Clean Water Act §319(h) Nonpoint Source Grant Program

Surface Water Quality Monitoring to Support Coordinating Facilitation and Implementation of the Lavon Lake Watershed Protection Plan (WPP)

TSSWCB Project Number 18-10

Quality Assurance Project Plan

Texas State Soil and Water Conservation Board

Prepared by

North Texas Municipal Water District

Effective Period: Upon TSSWCB approval through May 31, 2022
(with Annual Updates Required)

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

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A1 APPROVAL PAGE

Surface Water Quality Monitoring to Support Coordinating Facilitation and Implementation of the Lavon Lake Watershed Protection Plan (WPP)

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List of Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
AWRL	Ambient Water Reporting Limit
BMP	Best Management Practices
CAR	Corrective Action Report
CFU	Colony Forming Units
COC	Chain-of -Custody
CR	County Road
CRP	Clean Rivers Program
DM	Data Manager
DMRG	Data Management Reference Guide
DO	Dissolved Oxygen
FY	Fiscal Year
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
LL WPP	Lavon Lake Watershed Protection Plan
LOD	Limit of Detection
LOQ	Limit of Quantitation
mL	Milliliters
MPN	Most Probable Number
NELAC	National Environmental Laboratory Accreditation Committee
NELAP	National Environmental Laboratory Accreditation Program
NPS	Nonpoint Source
NTMWD	North Texas Municipal Water District
PM	Project Manager
QA	Quality Assurance
QAM	Quality Assurance Manual
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
SA	Sample Amount (reference concentration)
SM	Standard Methods
SOP	Standard Operating Procedure
SR	Sample Result
SWQM	Surface Water Quality Monitoring
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TKN	Total Kjeldahl Nitrogen
TSS	Total Suspended Solids
TSSWCB	Texas State Soil and Water Conservation Board
TSWQS	Texas Surface Water Quality Standards
USEPA	US Environmental Protection Agency
USGS	US Geological Survey
WPP	Watershed Protection Plan
WIMS	Water Information Management Solution

A3 DISTRIBUTION LIST

Organizations, and individuals within, which will receive copies of the approved QAPP and any subsequent revisions include:

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Kelly Harden
NTMWD Laboratory Manager

Catherine Hobbs
NTMWD Laboratory QAO

NTMWD will provide copies of this project plan and any amendments or appendices of this plan to each person on this list and to any sub-tier project participant, e.g., subcontractors, other units of government, laboratories. NTMWD will document distribution of the plan and any

amendments and appendices, maintain this documentation as part of the project's quality assurance records, and will be available for review.

A4 PROJECT/TASK ORGANIZATION

The following is a list of individuals and organizations participating in the project with their specific roles and responsibilities:

EPA

Anthony Suttice, EPA Project Officer
Responsible for managing the project for EPA. Reviews project progress and reviews and approves QAPP and QAPP amendments

Texas State Soil and Water Conservation Board (TSSWCB)

Jett Preston, TSSWCB PM
Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Responsible for submitting data sets to TCEQ's Data Management and Analysis Team. Provides the primary point of contact between NTMWD, TSSWCB, TCEQ and EPA. Tracks and reviews deliverables to ensure that tasks in the workplan are completed as specified in the contract. Responsible for verifying that the QAPP is followed by the NTMWD. Notifies the TSSWCB QAO of significant project non-conformances and corrective actions taken as documented in quarterly progress reports from NTMWD.

Mitch Conine, TSSWCB QAO
Reviews and approves the project QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB participants. Assists the TSSWCB Project Manager on QA-related issues. Coordinates reviews and approvals of QAPPs and amendments or revisions. Conveys QA problems to appropriate TSSWCB management. Monitors implementation of corrective actions. Coordinates and conducts audits.

North Texas Municipal Water District (NTMWD)

David Cowan, Project Manager
Responsible for managing the project for NTMWD and implementing the QAPP. Reviews project progress and reviews and approves QAPP and QAPP amendments.

Responsible for maintaining records of QAPP distribution, including appendices and amendments. Coordinates project planning activities and ensures the QAPP is followed by project participants. Ensures tasks and other requirements in contracts, QAPPs, and QAPP amendments and appendices are executed on time and are of acceptable quality. Ensures monitoring systems audits are conducted to ensure QAPPs are followed and the project is producing data of known quality. Ensures the TSSWCB project manager is notified of deficiencies and corrective actions and that issues are resolved. Responsible for supervising sample collection, processing, handling, holding and reporting activities to ensure compliance with monitoring requirements. Responsible for writing and maintaining the QAPP. Responsible for maintaining records of QAPP distribution, including appendices and amendments.

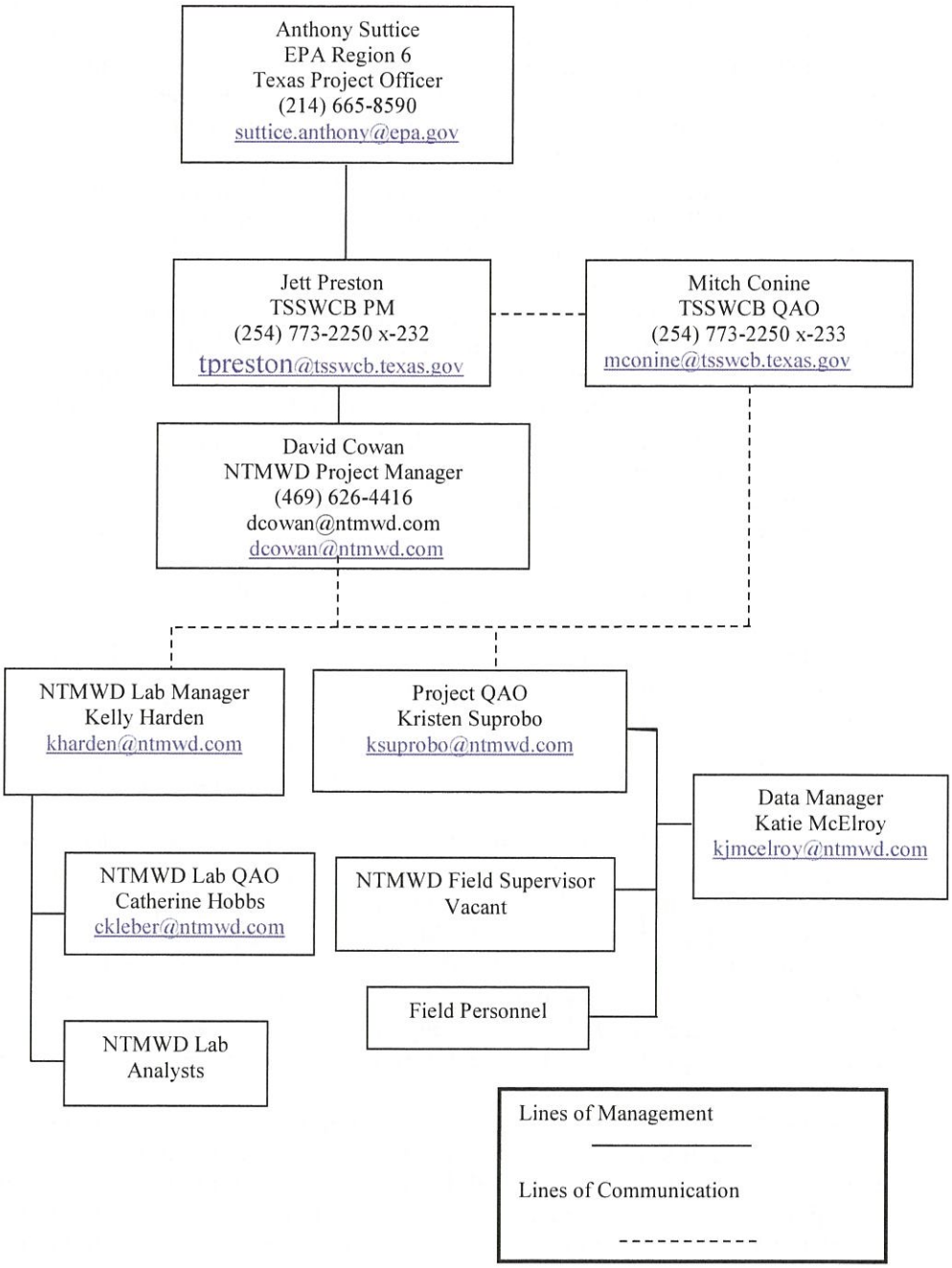
Kristen Suprobo, Project Quality Assurance Officer (QAO)
Responsible for coordinating the implementation of the QA program. Responsible for writing and maintaining the QAPP and monitoring its implementation. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Responsible for identifying, receiving, and maintaining project QA records. Responsible for coordinating with the NTMWD PM to resolve QA-related issues. Notifies the NTMWD Project Manager of particular circumstances which may adversely affect the quality of data. Coordinates and monitors deficiencies and corrective action. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Conducts monitoring systems audits on project participants to determine compliance with project and program specifications, issues written reports, and follows through on findings. Ensures that field staff is properly trained and that training records are maintained. Coordinates field personnel to ensure all monitoring is conducted as stated in approved QAPP. 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.

Katie McElroy, Data Manager (DM)
Responsible for ensuring that field data are properly reviewed and verified. Formats project data for QAO review. Coordinates and maintains records of data verification and validation. Completes the data summary reports, prepares the electronic data deliverables for submission to the TCEQ Data Management and Analysis team, and serves as primary NTMWD contact with the TCEQ Data Management and Analysis team with respect to data management and data delivery. Submits data sets to TCEQ Data Management and Analysis Team via TSSWCB PM. Maintains quality-assured data on the NTMWD servers.

Kelly Harden, Laboratory Manager
Responsible for producing quality analytical data for samples collected by NTMWD. Maintains verification of procedures establishing the level of quality. Responsible for generating lab data and COC forms.

Catherine Hobbs, Laboratory QAO
Checks training, competency, and re-training of technicians. Performs verification and validation procedures to confirm quality data is issued to clients. Performs other QA/QC duties and checks associated with lab activities. Resolves out-of-control issues. Conducts internal lab audits.

Figure A4.1 Project Organizational Chart*-- Lines of Communication



* See Project/Task Organization in this section for a description of each position's responsibilities.

A5 PROBLEM DEFINITION/BACKGROUND

Lake Lavon (Segment 0821) is a 492,095-acre watershed in the Trinity River basin with a concern for nitrate. Two major tributaries to Lake Lavon, Wilson Creek (Segment 0821C) and the East Fork of the Trinity River above Lake Lavon (Segment 0821D), are identified as impaired on the 2014 303(d) list due to bacteria. Data used for the 2014 Integrated Report were 22 samples for Wilson Creek and 17 samples for the East Fork of the Trinity River above Lake Lavon, taken during the 7-year period between December 2005 and November 2012. The geometric mean of these data for E. coli bacteria was 164 colony forming units per 100 milliliters (cfu/100 mL) for Wilson Creek and 151cfu/100mL for the East Fork of the Trinity River above Lake Lavon, which exceed the state standard of 126 cfu/100 mL for waterbodies designated for primary contact recreation.

The 2014 Texas Integrated Report lists the sources of the bacteria impairment for Wilson Creek and the East Fork of the Trinity River above Lake Lavon as unknown. The Integrated Report also lists the source of nitrate in Lake Lavon as unknown. However, analysis conducted in support of the Lavon Lake Watershed Protection Plan (WPP) indicates that nonpoint sources are the primary cause of bacteria and nutrient pollution in the Lavon Lake watershed. In addition, an analysis of land use/cover showed that rangeland, forests, and agricultural lands represent over 80% of the watershed. Consequently, potential nonpoint source pollution from agricultural operations and rural properties was determined to be a significant source of bacteria, nutrient, and sediment in the Lavon Lake watershed.

There are eleven wastewater treatment plants in the watershed. All but one of these facilities, the Wilson Creek Regional WWTF, are identified as minor discharges by the National Pollutant Discharge Elimination System (NPDES) and have a design flow of <1 MGD. The Wilson Creek WWTF, operated by the NTMWD, discharges directly into Lavon Lake and has an average daily discharge rate of 44 MGD. Also located in the watershed is Melissa Feeders, a concentrated animal feeding operation (CAFO) located approximately 4 miles east of Melissa, TX. This facility is focused on beef production. There are no other permitted point sources of bacteria or nutrients in the watershed.

