion of probable construction cost was developed for each proposed flood hazard mitigation improvement. This section discusses the process for development of the conceptual opinions of probable costs.

C.4.1 Methodology

The conceptual opinions of probable construction costs included the following primary elements:

- Construction cost;
- Construction contingency cost;
- Engineering, permitting, management cost.

The primary sources of unit costs for cost estimations were recent bid tabulations from the Texas Department of Transportation (TxDOT) and City of Austin, Texas (COA). Table C-1 summarizes the construction unit price assumptions. Construction contingency costs were assumed to be 25% of the construction costs. Engineering, permitting, and management costs were assumed to be 25% of the construction costs for problem areas, and 30% of the construction costs for crossings.

Land acquisition for drainage construction easements and for rights-of-ways was not included in the cost opinions at the request of the City of Georgetown. The City's recent experience with land acquisition has been that land costs are extremely volatile and are difficult to estimate without a formal survey and appraisal.

For the purpose of this planning study, aggregate unit costs were developed for the following key project elements:

Channel Improvements

- Channel preparation (including clearing, grubbing, and removal of any other miscellaneous item)
- Channel Excavation (includes excavation, topsoil, seedbed preparation, seeding, and turf reinforcement mats)
- Cofferdams and Dewatering

Roadway Crossing Improvements

- Bridge Deck, Piers, Foundation
- Channel Improvements
- Approach Fill, Retaining Walls, Utility Relocation, HMAC Pavement
- Environmental Controls
- Water Quality Treatment for Edwards Aquifer (if applicable)
- Traffic Control

Flood Detention

- Tree Removal
- Excavation
- Embankment
- Outlet Structures

C.4.2 Problem Area Cost Estimation Results

The conceptual cost estimates of all proposed Problem Area flood hazard mitigation improvements are summarized on Table C-3.

C.4.3 Flooded Road Crossing Cost Estimation Results

The conceptual cost estimates of all proposed road crossing flood hazard mitigation improvements are summarized on Table C-2.

C.5.0 Flood Hazard Mitigation Prioritization

Shown in Tables C-2 and C-3, the Georgetown-San Gabriel Flood Protection Planning Study (FPPS) identified flood hazard mitigation improvements for 13 Problem Areas and 33 flooded road crossings, totaling 46 projects overall and approximately $350,000,000 of total construction costs across all study areas and jurisdictions. After the flood hazard mitigation improvement costs were assessed (see Section C.4.0), the proposed flood hazard mitigation improvements were prioritized. This section discusses the prioritization of the flood hazard mitigation improvements.

C.5.1 Methodology

The prioritization of the proposed flood hazard mitigation improvements included the following primary process steps:

- A Flood Severity Index ranking matrix was developed for the proposed Problem Area flood hazard mitigation improvement projects;
- A Flood Severity index ranking matrix was developed for the proposed road crossing flood hazard mitigation improvement projects;
- The proposed flood hazard mitigation improvement projects for the Problem Areas and the Road Crossings were combined into one ranking matrix for Tier I higher priority projects and for Tier II lower priority projects for the City of Georgetown & ETJ. Only Tier I is applied for all other jurisdictions.

C.5.2 Flood Severity Index Factors

Flood Severity Index factors were developed for the two major groupings of proposed flood hazard mitigation improvements:

Problem Areas (Flooded Structures)

- Public Safety: This factor considers if there are alternate evacuation routes available from the Problem Area in the event of 100-year event flooding and whether improvements to flooded evacuation routes will benefit the overall transportation system of the area.
- Flood Significance: This factor considers the number of structures flooded by the 100-year event and the frequency of structure flooding at the more frequent events (i.e. 10-year and 25-year events).
- Dependence on Other Projects: This factor considers if the effectiveness of the proposed improvement will depend on the development of other projects.
- Environment: This factor considers the environmental impact of the proposed improvement and the degree of environmental constraints on the development of the proposed improvement.
- Easement/O&M: This factor considers the impact of the relative costs and requirements of easement acquisition and of operations/maintenance of the proposed improvement.
- Benefit/Cost Ratio: This factor considers the ratio of benefit of the proposed improvement (i.e. reduction in flood damage costs) and the improvement costs as outlined in Section 4 of the main report.

Flooded Roadway Crossings

- Public Safety: This factor considers the functionality of the roadway and its impact on the transportation system (i.e. Local, Collector, Arterial) and if there is an alternative route if the roadway is flooded at the crossing.
- Flood Significance: This factor considers the frequency of the storm event at which the roadway crossing begins to be flooded and the number of structures flooded due to the insufficient channel conveyance at the crossing.
- Dependence on Other Projects: This factor considers if the effectiveness of the proposed improvement will depend on the development of other projects.
- Environment: This factor considers the environmental impact of the proposed improvement and the degree of environmental constraints on the development of the proposed improvement.
- Project Cost: This factor considers the total estimated cost of the project (excluding land acquisition cost).

These factors were assigned point values weighted based on the relative significance of each factor that were summed together based on the characteristics of each improvement. Tables C-4 and C-5 present each element and its respective point assignments.

C.5.3 Flood Severity Index and Priority Rankings

The Flood Severity Index was calculated for each proposed flood hazard mitigation improvement project, and based upon the resulting values, the proposed improvement projects were ranked in the order of highest to lowest priority. Table C-4 summarizes the Flood Severity Index point values and rankings for the Problem Area improvement projects, and Table C-5 summarizes the Flood Severity Index point values for the flooded roadway crossing improvement projects.

C.5.4 Tier I and Tier II Priority Rankings

The final step of ranking the priorities of the proposed flood hazard mitigation improvement projects involved combining all proposed improvement projects (both Problem Area projects and flooded roadway crossing projects) into a Tier I group and a Tier II group as outlined below.

C.5.4.1 Tier I Group

The Tier I group consists of the highest priority improvement projects per the jurisdictional areas below. All proposed Tier I projects are ranked from highest priority to lowest priority based upon the Flood Severity Index point values.

City of Georgetown

A total of 10 improvement projects (7 Problem Area improvement projects and 3 flooded roadway crossing improvement projects) for an estimated total cost of $20,000,000 are summarized on Table 7-1.

City of Leander

A total of 1 improvement project (1 Problem Area improvement project) for an estimated total cost of $800,000 is summarized on Table 7-1.

Williamson County

A total of 1 improvement project (1 flooded roadway crossing improvement project) for an estimated total cost of $4,900,000 is summarized on Table 7-1.

Burnet County

A total of 3 improvement projects (3 flooded roadway crossing improvement projects) for an estimated total cost of $10,200,000 are summarized on Table 7-1.

City of Liberty Hill

A total of 3 improvement projects (2 Problem Area improvement projects and 1 flooded roadway crossing improvement project) for an estimated total cost of $47,200,00 are summarized on Table 7-1.

C.5.4.2 Tier II Group

The Tier II group consists of all City of Georgetown jurisdiction projects that are not Tier I projects, which includes a total of 5 improvement projects (5 flooded roadway crossing improvement projects) for an estimated total cost of $30,800,000. Table 7-1 summarizes the Tier II proposed flood hazard mitigation improvement projects.

TABLES

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Table C-1. Summary of Significant Cost Factors/Unit Costs

Item	Unit	Unit Cost	Source	Notes
Channel Improvements				
Channel Preparation	AC	$5,500.00	TxDOT & City of Austin Bid Tabs	Includes clearing, grubbing, misc. concrete removal & demo
Channel Excavation, Plan Quantity	CY	$15.00	TxDOT & City of Austin Bid Tabs	Includes excavation, topsoil, seedbed preparation, seeding, and turf reinforcement mats
Class A Select Borrow, Plan Quantity	CY	$42.00	TxDOT & City of Austin Bid Tabs	If borrow is required
Embankment	CY	$25.00	TxDOT & City of Austin Bid Tabs	Placement/compaction (excludes borrow), topsoil, seedbed preparation, seeding, and turf reinforcement mats
Cofferdams & Dewatering	LS	$32,000.00	TxDOT & City of Austin Bid Tabs	
Angular Limestone Block Wall (w/o footing)	CY	$510.00	TxDOT & City of Austin Bid Tabs	Serves as floodwall and to be placed outside of residential lot property boundaries
Dry Rock Riprap (D50=24")	CY	$160.00	TxDOT & City of Austin Bid Tabs	Grade control structure or other erosion protection measures, assumed 1 for each channel improvement at downstream end of improvements
Limestone Block Footing	LF	$280.00	TxDOT & City of Austin Bid Tabs	Footing/pad for angular limestone block wall, includes swale adjacent to footing to convey localized runoff
Temporary Erosion Controls	LS	3% of construction subtotal	TxDOT & City of Austin Bid Tabs	Includes temporary erosion control measures, tree protection, stabilized construction entrance, and SWPPP; Approx. 3% of construction subtotal before mobilization costs
Permanent Erosion Control & Revegetation	SY	$14.00	TxDOT & City of Austin Bid Tabs	
Total Mobilization	LS	5% of construction subtotal	TxDOT & City of Austin Bid Tabs	Approx. 5% of construction subtotal with temporary erosion controls costs included
Barricades, Signs, & Traffic Control	LS	$10,000.00	TxDOT & City of Austin Bid Tabs	
Temporary Access Routes & Ramps	LS	$60,000.00	TxDOT & City of Austin Bid Tabs	
Contingencies	LS	25% of construction subtotal		
Engineering, Permitting, Administrative	LS	25% of construction subtotal		
Clear Span Bridge Improvements				
Bridge Deck, Piers, Foundations, Channel Improvements	SF	$86.10	TxDOT & City of Austin Bid Tabs	Bridge Deck Surface Area
Approach Fill, Retaining Walls, Utility Adjustments, HMAC Pavement	SF	$43.70	TxDOT & City of Austin Bid Tabs	HMAC Surface Area
Environmental Controls	SF	$3.05	TxDOT & City of Austin Bid Tabs	HMAC + Bridge Deck Impervious Cover Surface Area
Water Quality Treatment for Edwards Aquifer	SF	$0.95	TxDOT & City of Austin Bid Tabs	HMAC + Bridge Deck Impervious Cover Surface Area; In Recharge Zone
Traffic Controls	SF	$0.74	TxDOT & City of Austin Bid Tabs	HMAC + Bridge Deck Impervious Cover Surface Area
Mobilization/Demobilization	LS	5% of construction subtotal		5% of all construction costs excluding Mobilization/Demobilization
Contingencies	LS	25% of construction subtotal		
Engineering, Permitting, Administrative	LS	30% of construction subtotal		30% of all construction costs
Culvert Crossing Improvements				
Box Culvert (varies on size)	LF	Size Varying	TxDOT & City of Austin Bid Tabs	$70 per Perimeter Length x Number of Culverts x Width Span of Culverts
Approach Fill, Retaining Walls, Utility Adjustments, HMAC Pavement	SF	$27.90	TxDOT & City of Austin Bid Tabs	HMAC Surface Area
Environmental Controls	SF	$3.05	TxDOT & City of Austin Bid Tabs	HMAC + Bridge Deck Impervious Cover Surface Area
Water Quality Treatment for Edwards Aquifer	SF	$0.95	TxDOT & City of Austin Bid Tabs	HMAC + Bridge Deck Impervious Cover Surface Area; In Recharge Zone
Traffic Controls	SF	$0.74	TxDOT & City of Austin Bid Tabs	HMAC + Bridge Deck Impervious Cover Surface Area
Mobilization/Demobilization	LS	5% of construction subtotal		5% of all construction costs excluding Mobilization/Demobilization
Contingencies	LS	25% of construction subtotal		
Engineering, Permitting, Administrative	LS	30% of construction subtotal		30% of all construction costs

Table C-2. Summary of Crossing Concept Designs

Project ID	Jurisdiction	Existing Crossing	Improvement	Construction Cost	Total Cost
Berry Creek					
FM 971	Georgetown	300-ft Length Bridge	New Bridge: 490-ft Length x 72-ft Width with 2060-ft x 60-ft Wide Roadway	$12,065,000	$14,960,000
CR 245	Georgetown ETJ	180-ft Length Bridge	New Bridge: 800-ft Length x 72-ft Width with 1700-ft x 60-ft Wide Roadway	$13,155,000	$16,310,000
CR 241	Georgetown ETJ	155-ft Length Bridge	New Bridge: 700-ft Length x 72-ft Width with 1500-ft x 60-ft Wide Roadway	$11,555,000	$14,330,000
CR 152	Georgetown	200-ft Length Bridge	New Bridge: 700-ft Length x 72-ft Width with 400-ft x 60-ft Wide Roadway	$7,535,000	$9,345,000
CR 143 @ Dry Berry	Georgetown	Five 12-ft x 6-ft Culverts	New Bridge: 800-ft Length x 72-ft Width with 900-ft x 60-ft Wide Roadway	$10,300,000	$12,775,000
CR 234 @ Dry Berry	Georgetown ETJ	Eight 7-ft Arch Culverts	New Bridge: 450-ft Length x 72-ft Width with 710-ft x 60-ft Wide Roadway	$6,570,000	$8,150,000
Live Oak Trails @ Dry Berry	Georgetown ETJ	Four 8-ft x 4-ft Culverts	New Bridge: 400-ft Length x 72-ft Width with 75-ft x 60-ft Wide Roadway	$3,720,000	$4,615,000
CR 152 @ Dry Berry	Georgetown ETJ	400-ft Length Bridge	Existing Approach: Raise 600-ft x 60-ft Wide Roadway	$1,545,000	$1,915,000
CR 245 @ Cowan	Georgetown ETJ	Two 8-ft x 4-ft & Two 3-ft Arch Culverts	New Bridge: 350-ft Length x 72-ft Width with 800-ft x 60-ft Wide Roadway	$7,795,000	$9,665,000
Andice Road/RM 2338 @ Cowan	Georgetown ETJ	Eight 9-ft x 5-ft Culverts	New Culverts: Seven 9-ft x 7-ft Culverts with 113-ft x 60-ft Wide Roadway	$1,995,000	$2,475,000
Mankins Branch					
McShepherd Road/CR 100	Georgetown ETJ	Three 4-ft Arch Culverts	New Bridge: 200-ft Length x 72-ft Width with 550-ft x 60-ft Wide Roadway	$3,755,000	$4,655,000
Bell Gin Road/CR 104	Georgetown ETJ	One 48-in Dia. Culvert	New Culverts: Four 4-ft x 5-ft Culverts with 125-ft x 60-ft Wide Roadway	$860,000	$1,065,000
Hutto Road	Georgetown ETJ	Four 4.5-ft Arch Culverts	New Culverts: Four 5-ft x 4-ft Culverts with 272-ft x 60-ft Wide Roadway	$1,240,000	$1,540,000
Pecan Branch					
West Sequoia Spur	Georgetown ETJ	One 48-in Dia. Culvert	New Culverts: Four 5-ft Dia. Culverts with 175-ft x 60-ft Wide Roadway	$775,000	$1,305,000
Esperada Drive	Georgetown ETJ	One 3.25-ft & Three 5-ft Arch Culverts	New Culverts: Five 10-ft x 6-ft Box Culverts with 390-ft x 60-ft Wide Roadway	$1,650,000	$2,770,000
Serenada Drive	Georgetown ETJ	Two 3-ft & Three 5-ft Arch Culverts	New Culverts: Five 10-ft x 6-ft Box Culverts with 175-ft x 60-ft Wide Roadway	$1,205,000	$2,030,000
West Shady Hollow Drive	Georgetown ETJ	Four 4-ft Arch Culverts	New Culverts: Seven 10-ft x 6-ft Box Culverts with 255-ft x 60-ft Wide Roadway	$1,100,000	$1,850,000
West Golden Oaks Road	Georgetown ETJ	Three 5-ft Arch Culverts	New Culverts: Seven 10-ft x 6-ft Box Culverts with 390-ft x 60-ft Wide Roadway	$1,460,000	$2,455,000
North Austin Avenue	Georgetown	Three 8-ft x 8-ft Box Culvert	New (Added) Culverts: Six 8-ft x 8-ft Box Culverts with 675-ft x 60-ft Wide Roadway	$2,405,000	$4,040,000
CR 151	Georgetown	Five 6.4-ft Arch Culverts	New Culverts: Ten 10-ft x 8-ft Box Culverts with 825-ft x 60-ft Wide Roadway	$3,600,000	$6,050,000
NE Inner Loop	Georgetown	Six 6.4-ft Arch Culverts	New Culverts: Ten 10-ft x 6-ft Box Culverts with 360-ft x 60-ft Wide Roadway	$2,125,000	$3,570,000
CR 152	Georgetown	One 1.6-ft Arch Culvert	New Culverts: Ten 10-ft x 6-ft Box Culverts with 570-ft x 60-ft Wide Roadway	$2,865,000	$4,815,000
FM 971	Georgetown ETJ	Five 8-ft x 5-ft Box Culvert	New Culverts: Fifteen 10-ft x 10-ft Box Culverts with 850-ft x 60-ft Wide Roadway	$4,925,000	$8,270,000
Smith Branch					
CR 166	Georgetown ETJ	Two 3.2-ft Arch Culvert	New Culverts: Four 5-ft x 5-ft Box Culverts with 115-ft x 60-ft Wide Roadway	$395,000	$660,000
Madison Oaks Avenue	Georgetown	Four 10-ft x 6-ft Box Culverts	Existing Approach: Raise 290-ft x 60-ft Wide Roadway	$400,000	$670,000
S. Austin Avenue	Georgetown	Four 9-ft x 7-ft Box Culverts	Existing Approach: Raise 900-ft x 60-ft Wide Roadway	$1,835,000	$3,085,000
E. University Avenue	Georgetown	118-ft Length Bridge	New Bridge: 150-ft Length x 72-ft Width with 210-ft x 60-ft Wide Roadway	$1,635,000	$2,750,000
Smith Creek Road	Georgetown	4.6-ft x 8.1-ft Box Culvert	New Bridge: 150-ft Length x 72-ft Width with 1300-ft x 60-ft Wide Roadway	$4,945,000	$8,305,000

Table C-2. Summary of Crossing Concept Designs (continued)

Project ID	Jurisdiction	Existing Crossing	Improvement	Construction Cost	Total Cost
North Fork San Gabriel River					
CR 257	Williamson County	175-ft Length Bridge	New Bridge: 200-ft Length x 72-ft Width with 230-ft x 60-ft Wide Roadway	$2,560,000	$3,175,000
FM 2340	Burnet County	36-ft Length Bridge	New Culverts: Eight 9-ft x 7-ft Culverts with 372-ft x 60-ft Wide Roadway	$2,920,000	$3,625,000
CR 202	Burnet County	Two 24-in Dia. Culverts	New Bridge: 200-ft Length x 72-ft Width with 1100-ft x 60-ft Wide Roadway	$5,815,000	$7,210,000
FM 243	Burnet County	200-ft Length Bridge	New Bridge: 300-ft Length x 72-ft Width with 1600-ft x 60-ft Wide Roadway	$8,535,000	$10,580,000
CR 200	Burnet County	140-ft Length Bridge	New Bridge: 300-ft Length x 72-ft Width with 700-ft x 60-ft Wide Roadway	$5,165,000	$6,405,000
CR 203	Burnet County	One 9-in Dia. Culvert	New Bridge: 200-ft Length x 72-ft Width with 1025-ft x 60-ft Wide Roadway	$5,535,000	$6,860,000
RM 1174	Burnet County	250-ft Length Bridge	New Bridge: 300-ft Length x 72-ft Width with 600-ft x 60-ft Wide Roadway	$3,670,000	$4,550,000
RM 963	Burnet County	100-ft Length Bridge	New Bridge: 250-ft Length x 72-ft Width with 350-ft x 60-ft Wide Roadway	$3,435,000	$4,255,000
CR 258	Georgetown ETJ	70-ft Length Bridge	New Bridge: 200-ft Length x 72-ft Width with 1000-ft x 60-ft Wide Roadway	$5,440,000	$6,745,000
Middle Fork San Gabriel River					
Cedar Hollow Road	Georgetown ETJ	Four 4-ft Arch Culverts	New Culverts: Nine 12-ft x 10-ft Culverts with 690-ft x 60-ft Wide Roadway	$4,785,000	$5,930,000
Rancho Bueno Drive	Georgetown ETJ	Six 48-in Dia. Culverts	New Bridge: 90-ft Length x 72-ft Width with 230-ft x 60-ft Wide Roadway	$3,360,000	$4,165,000
Cross Creek Road	Georgetown ETJ	Four 60-in Dia. Culverts	New Bridge: 550-ft Length x 72-ft Width with 700-ft x 60-ft Wide Roadway	$7,390,000	$9,165,000
South Fork San Gabriel River					
CR 330B	Burnet County	Two 4-ft Dia. Culverts	New Bridge: 50-ft Length x 72-ft Width with 860-ft x 60-ft Wide Roadway	$1,565,000	$2,630,000
CR 323	Burnet County	60-ft Length Bridge	New Bridge: 100-ft Length x 72-ft Width with 560-ft x 60-ft Wide Roadway	$2,325,000	$3,910,000
FM 1869	Williamson County	210-ft Length Bridge	New Bridge: 300-ft Length x 72-ft Width with 315-ft x 60-ft Wide Roadway	$2,930,000	$4,920,000

Table C-3. Summary of Problem Area Mitigation Projects

Project ID	Jurisdiction	Issue to be Addressed	Description of Improvements	Type of Improvement			Estimated Benefit (Flood Risk Reduction)	Estimated Total Cost	Benefit / Cost Ratio
				Crossing	Channel	Detention			
Berry Creek									
BC01 (Cowan)	Georgetown	This problem area is located near Independence Creek Lane on Cowan Creek. Approximately 10 structures are flooded along this reach in the Existing Conditions 100-year storm event.	The project includes approximately 7,070 cubic yards of channel excavation. Overall the improvement extends 1,275 feet along Cowan Creek, a tributary to Berry Creek. It is anticipated that this specific project will remove all flooded structures from the 100-year floodplain.		**X**		$865,000	$935,000	0.92
BC02 (Berry)	Georgetown	The problem area is located along Berry Creek in between Dove Hollow Trail and Dawson Trail. Approximately 14 structures are flooded along this reach in the Existing Conditions 100-year storm event.	The project includes approximately 48,000 cubic yards of channel excavation. Overall the improvement extends 1,350 feet along Berry Creek. It is anticipated that this project will remove all flooded structures from the 100-year floodplain.		**X**		$9,725,000	$2,310,000	4.21
BC03 (Berry)	Georgetown	This problem area is located near Painted Bunting Lane and Great Frontier Drive along Berry Creek. Approximately 18 structures are flooded along this reach in the Existing Conditions 100-year storm event.	The project includes approximately 24,500 cubic yards of channel excavation. Overall the improvement extends 1,300 feet along Berry Creek with an additional 2,000 feet of berm. It is anticipated that this project will remove all flooded structures from the 100-year floodplain.		**X**		$6,735,000	$3,650,000	1.84
BC04 (Berry)	Georgetown	The problem area is located along Berry Creek near Crystal Springs Drive. Approximately 24 structures are flooded along this reach in the Existing Conditions 100-year storm event.	The project includes approximately 90,300 cubic yards of channel excavation. Overall the improvement extends 3,350 feet along Berry Creek. It is anticipated that the project will remove 19 flooded structures from the 100-year floodplain.		**X**		$3,120,000	$4,015,000	0.80
BC05 (Berry)	Georgetown	The problem area is located along Berry Creek near Trail Rider Way. Approximately 23 structures are flooded along this reach in the Existing Conditions 100-year storm event.	The project includes approximately 105,300 cubic yards of channel excavation. Overall the improvement extends 1,580 feet along Berry Creek. It is anticipated that the project will remove 17 flooded structures from the 100-year floodplain.		**X**		$3,910,000	$4,115,000	0.95
Pecan Branch									
PB01 (Pecan)	Georgetown ETJ	This problem area is located within the Golden Oaks Subdivision on Pecan Branch. Approximately 8 structures are flooded along this reach in the Existing Conditions 100-year storm event.	This project involves constructing a 100 ac-ft peak-shaving detention pond including an earthen lateral weir to divert flows into the detention pond and an outlet pipe with a flap gate to prevent low-flows from entering the pond. The purpose of the pond is to significantly reduce downstream peak flow rates within the Golden Oaks Subdivision during events greater than the 25-year storm event.			**X**	$565,000	$8,900,000	0.06

Table C-3. Summary of Problem Area Mitigation Projects (continued)

