April 2016
Rev. 10

Quality Assurance Project Plan for Continuous Water Quality Monitoring Network Program

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Water Quality Planning Division
TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Quality Assurance Project Plan for Continuous Water Quality Monitoring Network Program

Prepared by
Monitoring and Assessment Section
Water Quality Planning Division
(512) 239-1678

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A1.1 Preface

Continuous Water Quality Monitoring Network

Quality Assurance Project Plan

EPA Grant No. I9-8665307

Contact:

Charles Dvorsky, (512) 239-5550
Continuous Water Quality Monitoring Network Coordinator
Surface Water Quality Monitoring Team
Monitoring & Assessment Section
Water Quality Planning Division
Texas Commission on Environmental Quality

Mailing Address:

Texas Commission on Environmental Quality
P.O. Box 13087 (MC 234)
Austin, Texas 78711-3087

A1.2 Approval Page

CWQM Network Coordinator
Surface Water Quality Monitoring Team
Monitoring & Assessment Section
Water Quality Planning Division
Texas Commission on Environmental Quality

2/23/16
Charles Dvorsky Date

CWQMN Program Manager
Surface Water Quality Monitoring Team Leader
Monitoring & Assessment Section
Water Quality Planning Division
Texas Commission on Environmental Quality

2/23/16
John Andrew Sullivan Date

Monitoring & Assessment Section Manager
Water Quality Planning Division
Texas Commission on Environmental Quality

2/23/2016
Patricia Wise Date

Data Management & Analysis Team Leader
Monitoring & Assessment
Water Quality Planning Division
Texas Commission on Environmental Quality

2/24/2016
Cathy Anderson Date

Data Management Section Manager
Monitoring Division
Texas Commission on Environmental Quality

2/23/16
Cindy Maresh Date

Ambient Monitoring Section Manager
Monitoring Division
Texas Commission on Environmental Quality

for PDLC 2/23/16
Patricia De La Cruz Date

Network Implementation Team Leader
Monitoring Division
Texas Commission on Environmental Quality

2/23/16
Holly Landuyt Date

Data Collection Team, Team Leader
Monitoring Division
Texas Commission on Environmental Quality

2/23/16
James Janysek Date

A1.2 Approval Page (continued)

CWQMN Quality Control Officer
Surface Water Quality Monitoring Team
Water Quality Planning Division
Texas Commission on Environmental Quality

Edward Ragsdale — Date: 2/23/16

CWQMN Quality Assurance Officer
Monitoring Division
Texas Commission on Environmental Quality

Daniel R. Burke — Date: 2/24/2016

TCEQ Quality Assurance Manager
Monitoring Division
Texas Commission on Environmental Quality

Sharon Coleman — Date: 2/24/2016

A1.2 Approval Page (continued)

TCEQ Program Support Section

Section Manager
Program Support Section
TCEQ Office of Compliance and Enforcement

Beryl Thatcher 04/15/16
Beryl Thatcher Date

A1.2 Approval Page (continued)

TCEQ Office of Compliance and Enforcement

Area Director
TCEQ Central Texas Area

Susan M. Jablonski, P.E. Date 04/15/16

A1.2 Approval Page (continued)

TCEQ Office of Compliance and Enforcement, cont.

Area Director
TCEQ Coastal and East Texas Area

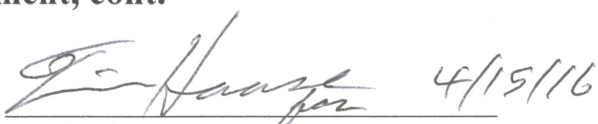
K Keel Linden 4.15.16

Kelly Keel Linden Date

A1.2 Approval Page (continued)

TCEQ Office of Compliance and Enforcement, cont.

Area Director
TCEQ North Central and West Texas Area



Randy J. Ammons Date

A1.2 Approval Page (continued)

TCEQ Office of Compliance and Enforcement, cont.

Area Director
TCEQ Border and Permian Area

Cynthia McKeen 4-15-16

David A. Ramirez Date

A1.2

Approval Page (continued)

Contractor
Director, Texas Water Science Center
USGS Texas Water Science Center
1505 Ferguson Lane
Austin, Texas 78754

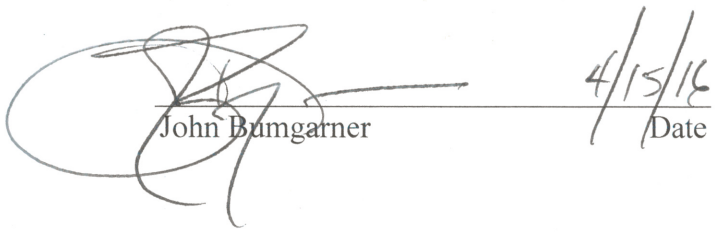
Robert L. Joseph

April 15, 2016
Date

A1.2 Approval Page (continued)

Contractor

Director, New Mexico Water Science Center
USGS New Mexico Water Science Center
5338 Montgomery Blvd., NE
Suite 400
Albuquerque, NM 87109-1311



John Bumgarner — Date 4/15/16

A1.2 Approval Page (continued)

Cooperator

Water Quality Supervisor/Aquatic Biologist
Colorado River Municipal Water District
P.O. Box 869
Big Spring, Texas 79721-0869

John D. Burch 2/12/2016

John D. Burch Date

A1.2 Approval Page (continued)

Cooperator

Lower Neches Valley Authority
Neches River Saltwater Barrier & Laboratory
6790 Bigner Road
Beaumont, Texas 77708

David Hancock — Date ~~2/15/16~~ 4/15/16

A1.2 Approval Page (continued)

Cooperator

Upper Colorado River Authority
512 Orient
San Angelo, TX 76903

Chuck Brown — 4/15/2016
Chuck Brown — Date

A1.2 Approval Page (continued)

U.S. Environmental Protection Agency (EPA)

Teresita Mendiola 4/21/16
Teresita Mendiola Date
U.S. EPA 106 Project Officer
State and Tribal Programs Section
Assistance Programs Branch

Kim 2. Alexander 4/21/16
for Curry Jones, M.P.H Date
Chief
State and Tribal Programs
Section

The TCEQ will secure written documentation from each sub-tier project 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 TCEQ 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 E of this document).

A2 Table of Contents

The current revision of the Continuous Water Quality Monitoring Network (CWQMN) Quality Assurance Project plan (QAPP) is available at: (www.texaswaterdata.org)

A2 Table of Contents (continued)

A2 Table of Contents (continued)

A2.1 List of Figures

A2.2 List of Tables

A2.2 List of Tables (continued)

A2.3 List of Appendices

Appendix	Title	Pages	Revision	Date
A	Definitions	3	4	12/14
B	Acronyms	3	6	12/14
C	CWQMN Project Plan Shell	11	9	12/14
D	References	1	5	12/14
E	Operator Log Content	3	4	12/14
F	Adaptation of Data Validation and Fouling Correction Procedures for Water-Quality Monitoring Stations on The Upper Rio Grande	6	1	12/13
G	Example Letter to Document Adherence to the QAPP	1	0	1/09

A2.4 TCEQ CWQMN Standard Operating Procedures

CWQMN Standard Operating Procedures are available via the internet at:
http://www.tceq.texas.gov/waterquality/monitoring/cwqm_sops.html

Table A2.4

Active TCEQ CWQMN Standard Operating Procedures:

SOP Number	Title	Pages	Revision	Effective Date
AMPM-011	Analysis of *In Situ* Dissolved Oxygen, Electrical Conductivity, pH, Water Temperature, and Sample Depth in Ambient Surface Water Using Yellow Springs Instrument 6-Series Multi-probes	29	3	9/12/14
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	23	1	12/15/2015
NA	*In Situ* Analysis of Electrical Conductivity and Water Temperature in Ambient Surface Water for the Lower and Middle Rio Grande Using Hydrolab-Hydrotech Compact Minisondes	13	0	3/15/2015
NA	Analysis of In Situ Specific Conductance, Water Temperature, and Sample Depth for the Bosque River Environmental Monitoring Response System Using Aqua TROLL 200 Multiprobes	13	1	7/15/15
NA	Analysis of In-Situ Turbidity at Pine Island Bayou for Environmental Monitoring Response System using YSI 6-Series Multiprobes	14	0	4/22/2015
NA	Validation of Continuous (non-EMRS) Water Quality Monitoring Data Collected by Multiparameter Sonde	9	2	10/07/13

CAMS = Continuous Ambient Monitoring Station

A2.5 CWQMN Project Plans

Throughout the year, new CWQMN Project Plans may be approved. Existing projects/sites can also be deactivated. Project plans are available upon request. Tables A5.1 - 4 in Section A5 lists active network sites, these Tables are updated annually. Table A2.5 (below) lists active and inactive projects/sites. Inactive projects are listed for historical project informational purposes.