The North Texas Municipal Water District (NTMWD) conducts surface water quality monitoring under the auspices of the Texas Clean Rivers Program (CRP). Currently, NTMWD and other local CRP partners collect valid, representative environmental data to accurately assess water quality conditions in the region and to support effective water quality decision making. Routine samples are collected from classified streams and reservoirs to monitor for the attainment of uses and numerical criteria. Unclassified water bodies are also monitored in response to perceived risk for pollution and/or to define water quality. NTMWD will conduct in-stream water quality monitoring at 4 routine monthly sites and 10 quarterly sites on tributaries to Lavon Lake to support implementation of the Lavon Lake WPP.

The purpose of this Quality Assurance Project Plan (QAPP) is to clearly delineate NTMWD's Quality Assurance (QA) policy, management structure, and procedures which will be used to implement the QA requirements necessary to verify and validate the surface water quality data collected. The QAPP is reviewed by the Texas State Soil & Water Conservation Board (TSSWCB) to help ensure that data generated are scientifically valid and legally defensible. This process will ensure that data collected under this QAPP and submitted to the Texas Commission on Environmental Quality (TCEQ) Surface Water Quality Monitoring Information System (SWQMIS) database have been collected and managed in a way that guarantees its reliability and, therefore, may be used in water quality assessments, watershed protection plan (WPP) development, establishing water quality standards, making permit decisions, and used by other programs deemed appropriate by the TCEQ or the TSSWCB.

A6 PROJECT/TASK DESCRIPTION

NTMWD will conduct work performed under this project associated with technical and financial supervision, preparation of status reports, and coordination with local stakeholders, data analysis and development of the final project report. NTMWD will facilitate the Lavon Lake Watershed Partnership in order to efficiently and effectively achieve project goals and summarize activities and achievements made throughout the course of this project.

NTMWD will conduct all surface water quality monitoring, sample collection, and data preparation for submission to SWQMIS, as required. Sample analysis will be performed by the NTMWD Laboratory located in Wylie, TX. All monitoring procedures and methods will follow the guidelines prescribed in this QAPP and the most current versions of TCEQ's *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring (RG-415).*

Following field reconnaissance, numerous sites on Lavon Lake's tributaries were selected for monitoring as part of development of the Lavon Lake WPP. NTMWD will continue these monitoring efforts to support implementation of the Lavon Lake WPP by retaining 4 routine monthly sites and 10 quarterly sites on tributaries to Lavon Lake. The sampling period extends over 33 months, generating a total of 242 routine samples. Routine monitoring will be pre-scheduled on approximately the same days each month or quarter as soon as the QAPP is approved. Sampling will be conducted as scheduled as long as conditions do not create a safety hazards for the field crew. Sampling will reconvene as soon as the hazard has ceased or been eliminated.

Figure A6.1 illustrates the Lavon Lake watershed and the selected monitoring locations for this project. The sites designated by the red circles are the routine monitoring stations. Table A6.1 lists the monitoring stations, their geographical locations and the monitoring schedule.

Figure A6.1 Map of NTMWD Monitoring Stations

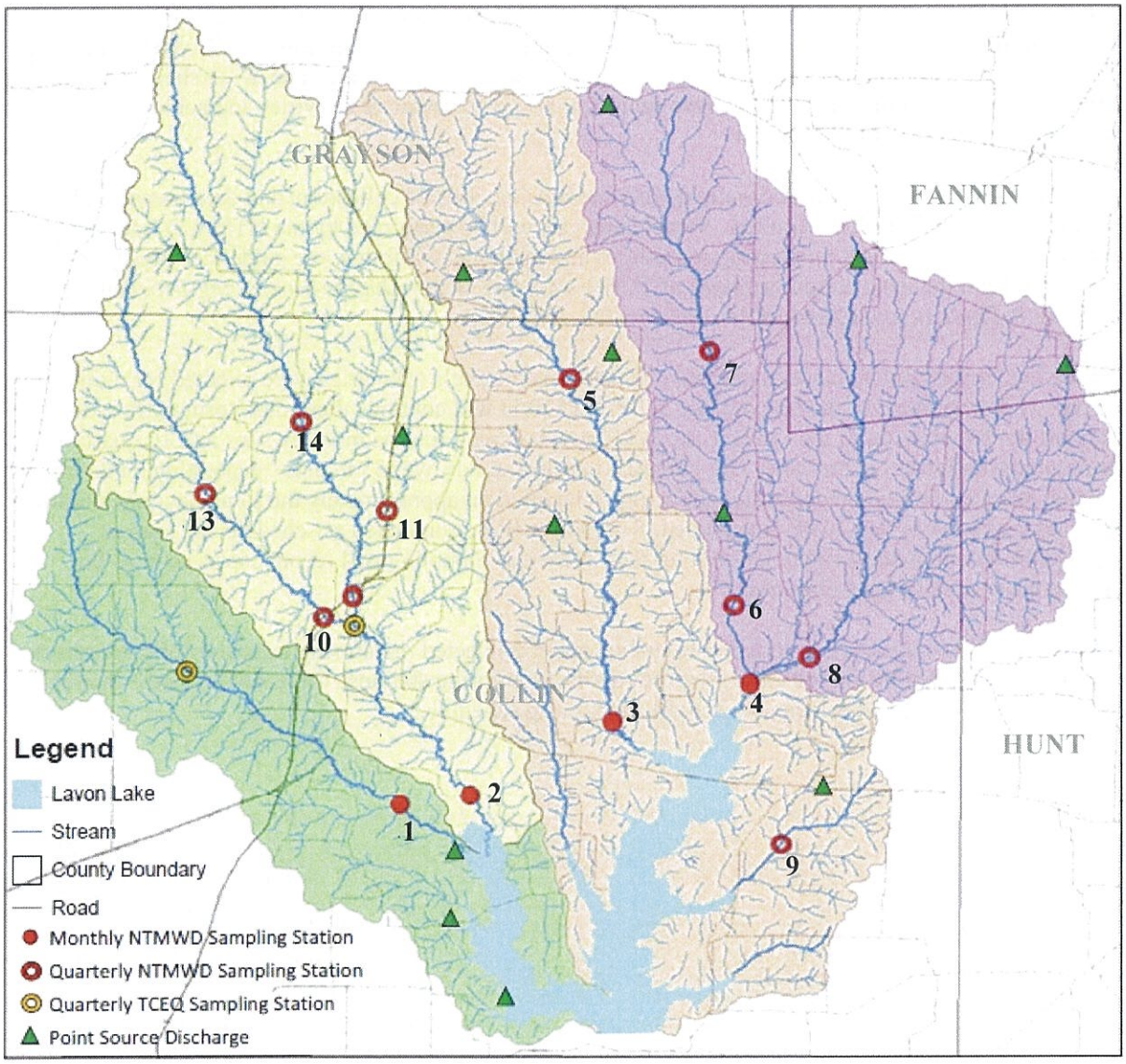


Table A6.1 Monitoring Stations and GIS Locations

Site	Site_Name	TCEQ Site ID	Latitude	Longitude	Description
1	Lower Wilson Creek*	21764	33.14877222	-96.58308611	WILSON CREEK AT CR 317 NEAR MCKINNEY
2	East Fork Trinity River*	22130	33.154360	-96.549415	EAST FORK OF TRINITY RIVER AT CR 546 IN LOWRY CROSSING, TX
3	Lower Sister Grove Creek*	21396	33.193639	-96.476161	SISTER GROVE CREEK DOWNSTREAM FM1377/MONTE CARLO BLVD 1.6 KM EAST OF INTERSECTION OF 6TH STREET AND FM 1377 NEAR PRINCETON, TX
4	Lower Pilot Grove Creek*	21717	33.214317	-96.402406	PILOT GROVE CREEK AT FM 2756 UPSTREAM OF LAVON LAKE
5	Headwaters Sister Grove Creek	21767	33.3676	-96.49466111	SISTER GROVE CREEK AT CR 2862 APPROXIMATELY 4 MILES NORTHEAST OF ANNA
6	Pilot Grove Creek	15692	33.253613	-96.412224	PILOT GROVE CREEK IMMEDIATELY DOWNSTREAM OF COLLIN CR 574 AND 3.2 MI SOUTH OF FM 545 NEAR BLUE RIDGE
7	Headwaters Pilot Grove Creek	21768	33.38000556	-96.42491111	PILOT GROVE CREEK AT CR 584 APPROXIMATELY 2.5 MILES NORTHEAST OF WESTMINSTER
8	Indian Creek	21769	33.22611389	-96.37344722	INDIAN CREEK AT SR 78 APPROXIMATELY 4.5 MILES NORTH OF FARMERSVILLE
9	Elm Creek	21773	33.12769444	-96.38789167	ELM CREEK AT CR 605 APPROXIMATELY 3 MILES SOUTHWEST OF FARMERSVILLE
10	Lower Honey Creek	21776	33.24653889	-96.62408611	HONEY CREEK AT US 75 NEAR MCKINNEY
11	Throckmorton Creek	21777	33.30101667	-96.5909	THROCKMORTON CREEK AT US 75 APPROXIMATELY 1.5 MILES NORTHEAST OF MELISSA
12	East Fork Trinity River 3	21778	33.25772222	-96.60959167	EAST FORK TRINITY RIVER AT US 75 NORTHEAST OF MCKINNEY
13	Upper Honey Creek	20932	33.31151	-96.68522	HONEY CREEK 40 M UPSTREAM OF COLLIN CR 170 4.3 KM SOUTHWEST OF WESTON AND 2.3 KM NORTHWEST OF INTERSECTION OF FM 543 AND COLLIN CR 170
14	East Fork Trinity River 4	21779	33.34946944	-96.63760556	EAST FORK TRINITY RIVER AT CR 210 APPROXIMATELY 1.8 MILES EAST OF WESTON

*denotes monthly monitoring locations

Each month during the sampling period, a full suite of lab parameters will be analyzed (See Table A7.1b). The same field parameters will be collected during every monitoring event (See Table A7.1a).

NTMWD will manage monitoring data in support of implementation of the Lavon Lake WPP. NTMWD will submit monitoring data on a quarterly basis to the TSSWCB and TCEQ Data Management and Analysis Team, using required formatting and protocols.

NTMWD will summarize the results and activities of this project for possible inclusion in the TRA's *Clean Rivers Program Basin Highlights Report*. Additionally, NTMWD will develop a final Assessment Data Report summarizing water quality data collected. NTMWD will provide a baseline assessment of water quality to stakeholders to discuss progress in achieving the Lavon Lake WPP water quality goals.

Table A6.2 presents project milestones pertaining to this project.

Table A6.2 Project Milestones

TASK	PROJECT MILESTONES	AGENCY	START	END
2.1	Develop QAPP for review by TSSWCB.	NTMWD	12/2018	1/2019
2.2	Submit revisions to QAPP as necessary.	NTMWD	2/2019	05/2022
3.1	Monitor 4 routine sites monthly and 10 routine sites quarterly, for 33 months, collecting field, conventional, flow and bacteria parameter groups.	NTMWD	2/2019	05/2022
3.3	Transfer monitoring data on a quarterly basis to TCEQ Data Management and Analysis Team. Submit station location requests to TCEQ, if required. Submit data correction requests, if errors are discovered in reported data.	NTMWD	4/2019	05/2022
3.4	Summarize water quality data and conduct statistical and trend analysis.	NTMWD	8/2021	05/2022

Amendments

Amendments to this QAPP may be necessary to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and nonconformances; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests for amendments are directed from the NTMWD Project Manager to the TSSWCB NPS Project Manager in writing. The changes are effective immediately upon approval by the TSSWCB NPS Project Manager.

Amendments to the QAPP and the reasons for the changes will be documented, and full copies of amendments will be forwarded to all persons on the QAPP distribution list by the TSSWCB or NTMWD PM.

A7 QUALITY OBJECTIVES AND CRITERIA FOR DATA QUALITY

The purpose of the water quality monitoring described in this QAPP is to collect surface water quality data that can be used to facilitate adaptive management activities and to continue progress toward addressing nonpoint source water quality concerns in the Lavon Lake watershed. The water quality data and evaluations of water quality conditions will be communicated to the public and the Lavon Lake Watershed Stakeholders to support adaptive management of the Lavon Lake WPP and expand public knowledge on Lavon Lake water quality data.

The measurement performance specifications to support the project objectives for a minimum data set are specified in Tables A7.1a and b, below.

