Bryan W. Shaw, Ph.D., *Chairman*
Carlos Rubinstein, *Commissioner*
Toby Baker, *Commissioner*
Zak Covar, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

August 28, 2012

Ms. Leslie Rauscher
US Environmental Protection Agency (EPA)
(6MD-AT) Region 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733

Re: FY09 319(h) City of Denton - Implementing the Hickory Creek Watershed Protection Plan (WPP) and Adapting the Plan for Use in Other Areas of the Lewisville Lake Watershed Quality Assurance Project Plan (QAPP) for Monitoring Grant No. 99614614

Approval Date: August 22, 2012 (Update due by August 22, 2013)

Dear Ms. Rauscher:

The above named QAPP has been approved. The original QAPP and signature page have been uploaded to the Grants Recording Tracking System (GRTS) as documentation of approval.

Should you have any questions, please contact Jack Higginbotham at Jack.Higginbotham@tceq.texas.gov or (512) 239-6699.

Sincerely,

Kerry Niemann
Team Leader, NPS Team
Office of Water

Bryan W. Shaw, Ph.D., *Chairman*
Carlos Rubinstein, *Commissioner*
Toby Baker, *Commissioner*
Zak Covar, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

August 23, 2012

David Hunter
Department of Environmental Services and Sustainability
City of Denton
901 A Texas Street
Denton, Texas 76209

Re: Implementing the Hickory Creek Watershed Protection Plan and Adapting the Plan for Use in Other Areas of the Lewisville Lake Watershed Quality Assurance Project Plan (QAPP)

Approved: August 22, 2012 (Next update due August 22, 2013)
QAPP Revision Date: July 20, 2012

Dear Mr. Hunter:

The above named QAPP has been approved. The original document and signature pages are enclosed as documentation of approval.

In accordance with the terms of the QAPP, **please ensure that copies of this document and any subsequent amendments are distributed to each sub-tier participant as noted in Section A3 of the QAPP.** This approval letter must be available for review during a monitoring systems audit.

Should you have questions, please contact me at (512) 239-0425.

Sincerely,

Kyle Girten
Quality Assurance Specialist

enclosure

cc: Sharon Coleman, Senior Quality Assurance Specialist, MC 165
Jack Higginbotham, Project Manager, MC 203

ATTACHMENT 1
Example Letter to Document Adherence to the QAPP

TO: Jack Higginbotham
TCEQ

FROM: David H. Hunter
City of Denton

RE: City of Denton, Principal Investigator

Please sign and return this form by Thursday, July 19, 2012 to:

Texas Commission on Environmental Quality
P.O. Box 13087, MC 203
Austin, TX 78711-3087

I acknowledge receipt of the "319 Grant for the Lake Lewisville Watershed, Revision Date". I understand that the document describes quality assurance, quality control, data management and reporting, and other technical activities that must be implemented to ensure the results of work performed will satisfy stated performance criteria.

My signature on this document signifies that I have read and approved the document contents. Furthermore, I will ensure that all staff members participating in activities covered under this QAPP will be required to familiarize themselves with the document contents and adhere to the contents as well.

Signature Date 2012 July 19

Copies of the signed forms should be sent by the Contractor to the TCEQ NPS Project Manager within 60 days of TCEQ approval of the QAPP.

Implementing the Hickory Creek Watershed Protection Plan and Adapting the Plan for Use in Other Areas of the Lewisville Lake Watershed Quality Assurance Project Plan

City of Denton
Denton, TX 76209

Funding Source:

Nonpoint Source Protection Program CWA §319(h)
Prepared in cooperation with the Texas Commission on Environmental Quality
and the U.S. Environmental Protection Agency
Federal ID #__ 99614614 _____

Effective Period: One year from date of final approval

Questions concerning this quality assurance project plan should be directed to:

David H. Hunter
Division Manager, Watershed Protection and Industrial Pretreatment
Department of Environmental Services and Sustainability
901 A Texas Street
Denton, TX
(940) 349-7123
David.Hunter@cityofdenton.com

A1 APPROVAL PAGE

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Field Operations Support Division

Stephen Stubbs 8-22-12

Stephen Stubbs, QA Manager Date
TCEQ QA Manager

8/21/12

Kyle Girten, QA Specialist Date
Quality Assurance Team

Water Quality Planning Division

8/21/12

Kerry Niemann, Team Leader Date
Nonpoint Source Program

for Lauren Billo 8/21/12

Anju Chalise, QA Specialist Date
Nonpoint Source Program

8/21/12

Jack Higginbotham Date
Project Manager, Nonpoint Source Program

City of Denton

2012JUL20

David H. Hunter, Project Manager Date
City of Denton

07.20.2012

Deborah. Viera, QA Officer Date
City of Denton

The City of Denton will secure written documentation from additional project participants (e.g., subcontractors, laboratories) stating the organization's awareness of and commitment to requirements contained in this quality assurance project plan and any amendments or revisions of this plan. The City of Denton will maintain this documentation as part of the project's quality assurance records. This documentation will be available for review. (See sample letter in Attachment 1 of this document.)

CH2MHill

Heather G. Harris, P.E.
CH2M HIL

Texas A&M University

Francisco Olivera, Ph.D., P.E.
Texas A&M University

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A3 DISTRIBUTION LIST

The TCEQ QA Specialist will provide original versions of this project plan and any amendments or revisions of this plan to the TCEQ Project Manager and the City of Denton Project Manager. The TCEQ Project Manager will provide copies to the USEPA Project Officer within two weeks of approval. The TCEQ Project Manager will document receipt of the plan and maintain this documentation as part of the project's quality assurance records. This documentation will be available for review.

U.S. Environmental Protection Agency Region 6
State/Tribal Section
1445 Ross Avenue
Suite # 1200
Dallas, TX 75202-2733
Leslie Rauscher, Project Officer
(214) 665-7107

The City of Denton will provide copies of this project plan and any amendments or revisions of this plan to each project participant defined in the list below. The City of Denton will document receipt of the plan by each participant and maintain this documentation as part of the project's quality assurance records. This documentation will be available for review.

City of Denton
901 A Texas Street
Denton, TX 76209

David H. Hunter, Project Manager
(940)-349-7123

Deborah Viera, Quality Assurance Officer
(940)-349-7162

List of Acronyms

AWRL	Ambient Water Reporting Limit
BASINS	Better Assessment Science Integrating Point and Nonpoint Sources
BMP	Best Management Practice
CAP	Corrective Action Plan
CAR	Corrective Action Report
CBMS	Computer Based Mapping System
COC	Chain of Custody
CWA	Clean Water Act
DEM	Digital Elevation Model
DM&A	Data Management and Analysis
DM	Data Manager
DMP	Data Management Plan
DO	Dissolved Oxygen
DOC	Demonstration of Capability
DQO	Data Quality Objective
DSS	Decision Support System
EOF	Edge-of-field
EPA	Environmental Protection Agency
FY	Fiscal Year
GIS	Geographic Information System
GPS	Global Positioning System
ISWM	Integrated Storm Water Management
HUMUS	Hydrologic Modeling of the United States Project
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LMU	Land Management Unit
LOD	Limit of Detection
LOQ	Limit of Quantitation
LULC	Land Use/Land Cover
MDMA	Monitoring Data Management & Analysis
MG/L	Milligrams per liter
MUID	Map Unit Identification
NA	Not Applicable
NCR	Non-conformance Report
NCTCOG	North Central Texas Council of Governments
NELAC	National Environmental Laboratory Accreditation Conference

NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
NTMWD	North Texas Municipal Water District
NWS	National Weather Service
OSSF	On-Site Sewage Facility
PI	Phosphorous Index
PM	Project Manager
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RUSLE	Revised Universal Soil Loss Equation
SELECT	System Effectiveness and Life-cycle Evaluation of Costs Tool
SLOC	Station Location
SOP	Standard Operating Procedure
SSURGO	Soil Survey Geographic
STEPL	Spreadsheet Tool for Estimating Pollutant Load
SWAT	Soil and Water Assessment Tool
SWCD	Soil and Water Conservation District
SWQM	Surface Water Quality Monitoring
TAMU	Texas A&M University
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TM	Technical Memorandum
TMDL	Total Maximum Daily Load
TP	Total Phosphorous
TRACS	TCEQ Regulatory Activities and Compliance System
TS	Technology Services
TSI	Trophic State Index
TSS	Total Suspended Solids
TSSWCB	Texas State Soil and Water Conservation Board
TSWQS	Texas Surface Water Quality Standards
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

UTRWD	Upper Trinity Regional Water District
WMT	Watershed Management Team
WPP	Watershed Protection Plan
WQCM	Water Quality Corridor Management
WQI	Water Quality Inventory
WQMP	Water Quality Management Plan

A4 PROJECT/TASK ORGANIZATION

TCEQ

Field Operations Support Division

Kyle Girten
Lead QA Specialist
Assists the TCEQ Project Manager in QA related issues. Serves on planning team for NPS projects. Participates in the planning, development, approval, implementation, and maintenance of the QAPP. Determines conformance with program quality system requirements. Coordinates or performs audits, as deemed necessary and using a wide variety of assessment guidelines and tools. Concurs with proposed corrective actions and verifications. Monitors corrective action. Provides technical expertise and/or consultation on quality services. Provides a point of contact at the TCEQ to resolve QA issues. Recommends to TCEQ management that work be stopped in order to safe guard project and programmatic objectives, worker safety, public health, or environmental protection.

Water Quality Planning Division

Kerry Niemann, Team Leader
NPS Program
Responsible for management and oversight of the TCEQ NPS Program. Oversees the development of QA guidance for the NPS program to be sure it is within pertinent frameworks of the TCEQ. Monitors the effectiveness of the program quality system. Reviews and approves all NPS projects, internal QA audits, corrective actions, reports, work plans, and contracts. Enforces corrective action, as required. Ensures NPS personnel are fully trained and adequately staffed.

Jack Higginbotham
TCEQ NPS Project Manager
Maintains a thorough knowledge of work activities, commitments, deliverables, and time frames associated with projects. Develops lines of communication and working relationships between the contractor, the TCEQ, and the USEPA. Tracks deliverables to ensure that tasks are completed as specified in the contract. Responsible for ensuring that the project deliverables are submitted on time and are of acceptable quality and quantity to achieve project objectives. Serves on planning team for NPS projects. Participates in the development, approval, implementation, and maintenance of the QAPP. Assists the TCEQ QAS in technical review of the QAPP. Responsible for verifying that the QAPP is followed by the contractor. Notifies the TCEQ QAS of particular circumstances which may adversely affect the quality of data derived from the collection and analysis of samples. Enforces corrective action.

Anju Chalise
TCEQ NPS Project Quality Assurance Specialist
Assists Lead QAS with NPS QA management. Serves as liaison between NPS management and Agency QA management. Responsible for NPS guidance development related to program quality assurance. Serves on planning team for NPS projects. Participates in the development, approval, implementation, and maintenance of the QAPP.

Rebecca Ross
TCEQ NPS Data Manager
Responsible for coordination and tracking of NPS data sets from initial submittal through NPS Project Manager review and approval. Ensures that data is reported following instructions in the Surface Water Quality Monitoring Data Management Reference Guide (February 2009, or most current version). Runs automated data validation checks in SWQMIS and coordinates data verification and error correction with NPS Project Managers' data review. Generates SWQMIS summary reports to assist NPS Project Managers' data reviews. Provides training and guidance to NPS and Planning Agencies on technical data issues. Reviews QAPPs for valid stream monitoring stations. Checks validity of parameter codes, submitting entity code(s), collecting entity code(s), and monitoring type code(s). Develops and maintains data management-related standard operating procedures for NPS data management. Serves on planning team for NPS projects.

City of Denton

David H. Hunter
City of Denton Project Manager
Responsible for ensuring tasks and other requirements in the contract are executed on time and are of acceptable quality. Monitors and assesses the quality of work. Coordinates attendance at conference calls, training, meetings, and related project activities with the TCEQ. Responsible for coordinating development and implementation of the QA program. Responsible for writing and maintaining the QAPP. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP. Responsible for identifying, receiving, and maintaining project quality assurance records. Responsible for coordinating with the TCEQ QAS to resolve QA- related issues. Notifies the contractor Project Manager and TCEQ Project Manager of particular circumstances that may adversely affect the quality of data. Responsible for validation and verification of all data collected according with procedures and acquired data procedures after each task is performed.

Deborah Viera
City of Denton QAO
Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Responsible for verifying the QAPP is followed and the project is producing data of known and acceptable quality. Ensures adequate training and supervision of all data collection activities. Complies with corrective action requirements. Assists in review of QAPP.

JoEtta K. Dailey
City of Denton Data Manager
Responsible for the acquisition, verification, and transfer of data to the TCEQ. Oversees data management for the study. Performs data quality assurances prior to transfer of data to TCEQ. Responsible for transferring data to the TCEQ in the acceptable format. Ensures data are submitted according to workplan specifications. Provides the point of contact for the TCEQ Data Manager to resolve issues related to the data. Assists in review of QAPP.

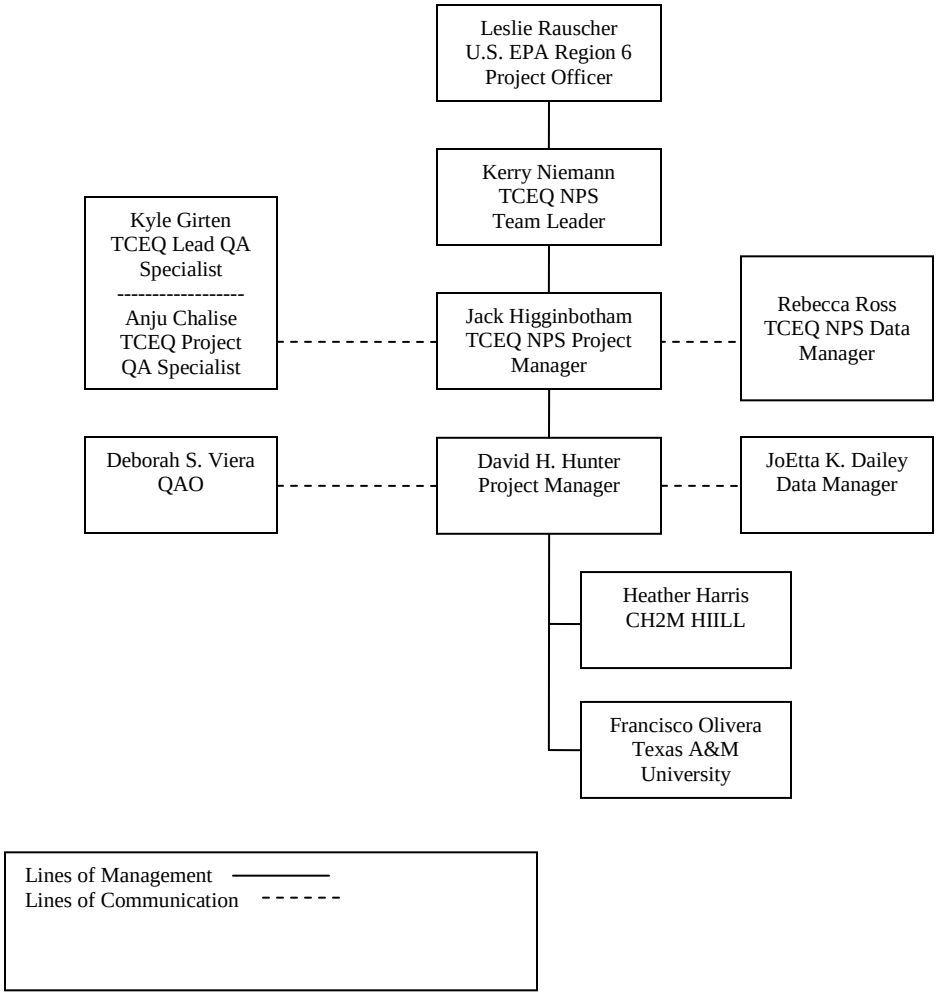
Heather Harris
CH2MHill Project Manager
CH2MHill Project Manager. Responsible for project coordination and development of BMP optimization protocol for stakeholder decision-, making. Responsible for developing presentations for stakeholder meetings. Responsible for engineering and design for BMPs. Responsible for review and refinement of local codes. Develops quarterly and final reports and assists in the development of presentations and publications related to the project.

Francisco Olivera, Ph.D., P.E.
Texas A&M University
Dr Olivera is responsible for using model output to generate loading estimation maps for area on the eastern half of the Lake Lewisville Watershed. He will be used for technical assistance on the output of the model and will produce and deliver maps and other related products for the project team, partners and stakeholders.

U.S. EPA Region 6
Leslie Rauscher
EPA Project Officer

Responsible for managing the CWA Section 319 funded grant on the behalf on USEPA. Assists the TCEQ in approving projects that are consistent with the management goals designated under the State's NPS management plan and meet federal guidance. Coordinates the review of project workplans, draft deliverables, and works with the State in making these items approvable. Meets with the State at least semi-annually to evaluate the progress of each project and when conditions permit, participate in a site visit on the project. Fosters communication within USEPA by updating management and others, both verbally and in writing, on the progress of the State's program and on other issues as they arise. Assists the regional NPS coordinator in tracking a State's annual progress in its management of the NPS program. Assists in grant close-out procedures ensuring all deliverables have been satisfied prior to closing a grant.