Table A2.5

CWQMN Project Plans

CAMS	Title	Pages	Date
TCEQ Project Plans			
726	Scarborough Creek Environmental Monitoring and Response System Project Plan*	22	4/3/07
742*	TCEQ/City of Waco Lake Waco Headwater Project Plan*	21	5/17/07
743*, 744*	North Concho River Project Plan*	37	8/13/07
748*	Lake Granbury Project Plan*	19	9/20/07
746*, 747*	Wichita River Project Plan*	17	12/4/07
768	Devils River Project Plan	18	3/5/08
764	Independence Creek Project Plan*	24	3/13/08
749	Pine Island Bayou Project Plan	17	3/17/08
728, 765	Little Duffau Creek and Un-named Tributary of Little Duffau EMRS Project Plan*	21	4/28/08
767, 781*, 782*	Lower Rio Grande Valley Project Plan*	15	3/25/09
787*	Big Cypress Bayou Project Plan*	18	4/5/10
793, 789, 792,736, 791	Lower Rio Grande Valley EMRS Project Plan*	19	6/14/10
736, 767, 789, 791, 792, 793, 796, 800, 801	Lower and Middle Rio Grande EMRS Project Plan*	18	7/8/13
773	North Concho River Project Plan (Revision 0)*	21	3/20/14
728, 765, 726, 804, 805, 806	North Bosque River Specific Conductance Environmental Monitoring Response System Project Plan	26	12/9/14
773	North Concho River Project Plan (Revision 1)	24	12/7/15

List of project Plans (continued)

CAMS	Title	Pages	Date
United States Geological Survey (USGS)/TCEQ Project Plans			
757, 758, 759	USGS Rio Grande River Project Plan (Water Quality)*	106	7/31/07
729, 735, 709, 710	USGS Pecos River Project Plan (Stream Discharge)*	72	7/31/07
762*	USGS North Bosque River at Valley Mills, TX Project Plan (Stream Discharge)*	78	7/31/07
761*	USGS Clear Creek at Mykawa Street near Pearland, TX Project Plan (Water Quality)*	42	7/31/07
746*	USGS Wichita River Project Plan (Stream Discharge)*	71	12/19/07
757, 758, 759, 720, 721	Rio Grande River Project Plan		1/10/08
771*, 772*	West Fork San Jacinto River Project Plan*	19	6/30/08
709, 710, 729, 735, 764, 785, 788, 798, 799	Pecos River Watershed Project Plan	26	3/16/12
730	Arroyo Colorado Project Plan	25	2/12/2016

* Stations and or Project Plans that are no longer active

A2.6 USGS Guidelines and Procedures

The USGS has been contracted by TCEQ to collect, validate, and report water quality and discharge monitoring data from sites in the Upper Rio Grande, Pecos Rivers, and Arroyo Colorado basins (See Table A5.1) following USGS guidelines and procedures. The USGS documents (and location of documents) are listed below.

USGS – *Standard Operating Procedures for the Collection of Water-Quality data Using a Vertical Profiling Water-Quality Monitor on the Arroyo Colorado South Texas*

www.texaswaterdata.org

USGS – *Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting TM1D3.* http://pubs.usgs.gov/tm/2006/tm1D3/

USGS/TCEQ – *Adaptation of Data Validation and Fouling Correction Procedures for Water-Quality Monitoring Stations on the Upper Rio Grande and Pecos River (May 2013), Revision 1, CWQMN QAPP, Revision 10, Appendix F.*

Discharge Measurements at Gaging Stations: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter A8. http://pubs.usgs.gov/twri/twri3a8/.

User's Manual for the National Water Information System of The U.S. Geological Survey Automated Data Processing System (ADAPS). http://pubs.usgs.gov/of/2003/ofr03123/

National Field Manual. Techniques of Water-Resources Investigations Book 9. http://water.usgs.gov/owq/FieldManual/

USGS Texas Water Science Center QAPPs are available upon request.

Quality-Assurance Plan for Water Quality Activities in the Texas Water Science Center.

Texas Water Science Center Surface-Water Quality-Assurance Plan.

A3 Distribution List

U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Teresita Mendiola, Project Officer

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

Katherine Nelson, Assistant Division Director, Water Quality Planning Division
Patricia Wise, Manager, Monitoring & Assessment Section, Water Quality Planning Division
Richard C. Chism, Division Director, Monitoring Division
Beryl Thatcher, Section Manager, Office of Compliance and Enforcement, Program Support Section
Andrew Sullivan, Team Leader, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Charles Dvorsky, Network Coordinator, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Sharon Coleman, Manager & CWQMN Quality Assurance Officer, Laboratory & Quality Assurance Section, Monitoring Division
Daniel R. Burke, CWQMN Quality Assurance Officer, Laboratory & Quality Assurance Section, Monitoring Division
Patricia De La Cruz, Manager, Ambient Monitoring Section, Monitoring Division
Cindy Maresh, Manager, Data Management Section, Monitoring Division
Holly Landuyt, Team Leader, Implementation Team, Ambient Monitoring Section, Monitoring Division
James Janysek, Team Leader, Data Collection Team, Data Management Section, Monitoring Division
Laurel Martin, Clean Water Act Section 106 Categorical and 604 Grant Project Manager, Division Support Section, Water Quality Planning Division
Cathy Anderson, Team Leader, Data Management & Analysis Team, Monitoring & Assessment Section, Water Quality Planning Division
(Vacant), Clean Rivers Program, Monitoring & Assessment Section, Water Quality Planning Division
Tom Heitman, Program Support Section, Office of Compliance and Enforcement
Michael Beatty, Program Support Section, Office of Compliance and Enforcement
Keith Talley, Implementation Team, Ambient Monitoring Section, Monitoring Division
Gary Sodergren, Implementation Team, Ambient Monitoring Section, Monitoring Division

A3 Distribution List (continued)

Laura Roberts, Data Collection Team, Data Management Section, Monitoring Division
Lloyd Lawrence, Data Collection Team, Data Management Section, Monitoring Division
Robert Hernandez, Data Collection Team, Data Management Section, Monitoring Division
Paul Boydston, Data Collection Team, Data Management Section, Monitoring Division
Robin Cypher, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Pat Bohannon, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Laura Ryckman, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Lauren Pulliam, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Daniele Baker, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Sarah Whitley, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Bill Harrison, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Michele Blair, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Edward Ragsdale, CWQMN Quality Control Officer, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Peter Bohls, Data Management & Analysis Team, Monitoring & Assessment Section, Water Quality Planning Division
Ivan Cruickshank, Data Management & Analysis Team, Monitoring & Assessment Section, Water Quality Planning Division
Amir Poursamadi, Data Management & Analysis Team, Monitoring & Assessment Section, Water Quality Planning Division
Debbie Peters, Division Support Section, Water Quality Planning Division

A3 Distribution List (continued)