Ambient Water Reporting Limits (AWRLs)

AWRLs establish the reporting specification at or below which data for a parameter must be reported to be compared with freshwater screening criteria. The AWRLs specified in Table A7.1 are the program-defined reporting specifications for each analyte and yield data acceptable for TCEQ water quality assessment. The limit of quantitation (LOQ) is the minimum level, concentration, or quantity of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. The following requirements must be met in order to report results to the TCEQ SWQMIS:

- The laboratory's LOQ for each analyte must be at or below the AWRL as a matter of routine practice
- The laboratory must demonstrate its ability to quantitate at its LOQ for each analyte by running an LOQ check sample for each batch of samples analyzed.

Table A7.1a - Field Measurement Performance Specifications for Routine Systematic Flow Monitoring Events

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Temperature, water	°C	water	SM 2550 and TCEQ SOP, V1	00010	NA[1]	NA	NA	NA	NA	Field
Temperature, air	°C	air	NA	00020	NA	NA	NA	NA	NA	Field
Specific Conductance	µS/cm	water	EPA 1201 and TCEQ SOP, V1	00094	NA[1]	NA	NA	NA	NA	Field
pH	standard units	water	EPA 150.1 and TCEQ SOP, V1	00400	NA[1]	NA	NA	NA	NA	Field
DO	mg/L	water	SM 4500-O G. and TCEQ SOP, V1	00300	NA[1]	NA	NA	NA	NA	Field
Transparency, Secchi Disc	meters	water	TCEQ SOP, V1	00078	NA[1]	NA	NA	NA	NA	Field
Days since precipitation event	days	other	TCEQ SOP V1	72053	NA[1]	NA	NA	NA	NA	Field
Flow Stream, Instantaneous	cfs	water	TCEQ SOP, V1	00061	NA[1]	NA	NA	NA	NA	Field
Flow method	1-gauge 2-electric 3-mechanical 4-weir/flume 5-doppler	water	TCEQ SOP, V1	89835	NA[1]	NA	NA	NA	NA	Field
Flow severity	1-no flow 2-low 3-normal 4-flood 5-high 6-dry	water	TCEQ SOP, V1	01351	NA[1]	NA	NA	NA	NA	Field
Stream Flow Estimate (CFS)	cfs	water	TCEQ SOP, V1	74069	NA[1]	NA	NA	NA	NA	Field
Maximum pool width at time of study[2]	meters	other	TCEQ SOP V2	89864	NA[1]	NA	NA	NA	NA	Field
Maximum pool depth at time of study[2]	meters	other	TCEQ SOP V2	89865	NA[1]	NA	NA	NA	NA	Field
Pool length[2]	meters	other	TCEQ SOP V2	89869	NA[1]	NA	NA	NA	NA	Field
% pool coverage in 500 meter reach[2]	%	other	TCEQ WOP V2	89870	NA[1]	NA	NA	NA	NA	Field
Wind Intensity (1=calm, 2=slight,3=mod, 4=strong)	NU	other	NA	89965	NA	NA	NA	NA	NA	Field
Present Weather (1=clear,2=ptcldy,3=cloudy, 4=rain,5=other)	NU	other	NA	89966	NA	NA	NA	NA	NA	Field
Water Color (1=brownish, 2=reddish,3=greenish, 4=blackish,5=clear,6=other)	NU	water	NA	89969	NA	NA	NA	NA	NA	Field
Water Odor (1=sewage,2=oily/chemical, 3=rotten egg,4=musky, 5=fishy,6=none,7=other)	NU	water	NA	89971	NA	NA	NA	NA	NA	Field
Water clarity (1=excellent,2=good,3=fair, 4=poor)	NU	water	NA	20424	NA	NA	NA	NA	NA	Field

1 Reporting to be consistent with SWQM guidance and based on measurement capability.
2 Parameters for pools to be reported only if pooled conditions are sampled as outlined under the TCEQ Interim Guidance for Routine Surface Water Quality Monitoring During Extended Drought.

References for Table A7.1a:

- 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," 20th Edition, (or most recent version)

- TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures Manual, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, August 2012 or most recent editions (RG-415)

Table A7.1b - Measurement Performance Specifications for Routine Systematic Monitoring Events.

PARAMETER	UNITS	MATRIX	METHOD	PARAMETER CODE	AWRL	LOQ	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Chemical Oxygen Demand (COD)	mg/L	water	HACH 8000	00335	10	10	70-130	20	80-120	NTMWD
Carbon, Total Organic, NPOC (TOC)	mg/L	water	SM 5310 C	00680	2	0.5	70-130	20	80-120	NTMWD
Alkalinity, Total (mg/L as $CaCO_3$)	mg/L	water	SM 2320 B	00410	20	20	NA	20	NA	NTMWD
Iron, Total (µg/L as Fe)	µg/L	water	EPA 200.8	01045	300	200	70-130	20	80-120	NTMWD
Manganese, Total (µg/L as Mn)	µg/L	water	EPA 200.8	01055	50	1	70-130	20	80-120	NTMWD
Hardness, Total (mg/L as $CaCO_3$)	mg/L	water	SM 2340 C	00900	5	5	NA	20	80-120	NTMWD
Residue, Total Filterable (Dried at 180 °C)	mg/L	water	SM 2540 C	70300	10	10	NA	20	80-120	NTMWD
Residue, Volatile Non-filterable	mg/L	water	EPA 160.4	00535	4	2.5	NA	NA	NA	NTMWD
Residue, Total Non-filterable	mg/L	water	SM 2540 D	00530	4	2.5	NA	NA	NA	NTMWD
Chloride (mg/L as Cl)	mg/L	water	EPA 300.0	00940	5	1	70-130	20	80-120	NTMWD
Sulfate (mg/L as SO_4)	mg/L	water	EPA 300.0	00945	5	1	70-130	20	80-120	NTMWD
Turbidity, Lab Nephelometric Turbidity Units	NTU	water	EPA 180.1 / SM 2130 B	82079	0.5	0.1	NA	NA	NA	NTMWD
Nitrogen, Ammonia, Total (mg/L as N)	mg/L	water	EPA 350.1	00610	0.1	0.1	70-130	20	80-120	NTMWD
Nitrogen, Kjeldahl, Total (mg/L as N)	mg/L	water	EPA 351.2	00625	0.2	0.2	70-130	20	80-120	NTMWD
Nitrite+Nitrate, Total one lab determined value (mg/L as N)	mg/L	water	EPA 353.2 / EPA 300.0 (calc.)	00630	0.05	0.05	70-130	20	80-120	NTMWD
Phosphorus, Total, Wet Method (mg/L as P)	mg/L	water	EPA 365.1 / EPA 365.3	00665	0.06	0.02	70-130	20	80-120	NTMWD
Orthophosphate phosphorus, diss, mg/L, Filtered >15 min	mg/L	water	EPA 365.3	70507	0.04	0.02	70-130	20	80-120	NTMWD
Chlorophyll-a, spectrophotometric acid method	µg/L	water	SM 10200 H	32211	3	3	NA	20	80-120	NTMWD
Pheophytin, spectrophotometric acid method	µg/L	water	SM 10200 H	32218	3	3	NA	NA	NA	NTMWD
E. coli, , Colilert, IDEXX method MPN/mL	MPN/ 100 mL	water	Colilert Quanti-Tray	31699	1	1	NA	0.5[3]	NA	NTMWD
E. coli, Colilert, IDEXX, holding time	hours	other	NA	31704	NA	NA	NA	NA	NA	NTMWD

3 This value is not expressed as a relative percent difference. It represents the maximum allowable difference between the logarithm of the sample result and the logarithm of the duplicate result. See Section B5.

4 *E.coli* samples analyzed by IDEXX Colilert Quanti-Tray should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended and samples must be processed as soon as possible and within 30 hours.

References for Table A7.1b:

- 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," 20th Edition or most recent version
- TCEQ SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures Manual, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, August 2012 or most recent editions (RG-415)

Precision

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. It is a measure of agreement among replicate measurements of the same property, under prescribed similar conditions, and is an indication of random error.

Laboratory precision is assessed by comparing replicate analyses of laboratory control samples in the sample matrix (e.g. deionized water, sand, commercially available tissue) or sample/duplicate pairs in the case of bacterial analysis. Precision results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for precision are defined in Table A7.1b.

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 determined through the analysis of laboratory control samples and LOQ check samples prepared with verified and known amounts of all target analytes in the sample matrix (e.g. deionized water) and by calculating percent recovery. Results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for laboratory control standards are specified in Table A7.1b.

Representativeness

Site selection, the appropriate sampling regime, the sampling of all pertinent media according to TCEQ *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring*, and use only of approved analytical methods will assure that the measurement data represents the conditions at the monitoring sites. Representativeness will be measured with the completion of sample collection in accordance with the approved QAPP.

Routine data collected for the project and submitted to TCEQ for water quality assessments is performed on a routine frequency. At a minimum, samples will be collected over at least two seasons (to include inter-seasonal variation) and will include some data collected during an index period (March 15 thru October 15). Routine systematic water quality data are collected on a monthly frequency and are separated by approximately even time intervals. Although data may be collected during varying regimes of weather and flow, the data sets collected during routine monitoring will not be biased toward unusual conditions of flow, runoff, or season.

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(s) that 90% data completion is achieved.

Comparability

Confidence in the comparability of routine data sets for this project and for water quality assessments 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 and in the most recent version of the TCEQ SWQM SOPs. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for rounding figures, and by reporting data in the format required for submission to SWQMIS. Laboratory measurement quality control requirements and acceptability criteria are provided in Section B5.

A8 SPECIAL TRAINING/CERTIFICATION

Monitoring staff personnel receive training in proper sampling and field data collection. Before independent sampling or data collection occurs, staff are required to demonstrate to the Field Operations Supervisor (or designee) their ability to properly calibrate field equipment and perform field sampling and data collection procedures. Field personnel training is documented and retained by the NTMWD QAO. The documentation is available during monitoring systems audits.

Contractors and subcontractors will ensure that laboratories analyzing samples under this QAPP meet the requirements contained in The NELAC Institute (TNI) Standards, Volume 1, Module 2, Section 4.5.5 (Subcontracting of Environmental Tests).

A9 DOCUMENTS AND RECORDS

The documents and records that describe, specify, report, or certify activities are listed In Table A9.1. These documents and records may be requested for review during a monitoring systems audit. All records are kept for a minimum of seven years after the end of the project.

Table A9.1 Project Documents and Records

Document/Record	Location	Retention*	Format
QAPPs, amendments and appendices	NTMWD	7 years	Paper/ Electronic
QAPP distribution documentation	NTMWD	7 years	Paper/Electronic
Field data sheets	NTMWD	7 years	Paper/Electronic
Field instrument print outs	NTMWD	7 years	Paper/Electronic
Field staff training records	NTMWD	7 years	Paper/Electronic
Field equipment calibration/maintenance logs	NTMWD	7 years	Paper/Electronic
Chain of custody records	NTMWD	7 years	Paper/Electronic
Field SOPs	NTMWD	7 years	Paper/Electronic
Laboratory SOPs	NTMWD	7 years	Paper/Electronic
Laboratory QA Manuals	NTMWD	7 years	Paper/Electronic
Laboratory data reports/results	NTMWD	7 years	Paper/Electronic
Laboratory staff training records	NTMWD	7 years	Paper/Electronic
Instrument printouts	NTMWD	7 years	Paper/Electronic
Laboratory equipment maintenance logs	NTMWD	7 years	Paper/Electronic
Laboratory calibration records	NTMWD	7 years	Paper/Electronic
Corrective Action Documentation	NTMWD	7 years	Paper/Electronic

*Retention period in paper format/electronic format.

Laboratory Test Reports

Test/data reports from the laboratory will document the test results clearly and accurately. Reporting of the data will follow standard formats and protocols for *TNI Volume 1 Module 2 Section 5.10* and include the information necessary for the interpretation and validation of data. The requirements for reporting data and procedures are provided below.

1) Title of report and unique identifiers on each page;
2) Name and address of laboratory, and phone number with name of contact person;
3) A unique identification number and the total number of pages, with all pages sequentially numbered;
4) Name and address of client;
5) Description and unambiguous identification of the sample(s) including the client identification code (i.e. station information);
6) Identification of results for any sample that did not meet sample acceptance requirements per A7.1 tables;
7) Date and time of receipt of sample, date and time of sample collection, sample matrix, and time of sample preparation and/or analysis if the required holding time for either activity is less than or equal to 30 hours;
8) Identification of the test method used plus its LOQ and LOD;
9) Reference to sampling procedure (grab or composite);
10) Any deviations from, additions to or exclusions from SOPs, and any conditions that may have affected the quality of results, and including the use and definitions of data qualifiers;
11) Measurements, examinations and derived sample results, supported by tables, graphs, sketches and photographs as appropriate, and any failures identified; identification of whether data are calculated on a dry weight or wet weight basis; identification of the reporting units such as µg/l or mg/kg;
12) Clear identification of all test data provided by outside sources, such as subcontracted laboratories, clients, etc.;
13) Clear identification of numerical results with values below the Reporting Limit, and
14) Identification of accreditation status per analysis.

