Guadalupe Blanco River Authority

Continuous Water Quality Monitoring Network, Data Collection and Validation

Quality Assurance Project Plan

Guadalupe-Blanco River Authority
933 E. Court St.
Seguin, TX 78155

Effective Period: One year from date of final approval

Prepared by:

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A1 Title and Approval

Preface

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

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Approval Page

Texas Commission on Environmental Quality (TCEQ)

CWQMN Network Coordinator Surface Water Quality Monitoring Team Monitoring & Assessment Section Water Quality Planning Division Texas Commission on Environmental Quality	6/22/15 Charles Dvorsky Date
CWQMN Quality Assurance Officer Monitoring Division (MD) Texas Commission on Environmental Quality	6/24/15 Daniel Burke Date
TCEQ Quality Assurance Manager Monitoring Division (MD) Texas Commission on Environmental Quality	6/29/2015 Sharon Coleman Date

Guadalupe-Blanco River Authority (GBRA)

Director of Water Quality/Project Lead/
Project Quality Control Officer
Water Quality Division
Guadalupe-Blanco River Authority

Michael Urrutia 6/22/15
Mike Urrutia Date

Water Quality Technician/
Data Validator
Water Quality Division
Guadalupe-Blanco River Authority

Lee Gudgell 06/22/15
Lee Gudgell Date

The Guadalupe-Blanco River Authority (GBRA) will secure written documentation from each sub-tier participant (e.g., subcontractors, organizations operating sites, laboratories) stating the organization's commitment to requirements contained in this quality assurance project plan and any amendments. The GBRA will maintain this documentation as part of the project's quality assurance records, and will ensure this documentation is available for review (See sample letter in Appendix G of this document).

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A2 CWQMN Standard Operating Procedures

Table 2.1 CWQMN Standard Operating Procedures (available via the internet at www.texaswaterdata.org)

SOP	Title	Revision	Date
AMPM-008	Measurement of Water Level and Sensor Depth in Surface Water using the In-Situ Level TROLL 500	0	10/01/07
AMPM-009	Analysis of In Situ Electrical Conductivity, Water Temperature, Water Level, and Sample Depth in Ambient Surface Water Using the In-Situ Aqua TROLL 200 Multiprobes.	0	02/15/12
N/A	Quality Assurance Project Plan for Continuous Water Quality Monitoring Network Program	7	04/13
AMPM-011	Analysis of Dissolved Oxygen, Specific Conductance, pH, Temperature, Sample Depth, and *in vivo* Chlorophyll A Detection in Ambient Surface Water using Yellow Springs Instrument (YSI) 6-Series Sondes	2	07/11/11
GBRA-001	Analysis of Dissolved Oxygen (DO), Specific Conductance (SC), pH, Temperature and Turbidity in Ambient Surface Water Using the In-Situ Inc. Multi-Parameter Water Quality TROLL 9500	2	05/13
GBRA-002	Analysis of Pressure/Water Level (Stage Height), in Ambient Surface Water Using the In-Situ Inc. Level-TROLL 500	2	05/13
N/A	Validation of Continuous Water Quality Monitoring Data Collected by Multi-parameter Sonde	2	02/14/11

*** - The current versions of these Standard Operating Procedures are not attached to this GBRA River Network CWQMN QAPP, but are available for reference via the internet on the TCEQ CWQMN website at (www.texaswaterdata.org).

A3 Distribution List

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

Charles Dvorsky, CWQMN Network Coordinator, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division

Daniel Burke, CWQMN Quality Assurance Officer, Monitoring Division

Sharon Coleman, TCEQ Quality Assurance Manager, Monitoring Division

Andrew Sullivan, Team Leader, Surface Water Quality Monitoring
Team, Monitoring & Assessment Section, Water Quality Planning Division

Cathy Anderson, Data Management & Analysis Team Leader, Monitoring & Assessment,
Water Quality Planning Division

Edward Ragsdale, CWQMN Quality Control Officer, Surface Water Quality Monitoring Team, Water Quality Planning Division

Patricia Wise, Clean Rivers Program, Monitoring & Assessment Section, Water Quality Planning Division

Bill Harrison, Surface Water Quality Monitoring Team, Monitoring and Assessment Section, Water Quality Planning Division

Cooperators

Guadalupe-Blanco River Authority
933 E. Court St.
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Mike Urrutia, GBRA CWQMN Project Lead/Project QC Officer

Lee Gudgell, GBRA CWQMN Project Water Quality Technician/ Project Data Validator

Josie Longoria, Regional Laboratory Director

Contractors

C.C. Lynch and Associates
300 Davis Ave.
Pass Christian, MS 39571
1-800-333-2252

Russell Park, Technical Support Representative

The Guadalupe-Blanco River Authority (GBRA) will provide copies of this QAPP and any amendments or appendices of this plan to each person on this list and to each sub-tier project participant, e.g., subcontractors, organizations operating sites, laboratories. The GBRA 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 ensure this documentation is available for review.

A4 Project/Task Organization

The Texas Commission on Environmental Quality (TCEQ) Continuous Water Quality Monitoring Network (CWQMN) Program is administered by the Monitoring & Assessment Section of the Water Quality Planning Division (WQPD). The CWQMN is operated by TCEQ regional staff, cooperators, and contractors. The TCEQ's Monitoring Division provides critical network infrastructure support. This Quality Assurance Project Plan (QAPP) is specific to the activities of the Guadalupe-Blanco River Authority (GBRA) and TCEQ. The organization, interrelationships, and responsibilities for the TCEQ CWQMN are described in the current revision of the *TCEQ CWQMN QAPP*. The organization of the GBRA Continuous Water Quality Monitoring Network (GBRA CWQMN) is described in Figure A4.1. The interrelationships and responsibilities of the participants in this project are described below:

TCEQ

TCEQ Water Quality Planning Division

TCEQ CWQMN Network Coordinator, WQPD (Chuck Dvorsky)

- Overall coordination of the CWQMN and primary contact.
- Develops and communicates objectives for the CWQMN.
- Coordinates and facilitates development of site-specific DQOs or MQOs.
- Approves sampling sites after consultation with TCEQ staff and stakeholders.
- Responsible for integrating new stations into the existing monitoring network.
- Develops and coordinates contracts and intergovernmental agreements of the CWQMN.

TCEQ CWQMN Program Manager, WQPD (Andrew Sullivan)

- Maintains a thorough knowledge of program work activities, commitments, deliverables, and time frames.
- Develops necessary lines of communication and good working relationships between the lead division staff and personnel of other divisions and organizations participating in the program.
- Maintains oversight of contracts and intergovernmental agreements of the CWQMN.

TCEQ Monitoring Division (MD)

- Provides technical support and logistics for monitoring site deployments.
- Provides overall support of monitoring station communication and electronic data acquisition needs and provides training on the operation of communications equipment.

- Coordinates activities related to the LEADS for both water and air monitoring.
- Provides LEADS site registration for CWQMN sites and establishes accounts for CWQMN operators and validators to access Manual Validation.
- Maintains the repository and the internal/external LEADS-based web. This includes MD RHONE web pages with water data reports, water data status pages, and online network documentation.

TCEQ Data Management and Analysis Team, WQPD

- Provides data validation training to interested parties, cooperators and contractors.
- Coordinates the development and maintenance of the SWQMIS for warehousing all CWQMN data.
- Coordinates the development of interfaces between LEADS and SWQMIS with MD.

TCEQ CWQMN QA Officer, Monitoring Division (Daniel Burke)

- Provides technical review of all third party cooperator QA activities.
- Provides technical expertise and/or consultation on quality services.

TCEQ CWQMN QC Officer, WQPD (Edward Ragsdale)

- Provides technical support and review of all third party cooperator QA/QC

TCEQ CWQMN External Web Page Maintenance

- Maintain various internal and external water-related web pages with guidance from WQPD staff.

Guadalupe-Blanco River Authority

GBRA Water Quality Division

GBRA Project Manager (Mike Urrutia)

- Responsible for ensuring tasks and other requirements in the contract are executed on time and are of acceptable quality.
- Monitors and assesses the quality of work.
- Coordinates attendance at conference calls, training, meetings, and related project activities with the TCEQ.
- Responsible for verifying the QAPP is followed and the project is producing data of known and acceptable quality.

- Ensures adequate training and supervision of all monitoring and data collection activities.
- Complies with corrective action requirements.

GBRA Project Quality Assurance Officer (Mike Urrutia)

- Responsible for coordinating development and implementation of the QA program.
- Responsible for writing and maintaining the Guadalupe River Basin Network QAPP.
- Responsible for maintaining records of QAPP distribution, including appendices and amendments.
- Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP.
- Responsible for identifying, receiving, and maintaining project quality assurance records.
- Responsible for coordinating with the TCEQ QAS to resolve QA- related issues.
- Notifies the contractor Project Manager and TCEQ CWQMN Network Coordinator of particular circumstances which may adversely affect the quality of data.
- Responsible for validation and verification of all data collected according with Table 4 procedures and acquired data procedures after each task is performed.
- Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques.
- Conducts laboratory inspections.
- Develops, facilitates, and conducts monitoring systems audits.

GBRA Project Data Manager (Mike Urrutia)

- Responsible for the acquisition, verification, and transfer of data to the TCEQ.
- Oversees data management for the study.
- Performs data quality assurances prior to transfer of data to TCEQ.
- Responsible for transferring data to the TCEQ in the Event/Result file format specified in the DMRG.
- Ensures data are submitted according to workplan specifications.
- Provides the point of contact for the TCEQ Data Manager to resolve issues related to the data.

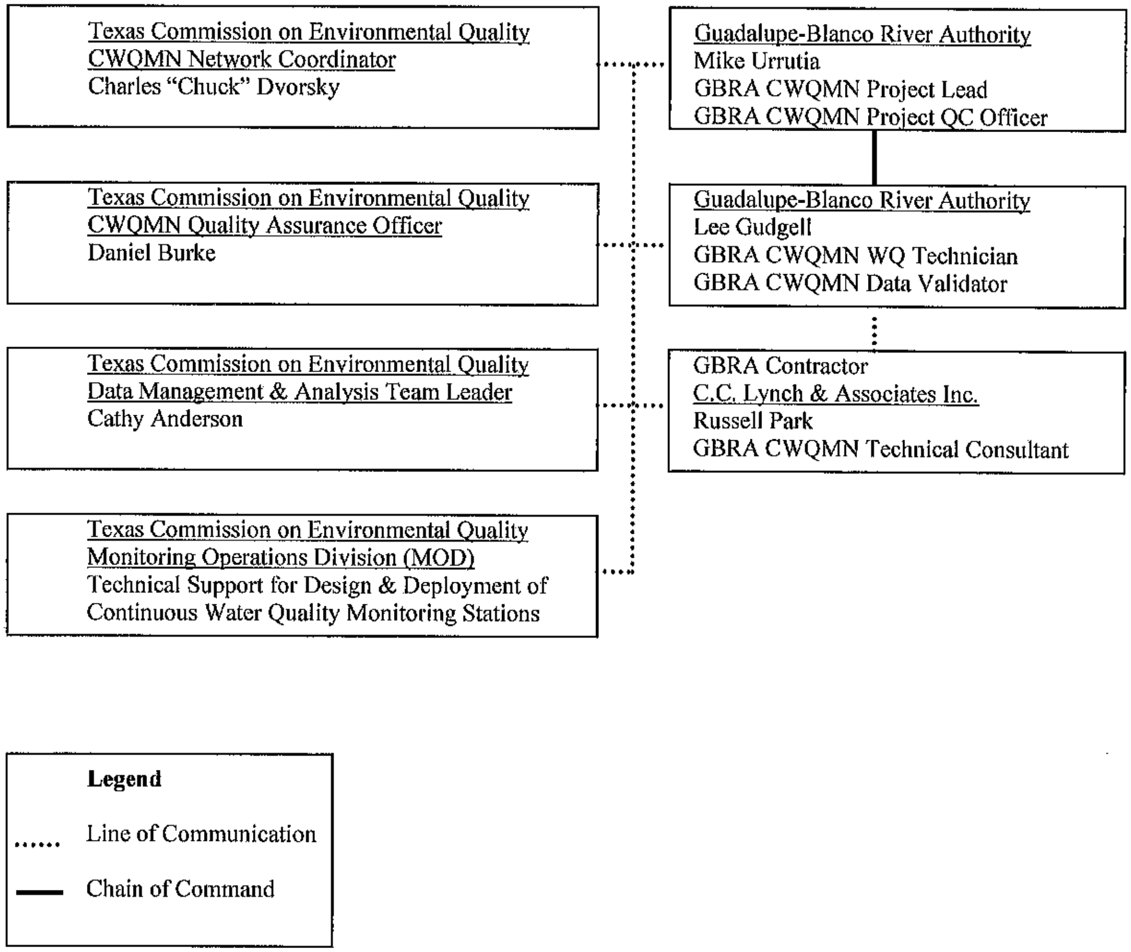
GBRA Water Quality Technician/Data Validator (Lee Gudgell)

- Responsible for supervising all aspects of the sampling and measurement of surface waters and other parameters in the field, as necessary.
- Responsible for the acquisition of water samples and field data measurements in a timely manner that meet the quality objectives specified in Table A7.1, as well as the requirements of Sections B1 through B8, as necessary.

- Responsible for field scheduling, staffing, and ensuring that staff is appropriately trained as specified in Sections A6 and A8.
- Provides overall support for the operation and maintenance of the CWQMN monitoring stations associated with this QAPP.
- Responsible for installation, operation and maintenance of monitoring sites and equipment according to current QAPPs and SOPs.
- Calibrates measurement instrumentation.
- Records instrument maintenance and/or calibration information associated with monitoring sites in any relevant physical or electronic logbooks.
- Performs QC checks on monitoring, sampling equipment according to current QAPPs and SOPs.
- Reviews QC data and ensures that quality data is being generated.
- Reviews, verifies and validates CWQMN data generated by the monitoring sites in this QAPP.
- Records Validation notes in any relevant physical or electronic validation logbooks for CWQMN monitoring sites associated with this QAPP.
- Assists auditors with performance evaluations and technical system audits.
- Participates in the development of SOPs for instrumentation.
- Performs preventative maintenance on monitoring equipment.
- Assists in the development of DQOs and MQOs.
- Responsible for notifying the GBRA Project Manager of particular circumstances which may adversely affect the quality of data.
- Responsible for completing and transferring chain of custody and field data sheets to the laboratory as necessary.

Figure A4.1 GBRA CWQMN Project Organization Chart

Refer to the Organizational Chart found in the TCEQ's *QAPP for Continuous Water Quality Monitoring Network Program, Revision 7, April 2013* or current revision for more information about the management structure of the TCEQ CWQMN Program.



A5 Project Definition/Background

Fourteen segments have been identified in the Guadalupe River Basin for having impairments or water quality concerns. Most of the impairments are based on the monthly or quarterly sampling of one or two sites on the respective segments over a period of at least seven years. The development of a TMDL or a watershed protection plan has begun or has been completed on many waterbodies in the Guadalupe River Basin, including Plum Creek in Hays and Caldwell Counties, Sandies Creek in DeWitt County, the Upper San Marcos River and the Cypress Creek watersheds in Hays County and the Geronimo Creek watershed in Guadalupe and Comal Counties. These segments have been listed on the 305b report and/or the 303d list of impaired water bodies with impairments or concerns.

The deployment of the continuous monitoring modules specified in this QAPP is in support of the ongoing TMDL and watershed planning processes, or implementation projects or best management practices (BMPs) that have been recommended as a result of the watershed studies. The implementation projects have been recommended as a means to reduce the pollutant loading and help bring the streams back into compliance with stream standards. Continuous monitoring stations installed prior to the implementation projects can monitor the changes that occur in the stream after installation and demonstrate the effectiveness of any BMPs that are implemented.

Additionally, stakeholders have voiced concerns during the TMDL and planning process that a true picture is not being represented by a monthly sample or by a short study. They see these studies or monitoring events as "snap shots in time", which may be less than adequate in representing the overall water quality of the streams in their areas of interest. Continuous water quality stream monitoring would paint a continuous picture of the ambient water quality as well as document the way the stream reacts to storm events and temporal spring flow and runoff cycles. These water quality monitoring stations will be incorporated into the TCEQ continuous water quality monitoring network (TCEQ CWQMN) and hosted on the associated webpage at www.texaswaterdata.org, which will provide access to real-time data for stakeholders in the water bodies of concern. The TCEQ CWQMN measures water quality parameters in various watersheds around the state at greater frequency than is possible with grab samples or short term deployments of monitoring instrumentation.

The GBRA will provide oversight of the GBRA Continuous Water Quality Monitoring Network (GBRA CWQMN) in the Plum Creek, the Geronimo Creek, the Cypress Creek and the Sandies Creek watersheds during the life of the project. Of the many watershed stakeholders, the GBRA has taken a leading role in working toward improving water quality in these watersheds. The GBRA currently monitors water quality on all three of these impaired water bodies and is in a unique position to monitor and improve the health of these creeks. In order to be able to make significant improvements, the GBRA will work towards expanding this network of continuous monitors in the future to provide a larger picture of the impacts of these impaired streams on the entire Guadalupe River Basin.

This QAPP is reviewed by the TCEQ to help ensure that data generated for the purposes described above are scientifically valid and legally defensible. This process will ensure that all data reported to TCEQ have been collected and analyzed in a way that guarantees their reliability and therefore can be used in programs deemed appropriate by the TCEQ.

The GBRA CWQMN measures turbidity (experimental data), pH, temperature, dissolved oxygen, and conductivity (collectively referred to as "field parameters") and stage height (until site can be calibrated for measurement of flow) in monitoring locations in the Guadalupe River Basin at a greater frequency than is possible with grab samples or short term deployments of monitoring instrumentation. The GBRA CWQMN will be used for a variety of purposes, including:

- Characterizing baseline conditions;
- Identifying trends;
- Assessing impacts of point and non-point source discharges, including short term pollution events;
- Providing timely surface water quality data to interested stakeholders in the Guadalupe River Basin;
- Providing specific conductance, dissolved oxygen, pH, and temperature data for
- the CWA Section 305(b) assessment;
- Providing data to support Texas Surface Water Quality Standards (TSWQS) reviews;
- Providing timely surface water quality data for water management decisions;
- Providing data in support of watershed protection plans;
- Providing real-time measurements for use as surrogates to estimate constituent concentration loading;
- Characterizing water quality conditions that lead to blooms of algae;
- Developing new water quality monitoring technology, applications and methodologies;
- Developing water quality controls and best management practices (BMPs) and assessing improvement after watershed management and implementation plans are in place;
- Providing continuous water quality data to the public (via the internet); and,
- Collecting data for water quality models.

Table A5.1 provides the summary of the GBRA CWQMN site and water quality monitoring objectives.

Table A5.1 GBRA CWQMN Objectives and Locations

River Basin	Seg No.	CAMS No.	Station Location	TCEQ Station	Objective	Station Parameter
Guadalupe	1804A	741	Geronimo Creek at SH123	14932	1) Providing timely turbidity, gage height and field parameter data to the Geronimo Creek Watershed Partnership and other interested stakeholders in the Geronimo Creek watershed; 2) Assessing impacts of non-point source discharges, including short term pollution events in the Geronimo Creek watershed.	<u>Surface</u> Turbidity pH Water Temperature Dissolved Oxygen Specific Conductance Gage Height Stream Flow
Guadalupe	1815	797	Cypress Creek 200 meters upstream of Confluence with Blanco River	12673	1) Providing timely turbidity, gage height and field parameter data to the Cypress Creek Watershed Partnership and other interested stakeholders in the Cypress Creek watershed; 2) Assessing impacts of non-point source discharges, including short term pollution events in the Cypress Creek watershed.	<u>Surface</u> Turbidity pH Water Temperature Dissolved Oxygen Specific Conductance Gage Height Stream Flow
Guadalupe	1803B	732	Sandies Creek at Cheapside Road, 2.0 NE of Westhoff	13657	1) Providing timely turbidity, gage height and field parameter data to interested stakeholders in the Sandies Creek watershed; 2) Assessing impacts of non-point source discharges, including short term pollution events in the Sandies Creek watershed.	<u>Surface</u> Turbidity pH Water Temperature Dissolved Oxygen Specific Conductance
Guadalupe	1810	763	Plum Creek at CR202 (Old McMahon Road) downstream of the City of Lockhart, TX	12647	1) Providing timely turbidity, stage height and field parameter data to the Plum Creek Watershed Partnership and other interested stakeholders in the Plum Creek watershed; 2) Assessing impacts of point (effluent discharges from the City of Lockhart wastewater treatment facilities) and non-point source discharges. 3) Assessing effectiveness of Plum Creek Watershed Protection Plan implementation BMPs.	<u>Surface</u> Turbidity pH Water Temperature Dissolved Oxygen Specific Conductance Stage Height

BMP = Best Management Practice
CAMS = Continuous Ambient Monitoring Station

A6 Project/Task Description

Currently, routine ambient water quality data, including laboratory nutrients, turbidity and field parameters, are collected monthly or quarterly at stations for the TCEQ Clean Rivers Program (CRP) by the GBRA. The GBRA CWQMN project will supplement this routine data by generating data of known and acceptable quality for surface water quality monitoring on tributaries of interest in the Guadalupe River Basin for turbidity, stage height and field parameters. Experimental turbidity instrumentation will be deployed at the continuous monitoring stations because of the links between bacteria loading and turbidity in freshwater systems.

Continuous measurement of turbidity, field parameters and stage height may be measured automatically (365 days per year) at the sites listed in Table A5.1. See section B2.1 for the measurement frequency. Data from the GBRA CWQMN sites will be telemetered back to the TCEQ headquarters in Austin, Texas.

See TCEQ website for maps and locations of sites. (www.texaswaterdata.org)

The GBRA CWQMN QAPP describes and documents policies, procedures, infrastructure requirements, assessments and response actions, and data management, needed to provide and maintain quality data for the monitoring objectives in Section A5. Additionally, the GBRA CWQMN QAPP describes procedures for developing new technologies and methodologies.

The GBRA CWQMN QAPP lists the active monitoring site(s) and is updated annually. Once approved, the plan is available via the internet at www.texaswaterdata.org. If new sites are added to the GBRA CWQMN during the year, the GBRA CWQMN Project Lead will document project details and requirements in an amendment to the GBRA CWQMN QAPP using the EPA QA/R5 format. This QAPP and any amendments will set forth project-specific requirements (or criteria) against which results can be compared, and help ensure that project data will be of the type and quality needed for its intended use. The GBRA CWQMN QAPP will refer to the CWQMN QAPP where applicable.

The GBRA CWQMN QAPP has been written as addenda to the TCEQ CWQMN QAPP and will require an abbreviated sign-off by the CWQMN Network Coordinator, various TCEQ managers and staff, CWQMN Program QA Officer, Data Management & Analysis, the Guadalupe-Blanco River Authority and relevant project participants/ cooperators or contractors.

The TCEQ's WQPD is responsible for overall administration of the TCEQ CWQMN. The TCEQ's MD provides logistic support for the TCEQ CWQMN. TCEQ Continuous water quality monitoring stations (CWQMS) are operated by Site Operators. The GBRA will operate and provide overall support of the GBRA CWQMN site. Table A6.1 shows the site operator and monitoring locations in the Guadalupe River Basin.

Table A6.1 Site Operators and Data Validators for the GBRA CWQMN

Basin	TCEQ Region	CAMS Number	Station ID	Operator CWQMN Element	Data Validator CWQMN Element	Site Location
Guadalupe	11	763	12647	GBRA – Water Quality	GBRA – Water Quality	Plum Creek at CR 202 (Old McMahon Road) downstream of the City of Lockhart, Texas
Guadalupe	13	741	14932	GBRA – Water Quality	GBRA – Water Quality	Geronimo Creek at SH123; 0.5 miles N of Geronimo, TX
Guadalupe	11	797	12673	GBRA – Water Quality	GBRA – Water Quality	Cypress Creek, 200 meters upstream of Confluence with Blanco River
Guadalupe	14	732	13657	GBRA – Water Quality	GBRA – Water Quality	Sandies Creek at Cheapside Road; 2.0 NE of Westhoff

CAMS = Continuous Ambient Monitoring Station

Table A6.2 contains a list of activities required to plan, implement, and assess the GBRA CWQMN.