Project ID	Jurisdiction	Issue to be Addressed	Description of Improvements	Type of Improvement			Estimated Benefit (Flood Risk Reduction)	Estimated Total Cost	Benefit / Cost Ratio
				Crossing	Channel	Detention			
PB02 (Pecan)	Georgetown	The existing crossings at the IH35 Southbound Frontage (3 - 10-ft x 8-ft box culverts) and Main Lanes (3 - 10-ft x 8-ft box culverts) do not fully convey the Existing Conditions 100-year storm event without flow overtopping the roadway. In the past, this flooded crossing has resulted in loss of life, and therefore, is considered a significant flood problem area.	This project would upgrade the existing Main Lanes IH35 crossing to convey the Existing Conditions 100-year storm event without overtopping the roadway. The proposed improvement would upgrade the South Bound crossing (5 - 10-ft x 8-ft reinforced box culverts) and the Main Lane crossing (6 - 10-ft x 8-ft reinforced box culverts). In order to prevent downstream hydrologic impacts, this alternative would require mitigation of lost flood volume storage upstream of the improved crossing. Therefore, the 100 ac-ft peak shaving detention pond included in PB01 is proposed as part of this alternative	**X**		**X**	$1,135,000	$10,825,000	0.10
PB03 (Pecan)	Georgetown ETJ	This problem area is located within the Serenada Subdivision on Pecan Branch. Approximately 8 structures are flooded along this reach in the Existing Conditions 100-year storm event.	This project involves channel clearing and maintenance for a 75 ft wide, 3,550 ft long section of Pecan Branch between Val Verde Drive and Serenda Drive. The purpose of this improvement is to provide improved channel capacity and flood protection thereby reducing flooding of residential structures along the channel. While this project is listed as a high-priority project, permanent easement requirements within residential lots and potential environmental impacts may make this project less desirable.		**X**		$5,755,000	$410,000	14.04*
PB04 (Pecan)	Georgetown	This problem area is located within the Reata Trails Subdivision between Canyon Road and Pecan Branch. Approximately 13 structures are flooded along this reach in the Existing Conditions 100-year storm event.	This project involves 1,200 feet of channel improvements including 8,175 cubic yards of excavation along the west bank of Pecan Branch behind Canyon Road. The purpose of this improvement is to provide sufficient channel capacity and flood protection for the design 100-year Existing Conditions flood event to be conveyed through the channel in this area without flooding the residential structures.		**X**		$5,085,000	$815,000	6.24
PB05 (Pecan)	Georgetown	This problem area is located along Lonnie Thomas Road on Pecan Branch. Approximately 4 structures are flooded along this reach in the Existing Conditions 100-year storm event.	This project involves channel clearing and maintenance for a 10-acre area south of Lonnie Thomas Road and west of CR 152. Permanent easements within existing residential properties must be obtained in order to maintain the efficiency and improved hydraulic capacity of the channel. The purpose of this improvement is to provide improved channel capacity and flood protection thereby reducing flooding of residential structures along the channel.		**X**		$120,000	$295,000	0.41

Table C-3. Summary of Problem Area Mitigation Projects (continued)

Project ID	Jurisdiction	Issue to be Addressed	Description of Improvements	Type of Improvement			Estimated Benefit (Flood Risk Reduction)	Estimated Total Cost	Benefit / Cost Ratio
				Crossing	Channel	Detention			
Smith Branch									
SB01 (Smith)	Georgetown	This problem area is located near the West Fork confluence with Smith Branch, primarily along Quail Valley Drive. Approximately 6 structures are flooded along this reach in the Existing Conditions 100-year storm event.	This project involves channel improvements including 14,500 cubic yards of excavation near the West Fork confluence of Smith Branch and the addition of four (4) 10' x 4' concrete box culverts at the Quail Valley Drive crossing. The purpose of this project is to improve channel capacity and hydraulic efficiency of the West Fork confluence to minimize overtopping and flooding of residential structures in the area.	**X**	**X**		$1,905,000	$1,885,000	1.01
SB02 (Smith)	Georgetown ETJ	This problem area is located within the Rabbit Hollow Subdivision along the main stem of Smith Branch. Approximately 6 structures are flooded along this reach in the Existing Conditions 100-year storm event.	This project involves the buy-out of flood prone structures within the low-lying problem area. No cost-effective structural alternatives were identified in this study; however, potential structural alternatives associated with removal of the existing FM1460 crossing that may benefit Rabbit Hollow and the WCJDC located a half-mile downstream should be evaluated in the future.				$2,615,000	$765,000	3.42
North Fork San Gabriel River									
NF01 (North Fork)	Liberty Hill	The problem area is located along the North Fork San Gabriel River near River Road. Approximately 12 structures are flooded along this reach in the Existing Conditions 100-year floodplain.	The project includes approximately 731,950 cubic yards of channel excavation. Overall the improvement extends 4,580 feet along the North Fork River. It is anticipated that the project will remove 11 flooded structures from the 100-year floodplain.		**X**		$1,195,000	$21,775,000	0.05
NF02, NF03 (North Fork)	Liberty Hill	The problem area is located along the North Fork San Gabriel River near the CR 256 and CR 257 intersection. There are two areas within the project area that contain approximately 10 flooded structures in the Existing Conditions 100-year storm event.	This project is a combined project (NF02 & NF03) that will address flooding issues for the two problem areas. The project includes approximately 820,330 cubic yards of channel excavation. Overall the improvement extends 3,090 feet along the North Fork River. It is anticipated that the project will remove 5 flooded structures from the 100-year floodplain.		**X**		$635,000	$22,275,000	0.03
South Fork San Gabriel River									
SFSG01 (South Fork)	Leander ETJ	This problem area is located within the High Gabriel & South San Gabriel Ranches Subdivisions along the South Fork San Gabriel River. Approximately 9 structures are flooded along this reach in the Existing Conditions 100-year storm event.	This project involves the buy-out of flood prone structures within the low-lying problem area. No cost-effective structural alternatives were identified in this study.				$800,000	$2,385,000	0.34

Table C-3. Summary of Problem Area Mitigation Projects (continued)

Project ID	Jurisdiction	Issue to be Addressed	Description of Improvements	Type of Improvement			Estimated Benefit (Flood Risk Reduction)	Estimated Total Cost	Benefit / Cost Ratio
				Crossing	Channel	Detention			
San Gabriel River									
SG01 (San Gabriel)	Georgetown ETJ	The problem area is located along the San Gabriel River at CR 103. Approximately 4 structures are flooded along this reach in the Existing Conditions 100-year storm event.	The project includes approximately 227,570 cubic yards of channel excavation. Overall the improvement would extend 5,310 feet along the San Gabriel. It is anticipated that the project will remove 0 flooded structures from the 100-year floodplain.		**X**		$3,810,000	$8,795,000	0.43
SG02 (San Gabriel)	Georgetown ETJ	The problem area is located along the San Gabriel River between McShepherd Road and SH 29. Approximately 13 structures are flooded along this reach in the Existing Conditions 100-year storm event.	The project includes approximately 279,670 cubic yards of channel excavation. Overall the improvement extends 4,070 feet along the San Gabriel. It is anticipated that the project will remove 6 flooded structures from the 100-year floodplain.		**X**		$3,020,000	$11,470,000	0.26
**Easement and O&M costs are not included in total project cost and may significantly affect Benefit/Cost Ration and overall feasibility of project. Additional cost analysis is recommended as part of future studies.*									

Table C-4. Flood Severity Index – Problem Areas
(Berry Creek)

Elements		Description	Points		Berry Creek at Painted Bunting Lane	Berry Creek at Trail Rider Way	Berry Creek at Dove Hollow Trail/Dawson Trail	Berry Creek at Crystal Spring Drive	Cowan Creek at Independence Creek Lane
					BC03	BC05	BC02	BC04	BC01
1.	Public Safety	a) All evacuation routes impassible due to flooding during 100-year fully developed conditions event	Yes	10 points	0	0	0	0	0
			No (streets are passible)	0 point					
		b) At least one evacuation street impassible due to flooding during 100-year fully developed conditions event	Yes	5 point	5	5	5	5	5
			No (streets are passible)	0 points					
		c) Improvements of flooded streets would benefit overall transportation system of the area	Yes	5 points	0	0	0	0	0
			No	0 point					
2.	Flood Significance	a) Number of structures flooded from the 100-year existing conditions event	Each structure within 100-year floodplain.	1 point	15	11	14	8	6
		b) Structure flooding frequencies	10-year fully developed	10 points	0	0	0	0	0
			25-year fully developed	5 points					
			100-year fully developed	0 point					
3.	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	10	10	10	10	10
			No	10 points					
4.	Environment	Environmental Impact of the proposed improvements	High	0 points	5	5	5	5	5
			Medium	5 points					
			Low	10 points					
5.	Easement/O&M	Easement and O&M costs and requirements associated with project	Less than 1 acre	10 points	-10	-20	-10	-20	0
			Less than 5 acres	-0 points					
			Less than 10 acres	-10 points					
			More than 10 acres	-20 points					
6.	Benefit/Cost Ratio	Ratio of benefit (damage reduction) and project costs	$BCR^{0.2}$ x 30 points		34	30	40	29	30
				Total Severity Index	**59**	**41**	**64**	**37**	**56**

Footnotes:
*Number of structures does not include RV Trailers in the mobile home park.
**Potentially one or two business structures are in this problem area.
***Benefit/Cost Ratio based on recommended non-structural alternative.
1) Manufactured homes are considered as permanent structures, but Mobile Homes/RV Trailers are not considered as permanent structures.

Table C-4. Flood Severity Index – Problem Areas
(Pecan Branch)

Elements		Description	Points		Golden Oaks Subdivision at Pecan Branch	IH35 at Pecan Branch	Serenada Subdivision at Pecan Branch	Canyon Rd at Pecan Branch	Lonnie Thomas Dr at Pecan Branch
					PB01	PB02	PB03	PB04	PB05
1.	Public Safety	a) All evacuation routes impassible due to flooding during 100-year fully developed conditions event	Yes	10 points	10	10	0	0	0
			No (streets are passible)	0 point					
		b) At least one evacuation street impassible due to flooding during 100-year fully developed conditions event	Yes	5 point	5	5	0	0	5
			No (streets are passible)	0 points					
		c) Improvements of flooded streets would benefit overall transportation system of the area	Yes	5 points	5	5	0	0	0
			No	0 point					
2.	Flood Significance	a) Number of structures flooded from the 100-year existing conditions event	Each structure within 100-year floodplain.	1 point	8	0	8	13	4
		b) Structure flooding frequencies	10-year fully developed	10 points	10	0	5	10	10
			25-year fully developed	5 points					
			100-year fully developed	0 point					
3.	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	10	10	10	10	10
			No	10 points					
4.	Environment	Environmental Impact of the proposed improvements	High	0 points	0	5	0	0	5
			Medium	5 points					
			Low	10 points					
5.	Easement/O&M	Easement and O&M costs and requirements associated with project	Less than 1 acre	10 points	-20	-20	-20	0	-20
			Less than 5 acres	-0 points					
			Less than 10 acres	-10 points					
			More than 10 acres	-20 points					
6.	Benefit/Cost Ratio	Ratio of benefit (damage reduction) and project costs	$BCR^{0.2}$ x 30 points		17	19	51	43	25
				Total Severity Indez	**45**	**34**	**54**	**76**	**39**

Footnotes:
*Number of structures does not include RV Trailers in the mobile home park.
**Potentially one or two business structures are in this problem area.
***Benefit/Cost Ratio based on recommended non-structural alternative.
1) Manufactured homes are considered as permanent structures, but Mobile Homes/RV Trailers are not considered as permanent structures.

Table C-4. Flood Severity Index – Problem Areas
(Smith Branch)

Elements		Description	Points		West Fork Confluence at Smith Branch	Rabbit Hollow Subdivision at Smith Branch
					SB01	SB02
1.	Public Safety	a) All evacuation routes impassible due to flooding during 100-year fully developed conditions event	Yes	10 points	0	0
			No (streets are passible)	0 point		
		b) At least one evacuation street impassible due to flooding during 100-year fully developed conditions event	Yes	5 point	5	5
			No (streets are passible)	0 points		
		c) Improvements of flooded streets would benefit overall transportation system of the area	Yes	5 points	5	0
			No	0 point		
2.	Flood Significance	a) Number of structures flooded from the 100-year existing conditions event	Each structure within 100-year floodplain.	1 point	6	6
		b) Structure flooding frequencies	10-year fully developed	10 points	5	5
			25-year fully developed	5 points		
			100-year fully developed	0 point		
3.	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	10	10
			No	10 points		
4.	Environment	Environmental Impact of the proposed improvements	High	0 points	5	10
			Medium	5 points		
			Low	10 points		
5.	Easement/O&M	Easement and O&M costs and requirements associated with project	Less than 1 acre	10 points	10	-20
			Less than 5 acres	-0 points		
			Less than 10 acres	-10 points		
			More than 10 acres	-20 points		
6.	Benefit/Cost Ratio	Ratio of benefit (damage reduction) and project costs	$BCR^{0.2}$ x 30 points		30	38
				Total Severity Index	**76**	**54**

Footnotes:
*Number of structures does not include RV Trailers in the mobile home park.
**Potentially one or two business structures are in this problem area.
***Benefit/Cost Ratio based on recommended non-structural alternative.
1) Manufactured homes are considered as permanent structures, but Mobile Homes/RV Trailers are not considered as permanent structures.

Table C-4. Flood Severity Index – Problem Areas
(North Fork San Gabriel River)

Elements		Description	Points		North Fork at River Road	North Fork at CR 256/CR 257
					NF01	NF02
1.	Public Safety	a) All evacuation routes impassible due to flooding during 100-year fully developed conditions event	Yes	10 points	0	0
			No (streets are passible)	0 point		
		b) At least one evacuation street impassible due to flooding during 100-year fully developed conditions event	Yes	5 point	5	0
			No (streets are passible)	0 points		
		c) Improvements of flooded streets would benefit overall transportation system of the area	Yes	5 points	0	5
			No	0 point		
2.	Flood Significance	a) Number of structures flooded from the 100-year existing conditions event	Each structure within 100-year floodplain.	1 point	9	6
		b) Structure flooding frequencies	10-year fully developed	10 points	0	0
			25-year fully developed	5 points		
			100-year fully developed	0 point		
3.	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	10	10
			No	10 points		
4.	Environment	Environmental Impact of the proposed improvements	High	0 points	5	5
			Medium	5 points		
			Low	10 points		
5.	Easement/O&M	Easement and O&M costs and requirements associated with project	Less than 1 acre	10 points	-20	-20
			Less than 5 acres	-0 points		
			Less than 10 acres	-10 points		
			More than 10 acres	-20 points		
6.	Benefit/Cost Ratio	Ratio of benefit (damage reduction) and project costs	$BCR^{0.2}$ x 30 points		21	21
				Total Severity Index	**30**	**27**

Footnotes:
*Number of structures does not include RV Trailers in the mobile home park.
**Potentially one or two business structures are in this problem area.
***Benefit/Cost Ratio based on recommended non-structural alternative.
1) Manufactured homes are considered as permanent structures, but Mobile Homes/RV Trailers are not considered as permanent structures.

Table C-4. Flood Severity Index – Problem Areas
(South Fork San Gabriel River)

Elements		Description	Points		High Gabriel / S. San Gabriel Ranches at South Fork San Gabriel
					SFSG01
1.	Public Safety	a) All evacuation routes impassible due to flooding during 100-year fully developed conditions event	Yes	10 points	0
			No (streets are passible)	0 point	
		b) At least one evacuation street impassible due to flooding during 100-year fully developed conditions event	Yes	5 point	0
			No (streets are passible)	0 points	
		c) Improvements of flooded streets would benefit overall transportation system of the area	Yes	5 points	0
			No	0 point	
2.	Flood Significance	a) Number of structures flooded from the 100-year existing conditions event	Each structure within 100-year floodplain.	1 point	9
		b) Structure flooding frequencies	10-year fully developed	10 points	0
			25-year fully developed	5 points	
			100-year fully developed	0 point	
3.	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	10
			No	10 points	
4.	Environment	Environmental Impact of the proposed improvements	High	0 points	10
			Medium	5 points	
			Low	10 points	
5.	Easement/O&M	Easement and O&M costs and requirements associated with project	Less than 1 acre	10 points	-20
			Less than 5 acres	-0 points	
			Less than 10 acres	-10 points	
			More than 10 acres	-20 points	
6.	Benefit/Cost Ratio	Ratio of benefit (damage reduction) and project costs	$BCR^{0.2}$ x 30 points		24
				Total Severity Index	**33**

Footnotes:
*Number of structures does not include RV Trailers in the mobile home park.
**Potentially one or two business structures are in this problem area.
***Benefit/Cost Ratio based on recommended non-structural alternative.
1) Manufactured homes are considered as permanent structures, but Mobile Homes/RV Trailers are not considered as permanent structures.

Table C-4. Flood Severity Index – Problem Areas
(San Gabriel River)

Elements		Description	Points		San Gabriel River at CR 103	San Gabriel River at McShepherd Road
					SG01	SG02
1.	Public Safety	a) All evacuation routes impassible due to flooding during 100-year fully developed conditions event	Yes	10 points	0	0
			No (streets are passible)	0 point		
		b) At least one evacuation street impassible due to flooding during 100-year fully developed conditions event	Yes	5 point	0	5
			No (streets are passible)	0 points		
		c) Improvements of flooded streets would benefit overall transportation system of the area	Yes	5 points	0	0
			No	0 point		
2.	Flood Significance	a) Number of structures flooded from the 100-year existing conditions event	Each structure within 100-year floodplain.	1 point	10	16
		b) Structure flooding frequencies	10-year fully developed	10 points	5	0
			25-year fully developed	5 points		
			100-year fully developed	0 point		
3.	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	10	10
			No	10 points		
4.	Environment	Environmental Impact of the proposed improvements	High	0 points	5	5
			Medium	5 points		
			Low	10 points		
5.	Easement/O&M	Easement and O&M costs and requirements associated with project	Less than 1 acre	10 points	-20	-20
			Less than 5 acres	-0 points		
			Less than 10 acres	-10 points		
			More than 10 acres	-20 points		
6.	Benefit/Cost Ratio	Ratio of benefit (damage reduction) and project costs	$BCR^{0.2}$ x 30 points		25	24
				Total Severity Index	**35**	**40**

Footnotes:
*Number of structures does not include RV Trailers in the mobile home park.
**Potentially one or two business structures are in this problem area.
***Benefit/Cost Ratio based on recommended non-structural alternative.
1) Manufactured homes are considered as permanent structures, but Mobile Homes/RV Trailers are not considered as permanent structures.

Table C-5. Flood Severity Index – Roadway Crossings (Berry Creek)

	Elements	Description	Points		FM 971 @ Berry Creek	CR 152 @ Berry Creek	CR 245 @ Berry Creek	CR 241 @ Berry Creek	CR 152 @ Dry Berry Creek	CR 143 @ Dry Berry Creek	CR 234 @ Dry Berry Creek	Live Oak Trl. @ Dry Berry Creek	CR 245 @ Cowan Creek	Andice Rd./RM 2338 @ Cowan Creek
1	Public Safety	a. Flooded Street Classifications (effects on transportation system)	Local	0 points	20	10	10	10	10	10	10	0	10	10
			Collector	10 points										
			Arterial	20 points										
		b. Is alternative route to go around flooded creek crossing readily available?	Yes	0 points	10	0	10	10	0	10	10	10	0	0
			No	10 points										
2	Flood Significance	a. Roadway flooding frequencies (overtops roadway)	5-year fully developed	20 points	10	20	20	20	0	20	20	20	20	5
			10-year fully developed	10 points										
			25-year fully developed	5 points										
			100-year fully developed	0 points										
		b. Number of structures flooded due to roadway crossing inadequacy	Each Structure within 100-year fully developed condition floodplain	1 point	0	0	0	0	0	0	0	12	0	0
3	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	10	0	10	10	0	10	10	10	10	0
			No	10 points										
4	Environment	Environmental Impact of the proposed improvements	High	0 points	5	5	5	5	5	5	5	5	5	5
			Medium	5 points										
			Low	10 points										
5	Project Cost	Total Cost of Project including Construction, Eng, and Admin	High (>$5M)	-10 points	-10	-10	-10	-10	10	-10	-10	0	-10	10
			Medium (>$3M)	0 points										
			Low (<$3M)	10 points										
				Total Points	45	25	45	45	25	45	45	57	35	30
				Total Cost	$14,960,000	$9,345,000	$16,310,000	$14,330,000	$1,915,000	$12,775,000	$8,150,000	$4,615,000	$9,665,000	$2,475,000

Table C-5. Flood Severity Index – Roadway Crossings (Mankins Branch)

	Elements	Description	Points		McShepherd Rd./CR 100 @ Mankins Branch	Bell Gin Rd./CR 104 @ Mankins Branch	Hutto Road @ Mankins Branch
1	Public Safety	a. Flooded Street Classifications (effects on transportation system)	Local	0 points	0	10	10
			Collector	10 points			
			Arterial	20 points			
		b. Is alternative route to go around flooded creek crossing readily available?	Yes	0 points	10	0	0
			No	10 points			
2	Flood Significance	a. Roadway flooding frequencies (overtops roadway)	5-year fully developed	20 points	20	20	20
			10-year fully developed	10 points			
			25-year fully developed	5 points			
			100-year fully developed	0 points			
		b. Number of structures flooded due to roadway crossing inadequacy	Each Structure within 100-year fully developed condition floodplain	1 point	0	0	0
3	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	10	0	0
			No	10 points			
4	Environment	Environmental Impact of the proposed improvements	High	0 points	5	5	5
			Medium	5 points			
			Low	10 points			
5	Project Cost	Total Cost of Project including Construction, Eng, and Admin	High (>$5M)	-10 points	0	10	10
			Medium (>$3M)	0 points			
			Low (<$3M)	10 points			
				Total Points	45	45	45
				Total Cost	$4,655,000	$1,065,000	$1,535,000

Table C-5. Flood Severity Index – Roadway Crossings (Pecan Branch)

	Elements	Description	Points		W Sequoia Spur @ Pecan Branch	Esperada Dr. @ Pecan Branch	Serenada Dr. @ Pecan Branch	W Shady Hollow Dr. @ Pecan Branch	W Golden Oaks Rd. @ Pecan Branch	N Austin Ave. @ Pecan Branch	CR 151 @ Pecan Branch	NE Inner Loop @ Pecan Branch	CR 152 @ Pecan Branch	FM 971 @ Pecan Branch
1	Public Safety	a. Flooded Street Classifications (effects on transportation system)	Local	0 points	10	10	10	0	0	20	10	20	10	20
			Collector	10 points										
			Arterial	20 points										
		b. Is alternative route to go around flooded creek crossing readily available?	Yes	0 points	0	0	0	10	10	0	0	0	0	10
			No	10 points										
2	Flood Significance	a. Roadway flooding frequencies (overtops roadway)	5-year fully developed	20 points	20	20	20	20	20	20	20	5	20	20
			10-year fully developed	10 points										
			25-year fully developed	5 points										
			100-year fully developed	0 points										
		b. Number of structures flooded due to roadway crossing inadequacy	Each Structure within 100-year fully developed condition floodplain	1 point	0	4	8	0	0	0	0	0	0	0
3	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	0	0	0	0	0	10	10	10	10	10
			No	10 points										
4	Environment	Environmental Impact of the proposed improvements	High	0 points	5	5	5	5	5	5	5	5	5	5
			Medium	5 points										
			Low	10 points										
5	Project Cost	Total Cost of Project including Construction, Eng, and Admin	High (>$5M)	-10 points	10	10	10	10	10	0	-10	0	0	-10
			Medium (>$3M)	0 points										
			Low (<$3M)	10 points										
				Total Points	45	49	53	45	45	55	35	40	45	55
				Total Cost	$1,305,000	$2,770,000	$2,030,000	$1,850,000	$2,455,000	$4,040,000	$6,050,000	$3,570,000	$4,815,000	$8,270,000

Table C-5. Flood Severity Index – Roadway Crossings (Smith Branch)

	Elements	Description	Points		CR 166 @ Smith Branch	University/Hwy. 29 @ Smith Branch	Smith Creek Rd. @ Smith Branch	Madison Oaks Ave. @ Smith Branch	S Austin Ave. @ Smith Branch
1	Public Safety	a. Flooded Street Classifications (effects on transportation system)	Local	0 points	0	20	10	0	20
			Collector	10 points					
			Arterial	20 points					
		b. Is alternative route to go around flooded creek crossing readily available?	Yes	0 points	10	0	0	10	0
			No	10 points					
2	Flood Significance	a. Roadway flooding frequencies (overtops roadway)	5-year fully developed	20 points	20	5	20	10	5
			10-year fully developed	10 points					
			25-year fully developed	5 points					
			100-year fully developed	0 points					
		b. Number of structures flooded due to roadway crossing inadequacy	Each Structure within 100-year fully developed condition floodplain	1 point	0	0	0	0	0
3	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	10	10	10	10	10
			No	10 points					
4	Environment	Environmental Impact of the proposed improvements	High	0 points	5	5	5	5	5
			Medium	5 points					
			Low	10 points					
5	Project Cost	Total Cost of Project including Construction, Eng, and Admin	High (>$5M)	-10 points	10	10	0	10	-10
			Medium (>$3M)	0 points					
			Low (<$3M)	10 points					
				Total Points	55	50	45	45	30
				Total Cost	$660,000	$670,000	$3,085,000	$2,750,000	$8,305,000

