Clean Water Act Section 319(h) Nonpoint Source Pollution Control Program

Monitoring Effectiveness of Nonpoint Source Nutrient Management in the North Bosque River Watershed (Project 09-07)

Revision No. 4

Quality Assurance Project Plan

Prepared by
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Texas State Soil and Water Conservation Board

Effective Period: One year from date of final approval

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A1 APPROVAL PAGE

Quality Assurance Project Plan (QAPP) for Project # 09-07, *Monitoring Effectiveness of Nonpoint Source Nutrient Management in the North Bosque River Watershed*

Texas State Soil and Water Conservation Board (TSSWCB)

____________________________	____________________________
Jana Lloyd Date	Mitch Conine Date
Project Manager	Quality Assurance Officer

Texas Institute for Applied Environmental Research (TIAER)

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Anne McFarland Date	Nancy Easterling Date
Project Manager	Project Quality Assurance Officer

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Mark Murphy Date
Laboratory Manager and Laboratory Quality Assurance Officer

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Jeff Stroebel Date
Field Supervisor

U.S. Environmental Protection Agency, Region 6 (EPA)

____________________________	__________________ __________
Curry Jones Date	Henry Brewer Date
Chief State/Tribal Programs Section	Texas Non Point Source Project Officer

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LIST OF ACRONYMS

AWRL	Ambient Water Reporting Limit
BMP	Best Management Practice
BRA	Brazos River Authority
CAFO	Concentrated Animal Feeding Operations
CAR	Corrective Action Report
COC	Chain-of-Custody
CMIP	Composted Manure Incentive Program
CNMP	Comprehensive Nutrient Management Plan
CWA	Clean Water Act
DOC	Demonstration of Capability
DMES	Dairy Manure Export Support
DMRG	Data Management Reference Guide
EPA	US Environmental Protection Agency
GM	General Maintenance
I-Plan	Implementation Plan
LCS	Laboratory Control Sample (formerly Laboratory Control Standard)
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
LOQ	Limit of Quantitation (formerly Reporting Limit)
NBR	North Bosque River
NELAP	National Environmental Laboratory Accreditation Program
NPP	National Pilot Project
NPS	Nonpoint Source
NWS	National Weather Service
QA	Quality Assurance
QAM	Quality Assurance Manual
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
SWCD	Soil and Water Conservation District
SWQM	Surface Water Quality Monitoring
SWQMIS	Surface Water Quality Monitoring Information System
TIAER	Texas Institute for Applied Environmental Research
TMDL	Total Maximum Daily Load
TCEQ	Texas Commission on Environmental Quality
TSS	Total Suspended Solids
TSSWCB	Texas State Soil and Water Conservation Board
USGS	United States Geological Survey
WWTF	Wastewater Treatment Facility

A3 DISTRIBUTION LIST

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The TIAER will provide copies of this project plan and any amendments or appendices of this plan to TIAER personnel on this list and copies to the TSSWCB for distribution within the TSSWCB and to EPA. The TIAER will document distribution of the plan and any amendments and appendices and maintain this documentation as part of the project's quality assurance records available for review.

A4 PROJECT/TASK ORGANIZATION

Description of Responsibilities

TSSWCB

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

Mitch Conine
TSSWCB QAO
Reviews and approves the QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB and EPA participants. Responsible for verifying that the QAPP is followed by project participants. Determines that the project meets the requirements for planning, quality assessment (QA), quality control (QC), and reporting under the Clean Water Act (CWA) Section 319 program. Monitors implementation of corrective actions. Coordinates or conducts audits of field and laboratory systems and procedures. Responsible for reviewing and accepting data from TIAER for submittal to Surface Water Quality Monitoring Information System (SWQMIS).

TIAER

Anne McFarland
TIAER 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 TSSWCB. Responsible for writing and maintaining the QAPP in cooperation with the TIAER QAO. Responsible for verifying the QAPP is followed and the project is producing data of known and acceptable quality. Notifies the TSSWCB project manager of particular circumstances that may adversely affect the quality of data derived from the collection and analysis of samples. Enforces corrective action. Responsible for coordinating data transfers to the TSSWCB for submittal to SWQMIS and developing and delivering the final project report.

Nancy Easterling
TIAER Project QAO
Responsible for coordinating development and implementation of the non-laboratory QA program. Participates in the planning, development, approval, implementation, and maintenance of the QAPP. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Responsible for identifying, receiving, and maintaining project quality assurance records. Responsible for coordinating with the TSSWCB QAO to resolve QA-related issues. Notifies the TIAER Project Manager of particular circumstances that may adversely affect the quality of data. Responsible for validation and verification of all data collected according to Table A7.1 and QC specifications and acquired data procedures after each task is performed. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Develops, facilitates, and conducts monitoring systems audits. Assists the TIAER Project Manager in completing the data summary and transfer of data to the TSSWCB QAO for submittal to SWQMIS.

Jeff Stroebel
TIAER Field Supervisor
Responsible for supervising all aspects of the sampling and measurement of surface waters and other parameters in the field. Responsible for the acquisition of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A7.1), as well as the requirements of Sections B1 through B8. Responsible for field scheduling, staffing, and ensuring that staff are appropriately trained as specified in Sections A6 and A8.

Mark Murphy
Laboratory Manager
Responsible for supervision of laboratory personnel involved in generating analytical data for this project. Responsible for ensuring that laboratory personnel involved in generating analytical data have adequate training and a thorough knowledge of the QAPP and all Standard Operation Procedures (SOP) specific to the analyses or task performed and/or supervised. Responsible for oversight of all operations, ensuring that all QA/QC requirements are met, and documentation related to the analysis is completely and accurately reported. Enforces corrective action, as required. Develops and facilitates monitoring systems audits.

Mark Murphy
Laboratory QAO
Monitors the implementation of the Quality Assurance Manual (QAM) and the QAPP within the laboratory to ensure complete compliance with QA objectives as defined by the contract and in the QAPP. Conducts internal audits to identify potential problems and ensure compliance with written SOPs. Responsible for supervising and verifying all aspects of the QA/QC in the laboratory. Performs validation and verification of data before data are evaluated to assess project objectives. Insures that all QA reviews are conducted in a timely manner from real-time review at the bench during analysis to final data approval. Conducts laboratory inspections.

U.S. EPA Region 6

Henry Brewer
EPA Texas Nonpoint Source Project Officer
Responsible for managing the CWA Section 319 funded grant on the behalf on EPA. Assists the TSSWCB in approving projects that are consistent with the management goals designated under the State's Non Point Source (NPS) management plan and meet federal guidance. Coordinates the review of project work plans, QAPPs, draft deliverables, and works with the TSSWCB 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 EPA 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.

PROJECT ORGANIZATION CHART

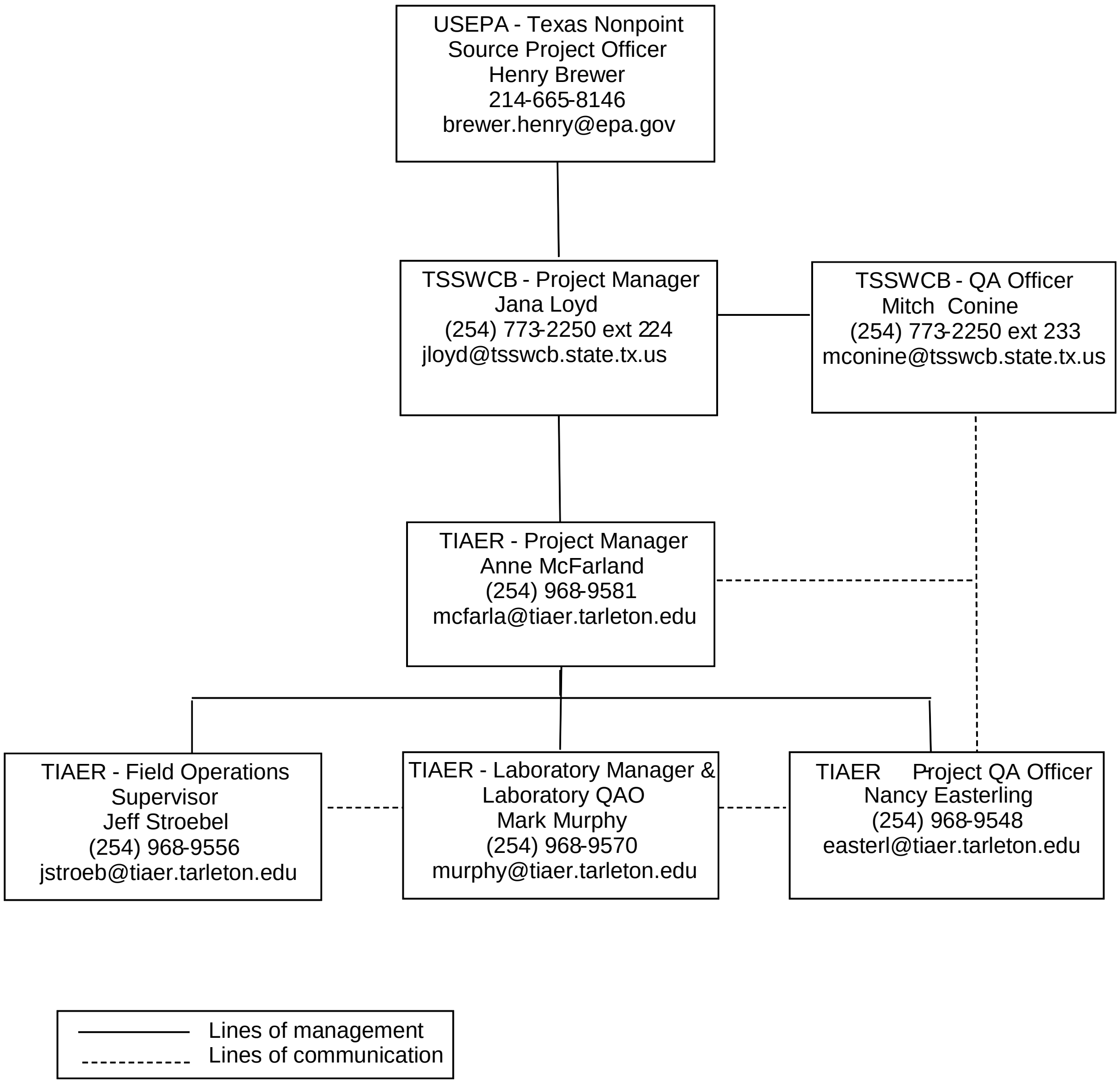

Figure A4.1. Project Organization Chart.

A5 PROBLEM DEFINITION/BACKGROUND

This project addresses continued monitoring of water quality reductions from agricultural NPS pollution associated with Implementation-Plan (I-Plan) activities for two Total Maximum Daily Loads (TMDLs) for the North Bosque River (NBR) at 13 microwatershed sites. Segments 1226 NBR and 1255 Upper NBR in the Brazos River Basin were included in the 1998 303(d) List as impaired under narrative water quality criteria related to nutrients and excessive growth of aquatic vegetation. Through the TMDL, phosphorus was identified as the nutrient most often limiting aquatic plant growth, and dairy operations and municipal wastewater treatment facility (WWTF) effluents were considered the major controllable sources of phosphorus to the river. The Texas Commission on Environmental Quality adopted two TMDLs for phosphorus in the NBR for Segments 1226 and 1255 in February 2001. These TMDLs were approved by the USEPA in December 2001. An I-Plan for Soluble Reactive Phosphorus in the NBR Watershed for Segments 1226 and 1255 was approved by the TCEQ in December 2002 and by the TSSWCB in January 2003.

As part of the I-Plan, a microwatershed approach to monitoring was included to provide finer geographic resolution for managing implementation activities (identified as “Tributary Monitoring” in the I-Plan). Monitoring at the microwatershed or subwatershed level also allows the impact of agricultural NPS implementation activities to be assessed separately from urban runoff and WWTF contributions. Monitoring at several microwatersheds was initiated in 2001 through TSSWCB projects 01-13 and 01-14, “Technical and Financial Assistance to Dairy Producers and Landowners of the NBR Watershed within the Cross-Timbers and Upper Leon Soil and Water Conservation Districts (SWCDs).” This monitoring has continued under a series of related projects: TSSWCB project 01-17, (Extending TMDL Efforts in the NBR Watershed), TSSWCB project 04-12, (Assessment of Springtime Contributions of Nutrients and Bacteria to the NBR Watershed), and TSSWCB project 08-09, (Microwatershed-Based Approach to Monitoring and Assessing Water Quality in the NBR Watershed). Data collected from these microwatersheds has been used to help the TSSWCB direct technical and financial assistance to property owners and to better characterize the effects of implemented management activities. This project also complements monitoring along the mainstem of the NBR conducted by TIAER under projects with the TCEQ. .