TCEQ Office of Compliance and Enforcement Program Support Section

Texas Commission on Environmental Quality - Regional Offices

Dallas/Fort Worth - Region 4, (817) 588-5800
Mr. Jeff Tate, Water Section Manager
2309 Gravel Dr.
Fort Worth, TX 76118-6951

Stephenville Special Project Office - Region 4, (254) 965-9200
Mr. Michael Martin, Team Leader
Ms. Christine Pearson
580-D. W. Lingleville Road (Rd.)
Stephenville, TX 76401

Harlingen - Region 15, (956) 425-6010
Mr. Carolyn Wood, Water Section Manager
Mr. Chris Caudle
1804 West Jefferson Avenue
Harlingen, TX 78550-5247

Laredo - Region 16, (956) 791-6611
Mr. Arnaldo Lanese, Water Section Manager
Ms. Elsa Hull
707 East Calton Rd., Suite 304
Laredo, TX 78041-3887

A3 Distribution List (continued)

Cooperators

Colorado River Municipal Water District
Mr. John D. Burch, (432) 267-6341
Colorado River Municipal Water District
P.O. Box 869
Big Spring, TX 79721-0869

Lower Neches Valley Authority
Mr. David Hancock (409) 898-0561 ext. 2
LNVA-SWB Laboratory
6790 Bigner Road
Beaumont, TX 77708

Upper Colorado River Authority
Mr. Chuck Brown, (325) 6174350
512 Orient
San Angelo, TX76903

A3 Distribution List (continued)

Contractors

USGS TX Water Science Center –Austin
1505 Ferguson Lane
Austin, TX 78754

Mr. Robert L. Joseph, (512) 927-3502
Mr. Michael Canova (512) 927-3536
Mr. Milton Sunvision (512) 927-3533

USGS South Central Area
944 Arroyo Drive
San Angelo, TX 76903

Mr. Cary Carman (325) 944-4600 x 20
Ms. Stephanie Marr (325) 944-4600
Ms. Barbara Lopez (325) 944-4600 x 10
Mr. Larry Pena (325) 944-4600 x 14

USGS TX Water Science Center – San Antonio
5663 De Zavala Suite 290
San Antonio, TX 78249

Ms. Cassi Crow (210) 691-9217
Mr. Michael Willis (210) 691-9207

USGS Texas Water Science Center – Corpus Christi
6300 Ocean Drive unit 5869
Corpus Christi, TX 78412

Mr. Jamie Ingold (361) 825-2073

USGS Rocky Mountain Area
5338 Montgomery Blvd NE
Suite 400
Albuquerque, NM, 87109-1311

Mr. John BumGarner (505) 830-7901
Mr. Rob Henrion (505) 830-7986
Mr. Joseph Beman (505) 830-7944
Mr. Mark Gunn (505) 830-7930

The Texas Commission on Environmental Quality will provide copies of this Quality Assurance Project Plan 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 TCEQ 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 TCEQ CWQMN is administered by the Monitoring & Assessment (MA) Section of the Water Quality Planning Division (WQPD). The TCEQ's Monitoring Division (MD) provides critical network station infrastructure support.

This QAPP is specific to the activities of the TCEQ. The CWQMN is operated by TCEQ regional staff, cooperators, and contractors. The organization of the CWQMN project is shown in Figure A4.1. The interrelationships and responsibilities of the participants in these projects are listed below:

A4.1 Project Sponsor, Monitoring & Assessment Projects, Water Quality Planning Division (Kelly Holligan)

Sets the preliminary objectives for network projects.

- Allocates adequate resources to ensure completion of the project in compliance with the stated objectives.

A4.2 CWQMN Network Coordinator, Monitoring & Assessment Section, Water Quality Planning Division, (Chuck Dvorsky)

- Receives input from CWQMN program managers on the various CWQMN projects.
- Facilitates coordination of the entire CWQMN.
- Coordinates the identification of representative project site(s) with input from interested parties.
- Coordinates and facilitates development of site-specific Data Quality Objectives (DQOs) or Monitoring Quality Objectives (MQOs).
- Approves sampling sites after consultation with TCEQ staff and stakeholders.
- Provides assistance to program managers for project plan development for new CWQMN projects or stations.
- Responsible for establishing new monitoring stations and integrating stations into the existing monitoring network.
- Coordinates CWQMN deployment schedules with MD.
- Purchases network equipment.
- Manages equipment repair contracts for the network.
- Manages and updates CWQMN web pages in accessible format.
- Maintains the WQPD's Interactive Flash Maps, the Static Maps and associated scripted map files, the EMRS water listserv administration, and water related Perl script edits to Rhone and WWW.
- Completes Site Initiation Forms, Lease Agreements, Site Access Agreements, and Data Validation Initiation forms for new sites.
- Develops various CWQMN processes to help ensure network goals are achieved.
- Advises network participants about known CWQMN data and/or project limitations.
- Assist QC officer in developing and revising SOPs.

- Assist QC officer conduct audits and implement corrective actions.
- Provides project planning and prepares comments and project status reports.
- Manages various budgets associated with the EPA grants and state funding.
- Receives and maintains USGS contract assessment records.
- Develops and coordinates contracts and intergovernmental agreements of the CWQMN.
- Coordinates station repairs.
- Assist MD in station installations and repair.
- Provides WQPD Management quarterly updates on CWQMN projects.
- Organizes training for site operators.
- Coordinates document reviews.
- Notify Data Management and Analysis staff when sites are deployed and determine a start date for data validation activities.
- Participates in CWQMN QA Meetings.
- Provides WQPD management quarterly network site updates.

A4.3 CWQMN Program Manager, Monitoring & Assessment Section, Water Quality Planning Division, (Andrew Sullivan)

- Develops and communicates objectives for CWQMN projects.
- Communicates to management the status, recommended changes, and goals of CWQMN projects.
- Maintains a thorough knowledge of project 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.
- Determines acceptability of the measurement data process and QA/QC protocols.
- Advises management about objectives, timetables, tasks, and coordination not being met.
- Elevates CWQMN/MD scheduling conflicts and other issues requiring resolution through the appropriate management chain(s) when appropriate.
- Maintains oversight of contracts and intergovernmental agreements of the CWQMN.
- Maintains oversight of various budgets associated with the EPA grants and state funding.
- Monitors the effectiveness of the overall program quality system.
- Participates in the development of site specific DQOs or MQOs.
- Selects SWQM Project Leads for specific CWQMN projects.
- Participates in CWQMN QA Meetings.
- Provides feedback to supervisory and administrative personnel as necessary regarding the performance of project leads and managers.

A4.4 Monitoring Division, Office of Compliance and Enforcement

- Provides limited support and logistics for monitoring site deployments depending on personnel availability, including: building, modifying, repairing, and testing communication equipment, assisting in monitoring equipment support structure fabrication, and reviewing specifications for support equipment.
- Maintains an inventory of monitoring items commonly used in both the air and the water monitoring networks. Assists with shipping, tracking, and receiving of CWQMN parts and supplies purchased and inventoried for CWQMN deployments, operations, maintenance, and repair.
- Maintains a database of modems used by the air and water monitoring programs with assistance from WQPD.
- Provides initial training to CWQMN Network Coordinator and QC Officer on the basic setup, configuration, and troubleshooting techniques for the appropriate communications and electronic data acquisition equipment based on the standard operating procedure (SOP) and/or manufacturer's operations manual.
- Provides advanced technical support of communications and electronic data acquisition equipment for issues that CWQMN operators, CWQMN Network Coordinator, and/or CWQMN QC Officer cannot resolve by following the SOP and/or manufacturer's operations manual.
- Manages the Leading Environmental and Analysis Display System (LEADS) umbrella contract. Each program area prepares, processes, and provides funds for their specific work orders, and tracks expenditures independently of one another under this umbrella contract.
- Provides LEADS site registration for CWQMN sites and establishes accounts for CWQMN operators and validators to access Manual Validation.
- Administers the LEADS system, including LEADS web pages with water data reports, water data status pages, and online network documentation.
- Participates in the revision of the CWQMN QAPP and CWQMN Project Plans.