Table C-5. Flood Severity Index – Roadway Crossings
(North Fork San Gabriel River)

	Elements	Description	Points		CR 258 @ North Fork	CR 257 @ North Fork	FM 243 @ North Fork	CR 200 @ North Fork	RM 1174 @ North Fork	RM 963 @ North Fork	CR 202 @ North Fork	CR 203 @ North Fork	FM 2340 @ North Fork
1	Public Safety	a. Flooded Street Classifications (effects on transportation system)	Local	0 points	0	10	10	0	10	10	0	0	10
			Collector	10 points									
			Arterial	20 points									
		b. Is alternative route to go around flooded creek crossing readily available?	Yes	0 points	0	10	10	10	10	10	10	10	10
			No	10 points									
2	Flood Significance	a. Roadway flooding frequencies (overtops roadway)	5-year fully developed	20 points	20	10	10	20	5	5	20	20	20
			10-year fully developed	10 points									
			25-year fully developed	5 points									
			100-year fully developed	0 points									
		b. Number of structures flooded due to roadway crossing inadequacy	Each Structure within 100-year fully developed condition floodplain	1 point	0	28	0	0	0	0	3	0	0
3	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	0	10	10	10	10	0	10	10	10
			No	10 points									
4	Environment	Environmental Impact of the proposed improvements	High	0 points	0	5	5	5	5	5	5	5	5
			Medium	5 points									
			Low	10 points									
5	Project Cost	Total Cost of Project including Construction, Eng, and Admin	High (>$5M)	-10 points	-10	0	-10	-10	0	0	-10	-10	0
			Medium (>$3M)	0 points									
			Low (<$3M)	10 points									
			Total Points		10	73	35	35	40	30	38	35	55
			Total Cost		$6,745,000	$3,175,000	$10,580,000	$6,405,000	$4,550,000	$4,255,000	$7,210,000	$6,860,000	$3,625,000

Table C-5. Flood Severity Index – Roadway Crossings
(Middle Fork San Gabriel River)

	Elements	Description	Points		Rancho Bueno Dr. @ Middle Fork	Cedar Hollow Rd. @ Middle Fork	Cross Creek Rd. @ Middle Fork
1	Public Safety	a. Flooded Street Classifications (effects on transportation system)	Local	0 points	0	0	0
			Collector	10 points			
			Arterial	20 points			
		b. Is alternative route to go around flooded creek crossing readily available?	Yes	0 points	10	10	10
			No	10 points			
2	Flood Significance	a. Roadway flooding frequencies (overtops roadway)	5-year fully developed	20 points	20	20	20
			10-year fully developed	10 points			
			25-year fully developed	5 points			
			100-year fully developed	0 points			
		b. Number of structures flooded due to roadway crossing inadequacy	Each Structure within 100-year fully developed condition floodplain	1 point	0	0	0
3	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	10	10	10
			No	10 points			
4	Environment	Environmental Impact of the proposed improvements	High	0 points	5	5	5
			Medium	5 points			
			Low	10 points			
5	Project Cost	Total Cost of Project including Construction, Eng, and Admin	High (>$5M)	-10 points	0	-10	-10
			Medium (>$3M)	0 points			
			Low (<$3M)	10 points			
				Total Points	45	35	35
				Total Cost	$4,165,000	$5,930,000	$9,165,000

Table C-5. Flood Severity Index – Roadway Crossings
(South Fork San Gabriel River)

	Elements	Description	Points		CR 330B @ South Fork	CR 323 @ South Fork	FM 1869 @ South Fork
1	Public Safety	a. Flooded Street Classifications (effects on transportation system)	Local	0 points	0	10	20
			Collector	10 points			
			Arterial	20 points			
		b. Is alternative route to go around flooded creek crossing readily available?	Yes	0 points	10	0	0
			No	10 points			
2	Flood Significance	a. Roadway flooding frequencies (overtops roadway)	5-year fully developed	20 points	20	20	20
			10-year fully developed	10 points			
			25-year fully developed	5 points			
			100-year fully developed	0 points			
		b. Number of structures flooded due to roadway crossing inadequacy	Each Structure within 100-year fully developed condition floodplain	1 point	0	0	0
3	Dependence on Other Projects	Improvements depend on other projects to be fully effective	Yes	0 points	10	10	10
			No	10 points			
4	Environment	Environmental Impact of the proposed improvements	High	0 points	5	5	5
			Medium	5 points			
			Low	10 points			
5	Project Cost	Total Cost of Project including Construction, Eng, and Admin	High (>$5M)	-10 points	10	0	0
			Medium (>$3M)	0 points			
			Low (<$3M)	10 points			
				Total Points	55	45	55
				Total Cost	$2,630,000	$3,910,000	$4,920,000

APPENDIX D
ENVIRONMENTAL CONSTRAINTS

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Table D1 Environmental Constraints

	Resource / Regulating Entity (or Policy)	Database Findings	Applicable Regulations & Following Steps	Associated Figure(s) / Attachments	Crossings or Proposed Project Locations Details[1]
Water Resources	**Edwards Aquifer** / Texas Commission on Environmental Quality (TCEQ)	TCEQ Edwards Aquifer digital files were reviewed. Portions of the Study Area are within the Edwards Aquifer Contributing, Edwards Aquifer Recharge, and Edwards Aquifer Transition Zones. The western and eastern most Study Area extents are outside of the Edwards Aquifer Zones.	• TCEQ regulates activities that have the potential to pollute within the Edwards Aquifer. • Comply with TCEQ Edwards Aquifer Rules and if deemed necessary, perform a Geological Assessment and Edwards Aquifer Protection Plan. • Comply with local city ordinances and if applicable: ➢ City of Georgetown Environmental Protection Provisions for Impervious Cover (Chapter 11 of the Unified Development Code). ➢ Comply with City of Georgetown Edwards Aquifer Recharge Zone Water Quality Ordinance (2013-59).	Edwards Aquifer Map	The following are located within the Edwards Aquifer Contributing Zone: D7, D8, D9, D10, D18, D19, S24, CI-7, and CI-8. The following are located within the Edwards Aquifer Recharge Zone: D1, D2, D3, D4, D5, D6, D15, D16, D17, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12, S14, S15, S16, S17, S18, S19, and S20. The following are located within the Edwards Aquifer Transition Zone: D12, D13, D14. The following are not located within any mapped Edwards Aquifer zone: D11, D20, D21, D22, D23, D24, D25, D26, S21, S22, S23, CI-9, CI-10, CI-11, and CI-12.
	Jurisdictional Waters of the U.S. / U.S. Army Corp of Engineers (USACE)	Data from the national hydrography dataset and the Texas Water Development Board (TWDB) was reviewed to identify surface waters within the study area. The major streams consist of: • Berry Creek • North Fork San Gabriel River • Middle Fork San Gabriel River • South Fork San Gabriel River • San Gabriel River mainstem. Tributaries of Berry Creek include: • Cowan Creek, • Dry Berry Creek, • Jennings Branch, and • Pecan Branch. Tributaries of the San Gabriel River mainstem include: • Mankins Branch • Smith Branch • West Fork Smith Branch	• The USACE regulates activities within jurisdictional waters, such as streams, rivers, and lakes. • Conduct a site survey to identify any USACE regulated water features, and delineate boundaries. • Follow USACE permitting procedures under Section 404 of the Clean Water Act (CWA), if applicable. • Depending on the nature of activity, activities that result in the placement of fill within waters of the U.S. under ½-acre or below 300 linear feet are generally authorized under a nationwide permit. A pre-construction notification and compensatory mitigation may be required. Impacts to waters of the U.S. above these thresholds may require an individual permit.	Water Feature & FEMA Floodplain Map	All Doucet crossing improvement locations, Doucet channel improvement locations, Scheibe problem crossings, and Scheibe mitigation alternative locations will be subject to Section 404 regulations if work is proposed within the ordinary high water mark (OHWM) of waters of the United States.

	Resource / Regulating Entity (or Policy)	Database Findings	Applicable Regulations & Following Steps	Associated Figure(s) / Attachments	Crossings or Proposed Project Locations Details[1]
	Floodplains / Federal Emergency Management Agency (FEMA)	Digital data derived from FEMA Flood Insurance Rate Maps (FIRM) were reviewed. Floodplains are mapped along nearly all of the named tributaries as well as numerous unnamed tributaries.	• Comply with FEMA floodplain regulations and local ordinances, and coordinate with the local floodplain administrator.	Water Feature & FEMA Floodplain Map	Nearly all Doucet crossing improvement locations, Doucet channel improvement locations, Scheibe problem crossings, and Scheibe mitigation alternative locations are located within the 100-year floodplain (Zone A or Zone AE), with the exception of Doucet crossing improvements D13 and D14.
	Wetlands / USACE, Texas Parks & Wildlife Department (TPWD), U.S. Fish & Wildlife Service (USFWS)	The USFWS National Wetland Inventory (NWI) was utilized to identify mapped wetlands. The Study Area contains wetlands located primarily along surface waters and in floodplains. The NWI is utilized only as a general guide to the potential location of wetlands and does not substitute for site surveys to identify and delineate wetlands regulated under Section 404.	• The USACE regulates activities within jurisdictional waters, including wetlands. • Conduct a site survey to identify any USACE regulated wetlands, and delineate boundaries. • Follow USACE permitting procedures under Section 404 of the CWA, if applicable.	Water Feature & FEMA Floodplain Map	The following locations are located within or within 1,500 feet of a mapped feature on the NWI map: D18, D21, D23, S23, S24, CI-5, CI-9, CI-10, CI-12, PB02, PB04, and PB05.
	Navigable Waters / Sections 9 & 10 of the Rivers and Harbors Act per United States Coast Guard (USCG) and USACE.	The USACE list of *Navigable Waters of the United States in the Fort Worth, Albuquerque, and Tulsa Districts within the State of Texas* (1999) was reviewed. No navigable waters are located within the Study Area.	No applicable regulations or following steps.	None	None
	Impaired Assessment Units / Section 303(d) of the Clean Water Act (CWA)	The *2014 Texas Integrated Report - 303(d) List* on surface water quality was reviewed in conjunction with the 2014 TCEQ geospatial data to determine if any impaired assessment units occur within the Study Area. The North Fork of the San Gabriel River, Segment ID 1248, is listed with *Category 5b* and *5c* status. The listed parameters are chloride and total dissolved solids. Mankins Branch, Segment ID 1248C, is listed as a *Category 5b* segment. The listed parameter is bacteria.	• Comply with Sections 303(d) of the CWA. • Issuance of permits to discharge into 303(d)-listed water bodies is described in the TCEQ regulatory guidance document *Procedures to Implement the Texas Surface Water Quality Standards* (January 2003, RG-194).	None	The following are located directly on an impaired stream segment: D11, CI-9, CI-10, CI-11, and CI-12.
Species	**Karst Zone** / USFWS	The USFWS karst zone data were utilized to determine if the Study Area is within one of the four karst zones. The USFWS karst zones are used to determine the likelihood of an area to contain rare cave fauna: ➢ Zone 1: Areas known to contain rare cave fauna. ➢ Zone 2: Areas with a high probability of containing rare cave fauna. ➢ Zone 3: Areas that probably do not contain rare cave fauna. ➢ Zone 4: Areas which do not contain rare cave fauna.	• The Endangered Species Act (ESA) regulates for the protection of habitat and species. • Based on the report findings and a review of aerial photography, there is a potential for Golden-cheeked Warbler and Black-capped Vireo habitat. • A site visit, conducted by a qualified biologist, should occur to determine if habitat for listed birds is present. • In Williamson County, the RHCP provides umbrella authorization for activities that	USFWS Karst Zone Map	The following are located within Karst Zone 1 (areas known to contain rare cave fauna): D15, D17, S1, S2, S3, S4, S6, S16, CI-1, CI-2, CI-3, CI-5, CI-6, PB01, PB03, and PB04. The following is located within Karst Zone 2 (areas with a high probability of containing rare cave fauna): D16. The following are located within Karst Zone 3 (areas that probably do not contain rare cave fauna): D5, D6, D7, D8, D9, S15, S17, S18, S20, CI-4, SB01a, SB01b, SB01c, and SB03.

	Resource / Regulating Entity (or Policy)	Database Findings	Applicable Regulations & Following Steps	Associated Figure(s) / Attachments	Crossings or Proposed Project Locations Details[1]
		A significant portion of the Study Area is located within Zones 1 and 2, centered around the western part of the City of Georgetown. Two portions of the project, east of IH-35 and a western portion of the Study Area in Burnet County, are not within Zones 1 through 4.	may affect the black-capped vireo and golden-cheeked warbler under an incidental take permit, provided that certain conservation and management actions are implemented. • A Geological Assessment and/or habitat survey may be necessary to determine whether or not habitat for listed species is present and to determine if karst invertebrates are present within the Study Area. • In Williamson County, the RHCP provides umbrella authorization for activities under an incidental take permit, provided that certain conservation and management actions are implemented. This authorized take applies to the Bone Cave Harvestman, and Coffin Cave Mold Beetle. The incidental take permit does not authorize take of the Tooth Cave ground beetle; therefore any actions that would impact this species would need to be authorized separately by the USFWS. • In 2015, the USFWS issued a final 4(d) rule which states that take of the Georgetown salamander will not be a violation of Section 9 of the ESA if the activity occurs on non-federal lands and is consistent with the water quality protection measures in Georgetown's development code. • Comply with City of Georgetown Edwards Aquifer Recharge Zone Water Quality Ordinance (2015-14). • The Texas Parks and Wildlife Code and Texas Administrative Code protect state-listed species and prohibit take of state-listed species.		The following are located within Karst Zone 4 (areas which do not contain rare cave fauna) or are located outside of the mapped karst zones: D1, D2, D3, D4, D10, D11, D12, D13, D14, D18, D19, D20, D21, D22, D23, D24, D25, D26, CI-7, CI-8, CI-9, CI-10, CI-11, CI-12, S7, S8, S9, S10, S11, S12, S14, S19, S21, S22, S23, S24, PB02, and PB05.
	Protected Species: Birds / USFWS	USFWS IPaC Trust Resource Reports were generated for Burnet & Williamson Counties. According to data in the reports, three bird species are listed as either threatened or endangered: Black-capped Vireo (*Vireo atricapilla*), Golden-cheeked Warbler (*Dendroica chrysoparia*), and the Whooping Crane (*Grus americana*). According to an USFWS online critical habitat mapper, no critical habitat for the whooping crane occurs within the Study Area. The Williamson County Conservation Foundation's (WCCF) Regional Habitat Conservation Plan (RHCP) was reviewed for potential habitat. Potential habitat for the Golden-cheeked Warbler and the Black-capped Vireo exists within the Study Area. No critical habitat has been established for the Black-capped Vireo or the Golden-cheeked Warbler.		None	The following are located within or within 1,500 feet of potential habitat for the Golden-cheeked Warbler and/or the Black-capped Vireo: D9, D10, S16, CI-5, CI-6, C-7, CI-8, CI-5, CI-6, CI-7, CI-8, PB01 and PB02.
	Protected Species: Karst Invertebrates / USFWS, TPWD Texas Natural Diversity Database	USFWS IPaC Trust Resource Reports were generated for Burnet and Williamson Counties. According to USFWS, the Bee Creek Cave Harvestman (*Texella reddelli*) is listed as endangered within Burnet County. The Bone Cave Harvestman (*Texella reyesi*), Coffin Cave Mold Beetle (*Batrisodes texanus*), and Tooth Cave Ground Beetle (*Rhadine persephone*) are listed as endangered within Williamson County. The WCCF RHCP was reviewed. The Study Area is within the North Williamson County and Georgetown Karst Fauna Regions. Listed species are present within the Study Area. While not appearing in the IPaC report for Williamson County, the Kretschmarr Cave Mold Beetle (*Texamaurops reddelli*) is listed as endangered by the USFWS wherever found.		USFWS Karst Zone Map; Texas Natural Diversity Database Map	The following are located within Karst Zone 1 (areas known to contain rare cave fauna) or Karst Zone 2 (areas with a high probability of containing rare cave fauna): D15, D16, D17, S1, S2, S3, S4, S6, S16, CI-1, CI-2, CI-3, CI-5, CI-6, PB01, PB03, and PB04 The Doucet crossing improvement locations D7 and D8 are located within a TXNDD element occurrence record area for the Krestchmarr Cave Mold Beetle. The Scheibe problem crossings S2 and S3 are located within 1,500 feet of a karst invertebrate cave. The Scheibe problem crossings S16 and S17 are located within the element occurrence record area for the Bone Cave Harvestman. The Scheibe problem crossing S18 is within 1,500 feet of the element occurrence record area for the Bone Cave Harvestman.

	Resource / Regulating Entity (or Policy)	Database Findings	Applicable Regulations & Following Steps	Associated Figure(s) / Attachments	Crossings or Proposed Project Locations Details[1]
					The Scheibe mitigation alternative area PB03 is located within 1,500 feet of a karst invertebrate cave.
	Protected Species: Salamanders / USFWS	USFWS IPaC Trust Resource Reports were generated for Burnet and Williamson Counties. According to the Burnet County report, no salamanders are listed as endangered. However, three species are listed as threatened in Williamson County: Georgetown Salamander (*Eurycea naufragia*), Jollyville Plateau Salamander (*Eurycea tonkawae*), and Salado Springs Salamander (*Eurycea chisholmensis*).		USFWS Critical Habitat Map, Texas Natural Diversity Database Map	The Doucet channel improvement locations CI-1 is located within 1,500 feet of a TXNDD element occurrence record area for the Salado Springs Salamander.
	Protected Species: Mollusks / USFWS, TPWD	USFWS IPaC Trust Resource Reports were generated for Burnet and Williamson Counties. According to data for both counties, the Smooth Pimpleback (*Quadrula houstonensis*), Texas Fawnsfoot (*Truncilla macrodon*), Texas Fatmucket (*Lampsilis bracteata*), Texas Pimpleback (*Quadrula petrina*) are all federal candidate species. TPWD lists all of these species as state-threatened, with the addition of the False Spike Mussel (*Quadrula mitchelli*).		None	No occurrence records for mussels were found in the TXNDD database; however, there is potential for mussel species to occur in perennial or intermittent streams.
	Critical Habitat / USFWS	Critical habitat is located in Williamson County for the Georgetown Salamander (*Eurycea naufragia*). The critical habitat consists of 14 locations which are springs or caves located in the Edwards Aquifer Recharge Zone. The critical habitat consists of both surface and subsurface zones. No critical habitat has been established for the Black-capped Vireo or the Golden-cheeked Warbler.	• Critical habitat designations affect only federal agency actions or federally funded or permitted activities. Critical habitat designations do not affect activities by private landowners if there is no Federal "nexus"—that is, no Federal funding or authorization. Federal agencies are required to avoid "destruction" or "adverse modification" of designated critical habitat.	USFWS Critical Habitat Map	The Doucet channel improvement location CI-1 is located adjacent to designated critical habitat for the Georgetown Salamander.
	Texas Listed Rare, Threatened, & Endangered Species / TPWD	The TPWD's rare, threatened and endangered species by county lists were utilized for Burnet and Williamson Counties. TPWD Texas Natural Diversity Database (NDD) data were obtained for all intersecting USGS quadrangles within the Study Area. Representative Element of Occurrence Records (EOR) within the Study Area include: • Ashe Juniper - Oak series (*Juniperus ashei – Quercus* spp.) • Bat roost	• Comply with Texas Parks and Wildlife (TPW) Code and the Texas Administrative Code (TAC) for laws and regulations pertaining to endangered or threatened species. • A site visit, conducted by a qualified biologist, should occur to determine if habitat or species are present.	Texas Natural Diversity Database Map	D3 and D11 are located within an EOR for the Guadalupe Bass. D12 is located within 1,500 feet of the EOR for the Guadalupe Bass. D13 and D14 are located within 1,500 feet of the EOR for Vertisol Blackland Prairie. D18 is located within 1,500 feet of the EOR for Plateau loosestrife. Crossings S2 and S3 are located within 1,500 feet of a karst invertebrate cave. Crossings S8 and S9 are located within 1,500 feet of a Cave Myotis Bat EOR and a bat roost.

	Resource / Regulating Entity (or Policy)	Database Findings	Applicable Regulations & Following Steps	Associated Figure(s) / Attachments	Crossings or Proposed Project Locations Details[1]
		• Bee Creek Cave Harvestman/Reddell Harvestman • Black-capped Vireo • Bone Cave Harvestman • Cave Myotis Bat (*Myotis velifer*) • Cedar Elm - Sugarberry series (*Ulmus americana – Celtis laevigata*) • Fountain Darter (*Etheostoma fonticola*) • Georgetown Salamander • Golden-cheeked Warbler • Gravelbar Brickellbush (*Brickellia cylindracea*) • Guadalupe Bass (*Micropterus treculii*) • Jollyville Plateau Salamander • Karst Invertebrate Cave • Kretschmarr Cave Mold Beetle • Plateau Loosestrife (*Lythrum ovalifolium*) • Salado Springs Salamander • Sycamore-leaf Snowbell (*Styrax platanifolius*) • Texas Almond (*Prunus minutiflora*) • Texas Oak series (*Quercus buckleyi*) • Texas Shiner (*Notropis amabilis*)			Crossing S14 is located within an EOR for the Guadalupe Bass. Crossing S16 is located within 1,500 feet of the EOR for the Coffin Cave Mold Beetle and the Bone Cave Harvestman. Crossings S16 and S17 are located within the EOR for the Bone Cave Harvestman. Crossing S18 is located within 1,500 feet of the EOR for the Bone Cave Harvestman. Crossings S17 and S17 are located within the EOR for the Gravelbar Brickellbush. Crossing S16 located within 1,500 feet of the EOR for the Gravelbar Brickellbush. CI-1 is located within 1,500 feet of the EOR for the Salado Springs Salamander. CI-9, CI-10, and CI-11 are located within 1,500 feet of the EOR for the Guadalupe Bass. PB02 is located within 1,500 feet of a Cave Myotis Bat EOR and a bat roost. PB03 is adjacent to the EOR for a karst invertebrate cave.
	Management Areas / TPWD	The TPWD's wildlife management areas (WMA) were reviewed. No WMAs occur within the Study Area.	No applicable regulations or following steps.	None	None
Cultural	**Archeological Resources** / Texas Historical Commission (THC)	Digital data from THC of previously conducted archeological surveys were reviewed. Many surveys have occurred within the Study Area. The Study Area contains numerous water features and per aerial photography, portions of the Study Area are undeveloped. There is a potential for cultural resources to occur within the Study Area.	• Many factors go into determining the level of effort required for cultural resources. For example, if a USACE permit is required, then these resources will need to be investigated per Section 106 of the National Historic Preservation Act of 1966 and coordinated with the THC. • Per the Texas Antiquities Code, notification to the THC would be required prior to project commencement for counties, municipalities, and other local government agencies for any project on public land if one of the following occurs: 5 or more acres	None	The following are located within or within 1500 feet of previously surveyed archeological studies: D1, D2, D3, D12, D13, D14, D15, D18, D19, D22, S4, S5, S6, S7, S8, S9, S10, S11, S12, S13, S14, S15, S16, CI-7, PB-01, PB-02, PB04, PB05, SB01a, SB01b, SB01c, and SB03.
	Historical Resources / THC	The Texas Historic Sites Atlas data was reviewed for locations of historical markers, State Antiquities Landmarks, National Register Historic Districts, and listed & eligible historic bridges. The Study Area contains 60 historical markers and 67 known cemeteries.		Texas Historical Sites Atlas Results Map	The following are located within or within 1500 feet of historic resources: D3, D5, D8, D13, D14, D18, D21, D22, S11, S12, S16, S19, CI-7, PB05, and SB03.