Table A6.2 Schedule of Activities

Activity	Status/Completion Date
Annual GBRA CWQMN QAPP	Revision 3 submitted May 2013
Deployment of In-Situ MP Troll 9500 (water quality) and In-Situ Troll 500 pressure/level gage (stage height) – Plum Creek	December 2009
Deployment of In-Situ MP Troll 9500 (water quality) and In-Situ Troll 500 pressure/level gage (stage height) – Geronimo Creek (14932)	December 2010
Deployment of In-Situ MP Troll 9500 (water quality) and In-Situ Troll 500 pressure/level gage (stage height) – Cypress Creek (12673)	June 2011
Deployment of In-Situ MP Troll 9500 (water quality) and In-Situ Troll 500 pressure/level gage (stage height) – Sandies Creek (13657)	August 2011
Implement maintenance and data download schedule	Monthly
Transmit data to TCEQ headquarters with Cellular Modem.	Hourly
Validation of data transmitted to LEADS	Monthly
GBRA CWQMN Standard Operating Procedures (SOPs)	
GBRA-001, In-Situ Inc. TROLL 9500 MP	Revision 1 submitted May 2011
GBRA-002 In-Situ Inc. Level TROLL 500	Revision 1 submitted May 2011

The sites in the GBRA CWQMN will measure turbidity (data cannot currently be used for assessments), pH, temperature, dissolved oxygen, and specific conductance

(collectively referred to as "field parameters") and flow and/or gage height (until site can be calibrated for measurement of flow) in these watersheds at a greater frequency than is possible with grab samples or short term deployments of monitoring instrumentation.

To aid in the modeling of stream pollutant loading, stream flow will be calculated at some of the stations. These stations are equipped with a vented pressure sensor to measure stage height and a real-time side-looking acoustic Doppler flow meter to measure velocity across the channel. An attached Zeno data logger will be programmed to use the numerical method of stream discharge calculation to report instantaneous flow at the station (Figure A6.1). Stations that are located next to a USGS flow monitoring gage will use USGS discharge measurements to aid in the modeling of stream pollutant loading.

Figure A6.1 Numerical Model for Acoustic Doppler Stream Flow Calculation

1. **Assume a power law to generate velocity distribution of a cross-section:**

$$V(y,z) = \alpha(y) \cdot (z - z_b)^{\beta}$$

V(y,z) = velocity perpendicular to the channel cross-section where a CM H-ADCP is installed.

Z_b = channel bottom elevation.

α(y) = velocity distribution coefficient as a function of y.

β = empirical constant. β = 1/6 is usually used for open channel flows.

2. **Extrapolation is employed to obtain α(y) in the unmeasured region near each bank.**

α(y) can be solved by :

$$\alpha(y) = \frac{V(y,z)}{(z - z_b)^{\beta}}$$

3. **The cross-section is divided into grids, velocity is calculated at each of the nodes and Gaussian integration is employed to obtain Q.**

$$Q = \iint_s V(y,z)\, dxdy$$

s = wetted area of the cross-section.

Revisions to the QAPP

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually on the anniversary date, or revised and reissued within 120 days of significant changes, whichever is sooner. The most recently approved QAPPs shall remain in effect until revisions have been fully approved; reissuances (i.e., annual updates) must be submitted to the TCEQ for approval before the last version has expired. If the entire QAPP is current, valid, and accurately reflects the project goals and

organization's policy, the annual reissuance may be done by a certification that the plan is current. This can be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP.

QAPP Amendments

Amendments to the QAPP may be necessary to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and non-conformances; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests for amendments are directed from the GBRA Project Manager to the TCEQ CWQMN Network Coordinator in writing using the QAPP Amendment shell. The changes are effective immediately upon approval by the TCEQ CWQMN Network Coordinator and Quality Assurance Specialist as necessary, or their designees, and the EPA Project Officer (if necessary).

Amendments to the QAPP and the reasons for the changes will be documented, and full copies of the amendments will be forwarded to all persons on the QAPP distribution list by the GBRA QAO. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes.

A7 Quality Objectives and Criteria

The Measurement Quality Objectives (MQOs) and Data Quality Objectives (DQOs) to support the GBRA CWQMN are specified in Table A7.1. The quality control (QC) program has been developed with these objectives in mind. Methods used for water quality measurements in the GBRA CWQMN are based on *Standard Methods for the Examination of Water and Wastewater,* 20th Edition, 1998 unless otherwise noted.

GBRA CWQMN Multiprobe Quality Objectives and Criteria

GBRA CWQMN QC measurement procedures and DQO's for multi-probe physicochemical parameters were adopted from the TCEQ SWQM Program. SWQM monitoring activities include grab sampling and 24- hour deployments. Currently, GBRA CWQMN QC measurements for multi-probe data validation consist of analyzing standards (as well as checking multi-probe temperature sensors) after deployment periods in a temperature controlled environment. Multi-probe sensor responses to standards are compared against DQO's found in Table A7.1. If results exceed criteria found in A7.1, the corresponding data are flagged as invalid (AQI).

GBRA CWQMN water quality measurement sensors are deployed for extended periods of time. Over deployment periods, the interface between sensors and the environment can become fouled by a variety of organisms, sedimentation and chemical coatings. Sensor fouling can compromise data quality. Since existing GBRA CWQMN QC protocols (analyzing standards) were adapted from SWQM routine protocols the procedures may not accurately assess potential effects of fouling on sensor performance for sensors used in longer term deployments.

The USGS has developed measurement techniques for assessing sensor fouling and electronic drift. The TCEQ has incorporated USGS-based procedures into multi-probe SOPs. The TCEQ has adopted USGS-based multiprobe fouling measurement procedures for non-EMRS stations. Sensor drift is quantified through the analysis of standards. USGS uses multiprobe fouling and sensor electronic drift measurements to "correct" data over deployment periods, whereas TCEQ (non-EMRS stations) compares the sum and individual fouling and drift measurement results against project DQOs. TCEQ does not "correct" measured values. For a summary of TCEQ procedures, calculations, and limitations refer to the *QAPP for Continuous Water Quality Monitoring Network Program, Revision 7, April 2013.* Currently, sensor fouling and electronic drift measurements are being recorded into LEADS operator logs.

If fouling measurement results are used for data validation purposes, it is possible (with current station service intervals) that the GBRA CWQMN site(s) may not routinely meet DQO's listed in Table A7.1. The program is currently in the early stages of trying to develop continuous water quality DQO's for multi-probe sensor fouling and electronic drift measurements.

Sensor fouling will not be addressed by the GBRA CWQMN project at this time. If the TCEQ determines a method for accurately assessing sensor fouling, then those procedures will be included in future amendments to this QAPP and future revisions of the GBRA-001, *In-Situ Inc. Multi-Parameter TROLL 9500* SOP.

Table A7.1 DQOs for In-Situ TROLL 9500 Sondes (Multi-Probes)

PARAMETER	LEADS/ SWQMIS PARAMETER CODE	UNITS	INSTRUMENT	METHOD	Calibration Verification Sample Acceptance Limits (CVS)	Completeness (%)
pH*	10400/00400	pH units	In-Situ MP TROLL 9500	SM 4500-H^+ B. and TCEQ SOP, V1	±0.50 pH unit*	75
Dissolved oxygen*	10302/00302	mg/L	In-Situ MP TROLL 9500	Optical (luminescence quenching) ASTM D888-05 **	±6.0% Saturation*	75
Specific Conductance*	10095/00094	uS/cm	In-Situ MP TROLL 9500	Conductivity Cell, Standard Method 2510B	≤ 5.0% RPE*	75
Temperature*	10010/00010	°C	In-Situ MP TROLL 9500	Standard Method 2550 B	± 0.50 °C*	75
TDS	10294/47004	mg/L	In-Situ MP TROLL 9500	Calculated by LEADS. SC measurements are multiplied by 0.65	± 5.0% RPE (SC CVS)	75
Turbidity	10104/13854	NTU	In-Situ MP TROLL 9500	ISO 7027	± 3 NTU **	75

*Parameters and CVS acceptance criteria for use in the CWA 305(b) and 303(d) lists per SWQM DQOs
**LEADS reports Turbidity measurements in NTUs. Turbidity DQO taken from USGS CWQMN monitoring stations.
°C = degrees centigrade
mg/L = milligrams per liter
uS/cm = micro Siemens per centimeter
CWA = Clean Water Act
DO = Dissolved Oxygen
DQO = Data Quality Objective
USGS = United States Geological Survey
LEADS = Leading Environmental Analysis and Display System
NTU = Nephelometric Turbidity Unit
RPE = relative percent error
TDS = Total Dissolved Solids
SC = specific conductance
In-Situ = In-Situ Inc. Ft. Collins, CO.

In-Situ TROLL 500 Level Sensor

The GBRA CWQMN water level and sample depth measurements are used for water quality measurement data interpretation at all network sites where level sensors are deployed, providing information to data validators, site operators, and data users to remotely (via website) survey near real-time or historic conditions at a given station. The TROLL 500 is equipped with an SDI-12 interface in order to transfer data to a Zeno data logger. The Zeno datalogger is capable of utilizing simple math calculations to predict stream flow from a linear regression analysis of gage height data versus instantaneous flow readings. The stream flow measurement becomes more accurate as more stage height and instantaneous flow readings are measured and added into the calculation.

Table A7.2 gives the monitoring quality objectives for In-Situ TROLL 500 Level Sensors.

Table A7.2 Monitoring Quality Objectives for In-Situ TROLL 500 Level Sensors

PARAMETER	LEADS PARAMETER CODE	SOP	UNITS	INSTRUMENT	RANGE	METHOD	Acceptance Criteria
Stage Height	10065^	GBRA-002	feet	In-Situ Level TROLL 500	0-35.0 feet	Vented Pressure Transducer	± 6.0 in.*

^Parameter will not be used in SWQMIS
*A physical check of the instrument with a survey rod will be used in lieu of a calibration verification standard for the Stage Height parameter. If sensor does not meet acceptance criteria, sensor corrective action and/or sensor re-calibration is performed. Data is not invalidated as a result of not meeting acceptance criteria
in. = inches
SOP = Standard Operating Procedure

Teledyne RD Instruments ChannelMaster H-ADCP

The Teledyne RD Instruments ChannelMaster horizontally oriented acoustic Doppler current profiler (H-ADCP) is used to measure stream stage and velocity and to calculate discharge. The RD ChannelMaster is equipped with a temperature gage, pressure transducer, and vertical beam system in order to provide more accurate water velocity, stage and discharge data and an SDI-12 interface to transfer collected data to an attached Sutron data logger. This system is designed to provide highly accurate flows in areas of slow and rapidly changing stream flows. Table A7.3 gives the monitoring quality objectives for the Teledyne RD ChannelMaster H-ADCP.

Table A7.3 Monitoring Quality Objectives for Teledyne RD ChannelMaster H-ADCP

PARAMETER	LEADS PARAMETER CODE	UNITS	INSTRUMENT	RANGE	METHOD	Acceptance Criteria
Gage Height	10065	feet	Teledyne RD Instruments ChannelMaster horizontally oriented acoustic Doppler current profiler (H-ADCP)	0-33 feet	Vertical Beam w/Backup Pressure Transducer	± 6.0 in.*
Stream Velocity	10026	f/s	Teledyne RD Instruments ChannelMaster horizontally oriented acoustic Doppler current profiler (H-ADCP)	Highly dependent upon temperature, salinity, suspended materials and accuracy of channel profile	Horizontally Oriented Acoustic Doppler	± 0.1 f/s*
Stream Flow	10025	cfs	Teledyne RD Instruments ChannelMaster horizontally oriented acoustic Doppler current profiler (H-ADCP)	Dependent upon temperature, salinity, suspended materials and accuracy of channel profile	Horizontally Oriented Acoustic Doppler	± 0.1 cfs*

*If sensor does not meet acceptance criteria, sensor corrective action and/or sensor re-calibration is performed. Data is not invalidated as a result of not meeting acceptance criteria
in. = inches
cfs = cubic feet per second

GBRA CWQMN Network Turbidity Measurements

A variety of measurement techniques can be used to measure turbidity. Data from differing instrumentation and sample matrixes can be highly variable. The only approved EPA method for turbidity is EPA Method 180.1. EPA Method 180.1 utilizes a white or broadband light source. Data produced by this method are reported as NTU. EPA Method 180.1 is a laboratory method.

Currently, the CWQMN utilizes ISO Method 7027 for turbidity (for more details see section B4). CWQMN turbidity data is not usable for regulatory purposes. CWQMN uses NTUs to report turbidity data collected by the ISO Method 7027 until the appropriate SWQMIS Parameter code can be identified.

Ambient Water Reporting Limits (AWRLs)

The AWRL establishes the reporting specifications at or below which data for a parameter must be reported to be compared with freshwater criteria. AWRLs have been set by water programs for ambient data to be used in assessments that have a regulatory purpose. These levels are established for each analyte as a minimum concentration where data can be reliably reported. AWRLs will not be analyzed with the Guadalupe River Basin Network continuous monitoring instrumentation.

Representativeness

By design, the GBRA CWQMN measures water quality in greater temporal detail and resolution than is possible with grab samples or short term deployments of monitoring instrumentation. In general, monitoring locations are chosen based on the location being representative of the water body. Areas of excessive vegetation, turbulence, shifting stream bottoms should be avoided. Back-water area with little flow should be avoided unless the type of area is representative of the water body. Site selection, the appropriate sampling regime, the sampling of all pertinent media according to TCEQ SOPs, and use of only approved analytical methods will assure that the measurement data represents the conditions at the site. Continuous water quality data are collected on a routine frequency and are separated by approximately even time intervals.

Comparability

Confidence in the comparability of 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 TCEQ approved SOPs. Water quality measurements for GBRA CWQMN and this project are based on *Standard Methods for the Examination of Water and Wastewater*, 20th edition, 1998, unless otherwise noted. Comparability is also achieved by using SOPs, reporting data in standard units by using accepted rules for significant figures and by reporting data in standard formats.

Bias, Precision, Calibration Verification Sample (CVS), DQOs and MQOs

Definitions for bias, precision, CVS, DQOs, and MQOs are provided in the Appendix A. Determining and calculating bias and precision for the purposes of the GBRA Continuous Water Quality Monitoring QAPP are discussed in Section B5.

Completeness

The general requirement of data completeness has been set at 75 percent return. Periods of no flow or dry conditions necessitate shutdown of the In-Situ TROLL 9500 sonde, and In-Situ TROLL 500 sonde. These times are not considered in the goal for data completeness. Data completeness is discussed in Section C. Requirements for data completeness for use in the CWQ 305(b) and 303(d) Lists are discussed in Section D2.3.

A8 Special Training/Certification

GBRA staff will be the Project Lead for site operation and maintenance for the GBRA CWQMN sites. Training will be provided by the manufacturer's vendor representative, C.C. Lynch and Associates. TCEQ has an extensive base of professional and skilled employees that GBRA will access if the need for additional information, troubleshooting or training is needed on the In-Situ TROLL 9500 or In-Situ TROLL 500. Data validation training is provided to network participants by the TCEQ.

When developing new instrumentation, sampling techniques or applications training may be limited to vendor support or what is learned during method development. Expertise and SOPs are derived from this developmental process.

Available approved standard operating procedures (SOPs) shall be used by employees of the GBRA along with any cooperators and contractors, who audit, calibrate, operate sampling and analytical instrumentation, or validate network data. Instrument manuals are available for reference.

All GBRA staff associated with the project has detailed functional job descriptions describing the requirements for their positions. All formal training is documented by the administrative staff.

GBRA staff has completed LEADS Data Management training. GBRA will attend future training on any updates to the system if necessary.

A9 Documents and Records

The GBRA CWQMN QAPP, Project Plans, SOPs, Audit Reports, and Finding Summary Reports are filed and maintained by the GBRA. The TCEQ CWQMN QAPP, Project Plans, SOPs, Audit Reports, and Finding Summary Reports are filed and maintained by the SWQM Central Office. Measurement data and other site information can be found on TCEQ's CWMQN website. Instrument calibration and calibration verification forms, instrument logbooks, and certificate of analysis are filed and maintained by the GBRA CWQMN staff.

GBRA maintains records that include sufficient information to reconstruct each final reported measurement from the variables originally gathered in the measurement process. This includes, but is not limited to, information (raw data, electronic files, and/or hard copy printouts) related to sample collection, measurement instrument calibration, QC checks of sampling or measurement equipment, "as collected" measurement values, an audit trail for any modifications made to the "as collected" measurement values and traceability documentation for reference standards.

Difficulties encountered during sampling or analysis is documented in operator logs to clearly indicate the affected measurements.

Documentation of Procedures and Objectives

1. Published guidance (*Code of Federal Regulations*, U.S. Environmental Protection Agency (EPA), and EPA *Quality Assurance Handbook*)
2. CWQMN Project Plan
3 Method specific standard operating procedures (SOPs)
4. Instrument manufacturer's technical support manuals
5. Texas Commission on Environmental Quality (TCEQ) *Quality Management Plan (QMP), Standard Operating Procedures (SOPs), and the Continuous Water Quality Monitoring Network (CWQMN) Quality Assurance Project Plan*
6. TCEQ *Surface Water Quality Monitoring (SWQM) Procedures, Volume 1*

Record Keeping

GBRA paper records are kept for a minimum of one year. GBRA CWMQN written records are archived after one year and kept as retrievable electronic records indefinitely, or for the life of the project. Electronic Data records stored in the TCEQ LEADS system are kept indefinitely or for the life of a project. Please see Table A9.1 for type of record and location. Table A9.1 lists the type of record, record location, retention schedule, and format of the retention.

Table A9.1 GBRA CWQMN Records Location

Document/Record	Location	Retention (Paper/electronic)	Format
QAPPs, amendments and appendices	TCEQ/GBRA	5 years/indefinitely	Paper/Electronic
QAPP distribution documentation	GBRA	one year/indefinitely	Paper/Electronic
QAPP commitment letters	GBRA	one year/indefinitely	Paper/Electronic
Instrument calibration and calibration verification forms	GBRA	one year/indefinitely	Paper/electronic
Instrument and equipment maintenance logbooks	GBRA/With Equipment	5 years/indefinitely	Paper/electronic
Field staff training records	GBRA	one year/indefinitely	Paper/electronic
TCEQ Sampling Information	TCEQ Website	Indefinitely	Electronic
LEADS electronic Operator logs, Validator logs and Calibration Verifications	CFEP	Indefinitely	Electronic
Project Specific Field Instrumentation & Field Sampling SOPs	GBRA	one-year/indefinitely	Paper/electronic
Certificate of Analysis for pH, Conductivity and Turbidity Standards	GBRA	one year/indefinitely	Paper/electronic
Instrument printouts	GBRA	one year/indefinitely	Paper/electronic
Equipment maintenance logs	GBRA	one year/indefinitely	Paper/electronic
Post Deployment logs	GBRA	one year/indefinitely	Paper/electronic
GBRA CWQMN Project Plan	GBRA	one year/indefinitely	Paper/electronic
Laboratory calibration records	GBRA	one year/indefinitely	Paper/electronic
Standard Operating Procedures (SOPs)	GBRA	one year/indefinitely	Paper/electronic
Finding Summary Reports	SWQM Central Office	Five years/indefinitely	Paper/electronic
Technical systems and performance evaluation audits	SWQM Central Office	Five years/indefinitely	Paper/electronic
Corrective Action Documentation	GBRA	one year/indefinitely	Paper/electronic

Paper/Electronic = retention in paper format /retention in electronic format
CFEP = Comms Front-End Processor computer located at TCEQ headquarters in Austin, Texas

Data Reporting

GBRA CWQMN environmental data is stored electronically in the MeteoStar/LEADs System. Selected validated GBRA CWQMN data may be loaded into the SWQMIS database. See Section B10 and Sections D1 and D2 for more details.

Documentation Control Plan

This section describes the procedure and responsibilities for document control used by the GBRA CWQMN project for environmental sample collection and analysis.

All SOPs must have a document title, a revision number, approval signatures, and effective date. The official copy of this document is the hard copy document with the original signatures. SOPs are formally reviewed and re-signed on an as needed basis. SOPs will stay in effect until superseded by a later version or the project is completed. Copies of the official documents shall be clearly identified as such. Standard operating procedures (SOPs) that are written specifically for the GBRA CWQMN project will be attached to the GBRA CWQMN QAPP. The official copy of any GBRA CWQMN specific SOPs will be found attached to the current revision of the GBRA CWQMN QAPP and will be reviewed and amended annually along with the GBRA CWQMN QAPP.

The GBRA is responsible for obtaining and providing the document control number, maintaining the official copy, controlling and documenting access to the documents, maintaining the electronic version of the current copy of the QAPP on the GBRA server, and mailing a hard copy to all GBRA CWQMN associated staff listed on Section A3 of the GBRA CWQMN QAPP. PDFs of the GBRA CWQMN QAPP, and SOPs are available via the internet at: (www.texaswaterdata.org)

It is the responsibility of GBRA to ensure that the GBRA CWQMN Water Quality Technician/Project Data Validator is properly following the most current version of these documents. The TCEQ CWQMN Coordinator, TCEQ CWQMN QA Officer, GBRA CWQMN Program Manager, and GBRA CWQMN QC Officer are responsible for approving new SOPs and SOP revisions. The GBRA CWQMN QC Officer is responsible for changes to the SOPs.

All logbooks containing data or sample information are uniquely identified with a logbook number. The GBRA CWQMN Water Quality Technician/Project Data Validator has the responsibility of maintaining the logbooks for a minimum of five years or until all sample information contained within is no longer required to be kept. Analytical data records are stored on site for a minimum of five years, unless otherwise required by a project or regulation. Indelible ink will be used for all hand-written documents. Changes made to hand-written documents must be done by using a single line to strike-out the text. The changes are then initialed and dated.

B1 Sampling Process Design

Network Design/Siting Rationale

The GBRA CWQMN measurement parameters are outlined in Table A5.1.

Monitoring Station Design

Monitoring and support equipment are installed in a weather-tight, fiberglass enclosure, containing a Zeno data logger and cellular modem. An In-Situ TROLL 9500 Multi-Probe and In-Situ Level TROLL 500 pressure/level gage are deployed in the stream, to measure water quality and stage height measurements. The In-Situ Multi-probe and In-Situ Level TROLL are powered by a 65 Watt solar panel and a 100 Amp/Hr. deep cycle marine battery. The In-Situ 9500 multi-probe is deployed in a perforated 4" diameter PVC housing attached to the right bank of the stream as an observer faces downstream. The In-Situ Level TROLL 500 is attached to a fixed concrete block in the middle of the stream. The power chords from both instruments travel up to the fiberglass enclosure and battery and these chords are surrounded by a flexible conduit, which is secured to an immovable fixture nearby by masonry anchors and fasteners. The data from the instruments are collected by a Zeno data logger and transmitted by cellular modem to the TCEQ LEADS database. The turbidity data is also available for viewing by GBRA and TCEQ, but will not be used for assessment. All field parameters will be available for viewing by the public on the TCEQ CWQMN website (www.texaswaterdata.org).

B2 Sampling Methods

The In-Situ MP TROLL 9500 (field parameters) measures ambient surface water quality parameters *in situ*. The instrument is deployed directly into the water body, and anchored to an immovable fixture located on the shoreline. This configuration was selected because of the potential for flash flooding that could lead to the loss of the equipment due to flood flows. The perforated PVC hosing is positioned so that the sensors on the instrument rest in a representative section of the water body. The multi-probe is located as close as possible to the thalweg or midpoint of the stream width, which contains 50 percent of the total flow and is positioned within the top foot of the water column under normal flow conditions.

The In-Situ Level TROLL 500 pressure transducer is positioned at approximately three inches above the stream substrate, near the mid-point of the stream width. Table B2.1 gives specific sampling frequencies.

The data from both probes is stored in a Zeno data logger via SDI-12 communication cables. The data is transmitted via cellular modem from the data logger to the TCEQ MeteoStar/LEADS system in Austin, Texas, where the data are ingested and archived. Averaged data are then posted to the appropriate TCEQ internet site. Table B2.1 describes equipment, sampling method, and telemetry method for this site.

Table B2.1 Monitoring Methods and Equipment

CAMS	Station Location	MeteoStar/LEADS Data Averaging Time	Measurement Method	Measurement Equipment	Telemetry	Station Parameters
763	Plum Creek at CR 202 (Old McMahon Road), downstream of the City of Lockhart, TX (Station #12647)	Measurement every fifteen minutes/Data is averaged every hour	Sonde: *in situ*	In-Situ Inc. TROLL 9500 multi-probe	Wireless modem	Surface Water Temperature, SC, DO, pH, Turbidity
		Measurement every fifteen minutes/Data is averaged every hour	Sonde: *in situ*	In-Situ Inc. Level TROLL 500*	Wireless modem	Stage Height
741	Geronimo Creek at SH 123, near Geronimo, TX (Station #14932)	Measurement every fifteen minutes/Data is averaged every hour	Sonde: *in situ*	In-Situ Inc. TROLL 9500 multi-probe	Wireless modem	Surface Water Temperature, SC, DO, pH, Turbidity
		Measurement every fifteen minutes/Data is averaged every hour	Sonde: *in situ*	In-Situ Inc. Level TROLL 500*	Wireless modem	Stage Height

Table B2.1 Monitoring Methods and Equipment (cont.)