A4.5 Data Management and Analysis Team, Monitoring & Assessment Section, Water Quality Planning Division

- Reviews, verifies, and validates CWQMN data.
- Ensures maintenance of records that will demonstrate defensibility of data (Post Deployment Worksheets and data validation notes).
- Provides technical support for analyzing and interpreting the data collected from the CWQMN.
- Provides data validation training to interested parties, cooperators and contractors.
- Provides technical support on statistical evaluation issues that may arise.
- Documents all data management activities.
- Establishes procedures to routinely assess data completeness.

- Participates in the development, approval, implementation and maintenance of written QA standards (e.g., SOPs, QAPPs) and other guidance documents.
- Participates in CWQMN QA Meetings.
- Coordinates the development and maintenance of the SWQMIS for warehousing all CWQMN data.
- Coordinates the development of interfaces between LEADS and SWQMIS with PSS.

A4.6 CWQMN QA Officer, Monitoring Division (Daniel R. Burke)

- Provides oversight of all QA activities.
- Participates in the development, approval, implementation and maintenance of written QA standards (e.g., QMP and QAPPs).
- Participates in the preparation of quality reports (e.g., annual reports).
- Determines conformance with program quality system requirements.
- Recommends to division directors and project managers and through them to deputy directors, that work be stopped in order to safeguard programmatic objectives, worker safety, public health, or environmental protection.
- Assists grant, program, and project managers in developing and implementing quality systems.
- Receives and maintains assessment records.
- Provides technical expertise and/or consultation on quality services.
- Prepares and forwards an annual QA report to EPA.
- Participates in data quality assessments.
- Reports on the status of corrective action programs to EPA.
- Identifies positive and adverse trends in program quality systems.
- Serves as quality system representative.
- Participates in CWQMN QA meetings as needed.

A4.7 CWQMN QC Officer, Monitoring & Assessment Section, Water Quality Planning Division (Edward Ragsdale)

- Responsible for annual CWQMN QAPP revisions.
- Provides QC oversight for network activities.
- Assists program managers, network coordinator, and project managers in developing and implementing quality systems.
- Develops various CWQMN processes to help ensure quality objectives are achieved.
- Advises program managers, data users, and network participants about known CWQMN data and/or project limitations.
- Conducts on-going informal data reviews.
- Reviews and comments on CWQMN Project Plans.
- Researches measurement equipment technical specifications and test equipment if possible.
- Lead for developing, coordinating, writing, and revising CWQMN SOPs.
- Investigate network measurement anomalies.

- Participates in the development of DQOs or MQOs.
- Develops, prepares, conducts, and distributes performance and technical systems/audits/inspections/readiness reviews of CWQMN CAMS.
- Evaluates proposed corrective actions and verifications.
- Concurs with proposed corrective actions and verifications.
- Responsible for determining if responses to audit findings are acceptable or not.
- Maintains files for Project Plans, performance and technical systems/audits/readiness reviews.
- Trains operators on monitoring equipment and QC procedures.
- Assists grant, program, and project managers in developing and implementing quality systems.
- Assist MD in station installations and repair.
- Facilitates CWQMN QA meetings.
- Assesses the effectiveness of program quality systems.
- Monitors the implementation of corrective actions.

A4.8 Primary Data Users

- Assist in the development of DQOs and MQOs.

A4.9 TCEQ Regional Staff, Local Cooperators, and Contractors

- Participate in locating, evaluating, establishing and documenting sites for monitoring stations.
- Provide overall support for the operation and maintenance of station.
- Operate and maintain monitoring sites and sampling equipment according to current TCEQ QAPPs and SOPs.
- Calibrate measurement instrumentation.
- Perform QC checks on monitoring, sampling equipment according to current TCEQ QAPPs and SOPs.
- Review QC data and ensure quality data is being generated.
- Train operators and cooperators on monitoring equipment and QC procedures.
- In some cases, review, verify, and validate CWQMN data according to TCEQ SOPs.
- Assist auditors with performance evaluations and technical systems audits.
- Participate in the development of SOPs for instrumentation.
- Perform preventative maintenance on monitoring equipment.
- Assist in the development of DQOs or MQOs.

A4.10 Administrative, Water Quality Planning Division

- Performs administrative reviews for CWQMN documents.
- Provides document control for CWQMN QAPP and SOPs.
- Process travel authorization and travel reimbursements for CWQMN activities.
- Purchases various network items and services.

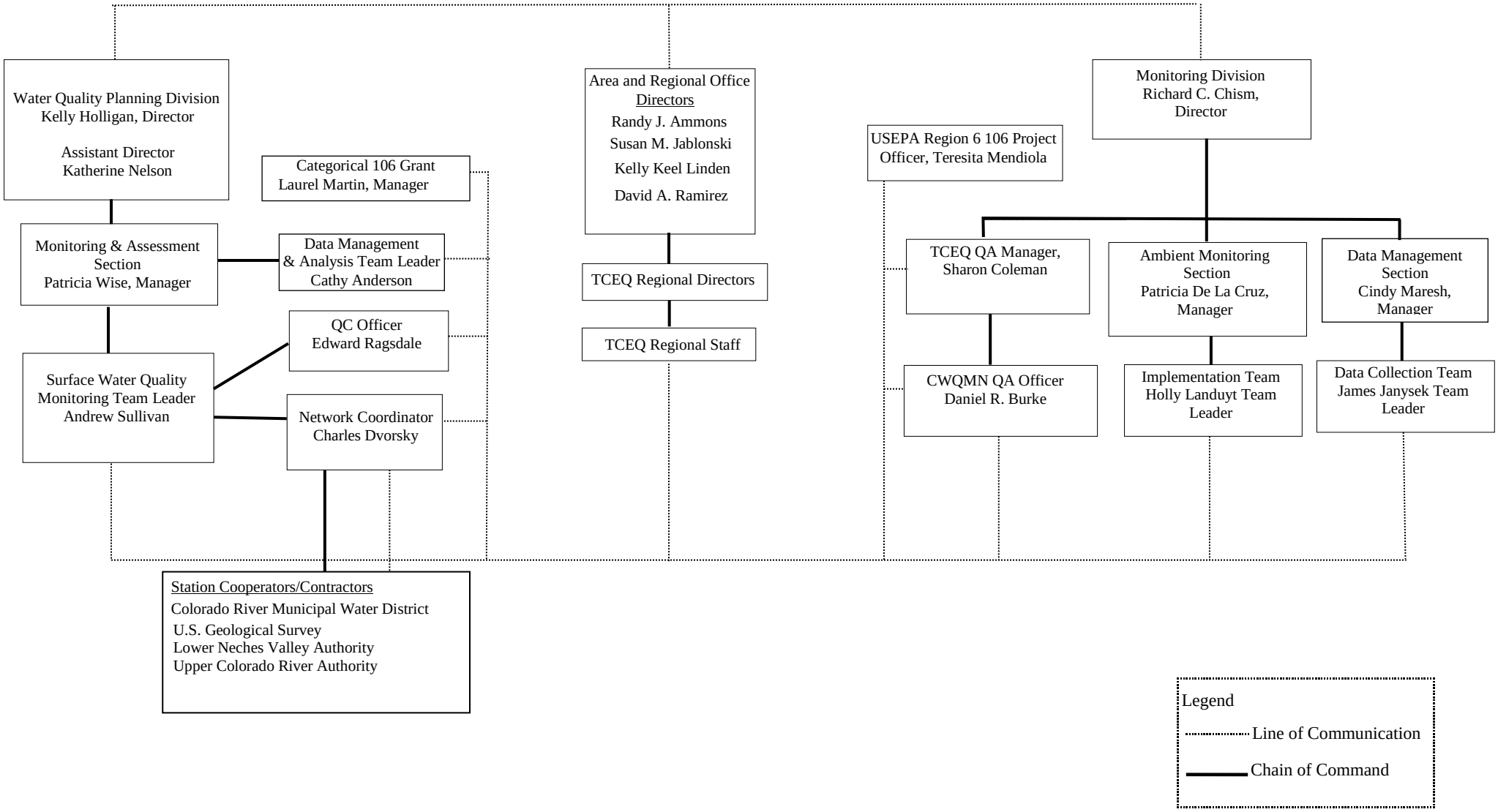
- Provide administrative support for Aqualab analyzer maintenance contract.