	Resource / Regulating Entity (or Policy)	Database Findings	Applicable Regulations & Following Steps	Associated Figure(s) / Attachments	Crossings or Proposed Project Locations Details[1]
			of ground disturbance; 5,000 or more cubic yards of earth moving; will occur in a historic district or other designated historic site; or will affect a recorded archeological site. • Compliance with local ordinances is also necessary. • It is recommended that a Texas Archeological Research Laboratory (TARL) records search be conducted for each project area.		
Other Resources	**Farmland** / Farmland Protection Policy Act (FPPA)	2016 NAIP aerials were reviewed to preliminarily assess vegetation. The Study Area has the potential to contain farmlands. The USDA Natural Resources Conservation Service (NRCS) website was utilized to generate a soil report for the Study Area. There are mapped prime farmlands within the Study Area.	• Comply with the Farmland Protection Policy Act.	None	The following are located within areas mapped as prime farmland: D5, D9, D10, D12, D13, D17, D20, D22, D23, D24, D25, D26, S6, S7, S8, S9, S10, S11, S12, S13, S17, S20, CI-2, CI-3, CI-4, CI-7, CI-8, CI-11, CI-12, PB01, PB02, PB05, and SB03.
	Significant Trees / City of Bertram	2014 NAIP aerials were reviewed to preliminarily assess vegetation. The Study Area has the potential to contain significant trees.	• Comply with the City of Bertram's Ordinance No. 20-99 regarding development regulations and Ordinance No. 26-2001 regarding Zoning. • Conduct a tree survey if the refined project area has the potential to remove trees within the City of Bertram.	None	None of the Doucet crossing improvement locations, Doucet channel improvement locations, Scheibe problem crossings, and Scheibe mitigation alternative locations are located within the boundaries of the City of Bertram or its extraterritorial jurisdiction (ETJ).
	Protected & Heritage Trees / City of Georgetown	2016 NAIP aerials were reviewed to preliminarily assess vegetation. The Study Area has the potential to contain protected and/or heritage trees.	• Comply with the City of Georgetown's Tree Preservation Ordinance. • Conduct a tree survey if the refined project area has the potential to remove trees within the City of Georgetown.	None	The following are located within the City of Georgetown boundary or ETJ: D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, D16, D17, and D18. The following are located within the City of Georgetown boundary or ETJ: CI-1, CI-2, CI-3, CI-4, CI-5, CI-6, CI-10, and CI-12. The following crossings are located within the City of Georgetown boundary or ETJ: S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, and S20. The following are located within the City of Georgetown boundary or ETJ: PB01, PB02, PB03, PB04, PB05, SB01a, SB01b, SB01c, and SB03.

	Resource / Regulating Entity (or Policy)	Database Findings	Applicable Regulations & Following Steps	Associated Figure(s) / Attachments	Crossings or Proposed Project Locations Details[1]
	Significant Trees / City of Leander	2016 NAIP aerials were reviewed to preliminarily assess vegetation. The Study Area has the potential to contain significant trees.	• Comply with the City of Leander's ordinances regulating significant trees. • Conduct a tree survey if the refined project area has the potential to remove trees within the City of Leander.	None	None of the Doucet crossing improvement locations, Doucet channel improvement locations, Scheibe problem crossings, or Scheibe mitigation alternative locations are located within the boundaries of the City of Leander or its extraterritorial jurisdiction (ETJ).
	Protected Trees / City of Liberty Hill	2016 NAIP aerials were reviewed to preliminarily assess vegetation. The Study Area has the potential to contain protected and/or heritage trees.	• Comply with the City of Liberty Hill's Tree Inventory and Protection Ordinance. • Conduct a tree survey if the refined project area has the potential to remove trees within the City of Liberty Hill.	None	The Scheibe problem crossing S24 is located within the City of Liberty Hill's ETJ. None of the other Doucet crossing improvement locations, Doucet channel improvement locations, Scheibe problem crossings, and Scheibe mitigation alternative locations are located within the boundaries of the City of Liberty Hill or its extraterritorial jurisdiction (ETJ).
	Hazardous Materials / TCEQ	The TCEQ hazardous materials digital data were reviewed for features that include: municipal setting desgination (MSD), municipal solid waste (MSW) sites, radioactive sites, Superfund sites, registered petroleum storage tanks (PST), wastewater outfalls, and leaking petroleum storage tanks (LPST).	• Due diligence/Phase I Environmental Site Assessments are typically required by leading agencies if a property transaction occurs, if structures are demolished, or if extensive excavation is conducted as part of the project. Determine if Phase I ESA is required by lending agency. • Perform Phase I ESA site visit and prepare report.	Hazardous Materials Map	Scheibe problem crossing S10 is located within 1,500 feet of a LPST. Scheibe problem crossing S11 is located within 1,500 feet of a PST. Scheibe problem crossings S17 and S18 are located within 1,500 feet of a LPST. Scheibe problem crossing S17 is located within 1,500 feet of a PST. Doucet channel improvement CI-3 is located within 1,500 feet of a PST. Doucet channel improvement CI-9 is located within 1,500 feet of a LPST. Scheibe mitigation alternative location PB05 is located within 1,500 feet of a PST.
	Community Impacts / Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations)	Limited English Proficiency, poverty, and minority data were reviewed for the general Study Area using select census tracts as a representative area. Approximately 12.4% of the population in sampled tracts in Burnet County and 7.6% of the population in sampled tracts in Williamson County is below the poverty level per 2010-2014 American Community Survey 5-Year Estimates. Minority populations occur within the generalized Study Area, and populations that speak English less than very well also occur within the sampled census tracts of Burnet and Williamson Counties per U.S. Census Bureau American Fact Finder data.	• If federal funding is utilized, comply with Executive Order (EO) 12898. This EO mandates that federal agencies identify and address, as appropriate, disproportionately high & adverse human health or environmental effects of their programs, policies, and activities on minority/low-income populations.	None	Results of the U.S. Census Bureau data analysis are generalized to the county level and not analyzed for each individual crossing.
	Parks and Wildlife Code, Chapter 26 Protected	A review of Williamson County listed parks and open spaces found that the following occur within the Study Area: 84 Lumber Park, Berry Creek Park, Berry Creek	• Comply with Parks and Wildlife Code, Chapter 26: A department, agency, political	Parks and Open Spaces Map	Locations D1 and D2 are located within 1,500 feet of Berry Springs Park and Preserve. D3 is located within 1,500 feet of Pecan Branch Park.

	Resource / Regulating Entity (or Policy)	Database Findings	Applicable Regulations & Following Steps	Associated Figure(s) / Attachments	Crossings or Proposed Project Locations Details[1]
	Property / TPWD; Williamson County	Section 5 Park, Berry Springs Parkland Preserve, Blue Hole Park, Cedar Breaks Park, Chandler Park, Chautauqua Park, Churchill Farms Park, Cobbs Cavern KFA (Karst Fauna Area), Coffin Cave Preserve, Crystal Knoll Park, Dove Springs Park, Edwards Park, Emerald Springs Park, Founders Park, Fountainwood Linear Park, Garey Park, Geneva Park, Georgetown Tennis Center, Heritage Gardens, Karankawa KFA, Katy Crossing Trail Park, Kelley Park, Lake Overlook Park, Lyndoch Park, McMaster Athletic Complex, Meadows of Georgetown Park, Newland Park, Old Oak Park, Pecan Branch Linear Greenbelt, Pecan Branch Park, Pickett Trail, Pinnacle Park, Priscilla's Well, Rain Tree Park, River Chase Park, River Chase Trail Easement, River Ridge Pool, River Road Park and Trail, Rivery Park and Trail, San Gabriel Park & Pool, San Gabriel River Frontage San Gabriel Village Open Space, San Jose Park, Shadow Canyon, Linear Park, Shadow Canyon Preserve, Smith Branch Trail, Summer Crest Park, Tejas Camp, Twin Springs Reserve, University Park, VFW Park, Village II Park, Village Pool and Parks, Windridge Village Park, Wolf Ranch Park, Woodlake Park, and Woodland Park Preserve.	subdivision, county, or municipality of this state may not approve any program or project that requires the use or taking of any public land designated and used prior to the arrangement of the program or project as a park, recreation area, scientific area, wildlife refuge, or historic site, unless the department, agency, political subdivision, county, or municipality, acting through its duly authorized governing body or officer, determines that: 1) there is no feasible and prudent alternative to the use or taking of such land; 2) and the program or project includes all reasonable planning to minimize harm to the land, as a park, recreation area, scientific area, wildlife refuge, or historic site, resulting from the use or taking. • Once the project location(s) is/are refined, review local data to determine if any of the aforementioned sites are within the project.		D18 is located within 1,500 feet of Tejas Camp. S1 is located within 1,500 feet of Village II Park. S3 is located within 1,500 feet of Emerald Springs Park. S12 is located within 1,500 feet of Pecan Branch Linear Greenbelt. S13 is located within 1,500 feet of Heritage Gardens, Smith Branch Trail, University Park, and Rain Tree Park. S14 is located within 1,500 feet of Pecan Branch Park. S17 and S18 are located within 1,500 feet of 84 Lumber Park. S19 is located within 1,500 feet of IOOF Cemetery. S20 is located within 1,500 feet of Smith Branch Trail and Summer Crest Park. PB04 is located within 1,500 feet of a City of Georgetown park. PB05 is located within 1,500 feet of the Pecan Branch Linear Greenbelt. SB01a, SB01b, and SB01c are partially located within Smith Branch Trail Park. SB03 is located within 1,500 feet of Geneva Park, Heritage Gardens, and Smith Branch Trail Park.
	Federal Lands / USFWS & USACE	A review of data depicting federal lands found two locations within the Study Area: Balcones Canyonlands National Wildlife Refuge (NWR)(USFWS) and Lake Georgetown Recreational Area (USACE). The Lake Georgetown Recreational Area includes the following parks: Bootys Crossing Park, Walnut Spring Park, Sawyer Park, Cedar Breaks Park, Lake Overlook Park, Russell Park, Jim Hogg Park, Tejas Camp, and Texas Traditions Park	• The primary purpose of the Balcones Canyonlands NWR is to protect the nesting habitat of the golden-cheeked warbler and the black-capped vireo. The Administration of national wildlife refuges is governed by various federal statutes, as well as by regulations and Presidential executive orders. Rules and regulations for the most recent fiscal year are found at 50 CFR 25-35, 43 CFR 3103.2, and 3120.3-3. For Rights-of-Way General Regulations see 50 CFR 29.21; 34 FR 19907 (1969). • Lake Georgetown and surrounding lands are managed by the USACE for water supply, flood control, and recreation. Rules and regulations governing public use of USACE water resources development projects are	Parks and Open Spaces Map	None of the Doucet crossing improvement locations, Doucet channel improvement locations, Scheibe problem crossings, or Scheibe mitigation alternative locations are located within the boundary or within 2 miles of the Balcones Canyonlands NWR. The Doucet crossing improvement location D18 is located within the boundary of the USACE Lake Georgetown parks property, near Tejas Camp.

	Resource / Regulating Entity (or Policy)	Database Findings	Applicable Regulations & Following Steps	Associated Figure(s) / Attachments	Crossings or Proposed Project Locations Details[1]
			found at Title 36 CFR, Chapter 111, Part 327. • Comply with Section 4(f) regulations, which govern the use of land from publicly owned parks, recreation areas, wildlife and waterfowl refuges, and public or private historic sites for federal highway projects.		

Notes:
[1] – The Doucet crossing improvement locations are indicated as Map ID D1 - D26.
The Doucet channel improvement locations are indicated as Map ID CI-1 – CI-12.
The Scheibe problem crossings are indicated as S1 – S24.
The Scheibe mitigation alternative locations consists of the following Map IDs: PB01, PB02, PB03, PB04, PB05, SB01a, SB01b, SB01c, and SB03.

Table D2 Environmental Constraints Matrix - Water Resources

			WATER RESOURCES					
	RESOURCE		Edwards Aquifer	Waters of the US	Floodplains	Wetlands	Navigable Waters	Impaired Assessment Units
	AGENCY/REGULATING ENTITY		TCEQ	USACE	FEMA	USFWS	USCG, USACE	CWA, TCEQ
DOUCET CROSSING IMPROVEMENTS	**AFFECTED STREAM**	**MAP ID**						
CR 152 IMPROVEMENT 400' OPENING	Dry Berry Creek	D1	X	X	X	O	O	O
CR 152 IMPROVEMENT 700' OPENING	Berry Creek	D2	X	X	X	O	O	O
FM 971 IMPROVEMENT 500' OPENING	Berry Creek	D3	X	X	X	O	O	O
CR 143 IMPROVEMENT 1400' OPENING	Dry Berry Creek	D4	X	X	X	O	O	O
CR 234 IMPROVEMENT 900' OPENING	Dry Berry Creek	D5	X	X	X	O	O	O
LIVE OAK TRAILS IMPROVEMENT 400' OPENING	Dry Berry Creek	D6	X	X	X	O	O	O
CR 241 IMPROVEMENT 500' OPENING	Berry Creek	D7	X	X	X	O	O	O
CR 245 IMPROVEMENT 800' OPENING	Berry Creek	D8	X	X	X	O	O	O
RM 2338 IMPROVEMENT 8 - 9X7' RBP	Jennings Branch	D9	X	X	X	O	O	O
CR 245 IMPROVEMENT 575' OPENING	Jennings Branch	D10	X	X	X	O	O	O
CR 100/ MCSHEPHERD RD IMPROVEMENT 200' OPENING	Mankins Branch	D11	O	X	X	O	O	X
CR 104/PATRIOT WAY IMPROVEMENT 50' OPENING	Mankins Branch	D12	X	X	X	O	O	X
BELL GIN RD IMPROVEMENT 5 - 4'X5' RBP	Unnamed Tributary to Mankins Branch	D13	X	X	O	O	O	O
CR 110/HUTTO RD IMPROVEMENT 4 - 5'X5' RBP	Unnamed Tributary to Mankins Branch	D14	X	X	O	O	O	O
CEDAR HOLLOW RD IMPROVEMENT 9 - 12'X10' RBP	Middle Fork San Gabriel River	D15	X	X	X	O	O	O
RANCHO BUENO DR IMPROVEMENT 300' OPENING	Middle Fork San Gabriel River	D16	X	X	X	O	O	O
CROSS CREEK RD IMPROVEMENT 550' OPENING	Middle Fork San Gabriel River	D17	X	X	X	O	O	O
CR 258 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D18	X	X	X	X	O	O
CR 257 IMPROVEMENT 200' OPENING	North Fork San Gabriel River	D19	X	X	X	O	O	O
FM 243 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D20	O	X	X	O	O	O
CR 200 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D21	O	X	X	X	O	O
RM 1174 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D22	O	X	X	O	O	O
RM 963 IMPROVEMENT 250' OPENING	North Fork San Gabriel River	D23	O	X	X	X	O	O
CR 203 IMPROVEMENT 200' OPENING	North Fork San Gabriel River	D24	O	X	X	O	O	O
CR 202 IMPROVEMENT 200' OPENING	North Fork San Gabriel River	D25	O	X	X	O	O	O
FM 2340 IMPROVEMENT 8 - 9'X7' RBP	North Fork San Gabriel River	D26	O	X	X	O	O	O

KEY

X - Identified feature in the location of the crossing or proposed work location.

O - No identified feature in the location of the crossing or proposed work location.

- Identified feature within 1500-foot radius of centerpoint of crossing.

- To avoid Section 404 permitting, no fill material shall be placed within the boundary of the OHWM of the stream or within wetland boundaries.

- Crossing is not located on an imparied stream segment, but the stream segment does drain into an impaired segment within a short distance.

* - Crossing or proposed work location is located within USFWS Karst Zone 1 (areas known to contain rare cave fauna) or Karst Zone 2 (areas with a high probability of containing rare cave fauna).

** - Results of analysis are generalized to the county level and not anyalzed for each individual crossing.

*** - For Burnet County, 4 mussel species are federal candidates for listing, and 5 are state-listed threatened. For Williamson County, 4 mussel species are federal candidates for listing, and 3 are state-listed endangered. No occurrence records were found in the TXNDD database; however, there is potential for mussel species to occur in perennial or intermittent streams.

Table D2 Environmental Constraints Matrix - Water Resources (continued)

			WATER RESOURCES					
	RESOURCE		Edwards Aquifer	Waters of the US	Floodplains	Wetlands	Navigable Waters	Impaired Assessment Units
	AGENCY/REGULATING ENTITY		TCEQ	USACE	FEMA	USFWS	USCG, USACE	CWA, TCEQ
SCHEIBE PROBLEM CROSSINGS	**AFFECTED STREAM**	**MAP ID**						
300' Upgrade to (4) 5' Dia RCP	Pecan Branch	S1	X	X	X	O	O	###
Upgrade to (5) 10'X6' RBC & Upgrade Road Elevation to 733.0	Pecan Branch	S2	X	X	X	O	O	###
Upgrade to (5) 10'X6' RBC & Upgrade Road Elevation to 762.50	Pecan Branch	S3	X	X	X	O	O	###
Upgrade to (7) 10'X6' RBC & Upgrade Road Elevation to 732.70	Pecan Branch	S4	X	X	X	O	O	###
Upgrade to (7) 10'X6' RBC & Upgrade Road Elevation to 730.50	Pecan Branch	S5	X	X	X	O	O	###
not specified	Pecan Branch	S6	X	X	X	O	O	###
not specified	Pecan Branch	S7	X	X	X	O	O	###
not specified	Pecan Branch	S8	X	X	X	O	O	###
Upgrade to (9) 8'X8' RBC & Upgrade Road Elevation to 712.75'	Pecan Branch	S9	X	X	X	O	O	###
Upgrade to (10) 10'X8' RBC & Upgrade Road Elevation to 709.20'	Pecan Branch	S10	X	X	X	O	O	###
Upgrade to (10) 10'X6' RBC & Upgrade Road Elevation to 696.50'	Pecan Branch	S11	X	X	X	O	O	###
Upgrade to (10) 10'X6' RBC & Upgrade Road Elevation to 689.00'	Pecan Branch	S12	X	X	X	O	O	###
not specified	West Fork Smith Branch	S13	X	X	X	O	O	###
Upgrade to (15) 10'X10' RBC & Upgrade Road Elevation to 645.45'	Pecan Branch	S14	X	X	X	O	O	###
Upgrade to (4) 5'X5' RBC	Smith Branch	S15	X	X	X	O	O	###
not specified	West Fork Smith Branch	S16	X	X	X	O	O	###
Raise Road 1.5'	West Fork Smith Branch	S17	X	X	X	O	O	###
Raise Road 1.0'	West Fork Smith Branch	S18	X	X	X	O	O	###
150' Span Bridge	Smith Branch	S19	X	X	X	O	O	###
150' Span Bridge	Smith Branch	S20	X	X	X	O	O	###
50' Span Bridge	South Fork San Gabriel	S21	O	X	X	O	O	O
125' Span Bridge	South Fork San Gabriel	S22	O	X	X	O	O	O
100' Span Bridge	South Fork San Gabriel	S23	O	X	X	X	O	O
300' Span Bridge & Upgrade to (8) Rows of 1' Piers	South Fork San Gabriel	S24	X	X	X	X	O	O

KEY

X - Identified feature in the location of the crossing or proposed work location.

O - No identified feature in the location of the crossing or proposed work location.

- Identified feature within 1500-foot radius of centerpoint of crossing.

- To avoid Section 404 permitting, no fill material shall be placed within the boundary of the OHWM of the stream or within wetland boundaries.

- Crossing is not located on an imparied stream segment, but the stream segment does drain into an impaired segment within a short distance.

* - Crossing or proposed work location is located within USFWS Karst Zone 1 (areas known to contain rare cave fauna) or Karst Zone 2 (areas with a high probability of containing rare cave fauna).

** - Results of analysis are generalized to the county level and not anyalzed for each individual crossing.

*** - For Burnet County, 4 mussel species are federal candidates for listing, and 5 are state-listed threatened. For Williamson County, 4 mussel species are federal candidates for listing, and 3 are state-listed endangered. No occurrence records were found in the TXNDD database; however, there is potential for mussel species to occur in perennial or intermittent streams.

Table D2 Environmental Constraints Matrix - Water Resources (continued)

			WATER RESOURCES					
	RESOURCE		Edwards Aquifer	Waters of the US	Floodplains	Wetlands	Navigable Waters	Impaired Assessment Units
	AGENCY/REGULATING ENTITY		TCEQ	USACE	FEMA	USFWS	USCG, USACE	CWA, TCEQ
DOUCET CHANNEL IMPROVEMENTS	**AFFECTED STREAM**	**MAP ID**						
Crystal Springs Drive @ Berry Creek	Berry Creek	CI-1	X	##	X	O	O	O
Dove Hollow Trail & Dawson Trail @ Berry Creek	Berry Creek	CI-2	X	##	X	O	O	O
Dove Hollow Trail & Dawson Trail @ Berry Creek	Berry Creek	CI-3	X	##	X	O	O	O
Painted Bunting Lane & Great Frontier Drive @ Berry Creek	Berry Creek	CI-4	X	##	X	O	O	O
Trail Rider Way @ Berry Creek	Berry Creek	CI-5	X	##	X	X	O	O
Independence Creek Lane @ Cowan Creek	Cowan Creek	CI-6	X	##	X	O	O	O
CR 256 & CR 257 @ North Fork San Gabriel River	North Fork San Gabriel River	CI-7	X	##	X	O	O	O
River Road @ North Fork San Gabriel River	North Fork San Gabriel River	CI-8	X	##	X	O	O	O
CR 103 @ San Gabriel River	San Gabriel River	CI-9	O	##	X	X	O	X
CR 103 @ San Gabriel River	San Gabriel River	CI-10	O	##	X	X	O	X
McShepherd Road & SH 29 @ San Gabriel River	San Gabriel River	CI-11	O	##	X	O	O	X
McShepherd Road & SH 29 @ San Gabriel River	San Gabriel River	CI-12	O	##	X	X	O	X
SCHEIBE MITIGATION ALTERNATIVES		**MAP ID**						
100 ac-ft Peak Shaving Pond	Pecan Branch	PB01	X	##	X	O	O	###
Upgrade SB to (5) 10'X8' RBC	Pecan Branch	PB02	X	X	X	#	O	###
3,550 LF Channel Clearing & Maintenance	Pecan Branch	PB03	X	X	X	O	O	###
1,200 LF Channel Improvements & 8,175 CY Excavation	Pecan Branch	PB04	X	##	X	#	O	###
1,050 LF Channel Clearing & Maintenance	Pecan Branch	PB05	X	X	X	#	O	###
Upgrade to (6) 8'X4' & (4) 10'X4' RBC	West Fork Smith Branch	SB01a	X	X	X	O	O	###
Channel Improvements	West Fork Smith Branch	SB01b	X	X	X	O	O	###
750 LF Channel Improvements & 14,500 CY Excavation	Smith Branch	SB01c	X	X	X	O	O	###
Detention/Channel Improvements	Smith Branch	SB03	X	X	X	O	O	###

KEY

X - Identified feature in the location of the crossing or proposed work location.

O - No identified feature in the location of the crossing or proposed work location.

- Identified feature within 1500-foot radius of centerpoint of crossing.

- To avoid Section 404 permitting, no fill material shall be placed within the boundary of the OHWM of the stream or within wetland boundaries.

- Crossing is not located on an imparied stream segment, but the stream segment does drain into an impaired segment within a short distance.

* - Crossing or proposed work location is located within USFWS Karst Zone 1 (areas known to contain rare cave fauna) or Karst Zone 2 (areas with a high probability of containing rare cave fauna).

** - Results of analysis are generalized to the county level and not anyalzed for each individual crossing.

*** - For Burnet County, 4 mussel species are federal candidates for listing, and 5 are state-listed threatened. For Williamson County, 4 mussel species are federal candidates for listing, and 3 are state-listed endangered. No occurrence records were found in the TXNDD database; however, there is potential for mussel species to occur in perennial or intermittent streams.