Electronic Data

Data will be submitted electronically to the TCEQ Data Management and Analysis Team and/or project partner for review in the Event/Result file format described in the most current version of the DMRG. A completed Data Summary (see example in Appendix D) will be submitted with each data submittal.

A9.2 Codes for Data Submittals

Sample Description	Tag Prefix	Submitting Entity	Collecting Entity	Monitoring Type Code
Routine monitoring to establish baseline conditions	*TX*	*TX*	*NM*	*RTWD*

1) RTWD - Sampling scheduled in advance without intentionally trying to target any certain environmental condition. The sampling seeks to set a baseline for the site. Sample will be collected regardless of the conditions encountered.

Revisions and Amendments 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. The last approved version of the QAPP shall remain in effect until a revised version has been fully approved; the revision must be submitted to the TSSWCB for approval before the last approved version has expired. If the entire QAPP is current, valid, and accurately reflects the project goals and the organization's policy, the annual re-issuance may be done by a certification that the plan is current. This will be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP.

Amendments to the QAPP may be necessary to address incorrectly documented information or to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and nonconformance; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests for amendments will be directed from the NTMWD Project Manager to the TSSWCB Project Manager electronically. Amendments are effective immediately upon approval by the NTMWD Project Manager, NTMWD Project QAO, the TSSWCB Project Manager, the TSSWCB QAO. They will be incorporated into the QAPP by way of attachment and distributed to personnel on the distribution list by the NTMWD Project Manager or designee. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process.

B1 SAMPLING PROCESS DESIGN

The sample design was developed to provide critical supporting data and information necessary to facilitate adaptive implementation of the Lavon Lake WPP. Utilizing historical knowledge of the watershed and after conducting analysis during the development of the Lavon Lake WPP, project participants developed a sampling plan to ensure a comprehensive water monitoring strategy within the watershed. In this project, routine systematic monitoring is designed to evaluate water quality during a variety of spatial, seasonal and meteorological conditions. The water quality data and evaluations of water quality conditions will be communicated to the public and the Lavon Lake stakeholders to support adaptive management of the Lavon Lake WPP and expand public knowledge of Lavon Lake water quality data.

Routine data collected from Lavon Lake and its tributaries will be used to support adaptive management of the Lavon Lake WPP and may be assessed by the TCEQ as part of the Integrated Report. Achievable water quality objectives and priorities and the identification of water quality issues were used to develop the work plan, in accordance with available resources.

This data collection effort involves routine water quality monitoring using procedures consistent with the TCEQ SWQM program for the purpose of data entry into the statewide database maintained by the TCEQ. To this end, some general guidelines were followed when selecting sampling sites, as basically outlined below, and discussed thoroughly in the *TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring*. Overall consideration is given to accessibility and safety. All monitoring activities have been developed with the TSSWCB project #16-62 in mind.

1. Locate stream sites so that samples can be safely collected from the centroid of flow. Centroid is defined as the midpoint of that portion of stream width which contains 50 percent of the total flow. If few sites are available for a stream segment, choose one that would best represent the water body, and not an unusual condition or contaminant source. Avoid backwater areas or eddies when selecting a stream site.

2. Because historical water quality data can be very useful in assessing use attainment or impairment, sampling stations with current or past monitoring data have higher preference in selection criteria.

3. Routine monitoring sites were selected to characterize water quality within UGSG Hydrological Units delineated on a subwatershed level (with only slight modifications) so data may be used in future modeling efforts.

Sites should be accessible. Flow measurement will be made during routine and biased flow monitoring events unless unsafe conditions exist.

See Tables A6.1 and A7.1a-b for sampling process design information and monitoring tables associated with data collected under this QAPP.

Table B1.1 Monitoring Stations and Sampling Process Design

Site	Site_Name	Site_ID	Latitude Decimal	Longitude Decimal	Description	Seg ID	Collected By	Monitor Type	Bacteria	Conven-tionals	Flow	Field
1	Lower Wilson Creek	21764	33.14877222	-96.58308611	WILSON CREEK AT CR 317 NEAR MCKINNEY	0821C	NM	RTWD	34	34	34	34
2	East Fork Trinity River	22130	33.154360	-96.549415	East Fork of Trinity River at CR 546 in Lowry Crossing, TX	0821D	NM	RTWD	34	34	34	34
3	Lower Sister Grove Creek	21396	33.193639	-96.476161	Sister Grove Creek Downstream FM1377/Monte Carlo Blvd 1.6 km East of intersection of 6th St. and FM 1377 near Princeton, TX.	0821B	NM	RTWD	34	34	34	34
4	Lower Pilot Grove Creek	21717	33.214317	-96.402406	Pilot Grove Creek at FM 2756 upstream of Lake Lavon	0821A	NM	RTWD	34	34	34	34
5	Headwaters Sister Grove Creek	21767	33.3676	-96.49466111	SISTER GROVE CREEK AT CR 2862 APPROXIMATELY 4 MILES NORTHEAST OF ANNA	0821B	NM	RTWD	11	11	11	11
6	Pilot Grove Creek	15692	33.253613	-96.412224	PILOT GROVE CREEK IMMEDIATELY DOWNSTREAM OF COLLIN CR 574 AND 3.2 MI SOUTH OF FM 545 NEAR BLUE RIDGE	0821A	NM	RTWD	11	11	11	11
7	Headwaters Pilot Grove Creek	21768	33.38000556	-96.42491111	PILOT GROVE CREEK AT CR 584 APPROXIMATELY 2.5 MILES NORTHEAST OF WESTMINSTER	0821A	NM	RTWD	11	11	11	11
8	Indian Creek	21769	33.22611389	-96.37344722	INDIAN CREEK AT SR 78 APPROXIMATELY 4.5 MILES NORTH OF FARMERSVILLE	0821	NM	RTWD	11	11	11	11
9	Elm Creek	21773	33.12769444	-96.38789167	ELM CREEK AT CR 605 APPROXIMATELY 3 MILES SOUTHWEST OF FARMERSVILLE	0821	NM	RTWD	11	11	11	11
10	Lower Honey Creek	21776	33.24653889	-96.62408611	HONEY CREEK AT US 75 NEAR MCKINNEY	0821	NM	RTWD	11	11	11	11
11	Throckmorton Creek	21777	33.30101667	-96.5909	THROCKMORTON CREEK AT US 75 APPROXIMATELY 1.5 MILES NORTHEAST OF MELISSA	0821	NM	RTWD	11	11	11	11
12	East Fork Trinity River 3	21778	33.25772222	-96.60959167	EAST FORK TRINITY RIVER AT US 75 NORTHEAST OF MCKINNEY	0821D	NM	RTWD	11	11	11	11

Site	Site_Name	Site_ID	Latitude Decimal	Longitude Decimal	Description	Seg ID	Collected By	Monitor Type	Bacteria	Conven-tionals	Flow	Field
13	Upper Honey Creek	20932	33.31151	-96.68522	HONEY CREEK 40 M UPSTREAM OF COLLIN CR 170 4.3 KM SOUTHWEST OF WESTON AND 2.3 KM NORTHWEST OF INTERSECTION OF FM 543 AND COLLIN CR 170	0821	NM	RTWD	11	11	11	11
14	East Fork Trinity River 4	21779	33.34946944	-96.63760556	EAST FORK TRINITY RIVER AT CR 210 APPROXIMATELY 1.8 MILES EAST OF WESTON	0821D	NM	RTWD	11	11	11	11

1) RTWD - Sampling scheduled in advance without intentionally trying to target any certain environmental condition. The sampling seeks to set a baseline for the site. Sample will be collected regardless of the conditions encountered.

Four (4) monthly and ten (10) quarterly routine monitoring sites were selected to provide spatial distribution of data in the watershed. (See Table B1.1.) Routine monitoring at each site includes field, conventional, and bacterial parameter groups. Analytical results will be used to characterize water quality throughout the watershed. There may be times, during dry weather conditions, when there is no water in the stream in some of the subwatersheds. Those visits will be documented but no water quality samples will be collected. During periods when water is not flowing, a flow severity of either No Flow (1) or Dry (6) will be recorded and reported. In addition, when pooled conditions exist, an Instantaneous Flow for parameter 00061 will be reported as 0. When the stream is dry no record is reported for parameter 00061. If waters are pooled at a station, not flowing, and pools meet guidelines as outlined in the TCEQ *Interim Guidance for Routine Surface Water Quality Monitoring During Extended Drought*, water samples will be collected and analyzed as routine samples. The additional parameters of maximum pool width, maximum pool depth, pool length, and % pool coverage in 500 meter reach will also be reported. Routine monitoring in this project will complement existing routine ambient monitoring being conducted by TCEQ.

Lab Parameters for the various monitoring events are listed in Table B1.2 below. The parameters were chosen to get the most relevant tests analyzed for the various scenarios while maximizing the budget.

Table B1.2 – Lab Parameter List Routine Monitoring Activities

Monthly Routine sampling (full suite of lab parameters)
Chemical Oxygen Demand (COD)
Total Organic Carbon (TOC)
Alkalinity
Iron
Manganese
Hardness
TDS
VSS
TSS
Chloride (mg/L as Cl)
Sulfate (mg/L as SO_4)
Turbidity, NTU
Nitrogen, Ammonia, Total (mg/L)
Nitrogen, Kjeldahl, Total (mg/L)
Nitrite+Nitrate-N, Total one lab determined value (mg/L)
Phosphorus, Total, Wet Method (mg/L)
Orthophosphate phosphorus, diss, mg/L
Orthophosphate phosphorus, diss, mg/L, Filtered >15 min
Chlorophyll-a, spectrophotometric method
Pheophytin, spectrophotometric method
E. coli, Colilert, IDEXX method MPN/100 mL
E. coli, Colilert, IDEXX, holding time

B2 SAMPLING METHODS

Field Sampling Procedures

Field sample and data collection will be conducted according to procedures documented in the most current version of *TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring*. Specifications outlined in Table B2.1 reflect additional requirements for sampling for the project and/or provide additional clarification.

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

Parameter	Matrix	Container	Preservation	Sample Volume	Holding Time
TOC	water	Plastic	H_3PO_4, cool to 6°C	100 mL	28 days
Iron	water	Plastic or Cubitaner	1-2 mL 1+1 HNO3 to pH<2 and cool to 6°C	100 mL	180 days
Manganese	water			100 mL	180 days
Alkalinity	water	Plastic or Cubitaner	Cool to 6°C, dark	100 mL[5]	14 days
Orthophosphate Phosphorus	water			250 mL[5]	180 days
TDS	water			250 mL[6]	7 days
VSS	water			400-1000 mL[4]	7 days
TSS	water			400-1000 mL[4]	7 days
Turbidity	water			50 mL[5]	48 hours
Sulfate	water			100 mL[6]	28 days
Chloride	water			100 mL[6]	28 days
E. coli IDEXX Colilert	water	Sterile Plastic w/ sodium thiosulfate	Cool to <6°C but not frozen	120 mL	8 hours[1]
TKN	water	Plastic or Cubitaner	1-2 mL conc. H_2S0_4 to pH <2 and cool to 6°C, dark	200 mL[3]	28 days
Ammonia-N	water			150 mL[3]	28 days
Phosphorus-P, Total	water			150 mL[3]	28 days
Hardness	water			250 mL[3]	48 hours
COD	water			500 mL[3]	28 days
Nitrite + Nitrate-N	water			125 mL[3]	28 days
Chlorophyll-*a* *(w/ Pheophytin calculation)*	water	Amber Plastic	Dark & iced before filtration; Dark & frozen after filtration	2 L	Filtered w/in 48 hours; after filtered, then frozen up to 28 days

[1] *E.coli* samples analyzed by IDEXX Colilert Quanti-Tray should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended and samples must be processed as soon as possible and within 24 hours.
[3] Five tests are analyzed from one 1L plastic bottle.
[4] Two tests are analyzed from one 2L plastic bottle.
[5] Four tests are analyzed from one 1L plastic bottle.
[6] Three tests are analyzed from one 250 mL bottle.