Continued monitoring of microwatershed sites in the headwaters of the NBR is needed to evaluate the ongoing effectiveness of agricultural NPS pollution prevention programs. While the I-Plan for the NBR phosphorus TMDL was adopted in early 2003, not all strategies within the I-Plan have yet been adopted. For example, the development and certification of comprehensive nutrient management plans (CNMPs) has had limited progress, until recently, due to a variety of reasons. Deadline extensions for the issuance of permits by TCEQ for concentrated animal feeding operations (CAFOs) have also delayed the adoption of CNMPs. These delays are being overcome, and continued monitoring at these microwatershed sites is, thus, needed to more fully monitor success of implementing CNMPs. Also, improvements in water quality lag changes in land management due to residual impacts (e.g., fertilizer applied in excess in previous years) and variations in weather patterns that occur seasonally, annually, and over decades. As part of monitoring for success for the NBR TMDL, water quality monitoring was initiated in the spring of 2001 at over a dozen microwatershed sites. While some improvements have been documented in previous project reports (see Millican and McFarland, 2008: Extending TMDL Efforts in the NBR Watershed: Data Evaluation through 2007), precipitation and runoff conditions have varied greatly between 2001 and 2007 from pre-TMDL conditions, somewhat confounding the evaluation of water quality changes. Precipitation and runoff patterns are expected to vary greatly from year to year but also may show climatic variations between decades that require long-term monitoring to understand. Assessment of conservation or land management practices often depends on the climatic "baseline" evaluated from short-term projects of only a few years. Rarely do "average" weather conditions occur and if weather conditions happen to be unusually wet or dry during the assessment period, the evaluation of effectiveness will be skewed. Long-term monitoring allows assessment of practices over a range of weather conditions and evaluation of the impact of "rare" events, such as large floods or extended droughts, on overall effectiveness. The findings from long-term monitoring can then be transferred to other watersheds to aid in realistically assessing the conditions and time needed to obtain NPS water quality improvements.

One component of the I-Plan that has shown clear reductions in the amount of in-stream phosphorus based on microwatershed data is the manure hauling and composting program. While financial support for the Composted Manure Incentive Project (CMIP) by TCEQ ended in August 2006 and TSSWCB funding for the Dairy Manure Export Support (DMES) program ended in February 2007, continuing microwatershed monitoring through this project will help assess the long-term effectiveness of these programs. While the public funding support for these projects has ceased, a goal of CMIP and DMES was to aid in the establishment of a self-sustaining composting industry. Within the watershed, six composting facilities are still active and many amended CAFO permits note the use of composting for manure disposal. While specific tracking of manure haul-off data is not available, indirect measures based on general information from permits and composting facilities should allow linkage of changes in water quality at the microwatershed level to the effectiveness of overall manure management including the use of composting.

Finally, while these TMDLs specifically address soluble reactive phosphorus with regard to excessive algal growth, total phosphorus, nitrogen constituents, total suspended solids and bacteria, will also be monitored. Several tributaries of the NBR are listed as impaired due to elevated bacteria, and many of the implementation practices for phosphorus reduction are anticipated to also decrease bacteria concentrations.

A6 PROJECT/TASK DESCRIPTION

This project provides assessment for evaluating reductions in agricultural NPS pollution associated with I-Plan activities. Monitoring will be conducted for 53 months during which TIAER will provide continued assessment activities at 13 microwatershed sites within the NBR watershed (Figure 1 and Table 1). The project will make use of automated sampling systems already in TIAER's possession, so no new equipment will be needed.

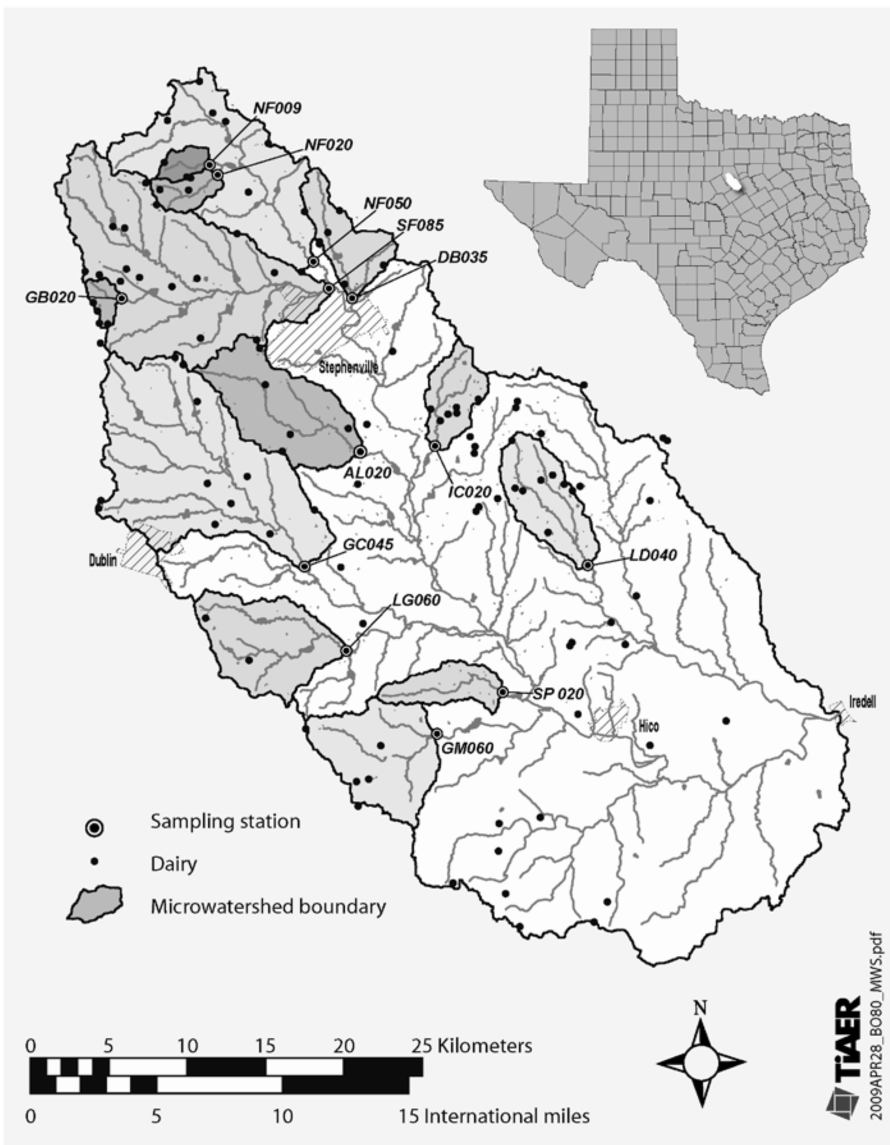

Figure A6.1. Location of project sampling sites.

These 13 microwatersheds were selected to represent the range of land management practices within the watershed and to provide focused monitoring in the upper portion of the NBR watershed, where most dairy operations are located. Selection of sampling sites also considered the availability of historical monitoring data. Most of these stream sites have been monitored since spring 2001, although some sites have a monitoring history extending back to 1991.

The data collected should allow demonstration of success of I-Plan activities. Smaller stream sites were chosen, because it is anticipated that changes in water quality will occur more quickly in these smaller watersheds than in larger watersheds and that changes observed can be more readily related to changes in land management. Monitoring at these microwatershed sites also helps isolate agricultural activities from urban runoff and WWTF discharges that impact the mainstem of the river.

Project-related tasks and schedule of deliverables are defined in Table A6.1.

Table A6.1. Schedule of Milestones

Task	Project Milestones	Start[1]	End[2]
1	**Project Administration**		
1.1	Quarterly Progress Reports	Month 1	Month 58
1.2	Quarterly Reimbursement Submittals	Month 1	Month 58
1.3	Attendance and participation at Clean Rivers Program and other appropriate meetings	Month 1	Month 58
2	**Quality Assurance**		
2.1	QAPP development and approval by the TSSWCB and EPA for 1st 6 months of monitoring	Month 1	Month 3
2.2	Annual QAPP revision and approval by the TSSWCB and EPA	Month 1	Month 58
3	**Surface Water Monitoring**		
3.1	Routine ambient monitoring	Month 5	Month 57
3.2	Biased-flow monitoring	Month 5	Month 57
3.3	Stage-discharge relationships	Month 1	Month 58
4	**Data Management and Reporting**		
4.1	Data reviews & transfers	Month 5	Month 58
4.2	Project summaries	Month 1	Month 58
4.3	Assessment Data Report	Month 47	Month 58

[1] Month 1 = November 2009
[2] Month 58 = August 2014

TIAER will conduct routine monitoring (grab samples) at 13 sites once every month, collecting field, flow, conventional and bacteria parameter groups. TIAER will avoid duplicative routine monitoring conducted at these sites by other entities including TCEQ and Brazos River Authority (BRA). Routine grab samples will be analyzed for nutrient forms, total suspended solids (TSS), and E. coli. In addition, field constituents of dissolved oxygen, pH, specific conductance (conductivity), and water temperature will be recorded at the time grab samples are collected. Historically, these sites are dry or not flowing about 50 percent of the time when visited for routine sampling. These sites flow primarily in response to rainfall-runoff events and have a fairly rapid hydrograph response making it necessary to include automated storm monitoring.

TIAER will conduct biased-flow monitoring (automated sampling) under high flow (storm event influenced) conditions at all 13 sites during about 16 storm events per site per year. TIAER will maintain and operate automated samplers and water-level recorders at all 13 sites, along with stage-discharge relationships for the measurement of flow. Automated samplers will be set to activate sampling upon a selected rise in water level and collect individual samples at sequential time intervals. At each site, individual samples will be retrieved and flow-composited into one sample on about a daily basis that will be analyzed for nutrient forms and TSS.

Constraints in meeting this work schedule include timely approval of the QAPP and unexpected extreme variability in weather conditions that preclude sampling. See Section B1 for sampling design and monitoring pertaining to this QAPP.

Revisions to the QAPP

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually on the anniversary date, or revised and reissued within 120 days of significant changes, whichever is sooner. If the entire QAPP is current and valid, the document may be reissued by certifying that the plan is current and including a new copy of the signed approval page. The approved version of the QAPP shall remain in effect until revised versions have been approved, only if the revised version is submitted for approval before the approved version expires.

Expedited Changes

Expedited changes to the QAPP should be approved before implementation to reflect changes in project organization, tasks, schedules, objectives, and methods, address deficiencies and non-conformance, improve operational efficiency and accommodate unique or unanticipated circumstances. Requests for expedited changes are directed from the TIAER Project Manager to the TSSWCB Project Manager in writing. They are effective immediately upon approval by the TSSWCB Project Manager and QAO, or their designees.

Justifications, summaries, and details of expedited changes to the QAPP will be documented and distributed to all persons on the QAPP distribution list under the direction of the TIAER QAO. Expedited changes will 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

The primary goal of this project is to obtain necessary water quality and streamflow data to allow assessment of the effectiveness of various best management practices (BMPs) and nutrient control activities that are either ongoing or scheduled for implementation in the NBR watershed. A secondary goal is to help target areas where further assistance from the TSSWCB might be needed to help meet TMDL reductions. Monitoring efforts and direct data collection will be conducted by TIAER. Measurement performance specifications for direct data are provided below in Table A7.1.

Table A7.1 - Measurement Performance Specifications

Parameter	Units	Matrix	Method [1]	Parameter Code	AWRL	Limit of Quantitation (LOQ)	Recovery at LOQ Ck Std. (%)	Precision [2] LCS/LCSD (% RPD)	Bias (% Recovery of LCS)	Com-pleteness (%)
Field Parameters										
pH	pH/ units	water	EPA 150.1 and TCEQ SOP, V1	00400	NA[3]	NA	NA	NA	NA	90
DO, dissolved oxygen	mg/L	water	EPA 360.1 and TCEQ SOP, V1	00300	NA[3]	NA	NA	NA	NA	90
Conductivity	µS/cm	water	EPA 120.1 and TCEQ SOP, V1	00094	NA[3]	NA	NA	NA	NA	90
Temperature	ºC	water	EPA 170.1 and TCEQ SOP V1	00010	NA[3]	NA	NA	NA	NA	90
Flow	cfs	water	TCEQ SOP V1	00061	NA[3]	NA	NA	NA	NA	90
Days since last precipitation	Days	water	TCEQ SOP V1	72053	NA[3]	NA	NA	NA	NA	90
Flow severity	1 no flow, 2 low, 3 normal, 4 flood, 5 high, 6 dry	water	TCEQ SOP V1	01351	NA[3]	NA	NA	NA	NA	90
Flow measurement method	1-gage 2-electric 3-mechanical 4-weir/flume 5-doppler	water	TCEQ SOP V1	89835	NA[3]	NA	NA	NA	NA	90
Laboratory Parameters										
TSS, total suspended solids	mg/L	water	SM 2540 D	00530	4	4	NA [4]	20	80-120	90
NH_3-N, Ammonia-N, dissolved	mg/L	water	SM 4500 NH3-G	00608	0.1	0.1	70-130	20	80-120	90
NO_2-N+NO_3-N, Nitrate/nitrite-N, dissolved	mg/L	water	SM 4500 NO3-F	00631	0.05	0.05	70-130	20	80-120	90
TKN, Total Kjeldahl Nitrogen	mg/L	water	SM 4500 NH3-G	00625	0.20	0.20	70-130	20	80-120	90

Parameter	Units	Matrix	Method [1]	Parameter Code	AWRL	Limit of Quantitation (LOQ)	Recovery at LOQ Ck Std. (%)	Precision [2] LCS/LCSD (% RPD)	Bias (% Recovery of LCS)	Com-pleteness (%)
PO_4-P, O-phosphate-P, field filtered <15 min.	mg/L	water	SM 4500P-E	00671	0.04	0.005	70-130	20	80-120	90
PO_4-P, O-phosphate-P, Lab-filtered >15 min.	mg/L	water	SM 4500P-E	70507	0.04	0.005	70-130	20	80-120	90
TP, Total phosphorus	mg/L	water	EPA 365.4	00665	0.06	0.06	70-130	20	80-120	90
E. coli, IDEXX Colilert	MPN/100 mL	water	IDEXX Colilert	31699	1	1	NA	0.5 [5]	NA	90
Holding Time *E. coli* IDEXX	Hours	water	NA	31704	NA	NA	NA	NA	NA	NA

Footnotes:
[1] For methods requiring filtration and/or acidification, samples collected by automated sampler will be filtered and acidified in the laboratory after aliquots have been composited. Additionally, if grab samples have too much sediment for field filtration, the samples will be filtered and acidified as soon as possible in the laboratory. Orthophosphate aliquots are not acidified.
[2] Precision will assessed using sample and sample duplicates, where a LCS is not appropriate. Precision results will not be used as acceptance criteria if values are below the practical quantitation limit.
[3] Reporting to be consistent with TCEQ SWQM guidance and based on measurement capability.
[4] Verification at the LOQ is not required for TSS.
[5] Based on range statistic as described in Standard Methods, online Edition, Section 9020-B, "QA/QC - Intralaboratory QC Guidelines." This criterion applies to bacteriological duplicates with concentrations >20 MPN/100 mL, which is the lower limit for acceptable counts, according to Standard Methods.