Table D3 Environmental Constraints Matrix – Protected Species

			PROTECTED SPECIES							
	RESOURCE		Karst Zone	Birds	Karst Invertebrates	Salamanders	Clams	Critical Habitat	Texas Listed Species & SOC	Management Areas
	AGENCY/REGULATING ENTITY		USFWS	USFWS	USFWS	USFWS	USFWS	USFWS	TPWD	TPWD
DOUCET CROSSING IMPROVEMENTS	**AFFECTED STREAM**	**MAP ID**								
CR 152 IMPROVEMENT 400' OPENING	Dry Berry Creek	D1	O	O	O	O	***	O	O	O
CR 152 IMPROVEMENT 700' OPENING	Berry Creek	D2	O	O	O	O	***	O	O	O
FM 971 IMPROVEMENT 500' OPENING	Berry Creek	D3	O	O	O	O	***	O	X	O
CR 143 IMPROVEMENT 1400' OPENING	Dry Berry Creek	D4	O	O	O	O	***	O	O	O
CR 234 IMPROVEMENT 900' OPENING	Dry Berry Creek	D5	X	O	O	O	***	O	O	O
LIVE OAK TRAILS IMPROVEMENT 400' OPENING	Dry Berry Creek	D6	X	O	O	O	***	O	O	O
CR 241 IMPROVEMENT 500' OPENING	Berry Creek	D7	X	O	X	O	***	O	O	O
CR 245 IMPROVEMENT 800' OPENING	Berry Creek	D8	X	O	X	O	***	O	O	O
RM 2338 IMPROVEMENT 8 - 9X7' RBP	Jennings Branch	D9	X	#	O	O	***	O	O	O
CR 245 IMPROVEMENT 575' OPENING	Jennings Branch	D10	O	#	O	O	***	O	O	O
CR 100/ MCSHEPHERD RD IMPROVEMENT 200' OPENING	Mankins Branch	D11	O	O	O	O	***	O	X	O
CR 104/PATRIOT WAY IMPROVEMENT 50' OPENING	Mankins Branch	D12	O	O	O	O	***	O	#	O
BELL GIN RD IMPROVEMENT 5 - 4'X5' RBP	Unnamed Tributary to Mankins Branch	D13	O	O	O	O	***	O	#	O
CR 110/HUTTO RD IMPROVEMENT 4 - 5'X5' RBP	Unnamed Tributary to Mankins Branch	D14	O	O	O	O	***	O	#	O
CEDAR HOLLOW RD IMPROVEMENT 9 - 12'X10' RBP	Middle Fork San Gabriel River	D15	X	O	*	O	***	O	O	O
RANCHO BUENO DR IMPROVEMENT 300' OPENING	Middle Fork San Gabriel River	D16	X	O	*	O	***	O	O	O
CROSS CREEK RD IMPROVEMENT 550' OPENING	Middle Fork San Gabriel River	D17	X	O	*	O	***	O	O	O
CR 258 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D18	O	#	O	O	***	O	#	O
CR 257 IMPROVEMENT 200' OPENING	North Fork San Gabriel River	D19	O	#	O	O	***	O	O	O
FM 243 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D20	O	O	O	O	***	O	O	O
CR 200 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D21	O	O	O	O	***	O	O	O
RM 1174 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D22	O	O	O	O	***	O	O	O
RM 963 IMPROVEMENT 250' OPENING	North Fork San Gabriel River	D23	O	O	O	O	***	O	O	O
CR 203 IMPROVEMENT 200' OPENING	North Fork San Gabriel River	D24	O	O	O	O	***	O	O	O
CR 202 IMPROVEMENT 200' OPENING	North Fork San Gabriel River	D25	O	O	O	O	***	O	O	O
FM 2340 IMPROVEMENT 8 - 9'X7' RBP	North Fork San Gabriel River	D26	O	O	O	O	***	O	O	O

KEY

X - Identified feature in the location of the crossing or proposed work location.

O - No identified feature in the location of the crossing or proposed work location.

- Identified feature within 1500-foot radius of centerpoint of crossing.

- To avoid Section 404 permitting, no fill material shall be placed within the boundary of the OHWM of the stream or within wetland boundaries.

- Crossing is not located on an imparied stream segment, but the stream segment does drain into an impaired segment within a short distance.

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** - Results of analysis are generalized to the county level and not anyalzed for each individual crossing.

*** - For Burnet County, 4 mussel species are federal candidates for listing, and 5 are state-listed threatened. For Williamson County, 4 mussel species are federal candidates for listing, and 3 are state-listed endangered. No occurrence records were found in the TXNDD database; however, there is potential for mussel species to occur in perennial or intermittent streams.

Table D3 Environmental Constraints Matrix – Protected Species (continued)

			PROTECTED SPECIES							
	RESOURCE		Karst Zone	Birds	Karst Invertebrates	Salamanders	Clams	Critical Habitat	Texas Listed Species & SOC	Management Areas
	AGENCY/REGULATING ENTITY		USFWS	USFWS	USFWS	USFWS	USFWS	USFWS	TPWD	TPWD
SCHEIBE PROBLEM CROSSINGS	**AFFECTED STREAM**	**MAP ID**								
300' Upgrade to (4) 5' Dia RCP	Pecan Branch	S1	X	O	O	O	***	O	O	O
Upgrade to (5) 10'X6' RBC & Upgrade Road Elevation to 733.0	Pecan Branch	S2	X	O	#*	O	***	O	#	O
Upgrade to (5) 10'X6' RBC & Upgrade Road Elevation to 762.50	Pecan Branch	S3	X	O	#*	O	***	O	#	O
Upgrade to (7) 10'X6' RBC & Upgrade Road Elevation to 732.70	Pecan Branch	S4	X	O	*	O	***	O	O	O
Upgrade to (7) 10'X6' RBC & Upgrade Road Elevation to 730.50	Pecan Branch	S5	X	O	O	O	***	O	O	O
not specified	Pecan Branch	S6	X	O	*	O	***	O	O	O
not specified	Pecan Branch	S7	O	O	O	O	***	O	O	O
not specified	Pecan Branch	S8	O	O	O	O	***	O	#	O
Upgrade to (9) 8'X8' RBC & Upgrade Road Elevation to 712.75'	Pecan Branch	S9	O	O	O	O	***	O	#	O
Upgrade to (10) 10'X8' RBC & Upgrade Road Elevation to 709.20'	Pecan Branch	S10	O	O	O	O	***	O	O	O
Upgrade to (10) 10'X6' RBC & Upgrade Road Elevation to 696.50'	Pecan Branch	S11	O	O	O	O	***	O	O	O
Upgrade to (10) 10'X6' RBC & Upgrade Road Elevation to 689.00'	Pecan Branch	S12	O	O	O	O	***	O	O	O
not specified	West Fork Smith Branch	S13	X	O	O	O	***	O	O	O
Upgrade to (15) 10'X10' RBC & Upgrade Road Elevation to 645.45'	Pecan Branch	S14	O	O	O	O	***	O	#	O
Upgrade to (4) 5'X5' RBC	Smith Branch	S15	X	O	O	O	***	O	O	O
not specified	West Fork Smith Branch	S16	X	#	X*	O	***	O	X	O
Raise Road 1.5'	West Fork Smith Branch	S17	X	O	X	O	***	O	X	O
Raise Road 1.0'	West Fork Smith Branch	S18	X	O	#	O	***	O	X	O
150' Span Bridge	Smith Branch	S19	O	O	O	O	***	O	O	O
150' Span Bridge	Smith Branch	S20	X	O	O	O	***	O	O	O
50' Span Bridge	South Fork San Gabriel	S21	O	O	O	O	***	O	O	O
125' Span Bridge	South Fork San Gabriel	S22	O	O	O	O	***	O	O	O
100' Span Bridge	South Fork San Gabriel	S23	O	O	O	O	***	O	O	O
300' Span Bridge & Upgrade to (8) Rows of 1' Piers	South Fork San Gabriel	S24	O	O	O	O	***	O	O	O

KEY

X - Identified feature in the location of the crossing or proposed work location.

O - No identified feature in the location of the crossing or proposed work location.

- Identified feature within 1500-foot radius of centerpoint of crossing.

- To avoid Section 404 permitting, no fill material shall be placed within the boundary of the OHWM of the stream or within wetland boundaries.

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Table D3 Environmental Constraints Matrix – Protected Species (continued)

			PROTECTED SPECIES							
	RESOURCE		Karst Zone	Birds	Karst Invertebrates	Salamanders	Clams	Critical Habitat	Texas Listed Species & SOC	Management Areas
	AGENCY/REGULATING ENTITY		USFWS	USFWS	USFWS	USFWS	USFWS	USFWS	TPWD	TPWD
DOUCET CHANNEL IMPROVEMENTS	**AFFECTED STREAM**	**MAP ID**								
Crystal Springs Drive @ Berry Creek	Berry Creek	CI-1	X	O	*	#	***	X	X	O
Dove Hollow Trail & Dawson Trail @ Berry Creek	Berry Creek	CI-2	X	O	*	O	***	O	O	O
Dove Hollow Trail & Dawson Trail @ Berry Creek	Berry Creek	CI-3	X	O	*	O	***	O	O	O
Painted Bunting Lane & Great Frontier Drive @ Berry Creek	Berry Creek	CI-4	X	O	O	O	***	O	O	O
Trail Rider Way @ Berry Creek	Berry Creek	CI-5	X	#	*	O	***	O	O	O
Independence Creek Lane @ Cowan Creek	Cowan Creek	CI-6	X	#	*	O	***	O	O	O
CR 256 & CR 257 @ North Fork San Gabriel River	North Fork San Gabriel River	CI-7	O	X	O	O	***	O	O	O
River Road @ North Fork San Gabriel River	North Fork San Gabriel River	CI-8	O	#	O	O	***	O	O	O
CR 103 @ San Gabriel River	San Gabriel River	CI-9	O	O	O	O	***	O	#	O
CR 103 @ San Gabriel River	San Gabriel River	CI-10	O	O	O	O	***	O	#	O
McShepherd Road & SH 29 @ San Gabriel River	San Gabriel River	CI-11	O	O	O	O	***	O	#	O
McShepherd Road & SH 29 @ San Gabriel River	San Gabriel River	CI-12	O	O	O	O	***	O	O	O
SCHEIBE MITIGATION ALTERNATIVES	**AFFECTED STREAM**	**MAP ID**								
100 ac-ft Peak Shaving Pond	Pecan Branch	PB01	X	O	*	O	***	O	O	O
Upgrade SB to (5) 10'X8' RBC	Pecan Branch	PB02	#	#	O	O	***	O	#	O
3,550 LF Channel Clearing & Maintenance	Pecan Branch	PB03	X	O	#*	O	***	O	#	O
1,200 LF Channel Improvements & 8,175 CY Excavation	Pecan Branch	PB04	X	O	*	O	***	O	O	O
1,050 LF Channel Clearing & Maintenance	Pecan Branch	PB05	O	O	O	O	***	O	O	O
Upgrade to (6) 8'X4' & (4) 10'X4' RBC	West Fork Smith Branch	SB01a	X	O	O	O	***	O	O	O
Channel Improvements	West Fork Smith Branch	SB01b	X	O	O	O	***	O	O	O
750 LF Channel Improvements & 14,500 CY Excavation	Smith Branch	SB01c	X	O	O	O	***	O	O	O
Detention/Channel Improvements	Smith Branch	SB03	X	O	O	O	***	O	O	O

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Table D4 Environmental Constraints Matrix – Cultural

			CULTURAL	
	RESOURCE		Archeological Resources	Historical Resources
	AGENCY/REGULATING ENTITY		THC	THC
DOUCET CROSSING IMPROVEMENTS	**AFFECTED STREAM**	**MAP ID**		
CR 152 IMPROVEMENT 400' OPENING	Dry Berry Creek	D1	#	O
CR 152 IMPROVEMENT 700' OPENING	Berry Creek	D2	#	O
FM 971 IMPROVEMENT 500' OPENING	Berry Creek	D3	#	#
CR 143 IMPROVEMENT 1400' OPENING	Dry Berry Creek	D4	O	O
CR 234 IMPROVEMENT 900' OPENING	Dry Berry Creek	D5	O	#
LIVE OAK TRAILS IMPROVEMENT 400' OPENING	Dry Berry Creek	D6	O	O
CR 241 IMPROVEMENT 500' OPENING	Berry Creek	D7	O	O
CR 245 IMPROVEMENT 800' OPENING	Berry Creek	D8	O	#
RM 2338 IMPROVEMENT 8 - 9X7' RBP	Jennings Branch	D9	O	O
CR 245 IMPROVEMENT 575' OPENING	Jennings Branch	D10	O	O
CR 100/ MCSHEPHERD RD IMPROVEMENT 200' OPENING	Mankins Branch	D11	O	O
CR 104/PATRIOT WAY IMPROVEMENT 50' OPENING	Mankins Branch	D12	X	O
BELL GIN RD IMPROVEMENT 5 - 4'X5' RBP	Unnamed Tributary to Mankins Branch	D13	X	#
CR 110/HUTTO RD IMPROVEMENT 4 - 5'X5' RBP	Unnamed Tributary to Mankins Branch	D14	#	#
CEDAR HOLLOW RD IMPROVEMENT 9 - 12'X10' RBP	Middle Fork San Gabriel River	D15	#	O
RANCHO BUENO DR IMPROVEMENT 300' OPENING	Middle Fork San Gabriel River	D16	O	O
CROSS CREEK RD IMPROVEMENT 550' OPENING	Middle Fork San Gabriel River	D17	O	O
CR 258 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D18	X	#
CR 257 IMPROVEMENT 200' OPENING	North Fork San Gabriel River	D19	X	O
FM 243 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D20	O	O
CR 200 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D21	O	#
RM 1174 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D22	X	#
RM 963 IMPROVEMENT 250' OPENING	North Fork San Gabriel River	D23	O	O
CR 203 IMPROVEMENT 200' OPENING	North Fork San Gabriel River	D24	O	O
CR 202 IMPROVEMENT 200' OPENING	North Fork San Gabriel River	D25	O	O
FM 2340 IMPROVEMENT 8 - 9'X7' RBP	North Fork San Gabriel River	D26	O	O

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Table D4 Environmental Constraints Matrix – Cultural (continued)

			CULTURAL	
	RESOURCE		Archeological Resources	Historical Resources
	AGENCY/REGULATING ENTITY		THC	THC
SCHEIBE PROBLEM CROSSINGS	**AFFECTED STREAM**	**MAP ID**		
300' Upgrade to (4) 5' Dia RCP	Pecan Branch	S1	O	O
Upgrade to (5) 10'X6' RBC & Upgrade Road Elevation to 733.0	Pecan Branch	S2	O	O
Upgrade to (5) 10'X6' RBC & Upgrade Road Elevation to 762.50	Pecan Branch	S3	O	O
Upgrade to (7) 10'X6' RBC & Upgrade Road Elevation to 732.70	Pecan Branch	S4	#	O
Upgrade to (7) 10'X6' RBC & Upgrade Road Elevation to 730.50	Pecan Branch	S5	#	O
not specified	Pecan Branch	S6	X	O
not specified	Pecan Branch	S7	#	O
not specified	Pecan Branch	S8	#	O
Upgrade to (9) 8'X8' RBC & Upgrade Road Elevation to 712.75'	Pecan Branch	S9	#	O
Upgrade to (10) 10'X8' RBC & Upgrade Road Elevation to 709.20'	Pecan Branch	S10	#	O
Upgrade to (10) 10'X6' RBC & Upgrade Road Elevation to 696.50'	Pecan Branch	S11	#	#
Upgrade to (10) 10'X6' RBC & Upgrade Road Elevation to 689.00'	Pecan Branch	S12	#	#
not specified	West Fork Smith Branch	S13	#	O
Upgrade to (15) 10'X10' RBC & Upgrade Road Elevation to 645.45'	Pecan Branch	S14	X	O
Upgrade to (4) 5'X5' RBC	Smith Branch	S15	#	O
not specified	West Fork Smith Branch	S16	#	X
Raise Road 1.5'	West Fork Smith Branch	S17	O	O
Raise Road 1.0'	West Fork Smith Branch	S18	O	O
150' Span Bridge	Smith Branch	S19	O	#
150' Span Bridge	Smith Branch	S20	O	O
50' Span Bridge	South Fork San Gabriel	S21	O	O
125' Span Bridge	South Fork San Gabriel	S22	O	O
100' Span Bridge	South Fork San Gabriel	S23	O	O
300' Span Bridge & Upgrade to (8) Rows of 1' Piers	South Fork San Gabriel	S24	O	O

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O - No identified feature in the location of the crossing or proposed work location.

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Table D4 Environmental Constraints Matrix – Cultural (continued)

			CULTURAL	
	RESOURCE		Archeological Resources	Historical Resources
	AGENCY/REGULATING ENTITY		THC	THC
DOUCET CHANNEL IMPROVEMENTS	**AFFECTED STREAM**	**MAP ID**		
Crystal Springs Drive @ Berry Creek	Berry Creek	CI-1	O	O
Dove Hollow Trail & Dawson Trail @ Berry Creek	Berry Creek	CI-2	O	O
Dove Hollow Trail & Dawson Trail @ Berry Creek	Berry Creek	CI-3	O	O
Painted Bunting Lane & Great Frontier Drive @ Berry Creek	Berry Creek	CI-4	O	O
Trail Rider Way @ Berry Creek	Berry Creek	CI-5	O	O
Independence Creek Lane @ Cowan Creek	Cowan Creek	CI-6	O	O
CR 256 & CR 257 @ North Fork San Gabriel River	North Fork San Gabriel River	CI-7	X	#
River Road @ North Fork San Gabriel River	North Fork San Gabriel River	CI-8	O	O
CR 103 @ San Gabriel River	San Gabriel River	CI-9	O	O
CR 103 @ San Gabriel River	San Gabriel River	CI-10	O	O
McShepherd Road & SH 29 @ San Gabriel River	San Gabriel River	CI-11	O	O
McShepherd Road & SH 29 @ San Gabriel River	San Gabriel River	CI-12	O	O
SCHEIBE MITIGATION ALTERNATIVES	**AFFECTED STREAM**	**MAP ID**		
100 ac-ft Peak Shaving Pond	Pecan Branch	PB01	X	O
Upgrade SB to (5) 10'X8' RBC	Pecan Branch	PB02	X	O
3,550 LF Channel Clearing & Maintenance	Pecan Branch	PB03	O	O
1,200 LF Channel Improvements & 8,175 CY Excavation	Pecan Branch	PB04	#	O
1,050 LF Channel Clearing & Maintenance	Pecan Branch	PB05	X	#
Upgrade to (6) 8'X4' & (4) 10'X4' RBC	West Fork Smith Branch	SB01a	#	O
Channel Improvements	West Fork Smith Branch	SB01b	X	O
750 LF Channel Improvements & 14,500 CY Excavation	Smith Branch	SB01c	X	O
Detention/Channel Improvements	Smith Branch	SB03	X	X

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Table D5 Environmental Constraints Matrix – Other Resources

			OTHER RESOURCES								
	RESOURCE		Farmland	Significant Trees	Protected & Heritage Trees	Significant Trees	Protected Trees	Hazardous Materials	Community Impacts	Parks & Wildlife Code, Ch 26, Protected Property	Federal Lands
	AGENCY/REGULATING ENTITY		FPPA	City of Bertram	City of Georgetown	City of Leander	City of Liberty Hill	TCEQ	EO 12898	Williamson County, TPWD	USFWS, USACE
DOUCET CROSSING IMPROVEMENTS	**AFFECTED STREAM**	**MAP ID**									
CR 152 IMPROVEMENT 400' OPENING	Dry Berry Creek	D1	O	O	X	O	O	O	**	#	O
CR 152 IMPROVEMENT 700' OPENING	Berry Creek	D2	O	O	X	O	O	O	**	#	O
FM 971 IMPROVEMENT 500' OPENING	Berry Creek	D3	O	O	X	O	O	O	**	#	O
CR 143 IMPROVEMENT 1400' OPENING	Dry Berry Creek	D4	O	O	X	O	O	O	**	O	O
CR 234 IMPROVEMENT 900' OPENING	Dry Berry Creek	D5	X	O	X	O	O	O	**	O	O
LIVE OAK TRAILS IMPROVEMENT 400' OPENING	Dry Berry Creek	D6	O	O	X	O	O	O	**	O	O
CR 241 IMPROVEMENT 500' OPENING	Berry Creek	D7	O	O	X	O	O	O	**	O	O
CR 245 IMPROVEMENT 800' OPENING	Berry Creek	D8	O	O	X	O	O	O	**	O	O
RM 2338 IMPROVEMENT 8 - 9X7' RBP	Jennings Branch	D9	X	O	X	O	O	O	**	O	O
CR 245 IMPROVEMENT 575' OPENING	Jennings Branch	D10	X	O	X	O	O	O	**	O	O
CR 100/ MCSHEPHERD RD IMPROVEMENT 200' OPENING	Mankins Branch	D11	O	O	X	O	O	O	**	O	O
CR 104/PATRIOT WAY IMPROVEMENT 50' OPENING	Mankins Branch	D12	X	O	X	O	O	O	**	O	O
BELL GIN RD IMPROVEMENT 5 - 4'X5' RBP	Unnamed Tributary to Mankins Branch	D13	X	O	X	O	O	O	**	O	O
CR 110/HUTTO RD IMPROVEMENT 4 - 5'X5' RBP	Unnamed Tributary to Mankins Branch	D14	X	O	X	O	O	O	**	O	O
CEDAR HOLLOW RD IMPROVEMENT 9 - 12'X10' RBP	Middle Fork San Gabriel River	D15	O	O	X	O	O	O	**	O	O
RANCHO BUENO DR IMPROVEMENT 300' OPENING	Middle Fork San Gabriel River	D16	O	O	X	O	O	O	**	O	O
CROSS CREEK RD IMPROVEMENT 550' OPENING	Middle Fork San Gabriel River	D17	X	O	X	O	O	O	**	O	O

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Table D5 Environmental Constraints Matrix – Other Resources (continued)

			OTHER RESOURCES								
	RESOURCE		Farmland	Significant Trees	Protected & Heritage Trees	Significant Trees	Protected Trees	Hazardous Materials	Community Impacts	Parks & Wildlife Code, Ch 26, Protected Property	Federal Lands
	AGENCY/REGULATING ENTITY		FPPA	City of Bertram	City of Georgetown	City of Leander	City of Liberty Hill	TCEQ	EO 12898	Williamson County, TPWD	USFWS, USACE
DOUCET CROSSING IMPROVEMENTS (continued)	**AFFECTED STREAM**	**MAP ID**									
CR 258 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D18	O	O	X	O	O	O	**	#	#
CR 257 IMPROVEMENT 200' OPENING	North Fork San Gabriel River	D19	O	O	O	O	O	O	**	O	O
FM 243 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D20	X	O	O	O	O	O	**	O	O
CR 200 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D21	O	O	O	O	O	O	**	O	O
RM 1174 IMPROVEMENT 300' OPENING	North Fork San Gabriel River	D22	X	O	O	O	O	O	**	O	O
RM 963 IMPROVEMENT 250' OPENING	North Fork San Gabriel River	D23	X	O	O	O	O	O	**	O	O
CR 203 IMPROVEMENT 200' OPENING	North Fork San Gabriel River	D24	X	O	O	O	O	O	**	O	O
CR 202 IMPROVEMENT 200' OPENING	North Fork San Gabriel River	D25	X	O	O	O	O	O	**	O	O
FM 2340 IMPROVEMENT 8 - 9'X7' RBP	North Fork San Gabriel River	D26	X	O	O	O	O	O	**	O	O

KEY

X - Identified feature in the location of the crossing or proposed work location.

O - No identified feature in the location of the crossing or proposed work location.

- Identified feature within 1500-foot radius of centerpoint of crossing.

- To avoid Section 404 permitting, no fill material shall be placed within the boundary of the OHWM of the stream or within wetland boundaries.

- Crossing is not located on an imparied stream segment, but the stream segment does drain into an impaired segment within a short distance.

* - Crossing or proposed work location is located within USFWS Karst Zone 1 (areas known to contain rare cave fauna) or Karst Zone 2 (areas with a high probability of containing rare cave fauna).

** - Results of analysis are generalized to the county level and not anyalzed for each individual crossing.

*** - For Burnet County, 4 mussel species are federal candidates for listing, and 5 are state-listed threatened. For Williamson County, 4 mussel species are federal candidates for listing, and 3 are state-listed endangered. No occurrence records were found in the TXNDD database; however, there is potential for mussel species to occur in perennial or intermittent streams.