Figure A4.1. Organization Chart - Lines of Communication



A5 PROBLEM DEFINITION/BACKGROUND

Hickory Creek is a predominantly rural watershed that is currently meeting designated uses, but is under significant development pressures. Hickory Creek serves as a good example of conditions in the larger Lake Lewisville Watershed, which is also under substantial development pressures. Due to concerns about the potential water quality impacts from development, the City of Denton developed a municipal Watershed Protection Division in 2001. This Division was partially funded by a 104(b)3 grant from the USEPA for the first 3 years of the program, and has been funded by the City of Denton since the grant was completed. Building upon the initial successes of the Watershed Protection Division, the City of Denton, in conjunction with several project partners, has conducted numerous watershed research projects over the last 6 years.

These research activities have culminated in the recently finalized Hickory Creek Watershed Protection Plan (WPP). Watershed level modeling and associated research conducted during the development of WPP indicates that future development planned in the Hickory Creek Watershed will cause degradation in water quality, threaten designated uses, and possibly result in a future 303(d) listing and associated Total Maximum Daily Load (TMDL) Implementation Plan for Hickory Creek and Lake Lewisville.

In the Texas Commission on Environmental Quality's (TCEQ) 2002 and 2004 Water Quality Inventory (WQI), the presence of ammonia nitrogen was identified as a Nutrient Enrichment Concern in the Hickory Creek arm of Lake Lewisville. Monitoring for subsequent WQIs, however, has not demonstrated concerns for any water quality constituent in Hickory Creek. However, the 2008 WQI listed the Stewart Creek and Little Elm arms of Lake Lewisville as concerns for bacteria and nutrients. In the 2002 Reservoir and Lake Use Support Assessment, Lake Lewisville was ranked 96 out of 102 reservoirs (with number 102 being "the worst") based on Carlson 's Trophic state Index (TSI)(TCEQ, 2002).

In response to eutrophication concerns as demonstrated by the TSI, the TCEQ has imposed more stringent total phosphorus (TP) effluent limits for new or amended discharge permits. However, modeling conducted during the development of the Hickory Creek WPP indicates that continued development within the watershed will result in substantial increases in nonpoint source (NPS) loads. In the absence of action, loadings for TP, total nitrogen (TN), and sediments (as depicted by total suspended solids, TSS) are expected to increase from the land surfaces in the Hickory Creek watershed, which will negatively impact water quality in both Hickory Creek and Lake Lewisville. As development continues in the larger Lake Lewisville watershed, similar impacts are expected.

The City of Denton's approach to managing NPS loads and continued degradation of water quality is limited to municipal regulatory requirements. However, evaluations supporting the Hickory Creek WPP showed that current regulatory requirements are not sufficient for addressing water quality degradation within the watershed. New regulatory tools and BMP implementation strategies are therefore required to prevent declines in water quality. The Hickory Creek WPP identifies preliminary modifications to local regulations that are needed to improve water quality and provides a framework for optimizing BMP implementation, with the goal of providing the most pollutant reductions for the least cost.

Additional resources are needed to implement additional targeted BMPs, provide implementation tools, and further refine and codify local regulatory requirements for the purpose of protecting or enhancing water quality. Further, the Hickory Creek WPP also concluded that water quality protection activities, at some point, must be implemented at a larger scale than just the Hickory Creek watershed to truly result in meaningful improvements to water quality in the lake. Consequently, the project team has solicited the involvement of additional project partners in this grant, with the intent of using the resources, expertise, and influence of these additional partners to create products and tools that can facilitate implementation on the larger scale of the Lake Lewisville Watershed.

A6 PROJECT/TASK DESCRIPTION

This project has two parallel and integrated tracks: (1) efforts focused on implementing and advancing the Hickory Creek WPP; and (2) activities designed to expand and adapt the analytical methods and policy frameworks for broader geographic application within the Lake Lewisville watershed. The analytical methods utilized in the prior grant involved the use of a spreadsheet tool that incorporated model outputs and identified sub-drainage areas at an appropriate scale for the model vs. BMP application, then used the corresponding land uses and loading estimates as input to the tool to optimize potential BMP implementation by site. In this new project the tool was verified with all previous data used. The equations were verified and the tool was updated to a more current version of Microsoft Excel. That same methodology was then applied to the new sub-watersheds (Doe Branch and Stewart Creek) selected by the project partners and combined with model output from related partner research projects. As such the analytical methods utilized are a sequence of events applied with the use of an Excel-based tool developed for the current project.

The original Hickory Creek Watershed Protection Plan looked at efforts to create a point nonpoint trading system and best management practice implementation. It was understood that Hickory Creek was only a small component of the entire watershed and that a broader context would be needed. There had been independent studies and monitoring performed by the Upper Trinity Regional Water District (UTRWD) and the North Texas Municipal Water District (NTMWD). UTRWD had developed a model based on conservation of natural resources. NTMWD had performed analytical work looking at nutrients and Chlorophyll in Lake

Lewisville. This information could be incorporated into the decision making process originally developed by CH2MHill for selection of site for BMP implementation. Implementation of any watershed planning effort will require development of a framework for changes in administrative and legal frameworks across the area. There are many opportunities within the work from the original grant and various concurrent efforts with groups including the North Central Texas Council of Governments and City's own development code. The proposed planning effort will be completed as part of the second track, thus that description is what has been included.

Lake Lewisville Watershed-Focused Activities

Concurrent with the Hickory Creek-focused efforts, this project also will adapt the methods and policy framework embodied in the Hickory Creek WPP, as will be refined during this project, for application in the larger Lake Lewisville watershed. To advance these activities, NTMWD and UTRWD have joined the City of Denton in this project. These partners will be provided with all of the information and deliverables created by the Hickory Creek-specific efforts outlined above, and will have an opportunity to provide input and expertise as deliverables are developed. These partners do not, however, have quality assurance related roles for this project.

During the initial project in the Hickory Creek Watershed, Texas A&M University developed a combined SWAT QUAL-TX Model for the Lake Lewisville Watershed. This model was developed to evaluate existing and baseline sediment and nutrient loading to Lake Lewisville, which can be used to assess the impact of expected future development. This model was also used to determine loading in areas in Doe Branch and Stewart Creek in the eastern portion of the watershed under the previous 319 project.

The adaptation of the Hickory Creek management model(the combination of the SWAT/QUAL-TX Model and the Decision support tool) for the larger Lake Lewisville watershed will be accomplished by gathering and evaluating pertinent information from the substantial amount of research conducted by the project partners (particularly the watershed research conducted by UTRWD) and integrating this information with the information available through the Hickory Creek WPP. UTRWD already has an extensive Watershed "prioritization plan" that was created by the University of North Texas. The project team will evaluate these sources of information in conjunction with the existing implementation strategies outlined in the Hickory Creek WPP to determine the products needed to facilitate an optimized BMP implementation strategy for areas under the jurisdiction of the project members.

Since all project partners use the lake as a water supply source and recipient of wastewater discharges, ensuring the lake's water quality remains unimpaired is of paramount interest. We anticipate that expanding the scope of implementation efforts to the larger watershed area will involve addressing the following elements:

- Upon review of existing information from the NTMWD and UTRWD, determine how this information can be used in conjunction with the Hickory Creek WPP to create a more cohesive and transferable implementation methodology.
- Analyze the barriers to implementing BMPs in other areas of the Lewisville watershed and identify how these barriers can be overcome with implementation tools (including BMP optimization approaches).
- Estimate and compare the costs and benefits associated with implementing water quality controls in the watershed via BMPs compared with those of additional treatment at drinking water facilities and upgrading wastewater treatment plants.
- Conduct preliminary analyses of the viability of a water quality credit trading market within the partner group, and within and beyond Hickory Creek (e.g., sediment and/or nutrient credits).
- Explore the potential benefits and viability of a watershed permit for selected facilities and/or jurisdictions as a way of aligning nonpoint source management program goals with existing regulatory frameworks.

Model Information Related to Project

Two main modeling activities will be conducted under this grant project;

- The utilization of a Decision Support System (DSS) to identify BMP implementation locations in the Doe Branch and Stewart Creek watersheds.
- The calculation of load reductions for BMPs implemented in the Hickory Creek watershed under this project.

Decision Support System

This project utilizes model outputs from of an earlier 319 Project (City of Denton, 2008). The project included the development of a watershed protection plan for the watershed; a stakeholder outreach program; water quality monitoring; modeling of pollutant loading and water quality impacts; selection, siting and construction of BMPs; and the creation of incentives and a regulatory framework for accelerated BMP implementation. These BMPs would then lessen the volume of sediments and nutrients that enter the Hickory Creek and, ultimately, Lewisville Lake.

To develop a better understanding of the contributing sources of sediments and nutrients to Lake Lewisville, Texas A&M developed a combined model of the watershed that incorporated the Soil and Water Assessment Tool (SWAT) and QUAL-TX. This model was developed during the original project and applied to the current project. The combined SWAT/QUAL-TX model works as follows: pollutant loading estimated by SWAT is automatically transferred as

inputs into the QUAL-TX steady state in-stream dynamic model. The SWAT model results were employed for estimating sediment loads as outputs for the prior and current project. Nitrogen and phosphorous load outputs were estimated with the QUAL-TX model. The outputs were used as inputs to the Decision Support System (DSS) for prioritizing BMP implementation sites.

Additionally, the project will use the Water Quality Corridor Management (WQCM) model developed by UTRWD which classifies stream segments in order of priority for management. This prioritization will be used as inputs to the DSS for Doe Branch and Stewart Creek.

The DSS is the combination of watershed load information along with spatial and economic information that streamlines the selection of BMP implementation sites. The DSS helps to provide guidance for future development. The DSS framework developed under the Hickory Creek WPP project will be expanded to the entire Lake Lewisville watershed. The DSS is an Excel spreadsheet calculation tool that adds a value from the input sources for scoring based on location, ownership, accessibility, and on site limitations. The outputs are scores / ranking for subbasins for optimal BMP location based on effectiveness and cost.

DSS Model Data Sources

Soil Water Assessment Tool (SWAT)

SWAT is a conceptual model developed by the U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS). It is a continuous-time physically-based model, as opposed to a model that incorporates regression equations to describe the relationship between input and output variables. It allows for the prediction of the effects of land use management and climate on water sediment and agricultural chemical yields. Examples of land use management include agricultural practices, groundwater withdrawal, and reservoir management. The physical processes associated with water movement, sediment movement, crop growth, and nutrient cycling, among others, are directly modeled by SWAT based on input data. SWAT uses readily available inputs, i.e. the minimum data required to perform a model “run” are commonly available from government agencies. SWAT is able to simulate hydrology, pesticide and nutrient cycling, bacteria transport, and erosion and sediment transport. Major components of the hydrologic balance and their interactions are simulated, including surface runoff, lateral flow in the soil profile, groundwater flow, evapotranspiration, channel routing, and pond and reservoir storage. It is a spatially distributed parameter model that uses a daily time step for simulation. The primary factors considered when developing this model included land management, water quality loadings, flexibility in basin discretization, and continuous time simulation(Texas Water Resources Institute, 2007).

QUAL-TX

QUAL-TX is a one-dimensional model developed by the TCEQ and used to simulate the reactions of nutrient cycles, algal production, benthic and carbonaceous demand, and atmospheric reaeration, as well as the associated effects on the dissolved oxygen balance for waste load allocations of oxygen demanding materials. Pollutant loading estimated by SWAT was input into the QUAL-TX steady state in-stream dynamic model. It is a modification of QUAL-2E, which is a model widely, used by the U.S. Environmental Protection Agency for advective and dispersive transport systems with linear and branched channels (Texas Water Resources Institute, 2007). QUAL-TX was utilized for nutrient load estimates.

Both QUAL models are equivalent in approach, though there are some technical differences. For example, QUAL-2E can be applied to streams and well-mixed lakes but is not recommended for estuaries. QUAL-TX, on the other hand, has several kinetic terms based upon field experiments in Texas watercourses and allows for tidal boundary conditions. Dissolved oxygen is perhaps the most important modeled constituent within QUAL-2E and QUAL-TX, and the majority of the history of application of both of these models is in addressing DO problems. The greatest limitation of the QUAL models is that they cannot depict the response of a stream to time varying inflows (Texas Water Resources Institute, 2007).

Apart from discharge and flow quality, the most important QUAL model inputs can be categorized as follows:

• Site specific stream hydraulic characterization.

• Kinetic rates, such as CBOD decay rate (Kd), ammonia-nitrogen oxidation rate (Kn), sediment oxygen demand (SOD), among others.

• Critical conditions, e.g. combinations of environmental conditions and wastewater inputs that typically result in the lowest water body dissolved oxygen levels. Critical conditions are defined by several parameters, such as ambient flow and its DO level, flow from point and non-point sources, and ambient water temperature.

• Background water quality such as BOD concentration, ammonia-nitrogen concentration, temperature, and saturated DO level.

WQCM MODEL

A stream Water Quality Corridor Management (WQCM) model was developed by UTRWD to identify and assess potential water quality issues and to classify stream segments in order of priority for management. To establish the relative priority of stream reaches, five parameters were chosen based on their availability and capacity for manipulation within spatial analysis software, as well as their ability to predict current reach conditions. These parameters included

vegetation type, erosion potential, surface slope, percent of the stream defined by the FEMA 100-year floodplain, and amount of the stream corridor contained within the subwatershed. Each parameter consisted of an importance weight and scaling function, which was determined based on the delineation of parameter magnitude. Importance weights (i) and scaling functions (f) assigned to each WQCM component ranged from 1 to 5, with 5 indicating a greater need for protection. Values were calculated and summed for each stream segment, within the riparian buffer of the stream segment, generating an overall WQCM score for each subwatershed (Table 1). Based on the WQCM score, each of 90 subwatersheds that comprise the Lewisville Lake watershed was classified into one of four preservation priority groupings: low, moderate, high, and highest priority. The WQCM model produces a score that can range from 0 to 50, with the highest scores assigned to the highest preservation priority category and indicating the greater need for protection of a stream corridor under future development (University of North Texas, 2007). Outputs from the WQCM model are utilized as inputs to the DSS.

VERIFICATION OF LOAD REDUCTIONS

The purpose of this section will be to determine load reduction of BMPs for the sites selected by the stakeholder group and project team. During the previous 319 grant project this methodology was utilized at three locations (City of Denton Fire Station 7, City of Denton Municipal Airport and City of Denton Lake Forrest Park: Wiggley Field) outlined in Appendix F. The methods for determination of load reduction were developed in the prior grant and will be applied to the current project. During the current project two sites have been selected for BMP implementation (City of Denton South Lakes Park and City of Denton Cross Timbers Park). The current project will utilize the methodology that follows to determine load and load reduction for the selected sites based on BMP selection and design.

Load calculations will be made for each site under three conditions: pre-development, post-development, and post-development with BMPs. NPS loads will be calculated using two methods: the Revised Universal Soil Loss Equation (RUSLE) to estimate sediment loads, and the Schueler “Simple Method” to estimate sediment, total nitrogen, and total phosphorus loads. In the previous 319 grant project where the sediment load estimated using the Simple Method and the RUSLE did not agree, the results from the RUSLE method were adopted for use. The Project Manager may opt to use other new models such as the Spreadsheet tool for estimating pollutant load (STEPL). The use of STEPL will be determined by input from the project team and stakeholder group. Many of the identified stakeholders for the project are entities that may have potential development pressure but do not have the financial or staffing resource to develop more advanced models. STEPL provides an open-source tool that provides quick, efficient load and load reduction estimates for planning purposes.

Reduction efficiencies for the BMPs will be calculated in a similar manner to the original 319 grant BMP locations using sediment and nutrient reduction efficiencies outlined either the

Integrated Storm Water Site Development Manual (NCTCOG, 2006) or the BMP database (WERF, 1996). The selection of which data source will be utilized for load reduction calculations will be determined based on geographic similarity for the bmp type.

Revised Universal Soil Loss Equation (RUSLE)

The Revised Universal Soil Loss Equation (RUSLE) is defined as:

A = R * K * LS * C * P
where:
A = estimated average annual soil loss in tons per acre
R = rainfall-runoff erosivity factor
K = soil-erodibility factor
LS = topographic factor
C = cover-management factor
P = support practice factor

A more detailed description of each variable in the RUSLE and how these variables were assigned or determined is presented below.

Rainfall-Runoff Erosivity Factor (R)

The Rainfall-Runoff Erositivity Factor (R factor) is an empirical value derived from several different sources. The literature indicates that when factors other than rainfall are held constant, soil losses from cultivated fields are directly proportional to a rainstorm parameter: total storm energy (E) * the maximum thirty-minute intensity (I). This parameter incorporates both raindrop impact and overland flow.

Isoderent maps covering the entire United States with R factor “contours” are available from the United States Department of Agriculture (USDA) and the Environmental Protection Agency (EPA). These maps must be visually interpolated to assign an R factor to the area of interest. The area of interest is located within a hydrologic unit named Elm Fork Trinity, Hydrologic Unit Code (HUC) #12030103, which is halfway between the contours for an R factor of 250 and an R factor of 300. Thus, an R value of 275 was used.

Soil-Erodibility Factor (K)

The Soil-Erodibility Factor (K factor) describes the ease with which soil is detached by splash during rainfall or by surface flow or by a combination of both. It can also be thought of as the average long-term soil and soil-profile response to the erosive processes of rainstorms. These processes include soil detachment and transport by raindrop impact and surface flow, localized deposition due to topography and tillage-induced roughness, and rainwater infiltration into the

soil profile. K is the rate of soil loss per rainfall erosion index unit as measured on a unit plot, which is 72.6 feet long with a 9 percent slope.
There are a few different soil series within the area of interest, thus different soil textures and K values. Because of this, each site had a different K value.

Topographic Factor (LS)

The effect of topography on erosion is measured in the topographic factor (LS factor). This value is calculated using the rill susceptibility, slope length, and slope incline, providing a ratio of soil loss on a given slope length and steepness to soil loss from a reference slope that has a length of 72.6 feet and a steepness of 9 percent, all other conditions being the same.