A4.11 CWQMN External Web Page Maintenance

- LEADS is maintained by MD with guidance from WQPD staff. CWQMN web pages and SWQMIS is maintained by WQPD staff.

Figure A4.1

Project Organizational Chart



A5 Project Definition/Background

The TCEQ was tasked by executive management and commissioners to develop and deploy a CWQMN built on the existing air monitoring infrastructure. The vision of these leaders was to provide more timely and comprehensive water quality information.

In 2001, a request to monitor water quality was received by the TCEQ from the Texas Legislature to assess the impacts of CAFOs to water quality on the Bosque River. The TCEQ responded by establishing two CWQMN sites on the Bosque River and two CWQMN sites on the Leon River.

The CWQMN was expanded to include the additional sites listed in Tables A5.1 – A5.4. These Tables list active site/projects and are updated as part of QAPP revisions. CWQMN stations may be added and/or de-activated throughout the course of the year. These tables are not intended to list the current operational status of CWQMN sites.

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 TCEQ CWQMN may be used for a variety of purposes, including:

1. Characterizing baseline conditions.
2. Identifying trends.
3. Providing data to support the development of watershed protection plans.
4. Characterizing water quality conditions that lead to blooms of toxic golden algae.
5. Developing water quality controls and assessing improvement after watershed management and implementation plans are in place.
6. Collecting data for water quality models
7. Providing data to support TSWQS reviews.
8. Assessing impacts of point and non-point sources discharges, including short term pollution events.
9. Providing timely surface water quality data for screening and targeting field responses and investigations for the Bosque River Field Operation Division's Environmental Monitoring and Response System (EMRS) pilot program.
10. Developing new water quality applications, and methodologies.
11. Providing continuous water quality data to the public (via internet) for water bodies of interest.

The TCEQ CWQMN designates stations as TCEQ EMRS, TCEQ non-EMRS, USGS-Operated non-EMRS, and Lower/Middle Rio Grande stations. At EMRS stations, the data are used on a near-real time basis for a variety of purposes. Due to the near-real time data use, data from these stations are not validated. At non-EMRS stations data records are validated using QC measurement results. At the Lower & Middle Rio Grande stations the data are not validated or used for EMRS purposes.

See Tables A5.1, A5.2, A5.3, and A4 for project objectives and station measurement parameters for each station designation.

Table A5.1
Objectives and Locations for CWQMN USGS-Operated Non-EMRS Stations

River Basin	Seg. No.	CAMS	Station Location	Objective	Station Parameters
Rio Grande	2306	759	Rio Grande at Fosters Ranch upstream of Amistad Reservoir	1) Provide data to support TSWQS review for total dissolved solids and chloride. Redefine segment boundary to be more protective. 2) Support USNPS, USGS, and TCEQ joint salinity survey project. 3) Support USNPS research on spring flows in the lower canyons. 4) Support modeling of flow related to riparian vegetation removal. 5) Supports research into low DO/high flow related fish kills. 6) Supports the TCEQ Border Initiative (GI-394). 7) Monitor SC in the basin to provide information about increasing salinity to protect agricultural and domestic water supplies. 8) Provide data to National Oceanic and Atmospheric Administration and National Weather Service for flood forecasting. 9) Provide data to the United States Fish and Wildlife Service to support Rio Grande Silvery Minnow reintroduction efforts. 10) Provide flow data for recreational river use.	Surface Water Temperature* SC* DO* pH* USIBWC measures discharge at CAMSs 757, 758, & 759
	2307	757	Rio Grande upstream of the confluence of Rio Conchos near Presidio, TX		
	2306	758	Rio Grande downstream of the confluence of Rio Conchos near Presidio, TX		
		802	Rio Grande River at Santa Elena Canyon, Big Bend National Park		Gage Height* Discharge (Full Range)* Water Temperature* DO* SC* DO* pH*
		721	Rio Grande River at Rio Grande Village, Big Bend National Park		
	2312	788	Pecos River near Red Bluff New Mexico	Document water quality entering Texas for the Pecos River Compact Commission.	Surface Water Temperature SC Gage Height^^ Discharge^^
	2311	710	Pecos River at TX at Business 20, west of Pecos, TX	1) Monitor changes in SC and surface water flow associated with salt cedar eradication. 2) Provide data (segment 2311) for DO modeling purposes. 3) Track water quality improvements associated with TWRI's WPP. 4) Characterize water quality conditions that lead to blooms of toxic golden alga. 5) Monitor SC in the basin to provide information about increasing salinity to protect agricultural and domestic water supplies	Surface Water temperature* SC/TDS* DO* pH* Gage Height* Discharge (Low Range)* USGS discharge monitoring at CAMS 788 and 798 not under TCEQ contract.

Table A5.1 continued

River Basin	Seg. No.	CAMS	Station Location	Objective	Station Parameters
		798	Pecos River near Orla, TX		IBWC measures discharge at CAMS 799.
		709	Pecos River at FM 1776 near Coyanosa, TX		
		785	Pecos River near Girven TX upstream of US 67/385 Pecos river bridge		
		735	Pecos River near US Highway (Hwy) 290 Southeast of Sheffield, TX		
	2310	729	Lower Pecos River near Terrel/Val Verde/Crocket County Lines		
		799	Lower Pecos River at IBWC discharge monitoring location near Langtry, TX		
		764	Independence Creek at Caroline Springs (T-5) on the Nature Conservancy's Independence Creek Preserve south of Sheffield, TX	Independence Creek is a spring-fed tributary of the Pecos River. Monitoring at Caroline Springs will detect potential changes in groundwater. This site is paired with CAMS 735 and 729. Monitor SC in the basin to provide information about increasing salinity and to aid in golden alga research.	Surface Water Temperature* SC* DO* pH*
Rio Grande Coastal	2201	730	Arroyo Colorado Tidal at Rio Hondo FM 106 Bridge	Data may be used to model hydrodynamics and DO dynamics in the impaired portion of the tidal segment and for public education and outreach for the Arroyo Colorado Watershed Protection Plan	Vertical profile Water Temperature DO SC Gage Height

*Stage, discharge, and water quality measurement data provided by USGS under a TCEQ /USGS contract.
CAMS 798 and 799 are under a TSSWC/USGS contract.

^Discharge measurements collected by USIBWC for these locations. These stations are not under a TCEQ contract or under the CWQMN QAPP

^^Discharge measurements collected by USGS. Stations are not under a TCEQ contract or under the CWQMN QAPP.

CAMS = Continuous Ambient Monitoring Station

DO = Dissolved Oxygen

SC = Specific Conductance

TDS = Total Dissolved Solids. TDS is calculated from SC using TCEQ's correction factor of 0.65.