References for Table A7.1:

United States Environmental Protection Agency (USEPA) “Methods for Chemical Analysis of Water and Wastes,” Manual #EPA-600/4-79-020.
American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), “Standard Methods for the Examination of Water and Wastewater,” most recent online edition.
TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2012 or most recent version/update (RG-415).

Limit of Quantitation

The ambient water reporting limit (AWRL) set by TCEQ establishes the reporting specification at or below which data for a parameter will be reported for comparison with Texas Water Quality Standards. The AWRLs specified in Table A7.1 for each analyte should yield data acceptable for routine monitoring. The AWRL will be used as the limit of quantitation (LOQ) for all constituents but PO_4-P. A lower LOQ for PO_4-P will be used to keep in line with requirements of other projects within the Bosque River watershed and for comparison with historical monitoring data. The laboratory will meet two requirements in order to report meaningful results in evaluating the project’s objectives:

- The laboratory’s LOQ for each analyte will be at or below the AWRL.
- The laboratory will demonstrate and document the laboratory’s ability to quantitate at its LOQ for each analyte by running an LOQ check standard for each batch of project samples analyzed.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria are provided in Section B5.

Precision

Precision is a statistical measure of the variability of a measurement when a collection or an analysis is repeated and includes components of random error. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. Laboratory precision is assessed by comparing replicate analyses of laboratory control standards in the sample matrix (e.g., deionized water) or sample/duplicate pairs in the case of bacterial analysis. Precision results may be plotted on quality control charts that are based on historical data and used during evaluation of analytical performance. Performance specifications for laboratory control standard/laboratory control standard duplicate pairs are defined in Table A7.1. Field splits are used to assess the variability of sample handling, preservation, and storage, as well as the analytical process, and are prepared by splitting samples in the field. Control limits for field splits are defined in Section B5.

Bias

Bias is a statistical measurement of correctness and includes multiple components of systematic error. A measurement is considered unbiased when the value reported does not differ from the true value. Bias is verified through the analysis of laboratory control standards prepared with verified and known amounts of analytes and by calculating percent recovery. Results may be plotted on quality control charts and used during evaluation of analytical performance. Project control limits for laboratory control standards are specified in Table. A7.1.

Representativeness

Data collected as routine grabs and storm samples will be considered representative of the target population or phenomenon to be studied. The representativeness of the data is dependent on 1) the sampling location, 2) the flow regime during sample collection 3) the number of years sampling is performed, and 4) the sampling procedures. Site selection and sampling of pertinent media (i.e., water) and use of only approved analytical methods will assure that measurement data represent the population being studied at the site. Although data may be collected during varying regimes of weather and flow, data collection will be targeted toward both ambient conditions and storm events, representing water quality at low and high flow conditions. The goal for meeting total representation of the water body will be tempered by the funding available.

Comparability

Confidence in the comparability of data sets for this project is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for rounding figures, and by reporting data in a standard format as specified in Section B10 on Data Management.

Completeness

The completeness of the data is basically a relationship of how much of the data is available for use compared to the total potential data. Ideally, 100% of the data should be available. However, the possibility of unavailable data due to accidents, insufficient sample volume, broken or lost samples, etc. is to be expected. Therefore, it will be a general goal of the project that 90% data completion is achieved.

A8 SPECIAL TRAINING/CERTIFICATION

Staff responsible for operating the automated samplers and flow loggers will be trained by senior TIAER staff members who have experience operating the equipment. A training record will be completed to document the training of each staff member who operates the automated samplers and flow loggers.

Field personnel will receive training in proper sampling and field measurements. Before actual sampling or field analysis occurs, they will demonstrate to the Project QAO or designee, their ability to properly operate the automated samplers and multisondes and retrieve the samples. The Project QAO or designee will sign off each field staff in the field training logbook.

Laboratory analysts have a combination of experience, education, and training to demonstrate knowledge of their function. To perform analyses for the TCEQ, laboratory analysts will have a demonstration of capability (DOC) on record for each test that the analyst performs. The initial DOC should be performed prior to analyzing samples and annually thereafter. For cases in which analysts have been analyzing samples prior to an official certification of capability being generated, a certification statement is made part of the training record to document the analyst's initial on the job training. Annual DOCs are a part of analyst training thereafter.

A9 DOCUMENTS AND RECORDS

Hard copies of all field data sheets, general maintenance (GM) records, chain of custody forms (COCs), laboratory data entry sheets, field data entry sheets, calibration logs, and corrective action reports (CARs) will be archived by TIAER for at least five years. In addition, TIAER will archive electronic forms of all project data for at least five years. Examples are presented of GM and field data sheets in Appendix A, a COC form in Appendix B, and a CAR form in Appendix C.

Quarterly progress reports will be produced electronically for the TSSWCB and will note activities conducted in connection with audits of the water quality monitoring program, items or areas identified as potential problems, and any variations or supplements to the QAPP. CARs will be utilized when necessary (Appendix C). CARs will be maintained in an accessible location for reference at TIAER. CARs that result in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in an update or amendment to the QAPP, when appropriate.

Individuals listed in Section A3 at TIAER will be notified of approval of the most current copy of the QAPP by the TIAER project manager. The TIAER project manager will make available to the department secretary the most recent version of the QAPP. Current copies of the QAPP will be kept on file for all individuals on the TIAER distribution list to be signed out in the QAPP logbook kept by the department secretary.

The final project report will be produced electronically and as a hard copy and all files used to produce the final report will be saved electronically by TIAER for at least five years.

As an electronic data protection strategy, TIAER utilizes Double Take software to mirror the primary file server located in Hydrology 2nd floor (* RAID 5 fault tolerant) that will be mirrored to a secondary file server located in Davis Hall 4th floor (* RAID 5 fault tolerant). This provides instant fault recovery rollover capability in the event of hardware failure. TIAER also exercises complete backup of its primary server to tape on a weekly basis, coupled with daily incremental backups. This provides a third level of fault tolerance in the event that both the primary and secondary servers are disabled. TIAER will maintain all cyclic back up tapes for 26 weeks prior to reuse saving the 1st tape in the series indefinitely to preserve an historical snapshot. This will facilitate recovery of data lost due to human error. Backup tapes are stored in a secure area on the Tarleton State University campus and are checked periodically to ensure viability. If necessary, disaster recovery can also be accomplished by manually re-entering the data.

The documents and records that describe, specify, report, or certify activities are listed in Table A9.1.

Table A9.1 Project Documents and Records

Document/Record	Location	Retention (yrs)	Format
QAPPs, amendments and appendices	TIAER Main Office	5 years	Paper
QAPP, distribution documentation	TIAER Main Office	5 years	Paper
Field training records	TIAER Field Offices	5 years	Paper
Field notebooks or data sheets (see Appendix A for examples of field data sheets)	TIAER Field Offices	5 years	Paper
Field equipment calibration/maintenance logs	TIAER Field Offices	5 years	Paper
Field instrument printouts	TIAER Field Offices	5 years	Paper
Field SOPs	TIAER Field Offices	5 years	Paper
Chain of custody records (see Appendix B for example)	TIAER Data Management Offices	5 years	Paper
Laboratory Quality Manuals	TIAER Laboratory	5 years	Paper
Laboratory training records	TIAER Laboratory	5 years	Paper
Laboratory SOPs	TIAER Laboratory	5 years	Paper
Laboratory instrument printouts	TIAER Laboratory or Offsite Storage	5 years	Paper
Laboratory data reports/results	TIAER Laboratory or Offsite Storage	5 years	Paper/LIMS electronic
Laboratory equipment maintenance logs	TIAER Laboratory or Offsite Storage	5 years	Paper
Laboratory calibration records	TIAER Laboratory or Offsite Storage	5 years	LIMS electronic
Corrective Action Documentation (see Appendix C for example)	TIAER QAO Office	5 years	Electronic/ Paper

Laboratory Documentation

The laboratory will document sample results clearly and accurately. Information about each sample will include the following to aid in interpretation and validation of data:

- A clear identification of samples analyzed for the project including station information
- Date and time of sample collection
- Identification of preservation and analysis methods used
- Sample results, units of measurement, and sample matrix
- Information on QC failures or deviations from requirements that may affect the quality of results or is necessary for verification and validation of data

Electronic Data

Monitoring data will be submitted to the TSSWCB at least annually. All data will be submitted in the event/result format specified in the TCEQ Data Management Reference Guide (DMRG) for upload to SWQMIS. The Data Summary checklist required by the TCEQ will be submitted with the data. The routine stream data will be submitted under monitoring type RT. The monitoring type for wet weather data will be listed as BF for biased flow. TIAER will check with the TSSWCB project manager prior to submitting any data to make sure the appropriate codes and implemented. Data collection sites for this project have been or will be assigned a SWQMIS Station Identification Number by TCEQ.

Submitting Entity, Monitoring Entity, and Monitoring Type will reflect the project organization of reporting the data, who will be collecting the data, and data collection targeted toward NPS data as follows:

Sample Description	Submitting Entity	Monitoring Entity	Monitoring Type
Routine stream grab samples for all constituent	TSSWCB (TX)	TIAER (TA)	RT
Wet-weather stream samples	TSSWCB (TX)	TIAER (TA)	BF

B1 SAMPLING PROCESS DESIGN

The sample design rationale for the study is based on the intent that the data be usable for assessing reductions in levels of phosphorus and other constituents at microwatershed sites in the NBR following implementation of BMPs in the watershed. Monitoring sites are specified in Table B1.1 and locations are shown in the map in Figure A6.1. Sampling sites were selected to represent a range of land management practices within the watershed and were based on the availability of past monitoring data. The sampling program is designed to characterize water quality of both base flow and storm events at smaller, tributary stream sites. Smaller stream sites were chosen, because it is anticipated that changes in water quality will occur more quickly in these smaller watersheds than in larger watershed areas and that changes observed can be more readily related to changes in land management.

Because NPS runoff is rainfall driven, storm monitoring is very important. Storm samples will be collected throughout the extent of selected events and aggregated to obtain an event mean concentration. The project is budgeted to collect and analyze a maximum of 208 storm samples over a 12 month monitoring period or about 8 events per site each year assuming events are two days in duration. Based on historical monitoring efforts, this means that only about half of all storm events under average rainfall conditions will be monitored. Efforts will be made to sample storm events that are representative of NPS conditions throughout the monitoring period to best meet project objectives. Sampling at tributary sites is completely weather-dependent so the number of events sampled during the project cannot be guaranteed.

The current project represents a continuation of earlier CWA Section 319(h) projects[1] using a microwatershed approach to evaluate reductions in phosphorus loadings and to target areas where producer assistance may be needed. Continued monitoring of these sites is desired to better assess improvements in water quality associated with TMDL I-Plan management efforts.

Data collected will be such that it can be analyzed using trend[2] and/or before/after[3] statistical analysis methods to demonstrate the effectiveness of I-Plan management practices. Trend analysis would focus on decreases in event mean concentrations of nutrients and bacteria during the TMDL implementation period. The before/after evaluation would require a period of pre-BMP data to be used as a baseline, and then a period of time to collect samples following BMP implementation. Hence, water quality data collected pre-and post-implementation of the TMDL would be compared to demonstrate the effectiveness of BMPs in reducing nutrient NPS pollution. Historical data, as defined in Section B9, will be used to supplement data collected during this project for the pre- and post-BMP comparisons and trend analysis.

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[1] TSSWCB Projects 01-13 and 01-14, "Technical and Financial Assistance to Dairy Producers and Landowners of the NBR Watershed within the Cross-Timbers and Upper Leon Soil and Water Conservation Districts;" Project 01-17, "Extending TMDL Efforts in the NBR Watershed;" and Project 04-12, "Assessment of Springtime Contributions of Nutrients and Bacteria to the NBR Watershed" and Project 08-09, "Microwatershed-Based Approach to Monitoring and Assessing Water Quality in the NBR Watershed."

[2] U.S. Geological Survey, Techniques of Water-Resources Investigations Book 4, Chapter A3 by D.R. Helsel and R.M. Hirsch.