CAMS	Station Location	MeteoStar/LEADS Data Averaging Time	Measurement Method	Measurement Equipment	Telemetry	Station Parameters
797	Cypress Creek, 200 meters upstream of Blanco River Confluence in Wimberley, TX (Station #12673)	Measurement every fifteen minutes/Data is averaged every hour	Sonde: *in situ*	In-Situ Inc. TROLL 9500 multi-probe	Wireless modem	Water Temperature, SC, DO, pH, Turbidity
		Measurement every fifteen minutes/Data is averaged every hour	Sonde: *in situ*	In-Situ Inc. Level TROLL 500*	Wireless modem	Stage Height, Flow
732	Sandies Creek at Cheapside Road, 2 miles NE of Westhoff, TX (Station #13657)	Measurement every fifteen minutes/Data is averaged every hour	Sonde: *in situ*	In-Situ Inc. TROLL 9500 multi-probe	Wireless modem	Water Temperature, SC, DO, pH, Turbidity
		Measurement every fifteen minutes/Data is averaged every hour	Sonde: *in situ*	USGS Flow Gaging Station	Wireless modem	Stage Height, Flow

*In-Situ Inc. Level TROLL 500 measurement method = Vented Pressure Transducer
DO = Dissolved Oxygen
SC = Specific Conductance

Multi-probe and Water Level (Stage Height) Sensors

In-situ water quality, and stage height, measurements are logged once every 15 minutes by the data logger. The data are then transmitted to the MeteoStar/LEADS system in Austin, Texas where the data are stored. Data are averaged into one-hour averages and displayed on the external TCEQ web pages.

Monitoring Equipment

Instrument specific analytical standard operating procedures (SOPs) describe support equipment, sampling and analytical procedures. Currently, the In-Situ TROLL 9500 Multi-Probe GBRA-001 SOP and the In-Situ Level TROLL 500 GBRA-002 SOP are being used as guidance for normal sampling and maintenance activities. These SOPs are attached to this QAPP. Please see Table A2.4 for a list of completed instrument SOPs utilized by this project. The instrument operation manuals provided by In-Situ Inc. are also referenced as needed for troubleshooting and unusual maintenance concerns.

In-Situ TROLL 9500

This is a multi-probe capable of monitoring pH, water temperature, specific conductance, optical dissolved oxygen and turbidity.

In-Situ TROLL 500

Sonde deployed in stream, capable of measuring pressure/depth from 0 to 33 feet of water in order to determine gage height.

Limitations and Performance Criteria

See Section A7 for performance criteria for the network.

Sampling/Measurement System Corrective Action

Corrective action measures in the GBRA CWQMN will be taken to ensure that Data Quality Objectives (DQOs) and Measurement Quality Objectives (MQOs) are attained. The GBRA CWQMN Water Quality Technician/Project Data Validator is responsible for monitoring the performance of the measurement and support equipment and identifying problems or potential problems. When problems are identified that cannot be resolved by the GBRA CWQMN Water Quality Technician/Project Data Validator, the GBRA CWQMN Water Quality Technician/Project Data Validator notifies the GBRA CWQMN Project Lead and coordinates with the appropriate technical support personnel to resolve the problem. The GBRA CWQMN Project Lead reports the problem and necessary corrective action to the TCEQ MD and/or TCEQ Continuous Water Quality Monitoring Network (CWQMN) Coordinator.

The GBRA CWQMN Water Quality Technician/Project Data Validator is responsible for documenting problems and corrective actions in the appropriate instrument logbook and/or online MeteoStar/LEADS operator log. When problems could affect data quality the GBRA CWQMN Water Quality Technician/Project Data Validator is also responsible for making note of the problems on the online MeteoStar/LEADS operator log to provide information to the data validators for data assessment purposes.

GBRA is responsible for stocking various consumable and replacement items for the GBRA CWQMN. The GBRA CWQMN Water Quality Technician/Project Data Validator is responsible for ensuring that the necessary supplies and parts are on hand for maintenance activities. When necessary, personal from C.C. Lynch & Associates will travel to a particular site to repair or replace support equipment that cannot be repaired or replaced by the GBRA CWQMN Water Quality Technician/Project Data Validator . Monitoring equipment that cannot be repaired by the GBRA or TCEQ staff is sent to the manufacturer for repair.

The GBRA CWQMN site is located in the flood plain. Consequently, the site has the potential to be damaged by flood waters during severe floods. Potential flooding was a consideration in the site development process. Additionally, the sampling equipment and support equipment located in the stream bed is subject to frequent flooding. These components are secured to the bridge abutment and have proved capable of surviving a given flood. However, it is accepted that the support system and components will need periodic replacement and repair.

B3 Sample Handling and Custody

See Section B10 for electronic managing of the GBRA CWQMN data. Water quality is measured from *in situ* for the In-Situ TROLL 9500 and In-Situ TROLL 500 sonde instrumentation. All data for this project will be electronically captured and no physical samples will be collected or transported.

B4 Analytical Methods

The water quality measurement methods used by the In-Situ TROLL 9500 are based on the *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998, unless otherwise noted. The method used by the In-Situ TROLL 9500 for optical dissolved oxygen is ASTM No.D888-05 Method C. The In-Situ TROLL 500 calculates stage height and/or water level from vented pressure transducer measurements and a known reference point. Data comparability is achieved by following approved standardized analytical methods and operating procedures. Methods must be documented to minimize variation in procedures and results. Method-specific SOPs are used to document exact procedures necessary to perform the method or operate a specific instrument or apparatus.

The GBRA CWQMN method summaries are presented in Table A7.1-2. This table includes method, analytical technique and performance criteria.

Analytical system corrective actions are addressed in Section C1 of this quality assurance project plan.

GBRA CWQMN Turbidity Measurements

Continuous water quality monitoring network turbidity measurement methods are not based on *Standard Methods for the Examination of Water and Wastewater,* 20th Edition, 1998. Turbidity measurements are made using a near infrared (780-900 nanometers) or monochrome light source with 90 degree detection angle, and one detector (ISO Method 7027). ISO Method designates measurement units for this method as Formazin Nephelometric Units (FNU).

New Technology

The GBRA CWQMN is using experimental technology with the turbidity probe on the In-Situ MP TROLL 9500. The turbidity probe utilizes the established ISO 7027 method. Consequently, method performance determination can be re-evaluated at any point after instrument deployment for testing purposes. If necessary, the QAPP will be amended to reflect changes in method performance criteria based on evaluations of the instrument. The GBRA CWQMN Project Lead and GBRA CWQMN Water Quality Technician/Project Data Validator are responsible for developing new sampling and measurement technology.

New method (and non-published method) performance is evaluated and documented. Method performance for new methods is assessed for qualitative and quantitative bias, precision, sensitivity, sampling and/or analytical system contribution, comparability and stability by:

- Determining instrument linear range;
- Defining instrument working range using a multipoint calibration curve for each target analyte or physical water parameter.

- Demonstrating contamination potential from sampling and preparation procedures by analyzing blanks;
- Demonstrating calibration bias and accuracy by analyzing second source standards;
- Demonstrating measurement precision by analyzing second source standards multiple times;
- Demonstrating a measured sample is representative (i.e., measured at correct point in water column etc.);
- Determining method detection limits according to 40 Code of Federal Regulations (CFR) Part 136 Appendix B (see Section B5);
- Determining digestion or converter efficiencies, when applicable.
- Determining known or suspected limitations.
- Comparing results obtained with new sampling or measurement technology with grab sample results.

Method results are compiled by TCEQ personnel and the data are reviewed by the SWQM team leader, Network Coordinator, and QC support staff. TCEQ management evaluates available resources when planning expansion of the network.

B5 Quality Control (QC)

For a Quality Assurance/Quality Control (QA/QC) program to be successful, it is essential that specific controls be established and maintained throughout the measurement process. QC includes technical activities that measure the attributes and performance of the sampling and analysis process against defined standards to verify that they meet the needs of the project. Data quality is assessed, controlled and measured by using standard operating procedures (SOPs), QC sample, data reviews and audits. Specific QC samples and procedures shall be described in instrument specific SOPs. Program-defined measurement performance specifications for fouling and drift measurements are specified in Tables A7.1-2. For stations measuring both fouling and calibration drift, results are entered into GBRA's Post Deployment Excel Worksheet.

Multiprobe Quality Control

Currently, GBRA CWQMN multi-probe QC measurements consist of analyzing standards for calibration purposes and analyzing CVS at the conclusion of deployments for data validation purposes. Multi-probe temperature sensors are also checked at the conclusion of deployments. As mentioned previously in Section A7, the USGS-based fouling measurement procedures my used by the GBRA station operator to evaluate instrument fouling if it is suspected.

Calibration Verification Samples (CVSs)

Instrument calibration is assessed at the conclusion of deployment periods using CVSs. These standards are analyzed to determine if fouling and/or instrument drift has caused sensors to exceed criteria. The CVS is prepared from the same standard used to generate the initial calibration curve. The CWQMN CVS procedures may not accurately measure the effects of fouling on sensor performance.

Total Error Calculation for GBRA CWQMN Stations

Total error (*T*) for DO, pH, and conductivity is expressed as the sum of fouling (*F*) and calibration drift (C_d).

$$T = F + C_d$$

Where:

F = fouling; and

C_d= calibration drift.

Multiprobe Fouling Measurements

The USGS-based fouling measurement procedures are designed to measure the potential effect of various forms of sensor and deployment tube fouling on sensor performance. The procedure measures and compares the responses of non-cleaned and cleaned sensors and deployment tubes. As part of the procedure, an additional multiprobe/field meter is deployed at the same location as the deployed multiprobe. Field meter measurements are made at the beginning and at the conclusion of the procedure. Field meter measurements are used to correct fouling measurements for changes in water quality. This procedure will be used by the GBRA to ascertain sensor fouling, if the GBRA Water Quality Technician/Data Validator suspects that it is impacting the data at a particular station, but sensor fouling results alone will not be used to invalidate data in LEADS by the data Validator.

Change in Water Quality Calculation and Criteria

Fouling measurement procedures are intended for use in situations when water quality conditions are not considered rapidly changing or fluctuating. Change in water quality results are compared against USGS criteria found in Table B5.1.1. If changes in water quality exceed criteria found in Table B5.1.1 for a given parameter(s) the fouling measurement is not considered valid and the corresponding data are invalidated (AQI).

Change in water quality (C_w) during the fouling measurement procedure (for DO, pH, SC, and temperature) is determined by the field meter. Measurement results are used to ascertain sensor fouling at stations suspected to be susceptible by the station operator.

$$C_w = F_i - F_f$$

Where:
F_i = field meter response initial; and
F_f = field meter response final.

Table B5.1 USGS Change in Water Quality Criteria

Parameter	USGS Calibration Criteria
SC	$\pm$ 5 *u*S or 3% use greatest
DO	$\pm$ 0.3 mg/l
pH	$\pm$ 0.2 pH units

Sensor Fouling Calculations

Multiprobe percent conductivity sensor fouling (F) over the deployment period is evaluated during field service events where sensor fouling is suspected by comparing not cleaned and cleaned conductivity sensor responses:

$$F = \{[(S_i - S_f) - (F_i - F_f)] / S_f\} * 100$$

Where:

S_i = sensor response initial (not cleaned);
S_f = sensor response final (cleaned);
F_i = field meter response initial; and
F_f = field meter response final.

Multiprobe temperature, DO (mg/l), and pH (SU) sensor fouling (F) over the deployment period is evaluated during field service events where sensor fouling is suspected by comparing not cleaned and cleaned sensor responses:

$$F = (S_i - S_f) - (F_i - F_f)$$

Where:

S_i = sensor response initial (not cleaned);
S_f = sensor response final (cleaned);
F_i = field response initial; and
F_f = field response final.

Sensor Calibration Drift Calculations

Instrument calibrations are assessed at the conclusion of deployment periods using CVSs. These standards are analyzed to measure sensor drift. The The CVS is prepared from the same standard used to generate the initial calibration curve.

Multiprobe conductivity sensor calibration drift (C_d) over the deployment period is evaluated using relative percent error:

$$C_d = [(S_r - S_v) / S_v] * 100$$

Where:
S_r = sensor response; and
S_v = specific conductance KCl standard value.

DO and pH C_d over the deployment period is evaluated using absolute error:

$$Cd = (S_r - S_v)$$

Where:
S_r = DO or pH sensor response; and
S_v = DO mg/l theoretical value; pH KCl standard value

Multiprobe Fouling Measurement Limitations

Fouling measurements are estimates of environmental effects on sensor performance.

Stream scouring events can clean sensor interfaces and deployment tubes prior to performing the procedure and can result in the fouling measurement not being representative of the entire deployment period. When performing the procedure multiprobe measurements must not be fluctuating. Measurement stability criteria have not been developed. At some locations (and/or times of year) there is not enough stream flow to disperse biological and/or sediment debris clouds in a timely manner due to deployment tube cleaning activities. The debris can cause changes in water quality measurements that are not representative of stream conditions and can skew sensor/field meter final measurements. Debris clouds can also cause water quality measurements to fluctuate. Consequently, during low or no stream flow, site operators at some stations are allowing significant amounts of time to elapse in order for debris clouds to disperse before sensor/field meter final measurements are recorded. Due to extended time allowed, changes in water quality can exceed Table B5.1.1 criteria as measured by the field meter.

Potential Fouling Measurement Limitations

Fouling measurements are estimates of potential environmental effects on sensor performance. Stream scouring events can clean sensor interfaces and deployment tubes prior to performing the procedure and result in the fouling measurement not being representative of the entire deployment period.

When performing the procedure multi-probe measurements must be stable. Measurement stability criteria have not been developed.

Fouling measurement procedures are intended for use in situations when water quality conditions are not considered rapidly changing or fluctuating. The USGS defines (TM1D3) rapidly changing for DO, EC, pH and temperature as follows: Rapid change is relative to the length of time needed to service the monitor and generally is defined as a change that exceeds the (USGS) calibration criteria within 5 minutes (Table B5.1).

Multi-probe Anti-Fouling Measures

Multi-probes can be equipped with various anti-fouling measures. Anti-fouling measures can improve data quality and increase deployment periods. Generally, the program is not prescriptive of the type of anti-fouling measures that must be used at a particular site. USGS-based fouling measurement procedures might be useful in evaluating the various anti-fouling measures. The YSI optical DO sensor is outfitted with a mechanical wiper that utilizes disposable foam pads. Foam wiper pads must be replaced prior to each deployment period.

Multi-probe Deployment Tube Cleaning

Multi-probe deployment tubes can become fouled by a variety of organisms and sediment, which can compromise data quality. Every multi-probe deployment tube in the

network must be cleaned with a chimney brush (inside and out) as part of every service event as needed.

Multi-probe Temperature Sensor Checks

After every deployment period, network multi-probe temperature sensors are checked against National Institute of Standards and Technology (NIST)-traceable thermometers and thermistors. The multi-probe measured temperature must be within +/- 0.50 °C of the NIST thermometer. If the multi-probe temperature sensor does not meet the 0.50 °C criterion then the corresponding DO, SC, and temperature data are invalidated.

In-Situ Multi-Parameter TROLL 9500 Quality Control Samples

In-Situ MP TROLL 9500 dissolved oxygen (DO), pH, and specific conductance (SC) parameters are calibrated in a temperature controlled environment prior to every deployment period. Optical DO is calibrated with a single saturated water sample that has been bubbled for at least two minutes. SC is calibrated with a single point certified standard with a concentration similar to the values found in the ambient water of the deployment location. The pH parameter is calibrated with two certified standards that bracket the expected pH of the ambient waters of the deployment location. Turbidity is calibrated with a de-ionized water sample and three Formazin standards that have been created from a certified standard to bracket the expected range of the ambient water at the deployment location. DO, SC, pH, and turbidity calibration verification samples (CVSs) are analyzed in a temperature controlled environment at the end of every deployment period.

Using a variety of control samples, a determination is made as to whether the method and instrument performance are operating within acceptable limits. Control standards are used to check instrument calibration and bias, blank(s) are used to assess contamination, and duplicates are used to measure precision.

Control samples are fortified samples or blanks that are used as indicators of method and/or analytical system performance. Each analytical method SOP specifies the necessary control sample, frequency and performance criteria. Listed below is a synopsis of selected control samples and the information that can be derived from each sample. Definitions and a comprehensive list are provided in Appendix A.

- Duplicate samples or analyses provide an indication of system or method precision.
- Blank samples or analyses may provide an indication of positive interferences.
- Fortified sample analyses provide information on analytical bias and instrument response. If fortified samples are prepared and analyzed in duplicate, information on precision is also provided.

Program-defined measurement performance specifications are specified in Table A7.1-2.

Precision

Precision is assessed by comparing replicate analyses of LCSs or CVSs in the sample matrix (e.g., de-ionized water). Currently, In-Situ MP TROLL 9500 and In-Situ Level TROLL 500 sonde precision is not being calculated.

Analytical data precision is evaluated using relative percent difference (RPD). RPD is a measure of variability adjusting for the magnitude of the measurement values. It is used when the true value is unknown, as is the case with duplicate samples, and is given by:

$$RPD = \frac{[X1 - X2]}{(X1 + X2)/2} \times 100$$

Where:

X1 = duplicate sample measurements; and
X2 = duplicate sample measurements.

Bias

Bias is determined through the analysis of LCSs prepared with certified amounts of all target analytes in the sample matrix (e.g., de-ionized water) and by calculating percent recovery. Currently, sonde measurement bias is determined using CVSs. See Tables A7.1 and A7.2 for In-Situ MP TROLL 9500 and In-Situ Level TROLL 500 sonde performance specifications.

Analytical data bias can be presented in terms of percent recovery as given by:

$$\%Recovery = \frac{\text{Measured Value}}{\text{Actual Value}} \times 100$$

Conversely, measurement bias can be expressed in terms of relative percent error (RPE):

$$RPE = \frac{(Y - X)}{X} \times 100$$

Where:

Y = measured value; and
X = known value.

Sensitivity

Method sensitivity is estimated using method detection limit studies after initial instrument setup, after major modification and at least annually thereafter. Detection limit determination is consistent with *40 CFR Part 136*, Appendix B to the extent possible. This requires replicate fortification of seven different blanks at a concentration three to five times the expected detection limit, if possible. Each fortified sample is analyzed and the measured analytical standard deviation is multiplied by the appropriate Student's "t" value to determine the concentration at which there is a 99 percent certainty that the measured concentration is not due to background noise. The calculated detection limit is confirmed by analyzing one standard two to five times the calculated detection limit. Currently, no method analyses performed on the In-Situ MP TROLL 9500 or In-Situ Level TROLL 500 are being checked for sensitivity in this manner.

Corrective Action Related to QC

Any deviation from the procedures documented in the SOP should be documented in the operators log by the GBRA. The log entry should contain a description of the exception, the cause (if possible), the affected data, and the impact on the date record. Any affected data should be qualified by a data validator accordingly. **Note:** A failing QC sample can be followed by a single replicate analysis to determine if there is a systematic problem. If the replicate analysis meets all acceptance criteria, then the system may be deemed as providing acceptable data. Conducting multiple analyses, however, to obtain a single passing QC sample when no corrective action is performed as a result of an assignable cause or instrument maintenance is performed is not acceptable. If either the original QC sample or its rerun passes, then the failing QC analysis is considered to be an anomaly, and its results are not used for data assessment. Best professional judgment is needed at times to determine if a QC sample is representative of ambient measurements. QC sample anomalies should be documented in the operator's log by the GBRA CWQMN Water Quality Technician/Data Validator.

B6 Instrument/Equipment Testing, Inspection and Maintenance

Instrument maintenance activities are documented in equipment dedicated logbooks. Preventative maintenance records contain information on periodic routine maintenance, symptoms, troubleshooting effort descriptions, results and follow-up observations. Records will include the date, time, and the name or initials of the GBRA CWQMN Water Quality Technician/Project Data Validator performing the maintenance. These records are vital tools in historic instrument performance and are an aid to future troubleshooting. GBRA maintenance documents are based on the manufacturer's recommendations and experience gained with the instrument after deployment during the method development project phase. See Section B2 on how critical spare parts will be supplied and stocked.

In-Situ MP TROLL 9500

Currently, the In-Situ MP TROLL 9500 operation manual is being used as guidance for maintenance activities.

Multi-probe Optical DO Membranes (In-Situ Inc.)

According to the In-Situ Inc. manufacturer, multi-probe optical DO membranes should be replaced on an annual basis; the membrane's luminescent dye can degrade and the membrane's black protective coating can degrade and/or be worn down. The black coating keeps ambient light from affecting sensor response. It has been determined that optical DO membranes can be stored indefinitely in their shipment box (no light) in a temperature controlled environment. Once a membrane has been installed on an In-Situ MP TROLL 9500 the instrument will stop reporting an accurate value for the optical dissolved oxygen parameter after one year has elapsed. The GBRA CWQMN Water Quality Technician/Project Data Validator is responsible for ensuring optical DO membranes are replaced on an annual basis. The GBRA CWQMN Water Quality Technician/Project Data Validator can request permission to order new optical DO membranes from the GBRA CWQMN Project Lead.

In-Situ Level TROLL 500

Currently, the In-Situ Level TROLL 500 operation manual is being used as guidance for maintenance activities.

B7 Instrument Calibration and Frequency

Before multi-probe deployments, calibration standards are analyzed to establish instrument response. Instrument calibration is performed using calibration standards spanning the range of expected sample concentrations. Concentrations are calculated using single-point or multi-point calibration responses.

Standards

Calibration, CVS and LCS shall be National Institute of Standards and Technology (NIST) traceable standards or prepared from NIST traceable materials. Class "A" glassware and NIST traceable weights shall be used when making SC, pH, polymer B or Formazin (turbidity standards). All CWQMN non EMRS multi-probe standards must have a Certificate of Analysis that contains traceability and accuracy statements. Expired standards should not be used.

Instrument Calibrations

Multipoint and single point calibrations are performed whenever:

1. The instrument response has drifted so that the CVSs or other quality control checks do not meet established acceptance criteria; or
2. Instrumentation is calibrated at routine frequencies; or
3. Prior to *in situ* field deployment.

Sonde (Multi-probe) Temperature Checks

After every deployment period, network multi-probe temperature sensors are checked against NIST – traceable thermometers and thermistors.

The GBRA CWQMN Water Quality Technician/Project Data Validator has spirit filled thermometers. These thermometers are calibrated annually by the GBRA against a mercury filled NIST-calibrated (7-point) thermometer. The GBRA's NIST-calibrated (7-point) thermometer has been deemed valid for five-years between NIST traceable 7 point re-calibrations.

Continuing Calibration Verification

The In-Situ MP TROLL 9500 is calibrated using the respective quality control checks, i.e. NIST thermometer for temperature, and calibration standards for pH and conductivity. Dissolved oxygen calibration is accomplished by using a fully saturated water solution

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B8 Inspection/Acceptance of Supplies and Consumables

The GBRA procures, and stores all of the In-Situ MP TROLL 9500 and In-Situ Level TROLL parts, equipment and consumables used for this project.

Spare Parts

The GBRA CWQMN Water Quality Technician/Project Data Validator procures and stores spare parts for field equipment. Restock orders are tracked and placed by the GBRA CWQMN Water Quality Technician/Project Data Validator and/or GBRA Regional Laboratory Staff.

Standards and Reagents

Standards and reagents are traceable to NIST or certified by the vendor and a Certificate of Analysis is kept on file by the GBRA. Calibration standards, calibration verification samples (CVSs), reagents and laboratory control samples (LCSs) for the In-Situ MP TROLL 9500 and In-Situ Level TROLL 500 are purchased and certified by a vendor chosen by the GBRA Regional Laboratory staff or the GBRA CWQMN Water Quality Technician/Project Data Validator.

B9 Non-Direct Measurements

This quality assurance project plan does not include the use of routine data obtained from non-direct measurement sources and only data collected directly under this QAPP is submitted to the SWQMIS database.

B10 Data Management

GBRA CWQMN water quality data, water stage height data, flow, and operator logs (containing quality control results and other information) are transferred to the TCEQ headquarters (Austin, Texas) Comms Front-End Processor (CFEP) computer through Regional Hewlett Packard 712/60 computers that automatically download data every 15 minutes by wireless modem. The data are secured from tampering or corruption over the carrier line through an unlisted telephone number, pass code protection, and error checking protocol. GBRA CWQMN Water Quality Technician/Project Data Validator logs may be entered on-site or remotely via the Zeno data logger. GBRA CWQMN Water Quality Technician/Project Data Validator logs may also be entered via TCEQ's web based RHONE page (for those operators who have access to the page).

The measurement instrumentation is connected to a Zeno data logger system. The data loggers system records the analog output voltage of each instrument once a second, digitizes it, and stores the data sequentially as five-minute averages in a record. A record consists of sequential fields of data for as many channels as are activated for the monitoring station. Every 15 minutes, the Hub computer collects the previous data from the monitoring station's Zeno data logger by modem. The data are secured from tampering or corruption over the carrier line through an unlisted telephone number, pass code protection and error checking protocol.