Slope Length Factor (L)

Erosion increases as slope length increases, and this is taken into account using the slope length factor (L factor). Slope length is defined as the horizontal distance from the origin of overland flow to the point where either (1) the slope gradient decreases enough that deposition begins, or (2) runoff becomes concentrated in a defined channel. Slope lengths, as well as steepness values, are typically estimated from topographic contour maps. In this study, contour maps were used to estimate the longest length of flow and the steepest possible elevation drop for the site. These values were then used in the calculations to provide the worst case scenario. The slope length is the horizontal projection of plot length, not the length measured along the slope.
An important factor to consider in the calculation of L is the ratio of rill erosion, caused by flow, to interrill erosion, caused mainly by raindrop impact. Land use is the main issue affecting the rill to interrill ratio. For example, for rangeland and pasture, the ratio of rill to interrill erosion is low. For cropland, the ratio of rill to interrill erosion is moderate. For construction sites, the ratio of rill to interrill erosion is high and the soil has a strong tendency to rill. For the purposes of this study, the project team assumed the rill to interrill ratio is moderate in the area of interest.

Slope Steepness Factor (S)

Slope steepness plays an even greater role in erosion than slope length. There are separate equations for slopes longer than 15 feet in length and slopes shorter than 15 feet. Slopes with steepness values of 9 percent or less are also calculated differently from those slopes having steepness values greater than 9 percent. Contour maps were used in this study to estimate the slope steepness for each individual site in the area of interest, thus this value is site specific.

Cover Management Factor (C)

The cover management (C factor) is the ratio of soil loss with specific cropping and management practices to the corresponding loss with up-slope and down-slope tillage and continuously fallow conditions. This factor includes the effects of cover, crop sequence, productivity level, length of

growing season, tillage practices, residue management, and the expected time distribution of erosive rainstorms. The Natural Resources Conservation Service (NRCS) provides charts of C-factor values for various land uses. This value is not only site specific but also varies between pre and post-development conditions.

Support Practice Factor (P)

The support practice factor (P factor) is the ratio of soil loss with a specific support practice to the corresponding loss with up slope and down slope tillage and continually fallow conditions. These practices mainly affect erosion by modifying the flow pattern, grade, or direction of surface runoff and by reducing the amount and rate of runoff (Renard and Foster, 1985). For cultivated land, the support practices considered include contouring, strip cropping, terracing, and sub-surface drainage. On dry land or rangeland areas, soil-disturbing practices oriented on or near the contour that result in storage of moisture and reduction of runoff are also used as support practices.

The reduction in soil loss at a given slope is about 50 percent for the next more intensive practice. An overall P factor value is computed as a product of P subfactors for individual support practices (those mentioned above), which are typically used in combination. Factor values can be found on charts provided by the USDA, among other entities. In this study, however, few, if any, erosion reducing practices are used. Therefore, a P factor of 1.0 was used for each site representing practices that neither inhibit erosion nor encourage erosion.

Delivery Ratio

The edge of stream load is not always equal to the edge of field load because not all of the sediment created by upland erosion reaches the watershed outlet. Several processes occur within each site that prohibits the eroded material from reaching the watershed outlet. These processes include redeposition in surface water storage, trapping by vegetation and plant residues, and local scour and redeposition in rills and channels. Also, many factors inhibit the eroded material's delivery to the watershed outlet, including climate, soil particle size and texture, size and proximity of the upland erosion source, the ratio of rill versus sheet erosion, total watershed area, watershed length and relief, and drainage density (the ratio of total stream length within the system divided by the area).

To determine the delivery ratio, a calculation can be performed using the area, relief, length and bifurcation ratio of the stream of interest, or it can be found on graphs provided by the USDA. These graphs show that as drainage area increases, the delivery ratio decreases. For this study, a delivery ratio of 0.3 was assumed. This is a fairly typical value for developed yet mostly pervious areas.

Schueler's "Simple Method"

Schueler's Simple Method was also employed to calculate stormwater runoff pollutant loads. Input consists of the subwatershed drainage area and impervious cover percentages, stormwater runoff pollutant concentrations, and annual precipitation. The method enables the user to either break up land use into specific areas, such as residential, commercial, industrial, and roadway to calculate annual pollutant loads for each type of land, or to utilize more generalized pollutant values for land uses such as new suburban areas, older urban areas, central business districts, and highways.

The Simple Method estimates pollutant loads for chemical constituents as a product of annual runoff volume and pollutant concentration, and is defined by the following equation:

$$L = 0.226 * R * C * A$$

Where: L = Annual load (lbs)
R = Annual runoff (inches)
C = Pollutant concentration (mg/l)
A = Area (acres)
0.226 = Unit conversion factor

To determine the value for R, the Simple Method calculates annual runoff as a product of annual runoff volume, and a runoff coefficient (Rv). Runoff volume is calculated as:

$$R = P * P_j * Rv$$

Where: R = Annual runoff (inches)
P = Annual rainfall (inches)
Pj = Fraction of annual rainfall events that produce runoff (usually 0.9)
Rv = Runoff coefficient, based on the impervious cover in the subwatershed.
To determine the value of C, stormwater pollutant concentrations divided by land use can be estimated from local or regional data, or from national data sources. Numerous references are available for these values.

STEPL (Spreadsheet Tool for Estimating Pollutant Load)

This model tool employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). STEPL provides a user-friendly Visual Basic (VB) interface to create a customized spreadsheet-based model in Microsoft (MS) Excel. It employs simple

algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs), including Low Impact Development practices (LIDs) for urban areas. It computes surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. The land uses considered are urban land, cropland, pastureland, feedlot, forest, and a user-defined type. The pollutant sources include major nonpoint sources such as cropland, pastureland, farm animals, feedlots, urban runoff, and failing septic systems. The types of animals considered in the calculation are beef cattle, dairy cattle, swine, horses, sheep, chickens, turkeys, and ducks. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (from sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies (Tetra Tech, 2005). STEPL was not utilized in the previous grant project but was identified as an accepted, simple tool to determine loadings and load reductions for planning purposes.

GEOSPATIAL ANALYSES AND PRODUCTS

- Loading outputs of the SWAT/QUAL-TX Model conducted under the previous 319 project the Lake Lewisville Watershed were utilized for Doe Branch and Stewart Creek to create watershed pollutant loading maps. These maps have been created under the current 319 grant project.

- Loading outputs of the SWAT/QUAL-TX Model were integrated with DSS support tool and integrated with geospatial data to create BMP implementation site map outputs. These maps have been created under the current 319 grant project.

- WQCM Model outputs were integrated with loading outputs of the SWAT/QUAL-TX Model geospatial data and compared to the original (previous 319 project) DSS SWAT/QUAL-TX integration tool outputs for comparison purposes. These maps have been created under the current 319 grant project.

- Watershed prioritization maps were developed for Hickory Creek stakeholder site BMP selection process based on DSS output and SWAT/QUAL-TX watershed loading activities conducted under the previous 319 project. *Note these maps were created in 2010 under the current 319 grant project.

- BMP engineering design site maps will be developed.

- Thematic Geographic maps were be created for Stakeholder decision making on Hickory BMP site selection. Thematic geographic maps may be created for future stakeholder decision making on Doe Branch and Stewart Creek for planning purposes of BMP site selection. Loading and other data were/will be incorporated into these maps.

- Any additional Geospatial Analysis or product development will only be done with a prior change and approval in the QAPP

QAPP Revision

Until the work described is completed, this QAPP shall be reissued annually on the anniversary date, or revised and reissued prior to any significant changes being made in activities, whichever is sooner. Reissuances and annual updates must be submitted to the TCEQ for approval at least 90 days before the last approved version has expired. If the QAPP expires, the QAPP is no longer in effect and the work covered by the QAPP must be halted. If the entire QAPP is current, valid, and accurately reflects the project goals and the organization's policy, the annual re-issuance may be done by a certification that the plan is current. This can be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP. If the QAPP needs to be updated to incorporate amendments made earlier in the year or to incorporate new changes, a full annual update is required. This is accomplished by submitting a cover letter, a document detailing changes made, and a full copy of the updated QAPP (including signature pages).

QAPP Amendments

Amendments to the QAPP may be necessary to reflect changes in project organization, tasks, schedules, objectives and methods; address deficiencies and nonconformances; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests for amendments are directed from the City of Denton's Project Manager to the TCEQ NPS Project Manager in writing using the NPS QAPP Amendment form *(Lead Organizations should request the amendment form from NPS Project Managers).* The TCEQ PM will consult with the TCEQ QAS to determine if the changes are substantive. The changes are effective immediately upon approval by the TCEQ NPS Project Manager and TCEQ Quality Assurance Specialist, or their designees, and the EPA Project Officer *(if applicable).* Amendments to the QAPP and the reasons for the changes will be documented, and copies of the approved QAPP Amendment form will be distributed to all individuals on the QAPP distribution list by the City of Denton QAO.

Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes.

A7 QUALITY OBJECTIVES AND CRITERIA FOR MODEL INPUTS/OUTPUTS

Load reduction verification will be performed using only resources required to meet rigorous quality assurance criteria (such as government data services) or peer-reviewed literature. BMP reduction efficiency will be determined using accepted literature or resources such as the NCTCOG ISWM Site Design Manual or the Water Environment Research Federation BMP database (WERF, 1996).

A8 SPECIAL TRAINING/CERTIFICATION

No special certifications are required for this project.

A9 DOCUMENTS AND RECORDS

All records will be archived by City of Denton for at least 5 years and made available upon request. Any items or areas identified as potential problems and any variations or supplements to QAPP procedures noted will be made known to pertinent project personnel and included in an update or amendment to the QAPP. The project manager will ensure distribution of the most recent QAPP to all individuals listed in Section A3. Corrective action reports (CARs) will be utilized when necessary (see attachment 1). CARs will be maintained in accessible locations for reference at the City of Denton office. CARs that result in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in an amendment to the QAPP.

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Records and Documents Retention Requirements

Document/Record	Location	Retention	Form
QAPP, amendments, and appendices	Org.	5 years	Paper
QAPP distribution documentation	Org.	5 years	Paper
Training records	Org.	5 years	Paper
Electronic			
Corrective action documentation	Lab	5 years	Paper

(Note: items related to laboratory data, monitoring and/or analysis do not apply to this project)

B1 SAMPLING PROCESS DESIGN (EXPERIMENTAL DESIGN)

Not Relevant – No new sampling data will be collected under this QAPP during this project.

B2 SAMPLING METHODS

Not Relevant – No new sampling data will be collected under this QAPP during this project.

B3 SAMPLE HANDLING AND CUSTODY

Not Relevant – No new sampling data will be collected under this QAPP during this project.

B4 ANALYTICAL METHODS

Not Relevant – No new sampling data will be collected under this QAPP during this project.

B5 QUALITY CONTROL

Not Relevant – No new sampling data will be collected under this QAPP during this project.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

Not Relevant – No new sampling data will be collected under this QAPP during this project.

B7 MODEL CALIBRATION

Note: Model Calibration was done in the prior project
In general, data are necessary to properly calibrate the SWAT model, assuming that the data reflect a range of wet to dry precipitation years. In order to calibrate the SWAT model, parameters were adjusted to match cumulative runoff volume with inflow to the Lake.

A computer application, developed by the Texas A&M University researchers based on the Shuffled Complex Evolution (SCE-UA) algorithm, was used to calibrate the QUAL-TX model. The SWAT model was calibrated interactively. The objective function of the optimization was the sum of the square of the residuals between the predicted and observed concentrations at the permanent sites. In the calibration process, concentration ranges were used as constraints to ensure the results were consistent with values found in the literature (Texas A&M University et al. 2007).

The results obtained from this modeling exercise feed into a larger effort to identify, plan, and implement BMPs for the control of urban and suburban non-point source pollution within the Hickory Creek watershed. These results will allow the project team to ascertain the most cost-effective locations for BMP implementation. Information from the project partners will be used to aid in this decision-making process.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Not Relevant – No new sampling data will be collected under this QAPP during this project.

B9 NON-DIRECT MEASUREMENTS

Loading Estimate data from SWAT/QUAL-TX model outputs for sediments and nutrients were generated from a previous project and will be applied to subwatershed characterization.

WQCM MODEL OUTPUT

A final WQCM score (completed separate from this project) was calculated and a coordinating WQCM priority quartile (low, moderate, high, or highest) was designated for the stream corridors within each of the 133 subwatersheds of the pilot study area and 90 subwatersheds of the Lewisville Lake watershed. (University of North Texas, 2007). This information will be integrated with the SWAT model output to enhance watershed characterization and future BMP site selection.

Load reduction verification will typically use input data such as precipitation information or soil type. Site-specific information from BMP designs will also be utilized for calculations along with peer-reviewed data.

The output of the SWAT QUAL/TX model will be loadings estimates of Nutrients and TSS for two watersheds in central and eastern portion of the Lake Lewisville Watersheds.

The City of Denton provided georeferenced digital stream lines, subbasin polygons and 2004 land-use polygons; as well as water quality data (e.g., total suspended solids (TSS), nitrate and ammonia, and total phosphorous), and precipitation data (i.e., rainfall depth and event duration) associated with the water quality observations.

The Lake Lewisville SWAT model watershed (updated wherever more current data were available) was employed for estimating sediment loads. Nitrogen and phosphorous loads were estimated with the QUAL-TX model using the subbasins and stream network provided by the City of Denton (Texas A&M University et al. 2007).

Table B9-1 Non-Direct (acquired) data

Data Type	Data Source	Applicable Date or Other Attributes	Use/Relevance
Sediment, phosphorous, nitrogen loads (metric tons or pounds per year per acre)	Lake Lewisville SWAT/QUAL-TX model outputs		Input into DSS
Scoring/Ranking for protection of the environmentally sensitive areas within subbasins	WQCM		Input into DSS
Geospatial data: parcels, easements, utilities, boundaries, roads and streams	City of Denton GIS Department	current	Input into DSS: To determine accessibility, ownership, existence of underground utilities, and barriers to use
BMP reduction percentage for sediment, nitrogen, and phosphorous by BMP	iSWM	2006	Load calculations
BMP reduction percentage for sediment, nitrogen, and phosphorous by BMP	International Stormwater BMP Database	current	Load calculations
Geospatial data: parcels, easements, utilities, boundaries, roads and streams for Denton and Collin County	North Central Texas Council of Governments GIS Department	current	Input into DSS: To determine accessibility, ownership, existence of underground utilities, and barriers to use
Location, dimensions, and materials of BMPs	CH2M Hill engineering designs for BMPs to be installed	2012	Load calculations
RUSLE and Schueler's "Simple Method" factors identified in A6	United States Department of Agriculture (USDA) National Resource Conservation Service (NRCS)		Load calculations
Soils data, GIS Data, (Soil Survey Geographic Data)	NRCS Soil Survey Website	SSURGO is the most detailed soil map developed by NRCS	Load calculations and reduction verification in STEPL
Land use and land cover data	NLDC Website	USGS 2001 National Land Cover Database	Load calculations and reduction verification in STEPL
Routine ambient water quality data: TSS, nutrients, Conductivity, TDS	City of Denton, Dallas Watershed Department Monitoring Programs.	2002-2007	Development and validation of SWAT Models

Rainfall Data	City of Denton, Dallas Watershed Department Monitoring Programs.	2001-2005	Development and validation of SWAT Models

Rainfall Data

Weather is the driving force for any hydrologic model. Data collected at a few points are applied to an area of thousands of square miles. Rainfall can be quite variable, especially in the spring when convective thunderstorms produce precipitation with a high degree of spatial variability. It may rain heavily at a weather station, but may be dry a short distance away. On an average annual or average monthly basis, these errors may cancel. This limitation among others, cautions us against using daily model output.

Rainfall data provided by the City of Denton consisted of rainfall depth (mm) and storm duration (hr) for 13 events in the period 2001-2005 for which water quality samples were taken. Rainfall intensity (mm/hr) was estimated as the depth divided by the duration. A plot of rainfall depth and intensity as a function of duration showed no statistically significant relation between rainfall depth or intensity and storm duration, leading to low regression coefficients and/or high p values for the t-test (implying that the slope of the rainfall as a function of duration is not statistically different from zero). Neither rainfall depth nor rainfall intensity significantly depend on the storm duration. Thus, for the events observed, a median duration of 10 hours was taken.

Additionally, using the 2001-2004 hourly precipitation records of the National Climate Data Center (NCDC) rain gauge Denton SE (http://www5.ncdc.noaa.gov/pdfs/hpd/texas/), the average number of events were plotted as a function of rainfall depth. For developing this plot, a storm was considered a sequence of hours with precipitation depth greater than 2.5 mm (i.e., 0.1 inches) not interrupted by more than one hour with no precipitation (i.e., storms were separated by two or more hours with no precipitation) (Texas A&M University et al. 2007).

B10 DATA MANAGEMENT

Personnel

Section A4 lists responsibilities and lines of communication for data management personnel.

Data Management Process

Data management for this project will be related to data derived from the modeling process.

Record-keeping and Data Storage

City of Denton record keeping and document control procedures are contained in the water quality sampling and laboratory standard operating procedures (SOPs) and this QAPP. Original field and laboratory data sheets are stored in the City of Denton offices in a fireproof file in accordance with the record-retention schedule in Section A9. Copies of the database are backed up each day on magnetic tape. One copy is stored in a fireproof safe in the City of Denton office, and one copy is stored off-site. If necessary, disaster recovery will be accomplished by technology services staff using the backup database.

Archives/Data Retention

Complete original data sets are archived on permanent electronic databases and retained on-site by the City of Denton for a retention period specified in Section A9.