[3] Grabow, et al., 1999. Detecting Water Quality Changes Before and After BMP Implementation: Use of SAS for Statistical Analysis. NWQEP Notes, No. 93.

Table B1.1 Monitoring Sites and Monitoring Frequencies

CR = County Road; FM = Farm to Market Road; SH = State Highway

Station ID – TIAER/ TCEQ	Site Description	Latitude Longitude (Datum NAD27)	Start Date[1]	End Date	Sample Matrix	Estimated Sampling Frequency (per month)	
						Routine[2]	Wet-Weather Storms[3]
AL020 17604	Alarm Creek at FM 914	32º08’34”N 98º11’37”W	01Feb2010	31July2014	Water	1	2
DB035 17603	Dry Branch near FM 8	32º13’53”N 98º11’53”W	01Feb2010	31July2014	Water	1	2
GB020 17214	Unnamed tributary to Goose Branch between CR 541 and CR 297	32º13’59”N 98º21’15”W	01Feb2010	31July2014	Water	1	2
GC045 17609	Green Creek upstream of SH 6	32º04’40”N 98º13’60”W	01Feb2010	31July2014	Water	1	2
GM060 17610	Gilmore Creek at bend of CR 293	31º58’46”N 98º08’44”W	01Feb2010	31July2014	Water	1	2
IC020 17235	Indian Creek downstream of US 281	32º08’34”N 98º08’37”W	01Feb2010	31July2014	Water	1	2
LD040 17608	Little Duffau Creek at FM 1824	32º04’32”N 98º02’29”W	01Feb2010	31July2014	Water	1	2
LG060 17606	Little Green Creek at FM 914	32º01’46”N 98º12’20”W	01Feb2010	31July2014	Water	1	2
NF009 17223	Unnamed tributary of Scarborough Creek at CR 423	32º18’39”N 98º17’36”W	01Feb2010	31July2014	Water	1	2
NF020 17222	North Fork NBR Scarborough Creek at CR 423	32º18’12”N 98º17’16”W	01Feb2010	31July2014	Water	1	2
NF050 17413	North Fork of NBR at SH 108	32º15’10”N 98º13’27”W	01Feb2010	31July2014	Water	1	2
SF085 17602	South Fork of NBR at SH 108	32º14’16”N 98º12’50”W	01Feb2010	31July2014	Water	1	2
SP020 17242	Spring Creek at CR 271	32º00’09”N 98º06’02”W	01Feb2010	31July2014	Water	1	2

[1] Start date contingent on date of QAPP approval.
[2] Routine samples are scheduled for monthly collection. Samples will be collected only if flow is present. Routine grab samples will not be collected if the creek is dry or pooled.
[3] A maximum of 208 wet-weather samples are budgeted per year for the project representing about half of the potential wet-weather samples occurring on average based on historical runoff data. The actual number of wet-weather samples collected in any given month will depend on weather conditions during the project.

Routine instream water quality samples will be collected from project sampling stations on a monthly basis, when flow is present. Field measurements of dissolved oxygen, water temperature, specific conductance, and pH will occur with all grab sampling. All water samples will be analyzed for TSS and the nutrients described in Table A7.1. In addition, routine grab samples will be analyzed for *E. coli*. Field data and water samples will be collected using procedures detailed in the TCEQ guidance document Surface Water Quality Monitoring Procedures, Volume 1 (RG-415). Table B1.1 lists monitoring stations and frequency of routine sample collection at monitoring sites.

In order to assess water quality of elevated flows due to storm events, ISCO automated water samplers will be used to obtain samples during storm events for nutrient and TSS analyses. Automated samplers will be located at all project sites. Each wet-weather monitoring station will have an ISCO automated sampler with 24 one-liter bottles, a bubbler flow meter, and a housing unit. The automated sampler will be programmed to take liter samples, starting when a significant rise in water level occurs above the bubbler. After the initial sample, samples will be collected sequentially. The general collection sequence may vary by site, but will be structured for more frequent collection early in the storm event (when changes in water quality are most anticipated) with increased time between bottles as the runoff event continues. Sampling will continue until water level drops below the initiation level or it is determined that streamflow is no longer predominately representative of stormwater runoff. Initiation and termination levels may be adjusted during the project, depending on changing conditions. Adjustments to this sampling regime may become necessary due to the unique responsiveness of each site and storm event and needs to collect representative storm samples within project budget limitations. Wet-weather samples will be composited and analyzed for nutrient forms and TSS.

Flow will be measured on an opportunistic basis throughout the project to reflect a variety of water levels for the maintenance and revision of previously developed stage-discharge relationships for each site. Flow measurements will be conducted using a SonTek FlowTracker, Global Water FlowProbe or other appropriate equipment as dictated by water levels and equipment availability.

The water level data recorded by the flow meter as well as the sample partition indicating the time each sequential sample was collected will be down-loaded when storm samples are retrieved, so the storm hydrograph can be used to flow-weight samples in the lab. Flow rates will be determined according to specific level to flow rate relationships at each site. Stormwater samples from designated events will be retrieved within 36 hours, except on weekends. If storm samplers are initiated on weekends for a designated event, storm samples will be retrieved as soon as possible on Monday morning. If a storm that is being monitored was initiated during the week and continues through the weekend, storm samples will be retrieved throughout the weekend. Sample bottles will be collected, iced, transported to the TIAER laboratory, and composited, based on a flow-weighting program developed by TIAER using a maximum of 36 hours between the first and last bottle in a composite sample.

Project funds were budgeted for the collection and analysis of a maximum of 208 wet weather samples for all sampling sites per year, which represents about half the potential storm samples anticipated under average rainfall conditions based on historical data. Due to the unpredictable nature of wet weather monitoring, TIAER is not able to guarantee a set number of wet weather samples from each station. If stream conditions such as resulting from appreciably greater than average rainfall result in the likelihood of more samples than budgeted, corrective measures, such as discarding samples from small runoff events, will be implemented to reduce sample load and yet provide representative sampling over the three-year duration of the project sampling period. Efforts will be made to make sure storm samples are representative of NPS conditions throughout the monitoring period to best meet project objectives.

If for some reason during a designated event, wet-weather samples cannot be collected by the automated sampler at a station (e.g., distributor arm jam, sedimentation over intake line, flooding), a storm grab, if possible, will be collected by the field crew when the sampler is checked for storm samples. The TIAER project manager or designee will be consulted concerning the malfunctioning automated sampler to determine whether or not the storm grab should be analyzed by the lab. If a sampler is inoperative for an extended period of time during elevated flows, daily storm grabs may be collected in lieu of automated samples until the sampler is fixed, assuming a grab sample can safely be collected and the site is not in backwater. The collection and laboratory analysis of storm grab samples will be done in consultation with the TIAER project manager or designee.

During times of sub-freezing weather (e.g., daily high temperatures below freezing or forecast in the 20s in degrees Fahrenheit or below overnight), it may be necessary to turn off samplers and flow meters to protect the equipment. The sampling lines have been insulated, but there are still incidences when the lines can freeze. The primary concern is that when water levels are low, the bubbler line can freeze over, inhibiting the ability of the bubbler to force air from the line. This may result in the flow meter's air pump running constantly, burning up the motor. If it becomes this cold, it is likely the surface of these stream stations will freeze, prohibiting the collection of a grab sample as well. Samplers will be restarted as soon as the weather allows.

B2 SAMPLING METHODS

Field Sampling Procedures

Routine sample collection will follow field sampling procedures documented in the TCEQ Surface Water Quality Monitoring (SWQM) Procedures Manual (most recent addition). Container types, expected sample volumes, preservation requirements, and holding time requirements are specified in Table B2.1 for routine samples.

Table B2.1 Sample Storage, Preservation and Handling Requirements for Routine Samples

Parameter	Matrix	Container	Field Preservation[a]	Expected Sample Volume	Holding Time
Nitrite+nitrate-Nitrogen	Water	Pre-cleaned plastic	Filter within 15 minutes; pH<2 with H_2SO_4; cool to >0 to $\leq$6ºC	60 mL[b]	28 days
Total Phosphorus	Water	Pre-cleaned plastic	pH<2 with H_2SO_4; cool to >0 to $\leq$6ºC	250 mL[c]	28 days
Total Kjeldahl Nitrogen	Water	Pre-cleaned plastic	pH<2 with H_2SO_4; cool to >0 to $\leq$6ºC	250 mL[c]	28 days
Total Suspended Solids	Water	Pre-cleaned plastic	Cool to >0 to $\leq$6ºC	500 mL[e]	7 days
Ammonia Nitrogen	Water	Pre-cleaned plastic	Filter within 15 minutes; pH<2 with H_2SO_4; cool to >0 to $\leq$6ºC	60 mL[b]	28 days
Orthophosphate-Phosphorus	Water	Pre-cleaned plastic	Filter within 15 minutes; cool to >0 to $\leq$6ºC	50 mL	48 hours
E. coli	Water	Sterile plastic	Add sodium thiosulfate; cool to >0 to $\leq$6ºC	250 mL	8 hours [d]

[a] If samples have too much sediment for field filtration, they may be filtered and acidified, as needed, in the laboratory. All samples will be transported on ice and temperatures will be checked upon receipt.
[b] The same 60 mL is used for the analysis of nitrite+nitrate-nitrogen and ammonia-nitrogen.
[c] The same 250 mL is used for the analysis of total phosphorus and total Kjeldahl nitrogen.
[d] A holding time of up to 48 hours for *E.coli* samples may be used when transport conditions necessitate delays in delivery longer than 6-hours.
[e] Under conditions where there are low TSS levels, more volume may be needed by the lab to meet method specifications. When waters appear to be very clear, the field crew is requested to collect 1 L rather than 500 mL for TSS.

Routine samples for nutrients are collected in a liter plastic bottle. Aliquots for analytes requiring filtration and/or acidification will be taken from this bottle, after it has been agitated thoroughly to ensure total mixing of sediments that may have settled. Project samples that require field filtration are filtered in the field using a 0.45-micron filter generally using a filtration pump, although other filtration equipment may be used. An aliquot for NO_2-N+NO_3-N and NH_3-N is filtered and transferred to an acidified 60-mL plastic bottle, labeled as indicated in Section B3, capped, and shaken to disperse the acid in the sample. A filtered aliquot for PO_4-P is iced and submitted to the lab in an appropriate sample container. An aliquot for Total Phosphorous and Total Kjeldahl Nitrogen is poured from the liter bottle into a labeled and acidified 250-mL plastic bottle, which is capped and shaken to disperse the acid. For TSS, samples are collected in a separate plastic liter bottle (or two 1-L bottles if the water is very clear and low TSS concentrations are anticipated, see Table B2.1). The nutrient aliquots and TSS bottle (or bottles) are submitted to the laboratory for analysis.

Bacteria samples are collected in sterile, disposable plastic 290 ml bottles that have been factory autoclaved and sealed and include an addition of powdered sodium thiosulfate to minimize the impact of potential chlorine residuals. All samples for bacteria will be screened in the laboratory for the presence of chlorine residual. Bacteria samples are labeled as outlined in Section B3, iced immediately in the field, and transported to the laboratory.

All automated samplers for wet-weather sampling will consist of an ISCO 4230 or 3230 bubbler-type flow meter and an ISCO 6712 or 3700 sampler, both enclosed in a sheet metal shelter. Of note, TIAER maintains older ISCO equipment as backup equipment for use if malfunctions occur and temporary replacement of equipment is needed. Automated storm samples are collected in one-liter plastic bottles throughout the hydrograph. When retrieved, each bottle is labeled with site name and bottle number. Samples are transported on ice to the lab. At the lab, storm samples are flow-weight composited using a TIAER computer program that correlates collection time with estimated flow, which is calculated using downloaded level data and the site's rating curve. Samples are filtered and acidified after being composited and divided into analyte aliquots. Container types, field preservation, expected sample volumes, and holding time requirements are specified in Table B2.2 for wet-weather samples. Assuming the composite sample is a full liter, an aliquot of 250 mL would be obtained for analysis of TKN and total P, an aliquot of 100 mL for NH_3-N and NO_2-N+NO_3-N, 150 mL for PO_4-P, and 500 mL for TSS. Although rare for storm samples, if the composite sample appears to have fairly little sediment, a second composite sample should be prepared to increase the available volume for TSS analysis.

Table B2.2 Sample Storage, Preservation and Handling Requirements for Automated Wet-Weather Samples

Parameter	Matrix	Container	Field Preservation[a]	Expected Sample Volume	Holding Time
Nitrite + nitrate-Nitrogen	Water	Pre-cleaned plastic	Cool to >0 to ≤6ºC	100 mL[b]	28 days
Total Phosphorus	Water	Pre-cleaned plastic	Cool to >0 to ≤6ºC	250 mL[c]	28 days
Total Kjeldahl Nitrogen	Water	Pre-cleaned plastic	Cool to >0 to ≤6ºC	250 mL[c]	28 days
Total Suspended Solids	Water	Pre-cleaned plastic	Cool to >0 to ≤6ºC	500 mL [d]	7 days
Ammonia Nitrogen	Water	Pre-cleaned plastic	Cool to >0 to ≤6ºC	100 mL[b]	28 days
Orthophosphate-Phosphorus	Water	Pre-cleaned plastic	Cool to >0 to ≤6ºC	150 mL	48 hours

[a] Automated samples are composited, then filtered and acidified, as necessary, in the laboratory. All samples will be transported on ice and temperatures will be checked upon receipt.
[b] The same 100 mL is used for the analysis of nitrite + nitrate-nitrogen and ammonia-nitrogen.
[c] The same 250 mL is used for the analysis of total phosphorus and total Kjeldahl nitrogen.
[d] Under conditions where there are low TSS levels, more volume may be needed by the lab to meet method specifications. When waters appear to be very clear, a second sample may be composited to allow at least 1 L rather than 500 mL for TSS.