If the telemetry method fails, the data logger is capable of recording and storing data until the data are overwritten with newly generated data. Once communications are re-established the data are automatically downloaded to the CFEP computer. GBRA will check the operational status of the station every weekly via the TCEQ website. If communications problems are detected, the GBRA CWQMN Water Quality Technician/Project Data Validator will initiate corrective action in a timely manner, or data can be lost. The GBRA CWQMN Water Quality Technician/Project Data Validator will alert MD staff, the GBRA CWQMN Project Lead, and/or the TCEQ CWQMN Network Coordinator to initiate corrective action. Once MD's staff has been notified, MD staff will ensure that corrective action was taken and that the action was effective.

The MeteoStar/LEADS processing program will check for correct date, time, sampling site number, and proper formatting of raw data fields. For the water quality parameters it then calculates five-minute and hourly averages, converting voltages to engineering units. The data are stored in a temporary disk file. The GBRA CWQMN Water Quality Technician/Project Data Validator will work from this file through a GBRA or TCEQ personal computer on a graphical interface and behind the TCEQ LEADS firewall to validate the field parameter and turbidity data. The GBRA Water Quality Technician/Project Data Validator obtain field multi-probe QC information from the MeteoStar/LEADS TCEQ RHONE operator log, which is entered by the GBRA CWQMN Water Quality Technician/Project Data Validator. The GBRA will access the MeteoStar/LEADS TCEQ web page operator log at http://tceqwatercal.ipsmtx.com and will no longer use the RHONE webpage at http://rhone/ to enter operator logs. A password is needed to access the external web page. Network participants can obtain

passwords from the Network Coordinator. Site cooperators who have obtained authorization can access the MeteoStar/LEADS TCEQ RHONE web page operator log via the Virtual Private Network to enter operator logs.

After data validation, the data are coded in the file. The coded data in this file are considered "validated data" and are archived by the TCEQ on optical disk indefinitely.

SWQMIS Database

A data loader has been developed that loads validated CWQMN data into the SWQMIS data base for long term storage and management. Only data collected and validated under an EPA or TCEQ approved QAPP will be stored in SWQMIS. The dataset of record will be considered the SWQMIS dataset. Data collected and validated by CWQMN, and stored in SWQMIS may be requested from the Water Data Management & Analysis Team. Database system users have the ability to:

- Run database reports on the CWQMN data (see the *SWQMIS User's Guide, 2007* for a description of available reports). The report query builder allows users to specify criteria of records to include, specify how the information is sorted in the report, and select the format for the report output. Report output can easily be imported into other applications for further data analysis.
- Visualize, using ArcIMS map features of SWQMIS, CWQMN station locations.
- Access the CWQMN QAPP associated with each real-time data result.
- See the history of any changes made in SWQMIS to CWQMN data once it is stored in SWQMIS.

Only CWQMN data collected under an EPA or TCEQ approved QAPP will be stored in SWQMIS. Calculated parameters such as total dissolved solids (TDS) and salinity will not be stored in the SWQMIS. Additionally, water level and sample depth parameters will not be stored in SWQMIS.

See Table B10.1 for a complete list of CWQMN parameters that will be stored in SWQMIS. The table also contains a crosswalk of parameter codes from LEADS to SWQMIS.

Table B10.1 Surface Water Quality Monitoring Information System Parameters

Parameter	LEADS Parameter Code	SWQMIS Parameter Code	Units
Temperature	10010	00010	°C
Specific Conductance	10095	00094	µS/cm
Dissolved Oxygen	10302	00302	mg/L
pH	10400	00400	pH units
Turbidity	10104	13854	NTU
Stage Height	10065	00065*	Feet

mg/l = milligrams per Liter
µS/cm = micro Siemens / centimeter
NTU = Nephelometric Turbidity Unit
°C = Degrees Celsius
*Parameter will not be used in SWQMIS for the GBRA CWQMN

Data Users

Data stored in the MeteoStar/LEADS system may be provided to internal users (TCEQ data analyst, etc.) by email, on disk, on printouts, or through TCEQ web page reports. Other internal customers have read-only access. Public requests for CWQMN data, as well as MeteoStar/LEADS data, are made through the Data Management & Analysis Team. Non-validated data me be released to the public with disclaimers regarding the validity of the data.

Data Reporting

Data collected in the CWQMN are internally hosted on the MeteoStar Leads TCEQ RHONE server. Internal and external reports and summaries are compiled from data hosted on this server.

Data are reported internally on the RHONE Daily Reporting Page at various frequencies, which are dependent upon project monitoring instrumentation. Data collected with multi-probes and level sensors every 15 minutes are reported in the SWQM Daily Report in the 15-minute increment of their collection. Internal summary reports are available for all CWQMN data.

Hourly data summary reports are externally available on the TCEQ-hosted website (www.texaswaterdata.org) for all station in the network. See section B10 Data Users for specific information regarding data requests. Raw data, reported with the time of collection, are not available for external reporting.

C1 Assessments and Response Actions

The management of the TCEQ and GBRA advocates and encourages a "continuous improvement" philosophy in personnel development and work processes. Each employee is responsible for implementing and evaluating the effectiveness of quality improvement activities with which he/she is involved. Fostering a "no-fault" attitude to encourage the identification of opportunities for improvement so they can be brought to the forefront and addressed accordingly is recognized to be a critical factor in a continuous improvement environment. Review of process performance is done on a continuous basis. This section addresses the assessment and response actions for the GBRA CWQMN

Based on audit reports the network coordinator may recommend to the division director and GBRA CWQMN Project Lead to stop work if necessary in order to safeguard programmatic objectives, worker safety, public health, or environmental protection.

The GBRA staff may conduct monitoring station Technical System Audits (TSAs) and Performance Evaluation Audits (PEAs) for water quality monitoring related activities

Based upon audit reports, the TCEQ Network Coordinator, TCEQ QA Officer, and GBRA CWQMN QC officer will work collaboratively on recommendations to the GBRA CWQMN Project Lead to stop work if necessary to safeguard programmatic objectives, work safety, public health, or environmental protection.

Corrective Action

Corrective action is an essential part of any quality system and involves those procedures and actions taken to correct situations causing data quality to fall below established expectations. The need for corrective actions will be minimized by the implementation of applicable quality management plans, QAPP, and the application of statistical QC to establish appropriate measurements performance specification limits for measurement activities. When problems are identified at the monitoring site, the GBRA will initiate corrective action as soon as possible. Corrective action is accomplished at the lowest level and will be documented in the MeteoStar/LEADS operator log. For complex problems that cannot be readily resolved, the individual discovering the problem notifies the GBRA CWQMN project lead for resolution. If the problem cannot be resolved by the project lead, the TCEQ CWQMN network coordinator is notified and coordinates a resolution to the problem with the appropriate TCEQ CWQMN personnel. For complex problems, verbal and written communication between affected parties is started and continues until the issue is resolved.

CWQMN Participant-Initiated Corrective Action

It is expected that any individual in the GBRA CWQMN who discovers a problem will initiate corrective action appropriate to the situation. Corrective action is accomplished at the lowest level and shall be documented in the MeteoStar/LEADs operator log. The GBRA CWQMN QC Officer, TCEQ Network Coordinator, and GBRA CWQMN Project Lead must be notified of any proposed corrective action that can affect data quality and /or CWQMN protocols.

CWQMN Assessments

The Following types of assessments are conducted under the CWQMN Program:

- Annual CWQMN Site Reviews
- Monitoring Station TSAs and PEAs
- Data Management Assessments
- Multi-probe Data Completeness Assessments

Annual CWQMN Site Reviews

Each year, the TCEQ Network Coordinator manages a process to review every TCEQ CWQMN station. The GBRA CWQMN Project Lead will submit a GBRA CWQMN site evaluation form at the request of the TCEQ Network Coordinator.

Monitoring Station TSAs and PEAs

The GBRA CWQMN QC Officer may conduct TSAs and PEAs at the GBRA CWQMN site(s) at the request of the TCEQ.

Monitoring station TSAs and PEAs focus on project objectives, station operations, and measurement systems. An audit of the GBRA CWQMN site(s) may be requested by the TCEQ CWQMN Network Coordinator or TCEQ CWQMN QA Officer and this audit will be performed by the GBRA CWQMN QC Officer and any TCEQ CWQMN staff that wish to participate.

Technical System Audits (TSAs)

TSAs include a thorough systematic, on-site qualitative audit of station operation, equipment, training, personnel, documentation, sampling and measurement systems, quality control procedures, maintenance procedures and safety of the GBRA CWQMN system. They focus on conformance to procedures, if available.

Performance Evaluation Audits (PEAs)

PEAs audit procedures test the ability of the In-Situ MP TROLL 9500 and In-Situ Level TROLL 500 measurement systems to obtain acceptable results. Audit results are compared against applicable QC acceptance criteria which can be found in the Table A7.1 and A7.2. Audit results are documented on forms and spreadsheets.

To help communicate the structure and approach of an upcoming audit, the auditor notifies the auditee and details the scope, participating auditors, and the expected schedule. The auditors and participants review and discuss preliminary results during a post-audit conference. The auditor prepares a detailed audit report detailing audit results for each Monitoring Station Audit

Each audit report is individually numbered, dated, and identifies the auditor, auditee, and nonconformity (findings and observations). The audit report may suggest recommended corrective action to findings.

Data Management Technical System Audits (TSAs)

Data Management has developed procedures for TSAs of CWQMN validation activities external to the TCEQ. This process allows TCEQ Data Management staff to ensure the quality and integrity of CWQMN data validated by external cooperators and contractors. For more information see the following SOP(s): Quality Assurance of External Party Continuous Water Quality Data Validation (DATA-019)

Multi-probe Data Completeness Assessment

Data completeness reports for multi-probe sites can be obtained automatically from LEADS. See calculation below for how data completeness is calculated. Sites in the CWQMN may be located in intermittent streams. Needless to say, suspension of water monitoring can occur in times of drought.

Data completeness is calculated as follows for stream sites:

$$\% \text{ Completeness} = \frac{\text{Number of valid measurements during stream flow}}{\text{Total possible measurements - Total possible measurements during no stream flow.}} \times 100$$

Monitoring Station Audit Response Requirements

If an audit report contains findings a written response to the findings is required within thirty days of the issuance of the audit report. Written responses are used to track and verify the proposed corrective action initiated by the finding.

Audit report findings and observations can be categorized as program or project. Program findings/observations are typically associated with SOP/QC procedures, measurement systems, and multi-probe deployments or are process related. Project findings are typically associated with the site operator not following procedures. It is the responsibility of the GBRA CWQMN Project Lead to respond to program findings. Responses to Project findings are the responsibility of the GBRA CWQMN Water Quality Technician/Project Data Validator. GBRA Management may respond/provide comments as appropriate for the GBRA CWQMN Water Quality Technician/Project Data Validator.

It is the responsibility of the GBRA CWQMN QC officer to determine if responses to audit findings are acceptable or not. If a finding or proposed corrective action is disputed and cannot be readily resolved, the recommendation is pushed to successively higher management levels for resolution. The Network Coordinator is responsible for managing this process. Corrective actions can be verified during following inspections.

Audit Finding Response Requirements

Written audit responses are required within thirty (30) days of the issuance of the Audit Report. The response to finding must describe:

1. The nature and extent of the finding's impact on data quality,
2. The specific corrective actions taken or planned to address the finding,
3. Actions taken or planned to prevent recurrence,
4. The timetable for completing each action; and
5. The means to be used to document completion of each action.

Audit findings will remain open until an acceptable response has been received for negative findings.

C2 Reports to Management

Reports are distributed according to the TCEQ *Quality Management Plan*

Audit Reports

After every technical systems audit (TSA) and performance evaluation audit (PEA), the field auditor prepares a report that describes the results. The report includes audit findings, observations, suggested corrective actions, etc., if appropriate. The quality control officer or auditor assesses proposed corrective actions and makes technical recommendations to management.

Final reports are submitted to the auditee and to the TCEQ CWQMN QA Officer. Audit reports and audit responses are available upon request.

The GBRA CWQMN Project Lead has the ultimate responsibility for ensuring the correction of any deficiencies at the GBRA CWQMN site operated by the GBRA.

Table C2.1 Reports to Management and Actions Taken

Report Title	Frequency	Originator	Recipient	Actions To be Taken
Monitoring Station TSA (partial) and PEA	Audits of two stations per year	GBRA QC staff	Network Coordinator Site Operator/Cooperator CWQMN QA Officer CWQMN QC Officer Categorical 106 Grant Project Manager Monitoring & Assessment Section Manager WQPD Quality Assurance & Data Management Team Leader	1. Contact the Site operator to determine probable cause 2. Determine corrective action. 3. Notify QA/QC Officers, Categorical 106 Grant Project Manager, and Project Management if DQOs and/or MQOs are not met.
Quality Assurance of External Party Continuous Water Quality Data Validation	See SOP DATA-019	Data Management & Analysis Team		
Data Completeness Reports	Annual	GBRA QC staff	Network Coordinator Site Operator/Cooperator CWQMN QA Officer CWQMN QC Officer Categorical 106 Grant Project Manager Monitoring & Assessment Section Manager WQPD Quality Assurance & Data Management Team Leader	
Continuous Water Monitoring Project Update	Annual	Network Coordinator	WQPD Management	NA
Annual QA Report	Annual	QA Officer	EPA	NA
CWQMN site update and progress reports	Bi-Annually	CWQMN QC Officer	Categorical 106 Grant Project Manager	NA

DQO = Data Quality Objective
EMRS = Environmental Monitoring Response System
EPA = United States Environmental Protection Agency
MQO = Monitoring Quality Objective
NA = Not Applicable
PEA = Performance Evaluation Audit
QA = Quality Assurance
QC = Quality Control
SOP = Standard Operating Procedure
TBD = To Be Determined
TSA = Technical Systems Audit
WQPD = Water Quality Planning Division
M&A = Monitoring and Assessment

D1 Data Review, Verification and Validation

GBRA verifies and validates water quality generated by the Plum Creek Continuous Water Quality Monitoring Network (GBRA CWQMN) stations. The In-Situ MP TROLL 9500 and In-Situ Level TROLL 500 will be validated based on the TCEQ SOP DQRP-015 by GBRA Project Validator staff. GBRA has been trained by TCEQ Data Management staff to validate data based on LEADS procedures. Table D1.1 lists the GBRA CWQMN data validator and operator.

Table D1.1 GBRA CWQMN Data Validators

River Basin	CAMS No.	Station ID	Data Validator	Site Operator	Site Location
Guadalupe	763	12647	GBRA	GBRA	Plum Creek at CR202 (Old McMahan Road), Lockhart, TX
Guadalupe	741	14932	GBRA	GBRA	Geronimo Creek at SH 123
Guadalupe	797	12673	GBRA	GBRA	Cypress Creek above Confluence with Blanco River
Guadalupe	732	13657	GBRA	GBRA	Sandies Creek, 2 miles NE of Westhoff

CAMS = Continuous Ambient Monitoring Station
GBRA = Guadalupe-Blanco River Authority

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

Ambient measurement and QC data are accessed, verified, and validated by the GBRA CWQMN Water Quality Technician/Project Data Validator. Data validation processes and procedures are detailed and documented in TCEQ and GBRA SOPs. All GBRA CWQMN data are reviewed and verified for integrity and continuity, reasonableness, and conformance to project requirements. GBRA CWQMN Water Quality Technician/Project Data Validator performs data review using the MeteoStar/ LEADS interface to graphically display the data. Collection and transmission of the data are confirmed, and communications with site operators, and /or project leads are initiated if problems are detected. GBRA CWQMN Water Quality Technician/Project Data Validator performs weekly verification of data generated by sonde instrumentation. Only those data which are supported by appropriate QC samples and meet the measurement performance specifications defined for this project will be considered acceptable. Data that have been validated and have been designated as acceptable will be identified as validated data in the MeteoStar/LEADS data base.

Data Verification Sondes (Multi-probes)

All continuous water quality monitoring data are reviewed and verified for integrity and continuity, reasonableness, and conformance to project requirements. The GBRA Water Quality Technician/Project Data Validator performs data review of the data produced by the In-Situ TROLL 9500 and In-Situ TROLL 500, as the data is retrieved from the onboard computer or as it is captured by cellular phone or radio. Collection and transmission of the data are confirmed and communications with the GBRA CWQMN Project Leads are initiated if problems are detected. The GBRA CWQMN Water Quality Technician/Project Data Validator will perform verification of the data at a minimum of once per week. The method development will establish the appropriate time between servicing of the unit, based on propensity for unit fouling, and the shelf life of batteries, if used. Only those data which are supported by appropriate QC samples and meet the measurement performance specifications for this project defined in Tables A7.1 and A7.2 will be considered acceptable. Data that have been validated and have been designated as acceptable will be identified as validated data in the TCEQ CWQMN network.

Table A7.1 lists the criteria for QC sample results for sonde measurement data. Verification of SC, pH, DO and turbidity includes the analysis of DO, pH, and SC CVSs that are performed at a minimum of once monthly after instrument deployment. Sondes are calibrated prior to each deployment. After every deployment period the sonde's temperature sensor is checked. When a temperature check does not meet criteria, the corresponding DO and SC data are invalidated back to the last passing temperature check. CVS and temperature check results are entered into the MeteoStar/LEADS operator logs.

The GBRA CWQMN Water Quality Technician/Project Data Validator manually verifies sonde CVS data that is accessed from the Calibration Verification web page, and compares it to criteria in Table A7.1. Operator log notes contain related information about the sonde switch out and non-CVS information is also accessed from Operator Logs (See Appendix E for Operator Log content information). Any failed CVSs will result in all data back to the last calibration of that parameter being qualified as invalid. All data within one hour after any PMA flag is qualified as invalid. This 1-hour time period allows the sonde to equilibrate/stabilize to ambient water quality conditions before data may be considered valid. For further details see Validation of Continuous Water Quality Monitoring Data Collected by Multi-parameter Sonde SOP (DQRP-015).

The In-Situ TROLL 9500 will collect data for pH, temperature, dissolved oxygen specific conductance and turbidity once every 15 minutes. The In-Situ TROLL 500 will record the pressure changes in pressure exerted by the water on an internal media. Water level and/or stage height is converted from a reference depth to the water and recorder every 15 minutes. The data from both units are transmitted to TCEQ via a wireless modem. The TCEQ MeteoStar/LEADS will average the results and post an hourly value.

Table D1.2 In-Situ TROLL Sondes Performance Criteria and Frequency of QC Checks

Parameter	Units	Standard Concentration	Frequency of QC checks	Operating Limits
pH	pH units	7 and 10	Once a month	0-12
DO	mg/L	100% Saturated water	Once a month	0-20
Conductivity	µS/cm	1000 µS/cm	Once a month	5-20,000
Temperature	°C	NA	Once a quarter	5-50
Turbidity	NTU	20.0 NTU	Once a month	0-2000
Stage height	feet	NA	Once a quarter	0-33

D2 Verification and Validation Methods

Data Validation

The GBRA CWQMN Water Quality Technician/Project Data Validator reviews post-deployment CVS data, including temperature, for multi-parameter sondes. A CVS failure for any given parameter results in the invalidation of that parameter back to the last passing post-deployment CVS. In the event of a failing temperature check, all temperature data, as well as any associated DO and SC data are invalidated back to the last passing temperature check.

Any data deemed questionable by the data validator, due to inexplicable peaks, data dropouts, flat-lined data, etc., will be qualified as invalid. During data validation, certain issues or questions may arise about particular data point(s). In this case, the data validator refers to the operator logs. If no logs exist, or the log does not identify a source for the questionable data, the validator contacts the site operator via phone or email to try to resolve any issues and verify affected data. Since GBRA is the validator and the site operator, the GBRA will contact the manufacturer or its representative, to try and resolve any issues and verify any data involved. Additionally, sonde sample depth and water level measurement data may be used as a source of additional information for data validation decisions.

After validating any data, and for MeteoStar/LEADS to consider any data as being validated, the GBRA Water Quality Technician/Project Data Validator must enter validator notes. These notes document and explain any data qualifications made, other than valid (VAL) flags and why the qualification was made. In addition to the electronic validator notes, each validator also keeps a hard copy validator's notebook containing the same information. These notebooks are kept on file at GBRA for five years and are available upon request for audits.

The Data Management & Analysis Team conducts audits of cooperators and contractor data validation as well as self-audits of team member data validation. For complete details about this process, see SOP for the Quality Assurance of External Party Continuous Water Quality Data Validation (DATA-019).

Data Tracking

End data users can access validated data via the Internet (TCEQ web pages). Actual measurement values (or averages of these) are shown for data that has been qualified as valid, while the validation flag is shown for data that were qualified as invalid. All data, no matter the qualifier assigned by the system, is manually verified. For a list of validation flags and their definitions, see Table D2.1. After data is verified by the data validator, it is flagged as such in MeteoStar/LEADS.

Table D2.1 Data Validation Flags (Qualifiers)

Flag	Definition
AQI	Ambient Quality Invalid – Flag manually assigned when data point deemed invalid by data validator.
PMA	Preventative Maintenance – Flag manually assigned when site operator is performing maintenance on analytical equipment.
VAL	Valid – Flag automatically assigned to any data point that does not fall above or below pre-defined limits. Valid – Flag manually assigned to any data that was previously automatically assigned a Laboratory Information System flag that was later deemed valid by the data validator.
LIM	Limit Exceeded – Flag automatically assigned to any data that fall above or below pre-defined range.
LST	Lost Data – Flag automatically assigned when data is not retrievable by the data logger because of power outages, equipment malfunction, etc.

D3 Reconciliation with User Requirements

Problems with potential limitations of the data are handled at three different levels:

1. At the time of audit of the monitoring station or by the site operator who have prime responsibility for routine calibrations, maintenance, and analysis of quality control samples;
2. Data validators who review, verify and validate station data; and
3. By users of the data.

Issues are reconciled at the lowest level and at the earliest time possible. The mechanism for communication between the producers and the users of the data are telephone, internet and operator's log.

The auditors, GBRA (project lead, validator and site operator) staff, and managers are empowered to review and question any part of the measurement process and may initiate data reviews and corrective actions to bring the process back into compliance.

To assess the quality of the data produced during the monitoring efforts, the precision, accuracy, and completeness will be assessed in comparison to the measurement quality objectives as discussed in Section A7

Appendix A

Definitions

Equipment Blank (EB)

Definition – A clean sample that is introduced at the sample inlet. The point at which a normal ambient sample would enter the sampling system.

Application – Used to determine sampling system contamination.

Instrument Blank (IB)

Definition – Instrumental analysis with no sample injection. (Modified National Environmental Laboratory Accreditation Conference (NELAC); Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Application – Used to determine instrument contamination.

Reagent Blank (RB)

Definition – A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (NELAC; Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Application – Analyzed to determine the contribution of the reagents and of the analytical systems.

Duplicate Samples

Instrument Duplicate (ID)

Definition – Repeated but independent analytical determinations from the same sample.

Application – Used to estimate instrument precision.

Laboratory Control Sample (LCS)

Definition – An uncontaminated sample matrix spiked with known amounts of analytes from a source independent of the calibration standards. LCSs are taken through the entire sample preparation and analysis procedure. (NELAC; Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Application – Used to establish intra-laboratory or analyst specific accuracy or to assess the performance of all or a portion of the measurement system.

Laboratory Control Sample Duplicate (LCSD)

Definition – A replicate LCS

Appendix A (continued)

Application – Prepared and analyzed with the laboratory control sample to obtain a measure of precision for the recovery of each analyte.

Other Samples

<u>Performance Evaluation (PE) sample</u>

Definition – A sample, the composition of which is unknown to the analyst, provided to test whether the analyst/laboratory can produce analytical results within specified performance limits. (NELAC; Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Application – Data from PE samples are used to evaluate method accuracy (and precision if duplicate PE samples are submitted). This is commonly referred to as an audit sample.

<u>Calibration Standard (CS)</u>

Definition – A mixture prepared from the primary standard mixture or stock standard mixture and, when appropriate, containing the internal standards and surrogates. (Modified NELAC; Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Application – Used to calibrate the instrument response with respect to analyte concentration.

<u>Calibration Verification Sample (CVS)</u>

Definition – An analytical standard analyzed during a batch to ensure acceptable instrument calibration.

Application – Used to verify analytical system calibration.

<u>Calibration Verification Standard Duplicate (CVSD)</u>

Definition – A replicate calibration verification standard.

Application – Prepared and analyzed with the calibration verification standard to obtain a measure of precision for each analyte.

General Quality Control

<u>Chain-of-Custody (COC)</u>

Definition – An unbroken trail of accountability that documents the possession of samples, data, and records. (Modified NELAC; Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Application – Provides documentation to establish sample integrity

Appendix A (continued)

Instrument Detection Limit (IDL)

Definition – Constituent concentration that routinely produces an analytical signal significantly greater than at least three times the signal to noise ratio and provides 99 percent confidence that the instrument response detected above this level is not due to instrument noise.

Application – The IDL estimates the lower limit of analytical detectability.