Table D5 Environmental Constraints Matrix – Other Resources (continued)

			OTHER RESOURCES								
	RESOURCE		Farmland	Significant Trees	Protected & Heritage Trees	Significant Trees	Protected Trees	Hazardous Materials	Community Impacts	Parks & Wildlife Code, Ch 26, Protected Property	Federal Lands
	AGENCY/REGULATING ENTITY		FPPA	City of Bertram	City of Georgetown	City of Leander	City of Liberty Hill	TCEQ	EO 12898	Williamson County, TPWD	USFWS, USACE
SCHEIBE PROBLEM CROSSINGS	**AFFECTED STREAM**	**MAP ID**									
300' Upgrade to (4) 5' Dia RCP	Pecan Branch	S1	O	O	X	O	O	O	**	#	O
Upgrade to (5) 10'X6' RBC & Upgrade Road Elevation to 733.0	Pecan Branch	S2	O	O	X	O	O	O	**	O	O
Upgrade to (5) 10'X6' RBC & Upgrade Road Elevation to 762.50	Pecan Branch	S3	O	O	X	O	O	O	**	#	O
Upgrade to (7) 10'X6' RBC & Upgrade Road Elevation to 732.70	Pecan Branch	S4	O	O	X	O	O	O	**	O	O
Upgrade to (7) 10'X6' RBC & Upgrade Road Elevation to 730.50	Pecan Branch	S5	O	O	X	O	O	O	**	O	O
not specified	Pecan Branch	S6	X	O	X	O	O	O	**	O	O
not specified	Pecan Branch	S7	X	O	X	O	O	O	**	O	O
not specified	Pecan Branch	S8	X	O	X	O	O	O	**	O	O
Upgrade to (9) 8'X8' RBC & Upgrade Road Elevation to 712.75'	Pecan Branch	S9	X	O	X	O	O	O	**	O	O
Upgrade to (10) 10'X8' RBC & Upgrade Road Elevation to 709.20'	Pecan Branch	S10	X	O	X	O	O	#	**	O	O
Upgrade to (10) 10'X6' RBC & Upgrade Road Elevation to 696.50'	Pecan Branch	S11	X	O	X	O	O	#	**	O	O
Upgrade to (10) 10'X6' RBC & Upgrade Road Elevation to 689.00'	Pecan Branch	S12	X	O	X	O	O	O	**	#	O
not specified	West Fork Smith Branch	S13	X	O	X	O	O	O	**	#	O
Upgrade to (15) 10'X10' RBC & Upgrade Road Elevation to 645.45'	Pecan Branch	S14	O	O	X	O	O	O	**	#	O
Upgrade to (4) 5'X5' RBC	Smith Branch	S15	O	O	X	O	O	O	**	O	O

KEY

X - Identified feature in the location of the crossing or proposed work location.

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- Identified feature within 1500-foot radius of centerpoint of crossing.

- To avoid Section 404 permitting, no fill material shall be placed within the boundary of the OHWM of the stream or within wetland boundaries.

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Table D5 Environmental Constraints Matrix – Other Resources (continued)

			OTHER RESOURCES								
	RESOURCE		Farmland	Significant Trees	Protected & Heritage Trees	Significant Trees	Protected Trees	Hazardous Materials	Community Impacts	Parks & Wildlife Code, Ch 26, Protected Property	Federal Lands
	AGENCY/REGULATING ENTITY		FPPA	City of Bertram	City of Georgetown	City of Leander	City of Liberty Hill	TCEQ	EO 12898	Williamson County, TPWD	USFWS, USACE
SCHEIBE PROBLEM CROSSINGS (continued)	**AFFECTED STREAM**	**MAP ID**									
not specified	West Fork Smith Branch	S16	O	O	X	O	O	O	**	O	O
Raise Road 1.5'	West Fork Smith Branch	S17	X	O	X	O	O	#	**	#	O
Raise Road 1.0'	West Fork Smith Branch	S18	O	O	X	O	O	#	**	#	O
150' Span Bridge	Smith Branch	S19	O	O	X	O	O	O	**	#	O
150' Span Bridge	Smith Branch	S20	X	O	X	O	O	O	**	#	O
50' Span Bridge	South Fork San Gabriel	S21	O	O	O	O	O	O	**	O	O
125' Span Bridge	South Fork San Gabriel	S22	O	O	O	O	O	O	**	O	O
100' Span Bridge	South Fork San Gabriel	S23	O	O	O	O	O	O	**	O	O
300' Span Bridge & Upgrade to (8) Rows of 1' Piers	South Fork San Gabriel	S24	O	O	O	O	X	O	**	O	O

KEY

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Figures

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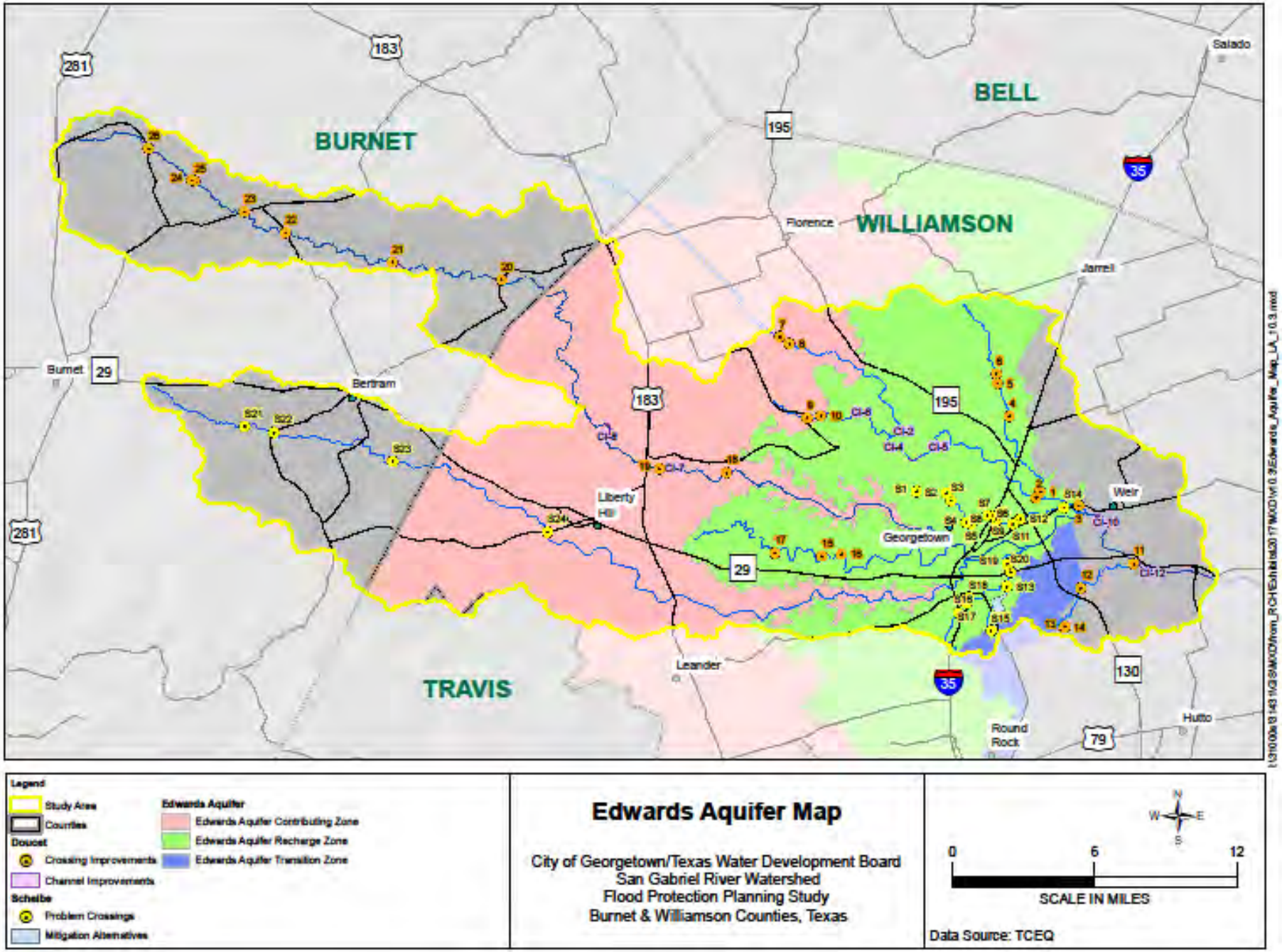
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Crossing Improvements
Channel Improvements
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Problem Crossings
Mitigation Alternatives
Edwards Aquifer
Edwards Aquifer Contributing Zone
Edwards Aquifer Recharge Zone
Edwards Aquifer Transition Zone
Edwards Aquifer Map
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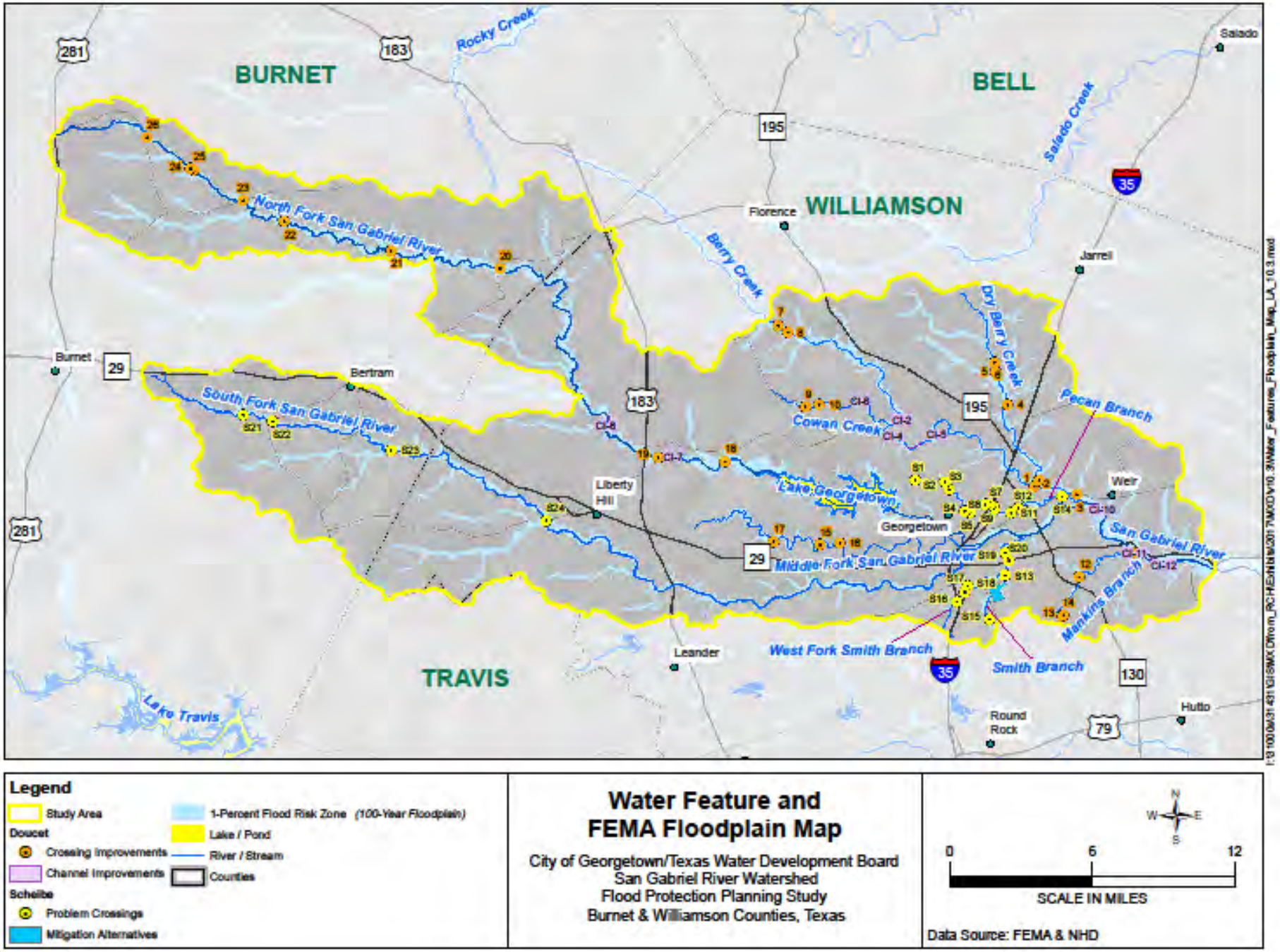
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Middle Fork San Gabriel River
San Gabriel River
Cowan Creek
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Lake Travis
West Fork Smith Branch
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FEMA Floodplain Map
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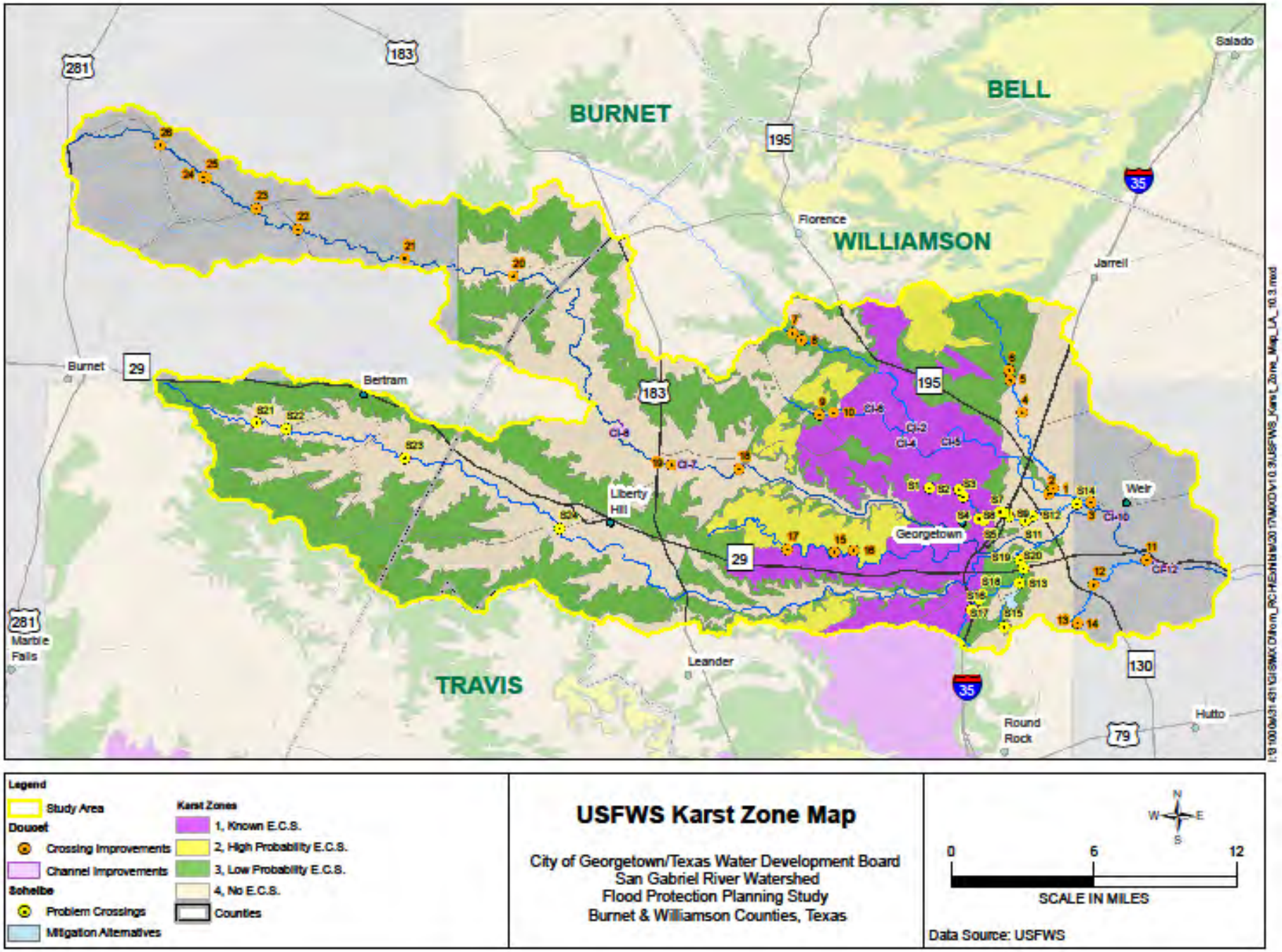
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Problem Crossings
Mitigation Alternatives
Karst Zones
1, Known E.C.S.
2, High Probability E.C.S.
3, Low Probability E.C.S.
4, No E.C.S.
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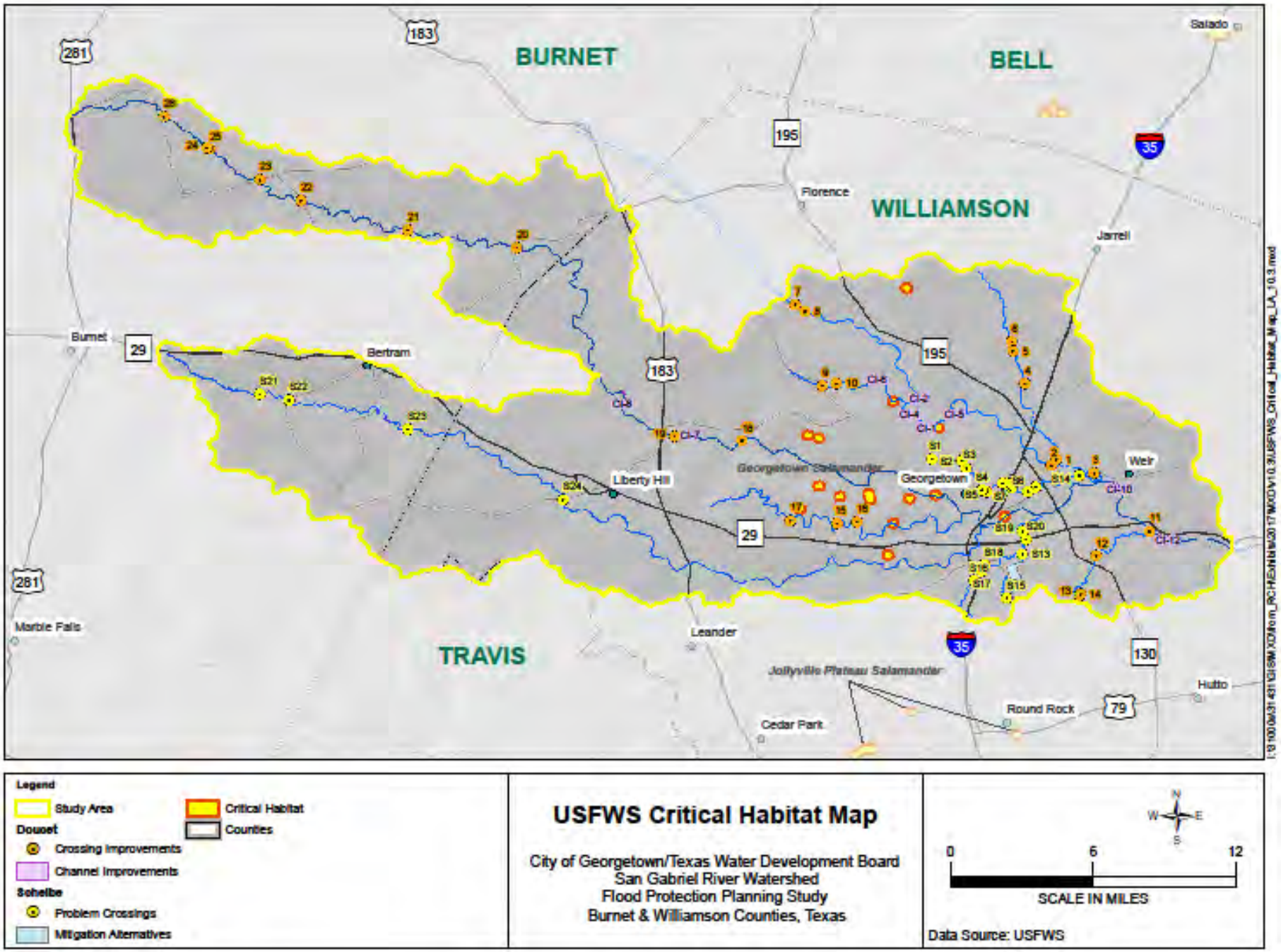
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Channel Improvements
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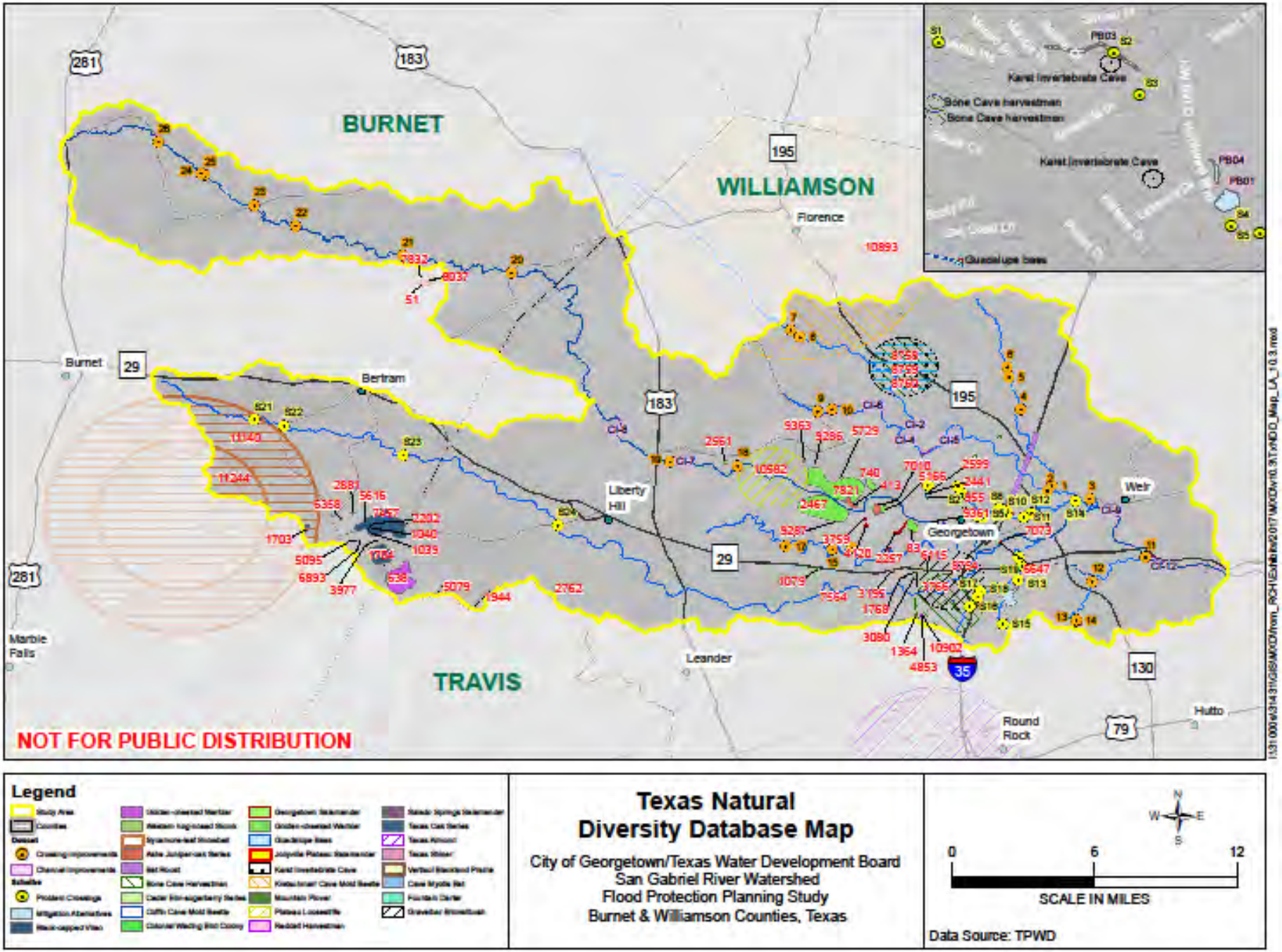
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Karst Invertebrate Cave
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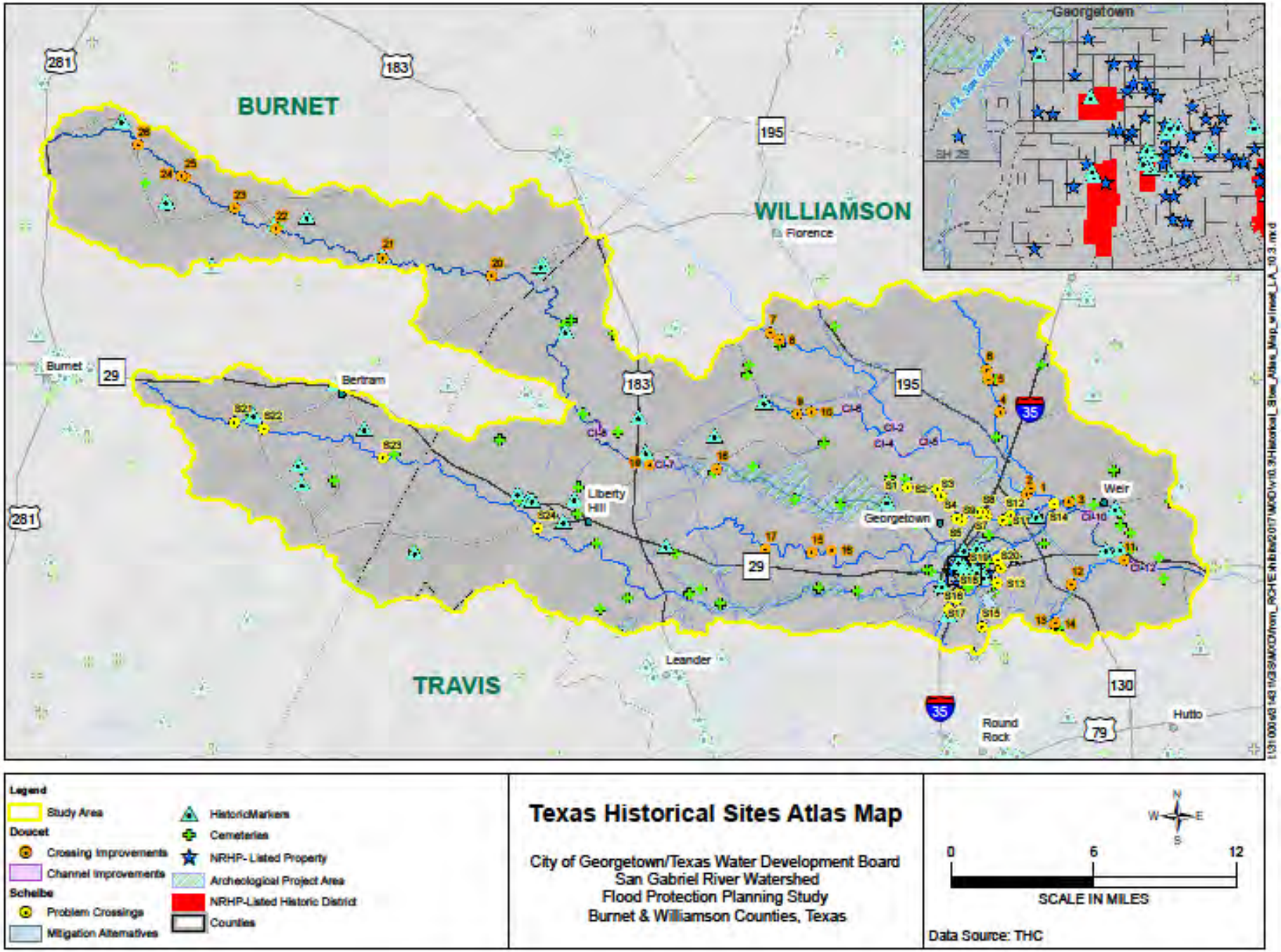
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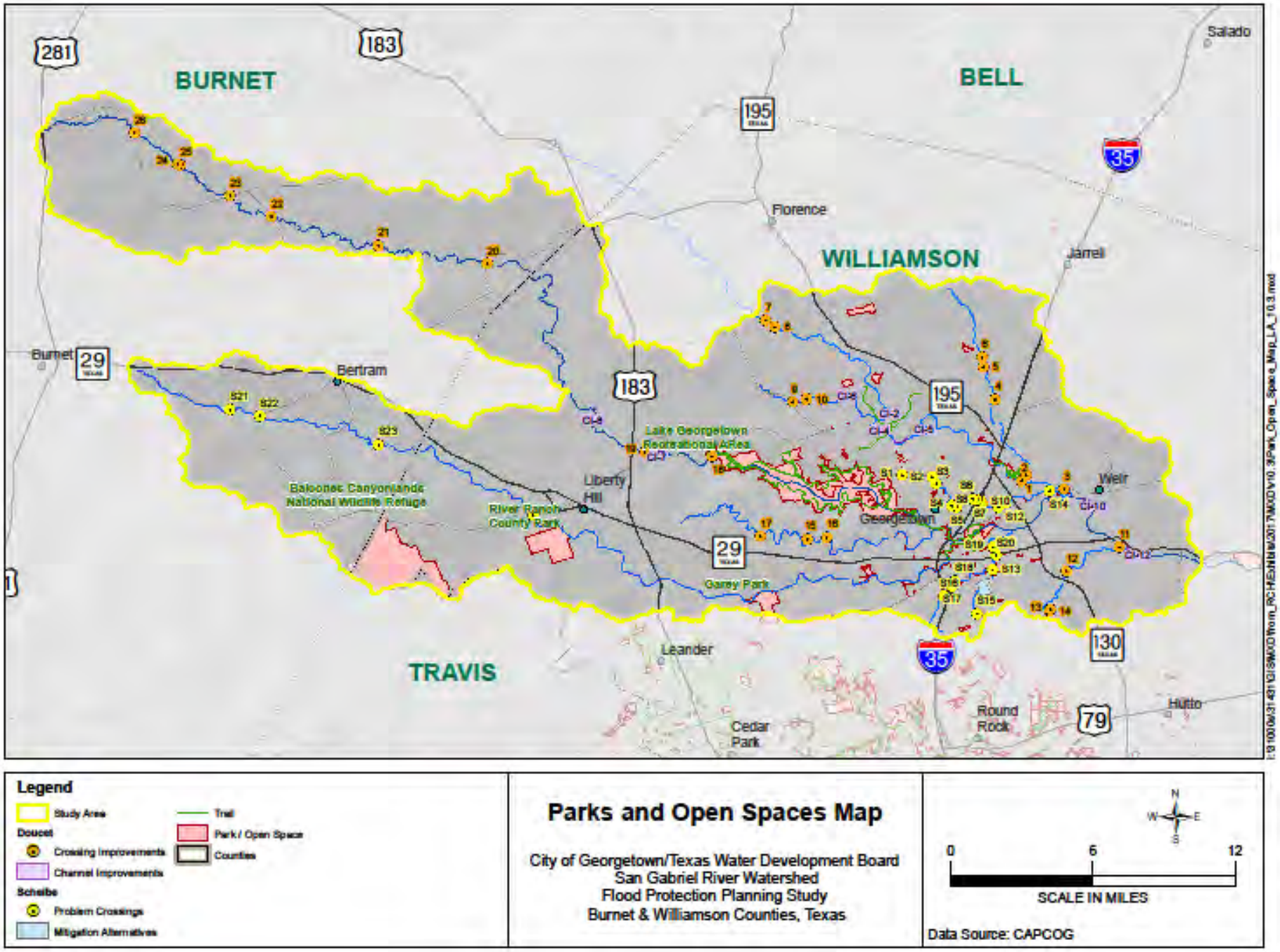
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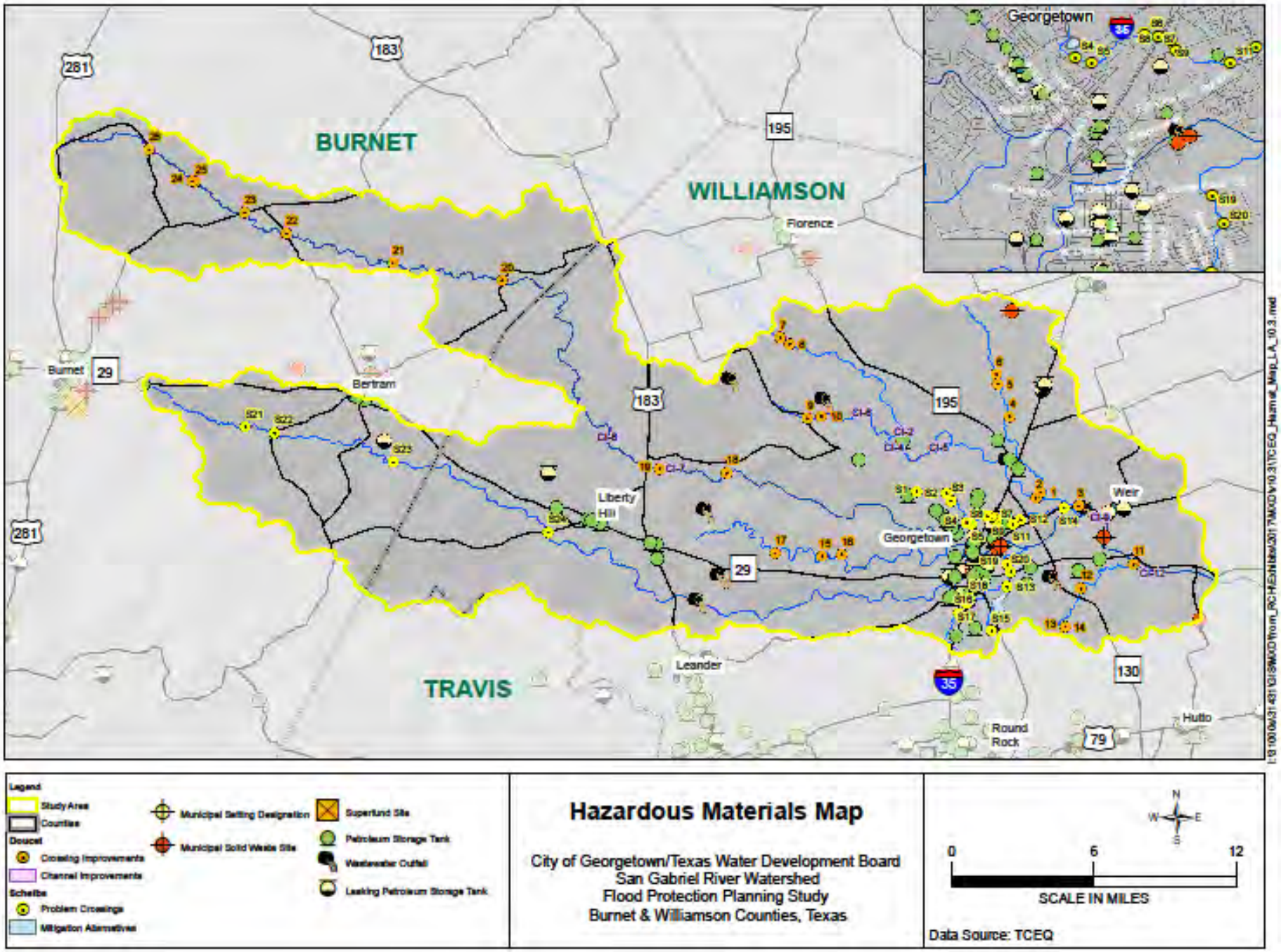
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Municipal Setting Designation
Municipal Solid Waste Site
Superfund Site
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Hazardous Materials Map
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San Gabriel River Watershed
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Data Source: TCEQ