Sample Containers

Certificates from sample container manufacturers are maintained by NTMWD Lab as appropriate. Information about the various sample containers is described below.

Sample containers are supplied by NTMWD and documentation is maintained by NTMWD. The containers have labels prepared by NTMWD and already contain acid where required. Amber HDPE bottles supplied by NTMWD are used routinely for chlorophyll samples. Bottles for E. coli collection are supplied to NTMWD by IDEXX and contain sodium thiosulfate powder.

Certification and documentation for IDEXX bottles are maintained by NTMWD. All IDEXX bottles delivered to NTMWD are new and have not been previously used.

NTMWD utilizes commercially purchased disposable plastic leak proof sample containers for the following conventional parameters: Total Organic Carbon and metals (iron and manganese). For all other conventional parameters, NTMWD utilizes reusable plastic leak proof sample containers that have been cleaned in accordance with NTMWD's Lab ware Cleaning Procedures (36-084). All sample containers are selected based on requirements from 40 CFR 136 and are both chemically and thermally preserved. Commercially purchased pre-sterilized plastic containers in 120 mL with sodium thiosulfate are used by NTMWD for collecting bacteriological samples. Certificates of Analysis for both commercially purchased disposable plastic leak proof sample containers and pre-sterilized plastic containers in 120 mL with sodium thiosulfate are permanently maintained by NTMWD.

Processes to Prevent Contamination

Procedures in the *TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring* outline the necessary steps to prevent contamination of samples, including direct collection into sample containers, when possible. Field QC samples (identified in Section B5) are collected to verify that contamination has not occurred.

Documentation of Field Sampling Activities

Field sampling activities are documented on field data sheets (see Appendix A). The following will be recorded for all visits:

- station ID
- sampling date
- location
- sampling time
- sampling depth
- sample collector's name/signature
- values for all field parameters, including flow and flow severity
- detailed observational data, where appropriate, including:
  - water appearance
  - weather
  - biological activity
  - unusual odors
  - pertinent observations related to water quality or stream uses (i.e., exceptionally poor water quality conditions; stream uses such as swimming, boating, fishing, irrigation pumps)
  - watershed or instream activities (i.e., bridge construction, livestock watering upstream)
  - specific sample information
- missing parameters (i.e., when a scheduled parameter or group of parameters is not collected)

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:

- Legible writing in indelible ink with no modifications, write-overs or cross-outs;

- Correction of errors with a single line followed by an initial and date;
- Close-out on incomplete pages with an initialed and dated diagonal line.

Sampling Method Requirements or Sample Processing Design Deficiencies and Corrective Action

Examples of sampling method requirements or sample design deficiencies include but are not limited to such things as inadequate sample volume due to spillage or container leaks, failure to preserve samples appropriately, contamination of a sample bottle during collection, storage temperature and holding time exceedance, sampling at the wrong site, etc. Any deviations from the QAPP and appropriate sampling procedures may invalidate resulting data and may require corrective action. Corrective action may include for samples to be discarded and re-collected. It is the responsibility of the NTMWD Project Manager, in consultation with the NTMWD Project QAO, to ensure that the actions and resolutions to problems are documented by completion of a corrective action report (CAR) and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the NTMWD Project Manager who will inform the TSSWCB Project Manager in writing in the project progress reports.

The definition of and process for handling deficiencies and corrective action are defined in Section C1.

B3 SAMPLE HANDLING AND CUSTODY

Sample Tracking

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, and analysis.

A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The Chain of Custody (COC) form is a record that documents the possession of the samples from the time of collection to receipt in the laboratory. The following information concerning the sample is recorded on the COC form (See Appendix B).

- Date and time of collection
- Site identification
- Sample matrix, indicated by the test group code
- Number of containers and container type ID designation
- Preservative used or if the sample was filtered, indicated by test group code
- Analyses required, indicated by the test group code
- Name of collector
- Custody transfer signatures and dates and time of transfer
- Name of laboratory accepting the sample

Sample Labeling

Samples containers used in the field are pre-labeled by the lab. Label information includes:

- Site identification
- Date of sampling
- Time of sampling
- Preservative added, if applicable

Sample Handling

After collection of samples is complete, sample containers are immediately stored in an ice chest for transport to the NTMWD laboratory. Ice chests remain in the possession of the field technician or in the locked vehicle until being delivered to the lab. After submission to the NTMWD laboratory, the samples remain in the log-in room until log-in is completed, then they are stored in the refrigeration unit or given to an analyst for immediate analysis. Only authorized laboratory personnel handle samples received by the laboratory. NTMWD Laboratory Quality Manual (QM) and SOPs address samples relinquished to the lab.

Sample Tracking Procedure Deficiencies and Corrective Action

All deficiencies associated with COC procedures and described in this QAPP are immediately reported to the NTMWD Project Manager or QAO. These include such items as delays in transfer resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; and broken or spilled samples. The NTMWD Project Manager, in consultation with the NTMWD PM and NTMWD Project QAO, will determine if the procedural violation may have compromised the validity of resulting data. Any failures that have reasonable potential to compromise data quality will invalidate data, and the sampling event should be repeated, if feasible. The resolution of the situation will be reported to the TSSWCB Project Manager in the project progress report. CARs will be prepared by the NTMWD personnel and summarized by the NTMWD PM for submittal to the NTMWD Project Manager for inclusion with project progress report.

The definition of and process for handling deficiencies and corrective action are defined in Section C1.

B4 ANALYTICAL METHODS

The analytical methods, associated matrices, and performing laboratories are listed in Table A7.1 of Section A7. The procedures for laboratory analysis shall be in accordance with the most recently published edition of Standard Methods for the Examination of Water and Wastewater, the latest version of the TCEQ Surface Water Quality Monitoring Procedures, 40 CFR Part 136, or other reliable procedures acceptable to the TSSWCB.

Laboratories collecting data under this QAPP are compliant with the NELAP® standards, at a minimum. Copies of laboratory SOPs are available for review by the TSSWCB.

Standards Traceability

All standards used in the field and laboratory are traceable to certified reference materials. Standards preparation is fully documented and maintained in a standards log book. Each documentation includes information concerning the standard identification, starting materials, including concentration, amount used and lot number; date prepared, expiration date and preparer's initials/signature. Reagent bottles are labeled to trace the reagent back to preparation. Table A7.1, Measurement Performance Specifications, lists the methods to be used for field and laboratory analyses.

Deficiencies, Nonconformances and Corrective Action Related to Quality Control

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP or other applicable documents. Nonconformances are deficiencies which affect quantity and/or 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, and QC sample failures.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the pertinent field or laboratory supervisor who will notify the NTMWD Project Manager. A Corrective Action Report to document the deficiency is written for each deficiency.

The NTMWD Project Manager, in consultation with the NTMWD Project QAO (and other affected individuals/organizations), will determine whether the deficiency could affect data quality. If it is determined the 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 a nonconformance does exist, the NTMWD Project Manager, in consultation with the NTMWD Project QAO, will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented in the CAR (see Appendix E).

The definition of and process for handling deficiencies and corrective action are defined in Section C1.

The TCEQ has determined that analyses associated with the qualifier codes (e.g. "holding time exceedance", "sample received unpreserved", "estimated value") may have unacceptable measurement uncertainty associated with them. Therefore, data with these types of problems shall be clearly qualified prior to submittal to the TCEQ Data Management and Analysis Team. Additionally, any data collected or analyzed by means other than those stated in the QAPP, or data suspect for any reason shall be appropriately qualified (see SWQM DMRG or most recent version for data qualifiers). TCEQ will review the data and load data approved by the TSSWCB Project Manager into SWQMIS.

B5 QUALITY CONTROL

Sampling Quality Control Requirements and Acceptability Criteria

The minimum field QC requirements, and program-specific laboratory QC requirements, are outlined in SWQM Procedures. Specific requirements are outlined below. Field QC sample results are submitted with the laboratory data report (see Section A9.).

Field blank
Field blanks are required for total metals-in-water samples when collected without sample equipment (i.e., as grab samples). For other types of samples, they are optional. A field blank is prepared in the field by filling a clean container with pure deionized water and appropriate preservative, if any, for the specific sampling activity being undertaken. Field blanks are used to assess contamination from field sources, such as airborne materials, containers, or preservatives. The frequency requirement for field blanks for total metals-in-water samples is specified in the SWQM Procedures.

The analysis of field blanks should yield values lower than the LOQ. When target analyte concentrations are high, blank values should be lower than 5% of the lowest value of the batch.

Field blanks are associated with batches of field samples. In the event of a field blank failure for one or more target analytes, all applicable data associated with the field batch may need to be qualified as not meeting project QC requirements, and these qualified data will not be reported to the TCEQ. These data include all samples collected on that day during that sample run and should not be confused with the laboratory analytical batch.

Field equipment blank
Field equipment blanks are required for metals-in-water samples when collected using sampling equipment. Field equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check the effectiveness of decontamination procedures. It is collected in the same type of container as the environmental sample, preserved in the same manner and analyzed for the same parameter.

The analysis of field equipment blanks should yield values lower than the LOQ, or, when target analyte concentrations are very high, blank values must be less than 5% of the lowest value of the batch, or corrective action will be implemented.

Field equipment blanks are associated with batches of field samples. In the event of a field equipment blank failure for one or more target analytes, all applicable data associated with the field batch may need to be qualified as not meeting project QC requirements, and these qualified data will not be reported to the TCEQ. These data include all samples collected on that day during that sample run and should not be confused with the laboratory analytical batch.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Batch
A batch is defined as environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same NELAP-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 25 hours. An **analytical batch** is composed of prepared environmental samples (extract, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Method Specific QC requirements

QC samples, other than those specified in this section (i.e., sample duplicates, surrogates, internal standards, continuing calibration samples, interference check samples, positive control, negative control, and media blank), are analyzed 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 SOPs. The minimum requirements to which all participants abide by are stated below.

Comparison Counting

For routine bacteriological samples, repeat counts on one or more positive samples are required, at least monthly. If possible, compare counts with an analyst who also performs the analysis. Replicate counts by the same analyst should agree within 5 percent, and those between analysts should agree within 10 percent. Record the results.

Limit of Quantification (LOQ)

The laboratory will analyze a calibration standard (if applicable) at the LOQ on each day calibrations are performed. In addition, a LOQ check sample will be analyzed with each analytical batch. Calibration results, including the standard at the LOQ listed in Table A7.1a-b, will meet the calibration requirements of the analytical method or corrective action will be implemented.

LOQ Check Sample

A LOQ check sample 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. The LOQ check sample is carried through the complete preparation and analytical process and run at a rate of one per analytical batch. 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 sample is spiked into the sample matrix at a level less than or near the LOQ for each analyte in each analytical batch of samples analyzed. If it is determined that sample results exceeded the high range of the calibration curve, samples should be diluted or run on another curve. For samples run on batches with calibration curves that do not include the LOQ, a check sample will be run at the low end of the calibration curve.

The percent recovery of the LOQ check sample 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 sample:

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

Measurement performance specifications are used to determine the acceptability of LOQ check sample analyses as specified in Table A7.1.

Laboratory Control Sample (LCS)

A LCS consists of a sample matrix (e.g. deionized water) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known 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 equal to the mid-point of the calibration curve 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. The LCS is carried through the complete preparation and analytical process and run at a rate of one per batch.

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.

Laboratory Duplicates

A laboratory duplicate is an aliquot taken from the same container as an original sample 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 batch.

For most parameters, except bacteria, precision is evaluated using the relative percent difference (RPD) between duplicate LCS 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, X1 and X2, the RPD is calculated from the following equation:

$$RPD = |(X1 - X2)/\{(X1+X2)/2\} * 100|$$

For bacteriological parameters, precision is evaluated using the results from laboratory sample duplicates. Bacteriological duplicate are collected on a 10% frequency (or once per sampling run, whichever is more frequent).

The base-10 logarithms of the results from the original sample and its duplicate are calculated. The absolute value of the difference between the two logarithms will be compared to the precision criterion in Tables A7.1b. If the difference in logarithms is greater than the precision criterion, the data are not acceptable for use under this project and will not be reported to TSSWCB. Results from all samples associated with that failed duplicate (usually a maximum of 10 samples) will be considered to have excessive analytical variability and will be qualified as not meeting project QC requirements.