Method Detection Limit (MDL)

Definition – The constituent concentration of a substance (an analyte) that can be measured and reported with a 99 percent confidence that the concentration is greater than zero and is determined from replicate analysis of a sample in a given matrix containing the analyte as described in 40 *CFR* Part 136, Appendix B. (Modified NELAC/40 *CFR* Part 136)

Application – Estimates the lower limit of method detectability. This measurement should be made under the same conditions as sample analysis and incorporate sample preparation, collection, and analysis to the extent possible to truly reflect method sensitivity. The concentration used to measure method variability should be one to ten times the expected MDL, if possible.

General Terminology

Accuracy – The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator. (NELAC; Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Audit (quality) – A systematic and independent examination and evaluation to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve specified objectives. (American National Standard Institute (ANSI)/American Society for Quality Control (ASQC), Standard E4-19)

Bias – The systematic or persistent distortion of a measurement process that causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (ANSI/ASQC, Standard E4-19)

Comparability – A measure of the confidence with which one data set can be compared to another. (ANSI/ASQC, Standard E4-19

Appendix A (continued)

Completeness – A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions. (ANSI/ASQC, Standard E4-19)

Data Quality objectives (DQOs) – Established quantitative measurements (with associated precision and bias or acceptable uncertainty) that must be obtained from the environmental data operations in order to demonstrate that the desired and expected result has been achieved. (ANSI/ASQC, Standard E4-19)

Deficiency – An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ANSI/ASQC, Standard E4-19).

Matrix – Substance being tested.

Measurement Quality Objective (MQO) – The desired sensitivity, range, precision, and bias of a measurement. (NELAC; Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Precision – A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions, expressed generally in terms of the standard deviation. (ANSI/ASQC, Standard E4-19)

Quality – The sum of features and properties/characteristics of a process, item, or service that bears on its ability to meet the stated needs and expectations of the user. (ANSI/ASQC, Standard #4-19)

Quality Management Plan (QMP) – A formal document or manual, usually prepared once for an organization that describes the quality system in terms of the organizational structure, functional responsibilities of management and staff, lines of authority, and required interfaces for those planning, implementing, and assessing all activities conducted. (ANSI/ASQC, Standard E4-19)

Quality Assurance Project Plan (QAPP) – A formal document describing in comprehensive detail the necessary quality assurance, quality control, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. (ANSI/ASQC, Standard E4-19)

Quality Assurance (QA) – An integrated system of activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the customer. (ANSI/ASQC, Standard E4-19)

Appendix A (continued)

Quality Control (QC) – The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality. (ANSI/ASQC, Standard E4-19)

Representativeness – A measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter, variations at a sampling point, a process condition, or an environmental condition. (ANSI/ASQC, Standard E4-19)

Sample Depth – Depth of sonde in the water column (TCEQ).

Standard Operating Procedure (SOP) – A written document that details the method of an operation, analysis, or action whose techniques and procedures are thoroughly prescribed and that is accepted as a method for performing certain routine or repetitive tasks. (NELAC; Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Water Level – (also known as Stage Height) is the height of water in the stream above a reference point. (USGS)

Appendix B

Acronyms

A

ADCP	Acoustic Doppler Current Profiler
AQI	Ambient Quality Invalid
AWRL	Ambient Water Reporting Limit
ASTM	American Society for Testing and Materials

B

BMP	Best Management Practices

C

CAFO	Concentrated Animal Feeding Operation
CAMS	Continuous Ambient Monitoring Station
CFEP	Comms Front End Processor
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
cm	Centimeters
COA	Certificate of Analysis
COMMS	Communications
CVS	Calibration Verification Sample
CWA	Clean Water Act
CWQMN	Continuous Water Quality Monitoring Network

D

DI	De-ionized water
DO	Dissolved Oxygen
DQO	Data Quality Objective

E

EB	Equipment Blank
EC	Electrical Conductance (Reported as Specific Conductance)
EMRS	Environmental Monitoring Response System
EPA	United States Environmental Protection Agency

F

FNU	Formazin Nephelometric Units
ft	Feet
ft/s	Feet per Second
FY	Fiscal Year

G

GBRA	Guadalupe-Blanco River Authority

Appendix B (continued)

	GRBN	Guadalupe River Basin Network
	GOES	Geostationary Operational Environmental Satellite
I		
	IB	Instrument Blank
	in	Inches
	In-Situ	In-Situ Inc. - Ft.Collins, CO
	ISO	International Organization for Standards
K		
	KCL	Potassium Chloride
L		
	LCRA	Lower Colorado River Authority
	LCS	Laboratory Control Sample
	LEADS	Leading Environmental Analysis and Display System
	LIM	Limit Exceeded
M		
	MD	Monitoring Division
	MDL	Method Detection Limit
	mg/L	Milligram per Liter
	MOD	Monitoring Operation Division
	MQO	Measurement Quality Objective
N		
	NA	Not Applicable
	NH_3-N	Ammonia-Nitrogen
	NIST	National Institute of Standards and Technology
	NOAA	National Oceanic & Atmospheric Administration
	NO_3-N	Nitrate-Nitrogen
	NTU	Nephelometric Turbidity Units
P		
	PC	Personal Computer
	PC	Plum Creek
	PCWP	Plum Creek Watershed Partnership
	PCWPP	Plum Creek Watershed Protection Plan
	GBRA	
	CWQMN	Plum Creek Continuous Water Quality Monitoring Network
	PEA	Performance Evaluation Audit
	PMA	Preventative Maintenance
	ppb	Parts per Billion

ppm	Parts per Million
ppt	Parts per Thousand

Q

QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan

R

RL	Reporting Limit
RPD	Relative Percent Difference
RPE	Relative Percent Error

S

SAS	Statistical Analysis Software
SC	Specific Conductance
SOP	Standard Operating Procedure
STORET	Storage and Retrieval
SWQM	Surface Water Quality Monitoring Team
SQMIS	Surface Water Quality Monitoring Information System

T

T	Temperature
TBD	To Be Determined
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TIAER	Texas Institute for Applied Environmental Research
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TPWD	Texas Parks & Wildlife Department
TRP	Total Reactive Phosphorus
TSA	Technical System Audit
TSWQS	Texas Surface Water Quality Standards
TSSWCB	Texas State Soil and Water Conservation Board

U

*u*S	micro Siemens
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USIBWC	United States International Boundary Water Commission
USNPS	United States National Parks Service

W

WQPD	Water Quality Planning Division

Appendix B (continued)

Y

YSI	Yellow Springs Instrument

Misc.

°C	Degrees Centigrade
*u*S/cm	micro Siemens per centimeter

Appendix C

References

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4. *United State Geological Survey – Turbidity 6.7*, Version 2.1 (09/2005).
5. *United State Environmental Protection Agency Requirements for Quality Assurance Project Plans.* United States Environmental Protection Agency QA/R-5.
6. *Standard Methods for the Examination of Water and Wastewater.* American Public Health Association, Washington, DC 20th edition, 1998.
7. Definition and Procedure for the Determination of the Method Detection Limit. 'Rev. 1.11, Chapter 40, *Code of Federal Regulations* Part 136, Appendix B.
8. *Guidance for the Data Quality Objectives Process*, Appendix D, Glossary of Quality Assurance Terms. United States Environmental Protection Agency, Quality Assurance Management Staff QA/G-4, Washington, DC, 1994.
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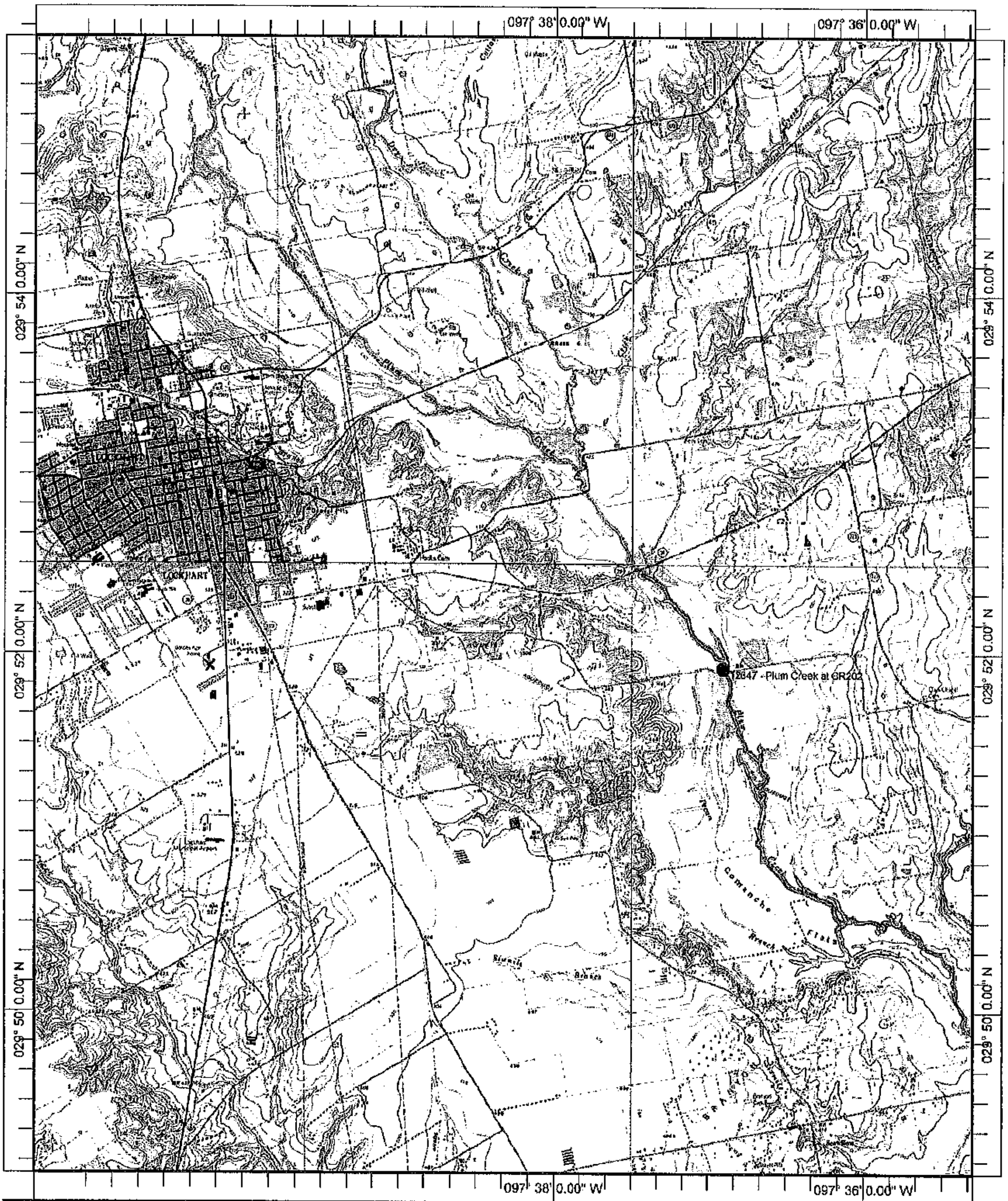
10. *American National Standard Institute [ANSI] American Society for Quality Control [ASQC] Z1*, Standard E4-19.
11. *Surface Water Quality Monitoring Quality Assurance Project Plan.* Texas Commission on Environmental Quality, Rev. 13, January 2010.
12. *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods*, October 2008. RG-415
13. *Chemical Hygiene Plan.* Texas Commission on Environmental Quality, November, 2000.

Appendix D

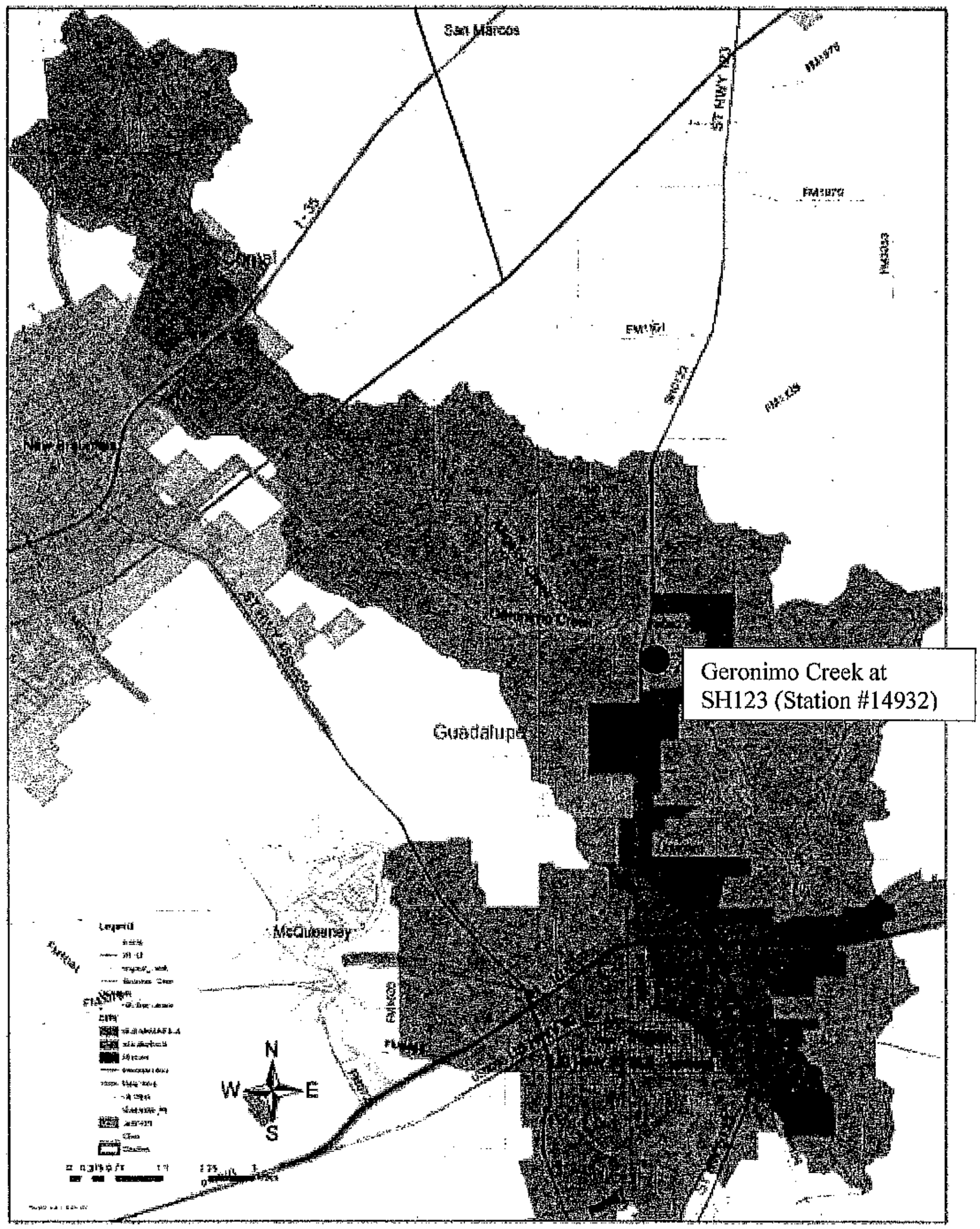
GBRA CWQMN Station Location Maps

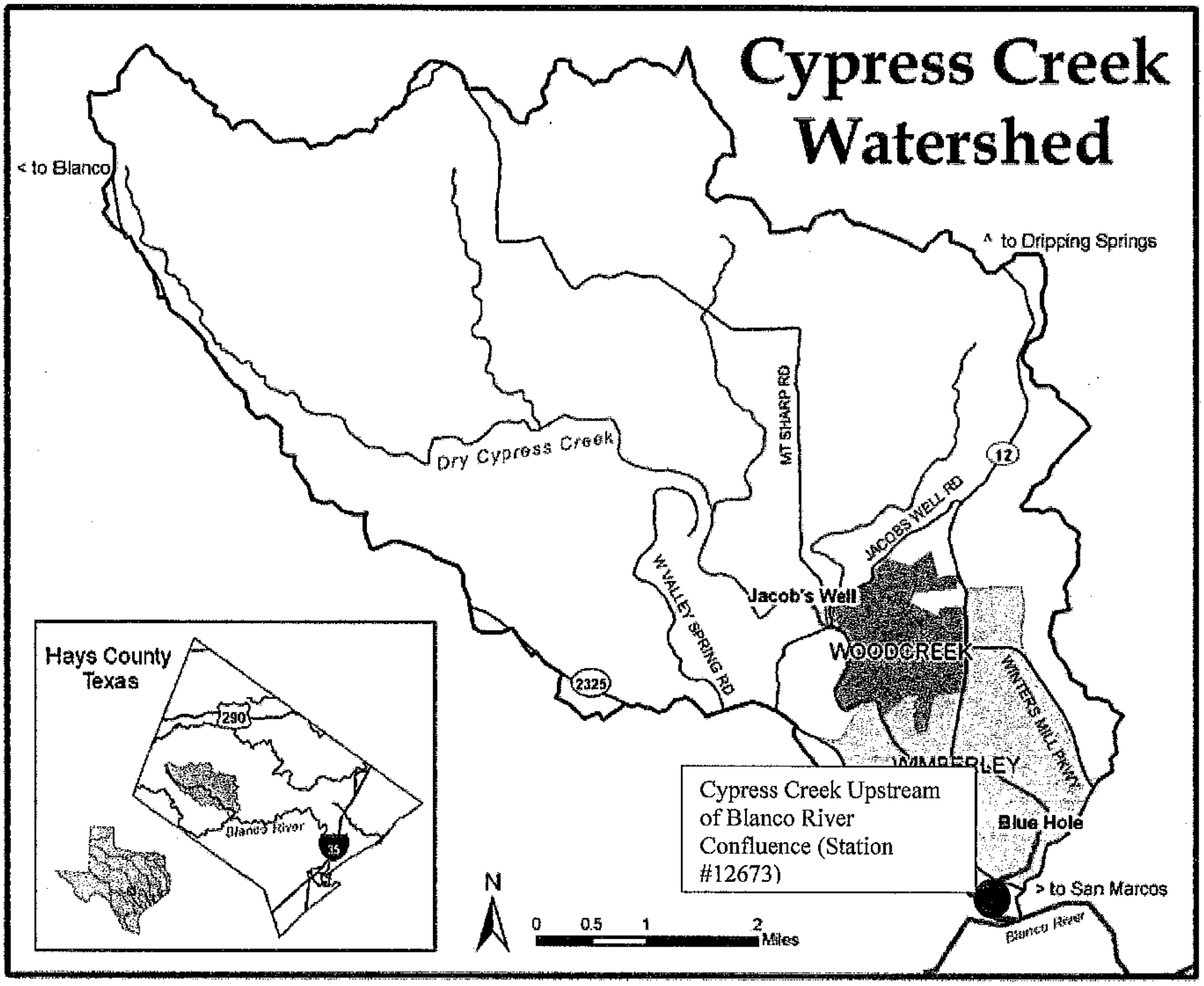


Name: MC MAHAN
Date: 5/13/2011
Scale: 1 inch equals 4000 feet

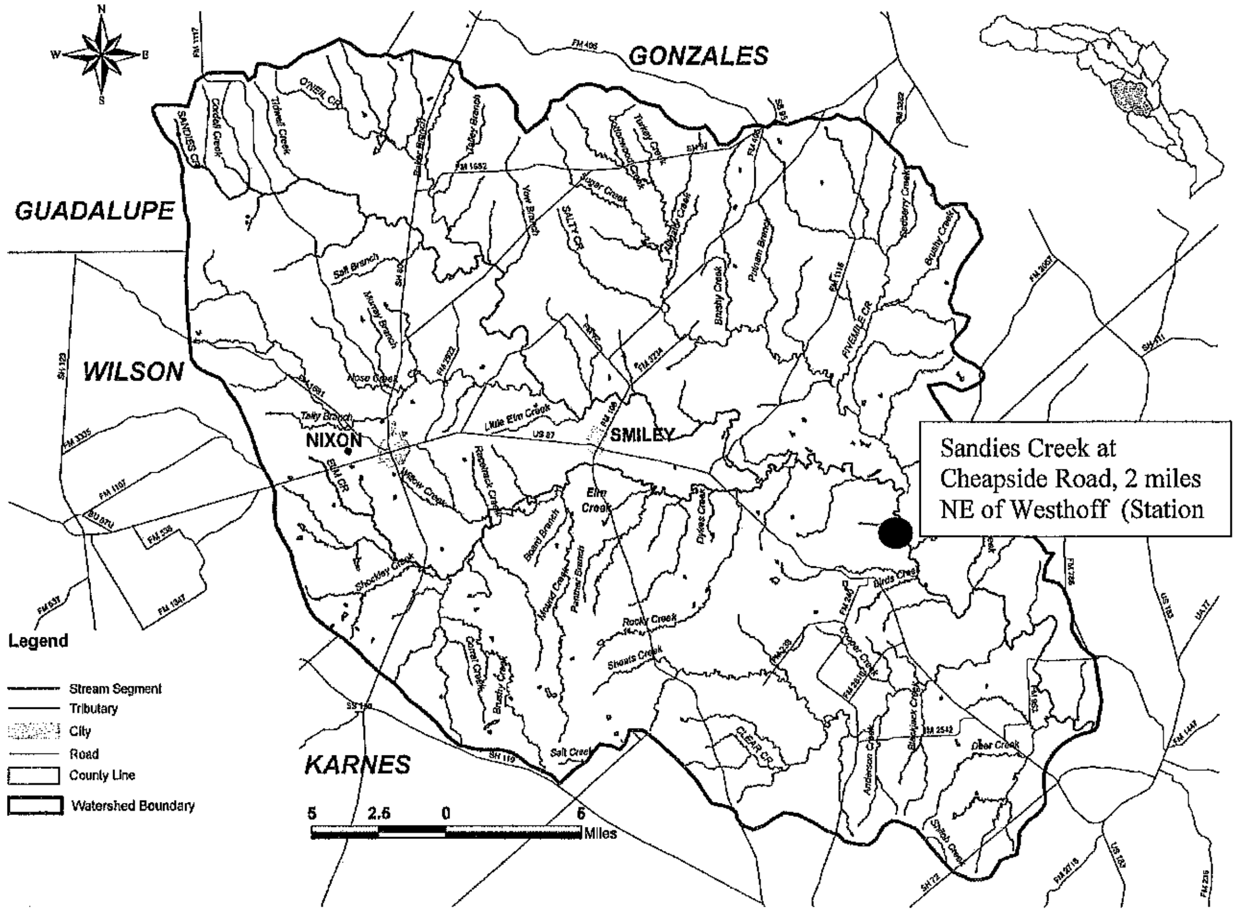
Location: 029° 52' 16.2" N 097° 38' 18.7" W

Geronimo and Alligator Creeks Watershed




Cypress Creek
Watershed
< to Blanco
^ to Dripping Springs
Dry Cypress Creek
MT SHARP RD
JACOBS WELL RD
12
W VALLEY SPRING RD
Jacob's Well
WOODCREEK
WINTERS MILL PKWY
2325
WIMBERLEY
Cypress Creek Upstream of Blanco River Confluence (Station #12673)
Blue Hole
> to San Marcos
Blanco River
Hays County Texas
290
Blanco River
35
N
0 0.5 1 2 Miles

Sandies Creek Watershed



Appendix E

Operator Calibration Data Entry, Public Flagging, and Site Termination Protocol (Revision 1)

CWQMN Water Calibration Data Entry and Operator Log Content

Overview: Following a site visit the operator is to enter either an Operator Log, or Calibration Verification Data Entry with an Operator Log. Both types of entries are to be performed by going to the web address of: http://tceqwatercal.ipsmtx.com which is an external version of the Calibration Verification web page on the internal TCEQ web site (rhone). Operator Logs and Calibration Verification Data Entry can no longer be entered into rhone. Three functions are provided by this web page. Site operators are to enter calibration values, update or edit calibration values, or if there are no calibration values they will enter an Operator Log without calibration values. Next reviewers of the operator entries verify the entries are appropriate and complete and either rejects the entry back to the operator for edits, or pushes the entry out into the Calibration Report area to allow users to view the entries and enable data validators to perform data validation tasks. User identification (IDs) and passwords are required for the entry, review, and push of operator entries out to the Calibration Report area. Upon logging into the site the operator will have the option to either Add a New Calibration Record which requires an Operator Log Message, or to Add and Operator Log Message (without any calibration verification values) when the sonde calibration is not appropriate or required (examples: the sonde is broken, washed downstream, or only site maintenance activities have been performed other than sonde switch out).

GBRA CWQMN Operator Log Content

Calibration Data entry and Operator Log content should include the following, as appropriate.

1. Name of site operator, organization conducting visit, and date of site visit.

2. Note Station status, station/instrument(s) damages, repairs, troubleshooting, and communication problems, etc. Note deployment tube cleanings and any other events or situations that can affect data quality.