Sample Containers

Sample containers are reusable plastic bottles, except for sterile bacteria containers and syringes used in the field for filtering, which are disposable containers. Reusable containers are thoroughly cleaned upon receipt before initial use and after each use, if reused. Reusable containers are cleaned by washing them in hot, soapy (non-phosphate) water. Containers are then rinsed first in warm tap water, then with 1 N hot HCl, and finally rinsed at least three times in type II ASTM (American Society for Testing and Materials) water, i.e., water with conductivity of less than 1 microsiemen per centimeter (µS/cm). Containers are then placed on a rack to dry. The following TIAER document contains the specific steps used for container cleaning and is available for review upon request:

QAM-I-116 Preparation of Labware (includes sampling bottles and equipment used in field operations)

TIAER's tracking system to detect contamination resulting from the washing procedure is based on method blanks. One method blank is evaluated with each preparation batch of 20 samples or less by analyzing deionized water in the same manner as environmental samples. Each lot of sterile, disposal bacteria containers is also tested for sterility as part of the bacterial analyses QC. If any measured concentration is greater than the LOQ, the method blank fails and is reanalyzed. If the method blank fails a second time, data are flagged for review by the Project Manager and QAO. Sources of contamination are remediated, if found. Corrective action documentation is maintained for all method blanks that exceed the LOQ.

Processes to Prevent Contamination

The TCEQ SWQM Procedures outline the necessary steps to prevent contamination of samples. These include direct collection into sample containers, when possible, and use of pre-cleaned sample containers.

For wet-weather samples collected with automated samplers, the sampler back-flushes the collection line before pulling each sample. As part of monthly maintenance, the steel strainer and bubbler lines are cleaned of debris or anything that might inhibit correct operation of the sampling equipment. The strainer is cleaned with a wire brush to remove rust and possible algae growth. The end of the bubbler line is also cleaned with a wire brush and a piece of wire is used to clean the inside of the bubbler line of any sand, silt or algae. Each sampler is manually enabled to determine if the sampler would respond to a storm event. As part of quarterly maintenance, the line for sample collection is cleaned using 1 N HCl. After washing the line with acid, the line is triple rinsed with deionized water.

Documentation of Field Sampling Activities

Field sampling activities are documented on Field Data Sheets for routine samples and on GM Sheets for automated wet-weather samples. Both types of field data sheets are included in Appendix A. For all routine visits, station ID, location, sampling time, sampling date, sampling depth, and sample collector's name/signature are recorded. Preservatives added to routine samples are indicated by the test group code marked on the COC and sample container in which it is delivered to the laboratory. Values for all measured field parameters (water temperature, pH, dissolved oxygen and conductivity) are recorded electronically by the data sonde and are also written on the field data sheet.

Recording Data

For the purposes of this section and subsequent sections, all field and laboratory personnel follow the basic rules for recording information as documented below:

1. Legible writing in indelible ink with no modifications, write-overs or cross-outs;
2. Correction of errors with a single line followed by an initial and date;
3. Close-out on incomplete pages with an initialed and dated diagonal line.

Deficiencies, Nonconformances and Corrective Action Related to Sampling Requirements

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP. Nonconformances are deficiencies that affect quality and render data unacceptable or indeterminate. Deficiencies related to sampling method requirements include, but are not limited to, such things as sample container, volume, and preservation variations, improper/inadequate storage temperature, holding-time exceedances, and sample site adjustments.

Deficiencies are documented in logbooks and field data sheets by field or laboratory staff and reported via Corrective Action Report (CAR) to the pertinent field or laboratory supervisor. The supervisor will forward the CAR to the Project QAO. If the situation requires an immediate decision concerning data quality or quantity, the TIAER Project Manager will be notified within 24 hours. The TIAER Project Manager will notify the TIAER Project QAO of the potential nonconformance. The TIAER QAO will record and track the CAR to document the deficiency.

The TIAER Project QAO, in consultation as appropriate with the TIAER Project Manager (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the CAR will be completed accordingly and closed. If it is determined that a nonconformance does exist, the TIAER Project Manager in consultation with TIAER QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by completion of a CAR, which is retained by the TIAER Project QAO.

CAR document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. The TSSWCB will be notified of excursions that affect data quality (i.e., deficiencies that lead to nonconformances) with quarterly progress reports. In addition, significant conditions (i.e., situations that, if uncorrected, could have a serious effect on safety or validity or integrity of data) will be reported to the TSSWCB immediately.

B3 SAMPLE HANDLING AND CUSTODY

Chain-of-Custody

Water quality data are generated in the field and the TIAER analytical laboratory. A COC form is used to record sample identification parameters and to document the submission of samples from the field staff to the analytical laboratory staff. Each COC has space to record data for at least 10 separate samples. An example of the COC is found in Appendix B. For samples collected by automated samplers that will be composited, a computer printout for each site showing aliquot volumes should be attached to the COC. For grab samples, a field data sheet for each site is attached to the COC. COCs and accompanying data sheets are kept in three-ring binders in TIAER offices for at least five years.

The field staff member submitting the sample transfers possession of samples to a laboratory staff member or alerts a laboratory staff member and leaves the sample containers, COCs and other paperwork in a secured area. The field staff member and the laboratory staff member both sign and date the COC. A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The COC form is used to document sample handling during transfer from the field to the laboratory. For this project, there will be no subcontract laboratories. All lab work will be performed by TIAER. The following information concerning the sample is recorded on the COC form (See Appendix B).

1. Date and time of collection
2. Site identification
3. Sample matrix, indicated by test group code
4. Number of containers and container type ID designation
5. Preservative used or if the sample was filtered, indicated by test group code
6. Sample composite information (bottle numbers and ending time)
7. Analyses required, indicated by test group code
8. Name of collector
9. Custody transfer signatures and dates and time of transfer
10. Name of laboratory admitting the sample

Sample Labeling

Water samples are labeled on the container with an indelible marker. Label information from the field crew includes:

1. Station identification
2. Time of sampling (or bottle number for composited samples)
3. Date of sampling
4. Preservation (if applicable)

These unique identifiers on the sample container can be matched with data on COC forms that are submitted to the laboratory generally the same day as samples are collected. Laboratory personnel then add information on container type ID designation, test group code, and sample number with log in of each sample, so it is clearly indicated what analytes need to be analyzed from each container.

The field staff member documents on a field data sheet the station, date, time, location, and sample type and pertinent comments. These identifying data are copied in ink or typed onto a COC. A unique sample identification number is assigned to water samples at the TIAER office and written in indelible ink on the sample container and on the COC. The sample identification number, time, date and station location serve to match the sample with the data on the COC.

Sample Handling

All samples are collected according to TCEQ SWQM procedures. All water samples are iced in the field and submitted to the laboratory on ice the same day they are collected in the field or retrieved from an automated sampler.

After samples are received at the laboratory, they are inventoried against the accompanying COC. Any discrepancies are noted at that time, remediated if possible, and the COC is signed for acceptance of custody. Sample numbers are assigned, and samples are checked for preservation (as allowed by the specific analytical procedure). Samples are then filtered or pretreated as necessary and placed in a refrigerated cooler dedicated to sample storage, as required.

The laboratory manager has the responsibility to ensure that all holding times are met (see Tables B2.1 and B2.2). Any problems will be documented with a CAR.

Deficiencies, Nonconformances and Corrective Action Related to Chain-of-Custody

Deficiencies are defined as unauthorized deviation from procedures documented in the QAPP. Nonconformances are deficiencies that affect quality and render the data unacceptable or indeterminate. Deficiencies related to COC include but are not limited to delays in transfer, resulting in holding time violations; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc.

Deficiencies are documented in logbooks and field data sheets by field or laboratory staff and reported via CAR to the pertinent field or laboratory supervisor. The supervisor will forward the CAR to the Project QAO. If the situation requires an immediate decision concerning data quality or quantity, the TIAER Project Manager will be notified within 24 hours. The TIAER Project Manager will notify the TIAER Project QAO of the potential nonconformance. The TIAER Project QAO will record and track the CAR to document the deficiency.

The TIAER Project QAO, in consultation as appropriate with the TIAER Project Manager (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the CAR will be completed accordingly and closed. If it is determined that a nonconformance does exist, the TIAER Project Manager in consultation with TIAER Project QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by completion of a CAR, which is retained by the TIAER Project QAO.

CAR document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. The TSSWCB will be notified of excursions that affect data quality with quarterly progress reports. In addition, significant conditions (i.e., situations that, if uncorrected, could have a serious effect on safety or validity or integrity of data) will be reported to TSSWCB immediately.

B4 ANALYTICAL METHODS

Dissolved oxygen, water temperature, conductivity and pH of water at sampling sites for this project will be measured *in-situ* using YSI multiprobe field sampling equipment. The remainder of the parameters will be analyzed by TIAER at Tarleton State University in Stephenville, Texas. A listing of analytical methods and equipment is provided in Table B4-1. Standard operating procedures have been established for all procedures undertaken by TIAER staff that concerns water quality monitoring and analysis, and copies of the SOPs are available upon request.

In the event of a failure in the analytical system, the Project Manager will be notified. The Laboratory Manager, Project QAO, and Project Manager will then determine if the existing sample integrity is intact, if re-sampling can and should be done, or if data should be omitted.

Table B4.1. Laboratory and Field Analytical Methods and Equipment

Parameter	Method[1]	Equipment Used
Laboratory Parameters		
Ammonia Nitrogen	SM 4500 NH3 G	Lachat QuickChem Autoanalyzer
Nitrite-Nitrogen+Nitrate Nitrogen	SM 4500-NO3 F	Lachat QuickChem Autoanalyzer
Total Kjeldahl Nitrogen	SM 4500-NH3 G	Lachat QuickChem Autoanalyzer w/ Tecator block digester
Orthophosphate Phosphorus	SM 4500P-E	Beckman DU-640 Spectrophotometer or equivalent
Total Phosphorus	EPA 365.4	Lachat QuickChem Autoanalyzer w/ Tecator block digester
Total Suspended Solids	SM 2540 D	Sartorius AC210P analytical balance, oven
Escherichia coli	IDEXX Colilert	Incubator, IDEXX Quantitray sealer
Field Parameters		
Dissolved Oxygen	EPA 360.1	YSI Multiprobe
Potential Hydrogen	EPA 150.1	YSI Multiprobe
Specific Conductance	EPA 120.1	YSI Multiprobe
Water Temperature	EPA 170.1	YSI Multiprobe
Flow	TCEQ SWQM	Global Water FlowProbe, Pygmy Flow Meter, Price Flow Meter, SonTek FlowTracker, RDI- Acoustic Doppler Current Profiler, or Gage Recording

[1] Some methods are modified by TIAER as outlined in Table A7.1.
EPA = Methods for Chemical Analysis of Water and Wastes, March 1983
SM = Standard Methods for Examination of Water and Wastewater, latest online edition
TCEQ SWQM = Texas Commission on Environmental Quality SWQM Procedures, Volume 1 (RG-415)

After samples have been analyzed and results reviewed by the laboratory manager, any remaining sample material will be disposed of appropriately per the analyte's SOP. The goal of TIAER's laboratory is to analyze all samples within the holding time indicated in Tables B2.1 and B2.2.

The analytical methods, associated matrices, and performing laboratories are listed in Table A7.1 of Section A7. Laboratories collecting data under this QAPP are compliant with NELAC

Standards. The TIAER laboratory was granted renewed National Environmental Laboratory Accreditation Program (NELAP) accreditation in January 2013 via TCEQ and maintains accreditation with annual renewals for all laboratory analyses performed for this project. Copies of laboratory SOPs are available for review by the TSSWCB. Laboratory SOPs are consistent with EPA requirements as specified in the method.

Standards Traceability

All standards used in the laboratory are traceable to verified and known amounts of analytes. Standards preparation is fully documented and maintained in a standards log book. The use of standards and reagents are documented when used in preparation and analytical logs. Each documentation includes traceability to purchased stocks, reference to the method of preparation, including concentration, amount used and lot number, date prepared, expiration date and preparer's initials or signature. The reagent bottle is labeled with concentration, date of preparation, expiration date, storage requirements, safety considerations, and a unique identifier that traces the reagent to the standards log book entry.

Analytical Method Modification

Only data generated using approved analytical methodologies as specified in this QAPP will be used as direct data for this project. Requests for method modifications will be documented and submitted for approval to the TSSWCB. Work using modified methods will begin only after the modified procedures have been approved.

Deficiencies, Nonconformances and Corrective Action Related to Analytical Methods

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP. Nonconformances are deficiencies that affect quality and render the data unacceptable or indeterminate. Deficiencies related to field and laboratory measurement systems include but are not limited to instrument malfunctions, blank contamination, quality control sample failures, etc.

Deficiencies are documented in logbooks and field data sheets by field or laboratory staff and reported via CAR to the pertinent field or laboratory supervisor. The supervisor will forward the CAR to the QAO. If the situation requires an immediate decision concerning data quality or quantity, the TIAER Project Manager will be notified within 24 hours. The TIAER Project Manager will notify the TIAER Project QAO of the potential nonconformance. The TIAER Project QAO will record and track the CAR to document the deficiency.