ATTACHMENT B

NOT APPLICABLE: NO DEVIATIONS IN STRAIGHT ALIGNMENT WITHOUT MANHOLES

ATTACHMENT C

NOT APPLICABLE: NOT EXCEEDING MAXIMUM MANHOLE SPACING

ATTACHMENT D

Project No.: 3-00582
Project: Berry Creek WW Interceptor
Calc. Desc.: Gravity Design Flow

Date: 5/30/2023
Released by: E. Nelson

Design Flow: 7.3 mgd

Criteria *[source]*:
1) Peak WWF (design flow) is not to exceed 80% of the capacity of the pipe flowing full *[2014 WWMP]*
2) Minimum slope to maintain a velocity greater than 2 fps when flowing full *[TCEQ]*
3) Maximum slope to maintain a velocity less than 10 fps when flowing full *[TCEQ]*
4) Minimum acceptable Manning's n of 0.013 *[TCEQ]*

30" HOBAS PROPOSED	Full Pipe Flow - Min. Velocity	Full Pipe Flow - Min. Slope	Full Pipe Flow - Max. Velocity	Partial Pipe Flow - Min. Slope	Partial Pipe Flow - Min. Slope	Critical Depth
Nominal Diameter (in) =	30	30	30	30	30	30
Average Outside Diameter, D (in) =	32	32	32	32	32	32
Min. Wall Thickness, t (in) =	0.69	0.69	0.69	0.69	0.69	0.69
Inside Diameter, D (in) =	30.62	30.62	30.62	30.62	30.62	30.62
Inside Diameter, D (ft) =	2.55	2.55	2.55	2.55	2.55	2.55
Manning's n =	0.013	0.013	0.013	0.013	0.013	0.013
Slope (ft/ft) =	0.056%	2.501%	1.394%	2.501%	2.501%	2.501%
g (fps^2)=	32.2	32.2	32.2	32.2	32.2	32.2
Depth, y (ft) =	2.55	2.55	2.55	0.50	0.70	1.12
Central Angle, θ = 2 arccos (1-2y/D) =	6.28	6.28	6.28	1.83	2.21	2.89
Area, A (sqft) = D^2 (θ - sin θ)/8 =	5.11	5.11	5.11	0.70	1.14	2.16
Wetted Perimeter, P (ft) = θ D/2 =	8.02	8.02	8.02	2.34	2.81	3.69
Hydraulic Radius, R (ft) = A/P =	0.64	0.64	0.64	0.30	0.41	0.58
Top Width, B (ft) = D sin (θ/2) =	0.00	0.00	0.00	2.02	2.28	2.53
Hydraulic Depth (ft) = A/B =				0.35	0.50	0.85
Q (mgd) =	6.61	44.28	33.06	3.70	7.30	7.30
Q (cfs) =	10.23	68.51	51.14	5.72	11.29	11.29
Max Flow (mgd) = 80% Q =	5.29	35.43	26.44			
v (fps) =	2.00	13.40	10.00	8.13	9.90	5.24
Is 2 ≤ v ≤ 10 ?				yes	yes	
$Fr^2 = TQ^2/gA^3$ =				5.89	6.08	1.00

*Solve for value in green box by adjusting variable in orange box.

Project No.: 3-00582
Project: Berry Creek WW Interceptor
Calc. Desc.: Gravity Design Flow

Date: 5/30/2023
Released by: E. Nelson

Design Flow: 7.3 mgd

Criteria *[source]*:
1) Peak WWF (design flow) is not to exceed 80% of the capacity of the pipe flowing full *[2014 WWMP]*
2) Minimum slope to maintain a velocity greater than 2 fps when flowing full *[TCEQ]*
3) Maximum slope to maintain a velocity less than 10 fps when flowing full *[TCEQ]*
4) Minimum acceptable Manning's n of 0.013 *[TCEQ]*

30" PVC PROPOSED	Full Pipe Flow - Min. Velocity	Full Pipe Flow - Min. Slope	Full Pipe Flow - Max. Velocity	Partial Pipe Flow - Min. Slope	Partial Pipe Flow - Min. Slope	Critical Depth
Nominal Diameter (in) =	30	30	30	30	30	30
Average Outside Diameter, D (in) =	32	32	32	32	32	32
Min. Wall Thickness, t (in) =	1	1	1	1	1	1
Inside Diameter, D (in) =	30	30	30	30	30	30
Inside Diameter, D (ft) =	2.50	2.50	2.50	2.50	2.50	2.50
Manning's n =	0.013	0.013	0.013	0.013	0.013	0.013
Slope (ft/ft) =	0.057%	2.501%	1.432%	2.501%	2.501%	2.501%
g (fps^2)=	32.2	32.2	32.2	32.2	32.2	32.2
Depth, y (ft) =	2.50	2.50	2.50	0.50	0.71	0.79
Central Angle, θ = 2 arccos (1-2y/D) =	6.28	6.28	6.28	1.86	2.24	2.39
Area, A (sqft) = D^2 (θ - sin θ)/8 =	4.91	4.91	4.91	0.70	1.14	1.33
Wetted Perimeter, P (ft) = θ D/2 =	7.85	7.85	7.85	2.32	2.80	2.99
Hydraulic Radius, R (ft) = A/P =	0.63	0.63	0.63	0.30	0.41	0.45
Top Width, B (ft) = D sin (θ/2) =	0.00	0.00	0.00	2.00	2.25	2.33
Hydraulic Depth (ft) = A/B =				0.35	0.51	0.57
Q (mgd) =	6.35	41.93	31.73	3.70	7.30	3.70
Q (cfs) =	9.82	64.87	49.09	5.72	11.29	5.72
Max Flow (mgd) = 80% Q =	5.08	33.55	25.38			
v (fps) =	2.00	13.22	10.00	8.15	9.92	4.30
Is 2 ≤ v ≤ 10 ?				yes	yes	
$Fr^2 = TQ^2/gA^3$ =				5.87	6.04	1.00

*Solve for value in green box by adjusting variable in orange box.

ITEM 18 – SITE PLAN
ITEM 25 – FINAL PLANS AND TECHNICAL SPECIFICATIONS

(FOR BOTH ITEMS 18 & 25: REFER TO PLAN & PROFILE SHEETS C101-C121 UNDER ATTACHMENT C.1 ON TCEQ-0590, TECHNICAL SPECIFICATIONS AT THE END OF FINAL PLANS)

ITEM 24 – LEGAL BOUNDARIES (ALL PROPOSED WORK WILL BE WITHIN CITY OWNED PROPERTY)

Temporary Stormwater Section

Texas Commission on Environmental Quality

for Regulated Activities on the Edwards Aquifer Recharge Zone and Relating to 30 TAC §213.5(b)(4)(A), (B), (D)(I) and (G); Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. This **Temporary Stormwater Section** is hereby submitted for TCEQ review and executive director approval. The application was prepared by:

Print Name of Customer/Agent: Eric L. Nelson P.E.

Date: 8/16/2023

Signature of Customer/Agent:



Regulated Entity Name: Berry Creek Wastewater Interceptor

Project Information

Potential Sources of Contamination

Examples: Fuel storage and use, chemical storage and use, use of asphaltic products, construction vehicles tracking onto public roads, and existing solid waste.

1. Fuels for construction equipment and hazardous substances which will be used during construction:

   ☒ The following fuels and/or hazardous substances will be stored on the site: Sun City Lift Station within City of Georgetown Property

   These fuels and/or hazardous substances will be stored in:

   ☒ Aboveground storage tanks with a cumulative storage capacity of less than 250 gallons will be stored on the site for less than one (1) year.

☐ Aboveground storage tanks with a cumulative storage capacity between 250 gallons and 499 gallons will be stored on the site for less than one (1) year.

☐ Aboveground storage tanks with a cumulative storage capacity of 500 gallons or more will be stored on the site. An Aboveground Storage Tank Facility Plan application must be submitted to the appropriate regional office of the TCEQ prior to moving the tanks onto the project.

☐ Fuels and hazardous substances will not be stored on the site.

2. ☒ **Attachment A - Spill Response Actions**. A site specific description of the measures to be taken to contain any spill of hydrocarbons or hazardous substances is attached.

3. ☒ Temporary aboveground storage tank systems of 250 gallons or more cumulative storage capacity must be located a minimum horizontal distance of 150 feet from any domestic, industrial, irrigation, or public water supply well, or other sensitive feature.

4. ☒ **Attachment B - Potential Sources of Contamination**. A description of any activities or processes which may be a potential source of contamination affecting surface water quality is attached.

Sequence of Construction

5. ☒ **Attachment C - Sequence of Major Activities**. A description of the sequence of major activities which will disturb soils for major portions of the site (grubbing, excavation, grading, utilities, and infrastructure installation) is attached.

   ☐ For each activity described, an estimate (in acres) of the total area of the site to be disturbed by each activity is given.

   ☐ For each activity described, include a description of appropriate temporary control measures and the general timing (or sequence) during the construction process that the measures will be implemented.

6. ☒ Name the receiving water(s) at or near the site which will be disturbed or which will receive discharges from disturbed areas of the project: Berry Creek

Temporary Best Management Practices (TBMPs)

Erosion control examples: tree protection, interceptor swales, level spreaders, outlet stabilization, blankets or matting, mulch, and sod. Sediment control examples: stabilized construction exit, silt fence, filter dikes, rock berms, buffer strips, sediment traps, and sediment basins. Please refer to the Technical Guidance Manual for guidelines and specifications. All structural BMPs must be shown on the site plan.

7. ☒ **Attachment D – Temporary Best Management Practices and Measures**. TBMPs and measures will prevent pollution of surface water, groundwater, and stormwater. The construction-phase BMPs for erosion and sediment controls have been designed to retain sediment on site to the extent practicable. The following information is attached:

☐ A description of how BMPs and measures will prevent pollution of surface water, groundwater or stormwater that originates upgradient from the site and flows across the site.

☐ A description of how BMPs and measures will prevent pollution of surface water or groundwater that originates on-site or flows off site, including pollution caused by contaminated stormwater runoff from the site.

☐ A description of how BMPs and measures will prevent pollutants from entering surface streams, sensitive features, or the aquifer.

☒ A description of how, to the maximum extent practicable, BMPs and measures will maintain flow to naturally-occurring sensitive features identified in either the geologic assessment, TCEQ inspections, or during excavation, blasting, or construction.

8. ☒ The temporary sealing of a naturally-occurring sensitive feature which accepts recharge to the Edwards Aquifer as a temporary pollution abatement measure during active construction should be avoided.

   ☒ **Attachment E - Request to Temporarily Seal a Feature**. A request to temporarily seal a feature is attached. The request includes justification as to why no reasonable and practicable alternative exists for each feature.

   ☒ There will be no temporary sealing of naturally-occurring sensitive features on the site.

9. ☒ **Attachment F - Structural Practices**. A description of the structural practices that will be used to divert flows away from exposed soils, to store flows, or to otherwise limit runoff discharge of pollutants from exposed areas of the site is attached. Placement of structural practices in floodplains has been avoided.

10. ☒ **Attachment G - Drainage Area Map**. A drainage area map supporting the following requirements is attached:

    ☐ For areas that will have more than 10 acres within a common drainage area disturbed at one time, a sediment basin will be provided.

    ☐ For areas that will have more than 10 acres within a common drainage area disturbed at one time, a smaller sediment basin and/or sediment trap(s) will be used.

    ☐ For areas that will have more than 10 acres within a common drainage area disturbed at one time, a sediment basin or other equivalent controls are not attainable, but other TBMPs and measures will be used in combination to protect down slope and side slope boundaries of the construction area.

    ☐ There are no areas greater than 10 acres within a common drainage area that will be disturbed at one time. A smaller sediment basin and/or sediment trap(s) will be used in combination with other erosion and sediment controls within each disturbed drainage area.

☒ There are no areas greater than 10 acres within a common drainage area that will be disturbed at one time. Erosion and sediment controls other than sediment basins or sediment traps within each disturbed drainage area will be used.

11. ☒ **Attachment H - Temporary Sediment Pond(s) Plans and Calculations**. Temporary sediment pond or basin construction plans and design calculations for a proposed temporary BMP or measure have been prepared by or under the direct supervision of a Texas Licensed Professional Engineer. All construction plans and design information must be signed, sealed, and dated by the Texas Licensed Professional Engineer. Construction plans for the proposed temporary BMPs and measures are attached.

    ☒ N/A

12. ☒ **Attachment I - Inspection and Maintenance for BMPs.** A plan for the inspection of each temporary BMP(s) and measure(s) and for their timely maintenance, repairs, and, if necessary, retrofit is attached. A description of the documentation procedures, recordkeeping practices, and inspection frequency are included in the plan and are specific to the site and/or BMP.

13. ☒ All control measures must be properly selected, installed, and maintained in accordance with the manufacturer's specifications and good engineering practices. If periodic inspections by the applicant or the executive director, or other information indicate a control has been used inappropriately, or incorrectly, the applicant must replace or modify the control for site situations.

14. ☒ If sediment escapes the construction site, off-site accumulations of sediment must be removed at a frequency sufficient to minimize offsite impacts to water quality (e.g., fugitive sediment in street being washed into surface streams or sensitive features by the next rain).

15. ☒ Sediment must be removed from sediment traps or sedimentation ponds not later than when design capacity has been reduced by 50%. A permanent stake will be provided that can indicate when the sediment occupies 50% of the basin volume.

16. ☒ Litter, construction debris, and construction chemicals exposed to stormwater shall be prevented from becoming a pollutant source for stormwater discharges (e.g., screening outfalls, picked up daily).

Soil Stabilization Practices

Examples: establishment of temporary vegetation, establishment of permanent vegetation, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, or preservation of mature vegetation.

17. ☒ **Attachment J - Schedule of Interim and Permanent Soil Stabilization Practices**. A schedule of the interim and permanent soil stabilization practices for the site is attached.

18. ☒ Records must be kept at the site of the dates when major grading activities occur, the dates when construction activities temporarily or permanently cease on a portion of the site, and the dates when stabilization measures are initiated.

19. ☒ Stabilization practices must be initiated as soon as practicable where construction activities have temporarily or permanently ceased.

Administrative Information

20. ☒ All structural controls will be inspected and maintained according to the submitted and approved operation and maintenance plan for the project.