The precision criterion in Tables A7.1b for bacteriological duplicates applies to only samples with concentrations > 10 MPN/100 mL. Field splits are not collected for bacteriological analyses.

Laboratory Equipment Blank

Laboratory equipment blanks are prepared at the laboratory where collection materials for metals sampling equipment are cleaned between uses. These blanks document the materials provided by the laboratory are free of contamination. The QC check is performed before the metals sampling equipment is sent to the field. The analysis of laboratory equipment blanks should yield values less than the LOQ. If the result is not less than the LOQ, the equipment should not be used.

Matrix Spike (MS)

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. The components to be spiked shall be specified by the mandated analytical method. 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).

Matrix spikes indicate the effect of the sample on the precision and accuracy of the results generated using the selected method. The frequency of matrix spikes is specified by the analytical method, or a minimum of one per preparation batch, whichever is greater. To the extent possible, matrix spikes prepared and analyzed over the course of the project should be performed on samples from different sites.

The percent recovery of the matrix spike is calculated using the following equation, where %R is percent recovery, SSR is the concentration measured in the matrix spike, SR is the concentration in the unspiked sample and SA is the concentration of analyte that was added:

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

Matrix spike recoveries are compared to the acceptance criteria 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. NTMWD uses matrix spike recovery limits of 80-120 for parameters where a spike solution is available. These recoveries are monitored with QC charts to help determine interferences or detect trends. Matrix spikes that fail to meet these guidelines are reanalyzed if possible. An alternate sample may be used to help determine whether the problem was specific to that sample. If matrix spikes are not achievable within 80-120 % recovery then this recovery is flagged as exceeding the control limit on the QC report.

Method Blank

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 blanks are performed at a rate of once per preparation batch. 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. Samples associated with a contaminated blank shall be evaluated as to the best corrective action for the samples (e.g., reprocessing or data qualifying codes). In all cases the corrective action shall be documented.

The method blank shall be analyzed at a minimum of one per preparation batch. In those instances for which no separate preparation method is used (example: volatiles in water) the batch

shall be defined as environmental 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.

Deficiencies, Nonconformances and Corrective Action Related to Quality Control

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

Deficiencies are documented in logbooks, field data sheets, etc., by field or laboratory staff and reported to the appropriate field or laboratory supervisor who will notify the NTMWD Project Manager. The NTMWD Project Manager will notify the TSSWCB QAO of the potential nonconformance. The NTMWD QAO will initiate a CAR to document the deficiency.

The NTMWD 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 the CAR closed. If it is determined a nonconformance does exist, the NTMWD Project Manager will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the NTMWD QAO by completion of a CAR (see Appendix E).

CARs document: root cause(s); impact(s); specific corrective action(s) to address the deficiency; action(s) to 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. CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to TSSWCB both verbally and in writing.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

All sampling equipment testing and maintenance requirements are detailed in the *TCEQ Surface Water Quality Monitoring Procedure: Volume 1.* 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 SOPs.

B7 INSTRUMENT CALIBRATION AND FREQUENCY

Field equipment calibration requirements are contained in the *TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring*. Post-calibration error limits and the disposition resulting from error are adhered to. Data not meeting post-error limit requirements invalidate associated data collected subsequent to the pre-calibration and are not submitted to the TCEQ Data Management and Analysis Team.

Detailed laboratory calibrations are contained within the laboratory QM and SOPs.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All supplies and consumables received by NTMWD Laboratory are inspected upon receipt for damage, missing parts, expiration dates, 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. All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory SOPs.

B9 NON-DIRECT MEASUREMENTS

Non-directly measured data, secondary data, or acquired data involves the use of data collected under another project, and collected with a different intended use than this project. The acquired data still meets the quality requirements of this project, and is defined below. The following data source(s) will be used for this project:

Rainfall data will be acquired from multiple sources to report parameter code 72053 (Days Since Precipitation Event) with each set of water quality data submitted to TCEQ. Each partner will use the internet source that best addresses the rainfall events occurring closest to but upstream of or within the drainage area affecting their various monitoring stations. Historical rainfall data is accessible on these web sites to determine the "number of days since" requirement for reporting the 72053 parameter code. These sites include:

- National Oceanic and Atmospheric Administration's (NOAA's) National Climatic Data Center (NCDC) (http://www.ncdc.noaa.gov/). The NCDC is responsible for preserving, monitoring, assessing, and providing public access to the nation's climate and historical weather data and information
- Weather Underground (http://www.wunderground.com/) which collects and maintains precipitation data from numerous sources in the selected area
- Drought Monitoring (http://droughtmonitor.unl.edu/)

The USGS National Water Information System (NWIS) web interface can also be used to determine when a significant change in flow occurred at the various flow gages operated around the state of Texas. The web site http://waterdata.usgs.gov/tx/nwis/current/?type=flow can display discharge data in graph or tabular format to determine days when runoff affected the stream.

USGS gage station data will be used throughout this project to aid in determining gage height and flow. Rigorous QA checks are completed on gage data by the USGS and the data are approved by the USGS and permanently stored at the USGS. This data will be submitted to the TCEQ under parameter code 00061 Flow, Instantaneous or parameter code 74069 Flow Estimate depending on the proximity of the monitoring station to the USGS gage station.

Reservoir stage data are collected every day from the Unites States Geological Survey (USGS) and the Unites States Army Corps of Engineers (USACE) websites. These data are preliminary and subject to revision. The Texas Water Development Board (TWDB) derives reservoir storage (in acre-feet) from these stage data (elevation in feet above mean sea level), by using the latest

rating curve datasets available. These data are published at the TWDB website at http://waterdatafortexas.org/reservoirs/statewide. The web application uses real time gaged observations 7 AM reading each day (or closest reading available) from 119 major reservoirs to approximate daily storage for each reservoir, as well as daily total storage for water planning regions, river basins and the state of Texas. These instantaneous data are updated to mean daily data for all previous days. These data will be submitted to the TCEQ under parameter code 00052 Reservoir Stage and parameter code 00053 Reservoir Percent Full.

For evaluating trends, historical data from SWQMIS will be included in the statistical dataset as well as samples collected during the study period by the TCEQ under the SWQM Program.

B10 DATA MANAGEMENT

Data Management Process

Data is received by NTMWD from all partners, including NTMWD's own data monitoring program.

NTMWD field sheets are kept electronically. The calibration sheets, field sheets, and COCs are reviewed by the QAO before any data entry is made. If there are nonconformances such as failed calibration, the QAO writes instructions in a different colored ink on the related field sheet regarding data entry. Then the instructions are initialed and dated.

Electronic data from datasondes and flow-measurement devices are downloaded into a raw data folder. These electronic files are reviewed for accuracy and completeness by either the NTMWD Data Manager or QAO (but not the person who performed the original data entry). When associated lab data is received from the lab, the electronic files are also saved in the raw data folder.

The NTMWD analytical data is entered directly or manually into a Laboratory Information Management System, LIMS. Field data is entered into the doForms® application on iPads, which sends the data from the field into Hach Water Information Management Solution™ (WIMS). Additional data can be entered directly into WIMS. All data corrections are tracked in WIMS via an audit trail. WIMS has many functions and can produce the event/result files required by TCEQ for entry into the SWQMIS database. A minimum of 10% of the files are inspected by the NTMWD CRP DM and a SWQMIS test user validator report and data summary report are produced to verify that the format is correct and that the dataset is reasonable. The event/result data, validator report, the data summary, and CAPs are emailed to the TCEQ for entry in to SWQMIS. The TSSWCB PM is CC'd on all email communications with TCEQ.

Data Dictionary - Terminology and field descriptions are included in the *SWQM Data Management Reference Guide*, November 2013 or most recent version. The following table contains the codes used by NTMWD when submitting data under this QAPP. The parameters associated with each sample and the sampling frequency by station are presented in Tables A7.1a-b.

Table B10.1 –Sampling Entity Data Submission Codes

Name of Monitoring Entity	Tag Prefix	Submitting Entity	Collecting Entity
North Texas Municipal Water District	TX	TX	NM

Data Errors and Loss

NTMWD stores original electronic data in a LIMS and Hach WIMS system. This data is saved in the original format and remains unchanged. Any changes to a data file are documented by audit trails within the WIMS system. Using spread reports within WIMS, data is merged, formatted, and converted to the correct reporting units before the files are exported into Excel spreadsheets. An Excel spreadsheet is made for each data set. Ten percent of the data is reviewed and checked by hand after the spreadsheets are generated by the NTMWD DM. WIMS is capable of catching many entry errors and will flag or highlight data which is out of range or below the LOQ. The data is analyzed visually in tabular form to catch obvious errors in format by the NTMWD QAO. All changes, validation, and verification actions on the data are documented in a Data Review Summary Report which accompanies each data set submittal (Appendix D).

Record Keeping and Data Storage

As each data set is processed by NTMWD, all hard copies of data and/or field forms are organized into packets. All correspondences or reports related to the data set are to be printed and placed in the packet of information. Including but not limited to the QAO review comments, the draft and final Data Summary Reports/Sheets. Any other documentation related to that specific data set is also to be attached. Each packet of information is archived in NTMWD's Laserfiche system for long term storage.

NTMWD field investigators submit electronic data along with hard copies of field sheets and COC forms to NTMWD's Data Manager. Electronic data is stored in folders on the NTMWD network as "originals" and as copies for data management, verification, and validation. Electronic data is also uploaded into NTMWD's Laserfiche system. Daily and weekly backups are completed on NTMWD's server. Hard copies are filed in filing cabinets or file boxes for use as needed. All data is maintained for at least seven (7) years by NTMWD in Laserfiche.

Copies of data submissions sent to the TCEQ Data Management and Analysis Team are kept on the NTMWD's network server. The network server is backed up nightly.

Details of the NTMWD's document management processes are described in NTMWD Administrative Directive 35.

Data Handling, Hardware, and Software Requirements

The field data sheets and the computer data entry screen are compared for completeness of data entry. The computer form can be printed out and compared to the data sheets where the entries can be validated manually. Ten percent of the data is reviewed and checked by hand after entry by the NTMWD DM. WIMS is capable of catching many entry errors and will flag or highlight data which is out of range or below the LOQ. The data is analyzed visually in tabular form to catch obvious errors in format by the NTMWD QAO. See Appendix D for examples of data forms.

The laboratory database is housed on a NTMWD server and backed up daily. The LIMS runs on a Windows operating system. Details of the NTMWD storage system and LIMS backup frequency can be found in the most current version of the NTMWD Environmental Laboratory Quality System Manual.

Information Resource Management Requirements

Data will be managed in accordance with the DMRG, and applicable NTMWD information resource management policies. NTMWD employs IT personnel responsible for maintaining all computer hardware and software, including but not limited to servers, network accounts, data back-ups, security, firewalls, etc. Daily management is conducted along with regular maintenance and upgrades to the system.

The stations to be monitored for this project will be assigned TCEQ station IDs through TCEQ's SLOC process described in TCEQ's most current DMRG. Global Positioning System (GPS) equipment may be used as a component of the information required by the Station Location (SLOC) request process for creating the certified positional data that will ultimately be entered into the TCEQ's SWQMIS database. Positional data obtained by NTMWD staff members using a Global Positioning System will follow the TCEQ's OPP 8.11 and 8.12 policy regarding the collection and management of positional data. All positional data to be entered into SWQMIS will be collected by a GPS certified individual with an agency approved GPS device to ensure that the agency receives reliable and accurate positional data. Certification can be obtained in any of three ways: completing a TCEQ training class, completing a suitable training class offered by an outside vendor, or by providing documentation of sufficient GPS expertise and experience.

In lieu of entering coordinates collected with a Global Positioning System, positional data may be acquired using a Geographical Information System (GIS) and verified with photo interpolation using a certified source, such as USGS Digital Ortho Quarter-Quadrangles (DOQQs), Google Earth or Google Maps. The verified coordinates and map interface can then be used to develop a new station location.

C1 ASSESSMENTS AND RESPONSE ACTIONS

The following table presents the types of assessments and response actions for data collection activities applicable to the QAPP.