Data Verification/Validation

The control mechanisms for detecting and correcting errors and for preventing loss of data during data reduction, data reporting, and data entry are contained in Sections D1, D2, and D3.

Data Handling

Data have been processed using the Microsoft Access 2000 suite of tools and applications or other data management system. Data integrity is maintained by the implementation of password protections which control access to the database and by limiting update rights to a select user group. No data from external sources are maintained in the database. The database administrator is responsible for assigning user rights and assuring database integrity.

Hardware and Software Requirements

Hardware configurations are sufficient to run Microsoft Access 2000 under the Windows XP operating system in a networked environment. City of Denton Technology Services (TS) staff is responsible for assuring hardware configurations meet the requirements for running current and future data management/database software as well as providing technical support. Software development and database administration are also the responsibility of TS department. TS develops applications based on user requests and assures full system compatibility prior to implementation.

Information Resource Management Requirements

City of Denton Technology Services (TS) policy is contained in TS SOPs which are available for review at City of Denton offices.

Quality Assurance/Control

See Section D of this QAPP

C1 ASSESSMENTS AND RESPONSE ACTIONS

Corrective Action Process for Deficiencies

Deficiencies are any deviation from the QAPP, SOPs, or Data Management Reference Guide. Deficiencies may invalidate resulting data and may require corrective actions. Corrective action may include model reruns for questionable output. It is the responsibility of the City of Denton Project Manager, in consultation with the City of Denton QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the NPS Project Manager both verbally and in writing in the project progress reports and by completion of a corrective action plan (CAP).

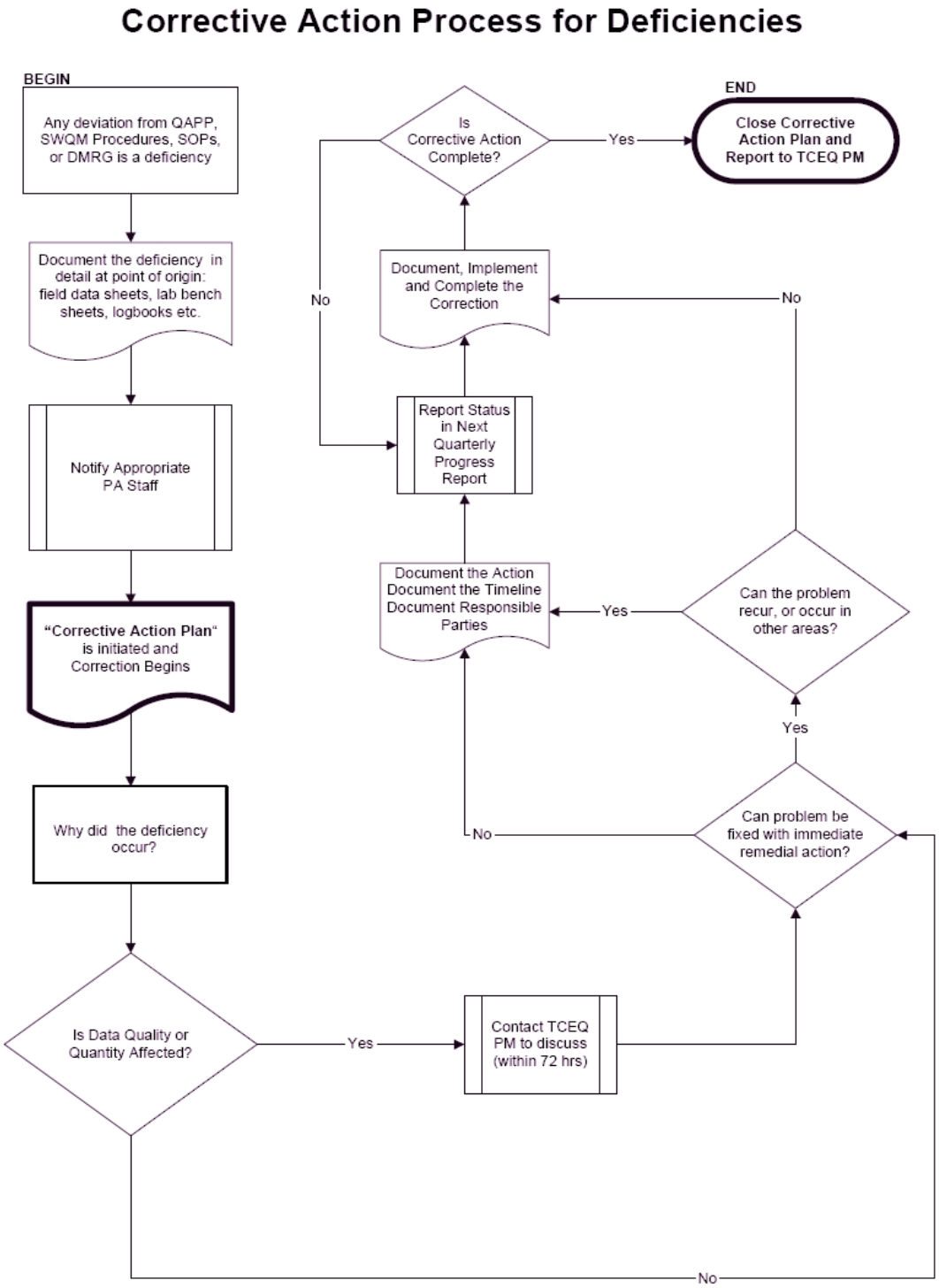
Corrective Action

CAPs should:

- Identify the problem, nonconformity, or undesirable situation
- Identify immediate remedial actions if possible
- Identify the underlying cause(s) of the problem
- Identify whether the problem is likely to recur, or occur in other areas
- Evaluate the need for Corrective Action
- Use problem-solving techniques to verify causes, determine solution, and develop an action plan
- Identify personnel responsible for action
- Establish timelines and provide a schedule
- Document the corrective action

To facilitate the process a flow chart has been developed (see figure C1.1: Corrective Action Process for Deficiencies).

Figure C1.1 Corrective Action Process for Deficiencies



Status of CAPs will be documented on the Corrective Action Status Table (See Appendix L) and included with Quarterly Progress Reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TCEQ immediately.

The City of Denton Project Manager is responsible for implementing and tracking corrective actions. Corrective action plans will be documented on the Corrective Action Plan Form (See Appendix M) and submitted, when complete, to the TCEQ Project Manager. Records of audit findings and corrective actions are maintained by both the TCEQ and the City of Denton QAO. Audit reports and corrective action documentation will be submitted to the TCEQ with the Quarterly Progress Report.

If audit findings and corrective actions cannot be resolved, then the authority and responsibility for terminating work are specified in the TCEQ QMP and in agreements in contracts between participating organizations.

C2 REPORTS TO MANAGEMENT

Reports to TCEQ Project Management

All reports detailed in this section are contract deliverables and are transferred to the TCEQ in accordance with contract requirements. The City of Denton will develop a report that summarizes and documents technical information regarding application of models in support of the watershed planning process. CH2MHill will assist in the development of this reporting criteria. Texas A&M will provide a report on analytical product methodology and presentation of the results.

Annual Report Article - Summarizes activities and project results upon request of the TCEQ.

Quarterly Progress Report - Summarizes the City of Denton's activities for each task; reports monitoring status, problems, delays, and corrective actions; and outlines the status of each task's deliverables.

Contractor Evaluation - The City of Denton participates in a Contractor Evaluation by the TCEQ annually for compliance with administrative and programmatic standards.

Technical Report – To outline local code language recommendations.

Technical Memorandum – To document the process and results of Tasks 3.1 and 3.2 BMP Construction Documents and BMP Construction Certifications.

Technical Report – To document the methods, analysis, results, and recommendations produced by the activities described under tasks 5.1-5.5, see Appendix B, "Work Plan". Technical report for one or more of the individual task results may be combined as seems appropriate to the content and audience and, for example, a total of two to three TM may comprise the results of Objective 5.

Final Project Report – The final report information on watershed prioritization using the earlier developed SWAT model. It will go into the prioritization process that was used to further refine the choices for BMP selection for sites in the Hickory Creek Watershed. BMP site selection and design information will be incorporated into the final report. It will also evaluate load reductions for each constructed BMP. Ecomic analysis developed by CH2MHill will be included along with any data integrated from earlier research. The report will summarize the City of Denton's activities for the entire project period including a description and documentation of major project activities; evaluation of the project results and environmental benefits; and a conclusion.

Reports by TCEQ Project Management

Contractor Evaluation - The City of Denton participates in a Contractor Evaluation by the TCEQ annually for compliance with administrative and programmatic standards. Results of the evaluation are submitted to the TCEQ Financial Administration Division, Procurement and Contracts Section.

Reports to City of Denton Project Management

City of Denton will communicate with project partners in development of regular Project partner meetings, stakeholder meetings and correspondence. Weekly meetings with City of Denton Management will be conducted throughout project to verify status of project. No formal reports other than regular quarterly reports will be provided for City of Denton Management.

D1 DEPARTURES FROM VALIDATION CRITERIA

Evaluation of the SWAT model will not be performed during this project. This was done during the

D2 VALIDATION METHODS

Validation is the process of verifying the ability of a calibrated model to make predictions outside the calibration period. All field and laboratory data used in this model have been

previously reviewed and verified and validated to ensure they conform to laboratory specifications. Validation of the model was also performed prior to this project. .

RUSLE, Schueler's SIMPLE method, and STEPL do not have validation and calibration procedures as they are data processing operations. The quality of potential load estimates is directly connected to the quality of any input data.

D3 RECONCILIATION WITH USER REQUIREMENTS

Project team will review output data from both the DSS and load calculation tools for any unexpected anomalies. Any course of possible resolution in correcting or adjusting the spreadsheet models will be taken by the project team. Anomalies and resolutions will be documented in the project reports. All inputs were based on previous projects, research, and stakeholder input and are not likely to be changed. However, in the event that inputs described in A6 and B9 need to be changed an amendment would be required.

Outputs of the DSS will be used to identify BMP locations and be presented to stakeholders at the final stakeholder meeting of the grant project. Outputs of the DSS will be represented graphically including charts, maps, and tables. Decisions for BMP locations will not be solely based on loading criteria and modeling outputs but will involve stakeholder and grant partner input. The stakeholders will review DSS output data and comment on chosen locations for BMPs. Stakeholders will be informed of any data limitations relative to future development that may use project outputs or tools. This information will be available for use by local authorities, stakeholders, and the development community for future development decisions in the Lake Lewisville Watershed.

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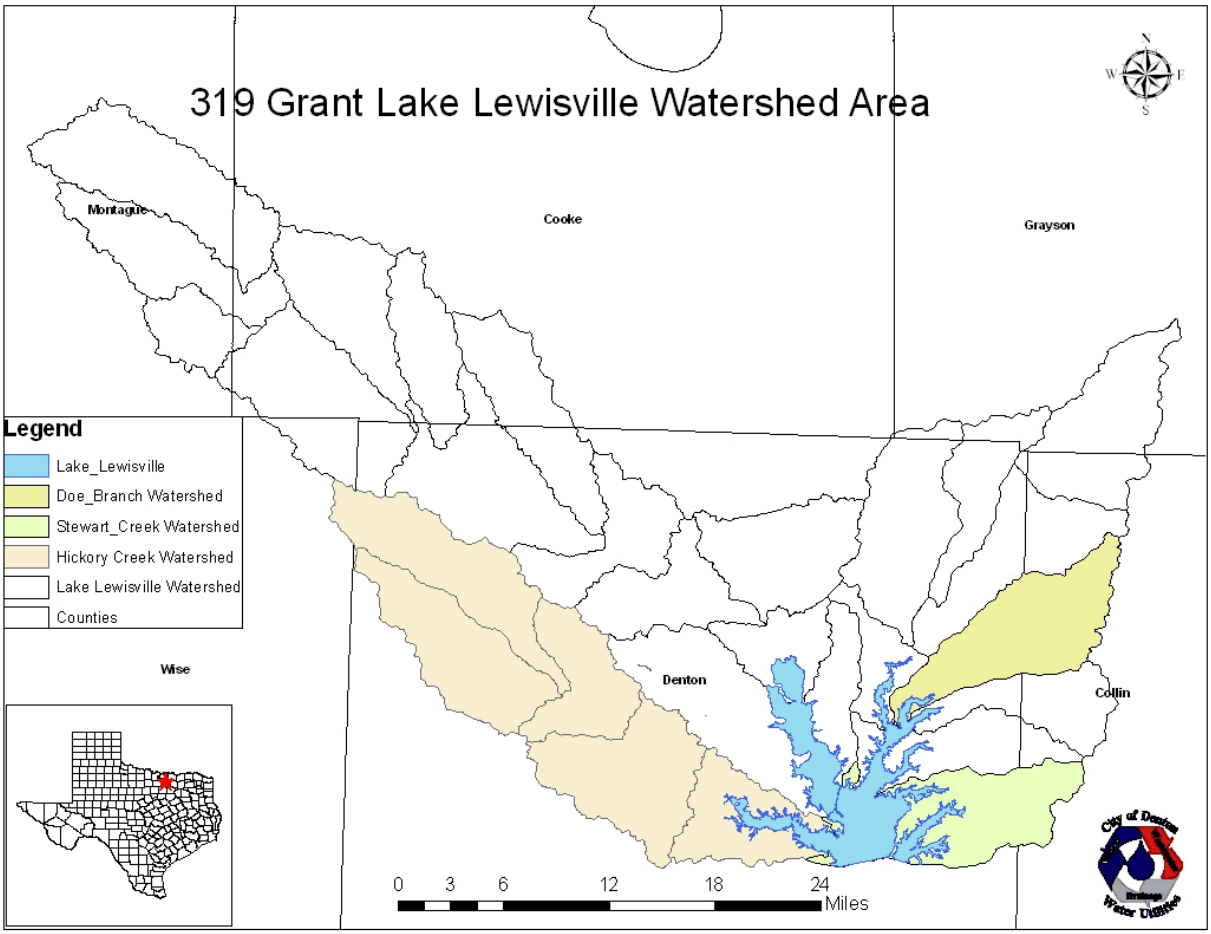
APPENDIX A. AREA LOCATION MAP



APPENDIX B. WORK PLAN

NONPOINT SOURCE SUMMARY PAGE for the CWA §319(h) Urban Nonpoint Source Grant Program			
Title of Project:	1.01 - Implementation of Hickory Creek Watershed Protection Plan (WPP) and Adapting the WPP for Other Areas in the Lake Lewisville Watershed		
Project Goals:	Implement Best Management Practices (BMPs) recommended in the Hickory Creek WPP and transfer planning tools to reduce nonpoint source pollution to the greater Lake Lewisville Watershed through 1) continued public participation and involvement of stakeholders, 2) completion of four to six BMPs that achieve the greatest amount of load reduction for the least cost, 3) development and modification of local codes to reduce nonpoint source pollution, 4) development of partnerships in the Lake Lewisville watershed and transfer technology and planning tools to reduce nonpoint source pollution.		
Project Tasks:	(1) Project administration; (2) Facilitate stakeholder participation; (3) BMP implementation; (4) Develop nonpoint source code modifications; (5) Transfer planning tools to greater Lake Lewisville Watershed; (6) Final report.		
Measures of Success:	(1) Successful public and stakeholder participation; (2) Completion of implementation of four to six BMPs that achieve the greatest amount of load reduction for the least cost; (3) Completion of local code modification to reduce nonpoint source pollution; (4) Successful development of partnerships to transfer technology and methodology to improve water quality in Lake Lewisville.		
Project Type:	Implementation (X); Education ( ); Planning (X); Assessment ( ); Groundwater ( )		
Status of Water Body: 2008 Texas Water Quality Inventory and 303(d) List	Segment ID: 0823_3 Hickory Creek Arm 0823_2 Stewart Creek Arm 0823_4 Little Elm Creek Arm 0823A Little Elm Creek 0823B Stewart Creek	Parameter: NA Bacteria, Nutrients Nutrients Dissolved Oxygen Nutrients	Category: NA CN,CS CS CS CS
Project Location (Statewide or Watershed and County)	Lake Lewisville Watershed		
Key Project Activities:	Hire Staff ( ); Surface Water Quality Monitoring ( ); Technical Assistance ( ); Education ( ); Implementation (X) BMP Effectiveness Monitoring (); Demonstration ( ); Planning (X); Modeling ( ); Bacterial Source Tracking ( ); Other ( )		
Texas NPS Management Program Elements:	Element One (LTG Objectives 1, 2, 5, & 6; STG Objectives 1c, and 2a) Element Two Element Four		

Project Costs:	Federal:	$405,291	Non-Federal:	$270,194	Total:	$675,485
Project Management:	City of Denton					
Project Period:	January 1, 2009 – August 31, 2012					

Part I – Applicant Information							
Applicant							
Project Lead	Kenneth E. Banks, Ph.D.						
Title	Manager, Department of Environmental Quality						
Organization	City of Denton						
E-mail Address	**Kenneth.Banks@cityofdenton.com**						
Street Address	901-A Texas Street						
City	Denton	County	Denton	State	TX	Zip Code	76209
Telephone Number	(940) 349-7165			Fax Number	(940) 349-8951		

Project Partners	
Names	**Roles & Responsibilities**
City of Denton	**Project management, implementation, construction of BMPs, quarterly and final reports, presentations and publications, stakeholder meetings**
Upper Trinity Regional Water District	**Data from previous and current research (including watershed protection study conducted with the University of North Texas), technical expertise for implementation.**
North Texas Municipal Water District	**Data from previous and current research, technical expertise for implementation**
CH2M Hill	**BMP optimization, presentation for stakeholder meetings, engineering and design for BMPs, review and refinement of local codes, quarterly and final reports, presentation and publications.**

Project Type							
Surface Water	X	Groundwater					
Does the project implement recommendations made in a completed Watershed Protection Plan or an adopted TMDL or Implementation Plan?				Yes	X	No	
If yes, identify the document.	Hickory Creek Watershed Protection Plan						
If yes, identify the agency/group that developed and/or approved the document.	City of Denton and Stakeholders			Year Developed	2008		

Watershed Information				
Watershed Name(s)	Hydrologic Unit Code (8 Digit)	Segment ID	305 (b) Category	Size (Acres)
Hickory Creek	12030103	0823_3	NA	124,800
Stewart Creek Arm	12030103	0823_2	CN,CS	22,377
Little Elm Creek Arm	12030103	0823_4	CS	66,426
Little Elm Creek	12030103	0823A	CS	66,426
Stewart Creek	12030103	0823B	CS	22,377

Water Quality Impairment		
Describe all known causes (pollutants of concern) of water quality impairments from any of the following sources: 2008 Texas Water Quality Inventory and 303(d) List, Clean Rivers Program Basin Summary, Basin Highlights Reports or Other Documented Sources.		
Concern (2008 Texas Water Quality Inventory)		**Level of Concern**
0823_2 Stewart Creek Arm	Bacteria	CN (concern for near non-attainment)
0823_2 Stewart Creek Arm	Nutrients	CS (concern screening levels)
0823_4 Little Elm Creek Arm	Nutrients	CS (concern screening levels)
0823A Little Elm Creek	Dissolved Oxygen	CS (concern screening levels)
0823B Stewart Creek	Nutrients	CS (concern screening levels)

2005 Clean Rivers Program Basin Summary Report: Trinity River Basin

Nutrients in Hickory Creek and Little Elm Creek arm maybe the result of urban or agricultural runoff. *Chlorophyll-a* concentrations in Hickory Creek arm may be increasing. Elevated nutrients are likely the cause for increased *chlorophyll-a* concentrations.