TSSWCB = Texas State Soil and Water Control Board

TSWQS = Texas Surface Water Quality Standards

TWRI = Texas Water Resource Institute

USGS = United States Geological Survey

USIBWC = United States International Boundary Water Commission

WPP = Watershed Protection Plan

Table A5.2
Objectives and Locations for CWQMN TCEQ Non-EMRS Stations

River Basin	Seg. No.	CAMS	Station Location	Objective	Station Parameters
Rio Grande	2309	768	Devils River downstream (State Hwy 163) Baker's Crossing .	The Devil's River, a spring-fed stream, is one of the most pristine water bodies in the state of Texas. The station will provide dense temporal water quality data to document status and trends and to screen water quality to ensure existing conditions are maintained. Monitor SC in the basin to provide information about increasing salinity. Station deactivated 6/21/12. Existing monitoring location at IBWC flow measuring station filled in with aquatic vegetation. TCEQ is in the process of identifying an alternative monitoring location.	Surface Water Temperature SC DO pH Discharge (Full Range)^
Neches	0607	749	Pine Island Bayou at Lower Neches Valley Authority Pump Station near U.S Hwy 69	1) Use DO data to determine if TSWQS are appropriate. 2) Station being used as a test site to test multi-probe anti-fouling measures.	Surface SC/TDS* DO pH Turbidity* Water temperature Sample Depth

^Discharge measurements collected by USIBWC. These stations are not under a TCEQ contract or under the CWQMN QAPP

*Turbidity and SC data are used on a near real-time basis by the Lower Neches River authority. Turbidity data records are not validated. See Table A5.3.

CAMS = Continuous Ambient Monitoring Station

DO = Dissolved Oxygen

EMRS = Environmental Monitoring Response System

SC = Specific Conductance

TDS = Total Dissolved Solids. TDS is calculated from SC using TCEQ's correction factor of 0.65.

TMDL = Total Maximum Daily Load

TSWQS = Texas Surface Water Quality Standards

USIBWC = United States International Boundary Water Commission

Table A5.3
Objectives and Locations for CWQMN TCEQ EMRS Stations

River Basin	Seg. No.	CAMS	Station Location	Objective	Station Parameters
Colorado	1412	716	Beals Creek Pump Station southeast of Big Spring, TX	Provide SC data to Colorado River Municipal Water District to manage water diversions	Surface Water Temperature SC Sample Depth
		717	Colorado River Pump Station northwest of Colorado City, TX		
	1421	773	North Concho River at Celebration Bridge upstream of the S. Oakes St. Bridge in San Angelo, TX	1) Provide near real-time data to the Upper Colorado River Authority to monitor water quality for potential fish kills. 2) Public outreach and education	Surface SC DO pH Temperature Sample Depth
Brazos	NA	804	Tributary of Upper Green Creek near the intersection of CR 385 and 382	Provide timely SC runoff data to the TCEQ Stephenville Office for screening and targeting field responses and investigations for the EMRS project.	Located in Rainfall Dependent Creeks SC Sample depth Temperature
	1226E	805	Indian Creek just east of U.S. Hwy 281		
	1255B	726	Scarborough Creek at County Road (CR) 423		
	1226K	728	Little Duffau Creek near FM 1824		
	NA	765	Un-named Tributary of Little Duffau Creek near FM 1824		
	1255	806	North Bosque River at CR 454	Data from this station will reviewed and assessed to determine if an EMRS SC notification value can be developed. The station is located downstream of a WWTP.	Surface SC Sample Depth Temperature
Neches	0607	749	Pine Island Bayou near U.S. Hwy 69	Provide near real-time data to the Lower Neches Valley Authority for water management decisions.	SC/TDS Turbidity

CAMS = Continuous Ambient Monitoring Station

SC = Specific Conductance

TDS = Total Dissolved Solids. TDS is calculated from SC using TCEQ's correction factor of 0.65

SC = Specific Conductance

WWTP = Waste Water Treatment Plant

Table A5.4
Objectives and Locations for CWQMN TCEQ Lower & Middle Rio Grande Stations

River Basin	Seg. No.	CAMS	Station Location	Objective	Station Parameters
Rio Grande	2304	801	Rio Grande at Eagle Pass, TX	Monitor SC/TDS and Temperature	Surface Water Temperature SC/TDS
		800	Rio Grande at Rio Bravo, TX		
	2302	767	Rio Grande at Roma, Texas		
		796	Rio Grande downstream of Arroyo Los Olmos		
		789	Rio Grande ~3.45 miles upstream of the of the bridge at County Rd. 409 (Harlingen Irrigation DST #1)		
		791	Rio Grande ~2.7 miles upstream of the confluence with El Morillo Drain (United Irrigation DST)		
		792	Rio Grande ~2.5 miles downstream of the confluence of El Morillo Drain (Hidalgo County Irrigation DST#18)		
		793	Rio Grande ~5.0 miles downstream of FM 1015 (HC&CC Irrigation DST #9)		
		736	Anzalduas Dam near Pier 7		

CAMS = Continuous Ambient Monitoring Station

HC&CCID #9 = Hidalgo & Cameron County Irrigation District #9

SC = Specific Conductance

TDS = Total Dissolved Solids. TDS is calculated from SC using TCEQ's correction factor of 0.65

A6 Project/Task Description

Network Description

Continuous surface water quality, sample depth, water level, and stream discharge may be measured automatically (365 days a year) at CWQMN sites located on water bodies of interest. Data from CWQMN sites are telemetered to the TCEQ headquarters in Austin, Texas.

See TCEQ's website for data, maps, and locations of sites. (www.texaswaterdata.org)

Some TCEQ CWQMN projects are funded in whole or in part by federal funds under CWA Sec 106 or other federal grants. Other projects are funded entirely with state and local funds. All TCEQ CWQMN projects listed in Table A5.1, A5.2, A5.3 and A5.4, regardless of funding source(s), are covered under the TCEQ CWQMN QAPP. Independent CWQMN sites are covered under separate quality assurance systems and are not included under the TCEQ CWQMN QAPP. QAPPs for independent stations are updated annually.

This 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.

The CWQMN QAPP lists active network projects for each year, and is updated annually. However, amendments to the QAPP may be necessary to address incorrectly documented information or to reflect changes in project organization, tasks, objectives, methods, and equipment. Requests for amendments will be directed from the Project Coordinator to the EPA Project Officer. Amendments are effective immediately upon approval by the Project Coordinator, the QC Officer, the TCEQ QA Manager (or designee), and the EPA Project Officer.

When new sites are added to the network during the year, project leads, CWQMN Network Coordinator and/or contractors will document project details and requirements in CWQM Project Plans (Appendix C) using EPA QA/R5 format. The plans 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. These project plans will refer to the CWQMN QAPP where applicable.

CWQMN Project Plans will be written as addenda to the CWQMN QAPP and will require an abbreviated sign-off by the CWQMN Network Coordinator, various TCEQ managers and staff, CWQMN Program QA Officer, CWQMN QC Officer, Data Management & Analysis, and relevant project participants/cooperators or contractors.

If a new project is substantially different from those described in the QAPP, and if the project is funded with §106 monies, TCEQ will send the associated project plan to EPA for comment during project development. Copies of all completed/approved Project Plans will be available to EPA regardless of project funding sources and will remain on file in the central office CWQMN program QA files.

Project Plans may be written and approved throughout the year. Once approved, the plans are available upon request. Please see Table A2.5 for a list of approved project plans available at the time of this particular QAPP revision.

The TCEQ's WQPD is responsible for the overall administration of the network. The TCEQ's MD provides logistical support for the network. Continuous water quality monitoring stations (CWQMS) are operated by Site Operators who may be:

- Staff in some of the TCEQ's 16 regional offices;
- Local Cooperators; and/or
- Contractors working with Central SWQM staff.

USGS Generated Data

The TCEQ has contracted with the USGS to provide stream discharge and water quality measurement data at sites on the Upper Rio Grande, Pecos River and Arroyo Colorado basins. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A6.2 and are available upon request.