Table C1.1 Assessment and Response Requirements

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	NTMWD	Monitoring of the project status and records to ensure requirements are being fulfilled	Report to TSSWCB in Quarterly Report

Monitoring Systems Audit of NTMWD	Dates to be determined by TSSWCB	TSSWCB QAO	Field sampling, handling and measurement; facility review; and data management as they relate to the TSSWCB project #14-57	30 days to respond in writing to the TSSWCB to address corrective actions
Laboratory Inspection	Dates to be determined by TSSWCB	TSSWCB QAO	Analytical and quality control procedures employed at the NTMWD laboratory	30 days to respond in writing to the TSSWCB to address corrective actions

Corrective Action Process for Deficiencies

Deficiencies are any deviation from the QAPP, *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring*, SOPs, or the *DMRG*. Deficiencies may invalidate resulting data and require corrective action. Repeated deficiencies should initiate a Corrective Action Plan (CAP). Corrective action for deficiencies may include for samples to be discarded and re-collected. Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff, are communicated to NTMWD Project Manager (or other appropriate staff), and should be subject to periodic review so their responses can be uniform, and their frequency tracked. It is the responsibility of the NTMWD Project Manager, in consultation with the NTMWD QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the TSSWCB both verbally and in writing in the project progress reports and by completion of a CAP. In the event a deficiency results in qualifying data already put in SWQMIS Production, NTMWD's Data Mgr. will prepare the required documentation as specified in the DMRG Data Correction Request protocol and submit to TSSWCB. TSSWCB's PM will review, approve and submit the Data Correction Request to TCEQ's Data Management and Analysis Team.

Corrective Action

CAPs should:

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

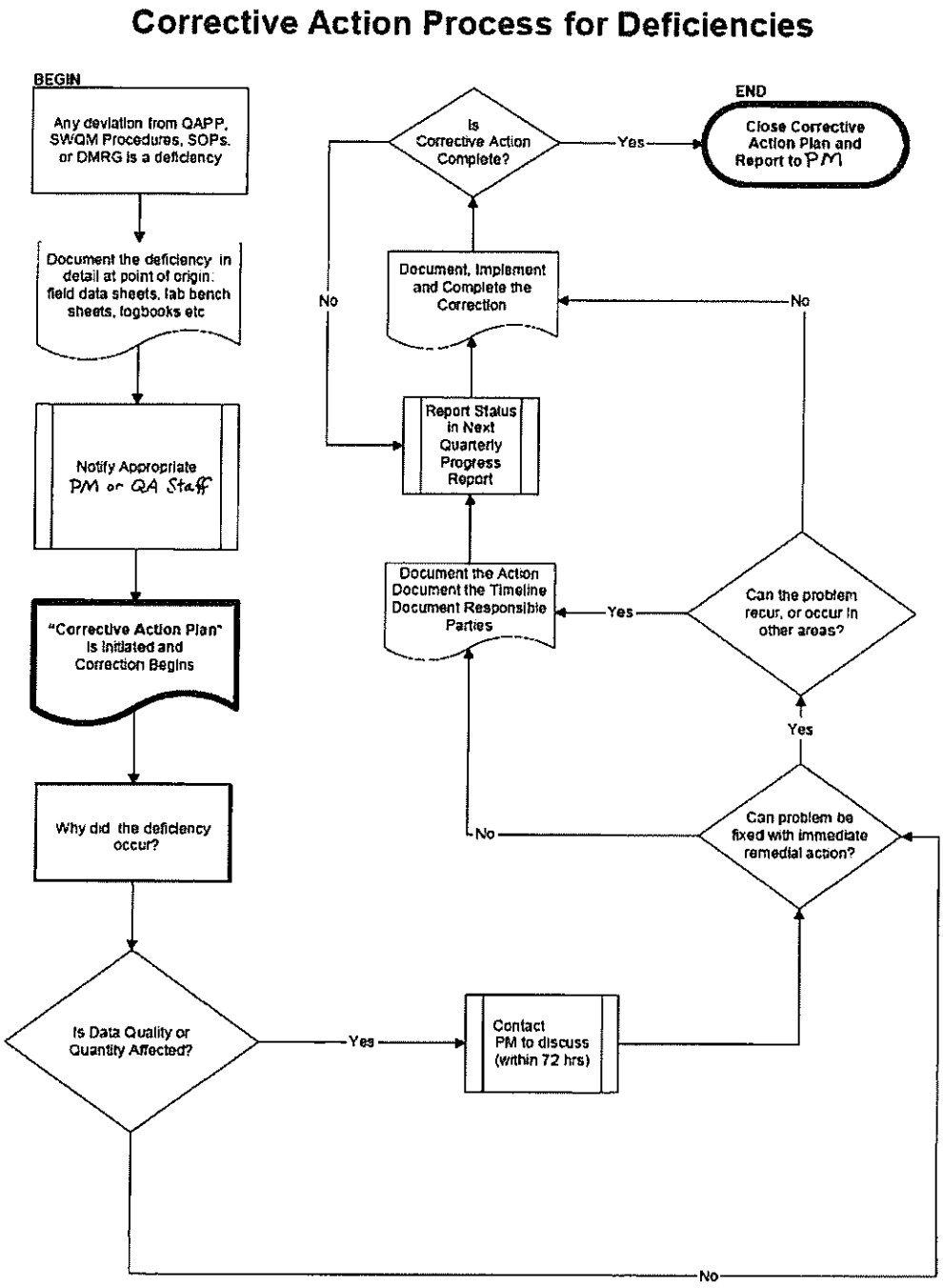
To facilitate the process a flow chart has been developed (see figure C1.1: Corrective Action Process for Deficiencies on the next page).

Status of CAPs will be included with progress reports. In addition, significant conditions which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data will be reported to the TSSWCB immediately.

The NTMWD Project Manager or their designee is responsible for implementing and tracking deficiencies and corrective actions in the NTMWD CAPA system. Records of audit findings and corrective actions are maintained by the NTMWD Project Manager. Audit reports and corrective action documentation will be submitted to the TSSWCB with the Progress Report.

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

Figure C1.1 Corrective Action Process for Deficiencies



C2 REPORTS TO MANAGEMENT

Reports to NTMWD Project Management

As part of the overall data review procedure, the NTMWD Lab Manager reviews all laboratory QC data results prior to reporting to the NTMWD DM and QAO. Any QC deficiencies are documented by a corrective action report (CAR), which are kept by the NTMWD QAO. The NTMWD Project QAO or DM reviews the data results and generates a CAR for any that do not pass project criteria. Any problems associated with sample collection, handling, log-in, or other situations are also documented with CARs. Pertinent supervisors, QAOs, and the TSSWCB Project Manager all review the CARs and provide input and evaluation as necessary prior to data being approved for use or submission to SWQMIS. Project status, assessments and significant QA issues will be dealt with by the NTMWD Project Manager who will determine whether it will be included in reports to TSSWCB Project Management.

Reports to TSSWCB Project Management

All reports detailed in this section are contract deliverables and are transferred to the TSSWCB in accordance with contract requirements.

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

Monitoring Systems Audit Report and Response - Following any audit performed by the TSSWCB, a report of findings, recommendations and response is included in the quarterly progress report sent to TSSWCB.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

For the purposes of this document, the term verification refers to the data review processes used to determine data completeness, correctness, and compliance with technical specifications contained in applicable documents (i.e., QAPPs, SOPs, analytical methods). Validation refers to a specific review process that extends the evaluation of a data set beyond method and procedural compliance (i.e., data verification) to determine the quality of a data set specific to its intended use.

All field and laboratory data will be reviewed and verified for integrity, completeness, reasonableness, and conformance to project requirements, and then validated against the project objectives and measurement performance specifications listed in Tables A7.1a-b. Only those data supported by appropriate quality control data and meet the measurement performance specifications defined for this project will be considered acceptable, and will be reported to TCEQ Data Management and Analysis Team for submittal to SWQMIS.

D2 VERIFICATION AND VALIDATION METHODS

All field and laboratory data will be reviewed, verified and validated to ensure they conform to project specifications and meet the conditions of end use as described in Section A7 of this document.

Data review, verification, and validation will be performed using self-assessments and peer and management review as appropriate to the project task. The data review tasks to be performed by field and laboratory staff are listed in the first two sections of Table D.2.1, respectively. Potential errors are identified by examination of documentation and by manual examination of corollary or unreasonable data. 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. If an issue cannot be corrected, the task manager consults with higher level project management to establish the appropriate course of action, or the data associated with the issue are rejected. Field and laboratory reviews, verifications, and validations are documented.

After the field and laboratory data are reviewed, another level of review is performed once the data are combined into a data set. This review step as specified in Table D2.1 is performed by the NTMWD Data Manager and QAO. Data review, verification, and validation tasks to be performed on the data set include, but are not limited to, the confirmation of laboratory and field data review, evaluation of field QC results, additional evaluation of anomalies and outliers, analysis of sampling and analytical gaps, and confirmation that all parameters and sampling sites are included in the QAPP.

Another element of the data validation process is consideration of any findings identified during the monitoring systems audit conducted by the TSSWCB Project Manager and QAO. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed.

After the data are reviewed and documented, the NTMWD Project Manager validates that the data meet the data quality objectives of the project and are suitable for reporting to TCEQ Data Management and Analysis Team for submittal to SWQMIS. Data Management and Analysis

Team prepares the test upload to the production environment of SWQMIS but waits for TSSWCB Project Manager approval of the dataset before completing the upload.

If any requirements or specifications of the TSSWCB project #18-10 are not met, based on any part of the data review, the responsible party shall document the nonconforming activities with a CAR, which will be reviewed by the NTMWD QAO, NTMWD Data Manager, NTMWD Project Manager with the data in the Data Summary. This information is communicated to the TSSWCB by the NTMWD Project Manager. Depending on the nonconformance, affected data will be flagged or not transmitted to TCEQ Data Management and Analysis Team for submittal to SWQMIS.

Table D2.1: Data Review Tasks for NTMWD

NTMWD Data to be Verified	Field Task	Laboratory Task (NTMWD Lab)	Lead Organization Data Manager Task
Sample documentation complete; samples labeled, sites identified	NTMWD QAO	Lab Analysts	
Field instrument pre- and post-calibration results within limits	NTMWD QAO		
Field QC samples collected for all analytes as prescribed in the TCEQ *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring*	NTMWD QAO		
Standards and reagents traceable	NTMWD QAO	Lab QAO	
Chain of custody complete/acceptable	NTMWD QAO	Lab Analysts	NTMWD Data Mgr
NELAP Accreditation is current		Lab QAO	
Sample preservation and handling acceptable	NTMWD QAO	Lab Analysts	
Holding times not exceeded		Lab QAO	NTMWD Data Mgr
Collection, preparation, and analysis consistent with SOPs and QAPP	NTMWD QAO	Lab QAO	
Field documentation (e.g., biological, stream habitat) complete	NTMWD QAO		
Instrument calibration data complete	NTMWD QAO	Lab QAO	
Bacteriological records complete		Lab QAO	
QC samples analyzed at required frequency	NTMWD QAO	Lab QAO	NTMWD Data Mgr
QC results meet performance and program specifications		Lab QAO	
Analytical sensitivity (Minimum Analytical Levels/Ambient Water Reporting Limits) consistent with QAPP		Lab QAO	
Results, calculations, transcriptions checked	NTMWD QAO	Lab Analysts	
Laboratory bench-level review performed		Lab Analysts	
All laboratory samples analyzed for all parameters		Lab QAO	
Corollary data agree		Lab QAO	NTMWD Data Mgr
Nonconforming activities documented	NTMWD QAO	Lab QAO	NTMWD QAO
Outliers confirmed and documented; reasonableness check performed	NTMWD QAO	Lab QAO	NTMWD Data Mgr & NTMWD QAO
Dates formatted correctly	NTMWD Data Mgr		NTMWD Data Mgr
Depth reported correctly	NTMWD Data Mgr		NTMWD Data Mgr
TAG IDs correct	NTMWD Data Mgr		NTMWD Data Mgr

NTMWD Data to be Verified	Field Task	Laboratory Task (NTMWD Lab)	Lead Organization Data Manager Task
TCEQ Station ID number assigned	NTMWD Data Mgr		NTMWD Data Mgr
Valid parameter codes	NTMWD Data Mgr		NTMWD Data Mgr & NTMWD QAO
Codes for submitting entity(ies), collecting entity(ies), and monitoring type(s) used correctly	NTMWD Data Mgr		NTMWD Data Mgr
Time based on 24-hour clock	NTMWD Data Mgr		NTMWD Data Mgr
Absence of transcription error confirmed	NTMWD Data Mgr & NTMWD QAO	Lab QAO	NTMWD Data Mgr
Absence of electronic errors confirmed	NTMWD Data Mgr & NTMWD QAO	Lab QAO	NTMWD Data Mgr
Sampling and analytical data gaps checked (e.g., all sites for which data are reported are on the coordinated monitoring schedule)	NTMWD Data Mgr & NTMWD QAO		NTMWD Data Mgr & NTMWD QAO
Field QC results attached to data review checklist	NTMWD Data Mgr & NTMWD QAO		NTMWD Data Mgr
Verified data log submitted	NTMWD Data Mgr		NTMWD Data Mgr
10% of data manually reviewed	NTMWD Data Mgr & NTMWD QAO	Lab QAO	NTMWD Data Mgr & NTMWD QAO

D3 RECONCILIATION WITH USER REQUIREMENTS

Data produced in this project, and data collected by other organizations (i.e., TCEQ, etc.), will be analyzed and reconciled with project data quality requirements. Data meeting project requirements will be used in the implementation of the Lavon Lake WPP and will be submitted to TCEQ SWQMIS for use as appropriate in the development of the biennial Texas Integrated Report for Clean Water Act Sections 305(b) and for WPP development, water quality standards development, and permit decisions. Data which do not meet requirements will not be submitted to SWQMIS nor will be considered appropriate for any of the uses noted above.