The TIAER Project QAO, in consultation as appropriate with the TIAER Project Manager (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the CAR will be completed accordingly and closed. If it is determined that a nonconformance does exist, the TIAER Project Manager in consultation with TIAER Project QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by completion of a CAR, which is retained by the TIAER Project QAO.

CARs document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. The TSSWCB will be notified of excursions that affect data quality with quarterly progress reports. In addition, significant conditions (i.e., situations that, if uncorrected, could have a serious effect on safety or validity or integrity of data) will be reported to TSSWCB immediately.

B5 QUALITY CONTROL

Sampling Quality Control Requirements and Acceptability Criteria

Field Split - A field split is a single sample subdivided by field staff immediately following collection and submitted to the laboratory as two separately identified samples. This requirement applies to composited grab samples as well as single grab samples, but not to automated samples or bacteria samples. Field splits will be collected on a 10% basis for instream routine samples. Because at times few if any project sites may be flowing, particularly during the summer when monthly grabs are scheduled, TIAER may use a field split collected for other projects in evaluating the handling of samples by the field crew. The precision of field split results is calculated by relative percent difference (RPD) using the following equation:

$$RPD = (X_1 - X_2)/((X_1 + X_2)/2))$$

A 30% RPD criteria will be used to screen field split results as a possible indicator of excessive variability in the sample handling and analytical system. If it is determined that elevated quantities of analyte (i.e., > 5 times the LOQ) were measured and analytical variability can be eliminated as a factor, then variability in field split results will be used to trigger discussions with field staff to ensure samples are being handled in the field correctly. Some individual sample results may be invalidated based on the examination of all extenuating information. The information derived from field splits is generally considered to be event specific and would not normally be used to determine the validity of an entire batch; however, some batches of samples may be invalidated depending on the situation. Professional judgment during data validation will be relied upon to interpret the results and take appropriate action. Deficiencies will be addressed as specified in this section under Deficiencies, Nonconformances, and Correction Action related to QC.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Method Specific QC requirements – QC samples, other than those specified later this section, are run (e.g., sample duplicates, surrogates, internal standards, continuing calibration samples, interference check samples, positive control, negative control, and media blank) as specified in the methods. The requirements for these samples, their acceptance criteria or instructions for establishing criteria, and corrective actions are method-specific.

Detailed laboratory QC requirements and corrective action procedures are contained within the individual laboratory QAMs. The minimum requirements that all participants abide by are stated below.

Limit of Quantitation (LOQ) – The laboratory will analyze a calibration standard (if applicable) at the LOQ on each day project samples are analyzed. Calibrations including the standard at the LOQ will meet the calibration requirements of the analytical method or corrective action will be implemented.

LOQ Check Standard – An LOQ check standard consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system at the lower limits of analysis. The LOQ check standard is spiked into the sample matrix at a level less than or near the LOQ for each analyte for each batch of samples that are run.

The LOQ check standard is carried through the complete preparation and analytical process. LOQ Check Standards are run at a rate of one per preparation batch. A preparation batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples.

The percent recovery of the LOQ check standard is calculated using the following equation in which %R is percent recovery, SR is the sample result, and SA is the reference concentration for the check standard:

$$\%R = SR/SA * 100$$

Measurement performance specifications are used to determine the acceptability of LOQ Check Standard analyses as specified in Table A7.1 in defining deficiencies.

As noted above, the LOQ check standard will be used for information in determining the performance of the measurement system at the lower limits of analysis and not as a sole criterion for determining overall data acceptability for a batch.

Laboratory Control Sample (LCS) - An LCS consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system. The LCS is spiked into the sample matrix at a level less than or near the mid point of the calibration for each analyte. In cases of test methods with very long lists of analytes, LCSs are prepared with all the target analytes and not just a representative number, except in cases of organic analytes with multipeak responses.

The LCS is carried through the complete preparation and analytical process. LCSs are run at a rate of one per preparation batch. A preparation batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples.

Results of LCSs are calculated by percent recovery (%R), which is defined as 100 times the measured concentration, divided by the true concentration of the spiked sample.

The following formula is used to calculate percent recovery, where %R is percent recovery; SR is the measured result; and SA is the true result:

$$\%R = SR/SA * 100$$

Measurement performance specifications are used to determine the acceptability of LCS analyses as specified in Table A7.1 in defining deficiencies.

Laboratory Duplicates – A laboratory duplicate is prepared by taking aliquots of a sample from the same container under laboratory conditions and processed and analyzed independently. A laboratory control sample duplicate (LCSD) is prepared in the laboratory by splitting aliquots of an LCS. Both samples are carried through the entire preparation and analytical process. LCSDs are used to assess precision and are performed at a rate of one per preparation batch. A preparation batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples.

For most parameters, precision is calculated by the relative percent difference (RPD) of LCS duplicate results as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set. For duplicate results, X_1 and X_2, the RPD is calculated from the following equation:

$$RPD = (X_1 - X_2)/\{(X_1+X_2)/2\} * 100$$

A bacteriological duplicate is considered to be a special type of laboratory duplicate and applies when bacteriological samples are run in the field as well as in the lab. Bacteriological duplicate analyses are performed on samples from the sample bottle on a 10% basis. Results of bacteriological duplicates are evaluated by calculating the logarithm of each result and determining the range of each pair.

Measurement performance specifications are used to determine the acceptability of duplicate analyses-as specified in Table A7.1 in defining deficiencies. The specifications for bacteriological duplicates in Table A7.1 apply to samples with concentrations > 20 MPN/100mL.

Matrix spikes are prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Percent recovery of the known concentration of added analyte is used to assess accuracy of the analytical process. The spiking occurs prior to sample preparation and analysis. Spiked samples are routinely prepared and analyzed at a rate based on the analytical method, or one per quality control batch whichever is greater. A quality control batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 10 environmental samples. The information from these controls is sample/matrix specific and is not used to determine the validity of the entire batch. The matrix spike is spiked at a level less than or equal to the midpoint of the calibration or analysis range for each analyte. Percent recovery (%R) is defined as 100 times the observed concentration, minus the sample concentration, divided by the true concentration of the spike.

The results from matrix spikes are primarily designed to assess the validity of analytical results in a given matrix and are expressed as percent recovery (%R). The laboratory shall document the calculation for %R. The percent recovery of the matrix spike is calculated using the following equation in which %R is percent recovery, SSR is the observed spiked sample concentration, SR is the sample result, and SA is the reference concentration of the spike added:

$$\%R = (SSR - SR)/SA * 100$$

Measurement performance specifications for matrix spikes are not specified in this document.

The results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory shall determine the internal criteria and document the method used to establish the limits. Matrix spike results outside established criteria shall be documented or the data reported with appropriate data qualifying codes.

<u>Method blank</u> –A method blank is a sample of matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as the samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination from the analytical process. The analysis of method blanks should yield values less than the LOQ. For very high-level analyses, the blank value should be less than 5% of the lowest value of the batch, or corrective action will be implemented.

Deficiencies, Nonconformances and Corrective Action Related to Quality Control

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP. Nonconformances are deficiencies that affect quality and render the data unacceptable or indeterminate. Deficiencies related to QC include but are not limited to QC sample failures.

Deficiencies are documented in logbooks and field data sheets by field or laboratory staff and reported via CAR to the pertinent field or laboratory supervisor. The supervisor will forward the CAR to the Project QAO. If the situation requires an immediate decision concerning data quality or quantity, the TIAER Project Manager will be notified within 24 hours. The TIAER Project Manager will notify the TIAER Project QAO of the potential nonconformance. The TIAER Project QAO will record and track the CAR to document the deficiency.

The TIAER Project QAO, in consultation as appropriate with the TIAER Project Manager (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the CAR will be completed accordingly and closed. If it is determined that a nonconformance does exist, the TIAER Project Manager in consultation with TIAER Project QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by completion of a Corrective Action Report, which is retained by the TIAER Project QAO.

CAR document: root cause(s); programmatic impact(s); specific corrective action(s) to address the deficiency; action(s) prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. The TSSWCB will be notified of excursions that affect data quality with quarterly progress reports. In addition, significant conditions (i.e., situations that, if uncorrected, could have a serious effect on safety or validity or integrity of data) will be reported to the TSSWCB immediately.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

Automated sampler testing and maintenance requirements are outlined in the following SOPs, which are available upon request for review:

- TIAER SOP-F-112 Programming Automated Samplers
- TIAER SOP-F-114 Downloading Automated Sampling Sites

All automated sampling equipment (ISCO samplers and flow meters) will be inspected monthly and serviced as needed by the field crew with a report going to the field supervisor. A GM sheet will be filled out for each sampling site during each GM inspection (Appendix A). The GM sheet contains a checklist for all equipment and routine maintenance activities. Any equipment that needs attention will be serviced during the GM inspection. Backup equipment will be maintained by TIAER so that failing equipment can be replaced as soon as possible. As part of monthly maintenance, sites are manually enabled to make sure the sampler will pull a sample under wet-weather conditions. Any deficiencies will be noted on the GM sheet as well as corrective actions. If during GM, it is found that sample integrity may be in question, a CAR will be filled out for the samples impacted.

Maintenance requirements for YSI multiprobes are detailed in the TCEQ SWQM Procedures. Maintenance requirements for velocity measurement equipment follow manufacturer guidelines. Sampling equipment is inspected and tested upon receipt and is assured appropriate for use. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory QAM and are inspected by appropriate laboratory personnel under the supervision of the laboratory manager. Testing and maintenance records are maintained and are available for inspection by the TSSWCB. Instruments requiring daily or in-use testing include, but are not limited to, water baths, ovens, autoclaves, incubators, refrigerators, and laboratory-pure water. Critical spare parts for essential equipment are maintained to prevent downtime. Maintenance records are available for inspection by the TSSWCB. Any deficiencies will be noted and how these deficiencies were resolved as part of routine maintenance records. If during routine maintenance of laboratory equipment, it is found that sample integrity may be in question, a CAR will be filled out for the samples impacted.

B7 INSTRUMENT CALIBRATION AND FREQUENCY

Calibration requirements for automated monitoring equipment are outlined in the following SOPs, which are available upon request for review:

- TIAER SOP-F-112 Programming Automated Samplers
- TIAER SOP-F-114 Downloading Automated Sampling Sites

Calibration requirements for other field equipment are contained in the TCEQ SWQM Procedures. Post-calibration error limits will be adhered to. Data not meeting post-error limit requirements invalidates associated data collected subsequent to the pre-calibration and will not be used for evaluation of project objectives.

Detailed laboratory calibrations are contained within the laboratory SOPs. The laboratory SOPs identify all tools, gauges, instruments, and other sampling, measuring, and test equipment used for data collection activities affecting quality that must be controlled and, at specified periods, calibrated to maintain bias within specified limits. Calibration records are maintained, are traceable to the instrument, and are available for inspection by the TSSWCB. Equipment requiring periodic calibrations include, but are not limited to, thermometers, pH meters, balances, incubators, and analytical instruments.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Chemicals for analysis are tested by the supplier and meet or exceed ACS certification, where applicable.

All supplies and consumables received by the TIAER chemistry laboratory are inspected upon receipt for damage, missing parts, expiration date, and storage and handling requirements by appropriate laboratory personnel. Labels on reagents, chemicals, and standards are examined to ensure they are of appropriate quality, initialed by staff member and marked with receipt date. Volumetric glassware is inspected to ensure class "A" classification, where required.

B9 NON-DIRECT MEASUREMENTS

TIAER has collected data from project sites, beginning as early as 1992, under a variety of quality assurance project plans that may be used in conjunction with the direct data collected under the current project for future statistical evaluations. These QAPPs include the following:

1. Data collected by TIAER in the Upper NBR Watershed under the USEPA-sponsored Livestock and the Environment: A National Pilot Project (NPP). The QAPP is the TIAER document entitled Quality Assurance Project Plan for the National Pilot Project (1993), which encompasses data collected from June 1, 1992 through August 31, 1995. Data that may be used from this project includes water quality, rainfall, and water level (streamflow).
2. Data collected by the BRA and TIAER, as a subcontractor, under the TCEQ Clean Rivers Program. The QAPP is the BRA document entitled, "Quality Assurance Project Plan for the Bosque River Watershed Pilot Project," (1995) which encompasses data collected from October 1, 1995 through May 31, 1996. Data that may be used from this project includes water quality, rainfall and water level (streamflow).
3. Data collected by TIAER under the USDA Lake Waco-Bosque River Initiative. The QAPPs are TIAER documents entitled, "Quality Assurance Project Plan for the Lake Waco-Bosque River Initiative," (1996, 1997-99, 1999-2000, 2000-2003, and 2003 - 2005) which encompasses data collected from September 1, 1996 through September 1, 2005. A QAPP for data collected from September 2005 and continuing through August 2006 was approved by TCEQ and is entitled, "United States Department of Agriculture Bosque River Initiative Quality Assurance Project Plan," Revision 6. Data that may be used from this project includes water quality, rainfall and water level (streamflow).
4. Data collected by TIAER under the CWA Section 319(h) NPS Pollution Control Program the following projects:
    - "Technical and Financial Assistance to Dairy Producers and Landowners of the NBR Watershed within the Cross Timbers Soil and Water Conservation District" (01-13)
    - "Technical and Financial Assistance to Dairy Producers and Landowners of the NBR Watershed within the Upper Leon Soil and Water Conservation District" (01-14)

    These projects include data collected from March 2002 through March 2006 under a TSSWCB and EPA approved QAPP. Data that may be used from these projects include water quality and water level (streamflow).
5. Data collected by TIAER under CWA Section 319(h) NPS Pollution Control Program project funded through TCEQ entitled, "NBR Effectiveness Monitoring." This project will include water quality and flow data collected at mainstem and major tributary sites along the NBR. Monitoring started February 1, 2006 and should continue through August 31, 2010 under a TCEQ and EPA approved QAPP. Data that may be used from this project includes water quality and water level (streamflow).
6. Data collected by TIAER under Clean Water Act Section 319(h) Nonpoint Source Pollution Control Program project funded through TSSWCB entitled, "Extending TMDL Efforts in the NBR Watershed." This project includes data collected from April 2006

through March 2008 under a TSSWCB and EPA approved QAPP. Data that may be used from this project include water quality and water level (streamflow).