3. Enter sonde deployment and retrieval information, including GBRA asset number or SN#, deployment/retrieval dates, and times.

4. Enter post deployment Calibration Verification Sample (CVS) results* and standard values into the appropriate fields. The system calculates the difference from the standard and assigns a quality rating (excellent, good, or poor) to the data. The operator enters comments in the parameter-specific field if necessary.

5. If possible, note assignable cause(s) for any failing CVS or quality control (QC) checks either in the parameter-specific comment field, or in the Operator Log Message field.

6. Note Field observations: Water Conditions, meteorological conditions, rain, drought, flood, etc. in the Operator Log Message field.

7. Note deployment of new sonde. GBRA asset number or serial number, date of calibration, and deployment date and time in the Operator Log Message field.

8. When the sonde is not being switched out or calibrated and only an Operator Log Message is to be entered there will be no values entered in the table of calibration verification data. At a minimum, the operator must provide at least what is listed above in line items 1,2, and 7, plus any additional information that is pertinent to the site visit.

9. Click Save not Reset. The system will verify the entries and ask if the user wants to enter more records.

10. Either enter more Calibration entries, or exit the system.

*Sites with vertical profilers need to include CVS results for percent fluorescence in the Operator Log Message field.

<u>Operator Log with Calibration Value Data Example Entry:</u>

Operator Name, TCEQ Midland Region – On July 21, 2008

Routine site visit, station on-line and operational. Cleaned deployment tube. Sediment debris cloud after cleaning. Recent (July 16, 2008) isolated heavy rains causing heavy sediment loading in river.

Retrieved Serial Number 022208 Greenspan sonde at 1200 hrs. (deployed on November 6, 2008 at 12:30 hrs.).

CVS results passed criteria for all parameters except pH (SC – 4.2% RPE, DO + 0.30 mg/l (or % sat), pH + 0.60.).

Temp Check = sonde #022208 passed temp check, +0.16 C.

Failing QC Checks = Water level pressure sensor clogged with debris, sensor cleaned. pH sensor heavily fouled with sediment, DO, SC, and temp sensors moderately fouled with sediment.

Field Observations = Water rising and turbid due to recent rains.

Deployed serial number 021512 Greenspan sonde that was calibrated on July 7, 2008.

Operator Log without Calibration Value Data Example Entry:

Operator Name, TCEQ Region Number – On November 21, 2008 an unscheduled site visit was made due to station off-line since November 20, 2008 at 15:30. Arrived at site at 12:25. Sunny, cold, and breezy; bank gauge at 0.73 m. Yellow fault light blinking on logger. All wires and cables connected properly. Quick view status window reported 'system malfunctions, measurements 1,2,3,4 have failed readings'. Logger communications window reported 'no data' and 'bad' quality. Stopped and restarted measurements, but still no data. Disconnected and reconnected all wires and cables to and from sonde, battery, and logger but still no data. Retrieved Greenspan sonde # 12345 and deployed Greenspan sonde # 67890 at 13:00 that was calibrated on November 21, 2008. Data collection and transmission resumed. Departed site at 13:30. Unable to complete entire post-calibration on sonde #12345 as it would not communicate with computer. Request for replacement sonde was submitted on November 21, 2008. Operator Name.

A new process is under development to measure fouling at CWQMN sites. When an operator is instructed to start collecting fouling measurements the above information is required along with the following requirements.

Post Deployment Excel Workbook

A Post Deployment Excel Workbook will be provided to track fouling and drift measurements for each site conducting such measurements. There will be a workbook for each calendar year using the following naming convention (PDW_CAMSXXX_CalenderYear) with labeled tabs (MMMDDYYYY) for each site visit. Water Data Management and Analysis (WDM&A) will provide the template to the operator who will in turn complete a tab for each site visit. When a new calendar year starts a new Excel workbook will be started. WDM&A or the data validator will store the Post Deployment Workbook on their team's electronic folder for CWQMN documents.

The Following naming convention examples need to be used for each Post Deployment Excel workbook and the tabs within the workbook.

Excel Workbook Naming Convention Example:
PDW_CAMS787_2011

Excel Workbook Tab Naming Convention Example:
MAR132011

Optional Photos of Sonde and Sensors

It is preferred that photos be taken during each site visit of the sonde and its sensors. The purpose of the photos is to photo-document fouling conditions of the probe and other pertinent areas at the Continuous Ambient Monitoring Station (CAMS). These optional photos will be emailed to the site's data validator along with the required Post Deployment Workbook. If the optional photos are not taken and submitted, greater detail is needed in the Operator Log to describe fouling conditions.

Operator Log

Along with information that is required for non-foul collecting sites the following information needs to be conveyed in the Operator Log to give the data validator knowledge to properly validate the site.

- Debris cloud present around deployment tube after cleaning (if observed)
- Stream Flow at deployment tube (No Flow, Low, Normal, Flood, High, Dry)
- Sonde maintenance (replaced DO membrane, pH bulb, etc.)

Public Flagging and Site Termination Protocol

Background

It is essential the CWQMN Site Operators routinely and thoroughly complete Calibration Verification (CV) and Operator Logs (OL) for the site(s) they operate. Without the CV/OL, Data Validators cannot validate CWQMN data. If the CV/OL entries are not completed in a timely manner, details may be lost and the opportunity to make early corrections to issues and errors in the field may be lost and additional invalid data may be collected.

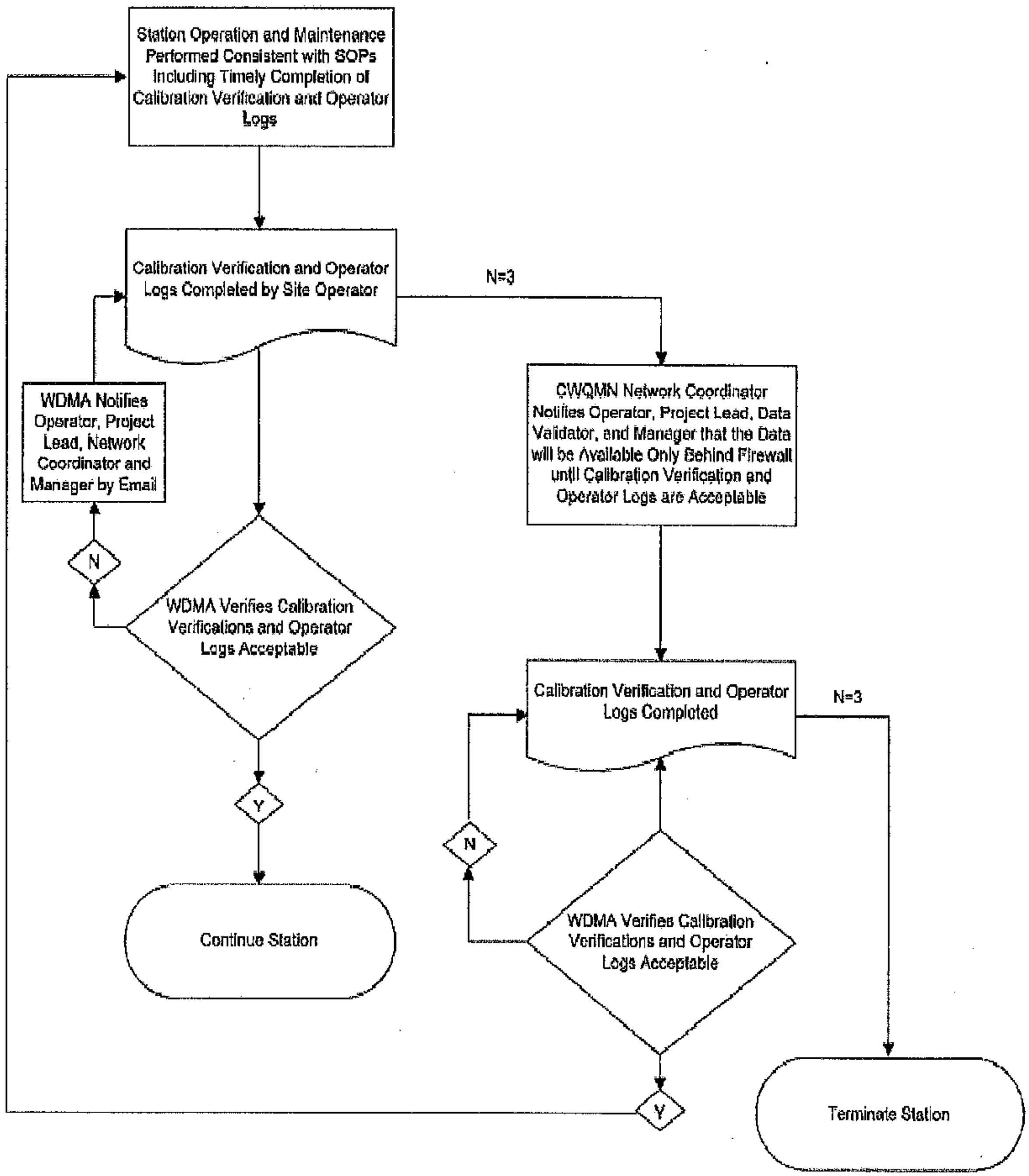
All CWQMN site operators have been assigned a user name and password to access an internet based CV/OL entry form. The internet based CV/OL entry form is located on an external server at: http://tceqwatercal.iipsmtx.com. The site and form are available from any PC with an internet connection. All operators have received general instruction on the use of the internet based system and TCEQ Monitoring and Assessment staff is available to assist operators with the system.

CWQMN Site Operators are expected to complete their CV/OL entries within 5 working days of any field visit or instrument exchange. In order to facilitate collection of valid data and the data validation process, a procedure is needed to monitor and confirm routine and timely completion of CV/OL entries. If CWQMN Site Operators cannot meet the requirements for CV/OL entry, the CWQMN site may be terminated.

Summary of Procedure

1. Operator performs routine operation and maintenance of site including calibration and deployment of instruments.
2. Operator completes CV/OL entry within 5 working days of field event.
3. WDM&A verifies CV/OL entries are complete and entered within 5 working days of the field event.
4. Three opportunities of 5 days duration will be afforded to correct the deficiency. If CV/OL entries are not completed within 5 working days and/or the CV/OL entries are not complete, WDMA will send email notification of the deficiency to the Site Operator, Project Lead, Network Coordinator, and/or the Site Operator's first-line manager:
   a. First occurrence – email to Site Operator and Project Lead.
   b. Second occurrence – email to Site Operator, Project Lead, and Network Coordinator.
   c. Third occurrence – email to Site Operator, Project Lead, Network Coordinator, and Site Operator's first-line manager.
5. If the deficiency is corrected under number 4 above, the site returns to normal state.
6. If the deficiency is not corrected under number 4 above, the site data will be removed from the public internet pages (the PUBLIC data flag will be removed) and the Site Operator, Project Lead, Network Coordinator, and/or the Site Operator's first-line manager will be notified.
7. Three additional opportunities of 5 days duration will be afforded to correct the deficiency. WDMA will send email notification to the Site Operator, Project Lead, Network Coordinator, and/or the Site Operator's first-line manager:
   a. First occurrence – email to Site Operator and Project Lead.
   b. Second occurrence – email to Site Operator, Project Lead, and Network Coordinator.
   c. Third occurrence – email to Site Operator, Project Lead, Network Coordinator, and Site Operator's first-line manager.
8. If the deficiency is corrected under number 7 above, the site returns to normal state.
9. If the deficiency is not corrected under number 7 above, WDMA will notify the Network Coordinator and the Network Coordinator will recommend termination of the site.

Process Flow Chart



Appendix F

Site Evaluation Form

Reset Form

FY 11 CWQMN Site Review

Review Quarter

SWQM Station ID | CAMS # | TCEQ Project Lead:

Station Description

Parameters Monitored

Check all that apply:

DO | pH | H2O Temp | Spec Cond | TDS (calc) | Depth | Discharge

Turbidity | Nitrate-Nitrogen | Ammonia-Nitrogen | Chl *a* | Total Reactive Phos (TRP)

Are all these parameters needed? Yes | No | Met.

Why or Why Not?

Period of Operation

Start-up Date

Is long-term continuous monitoring needed at this site? Yes | No

If no, would less intense monitoring satisfy data needs at this location? Yes | No

Additional Information:

Data User(s)

Check all that apply:

SWQM | Field Operations | TMDL | WQ Modeling | WQ Standards | Water Rights

Watermaster | CRP Partner | State Agency | Federal Agency

City | University | Other

No Current Data User Identified

Additional Information:

Intended Data Uses

Check all that apply:

- ◌ 305(b)
- ◌ Research
- ◌ Trends
- ◌ Public Education
- ◌ TMDL Implementation Monitoring
- ◌ WQ Standards
- ◌ Agriculture
- ◌ Water Quality Management
- ◌ Monitoring BMP Effectiveness
- ◌ Site supports an ongoing project

Special Project Name: ____________

- ◌ Watershed Protection Plan
- ◌ No Current Data Use Identified

Additional Information: ____________

Operator Performance

Operator: ____________

Check all that apply:

- ◌ The operator follows SOP MAIN-017.
- ◌ Operator consistently follows instrument specific SOPs.
- ◌ Site maintained at appropriate intervals.
- ◌ Calibration Verifications routinely entered.
- ◌ Operator Logs are routinely entered.

Additional Information: ____________

Project Objectives

What is the water quality issue associated with this site? ____________

Are the original objectives still appropriate? ◌ Yes ◌ No

If No, how has the project changed? ____________

Is the project still providing valid/useful data? ◌ Yes ◌ No

If No, why not? ____________

Should this site continue? ◌ Yes ◌ No

Additional Information: ____________

Save completed form to H/WQPD/01MnA \CWQMN\FY11 CWQMN Site Evaluation\... *Select appropriate quarter and station folder; add CAMS # to file name.*

Appendix G

Example Letter to Document Adherence to the QAPP

TO: (name)
(organization)

FROM: (name)
(organization)

Subject: RE: Commitments to requirements contained in the Plum Creek Continuous Water Quality Monitoring Network (GBRA CWQMN), Data Collection and Validation QAPP.

Please sign and return this form by (date) to:

(address)

I acknowledge receipt of the referenced document(s). I understand the document(s) describe quality assurance, quality control, data management and reporting, and other technical activities that must be implemented to ensure the results of work performed will satisfy stated performance criteria.

______________________________ ______________________
Signature Date

Copies of the signed forms should be sent by the GBRA to the TCEQ CWQMN Network coordinator within 60 days of TCEQ approval of the QAPP.

Appendix H.

In-Situ Inc. Multi-Parameter TROLL 9500 Calibration and Verification Worksheet

In-Situ Inc. Multi-Parameter TROLL 9500 Calibration and Maintenance Log

Initial Calibration

Date:	Time:	Technician:
Battery Voltage:		Multi-probe Type and Serial Number:
Conductivity Sensor Serial Number:		pH Sensor Serial Number:
RDO Sensor Serial Number:		Turbidity Sensor Serial Number:
RDO Sensor Cap Serial Number:		RDO Sensor Cap Expiration Date:

Function	Temperature of Standard	Stimulus	Response	Final Reading	Calibration Information
Specific conductance (low) ∃1,000 µS/cm					Std. Tracking No. Std. Exp. Date:
Conductivity cell constant (low-range)					Range 0.33 to 0.39 cm^{-1}
pH calibrated (~7)					Std. Tracking No. Std. Exp. Date:
pH mV response for pH 7 solution					Range 0 ∀ 20 mV
pH calibrated (~ 4/10)					Std. Tracking No. Std. Exp. Date:
pH mV response for pH 10 pH mV response for pH 4					Range: -160 ∀ 20 mV Range: +160 ∀ 20 mV
pH Slope (mV/pH)					-66 mV to -50 mV
pH Offset (mV/pH)					390 mV to 450 mV
Rugged Dissolved oxygen (100% Sat)					mmHg mbar
Rugged Dissolved Oxygen Slope					Range 0.9 to 1.1
Rugged Dissolved Oxygen Offset					
0 NTU Calibration Standard (Type I DI)					Std. Tracking No. Std. Exp. Date:
20 NTU Calibration Standard		20 NTU			2.50 ml of 4000 NTU Formazin in 500 ml DI H_2O
Sensor Slope (0-20)					
Sensor Offset NTU Adj. (0-20)					
200 NTU Calibration Standard		200 NTU			25.0 ml of 4000 NTU Formazin in 500 ml DI H_2O
Sensor Slope (20-200)					
Sensor Offset NTU Adj. (20-200)					Turbidity Pivot =

Post-Calibration

Date:	Time:	Technician:
Battery Voltage:		Multi-Probe Type and Serial No.:

Function	Temp. of Standard	Value of Standard	Initial Reading	Pass Post-Cal?	QC Standard Information
Specific conductance (*u*S)				☐Yes ☐No	Std. Tracking No. Std. Exp. Date:
pH calibrated (~7)				☐Yes ☐No	Std. Tracking No. Std. Exp. Date:
pH slope (~ 4/10)				☐Yes ☐No	Std. Tracking No. Std. Exp. Date:
RDO (100 % Saturation)				☐Yes ☐No	Barometric Pressure: mmHg
Turbidity 20.0 NTU CVS				☐Yes ☐No	Std. Tracking No. Std. Exp. Date:

Multi-probe Temperature Check (Replace Thermometer or Thermistor if Correction Factor is Greater than 0.5 degrees Celsius)

NIST Thermometer Number:			Laboratory Thermometer Number:	
Annual NIST Traceable Check:	Date:	NIST Temp:	Lab Thermometer Temp:	Correction Factor:
Maintenance Temperature Check:	Date:	Multi-Probe Temp:	Lab Thermometer Temp:	Correction Factor:
Comments:				

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Appendix I.

Standard Operating Procedure for the Analysis of Dissolved Oxygen (DO), Specific Conductance (SC), pH, Temperature and Turbidity in Ambient Surface Water Using the In-Situ Inc. Multi-Parameter Water Quality TROLL 9500

Analysis of Dissolved Oxygen (DO), Specific Conductance (SC), pH, Temperature and Turbidity in Ambient Surface Water Using the In-Situ Inc. Multi-Parameter Water Quality TROLL 9500

Standard Operating Procedure (SOP) GBRA-001
Title: Analysis of Dissolved Oxygen (DO), Specific Conductance (SC), pH, Temperature, and Turbidity in Ambient Surface Water Using the In-Situ Inc. Multi-Parameter Water Quality TROLL 9500
Team Leader:______________ Date:__________ Quality Control Review:______________ Date:__________ Section Manager:______________ Date:__________ Effective Date:______________

1.0 Purpose

This document describes the analytical procedures for continuous automated analysis of DO, SC, pH, Temperature and Turbidity in ambient surface water using the In-Situ Inc. Multi-Parameter Water Quality TROLL 9500.

2.0 Scope and Applicability

2.1 This procedure is intended for use in the Continuous Water Quality Monitoring Network (CWQMN).

2.2 Due to the extended length of time that TROLLs are deployed the data can be used to establish baseline conditions, identify trends, and characterize pollution events and seasonal variations in water quality.

2.3 SC, DO, pH, and Temperature data meeting Surface Water Quality Monitoring Data (SWQM) Quality Objective Criteria (DQOs) may be used for the Federal Clean water Act Sections 305(b) Report and 303(d) lists.

2.4 TROLL Turbidity measurements can be used for data validation purposes. The working range of the sensors is listed below.

Parameter	**Working Range**	**Reported Accuracy**
DO (optical, RDO)	0-20 milligrams/Liter (mg/L)	+/- 0.2 milligrams/Liter (mg/L)
SC (low range sensor)	5-20,000 µS/cm	+/- 2 µS/cm or 0.5% (whichever is greater)
pH	0-12 pH Standard Units	+/- 0.1 pH Standard Units
Temperature	-5 to 50 Degrees Celsius (°C)	+/- 0.1 (°C)
Turbidity (Nephelometer, 90° light scattering, 870 nm LED, solid state)	0-2000 Nephelometric Turbidity Units (NTU)	+/- 3 Nephelometric Turbidity Units (NTU) or +/- 5% (whichever is greater)

3.0 Method Summary

3.1 The TROLL is deployed in the water body of interest, or ambient surface water is pumped through a flow cell near the water body of interest, and DO, SC, pH, Temperature and Turbidity are measured in situ.

3.2 The DO is measured with an optical sensor that uses the principle of "dynamic luminescence quenching". With this principle, "lumiphore" molecules fluoresce when excited by light of a specific wavelength. The oxygen molecules present act to quench this fluorescence. The "lumiphores" in the sensor are embedded in a gas-permeable sensing foil in a replaceable cap. The sensor optics includes a lens, blue LED with filter, red LED with filter and a photo detector. When the blue LED emits light, the sensing foil emits red photons; the presence of oxygen in the foil causes a reduction in red light detected by the photodiode. The phase difference between the blue excitation light and the returned red light is measured and the result is used to compute dissolved oxygen. This method measures the "phase" (or delay) of the returned signal and is thus based on the "lifetime" rather than the "intensity" of the luminescence. The RDO optical dissolved oxygen sensor does not consume oxygen does not consume oxygen and thus it does not require flow past the sensor for measurement of DO. The RDO sensor does not require conditioning before use or frequent calibration.

3.3 The Electrical Conductivity (EC) sensor is a flow cell with four electrodes. The four electrodes consist of two drive electrodes and two sensing electrodes. Conductivity/specific resistance is measured by applying an alternating current to the cell and measuring the reciprocal of resistance, in ohms, between the two opposing electrodes in a 1 cm cell at a specific temperature. The resulting measurement is multiplied by a cell constant in order to make comparisons between conductivity cells of different sizes. A specific cell constant is determined for each sensor depending upon the amount of electrode area and the distance between the electrodes.

Conductivity units are reported in "Siemens", which are equivalent to the inverse of ohms or "mhos".

3.4 The pH sensor uses a potentiometric method to measure the pH of the solution. The pH sensor consists of a pH-sensitive glass whose voltage is proportional to the hydrogen ion concentration. A second sensor (electrode) serves as a reference, which supplies a constant stable output. Electrical contact is made with the solution using a saturated potassium chloride (KCl) solution. The electrode behavior is described by the Nernst equation: $E_m=E_o + (2.3\ RT/nF) \log [H+]$ where E_m is the potential from the pH electrode, E_o is related to the potential of the reference electrode, R is the Gas Law constant, F is Faraday's constant, T is the Temperature in Kelvin, n is the ionic charge (+1 for Hydrogen) and [H+] is the hydrogen ion concentration in moles/L. The In-Situ MP TROLL 9500 reads the signal from the pH electrode, the reference electrode and the temperature and then calculates the pH using the Nernst equation.

3.5 Surface water Temperature is measured by a platinum resistance thermometer

3.6 The turbidity sensor is an electronic Nephelometer, which compares the intensity of light scattered by the ambient water with the intensity of the light scattered by a standard reference suspension. The higher the intensity of scattered light, as measured in Nephelometric Turbidity Units (NTUs), the higher the turbidity. The turbidity sensor consists of a matched solid-state photodiode detector/emitter pair positioned at right angles. The light source is an infrared LED, optimized for operation at 870 nanometers (nm) with a photodiode detector. The sensor uses a detection angle of 90 degrees and a light wavelength of 860 nm. The sensor uses active modulation for ambient light rejection.

4.0 Limitations

4.1 DO, EC, pH and Turbidity sensors can become fouled due to bacteria, algae and chemical deposits. In some water bodies (or due to seasonal variation in water quality) sensor fouling can occur rapidly, decreasing deployment periods. Some In-Situ MP TROLL 9500s are equipped with a mechanical wiper brush that cleans turbidity sensor tips. This capability can increase deployment periods in some water quality conditions.

4.2 In rivers that have high sediment loading, sensors can periodically become covered with sediment.

4.3 Electrolytic conductivity increases with temperature. Significant errors can result from inaccurate temperature measurements.

4.4 The glass pH electrode is relatively free from interference from color, turbidity, colloidal matter, oxidants, reductants, or highly salinity, except for sodium error at pH>10. pH measurements are affected by temperature and can cause long term drift. The pH electrode can only accurately measure up to 12 standard units.

4.5 Expired standards should not be used.

5.0 Safety

This procedure includes processes that can be hazardous. Therefore, before attempting this process, review the TCEQ Chemical Hygiene Plan for proper equipment and procedures necessary for the safe completion of this procedure. Operators must read and be familiar with the Material Safety Data Sheets for all reagents listed in section 6.0 of this document. Lab Coasts, safety glasses with side shields and/or splash goggles, and chemical resistant gloves should be worn when handling harmful chemicals. Some of these chemicals have the potential to be skin and eye irritants.

6.0 Equipment and Reagents

6.1 Equipment

6.1.1 In-Situ Multi Parameter TROLL 9500 with EC, RDO, pH, Temperature, and Turbidity Sensors.

6.1.2 RS232 Connection Cable

6.1.3 Personal Computer

6.1.4 Instrument Logbook

6.1.5 Calibration Forms

6.1.6 Calibration Cup

6.1.7 Ring Stand and Clamp

6.1.8 Thermistor or Thermometer traceable to National Institute of Standards and Technology (NIST) with a 0.1°C tolerance.