Carlson 's Trophic State Index (TSI)

In the 2002 Reservoir and Lake Use Support Assessment, Lake Lewisville was ranked 96 out of 102 reservoirs (with number 102 being "the worst").

Project Narrative

Problem/Need Statement

Hickory Creek is a predominantly rural watershed in North Central Texas that is under significant development. The Hickory Creek Watershed serves as a good example of conditions in the larger Lake Lewisville Watershed, which is also under substantial development. Watershed level modeling and associated research conducted during the development of the Hickory Creek WPP indicates that future development planned in the Hickory Creek Watershed will cause degradation in water quality, threaten designated uses, and possibly result in a future 303(d) listing and associated Total Maximum Daily Load (TMDL) Implementation Plan for Hickory Creek and Lake Lewisville.

In the Texas Commission on Environmental Quality's (TCEQ) 2002 and 2004 Water Quality Inventory (WQI), the presence of ammonia nitrogen was identified as a Nutrient Enrichment Concern in the Hickory Creek arm of Lake Lewisville (Segment 0823_3). Monitoring for subsequent WQIs has not demonstrated concerns for any water quality constituent in Hickory Creek. However, the 2008 WQI listed the Stewart Creek (Segment 0823_2) and Little Elm (Segment 0823_04) arms of Lake Lewisville as concerns for bacteria and nutrients. In the 2002 Reservoir and Lake Use Support Assessment, Lake Lewisville was ranked 96 out of 102 reservoirs (with number 102 being "the worst") based on Carlson 's Trophic State Index (TSI).

In response to eutrophication concerns as demonstrated by the TSI, the TCEQ has imposed more stringent total phosphorus (TP) effluent limits for new or amended discharge permits. However, modeling conducted during the development of the Hickory Creek WPP indicates that continued development within the watershed will result in substantial increases in nonpoint source (NPS) loads. In the absence of action, loadings for TP, total nitrogen (TN), and sediments (as depicted by total suspended solids, TSS) are expected to increase from the land surfaces in the Hickory Creek watershed, which will negatively impact water quality in both Hickory Creek and Lake Lewisville. As development continues in the larger Lake Lewisville watershed, similar impacts are expected.

The City of Denton's approach to managing NPS loads and continued degradation of water quality is limited to current municipal regulatory requirements. However, evaluations supporting the Hickory Creek WPP showed that current regulatory requirements are not sufficient for addressing water quality degradation within the watershed. New regulatory tools and BMP implementation strategies are therefore required to prevent declines in water quality. The Hickory Creek WPP identifies preliminary modifications to local regulations that are needed to improve water quality and provides a framework for optimizing BMP implementation,

with the goal of providing the most pollutant load reductions for the least cost.

Additional resources are needed to implement additional targeted BMPs, provide evaluation and implementation tools, and further research local regulatory requirements for the purpose of protecting or enhancing water quality. Furthermore, the Hickory Creek WPP also concluded that water quality protection activities, at some point, must be implemented at a larger scale than just the Hickory Creek watershed to result in meaningful improvements to water quality in the Lake Lewisville. Consequently, the project team has solicited the involvement of additional project partners in this grant, with the intent of using the resources, expertise, and influence of these additional partners to create products and tools that can facilitate implementation on the larger scale of the Lake Lewisville watershed.

Project Narrative

General Project Description (Include Project Location Map)

This project has two parallel and integrated tracks: (1) efforts focused on implementing and advancing the Hickory Creek WPP; and (2) activities designed to expand and adapt the analytical methods and policy frameworks for broader geographic application within the Lake Lewisville watershed.

Hickory Creek Watershed-Focused Activities:
The initial objective of the proposed project is to implement targeted management practices that are optimized to produce the greatest amount of load reduction for the least cost within the Hickory Creek watershed. The proposed project will be based upon the implementation strategies recommended in the existing Hickory Creek WPP, and will therefore have the benefit of an extensive amount of previous research, an established stakeholder involvement process, and well developed public education and involvement programs.

The project team will use the research, evaluation tools, and recommendations of the Hickory Creek WPP to generate a list of candidate BMP implementation sites. These sites will then be presented and evaluated by a stakeholder group during a series of public meetings to narrow the candidate list down to the final implementation sites. BMP projects may include installation of new BMPs to address growth and development related loads, or retrofitting existing storm water infrastructure to enhance load reductions for target contaminants. Selection of BMP types and locations will take into account stakeholder recommendations and site conditions and site ownership, but, to the greatest extent practicable, will be optimized using the modeling and cost-effectiveness maximizing approaches outlined in the Hickory Creek WPP. The City of Denton Drainage Department will perform the construction necessary to implement the recommended management practices.

These BMPs will generate benefits in the form of pollutant loading reductions. Other important benefits will be provided by using the BMPs to demonstrate NPS pollution reduction technologies to developers and municipal decision makers and influence development of local code requirements to further enhance NPS pollution reduction. Additionally, the installed BMPs will serve as public education and involvement opportunities, as outlined in the Hickory Creek WPP, via such mechanisms as: signage explaining the water quality benefits of the sites; reinforcement of the importance of water quality improvement messages by postings on the existing Hickory Creek Watershed Protection Web page; workshops presented to citizens of Denton; and, if possible, regional forums. It should be noted that these additional benefits are ancillary to this grant, and are not being funded by grant resources.

The project also proposes to advance the development of local code to more adequately address the control of NPS pollution beyond the requirements of Denton's municipal storm water permit. An initial evaluation of the local development code needs was conducted as a component of the Hickory Creek WPP, and the ability to enact these requirements has been written into the agreements controlling Master Planned Communities within Hickory Creek. However, there is a need to translate the mainly narrative code recommendations outlined in the Hickory Creek WPP into actual code language. The project team will outline the narrative requirements and work with the stakeholder group and other team members during a series of meetings to perform the research needed to translate the existing narrative requirements into more defined code language.

Lake Lewisville Watershed-Focused Activities:
Concurrent with the Hickory Creek-focused efforts, this project also will adapt the methods and policy framework embodied in the Hickory Creek WPP, for application in the larger Lake Lewisville watershed. To advance these activities, the North Texas Municipal Water District (NTMWD) and the Upper Trinity Regional Water District (UTRWD) have joined the City of Denton in this project. These partners will be provided with all of the information and deliverables created by the Hickory Creek-specific efforts outlined above, and will have an opportunity to provide input and expertise as deliverables are developed.

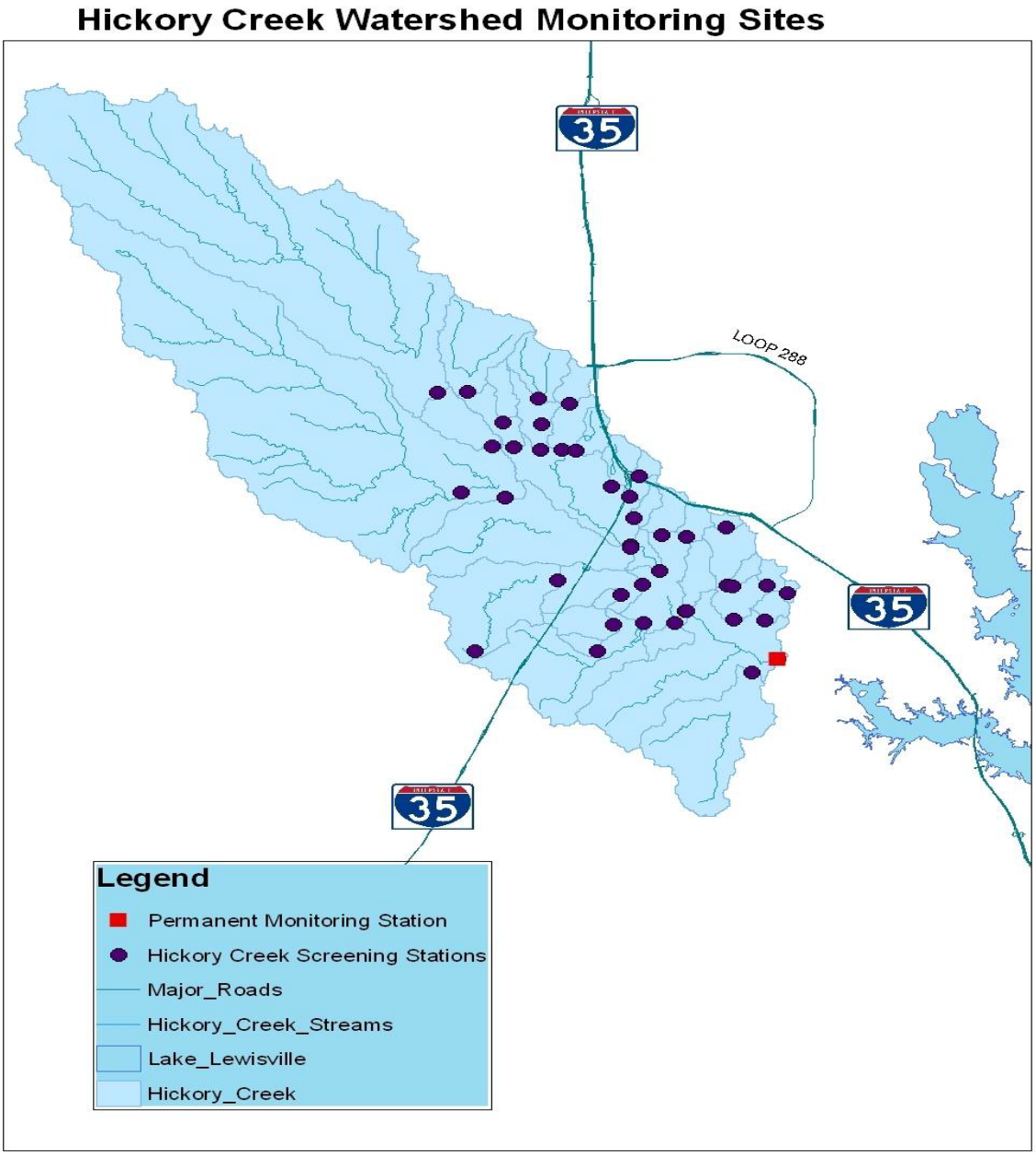
The adaptation of the Hickory Creek management model for the larger Lake Lewisville watershed will be accomplished by gathering and evaluating pertinent information. A substantial amount of research has been conducted by the project partners (particularly the watershed research conducted by UTRWD). Activities under this current project will integrate this information with the information available through the Hickory Creek WPP. UTRWD already has an extensive Watershed "prioritization plan" that was created by the University of North Texas. The project team will evaluate these sources of information in conjunction with the existing implementation strategies outlined in the Hickory Creek WPP to determine the products needed to facilitate an optimized BMP implementation strategy for areas under the jurisdiction of the project members.

Since all project partners use the lake as a water supply source and recipient of wastewater discharges, ensuring the lake's water quality remains unimpaired is of paramount interest. Expanding the scope of implementation efforts to the larger watershed area will involve addressing the following elements:

- Upon review of existing information from the NTMWD and UTRWD, determine how this information can be used in conjunction with the Hickory Creek WPP to create a more cohesive and transferable implementation methodology
- Analyze the barriers to implementing BMPs in other areas of the Lewisville watershed and identify how these barriers can be overcome with implementation tools (including BMP optimization approaches)
- Estimate and compare the costs and benefits associated with implementing water quality controls in the watershed via BMPs compared with those of additional treatment at drinking water facilities and upgrading wastewater treatment plants
- Conduct preliminary analyses of the viability of a water quality credit trading market within the partner group, and within and beyond Hickory Creek (e.g., sediment and/or nutrient credits)
- Explore the potential benefits and viability of a common watershed management strategy for selected

facilities and/or jurisdictions as a way of aligning nonpoint source management program goals within existing and potential regulatory frameworks

Summary:
The proposed project will serve to directly and cost-effectively reduce pollutant loads to Hickory Creek. In a larger context, the proposed project will further the goals and recommendations of the Hickory Creek WPP, and will provide tools to expand the goals and recommendations of the WPP to selected areas within the Lake Lewisville watershed. The project will also provide opportunities to leverage the knowledge and resources of the project team to demonstrate how municipalities and water/wastewater service providers can minimize NPS pollutant loads through cost-effective BMP implementation strategies.


Hickory Creek Watershed Monitoring Sites
35
LOOP 288
35
35
Legend
Permanent Monitoring Station
Hickory Creek Screening Stations
Major_Roads
Hickory_Creek_Streams
Lake_Lewisville
Hickory_Creek

Tasks, Objectives and Schedules (Replicate or modify table as needed)						
Task 1:	Project Administration					
Costs:	Federal:	$21,192	Non-Federal:	$14,128	Total:	$35,320
Objective:	To effectively coordinate and monitor all technical and financial activities performed under this contract, prepare regular progress reports, and manage project files and data.					
Subtask 1.1:	**Project Oversight –** The City of Denton and other project team members (Project Team) will provide technical and fiscal oversight of Denton's project staff, other grant partners, and contracted resources to ensure Tasks and Deliverables are acceptable, and are completed as scheduled and within budget. Project oversight status will be provided to the TCEQ with the Quarterly Progress Reports (QPRs). This task will include an internal project planning session to charter roles and responsibilities and to confirm and refine project milestones.					
	Start Date:	Month 1	Completion Date:	Month 36		
Subtask 1.2:	**QPRs –** The Project Team will submit QPRs to the TCEQ by the 15th of the month following each state fiscal quarter for incorporation into the Grant Reporting and Tracking System (GRTS). Progress reports will contain a level of detail sufficient to document the activities that occurred under each task during the quarter, and will detail the status of task deliverables. Progress reports will be distributed to all project partners.					
	Start Date:	Month 1	Completion Date:	Month 36		
Subtask 1.3:	**Reimbursement Forms** – The Project Team will submit Reimbursement Forms to the TCEQ by the last day of the month following each state fiscal quarter. For the last reporting period of the project, reimbursement forms are required on a monthly basis, for the months of June, July, and August.					
	Start Date:	Month 1	Completion Date:	Month 36		
Subtask 1.4:	**Contract Communication** – The Project Team will participate in a post-award orientation meeting with TCEQ within 60 days of contract execution. The Project Team will maintain regular telephone and/or email communication with the TCEQ Project Manager regarding the status and progress of the project with regard to any matters that require attention between QPRs. This will include a quarterly call or meeting (e.g., each January, April, July, and October, or as may be established consistent with the project start date). Minutes recording the important items discussed and decisions made during each call will be attached to the relevant QPR. Matters that will be communicated to the TCEQ Project Manager in the interim between QPRs include the following: • Requests for prior approval of activities or expenditures for which the contract requires advance approval or that are not specifically included in the scope of work • Notification in advance when GRANTEE has scheduled public meetings or events, initiation of construction, or other major task activities under this contract • Information regarding events or circumstances that may require changes to the budget, scope of work, or schedule of deliverables—such information must be reported within 48 hours of discovering these events or circumstances					
Subtask 1.5:	**Contractor Evaluation** – The City of Denton will participate in an annual Contractor Evaluation.					
	Start Date:	Month 7	Completion Date:	Month 36		
Subtask 1.6:	**Project Fact Sheet –** The Project Team will develop a one page fact sheet of the project using the TCEQ Nonpoint Source Projects Template. The fact sheet will briefly describe what the project is going to accomplish and will provide background information on why the project is being conducted, the current status of the project, and who is involved in the project. The project fact sheet will be submitted to the TCEQ within 60 days after contract initiation. The fact sheet will be updated annually, and submitted with the fourth QPR. Additional updates will be generated periodically as the project status changes. The fact sheet will be published on the City of Denton's website after approval from the TCEQ Project Manager.					
	Start Date:	Month 1	Completion Date:	Month 36		