Appendix A. Field Data Sheet

North Texas Municipal Water District
Stream
CRP Field Data Reporting Form

Date:		Station Location:			TCEQ Site ID:		
Time:		Basin/ Segment			Technicians (Print/Sign):		
County:		Monitoring Type:					
NM Laboratory ID #:			Stream Width (ft):		Section Width (ft):		
Chain of Custody #:			Time Start:		Time End:		

Parameter Code		Parameter		Section Midpoint	Section Depth (ft)	Velocity (ft/S)	Discharge (CFS)
00010		Water Temp (°C)	1				
00094		Conductivity (uS/cm)	2				
00300		Dissolved Oxygen (mg/L)	3				
00400		pH (Standard Units)	4				
01351		Flow Severity 1- No Flow 2-Low Flow 3 - Normal 4 - Flood 5 - High 6 - Dry	5				
			6				
00061		Flow (CFS)	7				
74069		Flow Estimate	8				
89835		Flow Measurement Method 1 - Gauge 2 - Electronic 3 - Mechanical 4 - Weir/Flume 5 - Doppler	9				
			10				
20424		Water Clarity 1 - Excellent 2 - Good 3 - Fair 4 - Poor 5 - Other*	11				
			12				
89969		Water Color 1 - Brown 2 - Reddish 3 - Green 4 - Black 5 - Clear 6 - Other*	13				
			14				
89971		Water Odor 1 - Sewage 2 - Oily/Chem 3 - Rotten Egg 4 - Musky 5 - Fishy 6 - None 7 - Other*	15				
			16				
00020		Air Temperature (° Celsius)	17				
89966		Weather 1 - Clear 2 - Partly Cloudy 3 - Cloudy 4 - Rain 5 - Other*	18				
			19				
89965		Wind Direction:	20				
		1 - Calm 2 - Slight 3 - Moderate 4 - Strong	Tech Taking Flow:				Total Flow (CFS)
72053		Significant Precipitation (Days)					
00078		Transparency, Secchi Disk (m)					
89978	NA	Primary Contact Observed Act # of people observed 0-10 >10	Comments and details/description for parameter codes marked other*:				
89979	NA	Evidence of Primary Contact Rec 1 - Observed 0 - Not observed					

Measurement Comments and Field Observations		
Biological Activities:		
Aquatic Vegetation:		
Terrestrial Vegetation:		
Aquatic Animals:		
Terrestrial Animals:		
Aquatic Insects:		
Terrestrial Insects:		
Left Bank:		
Right Bank:		
Water Shed Activities:		
Water Quality/ Stream Use:		
Specific Sample Info:		
Missing Parameters:		
Notes:		
Drought Parameters (if applicable)	Parameter Code	Result
Maximum Pool Width (m)	89864	
Maximum Pool Depth (m)	89865	
Pool Length (m)	89869	
% Pool Coverage in a 500 m Reach	89870	
Sonde Depth in Air (m):		
Drought Conditions:		

Date:		Station Location:		TCEQ Site ID:	
Final Review					
Final Review					

Appendix B. Chain of Custody Form

Client:	North Texas Municipal Water District	North Texas Municipal Water District Chain of Custody Record	Work Order Number:
Address:	505 E. Brown St.	Sampler(s):	Project: Lavon Watershed
	Wylie, TX 75098	Sampler(s) Signatures:	
Contact Name:	Kristen Suprobo		PAGE: 1

Sample Name	TCEQ ID	Lab Sample Number	Sample Type	Sampling Date	Sampling Time	*Cont.(1) 2L HDPE Unpres Iced*	*Cont.(2) 250ml HDPE Unpreserved Iced*	*Cont.(3) 1 L HDPE H2SO4 Iced*	*Cont.(4) 125ml HDPE H3PO4 Iced*	*Cont.(5) 250ml HDPE HNO3 (Lab) Iced*	*Cont.(6) 100ml Bact. Na2S2O3 Iced*	*Cont.(7) 1 L HDPE Unpreserved Iced*	*Cont. (8) 2L HDPE Amber Unpreserved Iced*
Lower Wilson Creek	21764												
East Fork @546	22130												
Lower Honey Creek	21776												
East Fork 3	21778												
Throckmorton Creek	21777												
Upper Honey Creek	20932												
East Fork 4	21779												
Pilot Grove	15692												
Indian Creek	21769												
Headwaters PG	21768												
Elm Creek	21773												
Headwaters SG	21767												
Dup 1													
Dup 2													
Field Split 1													
Field Split 2													
Field Blank 1	Field Blank 1												
Field Blank 2	Field Blank 2												

[A = TSS, VSS] [B = SO4,Cl,TDS] [C = Hardness, NH3, NO3/NO2, T-PO4, TKN, COD] [D = TOC] [E = Total Fe, Total Mn] [F = E-Coli] [G =Alk, Turbidity, O-PO4, NO2] [H = Chlorophyll a /Pheophytin a]

Notes/Comments:

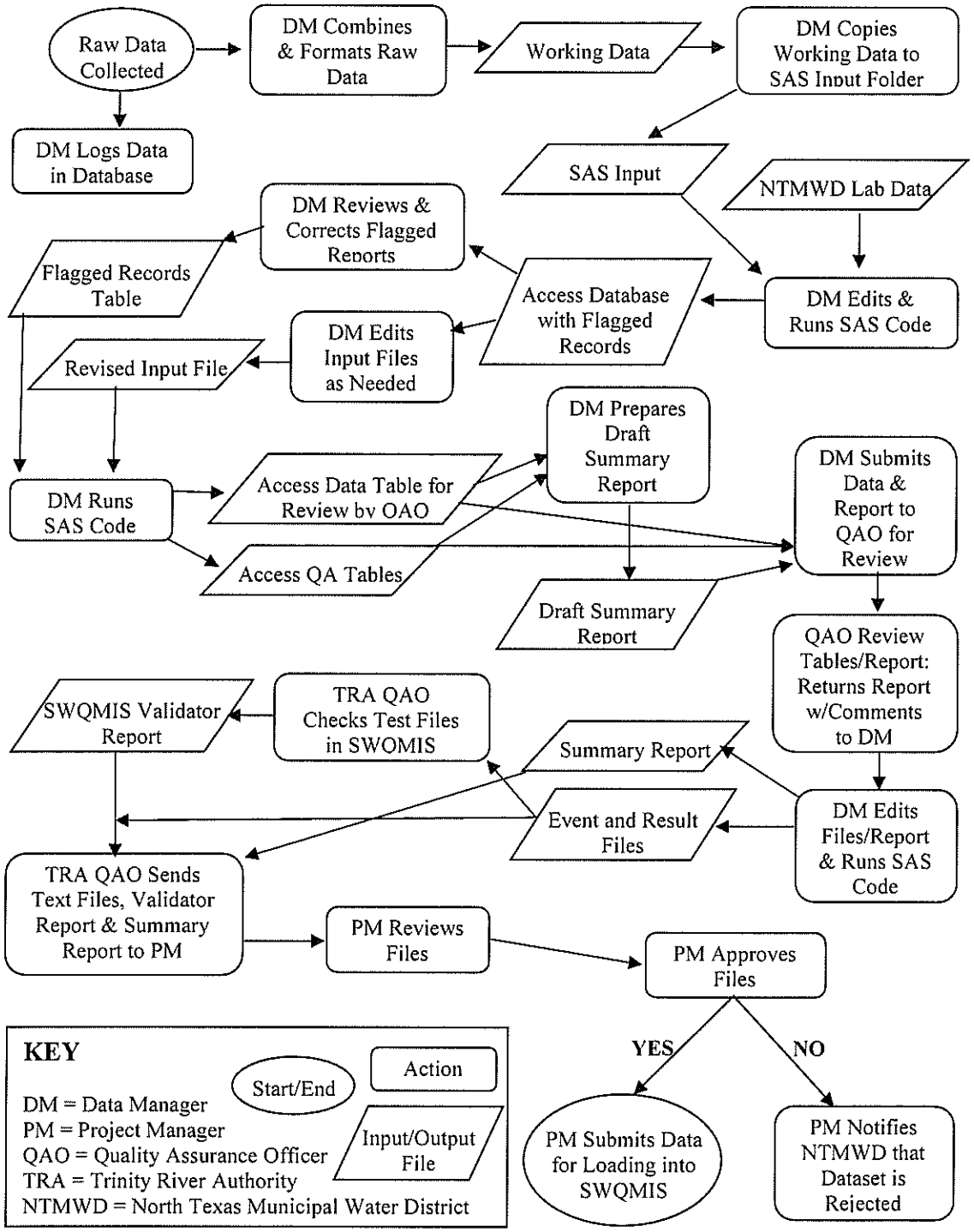
Relinquished By (signature):	Time:	Date:	Received By (signature):
Relinquished By (signature):	Time:	Date:	Received By (signature):

Note: *indicates the sample matrix is aqueous

Version 1.0 Created 3/4/16
Revised: 9/28/17

Appendix C

Data Management Flow Chart



Appendix D Data Summary Report

Data Information

Data Source: _____

Date Submitted: _____

Tag_id Range: _____

Date Range: _____

Comments

Please explain in the space below any data discrepancies including:

- **Inconsistencies with AWRL specifications;**
- **Failures in sampling methods and/or laboratory procedures that resulted in data that could not be reported to the TSSWCB or TCEQ; and**
- **Other discrepancies.**

_____
- _____
- _____
- _____
- _____
- _____
- _____

NTMWD Data Manager: _____

Date: _____

NTMWD QAO: _____

Date: _____

Appendix E Corrective Action Report

NC/CA Form (Interim), Rev. 0.0 Control # 36-678 Effective 10/14/2021

NC/CA ID #: NC36 - - *(e.g., NC36-YY-###)*
Department:
Method/Process:
Date Initiated:
Initiated By:
Date Closed: *(latest approval signature date)*

Non-conformance	
Non-conformance (NC) Description	
Items Affected *(e.g., specific samples or batches, SOPs, spreadsheets)*	
Most Probable Causes	

Corrective Action	
Corrective Action(s) (CA) to Address the NC	
Timetable for Implementing CA	
Means to Document CA	
Action(s) to Prevent Recurrence (APR)	
Timetable for Implementing APR	
Means to Document APR	
Follow-up Scheduled	
Action(s) for Follow-up	

Client Notification	
Client Notification	
Action(s) for Client Notification	
Timetable for Client Notification	
Means to Document Client Notification	
Verification of Effectiveness	
Timetable for Verification	
Means to Document Verification	

Attached Documents	
Name/Description	*# of pages*

Contributor Signatures

(Individuals other than those listed under "Approval Signatures")

	Date
	Date
	Date
	Date

Approval Signatures

(latest signature date is considered the "Date Closed")

Kelly Harden Laboratory Manager	Date
Catherine Hobbs QA/QC Officer	Date
Kevin Frantz Operations Manager	Date

Corrective Action for Nonconformance

NTMWD Environmental Services

Date:		**Project:**	
Person completing this form:			
Describe the nonconformance:			
Identify immediate remedial actions (if possible):			
Identify the root cause:			
Is the problem likely to recur?			
Corrective action:			
Personnel responsible:			
Data effected:			
List a timeline for the corrective action:			
Signatures:			
Enter Name	Date	Enter Name, **Supervisor**	Date
Enter Name	Date	Enter Name, **QA Officer**	Date