7. Data collected by TIAER under CWA Section 319(h) NPS Pollution Control Program project funded through TSSWCB entitled, "Assessment of Springtime Contributions of Nutrients and Bacteria to the NBR Watershed." This project includes data collected from April 2008 through August 2008 under a TSSWCB and EPA approved QAPP. Data that may be used from this project include water quality and water level (streamflow).
8. Data collected by TIAER under Clean Water Act Section 319(h) Nonpoint Source Pollution Control Program project funded through TSSWCB entitled, "Microwatershed-Based Approach to Monitoring and Assessing Water Quality in the NBR Watershed." This project includes data collected from September 2008 through February 2010 under a TSSWCB and EPA approved QAPP. Data that may be used from this project include water quality and water level (streamflow).
9. Data collected by TIAER under the TCEQ project, "North Bosque River Monitoring." This project includes data collected from September 1, 2010 through August 31, 2011 under a TCEQ approved QAPP. Data that may be used from this project include water quality and water level (streamflow).
10. Data collected by TIAER under the TCEQ project, "Evaluating Effectiveness of Implementation Plan (I-Plan) Activities within the North Bosque River Watershed." This project includes data collected from September 1, 2011 through August 31, 2014 under a TCEQ approved QAPP. Data that may be used from this project include water quality and water level (streamflow).

The water quality data associated with the projects listed above were collected and analyzed using similar assessment objectives, sampling techniques, laboratory protocols, and data validation procedures as the current project. One known deviation is in the measurement of bacteria. Prior to 2000 fecal coliform rather than *E. coli* was monitored at stream sites. From November 2000 through March 2004 both *E. coli* and fecal coliform were evaluated to allow comparison of these two types of bacteria data. This period of overlap will be used to determine if fecal coliform can be adjusted to comparable *E. coli* values using accepted statistical methods for comparing different analytical methods. Also, *E. coli* analysis used a membrane filtration technique prior to April 2004, after which the IDEXX Colilert method was used.

Another known deviation is in the reporting limits used for various parameters. For example, prior to September 2003, TIAER used method detection limits rather than AWRLs or LOQs as the reporting limits for data collected at project sites. Some LOQs have also changed over time. Non-direct data should be adjusted as appropriate for each constituent prior to statistical evaluation to make sure that these differences in reporting limits do not cause an indication of false trends in the data assessment.

In addition, flow data from the United States Geological Service (USGS) may be used to help determine flows and loadings along the mainstem of the NBR. The USGS maintains a high flow gauging station near site 11961 at Hico, Texas (gage # 08094800), and records flows at all levels at gauging stations #0809500 (near Clifton and site 11956) and # 08095200 (near Valley Mills and site 11954). TIAER will use USGS stream flow and/or rating curve data for sites 11961, 11954, and 11956, since these stations are either in close proximity to a USGS gauge or have established relationships with a proximate USGS gauge.

Supplemental precipitation data are available from the National Weather Service (NWS) observers in Dublin, Huckabay, Hico, Chalk Mountain, Cranfills Gap, Meridian, Morgan Mill, and Stephenville. Data from additional NWS observer sites may also be considered within or near the borders of the NBR watershed. These precipitation data can be used to augment data obtained from TIAER's network of precipitation gages. TIAER currently maintains a network of six precipitation gage sites in the upper portion of the NBR watershed and historically has had a more expanded network (see Jones, 2004).

B10 DATA MANAGEMENT

Data management, preparation and control procedures for TIAER laboratory standard operating procedures (SOPs) are outlined in QAM-A-101. Laboratory document and data control is addressed in TIAER QAM-A-102. Control of field data sheets is addressed in TIAER SOP-F-100. These SOPs are available for review upon request.

Data Management Process

Water quality samples are collected and transferred from the field to the laboratory for analyses as described in Section B3 using a COC form (Appendix B) following procedures in TIAER QAM-Q-110, Sample Receipt and Login. A unique sample identification number is given to each sample at log in. Identifying sample information and comments are manually entered into the initial database queue. Laboratory measurement results are entered into a secondary database queue, either automatically or manually, depending on the instrument. Following laboratory data verification and validation, the data are transferred from the secondary queue database to the master queue within the TIAER Laboratory Information Management System (LIMS). At this point, any additional manually generated field data or comments are added to the LIMS database by the field crew and validated by a separate individual. Data from TIAER's LIMS are then uploaded to a SAS software database, which is used for statistical evaluation of the data to evaluate project objectives. Procedures and personnel involved in data entry and review are outlined in TIAER QAM-Q-104, Data Entry and Review. The SAS water quality database is the final depository for TIAER water quality data for use and storage for all projects, including the non-direct water quality data outlined in Section B9 analyzed by TIAER for other projects.

Field parameters collected with the YSI multiprobe (pH, water temperature, conductivity, and dissolved oxygen) are automatically downloaded from the instrument and imported into an EXCEL spreadsheet. Printouts of the sonde data are compared with manually entered data on the field data sheets for validation. The electronic sonde data are then exported to a SAS database and automatically merged with the SAS database containing the LIMS data by site, date, and time and again reviewed by field crew personnel to make sure the data merge occurred correctly.

Other ISCO data, such as water level and sample partition information, are downloaded when storm samples are collected for use in flow weight compositing using field laptop computers or modems, where phone lines are available. The field crew maintains hard copies of the sample partition data for storm events. The electronic stage and sample partition data are transferred to a desktop computer in the TIAER laboratory Annex.

For storm samples that will be flow composited, a computer program has been developed by TIAER that correlates five-minute flow data with sample collection times in order to flow-weight composite a group of samples into one. When storm samples are to be composited, a Flowlink program is run which extracts the stream level and sample bottle data and writes this information to an ASCII text file. The ASCII file is imported into a SAS program that generates a report for flow-compositing of samples based on TIAER QAM-Q-112, Sample Compositing.

The results inform the laboratory staff how many milliliters of liquid from each sample bottle to use in creating a composite one-liter sample. For composited samples, field personnel record the date and time of the first and last sample bottles on the COC. The bottle numbers to be used are also recorded in the comment section of the COC.

Water level data for archival purposes is routinely downloaded every two weeks whether wet-weather has occurred or not and stored in a SAS or WISKI database for review. Records of site visits to download the flow meters are kept on the GM sheets (Appendix A). Of note, TIAER obtained the WISKI software package from the Kisters Corporation in December 2005. Stream level data are reviewed in WISKI by appropriate field staff and then transferred back to SAS for storage. Flow is calculated from the water level data using rating curves based on stage-discharge measurements or structural equations that are programmed in SAS. The SAS water level databases act as the final depository TIAER data for use and storage for all projects, including the non-direct data outlined in Section B9 collected under other TIAER projects. Water level and flow data obtained from the USGS as outlined in Section B9 will also be transferred to a SAS database for final storage and usage.

Various SAS programs will be used to format the data appropriately for transfer to the TSSWCB for submittal to SWQMIS and for statistical evaluation of the data, such as trend analysis, to evaluate project objectives.

Chain of Custody Forms

A COC form is used to record water sample identification parameters and to document the submission of samples from the field staff to the analytical laboratory staff (Appendix B). Each COC has space to record data for numerous separate samples. All entries onto the COC forms will either be typed or completed in ink, with any changes made by crossing out the original entry, which should still be legible, and initialing and dating the new entry. COCs are kept in three-ring binders in the TIAER office for at least five years.

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 are entered into a LIMS based on Microsoft Access software, then transferred to a SAS database. Data integrity is maintained by the implementation of password protections that control access to the database and by limiting update rights to a select user group. No data from external sources are maintained in the LIMS 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 and SAS software in a networked environment. Specific hardware need to be configured to run WISKI and FLOWLINK software, but not necessarily in a networked environment. TIAER information resources staff are responsible for assuring that hardware configurations meet the requirements for running current and future data management/database software as well as providing technical support. Software development of the LIMS and SAS applications are based on user requests and are tested for reliability prior to implementation.

As an electronic data protection strategy, TIAER utilizes Double Take software to mirror the primary file server located in Hydrology 2nd floor (* RAID 5 fault tolerant) that will be mirrored to a secondary file server located in Davis Hall 4th floor (* RAID 5 fault tolerant). This provides instant fault recovery rollover capability in the event of hardware failure. TIAER also exercises complete backup of its primary server to tape on a weekly basis, coupled with daily incremental backups. This provides a third level of fault tolerance in the event that both the primary and secondary servers are disabled. TIAER will maintain all cyclic back up tapes for 26 weeks prior to reuse saving the 1st tape in the series indefinitely to preserve a historical snapshot. This will facilitate recovery of data lost due to human error. Backup tapes are stored in a secure area on the Tarleton State University campus and are checked periodically to ensure viability. If necessary, disaster recovery can also be accomplished by manually re-entering the data.

C1 ASSESSMENTS AND RESPONSE ACTIONS

The following table presents the types of assessments and response actions for data collection activities applicable to this project (Table C1.1).

Table C1.1 Assessments and Response Requirements

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	TIAER Project Manager	Monitoring of the project status and records to ensure requirements are being fulfilled	Report to TSSWCB in Quarterly Report
Monitoring Systems Audit of TIAER	Dates to be determined by TSSWCB (minimum of one per life of project)	TSSWCB QAO	The assessment will be tailored in accordance with objectives needed to assure compliance with the QAPP. Field sampling, handling and measurement; facility review; and data management as they relate to the NPS Project	30 days to respond in writing to the TSSWCB to address corrective actions
Laboratory Inspection	Dates to be determined by TSSWCB (minimum of one per life of project)	TSSWCB QAO	Analytical and quality control procedures employed at the TIAER laboratory	30 days to respond in writing to TSSWCB to address corrective actions
Laboratory Management Review	Annually	TIAER Laboratory QAO	Conduct management reviews of the laboratory's quality system to ensure its effectiveness	Not applicable
Laboratory Internal Audits	Throughout the Year	TIAER Laboratory QAO	Conduct internal audits of the quality system to verify that activities comply with the quality system Standard	30 days to respond in writing to Lab QAO to address corrective actions
Internal Monitoring Systems Audit	Based on work plan and/or TIAER discretion	TIAER Project QAO	The assessment will be tailored in accordance with the objectives needed to assure compliance with the QAPP. Field sampling, handling and measurement; facility review; and data management as they relate to the project.	30 days to respond in writing to TIAER Project QAO to address corrective actions
Site Visit	Dates to be determined by TSSWCB (minimum of one per each fiscal year during life of project)	TSSWCB Project Manager	Status of activities. Overall compliance with work plan and QAPP	As needed

Corrective Action

The TIAER Project QAO or Laboratory QAO is responsible for making sure the project manager and appropriate section supervisors are aware of audit findings outlined in any internal or external audit report. The pertinent QAO will maintain records of audit findings and corrective actions. Internal audit reports will be made available to the TSSWCB upon request. External audits conducted by the TSSWCB will include CAR of any findings directly to the TSSWCB.

C2 REPORTS TO MANAGEMENT

Reports to TSSWCB Project Management

Quarterly Progress Report - Summarizes TIAER's activities for each task; reports problems, delays, and corrective actions; and outlines the status of each task's deliverables. Report written by the TIAER project manager.

Monitoring System Audit of TIAER Response - TIAER will respond in writing to the TSSWCB within 30 days upon receipt of a monitoring system audit report from the TSSWCB to address corrective actions. Response written by the TIAER Project QAO.

Laboratory Inspection Response - TIAER will respond in writing to the TSSWCB within 30 days upon receipt of a laboratory inspection report from the TSSWCB to address corrective actions. Response written by the TIAER’s Laboratory QAO.

Final Project Report - Summarizes TIAER's activities for the entire project period including a description and documentation of major project activities; evaluation of project results and environmental benefits; and a conclusion. Report written by or under the guidance of the TIAER project manager with assistance from other staff members.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

For the purposes of this document, data verification is a systematic process for evaluating performance and compliance of a set of data to ascertain its completeness, correctness, and consistency using the methods and criteria defined in the QAPP. Validation means those processes taken independently of the data-generation processes to evaluate the technical usability of the verified data with respect to the planned objectives or intention of the project. Additionally, validation can provide a level of overall confidence in the reporting of the data based on the methods used.