Subtask 1.7:	**Annual Report Article** – The Project Team will provide an article for the Nonpoint Source Annual Report upon request by the TCEQ. This report is produced annually in accordance with Section 319(h) of the Clean Water Act (CWA), and is used to report Texas' progress toward meeting the CWA § 319 goals and objectives, and toward implementing its strategies as defined in the Texas Nonpoint Source Management Program. The article will include a brief summary of the project and describe the activities of the past fiscal year.			
	Start Date:	Month 7	Completion Date:	Month 36
Deliverables	• Minutes of Post-Award Orientation Meeting • QPRs • Reimbursement Forms • Minutes of Quarterly Contract Conference Calls • Contractor Evaluations • Project Fact Sheets • Annual Report Articles			

Tasks, Objectives and Schedules (Replicate or modify table as needed)						
Task 2:	Stakeholder Participation					
Costs:	Federal:	$16,170	Non-Federal:	$10,780	Total:	$26,950
Objective:	To develop an information and communication process that informs the public. The process will be used to enhance partnerships with stakeholders, foster a public understanding of project goals and objectives, and encourage participation in developing, selecting, designing, implementing and maintaining appropriate BMPs. The process will also help the public achieve a better understanding of land use activities and their impact on water quality.					
Subtask 2.1:	**Prepare a Communication Plan –** The Project Team will develop a communication plan intended to guide communication with the stakeholder group and the Project Partners (defined in Task 2.3), as well as the public in general. The result of this task will be an effective communication plan to inform the public and stakeholder group regarding the project and to solicit their input. The plan will also include a framework with which to inform the Project Partners regarding previous and concurrent efforts performed by the Project Team, as well as to obtain input, expertise, and existing pertinent information developed by the Project Partners. The communication plan will be implemented through a variety of communication methods, including a series of public meetings. It will include a brief, pre-first public meeting questionnaire to solicit input/feedback for meeting agenda development and schedule**.**					
	Start Date:	Month 1	Completion Date:	Month 3		
Subtask 2.2:	**Stakeholder Participation** – Stakeholder participation will be engaged via meetings or workshops held at a frequency defined by the stakeholders and the Project Team. The meetings will be open to the public; invited stakeholders will include, but are not limited to: the Project Partners (see also below), the Clean Rivers Steering Committee, Trinity River Authority, North Central Texas Council of Governments, TCEQ, Texas State Soil and Water Conservation Board, local stakeholders, and other state and local authorities. The meetings/workshops will provide an opportunity to transmit study goals, activities, and results to the stakeholders in the Planning Area. Final meeting announcements and agendas will be distributed and/or publicly posted at least 15 days prior to the meetings (e.g., written invitations and announcements, including mail, email, fax, and posts on the project's official website). Meeting announcements will be provided to the TCEQ project manager for review and approval prior to posting.					
	Start Date:	Month 1	Completion Date:	Month 36		

Subtask 2.3:	**Project Partner Participation –** Project Partner participation will be included with the stakeholder participation activities described above, but will also include, among other methods, Partner-specific meetings, workshops, conference calls, and web-based information transfers. Project Partners include, but are not limited to, NTMWD and UTRWD. The meetings/workshops will provide an opportunity to transfer study goals, general ideas, future plans, existing information, etc. between the Project Team and the Project Partners. Additionally, the Project Partners will be used as senior technical resources during the development of materials to be distributed and dissemination of information to stakeholders and/or the public (Task 2.2), as well as BMP implementation and local code modifications.			
	Start Date:	Month 1	Completion Date:	Month 36
Subtask 2.4:	**Public Coordination –** Additional activities will be undertaken, consistent with stakeholder input, to disseminate information about the project to the public. Updates will be provided for inclusion on the City of Denton's web site and the TCEQ web if applicable. Periodic newspaper articles or other articles (e.g., newsletters and journals) may be published as well. The Project Team will coordinate with relevant entities and/or groups to solicit input, participate in public meetings, and provide information and input on project development.			
	Start Date:	Month 1	Completion Date:	Month 36
Subtask 2.5:	**Program Coordination** – The Project Team will coordinate with ongoing outreach programs (e.g., Texas Watershed Steward Program and Texas Stream Team) to inform the public and solicit their input on BMP development.			
	Start Date:	Month 1	Completion Date:	Month 36
Deliverables	• List of identified stakeholders (with appropriate QPR) • Updates to stakeholder list/database (as applicable, with QPRs) • Draft and Final Communication Plan • Public meeting notices, agendas, handouts, meeting materials, attendee lists, etc. A copy will be provided to the TCEQ project manager for review and approval prior to publication • Web site updates			

Tasks, Objectives and Schedules (Replicate or modify table as needed)						
Task 3:	Implementing the Hickory Creek Watershed Protection Plan, Part 1 Best Management Practice Development					
Costs:	Federal:	$291,039	Non-Federal:	$194,026	Total:	$485,065
Objective:	To implement targeted management practices that are optimized to produce the greatest amount of load reduction for the least cost within the Hickory Creek watershed, using the processes and procedures described in the Hickory Creek WPP.					
Subtask 3.1:	**BMP Implementation Sites** – The Project Team will use the research, evaluation tools, and recommendations of the Hickory Creek WPP, as well as input from Project Partners and stakeholders to develop a list of BMP implementation sites. This list of sites and alternative BMP(s) feasible within those sites will be developed and prioritized using the modeling and optimization approaches outlined in the Hickory Creek WPP, which is based on optimizing costs versus load reductions. Preference will be given to sites identified for NPS controls in the Hickory Creek WPP and with minimal requirements for acquisition of property, rights-of-way, or easements. Candidate sites, including both new development areas and retrofits, will be presented to the Stakeholder Group and Project Partners for consideration and input during one to two public meeting(s) to narrow the candidate list to 4 to 6 final implementation sites depending on the size, costs, and specific site conditions of each BMP. The BMPs will consist of a combination of graded grass waterways/filter strips, detention/retention, and infiltration basins for urban land. The BMPs will be located within the Denton City limits or extraterritorial jurisdiction. The BMPs will be targeted to areas with the highest pollutant loads. The yearly pollutant load estimates from BMP implementation are as follows: • Sediment = 120 tons • Nitrogen = 54 pounds • Phosphorous = 173 pounds					

	Start Date:	Month 1	Completion Date:	Month 4
Subtask 3.2:	**BMP Design** – Site survey and geotechnical data will be collected to a level of detail necessary to support design within professional engineering standards. The construction documents will make use of standard state and local design specifications and details, and will consist of design drawings with attached standard details.			
	Start Date:	Month 4	Completion Date:	Month 10
Subtask 3.3:	**BMP Construction and Certification –** This task includes the construction of BMPs through the City of Denton's existing programs, applying state and federal procurement requirements if needed. BMP construction certifications will be provided to ensure the BMPs were constructed as intended. It should be noted that the City of Denton will utilize City staff for construction. These construction activities will involve full municipal oversight, including ensuring safety and minimizing construction impacts.			
	Start Date:	Month 12	Completion Date:	Month 21
Subtask 3.4:	**Load Reduction Verification** – Load reductions and/or water quality benefits resulting from the implemented BMPs will be estimated using simple spreadsheet models (site specific), the previously developed SWAT/QUAL-TX model, or a similar defensible modeling approach. This information will be provided in the Final Report (Objective 7).			
	Start Date:	Month 18	Completion Date:	Month 33
Deliverables	• Prioritized list of BMP type and location presented to stakeholders • Draft BMP design drawings with attached standard details • ~~Technical Report documenting the process and results of Tasks 3.1 and 3.2~~ • BMP Construction Documents and BMP Construction Certifications • Load Reduction Estimates (included in the Final Report) • Report summarizing activities for this Objective			

Tasks, Objectives and Schedules (Replicate or modify table as needed)						
Task 4:	Implementing the Hickory Creek Watershed Protection Plan, Part 2 Local Code Modifications					
Costs:	Federal:	$12,942	Non-Federal:	$8,628	Total:	$21,570
Objective:	To research and make recommendations for local code requirements to further enhance nonpoint source pollution reduction, to include potential additions to local codes so that these codes more adequately address nonpoint source pollution from urban development.					
Subtask 4.1:	**Research and Recommendations for Code Language –** The Project Team will use the regulatory assessment performed for the Hickory Creek WPP and resulting recommendations contained in the WPP as a basis to develop proposed language for Denton's municipal code. The Project Team will seek additional input from the Project Partners and the Hickory Creek Stakeholder Group to further develop and refine the concepts and develop implementation language. The intent of the proposed language will be to evaluate establishing water quality targets and incentive-based programs in order to increase the level of nonpoint source management by public and private entities and ensure the resulting BMPs are as cost-effective as possible**.**					
	Start Date:	Month 1		Completion Date:		Month 33
Deliverables	• Technical Report outlining local code language recommendations					

Tasks, Objectives and Schedules (Replicate or modify table as needed)						
Task 5:	Technology Transfer from Hickory Creek Watershed to Lake Lewisville Watershed.					
Costs:	Federal:	$53,874	Non-Federal:	$35,916	Total:	$89,790

Objective:	To leverage the analysis and recommendations of the Hickory Creek WPP into a larger geographic area of the Lake Lewisville watershed for the purpose of evaluating and developing implementation frameworks for optimizing BMP selection and installation and introducing incentive-based mechanisms to support pollutant reduction targets in selected sub-watersheds for the benefit of the entire watershed. The result will be an identification of the ways in which the cost-effectiveness of meeting overall pollutant control and reduction goals could be improved with greater reliance on BMPs than currently forecasted.			
Subtask 5.1:	**Data Gathering and Analysis –** Concurrent with the Hickory Creek-focused efforts, the Project Team and Project Partners (NTMWD and UTRWD) will gather and evaluate pertinent information from the research conducted by the Project Partners and will integrate this information with the information available through the Hickory Creek WPP and related efforts. The Project Team will evaluate these sources of information in conjunction with the existing implementation strategies outlined in the Hickory Creek WPP to determine the products needed to facilitate an optimized BMP implementation strategy for areas under the jurisdiction of the Project Partners and the City of Denton.			
	Start Date:	Month 1	Completion Date:	Month 33
Subtask 5.2:	**Identification of Technology Transfer Opportunities –** Upon review of existing information (Task 5.1), the Project Team will determine how this information can be used to leverage the analyses, methods, and results of the Hickory Creek WPP into a set of transferable implementation methodologies. To support this evaluation, the Project Team will conduct a Strengths, Weaknesses, Opportunities, and Barriers (SWOB) analysis of the current programs relating to BMP implementation in other areas of the Lake Lewisville watershed to enhance current approaches for more cost-effective pollutant reductions. A key focus will be on identifying how leveraging the Hickory Creek WPP can help capture opportunities and eliminate or mitigate barriers through implementation tools, market-based incentives programs, technical support for BMP optimization, and similar approaches (set Tasks 5.3-5.5 below).			
	Start Date:	Month 1	Completion Date:	Month 33
Subtask 5.3:	**Cost-Effectiveness Analyses** – The Project Team will update to the extent necessary and possible the pollutant reduction, implementation cost, and resulting cost-effectiveness estimates for the set of BMP-land use combinations evaluated for the Hickory Creek WPP so that the estimates are applicable to the larger Lake Lewisville watershed. A set of "default" pollutant control options not involving these BMPs will be identified as being planned or under consideration for implementation within the watershed, including, for example, additional treatment at drinking water facilities and upgrading wastewater treatment plants. For each such option, a cost-effectiveness "profile" will be prepared that provides an estimate of pollutant reduction capabilities (mass-based over appropriate temporal periods), implementation costs, and resulting cost-effectiveness (on a unit cost as well as total cost basis). The analysis will then compare the control capabilities of the BMPs to the other options. The result will be an assessment of the ways in which the cost-effectiveness of meeting overall pollutant control and reduction goals could be improved with greater reliance on BMPs than currently forecasted.			
	Start Date:	Month 1	Completion Date:	Month 33
Subtask 5.4:	**Market-Based Pollutant Credit Trading –** Based on the results of the cost-effectiveness analysis, the Project Team will conduct a preliminary analysis of the viability of a market for water quality credit trading (e.g., sediment and/or nutrient credits) in the Lake Lewisville watershed in areas larger than, but including, Hickory Creek. The opportunity for trading will exist to the extent that more cost-effective alternatives than to the default control scheme (see Task 6.3) exist. Under this task, the Project Team will perform the research needed to create pro forma trading scenarios that illustrate the trades that are potentially feasible based on technical (i.e., relative supply and demand among potential trading partners) and economic considerations (i.e., relative cost-effectiveness among control options). Any discussions or coordination with stakeholders to seek input and present results will be included in Objective 2.			
	Start Date:	Month 1	Completion Date:	Month 33

Subtask 5.5:	**Regional Nonpoint Source Management Program** – Based on the results of Tasks 5.1 through 5.4, the Project Team will evaluate the need and opportunity for a mechanism(s) to help coordinate nonpoint source management programs, including optimized BMPs and BMPs that may be implemented to generate tradable pollutant credits. This evaluation will likely examine ways to coordinate technical and planning activities, and, based on the results of Tasks 5.3 and 5.4, will include evaluations of the regulatory and administrative frameworks that could support pollutant credit trading, including, as applicable, a regional credit exchange on a watershed scale.			
	Start Date:	Month 1	Completion Date:	Month 36
Deliverables	• Technical Report documenting the methods, analysis, results, and recommendations produced by the activities described under Tasks 5.1 – 5.5. Technical report for one or more of the individual task results may be combined as seems appropriate to the content and audience, and for example, a total of two to three TMs may comprise the results of Objective 5.			

Tasks, Objectives and Schedules (Replicate or modify table as needed)						
Task 6:	Final Report					
Costs:	Federal:	$10,074	Non-Federal:	$6,716	Total:	$16,790
Objective:	To provide the TCEQ and the EPA with a comprehensive report on the activities performed as a part of and successes of the above described project. The City of Denton will also conduct an assessment of the data for this report. The final report will include final versions of all Technical Memoranda specified for each objective, as outlined above.					
Subtask 6.1:	**Draft Report** – The final report will summarize and synthesize all project activities, findings, and the contents of all previous deliverables, referencing and/or attaching them as web links or appendices. This will be a comprehensive, technical report designed to make the analysis of all activities and deliverables under this scope of work accessible to a wider audience than the technical deliverables alone. The report will include standard sections, such as title, tables of contents and exhibits, executive summary, introduction, summary conclusion, references, and appendices. The main body will be organized into a chapter structure that best presents the information, and will include descriptions of processes, methodologies, analyses, results, and observations within the selected structure. The report will be provided to TCEQ in electronic format.					
	Start Date:	Month 29	Completion Date:	Month 30		
Subtask 6.2:	**Final Report** – The draft report will be modified to address comments provided by the TCEQ Project Manager, resulting in a Final Report, to be provided to TCEQ in electronic format.					
	Start Date:	Month 32	Completion Date:	Month 33		
Deliverables	• Draft Report • Final Report					

Project Goals (Expand from NPS Summary Page)
Utilize the Hickory Creek WPP to achieve cost effective load reductions and transfer planning elements to other areas in the Lake Lewisville watershed thru 1) developing an information and communication process to enhance partnerships with stakeholders, foster public understanding of the project goals, and encourage participation, 2) implementing targeted best management practices that are optimized to produce the greatest amount of load reduction for the least cost within the Hickory Creek watershed, 3) researching local code requirements and making recommendations for code modifications to further enhance nonpoint source pollution reduction, 4) transferring methods used to develop the Hickory Creek WPP to other areas in the Lake Lewisville watershed to develop cost effective means of controlling nonpoint source pollution.

Measures of Success (Expand from NPS Summary Page)
(1) Successful public and stakeholder participation as indicated by meeting attendance rosters and feedback received, and Project Partner participation, as indicated by the amount of collaboratively developed information to be distributed to stakeholders and the public and/or project components. (2) Completion of implementation of four to six BMPs that are optimized to produce the greatest amount of load reduction for the least cost, demonstrated load reductions through modeling, and construction certification documents. Ongoing state and local monitoring, stream assessment activities, and other indicators may verify improved water quality in the Hickory Creek arm of Lake Lewisville. (3) Completion of local code modification that may be adopted to reduce nonpoint source pollution. (4) Successful development of partnerships in the Lake Lewisville Watershed that facilitate the transfer of technology and methodology used to develop the Hickory Creek WPP resulting in cost effective broader scale BMP implementation and future improved water quality in Lake Lewisville.

2005 Texas Nonpoint Source Management Program Reference (Expand from NPS Summary Page)
Goals and/or Milestone(s)
Element One – Explicit short- and long-term goals, objectives and strategies that protect surface water. Long Term Goals Objectives • 1 – Focus available resources in watersheds identified as impacted by NPS pollution in the latest state approved *Texas Water Quality Inventory and 303(d) List.* • 2 – Support the implementation of state, regional and local programs to prevent NPS pollution through assessment and education. • 5 – Develop partnerships and relationships to facilitate collective, cooperative approaches to manage NPS pollution. • 6 – Increase overall public awareness of NPS issues and prevention activities. Short-term Goals Goal One – Data Collection and Assessment: Coordinate with appropriate federal, state, regional and local entities, private sector groups, and citizen groups and target CWA §319(h) grant funds toward water quality assessment activities in high priority, NPS-impacted watersheds. • Objective C – Conduct special studies to determine sources of NPS pollution and gain information to target TMDL and BMP implementation activities. Goal Two – Coordinate and administer the NPS program to support the implementation of TMDL Implementation Plan and/or Watershed Protection Plans and other state, regional and local plans/programs to reduce NPS pollution. • Objective A – Work with regional and local entities to determine priority areas and develop and implement strategies to address NPS pollution in those areas.
Element Two – Working partnerships and linkages with appropriate state, regional, and local entities, private sector groups and Federal agencies.
Element Four – Abatement of water quality impairments from nonpoint source pollution and prevention of significant threats to water quality from present and future nonpoint source activities.
Milestone A: Employ or develop a local watershed committee to solicit input and encourage the participation of affected stakeholders in the decision-making process.