Table A6.1
Site Operators and Data Validators

Basin	TCEQ Region	CAMS Number	Station ID	Operator CWQMN Element	Data Validator CWQMN Element	Site Location
Rio Grande	6	802	20617	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Big Bend National Park-Santa Helena Canyon
Rio Grande	6	721	18483	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Big Bend National Park-Rio Grande Village
Rio Grande	16	799	13420	USGS-Water Quality	USGS-Water Quality	Lower Pecos at IBWC discharge monitoring location near Langtry
Rio Grande	7	788	NA	USGS-Water Quality/Discharge	USGS-Water Quality	Pecos River near Red Bluff New Mexico
Rio Grande	7	785	13257	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Pecos River Girvin, TX
Rio Grande	7	709	13260	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	FM 1776 near Coyanosa, TX (Upper Pecos)
Rio Grande	7	710	13261	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	West of Pecos, TX at BUS 20 (Upper Pecos)
Rio Grande	7	729	18801	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Pecos River near the Terrel/Val Verde/ Crocket County lines
Rio Grande	16	759	13223	USGS-Water Quality	USGS-Water Quality	Rio Grande at Fosters Ranch upstream of Amistad Reservoir
Rio Grande	7	798	13265	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Pecos River near Orla, TX
Rio Grande	6	757	13230	USGS-Water Quality	USGS-Water Quality	Rio Grande upstream of the confluence of Rio Conchos near Presidio, TX
Rio Grande	6	758	13229	USGS-Water Quality	USGS-Water Quality	Rio Grande downstream of the confluence of Rio Conchos near Presidio, TX
Rio Grande	7	735	13249	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Pecos River near US Hwy 290 southeast of Sheffield, TX
Rio Grande Coastal	15	730	13072	USGS-Water Quality	USGS-Water Quality	Arroyo Colorado at FM 106, Rio Hondo, TX
Rio Grande	16	768	13238	TCEQ Region 16-Water Quality	TCEQ/WQPD-Water Quality	Devils River downstream of SH 163
Rio Grande	7	764	20338	USGS-Water Quality	USGS-Water Quality	Independence Creek at Caroline T-5 Spring, Independence Creek Preserve
Rio Grande	16	801	TBD	TCEQ SWQM Austin Staff	NV	Rio Grande at Eagle Pass
Rio Grande	16	800	TBD	TCEQ SWQM Austin Staff	NV	Rio Grande at Rio Bravo, Texas
Rio Grande	15	736	13182	TCEQ SWQM Austin Staff	NV	Rio Grande at Anzalduas Dam near Pier 7
Rio Grande	15	767	20737	TCEQ SWQM Austin Staff	NV	Rio Grande at Roma, Texas
Rio Grande	15	796	TBD	TCEQ SWQM Austin Staff	NV	Rio Grande downstream of arroyo Los Olmos
Rio Grande	15	789	TBD	TCEQ SWQM Austin Staff	NV	Harlingen Irrigation District #1

Table A6.1 (continued)
Site Operators and Data Validators

Basin	TCEQ Region	CAMS Number	Station ID	Operator CWQMN Element	Data Validator CWQMN Element	Site Location
Rio Grande	15	791	TBD	TCEQ SWQM Austin Staff	NV	United Irrigation District
Rio Grande	15	792	TBD	TCEQ SWQM Austin Staff	NV	Hidalgo Irrigation District #18
Rio Grande	15	793	TBD	TCEQ SWQM Austin Staff	NV	HC&CC Irrigation District # 9
Colorado	7	716	18815	CRMWD-Water Quality	NV	Beals Creek Pump Station southeast of Big Spring, TX
Colorado	3	717	18816	CRMWD-Water Quality	NV	Colorado River Pump Station northwest of Colorado City, TX
Brazos	4	726	17222	TCEQ Region 4, Stephenville-Water Quality	NV	Scarborough Creek (Upper North Bosque River tributary) at CR 423
Brazos	4	728	20322	TCEQ Region 4, Stephenville-Water Quality	NV	Little Duffau Creek (Upper North Bosque River Tributary) near FM 1824
Brazos	4	765	20323	TCEQ Region 4, Stephenville-Water Quality	NV	Unnamed Tributary of Little Duffau Creek (Bosque River Tributary) near FM 1824
Brazos	4	804	TBD	TCEQ Region 4, Stephenville-Water Quality	NV	Tributary of Upper Green Creek near the intersection of CR 385 and 382
Brazos	4	805	TBD	TCEQ Region 4, Stephenville-Water Quality	NV	Indian Creek just east of U.S. Hwy 281
Brazos	4	806	TBD	TCEQ Region 4, Stephenville-Water Quality	NV	North Bosque River at CR 454
Neches	10	749	10602	Lower Neches Valley Authority	TCEQ/WQPD-Water Quality	Pine Island Bayou near U.S. Hwy 69
Colorado	8	773	15889	UCRA	NV	North Concho River at Celebration Bridge upstream of S. Oakes St Bridge in San Angelo, TX

CAMS = Continuous Ambient Monitoring Station
CRMWD = Colorado River Municipal Water District
HC&CCID#9 = Hidalgo & Cameron County Irrigation District #9
NV = EMRS project data not validated
TBD = To be determined
TCEQ-WQPD Texas Commission on Environmental Quality Water Quality Planning Division
UCRA = Upper Colorado River Authority
USGS = United States Geological Survey
USIBWC = United States International Boundary Water Commission

Table A6.2
Schedule of Activities

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

Administrative Activities	**Status**
Annual CWQMN QAPP Revision	Revision 9 approved by EPA on 4/23/15. Revision 10 due to EPA by late February 2016
CWQMN Project Plans	Ongoing, for each new CWQMN Project
CWQMN Data Quality Objectives (measurement performance specifications for multiprobe fouling and drift quality control measurements). When applicable.	Ongoing for new non-EMRS stations
General Activities	**Status**
Update and re-configure TCEQ CWQMN web pages	Ongoing
Develop and post Data Collection Summaries on the CWQMN web page. These summaries detail historic and current data collection/validation protocols and known data quality issues.	Ongoing
Devils River CAMS 768 off-line due to change in stream morphology causing sediment deposition and aquatic plant growth at deployment tube.	TBD, TCEQ in the process of identifying an alternative monitoring location.
Install and test a Vendor's Long-term multiprobe deployment module at CAMS 749 Pine Island Bayou. Module designed to greatly reduce sensor fouling.	TBD
CWQMN Audits	Ongoing

TBD = To be determined

A7 Quality Objectives and Criteria

CWQMN water quality measurements are used for a variety of purposes. Section A7 describes quality objectives for the various projects.

A7.1 CWQMN Multiprobe Quality Objectives and Criteria

CWQMN Multiprobe Long Term Deployments

CWQMN multiprobe water quality measurement sensors are deployed in various water bodies around the state 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.

Quality Objectives for TCEQ CWQMN Stations

The TCEQ has three types of multiprobe stations, non-EMRS, EMRS, and Lower/Middle Rio Grande Stations. At non-EMRS stations, data records are validated using multiprobe sensor fouling and calibration drift QC measurements. At EMRS stations, near real-time measurements are used to screen water quality for a variety of purposes and data records are not validated. At the Lower & Middle Rio Grande stations the data are not used for EMRS purpose and the data are not validated.

For non-EMRS stations, the TCEQ has adopted USGS-based multiprobe fouling measurement procedures. Multi-probe sensor drift is quantified through the analysis of standards. Data records are validated using fouling and sensor drift measurements. The TCEQ procedure compares fouling and drift measurement results against project-specific DQOs. The TCEQ does not use sensor fouling and drift measurements to apply prorated data corrections over deployment periods.

For a summary of TCEQ multiprobe procedures, calculations, and limitations see Section B5.1. For complete details concerning a project's or station's quality objectives criteria see TCEQ SOPs. TCEQ SOPs used for particular projects and stations are listed in this Section.

Quality Objectives for USGS-Operated CWQMN Stations

Beginning September 1, 2011, the TCEQ contracted USGS to operate, maintain, and validate all CWQMN water quality stations in the Upper Rio Grande, Pecos River, and Arroyo Colorado basins according to: USGS – *Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting TM1D3*. Generally stated, the USGS uses multiprobe fouling and sensor electronic drift measurements to apply prorated data corrections over deployment periods. Multiprobe fouling and sensor drift measurements are also used by USGS to rate data quality.