21. ☒ If any geologic or manmade features, such as caves, faults, sinkholes, etc., are discovered, all regulated activities near the feature will be immediately suspended. The appropriate TCEQ Regional Office shall be immediately notified. Regulated activities must cease and not continue until the TCEQ has reviewed and approved the methods proposed to protect the aquifer from any adverse impacts.

22. ☒ Silt fences, diversion berms, and other temporary erosion and sediment controls will be constructed and maintained as appropriate to prevent pollutants from entering sensitive features discovered during construction.

ATTACHMENT A

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SPILL RESPONSE ACTIONS

No hazardous waste is expected to be generated in connection with the construction activities. However, any hazardous waste that is generated will be disposed of in a manner specified by local, state, and federal regulations and/or manufacturer's recommendations. All hazardous waste materials that result from spills will be disposed of in accordance with the requirements of the TCEQ TAC 327.4. If a spill of reportable quantity of a hazardous material (i.e., diesel, gasoline, or oil) occurs, the TCEQ Region 11 Office located in Austin may be reached at (512) 339-2929. Additional information is available in 30 TAC 327.4, 40 CFR 302.4, and https://www.tceq.texas.gov/response/spills/spill_rq.html.

Per TCEQ:

"In Texas, upon determining that a reportable discharge or spill has occurred, the responsible person must notify the state. The threshold quantity that triggers the requirement to report a spill is called the reportable quantity (RQ). The RQ depends on the type of substance released and where released (e.g., into water vs on land); different kinds of spills are subject to different provisions of state and federal rules."

Spill prevention and control measures shall be implemented onsite, including, but not limited to:

- Keeping waste storage areas clean, organized, and equipped with clean-up supplies.
- Use of containment structures, covers, or liners as appropriate.
- General education regarding spills and leaks.
- Designation of responsible individuals to oversee and enforce control measures.

A spill bucket with absorbent material should be located near all equipment, chemical storage, or handling areas. All spills should be cleaned up immediately and spills greater than one gallon shall be recorded along with a description of the clean-up and disposal method. Larger spills shall be reported to the Environmental Coordinator and shall be handled in accordance with TCEQ guidelines.

If a release occurs containing hazardous substances or oil in any amount equal to or in excess of a reportable quantity, the National Response Center will be notified at (800) 424-

8802 as soon as the spill is discovered.

If a hazardous spill occurs and threatens a surface water system, the TCEQ and the State Emergency Response Commission (SERC) will be notified through the State of Texas spill-Reporting Hotline at (800) 832-8224.

ATTACHMENT B

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POTENTIAL SOURCES OF CONTAMINATION

Construction may result in a temporary increase in stormwater runoff and soil erosion. Other potential pollutants and sources may include vehicle tracking, dust generated by vehicles and construction equipment, trash and debris, petroleum products, lubricants, hydraulic fluids, and fuels associated with construction vehicles, equipment operation, and maintenance. Non-stormwater discharges are listed below.

Construction Activity	Potential Pollutant
Mobilization and Storage of Equipment and Construction materials	• Sediment • Trash • Fertilizers • Organic Matter • Vehicle/Equipment Operation and Servicing Residues (oil, fuel, and fluids)
ROW Clearing and Grading	• Sediment • Organic Matter • Vehicle/Equipment Operation and Servicing Residues (oil, fuel, and fluids)
Excavation	• Sediment and • Vehicle/Equipment Operation and Servicing Residues (oil, fuel, and fluids)
Pipe Installation	• Sediment • Welding Residues • Pipe Coating Residues • Vehicle/Equipment Operation and Servicing Residues (oil, fuel, and fluids)
Backfilling	• Sediment • Vehicle/Equipment Operation and Servicing Residues (oil, fuel, and fluids)
Concrete Washout Area	• Concrete Waste
Cleanup	• Sediment • Welding Residues • Pipe Coating Residues • Cleaning/Painting Residues • Vehicle/Equipment Operation and Servicing Residues (oil, fuel, and fluids)

ATTACHMENT C

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SEQUENCE OF MAJOR ACTIVITIES

Major Construction Activities which will disturb soils for major portions of the site include clearing and grubbing, excavation, grading, and wastewater line utilities installation. Temporary controls to be inspected and maintained weekly and prior to any anticipated rainfall event, and after rainfall events as needed. The contractor is responsible for implementing and maintaining the Storm Water Pollution Prevention Plan (SWPPP). All disturbed soil areas shall be re-vegetated per the respective easement agreement with land owner.

MAJOR CONSTRUCTION ACTIVITIES AND SEQUENCING

The major construction activities for this project will include and be sequenced as follows:

1) Install Temporary Best Management Practices which shall consist of silt fencing, soil retention blanks, stabilized construction entrances, topsoil and sod placement.

2) Begin demolition, clearing, grubbing, and construction activities. Dispose of all demolished materials to an approved off-site facility.

3) Begin wastewater line installation by open cut or trenchless methods.

4) Complete site re-vegetation and construction of permanent maintenance driveways and culverts.

5) Site inspection and completion.

Refer to Sheet C027 Off-Site Wastewater Interceptor Connection Erosion Control & Tree Plan, Sheet C125 Off-Site Wastewater Interceptor Connection WW Line Plan & Profile. See Attachment G for map showing there are no disturbed areas greater than 10 acres within a common drainage area that will be disturbed at one time.

ATTACHMENT D

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TEMPORARY BEST MANAGEMENT PRACTICES AND MEASURES

The following Temporary Best Management Practices (BMPs) and measures will be utilized during construction and remain in place until final site stabilization:

1) Silt fencing, soil retention blankets, stabilized construction entrances, topsoil and sod placement will be used in accordance with City of Georgetown Standards Specifications and Details, and the latest edition of TCEQ's Technical Guidance Manual details and criteria, to prevent pollution of surface water and groundwater that originates up-gradient and on-site.

2) The BMPs shall be in place before any construction of the wastewater line begins. The silt fencing will be installed per the provided Erosion Control & Tree Plans, or at a minimum, downstream of any disturbed areas.

3) Silt fences will intercept any pollutants from entering the surface waters flowing towards Berry Creek.

4) The temporary BMP design for the site has been planned to prevent construction runoff and pollutants from directly entering surface streams, sensitive features, and the Edwards Aquifer Recharge Zone.

ATTACHMENT E

NOT APPLICABLE: NOT SEALING A FEATURE

ATTACHMENT F

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STRUCTURAL PRACTICES

The following structural practices will be installed prior to construction of the project and in accordance with the “Complying with Edwards Aquifer Rules: Technical Guidance on Best Management Practices” (TCEQ RG-348).

1) Installation of silt fences.

2) Installation of stabilized construction entrances/exits to minimize the tracking of mud and debris offsite by construction vehicles.

3) Installation of construction staging areas

Please refer to Sheet C027 Off-Site Wastewater Interceptor Connection Erosion Control & Tree Plan.

ATTACHMENT G



DRAINAGE LEGEND

- DRAINAGE AREA BOUNDARY
- DRAINAGE FLOW ARROWS

GRAPHIC SCALE (FEET)
0 50 100 200

REV.	DESCRIPTION	DATE

Walker Partners
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T.B.P.E. Registration No. 8053

CITY OF GEORGETOWN

BERRY CREEK W.W. INTERCEPTOR

DRAINAGE AREA MAP 3

PRELIMINARY
FOR REVIEW ONLY

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW UNDER THE AUTHORITY OF PROFESSIONAL ENGINEER ERIC LEE NELSON #114449 ON THE DATE SHOWN ON THE DATE STAMP. IT IS NOT TO BE USED FOR CONSTRUCTION, BIDDING, OR PERMIT PURPOSES.

PM	ELN
DESIGNED	HAM/TAR
DRAFTED	RC
CHECKED	DPS
PROJECT NO.	3-00582

DRAWING NO.
C200.3

A1
1"=100'

DRAINAGE AREA MAP 4

G:\PROJECTS\3-00582\2 DESIGN\2.0 CAD\EXHIBITS\TCEQ SCS DAM (SURFACE).DWG, DRAINAGE AREA MAP 4, 6/15/2023 3:41:39 PM, trobles

ATTACHMENT H

NOT APPLICABLE: NO TEMPORARY SEDIMENT POND OR BASIN

ATTACHMENT I

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INSPECTION AND MAINTENANCE FOR BMPS

INSPECTION

During construction, designated and qualified person(s) should inspect the SWPPP every seven (7) days and after each rainfall event. An inspection report that summarized the scope of the inspection, names and qualifications of personnel conducting the inspection, date of the inspection, major observations and actions that will be taken as a result of the inspection. These inspections reports should be kept with the TPDES date for the project. The general contractor will be responsible to review and reference sections 1.3 and 1.4 of "Complying with the Edwards Aquifer Rules: Technical Guidance and Best Management Practices" (TCEQ RG-348) for erosion and sedimentation control and maintenance as applicable.

MAINTENANCE

Construction Entrances and Construction Staging Area Maintenance:

1) The entrances should be maintained in a condition which will prevent tracking or flowing of sediment onto public right-of-way. This may require periodic top dressing with additional stone as conditions demand.

2) All sediment spilled, dropped, washed or tracked onto public right-of-way should be removed immediately by the contractor.

3) When necessary, wheels should be cleaned to remove sediment prior to entrance onto public right-of-way.

4) All sediment should be prevented from entering any storm drain, ditch or watercourse by using approved methods.

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Silt Fence Maintenance:

1) Inspect all fencing weekly, and after any rainfall events.

2) Remove sediment when build up reaches 6 inches.

3) Replace any torn fabric or install a second line of fencing parallel to the torn section.

4) Replace or repair any sections crushed or collapsing during construction activity. If a section of fence is obstructing vehicular access, consider relocating it to a spot where it will provide equal protection, but will not obstruct vehicles. A triangular filter dike may be preferable to a silt fence at common vehicle access points.

5) When construction is complete, the sediment should be disposed of in a manner that will not cause additional siltation and the locations of silt fence should be re-vegetated. The fence itself should be disposed of in an approved landfill.

ATTACHMENT J

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SCHEDULE OF INTERIM AND PERMANENT SOIL STABILIZATION PRACTICES

Stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased. Where the initiation of stabilization measures by the 14th day after construction activity temporarily or permanently ceased is precluded by weather conditions, stabilization measures shall be initiated as soon as practicable. Where construction on a portion of the site has temporarily ceased, and earth disturbing activities will be resumed within 21 days, temporary stabilization measures do not have to be initiated on that portion of the site. In areas experiencing droughts where the initialization of stabilization measures by the 14th day after construction activity has temporarily or permanently ceased is precluded by seasonal arid conditions, stabilization measures shall be initiated as soon as practicable. Soil retention blankets shall be installed as shown on the plans or as directed by the engineer. Only soil retention blankets included on the Texas Department of Transportation's (TxDOT) approved products list will be considered acceptable for use on this project. Below are guidelines from TCEQ for the installation of soil retention blankets to stabilize exposed areas.

MATERIALS

Blankets and matting materials can be used as an aid to control erosion on critical sites during the establishment period of protective vegetation. The most common uses are: in channels where designed flow exceeds 3.5 feet per second; on interceptor swales and diversion dikes when design flow exceeds 6 feet per second; on short, steep slopes where erosion hazard is high and planting is likely to be slow to establish adequate protective cover; and on stream banks where moving water is likely to wash out new vegetative plantings.

Blankets and matting can also be used to create erosion stops on steep, highly erodible watercourses. Erosion stops should be placed approximately 3 feet down channel from

point of entry of a concentrated flow such as from culverts, tributary channels or diversions or at points where a change in gradient or course of channel occurs. Spacing of erosion stops on long slopes will vary, depending on the erodibility of the soil and velocity and volume of flow. Erosion stops are placed beneath blankets and matting.

Biodegradable rolled erosion control products (RECPs) are typically composed of jute fibers, curled wood fibers, straw, coconut fiber, or a combination of these materials. In order for an RECP to be considered 100% biodegradable, the netting, sewing or adhesive system that holds the biodegradable mulch fibers together must also be biodegradable.

INSTALLATION

Soil Preparation

1) After site has been shaped and graded to approved design, prepare a friable seed bed relatively free from clods and rocks more than 1.5 inches in diameter and any foreign material that will prevent contact of the protective mat with the soil surface.

2) Fertilize and seed in accordance with seeding or other type of planting plan.

3) The protective matting can be laid over sprigged areas where small grass plants have been planted. Where ground covers are to be planted, lay the protective matting first and then plant through matting according to design of planting.

Erosion Stops

1) Erosion stops should extend beyond the channel liner to full design cross-section of the channel to check any rills that might form outside the channel lining.

2) The trench may be dug with a spade or a mechanical trencher, making sure that the down slope face of the trench is flat; it should be uniform and perpendicular to line of flow to permit proper placement and stapling of the matting.

3) The erosion stop should be deep enough to penetrate solid material or below level of ruling in sandy soils. In general, erosion stops will vary from 6 to 12 inches in

depth.

4) The erosion stop mat should be wide enough to allow a minimum of 2 inch turnover at bottom of trench for stapling, while maintaining the top edge flush with channel surface.

5) Tamp backfill firmly and to a uniform gradient of channel.

Final Check:

- Make sure matting is uniformly in contact with the soil.
- All lap joints are secure.
- All staples are flush with the ground.
- All disturbed areas seeded.

Inspection and Maintenance Guidelines:

1) Blankets and matting should be inspected weekly and after each rain event to locate and repair any damage. Apply new material if necessary to restore function.

Agent Authorization Form
For Required Signature
Edwards Aquifer Protection Program
Relating to 30 TAC Chapter 213
Effective June 1, 1999

I Chris Pousson,
Print Name

CIP Manager/Systems Engineering,
Title - Owner/President/Other

of City of Georgetown, Texas,
Corporation/Partnership/Entity Name

have authorized Eric Lee Nelson, P.E.
Print Name of Agent/Engineer

of Walker Partners
Print Name of Firm

to represent and act on the behalf of the above named Corporation, Partnership, or Entity for the purpose of preparing and submitting this plan application to the Texas Commission on Environmental Quality (TCEQ) for the review and approval consideration of regulated activities.

I also understand that:

1. The applicant is responsible for compliance with 30 Texas Administrative Code Chapter 213 and any condition of the TCEQ's approval letter. The TCEQ is authorized to assess administrative penalties of up to $10,000 per day per violation.

2. For those submitting an application who are not the property owner, but who have the right to control and possess the property, additional authorization is required from the owner.

3. Application fees are due and payable at the time the application is submitted. The application fee must be sent to the TCEQ cashier or to the appropriate regional office. The application will not be considered until the correct fee is received by the commission.

4. A notarized copy of the Agent Authorization Form must be provided for the person preparing the application, and this form must accompany the completed application.

5. No person shall commence any regulated activity on the Edwards Aquifer Recharge Zone, Contributing Zone or Transition Zone until the appropriate application for the activity has been filed with and approved by the Executive Director.

SIGNATURE PAGE:

Applicant's Signature

3-31-2023
Date

THE STATE OF Texas §

County of Williamson §

BEFORE ME, the undersigned authority, on this day personally appeared CHRIS POUSSON known to me to be the person whose name is subscribed to the foregoing instrument, and acknowledged to me that (s)he executed same for the purpose and consideration therein expressed.

GIVEN under my hand and seal of office on this 31st day of MARCH, 2023

NOTARY PUBLIC

SHEILA K. MITCHELL
Typed or Printed Name of Notary

SHEILA KAYE MITCHELL
Notary Public, State of Texas
Comm. Expires 11-10-2025
Notary ID 133441435

MY COMMISSION EXPIRES: 11-10-2025

Application Fee Form

Texas Commission on Environmental Quality
Name of Proposed Regulated Entity: Berry Creek Wastewater Interceptor
Regulated Entity Location: Georgetown
Name of Customer: City of Georgetown
Contact Person: Chris Pousson Phone: 512-930-8162
Customer Reference Number (if issued):CN 600412043
Regulated Entity Reference Number (if issued):RN 110600343

Austin Regional Office (3373)

☐ Hays ☐ Travis ☒ Williamson

San Antonio Regional Office (3362)

☐ Bexar ☐ Medina ☐ Uvalde
☐ Comal ☐ Kinney

Application fees must be paid by check, certified check, or money order, payable to the **Texas Commission on Environmental Quality**. Your canceled check will serve as your receipt. **This form must be submitted with your fee payment.** This payment is being submitted to:

☒ Austin Regional Office
☐ Mailed to: TCEQ - Cashier
Revenues Section
Mail Code 214
P.O. Box 13088
Austin, TX 78711-3088

☐ San Antonio Regional Office
☐ Overnight Delivery to: TCEQ - Cashier
12100 Park 35 Circle
Building A, 3rd Floor
Austin, TX 78753
(512)239-0357

Site Location (Check All That Apply):

☒ Recharge Zone ☐ Contributing Zone ☐ Transition Zone

Type of Plan	***Size***	***Fee Due***
Water Pollution Abatement Plan, Contributing Zone Plan: One Single Family Residential Dwelling	Acres	$
Water Pollution Abatement Plan, Contributing Zone Plan: Multiple Single Family Residential and Parks	Acres	$
Water Pollution Abatement Plan, Contributing Zone Plan: Non-residential	Acres	$
Sewage Collection System	304 L.F.	$ 650.00
Lift Stations without sewer lines	Acres	$
Underground or Aboveground Storage Tank Facility	Tanks	$
Piping System(s)(only)	Each	$
Exception	Each	$
Extension of Time	Each	$

Signature: _____ Date: 8-15-2023

Application Fee Schedule

Texas Commission on Environmental Quality
Edwards Aquifer Protection Program 30 TAC Chapter 213 (effective 05/01/2008)

Water Pollution Abatement Plans and Modifications

Contributing Zone Plans and Modifications

Project	*Project Area in Acres*	*Fee*
One Single Family Residential Dwelling	< 5	$650
Multiple Single Family Residential and Parks	< 5 5 < 10 10 < 40 40 < 100 100 < 500 ≥ 500	$1,500 $3,000 $4,000 $6,500 $8,000 $10,000
Non-residential (Commercial, industrial, institutional, multi-family residential, schools, and other sites where regulated activities will occur)	< 1 1 < 5 5 < 10 10 < 40 40 < 100 ≥ 100	$3,000 $4,000 $5,000 $6,500 $8,000 $10,000

Organized Sewage Collection Systems and Modifications

Project	*Cost per Linear Foot*	*Minimum Fee-Maximum Fee*
Sewage Collection Systems	$0.50	$650 - $6,500

Underground and Aboveground Storage Tank System Facility Plans and Modifications

Project	*Cost per Tank or Piping System*	*Minimum Fee-Maximum Fee*
Underground and Aboveground Storage Tank Facility	$650	$650 - $6,500

Exception Requests

Project	*Fee*
Exception Request	$500

Extension of Time Requests

Project	*Fee*
Extension of Time Request	$150

TCEQ Use Only

TCEQ Core Data Form

For detailed instructions on completing this form, please read the Core Data Form Instructions or call 512-239-5175.

SECTION I: General Information

1. Reason for Submission (*If other is checked please describe in space provided.*)

☒ New Permit, Registration or Authorization (*Core Data Form should be submitted with the program application.*)

☐ Renewal *(Core Data Form should be submitted with the renewal form)* ☒ Other

2. Customer Reference Number *(if issued)*	Follow this link to search for CN or RN numbers in Central Registry**	3. Regulated Entity Reference Number *(if issued)*
CN 600412043		RN 110600343

SECTION II: Customer Information

4. General Customer Information | **5. Effective Date for Customer Information Updates** (mm/dd/yyyy)

☐ New Customer ☒ Update to Customer Information ☐ Change in Regulated Entity Ownership
☐ Change in Legal Name (Verifiable with the Texas Secretary of State or Texas Comptroller of Public Accounts)

The Customer Name submitted here may be updated automatically based on what is current and active with the Texas Secretary of State (SOS) or Texas Comptroller of Public Accounts (CPA).

6. Customer Legal Name *(If an individual, print last name first: eg: Doe, John)* | *If new Customer, enter previous Customer below:*

City of Georgetown

7. TX SOS/CPA Filing Number	8. TX State Tax ID (11 digits)	9. Federal Tax ID (9 digits)	10. DUNS Number *(if applicable)*
		74-6000974	89592372

11. Type of Customer: ☐ Corporation ☐ Individual Partnership: ☐ General ☐ Limited
Government: ☒ City ☐ County ☐ Federal ☐ Local ☐ State ☐ Other ☐ Sole Proprietorship ☐ Other:

12. Number of Employees
☐ 0-20 ☐ 21-100 ☐ 101-250 ☐ 251-500 ☒ 501 and higher

13. Independently Owned and Operated?
☒ **Yes** ☐ **No**

14. Customer Role (Proposed or Actual) – *as it relates to the Regulated Entity listed on this form. Please check one of the following*

☐ Owner ☐ Operator ☒ Owner & Operator
☐ Occupational Licensee ☐ Responsible Party ☐ VCP/BSA Applicant ☐ Other:

15. Mailing Address:

PO Box 409

City	Georgetown	State	TX	ZIP	78627	ZIP + 4	

16. Country Mailing Information *(if outside USA)*	17. E-Mail Address *(if applicable)*
	chris.pousson@georgetown.org

18. Telephone Number	19. Extension or Code	20. Fax Number *(if applicable)*

(512) 930-8162		(512) 930-3359

SECTION III: Regulated Entity Information

21. General Regulated Entity Information *(If 'New Regulated Entity" is selected, a new permit application is also required.)*

☒ New Regulated Entity ☐ Update to Regulated Entity Name ☐ Update to Regulated Entity Information

The Regulated Entity Name submitted may be updated, in order to meet TCEQ Core Data Standards (removal of organizational endings such as Inc, LP, or LLC).

22. Regulated Entity Name *(Enter name of the site where the regulated action is taking place.)*

Berry Creek Wastewater Interceptor

23. Street Address of the Regulated Entity: ***(No PO Boxes)***								
	City		**State**		**ZIP**		**ZIP + 4**	
24. County								

If no Street Address is provided, fields 25-28 are required.

25. Description to Physical Location:	Sun City Lift Station in the Sun City Neighborhood at the end of Stetson Trail				
26. Nearest City			**State**	**Nearest ZIP Code**	
Georgetown			Tx	78633	

Latitude/Longitude are required and may be added/updated to meet TCEQ Core Data Standards. (Geocoding of the Physical Address may be used to supply coordinates where none have been provided or to gain accuracy).

27. Latitude (N) In Decimal:	30.7195205		**28. Longitude (W) In Decimal:**	-97.7011634	
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
30	43	10.2739	-97	42	04.1884

29. Primary SIC Code (4 digits)	**30. Secondary SIC Code** (4 digits)	**31. Primary NAICS Code** (5 or 6 digits)	**32. Secondary NAICS Code** (5 or 6 digits)
4952	0000		

33. What is the Primary Business of this entity? *(Do not repeat the SIC or NAICS description.)*

Public Works

34. Mailing Address:	**PO Box 409**							
	City	**Georgetown**	**State**	**TX**	**ZIP**	**78627**	**ZIP + 4**	
35. E-Mail Address:	**chris.pousson@georgetown.org**							

36. Telephone Number	**37. Extension or Code**	**38. Fax Number** *(if applicable)*
(512) 930-8162		**(512) 930-3559**

39. TCEQ Programs and ID Numbers Check all Programs and write in the permits/registration numbers that will be affected by the updates submit ed on this form. See the Core Data Form instructions for additional guidance.

☐ Dam Safety	☐ Districts	☒ Edwards Aquifer	☐ Emissions Inventory Air	☐ Industrial Hazardous Waste
☐ Municipal Solid Waste	☐ New Source Review Air	☐ OSSF	☐ Petroleum Storage Tank	☐ PWS
☐ Sludge	☐ Storm Water	☐ Title V Air	☐ Tires	☐ Used Oil
☐ Voluntary Cleanup	☒ Wastewater	☐ Wastewater Agriculture	☐ Water Rights	☐ Other:

SECTION IV: Preparer Information

40. Name:	Eric Lee Nelson, P.E.	**41. Title:**	Client Manager

42. Telephone Number	**43. Ext./Code**	**44. Fax Number**	**45. E-Mail Address**
(512 **)** 382-0021		**( ) -**	enelson@walkerpartners.com

SECTION V: Authorized Signature

46. By my signature below, I certify, to the best of my knowledge, that the information provided in this form is true and complete, and that I have signature authority to submit this form on behalf of the entity specified in Section II, Field 6 and/or as required for the updates to the ID numbers identified in field 39.

Company:	Walker Partners	**Job Title:**	Client Manager	
Name *(In Print):*	Eric Lee Nelson, P.E.		**Phone:**	**(** 512 **)** 382- **0021**
Signature:			**Date:**	8/16/2023