Milestone B:	Complete the assessment of pollutant problems by reviewing existing water quality data, conducting an inventory of point/nonpoint sources, land use data, and all known stressors influencing water quality.
Milestone D:	Develop and apply models to determine numerical load allocations.
Milestone F:	Implement voluntary and regulatory actions in the watershed and adjust the BMP implementation based on follow-up verification monitoring of effectiveness.

Estimated Load Reductions Expected (Only applicable to implementation projects)
Pollutant load reductions are estimates based on previous BMPs implemented in the Hickory Creek watershed. Yearly pollutant load reduction estimates are as follows: Sediment = 120 tons Nitrogen = 54 pounds Phosphorous = 173 pounds

INTERLOCAL AGREEMENT

This Interlocal Agreement (the "Agreement") is made and entered into this 13th day of May, 2011, between The City of Denton, Texas, a political subdivision of the State of Texas (hereinafter "City") and the TEXAS ENGINEERING EXPERIMENT STATION, a member of The Texas A&M University System, and an agency of the State of Texas ("TEES").

WHEREAS, both the City and TEES have the authority to enter into this Agreement pursuant to Chapter 791, Texas Government Code; and

WHEREAS, the research project ("Research Project") contemplated under this Agreement is of mutual interest and benefit to TEES and to the City and will further the instructional and technical objectives of TEES in a manner consistent with its status as an agency of the State of Texas; and

WHEREAS, it is mutually beneficial to both parties to execute this Agreement whereby each entity can achieve common objectives relating to the health, safety, and welfare of the citizens of Texas, and in the interest of saving the City of Denton and State of Texas taxpayer funding; and

NOW THEREFORE, in consideration of the mutual representations, terms and covenants hereafter set forth, the parties hereby agree as follows:

1. **STATEMENT OF WORK.** TEES agrees to use its reasonable efforts to perform the testing program described in the Statement of Work appended hereto and incorporated as Appendix A.

2. **PRINCIPAL INVESTIGATOR.** The Research Project will be supervised by Dr. Francisco Olivera in the Department of Civil Engineering at Texas A&M University.

3. **PERIOD OF PERFORMANCE.** TEES will conduct the Research Project during the period of **May 15th, 2011** through **August 31st, 2012.** This Agreement may be renewed only by written agreement executed by both parties.

4. **TOTAL AMOUNT OF THE CONTRACT.** The City agrees to pay TEES the fixed price of $12,000, as agreed to in the payment schedule, listed below.

5. **PAYMENT SCHEDULE.** The City shall make payments upon receipt of invoices, in accordance with the statutory provisions of Texas Government Code; Chapter 2251.The payment schedule indentified below, strictly follows a milestone performance schedule, in completion of the stated DELIVERABLES (Appendix A), and in the approval of invoices submitted to the City.

   $9,000.00 due upon execution of the Agreement, initiation of **Deliverable 1 tasks**, and receipt of invoice
   $3,000.00 due upon completion of **Deliverables 1 through 5 tasks**, and receipt of invoice; no later than August 31, 2012.

   Invoices shall be sent to the following address:

   City of Denton, Accounts Payable Department
   215 East McKinney Street
   Denton, TX 76201
   Company Rep Name: Alma Vigil Phone: 940-349-8223 Email: accountspayable@cityofdenton.com

6. **TERMINATION.** This agreement may be terminated by either party, upon sixty (60) days prior written notice.

7. **BREACH / OPPORTUNITY TO CURE.** The parties hereto expressly covenant and agree that in the event either party is in default of its obligations herein, the party not in default shall provide to the party in default at least thirty (30) days written notice to cure said default before exercising any of its rights as provided for in this Agreement.

8. **LIABILITY.** The parties to this Agreement and their respective officers and employees shall not be deemed to assume any liability for the acts, omissions and negligence of the other party.

9. **DISCLAIMER OF LIABILITY.** TEES MAKES NO REPRESENTATIONS AND EXTENDS NO WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED IN CONNECTION WITH THE TECHNICAL REPORTS, INVENTION DISCLOSURES OR RESEARCH DATA FURNISHED UNDER THIS AGREEMENT. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OR THAT USE OF SUCH MATERIALS OR MODIFICATION OF SUCH MATERIALS WILL NOT INFRINGE ON ANY PATENT, COPYRIGHT, TRADEMARK, OR OTHER PROPRIETARY RIGHT.

Figure 1 Texas A&M University Work Plan

10. **FORCE MAJUERE.** Except for the obligation for the payment of money, if either party fails to fulfill its obligations hereunder when such failure is due to an act of God, or other circumstance beyond its reasonable control, then said failure shall be excused for the duration of such event and for such a time thereafter as is reasonable to enable the parties to resume performance under this Agreement.

11. **DISPUTE RESOLUTION.** The City must use the dispute resolution process provided in Chapter 2260 of the Texas Government Code to attempt to resolve a dispute arising under this contract and such process is a required prerequisite to suit in accordance with Chapter 107, Texas Civil Practice and Remedies Code. The City must submit written notice of a claim of breach of contract under this chapter to Deena J. Wallace, Associate Vice Chancellor for Administration and Legal Affairs & Associate Agency Director. TEES is an agency of the State of Texas and nothing in this Agreement waives or relinquishes the right of TEES to claim any exemptions, privileges and immunities as may be provided by law.

12. **REMEDIES.** This Agreement shall be construed by and governed by the laws of the State of Texas. Venue for any legal action necessary to enforce the Agreement will be in Brazos County, Texas. No remedy herein conferred upon any party is intended to be exclusive of any other remedy, and each and every such remedy shall be cumulative and shall be in addition to every other remedy given hereunder or now or hereafter existing at law or in equity or by statute or otherwise. No single or partial exercise by any party of any right, power or remedy hereunder shall preclude any other or further exercise thereof.

13. **ENTIRE REPRESENTATION.** This Agreement contains the entire agreement between the parties and supersedes any prior oral or written agreements, commitments, understandings, or communications with respect to the subject matter of the Agreement. No amendments or modification of this Agreement shall be effective unless set forth in writing executed by duly authorized representatives of each party. This Agreement shall be construed in accordance with the laws of the State of Texas.

14. **WAIVER.** No waiver of any provision hereof or of any right or remedy hereunder shall be effective unless in writing and signed by the party against whom such waiver is sought to be enforced. No delay in exercising, no course of dealing with respect to, or no partial exercise of any right or remedy hereunder shall constitute a waiver of any right or remedy, or future exercise thereof.

15. **ASSIGNMENT.** This Agreement may not be assigned in whole or in part by any of the Parties without prior written consent of the other Party.

16. **SEVERABILITY.** In the event that any section, paragraph, sentence, clause or provision hereof is held by a court of competent jurisdiction to be invalid, such shall not affect the remaining portions of this Agreement and the same shall remain in full force and effect.

17. **AMENDMENTS.** This Agreement may be amended from time to time by written amendment by both parties.

18. **NOTICE.** Any notice required to be given in connection with this Agreement shall be in writing and shall be deemed effective if hand delivered, or if sent by United States certified mail, return receipt requested, postage prepaid, or if sent by private receipted courier guaranteeing same-day or next-day delivery, addressed to the respective party at its address provided below. If sent by U.S. certified mail in accordance with this Section, such notices shall be deemed given and received on the earlier of (a) actual receipt at the address of the named addressee, or (b) on the third (3rd) business day after deposit with the United States Postal Service. Notice given by any other means shall be deemed given and received only upon actual receipt at the address of the named addressee.

Texas Engineering Experiment Station 1470 William D. Fitch Parkway College Station, TX 77845-4645 Attn: Ragan Phillips Telephone: 979-458-7633 Email: raganp@tamu.edu	City of Denton Purchasing Department 901B Texas Street Denton, Texas 76201 Attn: Purchasing Manager Telephone: 940-349-7133 Email: purchasing@cityofdenton.com

19. **NO THIRD PARTY BENEFICIARIES.** For purposes of this Agreement, including its intended operation and effect, the parties specifically agree and contract that: (1) the Agreement only affects matters/disputes between the parties to this Agreement, and is in no way intended by the parties to benefit or otherwise affect any third person or entity notwithstanding the fact that such third person or entity may be in contractual relationship with TEES or the City, or both; and (2) the terms of this Agreement are not intended to release, either by contract or by operation of law, any third person or entity from obligations owed by them to either TEES or the City.

20. **ENTIRETY OF AGREEMENT.** This Agreement represents the entire understanding between TEES and the City and supersedes all other negotiations, representations or agreement, written or oral, relating to this Agreement.

The parties have caused this Agreement to be executed by their duly authorized representative.

TEXAS ENGINEERING EXPERIMENT STATION

By: _____
Mark Andrews
Title: TEES Contracting Officer
Date: 7/19/11

City of Denton, Texas

By: _____
Title: _____
Date: 7/12/11

ACKNOWLEDGEMENT

STATE OF TEXAS §
§
COUNTY OF DENTON §

This instrument was acknowledged before me on the 12 day of July, 2011 by Jody Hays, on behalf of the City of Denton, Texas.

Jody Hays
Notary Public in and for the State of Texas

JODY HAYS
Notary Public, State of Texas
My Commission Expires
December 27, 2014

Appendix A

Texas Engineering Experiment Station – Statement of Work

Clean Water Act 319 Grant
Lake Lewisville Watershed Planning Project

This document describes the services that TEES will provide to the City of Denton (Denton) as a subcontractor for a Texas Commission on Environmental Quality project. The general responsibilities of TEES for this project are the delineation of the drainage areas of the potential locations of Best Management Practices (BMPs) in the Doe Branch and Stewart Creek watersheds.

TASKS

Task 1. Gather GIS data of the Doe Branch and Stewart Creek watersheds
- Request coordinates of the outlets of both watersheds to the City of Denton;
- Request land use/land cover data to the City of Denton; and
- Gather best available Digital Elevation Model (DEM).

Task 2. Identify potential location of BMPs
- Conduct terrain analysis; and
- Identify points with drainage areas between 80 and 125 acres

Deliverable 1: Point shapefile of potential BMP locations

Due July 31, 2011

Task 3. Delineate drainage areas of potential BMP locations
- Delineate drainage areas based on DEM; and

Deliverable 2: Polygon shapefile of drainage areas.

Due July 31, 2011

Task 4. Land use analysis
- Identify and quantify land uses within each drainage area.

Deliverable 3: Table of areas of each land use within for each BMP.

Due July 31, 2011

Task 5. Report
- Preparation of a report explaining the methodology and presenting results.

Deliverable 4: Report in electronic format.

Due July 31, 2011

DELIVERABLES

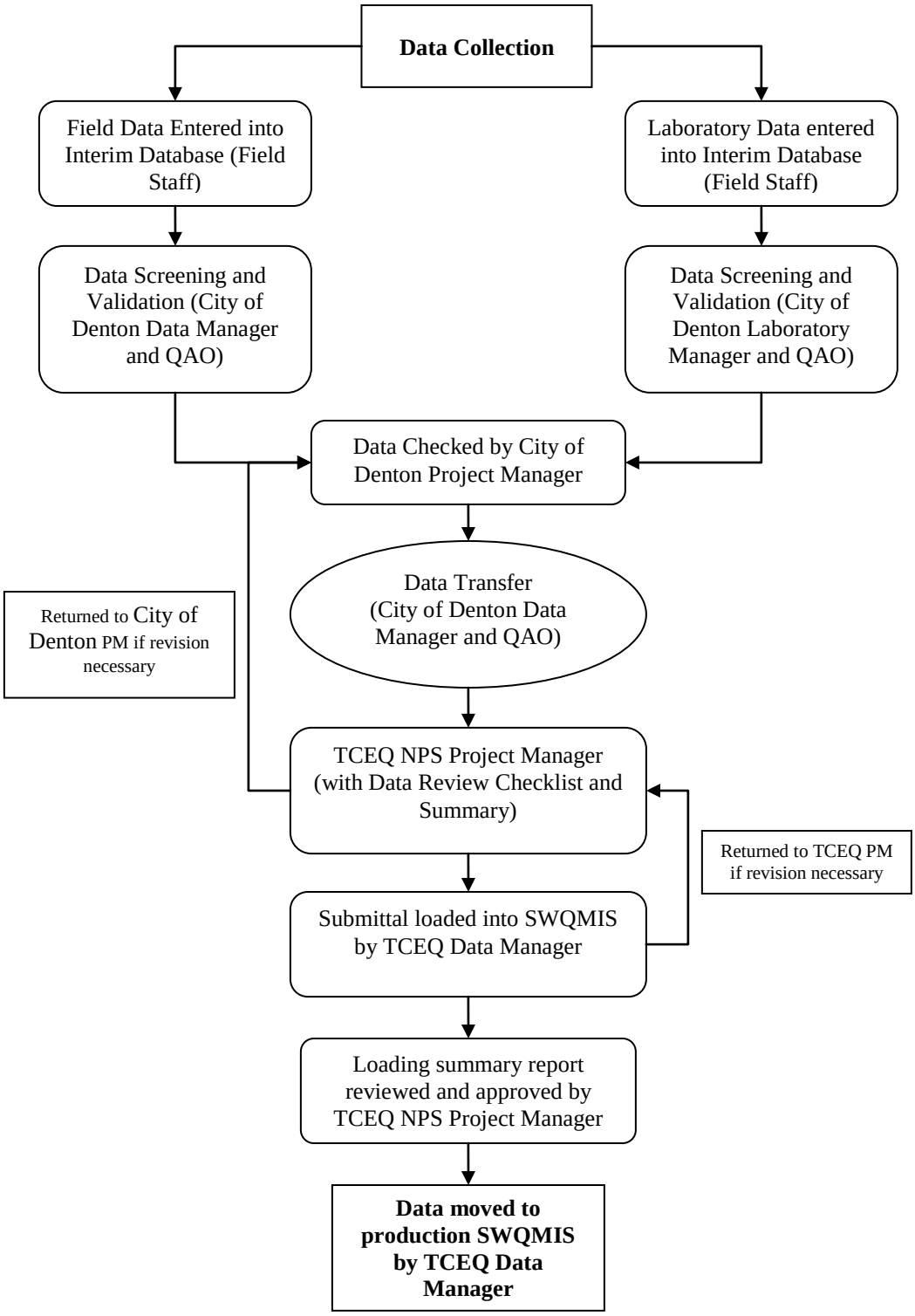
All products will be delivered prior to August 31, 2012.

BUDGET

All work will be performed for the amount of $12,000

APPENDIX C. DATA MANAGEMENT FLOW CHART

Draft NPS Data Management Process Flow Chart



APPENDIX D: CORRECTIVE ACTION STATUS TABLE

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Corrective Action #	Date Issued	Description of Deficiency	Action Taken	Date Closed

APPENDIX E: CORRECTIVE ACTION PLAN FORM

Error! Use the Home tab to apply Memo Subject to the text that you want to appear here.

Corrective Action Plan
Issued by:_____ Date Issued_____ Report No._____
Description of deficiency
Root Cause of deficiency
Programmatic Impact of deficiency
Does the seriousness of the deficiency require immediate reporting to the TCEQ? If so, when was it?
Corrective Action to address the deficiency and prevent its recurrence
Proposed Completion Date for Each Action
Individual(s) Responsible for Each Action
Method of Verification
Date Corrective Action Plan Closed?

Error! Use the Home tab to apply Memo Subject to the text that you want to appear here.

APPENDIX F. LOAD REDUCTION VERIFICATION DOCUMENTATION

This section refers to the Load reduction work done on the previous 319 grant project on three sites in the City of Denton, Hickory Creek Watershed. Three sites were selected for implementation of BMPs (City of Denton Fire Station 7, City of Denton Municipal Airport and City of Denton Lake Forest Park: Wiggley Field) during the earlier 319 grant project. During the current project two sites were selected for BMP implementation (City of Denton South Lakes Park and City of Denton Cross Timbers Park). The current project will utilize the methodology that follows to determine load and load reduction for the selected sites.

This appendix documents the load reduction calculation that were used to verify load reduction in an earlier 319 grant project. This will be the same method that will be utilized to verify load reductions in the current project.

LOAD CALCULATIONS

This section documents the calculations of non-point source (NPS) pollutant loads for the demonstration best management practice (BMP) sites. Load calculations were made for each of the sites under three conditions: pre-development, post-development, and post-development with BMPs. NPS loads were calculated using two methods: the Revised Universal Soil Loss Equation (RUSLE) to estimate sediment loads, and the Schueler "Simple Method" to estimate sediment, total nitrogen, and total phosphorus loads. Where the sediment load estimated using the Simple Method and the RUSLE did not agree, the results from the RUSLE method were adopted for use.

Revised Universal Soil Loss Equation (RUSLE)

The Revised Universal Soil Loss Equation (RUSLE) is defined as:

$$A = R * K * LS * C * P$$

where:

A = estimated average annual soil loss in tons per acre
R = rainfall-runoff erosivity factor
K = soil-erodibility factor
LS = topographic factor
C = cover-management factor
P = support practice factor

A more detailed description of each variable in the RUSLE and how these variables were assigned or determined is presented below.

Rainfall-Runoff Erosivity Factor (R)

The Rainfall-Runoff Erositivity Factor (R factor) is an empirical value derived from several different sources. The literature indicates that when factors other than rainfall are held constant, soil losses from cultivated fields are directly proportional to a rainstorm parameter: total storm energy (E) * the maximum thirty-minute intensity (I). This parameter incorporates both raindrop impact and overland flow.