6.1.9 100 ml volumetric flask

6.1.10 100-1000 ml pipette

6.1.11 100-1000 ml pipette tips

Optional Equipment

6.1.12 Peristaltic Pump

6.1.13 TROLL 9500 Flow Cell

6.2 Standards and Reagents (All reagents/chemicals must be AR grade)

6.2.1 pH 7.00 +/- 0.01 S.U. @ 25°C Buffer (ACS traceable reagent grade Dibasic Sodium Phosphate Na_2HPO_4 – Monobasic Potassium Phosphate KH_2PO_4 Buffer)

6.2.2 pH 10.00 +/- 0.02 @ 25°C Buffer (ACS traceable reagent grade Potassium Carbonate K_2CO_3 – Potassium Borate K[B5O6(OH)4] – Potassium Hydroxide KOH Buffer)

6.2.3 1000 µS/cm @ 25 °C Conductivity/TDS Standard (ACS traceable reagent grade Sodium Chloride NaCl in reagent grade de-ionized water H_2O.

6.2.4 4000 FNU Formazin Turbidity Standard (Formazin Polymer, De-mineralized water, Hexamethylenetetramine $(CH_2)_6N_4$)

6.2.4.1 20.0 NTU Turbidity Standard (This standard is produced by adding 0.5 ml of 4000 FNU Formazin Turbidity Standard to 99.50 ml of Type 1 deionized water in a 100 ml volumetric flask).

6.2.4.2 200.0 NTU Turbidity Standard (This Standard is produced by adding 5.0 ml of 4000 FNU Formazin Turbidity Standard to 95.0 ml of Type I De-ionized water in a 100 ml volumetric flask.

6.2.5 De-ionized (DI) Type I water

7.0 Procedure

Before water quality is monitored, the sensors are calibrated and quality control (QC) samples are analyzed at a minimum of once a month (30 days). The station's water quality parameters are monitored by the site operator, remotely, or with weekly data downloads to a laptop computer, to evaluate operational status of the station.

7.1 Monitoring

The TROLL measures ambient surface water while in situ. The TROLL can be deployed in polyvinyl chloride (PVC) tubing that is attached to a support structure. Alternatively, the TROLL can be placed in an enclosure near the edge of the stream bank and water can be pumped up to a flow cell which covers the sensors.

7.1.1 The TROLL should be deployed in a representative section of the water body. When monitoring rivers and streams, the TROLL should be located as close as possible to the centroid of flow. Centroid is defined as the midpoint of that portion of stream or river width which contains 50 percent of the total flow.

7.1.1.1 Alternatively, if water is pumped through a flow cell containing the TROLL sensors then the inlet hose should be place near the centroid of flow in the stream.

7.1.2 Sensors should be positioned at approximately one foot (0.3 m) of water depth. Areas of excessive vegetation, turbulence, or silt should be avoided.

7.1.2.1 Alternatively, if an inlet hose is used to pump water up to the flow cell containing the instrument sensors, the inlet hose should be attached to the top of a weight, at a fixed position above the bottom of the stream.

7.1.3 Drill holes in the PVC to allow for an exchange of water into the tubing.

7.1.4 Adjust the TROLL periodically due to fluctuations in water levels of the water body.

7.2 Station Monitoring

The site operator should monitor water quality and other parameters weekly to ensure the station is operational.

7.2.1 Every week, the site operator will monitor (via TCEQ website http://www.texaswaterdata.org) and screen EC, DO, pH , Temperature and Turbidity measurements for anomalies. If problems are identified, a site visit may be needed to correct any problems.

7.2.2 If online data is not available the site operator shall visit the site once per week to download data and identify any problems.

7.3 DO, EC, pH, and Turbidity Sensor Calibration Verification Samples (CVS) and Temperature QC.

EC, DO, and pH CVSs are analyzed and the sensors are re-calibrated at a minimum of once every month. Turbidity CVSs are analyzed at a minimum of once every month, but the Turbidity sensor is only recalibrated if the CVS check standard shows more than a +/- 5.0 % recovery difference from the nominal. More frequent sensor re-calibrations may be needed in high fouling environments. The site operator will need to determine sensor re-calibration frequency for their water body. Temperature sensors are checked after every deployment period. Note: The TCEQ Surface water Quality Monitoring Program has used the phrase "Post-Calibration" to describe QC samples used to assess analytical drift from previous sensor calibrations. For the purposes of this document, CVS is used in place of "Post-Calibration".

7.3.1 EC, DO, pH and Turbidity CVS are analyzed at a minimum of once every month (or more frequently), before the TROLL EC, DO, pH and Turbidity sensors are re-calibrated.

7.3.1.1 A check of a CVS standard can be made by connecting to the TROLL with the Win-Situ software and a laptop PC and selecting the TROLL in the Navigation tree.

7.3.1.2 The TROLL is washed with tap water and de-ionized water and shaken to remove the water.

7.3.1.3 The TROLL sensor is placed into the applicable CVS standard.

7.3.1.4 Select one of the appropriate parameter in the Win-Situ display and Tap the "Read" button in the navigation window. Multiple parameters can be selected and read at the same time by holding down the control key on the keyboard while selecting parameters. The Temperature parameter should be read alongside all of the other CVS readings.

7.3.1.5 Record the CVS reading and temperature for each parameter in the calibration logbook

7.3.2 The Temperature sensor should be checked against an NIST traceable thermometer at the same time that CVS samples are analyzed. If the sensor does not meet the acceptance criteria listed in Table 9-1, the temperature data must be invalidated back to the last temperature check. For further details, see Section 9.0.

7.3.3 If barometric pressure for DO calibrations is determined by barometer, the accuracy of the barometer will need to be checked once a year.

7.4 EC, DO, pH and Turbidity Sensor Calibration

DO, EC, and pH calibrations are performed at least once a month, prior to TROLL deployment, and after the monthly EC, DO, pH and turbidity CVSs have been analyzed. A Turbidity sensor calibration is performed if the Turbidity CVS recovery is reported at +/- 5.0% of the known value of the standard. After the EC, DO, pH and Turbidity sensor calibrations, calibration parameters/constants are recorded in the instrument logbook.

- Note: Perform calibrations and analyze EC, DO, pH and Turbidity CVSs as close to 25.0°C as possible in a temperature controlled environment.
- Note: Perform the EC calibration before the calibration of the pH sensor.
- Barometric pressure measurements for DO calibrations can be obtained at the National Weather Service.
- Allow the TROLL and calibration standards time to equilibrate (a minimum of 2 minutes) before calibration(s) or initial readings.
- Secure the TROLL in a vertical orientation (by length).
- Before calibration, make sure plugs are installed in empty sensor ports.
- Ensure that all sensors are immersed in the applicable calibration standard before calibration.
- Use a small amount tap water and de-ionized water to pre-rinse the sensors between each sensor calibration.
- Have several clean absorbent paper towels. Shake the excess rinse water off the TROLL between sensor calibrations. This will reduce carry –over contamination of calibration solutions.
- Connect the TROLL to a laptop computer with a standard RS232 Serial Port.
- Open the Win-Situ 4.0 software on a laptop computer
- Manually connect to the TROLL by selecting the appropriate COM port in the Win-Situ software and mouse-clicking the "Find" button.

7.4.1 Single-Point EC Calibration

The calibration of the EC sensor consists of a single-point calibration with a 1000 µS/cm Conductivity Standard. If the expected conductivity of the water body to be measured is significantly higher or lower than 1000 µS/cm then use a conductivity standard with a concentration closer to the expected conductivity of the water body. During the calibration, the In-Situ TROLL will measure the temperature of the standard and automatically calculate the (non-normalized) conductivity of the standard.

7.4.1.1 Rinse the EC sensor with tap water followed by de-ionized water.
7.4.1.2 Shake the probe to remove the rinse water from the sensor.
7.4.1.3 Pour the calibration standard into a beaker and insert the MP TROLL 9500 Turbidity sensor into the solution.
7.4.1.4 Connect the MP TROLL 9500 to a PC and establish a connection with the Win-Situ 4 software.
7.4.1.5 Select the MP TROLL 9500 in the Navigation tree.

7.4.1.6 Select conductivity in the Parameters list. The sensor serial number and recent calibration information is shown.
7.4.1.7 Select Calibrate
7.4.1.8 Select the "Other" row under the Calibration setup screen and type 1000 into the space provided. The number typed is the conductivity of the calibration solution. A solution of greater or less than 1000 μS/cm if another value would be more appropriate for the conductivity of specific water body.
7.4.1.9 Select the "Next" button
7.4.1.10 Select the "Run" button.
7.4.1.11 Wait for the word "Stable" to appear on the calibration screen at which point the display screen will automatically advance.
7.4.1.12 A final screen will appear containing the conductivity cell constant for this calibration. Record this value in the calibration logbook and press the "Finish" button on the display.
7.4.1.13 Record the Temperature during calibration, the Sensor Reading in ohms and the Sensor Deviation in the calibration logbook.

7.4.2 Two-Point pH Calibration

The pH calibration requires two pH buffer solutions (pH 4.00 and 7.00 or pH 7.00 and 10.00). Choose the solutions that bracket the expected pH range of the water body.
7.4.2.1 Rinse the pH sensor with tap water followed by de-ionized water.
7.4.2.2 Shake the probe to remove the rinse water from the sensor.
7.4.2.3 Pour the first calibration standard into a beaker and insert the MP TROLL 9500 Turbidity sensor into the solution.
7.4.2.4 Connect the MP TROLL 9500 to a PC and establish a connection with the Win-Situ 4 software.
7.4.2.5 Select the MP TROLL 9500 in the Navigation tree.
7.4.2.6 Select pH in the Parameters list. The sensor serial number and recent calibration information is shown.
7.4.2.7 Select Calibrate to launch the pH Calibration Wizard
7.4.2.8 Change the number of calibration points to 2 in the drop down menu.
7.4.2.9 Select the values of the two calibration points that will be used in the drop down menus.
7.4.2.10 Select "Next" to continue.
7.4.2.11 Select "Run." The screen will automatically advance when the word "Stable" is displayed under the stabilization readings column.

7.4.2.12 Remove the pH sensor from the first calibration solution and wash it with tap water and de-ionized water.
7.4.2.13 Place the sensor into a beaker containing the second calibration solution. Select "Run" to begin the stabilization process.
7.4.2.14 The word "Stable" will appear and automatically advance the screen.
7.4.2.15 Record the pH slope and offset millivolts (mV) for the pH 7.00 and pH 10.00 solutions in the calibration logbook and press "Finish" to apply the calculated calibration.

7.4.3 DO Calibration

The DO sensor is calibrated in water that is 100 % saturated with air. An oxygen bubbler is placed into beaker of tap water and allowed to run for at least 5 minutes prior to the calibration procedure.

7.4.3.1 Rinse the RDO sensor with tap water followed by de-ionized water.
7.4.3.2 Shake the probe to remove the rinse water from the sensor.
7.4.3.3 If necessary, utilize a lens wipe to clean the sensor lens.
7.4.3.4 Submerge the RDO sensor in a beaker of tap water aerated with a bubbler. Ensure that the sensor is completely submerged and the sensor cap is not directly in the bubble stream. The bubbler is allowed to run for 5 to 10 minutes before continuing.
7.4.3.5 Connect the TROLL 9500 to a PC and establish a connection with the Win-Situ 4 software.
7.4.3.6 Select the TROLL 9500 in the Navigation tree on the display screen. The software will automatically detect and display the installed sensors.
7.4.3.7 Select Rugged Dissolved Oxygen in the Parameters list. Information on the RDO sensor is shown, including its serial number (SN).
7.4.3.8 Select Calibrate
7.4.3.9 A screen will ask if the barometric pressure settings should be edited at this time. Press the "Yes" button. On the next screen, check the box indicating a non-vented cable for deployment and enter a barometric pressure value from a barometer. Record this value in the calibration logbook.
7.4.3.10 Select the "Calibrate" option on the next screen. Press the "Run" button on the screen.
7.4.3.11 When the Temperature and Dissolved Oxygen readings have stabilized, the screen will show the word "Stable" in

the status row. Record these values in the calibration logbook and select the "Next" button two times to use the factory calibrated 0% saturation value.

7.4.3.12 The final calibration screen for a 1-point calibration at saturation will be displayed on the screen. Press the "Finish" button to apply the calibration.

7.4.4 Turbidity Sensor Calibration

The Turbidity Sensor is factory calibrated, but instrument drift can occur over extended periods of deployment. A turbidity sensor calibration will only be performed when the turbidity calibration verification standard (CVS) from the previous deployment falls outside of the accepted quality control criteria. The CVS should always read between +/- 5.0 % or 3 NTU of the stated value of the standard. The turbidity sensor is calibrated with a 3 point Formazin standard calibration (0 NTU, 20 NTU and 200 NTU).

7.4.4.1 Rinse the Turbidity sensor with tap water followed by de-ionized water.
7.4.4.2 Shake the probe to remove the rinse water from the sensor.
7.4.4.3 Pour the calibration standard into a beaker and insert the MP TROLL 9500 Turbidity sensor into the solution.
7.4.4.4 The windows of the turbidity sensor should be submersed at least .25" deep in the solution.
7.4.4.5 If no wiper blade is present on the sensor, gently agitate the instrument to dispel any air bubbles.
7.4.4.6 Connect the MP TROLL 9500 to a PC and establish a connection in Win-Situ 4. Select the MP TROLL 9500 in the navigation tree. This will display the installed sensors (including the Turbidity sensor)
7.4.4.7 Click to select Turbidity in the Parameters list. The sensor serial number (S/N) and recent calibration information is displayed.
7.4.4.8 Select Calibrate. The turbidity calibration wizard will start automatically.
7.4.4.9 Select the Standard Calibration Option.
7.4.4.10 Select the Next button to continue.
7.4.4.11 Change the number of calibration points to 4 from the drop down menu.
7.4.4.12 Select the values of the three turbidity calibration solutions in the drop down menus for each point (Cal 1 = 0 NTU, Cal 2 = 20 NTU, Cal 3 = 200 NTU).
7.4.4.13 The first calibration point will always be 0 NTU and will be calibrated with Type I De-ionized water.

7.4.4.14 Press the Next Button to continue.

7.4.4.15 The value of the first calibration standard will be shown on the screen. Immerse the Turbidity sensor in the first calibration standard and press the "Run" button to calibrate the first calibration point. The "Accept" button becomes available when nominal stability is achieved. Continue to wait for the instrument to display the word "Stable" and automatically advance the screen to the next calibration point.

7.4.4.16 Discard the previous solution, rinse the beaker and the front end of the instrument with tap water and de-ionized water, then refill the beaker with the second calibration standard.

7.4.4.17 Select the "Run" button to calibrate the next calibration point. Wait for the screen to show "Stable" and automatically advance to the next calibration point.

7.4.4.18 Repeat steps 7.4.4.16-7.4.4.17 for the final two calibration points.

7.4.4.19 The final screen will show the sensor slope and offset calculated during the calibration process. A slope and offset value will also be shown for each point in used in the calibration. Record these values in the Calibration Logbook.

7.4.4.20 Select the "Finish" button on the display to program the sensor with the calculated calibration coefficients.

8.0 Calculations

8.1 Sea Level Corrected barometric Pressure Uncorrected to Actual Barometric Pressure

This equation is used to uncorrected sea level corrected barometric to actual barometric pressure. Local barometric pressure obtained from the National Weather Service is corrected to sea level and is usually reported in inches of Hg (inches HG x 2.54 = mm Hg).

$$ABP = CBP - (2.5 \text{ mm Hg})(A/100)$$

Where:

ABP = Actual Barometric Pressure in mm Hg.
CBP = Barometric Pressure corrected to sea level in mm Hg.
A – Local altitude in feet above mean sea level.
2.5 mm Hg = constant.

8.2 Sample Conductivity

Electrical Conductivity is reported as SC using Equation 8.2.1

8.2.1 SC is actual conductivity corrected to 25°C:

SC = (AC)/(1 + 0.0191 x (t-25.0))

Where:

AC = non-standardized conductivity in µS/cm.
t = the solution temperature in degrees Celsius.

8.3.1 To determine un-normalized (raw) conductivity standard EC concentration from normalized Raw EC = normalized EC in µS/cm (1 + 0.0191 (temp measured – 25)).

8.3 QC calculations

8.3.1 Recovery (percent recovery) = $\frac{X1 \times 100}{X2}$

X1 = measured CVS concentration

X2 = theoretical (known) CVS concentration

9.0 QC Samples

Note: Analyze EC, DO, pH and Turbidity CVSs as close to 25.0°C as possible.

QC samples are used to ensure that acceptable data quality is maintained throughout the process and to help assess data validation. The QC samples analyzed for this method are performed on a monthly basis, or more frequently as determined by the site operator. Any deviation from the procedure documented in the SOP, including any QC samples which do not meet the frequency requirement or acceptance criteria, need to be documented in the operators log. The log entry should contain a description of the exception, the cause (if possible), the affected data, and the impact on data. Any affected data should be qualified accordingly. Note: A failing CVS can be followed by a single replicate analysis to determine if there is a systematic problem. If the reanalysis meets all acceptance criteria, the system may be deemed as providing acceptable data. Conducting multiple analyses to single passing QC samples when no corrective action as a result of an assignable cause or instrument maintenance is performed is not acceptable. In other words, if the original QC sample or its rerun passes, then the failing QC analysis is considered to be an anomaly, its results are not used for data assessment.

EC QC Samples

9.1.1 An EC CVS is analyzed at a minimum of once monthly (before calibration of the EC sensor) to assess analytical drift from the previous calibration. The CVS should be the same standard used to generate the initial single-point calibration.

9.1.2 The CVS Calibration solution is introduced using a beaker or Cal Cup. Rinse the sensor with Tap water followed by DI Water and shake off the water before introducing the CVS. The Percent Recovery of the CVS should be 5.0%. If the CVS does not meet acceptance criteria, the previous month's EC (back to the last EC calibration) data should be invalidated. Note: a failing CVS could be the result of an aged EC CVS standard. If CVS failed, re-analyze the CVS using a fresh EC standard. CVS results should be entered into the operator log and instrument logbook.

DO QC Samples

The Amount of DO in a sample is pressure and temperature dependent.

9.1.3 A DO CVS is analyzed a minimum of once monthly (before calibration of the DO sensor) to assess analytical drift from the previous calibration. The CVS consists of percent saturation in air-saturated water using procedures in Section 7.4.3.

9.1.4 This reading should be within +/- 6.0 % saturation of 100 %.

9.1.5 If the CVS does not meet acceptance criteria the previous month's DO (back to the last passing CVS or DO calibration) data should be invalidated. CVS results should be entered in the operator log. The results should also be logged in the Instrument Logbook and/or recorded in the Calibration Logbook.

pH QC Samples

9.1.6 A pH CVS is analyzed a minimum of once monthly (before calibration of the pH sensor) to assess analytical drift from the previous calibration. The CVS consists of pH buffer solution of 4.00 or 10.00 pH units and a 7.00 buffer solution. The pH buffer solutions are introduced using the Calibration cup or a glass beaker. Note: Rinse the sensor with DI water and shake off DI water before introducing the CVS. The CVS should be within 0.50 pH units. Note: a failing CVS could be the result of an aged pH CVS standard. If CVS has failed, re-analyze the CVS using a fresh EC standard. If the CVS does not meet acceptance criteria, the previous month's pH (back to the last pH calibration) data should be invalidated. CVS results should be entered into the operator log. The results should also be logged in the instrument logbook and/or recorded in the Calibration Logbook.

Temperature QC

9.1.7 At least once every quarter (3 months), check the accuracy of the TROLL temperature sensor with a NIST traceable thermometer or thermistor. Fill a container with tap water and immerse the TROLL sensors into the water. Place the thermometer or thermistor thermocouple next to the TROLL temperature sensor and allow both temperature measuring devices time to stabilize. The TROLL Temperature measurement should be within 0.5°C of the NIST traceable thermometer or thermistor. If the TROLL temperature accuracy is not within acceptance criteria with the NIST traceable thermometer or thermistor the temperature data collected prior to the last NIST check should be invalidated. If it is determined that the TROLL's temperature sensor does not meet acceptance criteria, the sensor needs to be sent back to the factory for repairs/calibration. The temperature check should be entered into the operator log. The results should also be logged in the instrument logbook and/or recorded in the Calibration Worksheet.

Turbidity QC Samples

9.1.8 A Turbidity CVS is analyzed at a minimum of once monthly (before calibration of the Turbidity sensor) to assess analytical drift from the previous calibration.

9.1.9 The CVS Formazin solution is introduced using a beaker or Cal Cup. Rinse the sensor with Tap water followed by DI Water and shake off the water before introducing the CVS. The Percent Recovery of the CVS should be +/- 5.0% or +/- 3 NTU of the theoretical value. If the CVS does not meet acceptance criteria, the previous month's Turbidity (back to the last Turbidity calibration) data should be invalidated. Note: a failing CVS could be the result of an aged Turbidity CVS standard. If CVS failed, re-analyze the CVS using a fresh Turbidity standard. Any bio-fouling on the optical port should be wiped off with a lens wipe and the CVS should be reanalyzed to determine if the calibration has drifted or if the CVS failed due to instrument fouling. CVS results should be entered into the operator log and instrument logbook.

Table 9-1

QC Check	Purpose	Frequency	Acceptance Criteria	Response Action
Single-Point EC Calibration	To establish slope used for quantitation	A minimum of once monthly or after failing CVS	Stable Concentration level is detected	1. Analyze standard again 2. Perform corrective action as necessary 3. Re-calibrate
Single-Point DO Calibration	To establish slope used for quantitation	A minimum of once monthly or after failing CVS	Stable Concentration level is detected	1.Analyze standard again 2. Perform corrective action as necessary 3. Re-calibrate
Two-Point pH Calibration	To establish slope used for quantitation	A minimum of once monthly or after failing CVS	Stable Concentration level is detected	1. Analyze standard again 2. Perform corrective action as necessary 3. Re-calibrate
Four-Point Turbidity Calibration (Formazin polymer standards)	To establish slope used for quantitation	Only after an unexplainable failing CVS	Stable Concentration level is detected	1. Analyze standard again 2. Perform corrective action as necessary 3. Re-calibrate
DO CVS (Percent Saturation in Air-Saturated Water)	To assess sensor drift	Before Sensor re-calibration. A minimum of once a month	+/- 6.0 % Saturation or +/- 0.5 mg/L	1. Re-Analyze CVS 2. If still failing perform corrective action and/or recalibrate 3. Invalidate data accordingly
1000 µS/cm EC CVS	To assess sensor drift	Before Sensor re-calibration. A minimum of once a month	+/- 5.0 % REC	1. Re-Analyze CVS 2. If still failing perform corrective action and/or recalibrate 3. Invalidate data accordingly
7.00 and 10.00 pH CVS	To assess sensor drift	Before Sensor re-calibration. A minimum of once a month	+/- 0.5 SU	1. Re-Analyze CVS 2. If still failing perform corrective action and/or recalibrate 3. Invalidate data accordingly
20 NTU Turbidity CVS	To assess sensor drift	Before Sensor re-calibration. A minimum of once a month	+/- 5.0 % Recovery or 3 NTU whichever is greater	1. Re-Analyze CVS 2. If still failing perform corrective action and/or recalibrate 3. Invalidate data accordingly
Temperature QC Check of Tap Water against NIST Traceable Thermometer	To assess sensor drift	A minimum of once every quarter	+/- 0.5 degrees Celsius	1. Re-Analyze temperature reading 2. If still failing, send to manufacturer for repairs 3. Invalidate data accordingly

10.0 Definitions

10.1 CVS = Calibration Verification Sample

10.2 µS/cm = microSiemens per centimeter (unit of electrical conductance)

10.3 DO = Dissolved Oxygen

10.4 NTU = Nephelometric Turbidity Units (unit of turbidity)

10.5 mg/l = milligrams per liter (unit of concentration)

10.6 SU = Standard Units (units of pH measurement)

10.7 See Appendix A of the most current revision of the TCEQ CWQMN QAPP for additional definitions.

11.0 References

In-Situ Inc. TROLL 9500 Operator's Manual
Surface Water Quality Monitoring procedures Manual, Volume I
Continuous Water Quality Monitoring Network Quality Assurance Project Plan
GBRA Chemical Hygiene Plan

12.0 Pollution Prevention and Waste Management

Supervisors, sampling personnel, and laboratory analysts should identify and implement innovative and cost saving water reduction procedures as part of the method development, review, and revision of standard operating procedures. Wastes that result from these procedures are managed and disposed of in accordance with appropriate state and federal regulations.