All data obtained from field and laboratory measurements will be reviewed and verified for deficiencies with respect to project specifications listed in Section A7 and QC requirements outlined in Section B5. Deficiencies in measurement performance specification in Section A7 will be reviewed via CARs as outlined in Section B5 to determine acceptability of data. Only those data that are fully supported by appropriate quality control data or are determined after review to meet project objectives despite some deficiencies in specific measurement performance specifications will be considered acceptable and used in the project. The project manager in consultation with the Project QAO, lab manager, field supervisor, and/or others (as needed) will determine data usability when deviations from measurement performance specifications occur. The project manager may consider the magnitude of the deficiency, the impact of the deficiency on the measured value of environmental samples, comparison of environmental sample values with recent historical values, and conformance with other measurement performance specifications as justification for accepting data for use in evaluating project objectives. This justification will be documented in CARs associated with specific deficiencies determined to potentially impact data quality. Justification for determining that deficiencies are nonconformances (unacceptable for data submission) will also be documented in associated CARs.

The procedures for verification and validation of data are described in Section D2. The TIAER Field Supervisor is responsible for ensuring that field data are properly reviewed and verified for integrity. The Laboratory Manager is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and accuracy, and reviewed for integrity. The TIAER Project QAO and project manager will be responsible for ensuring that all data are properly reviewed and verified, and submitted in the required format to the project database. The TIAER Laboratory QAO is responsible for verifying a minimum of 10% of the data produced in each task. Finally, the TIAER Project Manager, with the concurrence of the TIAER Project QAO, is responsible for validating that all data collected and analyzed meet the objectives of the project.

D2 VERIFICATION AND VALIDATION METHODS

All data will be verified to ensure they are representative of the samples analyzed and locations where measurements were made, and that data and associated QC data conform to project specifications and that deficiencies are documented and reviewed to determine nonconformances or data usability. The staff and management of the respective field, laboratory, and data management tasks are responsible for the integrity, validation and verification of the data each task generates or handles throughout each process (Table D2.1). The field and laboratory tasks ensure the verification of raw data, electronically generated data, and data on COC forms and hard copy output from instruments.

Verification, validation and integrity review of laboratory data will be performed using self-assessments and peer review, as appropriate to the project task, followed by technical review by the manager of the task. The data to be verified are evaluated against project performance specifications (Section A7 and B5) and are checked for errors in transcription, calculations, and data input and for deficiencies in performance. If a question arises or an error is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues that can be corrected are corrected and documented electronically or by initialing and dating the associated paperwork. If an issue cannot be corrected, the task manager consults with higher level project management to establish the appropriate course of action, which may include rejection of the data as unusable for the project. Deficiencies to performance specifications are dealt with via CARs and reviewed for potential nonconformances as outlined in Section B5.

The TIAER Project Manager and QAOs are each responsible for validating that verified data are scientifically valid, defensible, of known precision, accuracy, integrity, meet the data quality objectives of the project, and are reportable to TSSWCB. One element of the validation process involves evaluating the data again for anomalies. This validation process involves activities such as verifying values above the TCEQ maximum, evaluating for PO_4-P values that are greater than total-P and NH_3-N values that are greater than TKN, and graphically and/or statistically comparing data by site and sampling type for potential outliers. The manager of the task associated with the suspected data errors or anomalous data must address these issues before data validation can be completed.

A second element of the validation process is consideration of any findings identified during a laboratory or monitoring systems audit conducted by the TSSWCB QAO. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed. Finally, the TIAER Project Manager, with the concurrence of the TIAER Project QAO, validates that the data meet the data quality objectives of the project and are suitable for meeting project objectives for the TSSWCB.

Table D2.1: Data Review Tasks

Field Data Review	Responsibility
Field data reviewed for conformance with data collection, sample handling and chain of custody, analytical and QC requirements	TIAER Field Supervisor
Post-calibrations checked to ensure compliance with error limits	TIAER Field Supervisor
Field data calculated, reduced, and transcribed correctly	TIAER Field Supervisor
Laboratory Data Review	
Laboratory data reviewed for conformance with data collection, sample handling and chain of custody, analytical and QC requirements to include documentation, holding times, sample receipt, sample preparation, sample analysis, project and program QC results, and reporting	TIAER Laboratory Manager
Laboratory data calculated, reduced, and transcribed correctly	TIAER Laboratory Manager
Reporting limits consistent with requirements for Ambient Water Reporting Limits.	TIAER Laboratory Manager
Analytical data documentation evaluated for consistency, reasonableness and/or improper practices	TIAER Laboratory Manager
Analytical QC information evaluated to determine impact on individual analyses	TIAER Laboratory Manager
All laboratory samples analyzed for all parameters	TIAER Laboratory Manager
Data Set Review	
Data reported has all required information as described in Section A9 of the QAPP	TIAER Project QAO
Confirmation that field and lab data have been reviewed	TIAER Project QAO
Data set (to include field and laboratory data) evaluated for reasonableness and if corollary data agree	TIAER Project Manager
Outliers confirmed and documented	TIAER Project QAO and Project Manager
Field QC acceptable (e.g., field splits)	TIAER Project QAO
Sampling and analytical data gaps checked and documented	TIAER Project QAO and Project Manager
Verification and validation confirmed. Data meets conditions of end use and are reportable	TIAER Project Manager

D3 RECONCILIATION WITH USER REQUIREMENTS

Data produced in this project will be analyzed and reconciled with project data quality requirements. Data meeting project requirements will be of a quality that they may be used by the TSSWCB to determine reductions in nonpoint source loadings, specifically those associated with soluble reactive phosphorus related to the NBR TMDL and Implementation Plan, and to aid in targeting locations where further reduction efforts are needed. Data that do not meet project requirements will not be used or transferred for submittal to the SWQM portion of SWQMIS.

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Appendix A. Example Field Data Sheets

General Maintenance

SITE________ DATE _________ TIME (CST)________ INITIALS _______

Level ______________ Enable ___________ callout_______

Battery ___% New En/Dis_________

Desiccants: OK Changed

Bottles: Full of Clean Needs______ Added

Flowmeter SPA652 4230 3230

Sampler :

Display ____________ Reset to SI Yes No

Reset arm to bottle 1 Yes

Checked distributor arm nut

Time interval: Uniform Reset start time Yes Time________

NonUniform Reset start time No

Sampling interval: Time Flow

Line: OK Clear Damaged Silted/Clogged

Purged Acid Washed Test sample collected (monthly)

Position in arm OK Reset

Pump tubing Current counts __________ Alarm counts____________

Changed Reversed Checked all connections

Reset counter # counts _______________ Restart sampler YES

Bubbler: XS OK Silted Scoured Requires new survey

Line OK Clear Damaged Requires new survey

TB Rain Gauge: Clear Cleaned Weekly inches recorded _______

Checked operation Number of tips _____________

QA rain gauge: Clear Cleaned Weekly inches collected _______

Downloaded: **Sampler** **Flowmeter** Met **Viewed graph**

Color Code:___________________

Bottles used for composite: ____

Samples Missed: Yes No CAR number ________

Comments:

Field Data Sheet
Streams
(Working draft: 01SEP11)

Site:TIAER TCEQ	Flowmeter level in ft. (bl sites)	Time:	Investigators:
		Color Code:	Project:
Date:		Location: *run* *glide*	**Observations (select from below):** Wind intensity Dir.(opt.)
Air Temp:		*riffle* *pool*	Present Weather

Hydrological Parameters

Total Depth: ____________ft.

	Sample	*Place Sonde Readings Here*						
Sample #	Depth (ft)	Temp C	Cond *u* s	DO %Sat	DO mg/L	pH	[redacted]	Flow Sev. (select from below)
	*							
	1.00 **							
	record depth	* If total depth is <1.5 ft. collect at 1/3 total de	** If total depth >1.5 ft. collect at 1 ft.					
		Conventional Sample - iced plastic bottle A						
		Bacteria Sample - sterilized bottle S						
		Chlorophyl Sample - dark bottle B						
		Filtered NO2NO3N, NH3N - acidified E						
		TKN, TP acidified D						
		Filtered OPO4 (FPO4) C						
		BOD sample iced plastic A						
		Field Split of Sample __________ Nutrient Fecal Chl						

Estiimated Flow Severity 1. no flow 2. low 3. normal 5. high 4. flood 6. dry
Wind intensity 1. Calm 2. Slight 3. Moderate 4. Strong
Present Weather 1. Clear 2. Pt. Cloudy 3. Cloudy 4. Rain
Last Significant Rainfall (in days) <1 (w/in 24 hrs) 1 2 3 4 5 6 7 >7 (over a week) __________

Flow Field Data **Method** 1-gage 2-electric 3-mechanical 4-weir/flume 5-doppler
Smp No. Start End cfs area^2
__________ ___________ __________ __________ __________

Hi/Lo Drop DO **Atm % Start** **Atm % End** **DO ch** **pH mv**
__________ ______________ _____________ ________ __________

Datasonde used: ________________________________

Comments:
Unusual Observations: (dBase info) ____

____

____

____

General Observations: ____

____

____

Appendix B. Example Chain-of-Custody Form

TiAER ***Chain of Custody / Sample Information Form*** **Page __ of __** **Field data or attachments? (Y/N)**

Client or Project Manager	Client phone:	Sampler(s) and Delivery information	0-6 °C temp. Therm. used:
			T-

TIAER Project Code	TIAER Lab Sample Number	TIAER Test Group Code	Sample Date(s) (mm/dd/yy)	Sample Time(s) (hh:mm) CST for TIAER	Client Sample or Site ID	Sample Type	Matrix	Preservative	Preservative and Container types/ number	Comments (if applicable): Flow Weighted data start/end date/time:	bottle numbers:	Other notes (special turnaround times requested may incur premium charges):	Composite only - last bottle collection date/time:	pH <2 check	temp check	Disposed

Relinquished by:	Date/Time: CST DST	Received by:	Date/Time: CST DST
Relinquished by:	Date/Time: CST DST	Received by:	Date/Time: CST DST

Sample Types: G=Grab, SG=Storm Grab, S=Sequential, T=Time based comp., F=Flow based comp., M=Multisonde, O=other — **Matrix:** L=Liquid (nonpotable water), S=Solid or chemical — Form review initials/ date

Preservative/container codes: **A**= plastic unfiltered (uf) unacidified (ua), **B**= dark plastic uf/ua, **C**= field filtered ua plastic, **D**=acidified uf plastic, **E**= acidified filtered plastic, **F**=filter, **G**=glass ua/uf, **H**=dark glass uf, **J**=glass acidified uf, **O**=other (describe), **S**=sterile plastic ua/uf, V=VOA vial uf, W= plastic bag ua/uf. I=Ice, HS=Sulfuric acid, HN=Nitric acid — Data entry: — Field review:

Each preservative/container code represents one container ID. If more than one container is submitted for a code, enter the number of each beside the code.

Texas Institute for Applied Environmental Research
Box T-0410, Stephenville, TX 76402, Tarleton State University 254-968-9570, 968-9560

Lab review:
Q-110-1, rev. 6 mm 11/2/09

Sample Acceptance Policy: TIAER retains the right to refuse acceptance of any sample and return any and all portions of samples to the client. Samples submitted with little holding time remaining may not be analyzed in time to meet project requirements. Samples should have at least 50% of holding time remaining when submitted. Unless otherwise agreed upon in writing, Client should submit samples collected and preserved in accordance with 40 CFR 136, the 2003 NELAC Standard, or other regulatory requirement stated by the Client's project. TIAER Lab shall not be responsible for data accuracy on samples improperly collected, preserved or submitted. Samples not appropriately collected, preserved or submitted may be accepted and analyzed by the TIAER Lab at the request of the Client. Unless previously arranged, normal sample acceptance hours without premium fees are Monday-Friday, 0800-1600, exclusive of official Tarleton holidays . Samples submitted outside of the normal hours may be processed at a premium surcharge. By signing to relinquish the sample(s) above, the Client or Client's representative hereby agrees to this policy & conforms to Contract or Cooperative Agreement between Client and TIAER.

Appendix C. Example Corrective Action Report

Corrective Action Report

SOP-Q-105

CAR #:

Report Initiation Date __________ **Report By:** ________________________ **Procedure or QC Typ** ________________________

Deviation: ____

Analyte: ____

Affected Sample #s: ____

Sampling Station: ____

Project(s): ____

Attached Documentation:

- ☐ COC
- ☐ FDS
- ☐ FlowLink
- ☐ Flow8
- ☐ GM
- ☐ Log Book
- ☐ QC Sheet
- ☐ Memo
- ☐ Other

Details of the problem, nonconformance or out-of-control situation:

____

Possible Causes:

____

Corrective Actions Taken:

____

Corrective Actions Suggested:

____

CAR routed to: ________________________ **Date:** ____________

Supervisor: ○ **Tier 1** (does not affect final data integrity) ○ **Tier 2** (data accepted but flag required) ○ **Tier 3** (possibly affects final data integrity)

Corrective actions taken for specific incident: ______________________________

Corrective actions taken to prevent recurrences: ______________________________

Corrective actions to be taken: ______________________________

Responsible Party: ____________________ **Proposed completion date:** ____________

Effect on data quality: ______________________________

Responsible Supervisor: ____________________ **Date:** ____________

Concurrence:

Program/Project Manager: ____________________ **Date:** ____________
(Tier 3 CARs only)

Quality Assurance Officer: ____________________ **Date:** ____________

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