Isoderent maps covering the entire United States with R factor "contours" are available from the United States Department of Agriculture (USDA) and the Environmental Protection Agency (EPA). These maps must be visually interpolated to assign an R factor to the area of interest.

The area of interest is located within a hydrologic unit named Elm Fork Trinity, Hydrologic Unit Code (HUC) #12030103, which is halfway between the contours for an R factor of 250 and an R factor of 300. Thus, an R value of 275 was used.

Soil-Erodibility Factor (K)

The Soil-Erodibility Factor (K factor) describes the ease with which soil is detached by splash during rainfall or by surface flow or by a combination of both. It can also be thought of as the average long-term soil and soil-profile response to the erosive processes of rainstorms. These processes include soil detachment and transport by raindrop impact and surface flow, localized deposition due to topography and tillage-induced roughness, and rainwater infiltration into the soil profile. K is the rate of soil loss per rainfall erosion index unit as measured on a unit plot, which is 72.6 feet long with a 9 percent slope.
There are a few different soil series within the area of interest, thus different soil textures and K values. Because of this, each site had a different K value.

Topographic Factor (LS)

The effect of topography on erosion is measured in the topographic factor (LS factor). This value is calculated using the rill susceptibility, slope length, and slope incline, providing a ratio of soil loss on a given slope length and steepness to soil loss from a reference slope that has a length of 72.6 feet and a steepness of 9 percent, all other conditions being the same.

Slope Length Factor (L)

Erosion increases as slope length increases, and this is taken into account using the slope length factor (L factor). Slope length is defined as the horizontal distance from the origin of overland flow to the point where either (1) the slope gradient decreases enough that deposition begins, or (2) runoff becomes concentrated in a defined channel. Slope lengths, as well as steepness values, are typically estimated from topographic contour maps. In this study, contour maps were used to estimate the longest length of flow and the steepest possible elevation drop for the site. These values were then used in the calculations to provide the worst case scenario. The slope length is the horizontal projection of plot length, not the length measured along the slope.
An important factor to consider in the calculation of L is the ratio of rill erosion, caused by flow, to interrill erosion, caused mainly by raindrop impact. Land use is the main issue affecting the rill to interrill ratio. For example, for rangeland and pasture, the ratio of rill to interrill erosion is low. For cropland, the ratio of rill to interrill erosion is moderate. For construction sites, the ratio of rill to interrill erosion is high and the soil has a strong tendency to rill. For the purposes of this study, the project team assumed the rill to interrill ratio is moderate in the area of interest.

Slope Steepness Factor (S)

Slope steepness plays an even greater role in erosion than slope length. There are separate equations for slopes longer than 15 feet in length and slopes shorter than 15 feet. Slopes with steepness values of 9 percent or less are also calculated differently from those slopes having steepness values greater than 9 percent. Contour maps were used in this study to estimate the slope steepness for each individual site in the area of interest, thus this value is site specific.

Cover Management Factor (C)

The cover management (C factor) is the ratio of soil loss with specific cropping and management practices to the corresponding loss with up-slope and down-slope tillage and continuously fallow conditions. This factor includes the effects of cover, crop sequence, productivity level, length of growing season, tillage practices, residue management, and the expected time distribution of erosive rainstorms. The Natural Resources Conservation Service (NRCS) provides charts of C-factor values for various land uses. This value is not only site specific but also varies between pre and post-development conditions.

Support Practice Factor (P)

The support practice factor (P factor) is the ratio of soil loss with a specific support practice to the corresponding loss with up slope and down slope tillage and continually fallow conditions. These practices mainly affect erosion by modifying the flow pattern, grade, or direction of surface runoff and by reducing the amount and rate of runoff (Renard and Foster, 1985). For cultivated land, the support practices considered include contouring, strip cropping, terracing, and sub-surface drainage. On dry land or rangeland areas, soil-disturbing practices oriented on or near the contour that result in storage of moisture and reduction of runoff are also used as support practices.

The reduction in soil loss at a given slope is about 50 percent for the next more intensive practice. An overall P factor value is computed as a product of P subfactors for individual support practices (those mentioned above), which are typically used in combination. Factor values can be found on charts provided by the USDA, among other entities. In this study, however, few, if any, erosion reducing practices are used. Therefore, a P factor of 1.0 was used for each site representing practices that neither inhibit erosion nor encourage erosion.

Delivery Ratio

The edge of stream load is not always equal to the edge of field load because not all of the sediment created by upland erosion reaches the watershed outlet. Several processes occur within each site that prohibits the eroded material from reaching the watershed outlet. These processes include redeposition in surface water storage, trapping by vegetation and plant residues, and local scour and redeposition in rills and channels. Also, many factors inhibit the eroded material's delivery to the watershed outlet, including climate, soil particle size and texture, size and proximity of the upland erosion source, the ratio of rill versus sheet erosion, total watershed area, watershed length and relief, and drainage density (the ratio of total stream length within the system divided by the area).

To determine the delivery ratio, a calculation can be performed using the area, relief, length and bifurcation ratio of the stream of interest, or it can be found on graphs provided by the USDA. These graphs show that as drainage area increases, the delivery ratio decreases. For this study, a delivery ratio of 0.3 was assumed. This is a fairly typical value for developed yet mostly pervious areas.

The RUSLE calculations for each of the sites in their developed and undeveloped stages are presented in Table 1.

TABLE 1
RUSLE Coefficient Values
LoadingCalcs.doc

Site	Land Use	Soil Series	Soil Erodibility (K)	Rainfall and Runoff (R)	Topography (LS)	Cover and Management (C)	Support Practice (P)	Segment Area (acres)	Edge of Field Load (tons/yr)	Delivery Ratio (DR)	Edge of Stream Load (tons/yr)
Lake Forest Park	Pre-Development	Birome	0.33	275	1.59	0.01	1	5.27	8	0.3	2
Lake Forest Park	Post-Development	Birome	0.33	275	1.59	0.09	1	5.27	68	0.3	20
Airport	Pre-Development	Ponder	0.35	275	0.45	0.003	1	24.81	3	0.3	1
Airport	Post-Development	Ponder	0.35	275	0.45	0.01	1	24.81	11	0.3	3
Fire Station No. 7	Pre-Development	Altoga	0.32	275	0.47	0.003	1	41.57	5	0.3	2
Fire Station No. 7	Post-Development	Altoga	0.32	275	0.47	0.01	1	66.86	28	0.3	8

SCHUELER'S "SIMPLE METHOD"

Schueler's Simple Method was also employed to calculate stormwater runoff pollutant loads. Input consists of the subwatershed drainage area and impervious cover percentages, stormwater runoff pollutant concentrations, and annual precipitation. The method enables the user to either break up land use into specific areas, such as residential, commercial, industrial, and roadway to calculate annual pollutant loads for each type of land, or to utilize more generalized pollutant values for land uses such as new suburban areas, older urban areas, central business districts, and highways.

The Simple Method estimates pollutant loads for chemical constituents as a product of annual runoff volume and pollutant concentration, and is defined by the following equation:

$$L = 0.226 * R * C * A$$

Where: L = Annual load (lbs)
R = Annual runoff (inches)
C = Pollutant concentration (mg/l)
A = Area (acres)
0.226 = Unit conversion factor

To determine the value for R, the Simple Method calculates annual runoff as a product of annual runoff volume, and a runoff coefficient (Rv). Runoff volume is calculated as:

$$R = P * P_j * Rv$$

Where: R = Annual runoff (inches)
P = Annual rainfall (inches)
Pj = Fraction of annual rainfall events that produce runoff (usually 0.9)
Rv = Runoff coefficient, based on the impervious cover in the subwatershed.

To determine the value of C, stormwater pollutant concentrations divided by land use can be estimated from local or regional data, or from national data sources. Numerous references are available for these values.

The Simple Method load calculations for each of the sites in their developed and undeveloped stages are presented in Table 2.

TABLE 2
Simple Method Coefficient Values
LoadingCalcs.doc

										Annual Load			
Site	**P**	**Pj**	**I (%)**	**Rv**	**R**	**Csed**	**Cphos**	**Cnit**	**A (acres)**	**Lsed (lb/yr)**	**Lsed (tons/yr)**	**Lp (lb/yr)**	**Ln (lb/yr)**
Airport													
Undeveloped	35	0.9	0	0.05	1.6	10	0.05	0.1	24.81	90	0.0	0.449	0.897
Developed	35	0.9	50	0.48	15.1	120	0.4	2.5	24.81	10,631	5.3	35.437	221.479
Fire Station No. 7													
Undeveloped	35	0.9	2	0.068	2.1	10	0.05	0.1	41.57	197	0.1	0.986	1.973
Developed	35	0.9	36	0.374	11.8	75	0.2	2	66.86	13,373	6.7	35.660	356.604
Lake Forest Park													
Undeveloped	35	0.9	0	0.05	1.6	10	0.05	0.1	5.27	19	0.0	0.095	0.191
Developed	35	0.9	5	0.1	3.2	50	0.1	2	5.27	191	0.1	0.381	7.623

The difference between the sediment loading values estimated using the RUSLE method versus the Simple Method can be attributed to a number of things. First, the Simple method was developed more for urban areas, where the RUSLE method was developed more for non-urban areas. As the majority of the BMP sites are pervious areas, the RUSLE method seems more appropriate. Additionally, the RUSLE method incorporates soil type and texture, as well as local topography (slope and slope length, to be specific), which provides a more site-specific value. This is most important related to the Lake Forest Dog Park site as the area is relatively steep. Finally, obviously, the RUSLE provides a worst-case scenario relative to loading, which is almost always beneficial for planning purposes. It is for these reasons, that the project team chose the RUSLE values developed for sediment loading rather than the Simple Method. Relative to phosphorus and nitrogen, however, the project team believed the Simple Method to be the best available estimating tool. Table 3 presents the estimated pre and post-development loadings.

TABLE 3
Summary of RUSLE Loads

	Edge of Field Ld. (tons/yr)	**Edge of Stream Ld. (tons/yr)**	**Selected Sediment Load**
Airport			
Permanent Grass	3	1	**1**
Urban Areas	11	3	**3**
Fire Station No. 7			
Permanent Grass	5	2	**2**
Urban Areas	28	8	**8**
Lake Forest Park			
Permanent Grass	8	2	**2**
Parks	68	20	**20**

Proposed Best Management Practices

The following section is intended to provide more information regarding each of the proposed BMPs for each site.

DENTON AIRPORT

Enhanced Grass Swale

Enhanced swales are vegetated open channels designed to capture and treat the water quality volume for a given drainage area. The proposed design improves an existing drainage swale at the Airport. The drainage area to the existing swale is 8 acres in size. Impervious area covers 32% of the drainage area. The existing swale will be improved by expanding the cross section,

leveling the slope, improving the vegetation, and adding a riprap basin at the inlet for erosion protection. The intent is to force the stormwater flow to be slow and shallow, thus allowing particulates to settle and limiting the effects of erosion.

Extended Detention Dry Basin

Dry detention basins are surface facilities intended to provide temporary storage and some water quality treatment through settling and infiltration, as well as reduction of runoff peaks. Standing water is not allowed at the Denton Airport to prevent the attraction of birds. Therefore it is necessary that the pond will drain in a relatively short period (less than 24 hours). For more effective water quality treatment, a portion of the dry detention pond will be developed as a bioretention area.

Runoff from an existing drainage system will be diverted into the pond. The pond will also capture local runoff from adjacent areas. The total drainage area to the pond will be approximately 17 acres. An outlet structure will be constructed with small weep holes that will detain small runoff events for settling and larger overflow weirs to release larger runoff events with some attenuation of the peak flow. The outlet structure discharges into Masch Branch. A riprap apron will be provided for erosion protection at the outfall.

Bioretention Area

Bioretention areas are designed to capture the water quality protection volume, the treatment volume required to remove a significant percentage of the storm water pollution load, from relatively small drainage areas using vegetation and infiltration through an engineered soil profile to remove pollutants. The proposed bioretention area at the Airport will be incorporated into the shallow detention pond. The pond outlet structure is constructed to provide a typical ponding depth of 6 inches to facilitate slow infiltration for the detained runoff volume of small storms. The overflow weirs are set to drain storage above the 6-inch level. The soil profile consists of a mulch layer, planting soil, pea gravel layer, and gravel layer. Perforated pipe is used to create an underdrain system in the lower gravel layer. The ponded water volume will slowly infiltrate the upper mulch and soil layers providing filtration and uptake of pollutants by the vegetation. Once the water reaches the lowest point of the gravel layer, it is collected in the underdrain and conveyed to Masch Branch. A flap gate will be installed on the outfall to prevent high flows in Masch Branch from backing up into the underdrain area.

LAKE FOREST DOG PARK

Vegetated Filter Strips

Filter strips are uniformly graded and densely vegetated areas designed to treat stormwater runoff using vegetative filtering and infiltration. To be effective, flow must enter filter strips as shallow, sheet flow (typically only 1-2 inches in depth), and either travel slowly through the strip or pond behind a low berm in order to provide time for settling and infiltration. The intent of the filter strip at the Lake Forest Park is to treat runoff from the dog park prior to entering an existing pond. A strip of gravel is provided above the filter strip to intercept concentrated runoff and promote sheet flow through the filter strip. A low berm will be constructed to allow for

ponding. Small outlets will be used to slowly release the ponded volume, promoting vegetative filtering and infiltration. An overflow channel is provided for runoff volumes in excess of the typical 8-inch ponding depth.

DENTON PUBLIC SAFETY TRAINING FACILITY

The Denton Public Safety Training Facility is expected to be developed in several phases. The first phase, currently under construction, includes Fire Station No. 7 with a surrounding road and parking areas. A conceptual BMP plan was prepared based on the City's current master plan for the entire site. The post-development load calculations presented in this study are based on the expected ultimate development of the site.

Vegetated Filter Strips

The design for the Denton Public Safety Training Facility includes the use of vegetated filter strips. Initially, filter strips will be constructed to surround the Fire Station No. 7 development, which covers approximately 2 acres. The site is built on a slight rise with the runoff draining evenly in all directions. The filter strips will be built adjacent to the surrounding road. The strips will be built on a 2% slope away from the road and will be 50 feet wide. A gravel spreader will be incorporated to ensure sheet flow. Upon further development, vegetated filter strips should be constructed as appropriate. Based on the current master planning effort, the project team assumed approximately 50 percent of the ultimate site development will be treated by vegetated filter strips.

Extended Detention Dry Basin

A dry detention basin will be constructed in the Southern portion of the site to capture as much runoff as possible from the ultimate site development. As described above, dry detention basins are surface facilities intended to provide temporary storage and some water quality treatment through settling and infiltration. Although not intended primarily for runoff control, some reduction in peak flows may be provided. The total pre-development area draining to the pond site is 42 acres. When development of the site is completed, this is expected to become approximately 67 acres. However, due to uncertainty in the master plan, the proposed pond will initially be constructed with enough volume to treat approximate two-thirds of the development. Additional storage volume will need to be provided for future development at the site.

Within the basin, an outlet structure will be constructed such that small runoff events are retained for settling purposes and larger runoff events will be transported to the Branch Creek, the stream located directly to the south of the pond. A riprap apron will be provided for erosion protection at the outfall.

Table 4 provides the pollutant removal efficiencies for each of these BMPs as provided by the *Design Manual for Site Development*, written by the North Central Texas Council of Governments.

TABLE 4
Contaminant Removal Efficiencies per BMP
LoadingCalcs.doc

BMP	Percent Removal Sediment	Percent Removal Phosphorus	Percent Removal Nitrogen
Detention	65%	50%	30%
Bioretention	80%	60%	50%
Filter Strip	50%	20%	20%
Grass Swale	80%	25%	40%

Table 5 provides the estimated contaminant removal associated with the BMPs described above.

TABLE 5
Summary of Loads

	Simple	**Simple**	**RUSLE**	**Simple**	**Simple**
Site	**Lsed (lb/yr)**	**Lsed (ton/yr)**	**L sed (ton/yr)**	**Lp (lb/yr)**	**Ln (lb/yr)**
Airport					
Undeveloped	90	0.0	**1**	**0.0**	**1**
Developed	10631	5	**3**	**35**	**221**
With BMPs			**1**	**19**	**133**
Fire Station No. 7					
Undeveloped	197	0.0	**2**	**1**	**2**
Developed	13373	7	**8**	**36**	**357**
With BMPs			**3**	**25**	**274**
Lake Forest Park					
Undeveloped	19	0.0	**2**	**0.0**	**0.0**
Developed	191	0.0	**20**	**0.0**	**8**
With BMPs			**10**	**0.0**	**6**

ATTACHMENT 1
Example Letter to Document Adherence to the QAPP

TO: Jack Higginbotham
TCEQ

FROM: David H. Hunter
City of Denton

RE: City of Denton, Principal Investigator

Please sign and return this form by Friday, July 20, 2012 to:

Texas Commission on Environmental Quality
P.O. Box 13087, MC 203
Austin, TX 78711-3087

I acknowledge receipt of the "319 Grant for the Lake Lewisville Watershed, Revision Date". I understand that the document describes quality assurance, quality control, data management and reporting, and other technical activities that must be implemented to ensure the results of work performed will satisfy stated performance criteria.

My signature on this document signifies that I have read and approved the document contents. Furthermore, I will ensure that all staff members participating in activities covered under this QAPP will be required to familiarize themselves with the document contents and adhere to the contents as well.

_____

Signature Date

Copies of the signed forms should be sent by the Contractor to the TCEQ NPS Project Manager within 60 days of TCEQ approval of the QAPP.