Refer to Chapter 6.13 of the TCEQ Operating Policies and Procedures for guidelines on general recycling, waste reduction and water and energy conservation. Review these procedures for specific employee responsibilities and mechanisms of office-related waste prevention and management. Consult the Monitoring Operations Hazardous Waste Disposal Plan for laboratory-specific waste minimization recommendation and requirements for proper handling of hazardous waste that result from laboratory procedures.
The Reagents, washes, standards, and waste associated with this procedure do not require special disposal. Before disposing waste into a municipal sewer system check with respective municipal sewer system on what concentration levels are allowed to be put into their system.

13.0 Shorthand Procedure

- Setup Procedures (Section 7.1 and 7.3).
- Calibrate EC, DO, and pH sensors once a month at a minimum.
- Deploy TROLL
- Monitoring and Sensor Verification (Section 7.2 and 7.4).
- Monitor TROLLS weekly via the internet if online data is available.
- Analyze EC, DO, pH and Turbidity CVSs once a month.
- Check TROLL temperature sensors every 3 months with an NIST traceable thermometer.

Appendix J.

Analysis of Pressure/Water Level (Stage Height), in Ambient Surface Water Using the In-Situ Inc. Level-TROLL 500

Analysis of Pressure/Water Level (Stage Height), in Ambient Surface Water Using the In-Situ Inc. Level-TROLL 500

Standard Operating Procedure (SOP) GBRA-002	
Analysis of Pressure/Level, Using the In-Situ Inc. Level-TROLL 500	
Team Leader:____________________	Date:________________
Quality Control Review:________________	Date:________________
Section Manager:____________________	Date:________________
Effective Date:____________________	

1.0 Purpose

This document describes the analytical procedures for continuous automated analysis of Pressure/Level and Temperature in ambient surface water using the In-Situ Inc. Level-TROLL 500

2.0 Scope and Applicability

2.1 This procedure is intended for use in the Continuous Water Quality Monitoring Network (CWQMN).

2.2 Due to the extended length of time that TROLLs are deployed the data can be used to establish baseline conditions, identify trends, and characterize pollution events and seasonal variations in water quality.

2.3 Pressure/Level and Temperature data meeting Surface Water Quality Monitoring Data (SWQM) Quality Objective Criteria (DQOs) may be used for the Federal Clean water Act Sections 305(b) Report and 303(d) lists.

Table 2-1

Parameter	**Working Range**	**Reported Accuracy**
Vented Pressure/Level Sensor	Pressure: 0-15 PSIG or 0-103.4 kPa Depth: 0-33 feet	+/- 0.1 % FS
Temperature Sensor	-5 to 50 Degrees Celsius (°C)	+/- 0.1 (°C)

3.0 Method Summary

3.1 The TROLL is deployed in the water body of interest, and Pressure/Depth and Temperature are measured in situ.

3.2 The Pressure/Depth is measured with a vented or "gauged" pressure sensor, where a vent tube in the cable applies atmospheric pressure to the back of the strain gauge. These vented measurements exclude the atmospheric or barometric pressure component and are reported in the basic unit of pounds per square inch "gauged"

(PSIG). The pressure measurements taken by this sensor can be output as Pressure in PSI or kPa, Depth in feet or meters, Water Level with a reference or "offset" (Offset can be either from Surface Elevation reference or Depth to Water reference).

3.3 Surface water Temperature is measured by a platinum resistance thermometer

4.0 Limitations

4.1 Although the sensor is calibrated at the factory a recalibration is recommended every 12-18 months or after a failed calibration verification check.

4.2 A Field calibration can be performed at zero PSI, however, a factory recalibration is recommended if the offset from zero is greater than +/- 0.015 PSI of ambient pressure or +/- 0.1% FS.

5.0 Safety

Operators must read and be familiar with the Material safety Data Sheets for all reagents listed in section 6.0 of this document. Lab Coasts, safety glasses with side shields and/or splash goggles, and chemical resistant gloves should be worn when handling harmful chemicals.

6.0 Equipment and Reagents

6.1 Equipment

6.1.1 In-Situ Level TROLL 500 Pressure/Level and Temperature Sensors.

6.1.2 RS232 Connection Cable

6.1.3 Personal Computer

6.1.4 Instrument Logbook

6.1.5 Calibration Forms

6.1.6 Calibration Cup

6.1.7 Ring Stand and Clamp

6.1.8 Thermistor or Thermometer traceable to National Institute of Standards and Technology (NIST) with a 0.1°C tolerance.

6.1.9 Graduated Measuring Stick or Survey Rod with markings at 1 inch intervals.

7.0 Procedure

Before water quality is monitored, the sensors are calibrated and quality control (QC) samples are analyzed at a minimum of once a quarter. The station's water quality parameters are monitored by the site operator, remotely, or with weekly data downloads to a laptop computer, to evaluate operational status of the station.

7.1 Monitoring

The TROLL measures ambient surface water while in situ. The TROLL can be deployed in polyvinyl chloride (PVC) tubing that is attached to a support structure.

7.1.1 The TROLL should be deployed in a representative section of the water body. When monitoring rivers and streams, the TROLL should be located as close as possible to the centroid of flow. Centroid is defined as the midpoint of that portion of stream or river width which contains 50 percent of the total flow.

7.1.2 Sensors should be positioned at a known water depth. If the TROLL is attached to a weight at the bottom of the water body the initial deployment depth must be measured. Areas of excessive vegetation, turbulence, or silt should be avoided.

7.1.3 Drill holes in the PVC to allow for an exchange of water into the tubing.

7.1.4 Examine the TROLL periodically to ensure that it has not been covered by excessive siltation.

7.2 Station Monitoring

The site operator should monitor water quality and other parameters weekly to ensure that the station is operational if internet data is available.

7.2.1 The site operator will monitor (via TCEQ website http:// http://www.texaswaterdata.org) and screen Pressure/Depth and Temperature measurements for anomalies. If problems are identified, a site visit may be needed to correct any problems.

7.2.2 If online data is not available the site operator shall visit the site once per week to download data and identify any problems.

7.3 Pressure/Level and Temperature Sensor QC.

Pressure/Level and Temperature Sensor QC is analyzed and the Pressure/Level sensor is re-calibrated when the QC data exceeds the criteria set in table 9-1.

7.3.1 Pressure/Level Sensors are checked at a minimum of once every quarter (or more frequently). The temperature sensor is checked at a minimum of once every quarter if temperature data is to be reported. The Level TROLL 500 Pressure/Depth sensors are re-calibrated when they exceed QC acceptance criteria.

7.3.1.1 The TROLL is cleaned of any debris that has accumulated on its surface by the operator.

7.3.1.2 A check of the Pressure/Level sensor drift can be made by connecting to the TROLL with the Win-Situ 5 software and a laptop PC and selecting the Level TROLL in the Navigation tree.

7.3.1.3 Press the yellow connect button in the lower right corner of the Win-Situ 5 software screen after the TROLL is connected to the laptop computers serial port.

7.3.1.4 The Connect button will change its appearance to a blue color to show that a connection has been established with the instrument.

7.3.1.5 Download the Level/Pressure and temperature Data as described in Section 7.5

7.3.1.6 The current water depth immediately adjacent to the sensor location will be measured with a graduated survey rod or stick to determine the current stage height. The stage height of the instrument should be equivalent to the manual measurement within a tolerance of +/- 6.0 inches.

7.3.1.6.1 If the current stage height reading is outside of this level the sensor will be calibrated as in section 7.4.

7.3.1.7 Record the current stage height reading in the calibration logbook

7.3.2 If TROLL 500 temperature data will be reported to SWQMIS, then the temperature sensor should be removed from the water and checked against an NIST traceable thermometer at the same time that the pressure/level sensor is analyzed. If the sensor does not meet the acceptance criteria listed in Table 9-1, the temperature data must be invalidated back to the last temperature check. For further details, see Section 9.0.

7.4 Pressure/Level Sensor Calibration

Pressure/Level calibrations are performed prior to initial TROLL deployment, and in response to failed quality control calibration verification check. Sensor calibrations are recorded in the instrument logbook.

7.4.1 The TROLL is removed from the water cleaned of any debris that has accumulated on its surface by the operator.

7.4.2 Connect to the TROLL with the Win-Situ 5 software and a laptop PC and select the Level TROLL in the Navigation tree.

7.4.3 Press the yellow connect button in the lower right corner of the Win-Situ 5 software screen after the TROLL is connected to the laptop computers serial port.

7.4.4 The Connect button will change its appearance to a blue color to show that a connection has been established with the instrument.

7.4.5 While connected to the Level TROLL select the "Sensors" tab.

7.4.6 Select the pressure sensor and click the calibrate button.

7.4.7 Ensure that the device has been removed from the water and press the "Calibrate" button. The current pressure reading will be set to zero. Record the pressure reading in the calibration logbook

7.5 Downloading Data

7.5.1 Connect to the Device as shown in Section 7.4.2

7.5.2 Select the "Logging" Tab

7.5.3 Select the appropriate log (data file) to be viewed

7.5.4 Click "Download" in the control panel

7.5.5 In the next screen, select the download option: "New Data" for data recorded since the last data download.

7.5.6 The log will be downloaded to the connected PC.

7.5.7 Ate the end of the download the option of viewing the data is presented.

7.5.7.1 Click the Yes prompt to display the data downloaded or the No prompt if it is not be viewed at the current time.

8.0 Calculations

8.1 Sea Level Corrected barometric Pressure Uncorrected to Actual Barometric Pressure

This equation is used to uncorrected sea level corrected barometric to actual barometric pressure. Local barometric pressure obtained from the National Weather Service is corrected to sea level and is usually reported in inches of Hg (inches HG x 2.54 = mm Hg).

ABP = CBP – (2.5 mm Hg)(A/100)
Where:

ABP = Actual Barometric Pressure in mm Hg.

CBP = Barometric Pressure corrected to sea level in mm Hg.
A – local altitude in feet above mean sea level.
2.5 mm Hg = constant.

9.0 QC Samples

QC samples are used to ensure that acceptable data quality is maintained throughout the process and to help assess data validation. The QC samples analyzed for this method are performed on a quarterly basis, or more frequently as determined by the site operator. Any deviation from the procedure documented in the SOP, including any QC samples which do not meet the frequency requirement or acceptance criteria, need to be documented in the operators log. The log entry should contain a description of the exception, the cause (if possible), the affected data, and the impact on data. Any affected data should be qualified accordingly.

Pressure/Level QC Samples

9.1.1 Once every quarter (3 months), check the accuracy of the TROLL Pressure/Level sensor in situ. The Level TROLL is cleaned of debris. The current stage height reading is recorded by the Win-Situ 5 software and downloaded onto a laptop computer. The current stage height is checked by measuring the depth of the stream immediately adjacent to the TROLL 500, with a graduated measuring rod or stick. The stream depth measurement of the instrument should agree with the physically measured value within +/- 6.0 inches. If the current depth measurement is outside of this range then the measurements should be re-checked and if acceptance criteria is still not met, then corrective action will be taken to correct the current reading by recalibrating or repairing the instrument as necessary. The depth check reading will be recorded in the instrument logbook and/or in the Calibration Logbook.

Temperature QC

9.1.2 If TROLL 500 temperature data will be reported to SWQMIS then at least once every quarter (3 months), check the accuracy of the TROLL temperature sensor with a NIST traceable thermometer or thermistor. Fill a container with tap water and immerse the TROLL sensors into the water. Place the thermometer or thermistor thermocouple next to the TROLL temperature sensor and allow both temperature measuring devices time to stabilize. The TROLL Temperature measurement should be within 0.5°C of the NIST traceable thermometer or thermistor. If the TROLL temperature accuracy is not within acceptance criteria with the NIST traceable thermometer or thermistor the previous temperature data obtained prior to the last quality control check should be invalidated. If it is determined that the TROLL's temperature sensor does not meet acceptance criteria, the sensor needs to be sent back to the factory for repairs/calibration. The temperature check should be entered into the operator log. The results should also be logged in the instrument logbook and/or recorded in the Calibration Worksheet.

Table 9-1

QC Check	Purpose	Frequency	Acceptance Criteria	Response Action
Single-Point Ambient Air Pressure/Level Calibration	To establish slope used for quantitation	After failing CVS	0 PSI +/- 0.015 PSI	1. Re-calibrate pressure sensor in ambient air.
Pressure/Level QC Check	To assess sensor drift	Before Sensor re-calibration. A minimum of once a quarter	Manually Measured Depth +/- 6.0 inches	1. Re-Analyze depth measurement 2. If still failing perform corrective action and/or recalibrate
Temperature QC Check*	To assess sensor drift	A minimum of once every quarter	+/- 0.5 degrees Celsius	1. Re-Analyze temperature reading 2. If still failing, send to manufacturer for repairs 3. Invalidate data accordingly

*Temperature QC Check does not need to be performed if this data will not be reported.

10.0 Definitions

10.1 CVS = Calibration Verification Sample

10.2 PSI = Pounds per square inch (unit of pressure)

10.3 PSIG = Pounds per square inch "gauged" (unit of pressure measured with a vented pressure gauge).

10.4 kPa = Kilopascal (unit of pressure describing force per unit area)

10.5 See Appendix A of the most current revision of the TCEQ CWQMN QAPP for additional definitions.

11.0 References

In-Situ Inc. Level TROLL 500 Operator's Manual
Surface Water Quality Monitoring procedures Manual, Volume I
Continuous Water Quality Monitoring Network Quality Assurance Project Plan
GBRA Chemical Hygiene Plan

12.0 Pollution Prevention and Waste Management

Supervisors, sampling personnel, and laboratory analysts should identify and implement innovative and cost saving water reduction procedures as part of the method development, review, and revision of standard operating procedures. Wastes that result from these procedures are managed and disposed of in accordance with appropriate state and federal regulations.

Refer to Chapter 6.13 of the TCEQ Operating Policies and Procedures for guidelines on general recycling, waste reduction and water and energy conservation. Review these procedures for specific employee responsibilities and mechanisms of office-related waste prevention and management. Consult the Monitoring Operations Hazardous Waste Disposal Plan for laboratory-specific waste minimization recommendation and requirements for proper handling of hazardous waste that result from laboratory procedures.
The Reagents, washes, standards, and waste associated with this procedure do not require special disposal. Before disposing waste into a municipal sewer system check with respective municipal sewer system on what concentration levels are allowed to be put into their system.

13.0 Shorthand Procedure

- Setup Procedures (Section 7.1 and 7.3).
- Calibrate Pressure sensor once after a failed QC check.
- Deploy Level TROLL 500
- Monitoring and Sensor Verification (Section 7.2 and 7.4).
- Monitor TROLLS every week via the internet if online data is available.
- Analyze Pressure/depth once every 3 months.
- Check TROLL temperature sensors every 3 months.

Appendix K.

Standard Operating Procedure for the Validation of Continuous Water Quality Monitoring Data Collected by Multi-parameter Sonde

STANDARD OPERATING PROCEDURE (SOP)	
Title: Validation of Continuous Water Quality Monitoring Data Collected by Multi-parameter Sonde	
Team Leader: ______________________	Date: ______________
Quality Control Review: ______________________	Date: ______________
Effective Date: 01/19/2010	

1.0 PURPOSE

This SOP describes the procedure for validation of ambient water quality data acquired from continuous water quality monitoring stations located within selected river basins of the State of Texas utilizing existing infrastructure and Leading Environmental Analysis and Display System (MeteoStar/LEADS) data processing software.

2.0 SCOPE AND APPLICABILITY

Continuous water quality monitoring data for validation may include, but are not limited to: temperature, pH, dissolved oxygen (DO), specific conductance, turbidity, nitrate, ortho-phosphorus, and ammonia. LEADS calculated parameters such as Total Dissolved Solids (TDS) and salinity are not subject to validation. The LEADS computer system performs automated validation, and manual validation procedures are performed by the DM&A Data Validator.

3.0 METHOD OR PROCEDURAL SUMMARY

Validation of Continuous Water Quality Monitoring (CWQMN) Data is initiated by submittal of the Data Validation Initiation form completed by the CWQMN Network Coordinator. The DM&A team lead maintain the original form and assign a validator to the site, while the assigned Data Validator receives a copy of the Data Validation Initiation form for their records.

Data is examined for record completeness and reporting accuracy. Operator logs are reviewed for calibration and post-calibration records, post deployment temperature check results, and unusual events. Data losses are investigated and data values exceeding or falling below established critical limits (Appendix A) are reviewed and qualified as invalid or valid.

4.0 LIMITATIONS

4.1 Data validation is dependent upon the quality of field observations and reported calibration information in the Operator Log.

4.2 If data is reloaded or reprocessed after validation, previously qualified and/or recovered data defaults to the original status. Data must be validated again by referring to the Validator's Log and operator logs.

4.3 LEADS is a developing system. The software tools used to validate data may contain defects that may or may not be identified. This may necessitate checking one tool against another.

5.0 SAFETY

Usual office and computer safety practices apply. For additional information about the TCEQ safety program, see: http://home.tceq.state.tx.us/internal/admin/support/riskmgt/healthsafety/

6.0 EQUIPMENT

Computer Hardware:

- 486 PC, 8MB RAM, 80 MB hard-drive or 68040 Macintosh, 8MB RAM 80 MB hard-drive
- Data logger, data communication hardware
- SCO UNIX computer system, 16 MB RAM, 500 MB hard-drive
- Modems (118)
- Central office HP Computer K460
- Ethernet Connection

Data logger, data communication hardware:

- SCO UNIX computer system, 16 MB RAM, 500 MB hard-drive
- Modems (118)
- Central office HP Computer K460
- Ethernet Connection

Computer Software (Validation Tools):

- HP UNIX
- SCO UNIX
- HP View Light, View, CDE
  (Common Desktop Environment)
- Exceed for PC
- LEADS pollution user interface
- LEADS user interface
- Microsoft Excel
- Microsoft Word
- Internet Explorer
- Lab view/Zeno data logger application
- Power Point

7.0 PROCEDURES

After the DM&A Data Validator receives a copy of the Data Validation Initiation form, the Data Validator can start the data validation activities.

7.1 Daily procedure

7.1.1 Verify the operation of the *in-situ* multi-parameter data sonde, the ZENO data logger, and completed data transmission in the morning and at close of business, at a minimum.

- Using an internet browser, access the Texas Commission on Environmental Quality (TCEQ) internal server at **http://rhone.tceq.state.tx.us/**. Within the **Water Data** section, view the *Daily Report*. Select the monitoring site, date, number of days to report, parameters of interest, and generate a report. Confirm the data retrieval for all parameters.
- If data is missing, access the *Comms Report* within the Status Pages section to confirm communication between the remote sites and the central computer site.
- Access the *Operator Logs* to check for unscheduled maintenance or unusual events.
- Contact the site operators and the project lead for possible site investigation/repairs, if necessary.
- Contact the LEADS administrator for possible data recovery and/or to resolve communications problems.

7.2 Weekly Procedure

7.2.1 Using an internet browser, access the TCEQ internal server at http://rhone.tceq.state.tx.us/. Within the Status Pages Section, review the *Operator Logs* for each site to be validated. Confirm timely reporting of preventative maintenance information and calibration/post-calibration data.

7.2.2 Access the LEADS Interface via an x-terminal emulation package (Exceed). Contact the LEADS Administrator for access rights, validation rights, and passwords.

7.2.3 Access the Manual Validation Retrieve window via Manual Validation Login.

7.2.3.1 Validation of Discrete Data and Five Minute (Profiler) Data.

- Select the beginning year, month, day, and time of the data validation interval.
- Select the end year, month, day, and time of the data validation interval. Please note that manual validation will only allow you to select up to a maximum of 31 days of data.
- Select the appropriate time zone.

- Select the "Discrete Data" Database. For profiler data, select "Five Minute" Database.
- Select the Region.
- Select sort by "CAMS."
- Select "Show Sites."
- Highlight the CAMS site for validation from the site list.
- Select "Show Available Parameters."
- Highlight the validation parameters. Hold down the CTRL key to select up to four validation parameters at one time.
- Select "Display Data."
- Compare the automatically generated LEADS data qualifiers (LST, LIM, VAL) with the Operator Logs. Edit any data qualified incorrectly by selecting the data interval in the Manual Validation window and selecting the appropriate data qualifier from the EDIT drop-down menu. Document any changes in the Validator's Log. See Appendix A for data flags.
- If the Operator Log indicates that a parameter failed post calibration, qualify the data associated with that parameter for the corresponding time period as invalid with an Ambient Quality Invalid (AQI) flag. If Preventive Maintenance Action (PMA) qualifiers have been generated, the data for the subsequent hour is qualified as AQI.
- If the Operator Log does not indicate temperature checks for the validator to review, the validator will contact (via Email) the operator carbon copying their Project Lead, and tell them that there is not enough information for validation of the data. The data will not be validated if there are no temperature checks. If the temperature check failed, the corresponding DO, DO%, specific conductance, and temperature data back to the last passing temperature check will be invalidated with AQI flag.
- Investigate irregular data patterns by referring to the Operator Log, contacting the site operator for further information, using Best Professional Judgment (BPJ), and/or notifying the GBRA CWQMN project lead.
- Evaluate all data qualified as LIM. These data values have exceeded or fallen below established critical limits. Use BPJ and remove the LIM qualifier, marking the data as valid or qualifying as AQI.
- After all data qualification is complete, choose "Validate Data" from the FILE drop-down menu. Note any changes made to the data during manual validation in the Manual Validation Notes window. Include detailed explanation for any changes. Initial all entries. Ensure all changes are documented in the hard copy and the electronic copy of Validator's Log.
- Select the "Validate" button on the Manual Validation Notes Page to complete the validation procedure.

7.2.3.2 Validation of Hourly Average Data for Discrete Data.

- The data validator ensures that the "Discrete Data" have been validated.
- Select the beginning year, month, day, and time of the data validation interval.
- Select the end year, month, day, and time of the data validation interval. Please note that manual validation will only allow you to select up to a maximum of 31 days of data.
- Select the appropriate time zone.
- Select the "Hourly Average" Database.
- Select the Region.
- Select sort by "CAMS."
- Select "Show Sites."
- Highlight the CAMS site for validation from the site list.
- Select "Show Available Parameters."
- Highlight the validation parameters. Hold down the CTRL key to select up to four validation parameters at one time.
- Select "Display Data."
- Review the data flags assigned to the hourly average data and verify the flags with the associated discrete data. See Appendix A for data flags.
- Choose "Validate Data" from the FILE drop-down menu. Enter the validator's comments in the Manual Validation Notes window. Initial all entries. Ensure all comments are documented in the hard copy and the electronic copy of Validator's Log.
- Select the "Validate" button on the Manual Validation Notes Page to complete the validation procedure.
- Please note that if you validate the hourly average data, then you go and change the associated discrete data validation, the hourly average data will be un-validated. The hourly average data must be validated again.

8.0 CALCULATIONS

Not applicable.

9.0 QUALITY CONTROL

9.1 Each experienced data validator is responsible for review, validation, and verification of data from assigned ambient stations.

9.2 Maintain detailed records in the form of both a hardcopy and an electronic copy of the Validator's Log that includes all activities and follow-up actions relating to the data record. The records should be sufficient to reconstruct the data validation event.

9.3 The data validator reviews and questions any part of the measurement process and initiates data reviews and corrective actions to bring the process back into compliance.

10.0 DEFINITIONS

AQI - Ambient Quality Invalid
BPJ – Best Professional Judgment
CAMS – Continuous Ambient Monitoring Station
DM&A - Data Management & Analysis
DO – Dissolved Oxygen
LEADS - Leading Environmental Analysis and Display System
PMA - Preventive Maintenance Action
SOP - Standard Operating Procedure
SWQMIS - Surface Water Quality Monitoring Information System
TCEQ - Texas Commission on Environmental Quality
TDS - Total Dissolved Solids

11.0 REFERENCES

- LEADS Operator's Manual
- LEADS Web pages
- *TCEQ Operating Policies and Procedures*, Chapter 6.13
- Training Material: Manual Validation

12.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

Supervisors, sampling personnel, and laboratory analysts should identify and implement innovative and cost-saving waste reduction procedures as part of the method development, and review and revision of standard operating procedures. Wastes that do result from these procedures are managed and disposed in accordance with appropriate state and federal regulations.

Refer to Chapter 6.13 of the *TCEQ Operating Policies and Procedures* for guidelines on general recycling, waste reduction, and water and energy conservation. Review these procedures for specific employee responsibilities and mechanisms for office related waste prevention and management.

13.0 SHORTHAND PROCEDURE

13.1 Daily

- Confirm the collection and transmission of data.
- Contact the LEADS administrator for recovery of lost data, if necessary.
- Contact area operators and the project lead for site investigations, if necessary.

13.2 Weekly

13.2.1 Validation of Discrete Data and Five Minute (Profiler) Data.

- Investigate any irregular data patterns.
- Confirm all data qualifiers generated by LEADS.
- Edit any incorrect data qualifiers
- Evaluate all data with LIM qualifiers.
- Document any data changes in the Validator's Log.
- Validate data.