Due to multiprobe data collection problems at some stations on the Upper Rio Grande and Pecos Rivers, the USGS and TCEQ worked collaboratively to interpret and adapt guidelines and standard procedures found in TM1D3. The following procedures are now

in use by USGS: USGS/TCEQ - *Adaptation of Data Validation and Fouling Correction Procedures for Water-Quality Monitoring Stations on the Upper Rio Grande and Pecos River (May 2013)*. These procedures are in Appendix F of this QAPP.

TCEQ has a "Fair" (Table A7.1.1 USGS data ratings) or better data acceptance requirement. If data does not meet "Fair" criteria, the USGS does not report the data to TCEQ. However, there are circumstances when data quality cannot be rated because sensor fouling measurements are not available for particular time periods. These data can be reported to TCEQ; however, these data are not rated. See procedures in Appendix F for details.

USGS-Operated NON-EMRS Stations

Table A7.1.1

TM1D3 Ratings of Accuracy
USGS Operated Multiprobe CAMSs 709, 710, 721, 729, 730, 735, 757, 758, 759, 764, 785, 788, 798, 799, and 802

Parameter	Ratings of accuracy (based on combined fouling and calibration drift corrections applied to the record)			
	Excellent	Good	Fair	Poor
Temperature	≤±0.2°C	>±0.2-0.5 °C	>±0.5-0.8 °C	>±0.8 °C
Specific Conductance	≤±3%	>±3-10%	>±10-15%	>±15%
Dissolved Oxygen	≤±0.3 mg/l or ≤±5%, whichever is greater	>±0.3-0.5 mg/l or > ±5-10%, whichever is greater	>±0.5-0.8 mg/l or > ±10-15%, whichever is greater	>±0.8 mg/l or >±15%, whichever is greater
pH	≤±0.2 units	>±0.2-0.5 pH units	>±0.5-0.8 pH units	>±0.8 pH units

°C = degrees centigrade
mg/l = milligrams per liter

TCEQ NON-EMRS Stations

Table A7.1.2
Quality Objectives
TCEQ Multiprobe CAMSs 749 and 768

Parameter	Fouling & Drift/(CVS) Acceptance Limits (sum and individual fouling & drift acceptance limits)	Temperature Acceptance Limit	Instrument/SOP
Specific Conductance/ Total Dissolved Solids	±5 RPE	±0.5 °C[1]	YSI 6-Series AMPM-011, Rev.3
Dissolved Oxygen	±0.5 mg/l		
pH	±0.5 units		
Temperature		±0.5 °C	
Sample Depth	NA		

[1]If temperature sensor checks do not meet the ±0.5 °C criterion, the corresponding temperature, DO, SC, and calculated total dissolved solids data are considered invalid.
CVS = calibration verification sample
°C = degrees centigrade
NA = not applicable, sample depth measurements not assessed for accuracy.
mg/l = milligrams per liter
RPE = Relative percent error
YSI = Yellow Spring Instrument

TCEQ EMRS Stations

Colorado River Municipal Water District EMRS Project

The Colorado River Municipal Water District (CRMWD) operates CAMSs 716 and 717. The CRMWD staff uses near-real time SC measurements to manage water diversions. SC and temperature data records from the stations are not validated.

Table A7.1.3
Quality Objectives
CRMWD Multiprobe CAMS 716 and 717

Parameter	Drift/(CVS) Acceptance Limits[1]	Temperature Acceptance Limit	Instrument/project-specific SOP
Specific Conductance/ Total Dissolved Solids	±5 RPE[1]		YSI 6-Series AMPM-011, Rev.3 (minus fouling measurements)
Temperature		±0.5°C[1]	

[1] CVS and temperature check criteria are used as guidelines to ensure measurement equipment is operating within limits.
CVS = calibration verification sample
°C = degrees centigrade
RPE = relative percent error

TCEQ North Bosque River Specific Conductance EMRS Project

SC, sample depth, and temperature sensor multiprobes are deployed at five rainfall-dependent microwatershed locations. The goal of this EMRS pilot project is to automatically measure and screen in-stream SC values and to provide notifications to the TCEQ Stephenville Regional staff via email when SC measurements exceeds established trigger level(s). These notifications are intended to assist regional staff in targeting field investigations to identify dairy-related point source pollution discharges. SC and temperature data records from the stations are not validated.

When an email notification is received indicating conductivities exceed notification level(s), the EMRS responder remotely assesses station multiprobe sensor measurements (SC, sample depth, and water temperature) and decides if a field investigation is warranted.

Table A7.1.4
Quality Objectives
TCEQ Multiprobe CAMS 726, 728, 765, 804, and 805

The following instrument and project-specific SOP is used for the project: *Analysis of In Situ Specific Conductance, Water Temperature, and Sample Depth for the Bosque River Environmental Monitoring Response System Using Aqua TROLL 200 Multi-probes (Revision1).*

QC Checks	Purpose	Frequency	Acceptance Criteria
Monitor Operational Status of the Stations	To ensure stations are on-line and operational	Every business day	Stations are reporting measurement data and data appear reasonable
SC and Depth Sensor Cleaning	Improve conductivity and depth sensor responses	As needed and at the conclusion of deployment periods	None
Calibration Verification Sample (CVS)	To assess sensor drift	Monthly	± 5 RPE[1]
Temperature Sensor Check	To assess thermistor accuracy	Monthly	± 0.50 °C[1]

[1] CVS and temperature check criteria are used as guidelines to ensure measurement equipment is operating within limits.
RPE = relative percent error

Lower Neches Valley Authority EMRS Project

The Lower Neches Valley authority (LNVA) operates CAMS 749 at Pine Island Bayou. The LNVA uses SC/TDS on a near real-time basis for water management decisions. The LNVA may divert water from Pine Island to supply a secondary source of freshwater to various consumers. The near real-time turbidity data provides LNVA information about potential water treatment needs of this secondary source of water. Turbidity data records are not validated.

Table A7.1.5
Quality Objectives
LNVA Multiprobe CAMS 749

Parameter	Drift/(CVS) Acceptance Limits[1]	Sensor Specific SOP
Turbidity	± 3 NTU/FNU or 5 RPE	Analysis of In-Situ Turbidity at Pine Island Bayou for Environmental Monitoring Response System Purposes

[1] CVS criteria are used to ensure measurement equipment is operating within limits.
FNU = Formazin Nephelometric Units
NTU = Nephelometric Turbidity Units
RPE = relative percent error

Upper Colorado River Authority North Concho River Project

The Upper Colorado River Authority (UCRA) operates CAMS 773. The station provides UCRA with near real-time data to monitor water quality for potential fish kills. Data records from the station are not validated.

Table A7.1.6
Quality Objectives
TCEQ Multiprobe CAMSs 773

Parameter	Drift/(CVS) Acceptance Limits[1]	Temperature Acceptance Limit	Instrument/SOP
Specific Conductance/ Total Dissolved Solids	±5 RPE	±0.5 ºC	YSI 6-Series AMPM-011, Rev.3 (multiprobe fouling measurements are not performed)
Dissolved Oxygen	±0.5 mg/l		
pH	±0.5 units		
Temperature		±0.5 ºC	
Sample Depth	NA		

[1] CVS and temperature check criteria are used as guidelines to ensure measurement equipment is operating within limits.
ºC = degrees centigrade
CVS = calibration verification sample
mg/l = milligrams per liter
NA = not applicable, sample depth measurements not assessed for accuracy.
RPE = relative percent error

Lower and Middle Rio Grande Project

SC and temperature sensor multi-probes are deployed at nine stations downstream from Amistad Reservoir. The stations were designed and deployed to automatically measure and screen in-stream SC values exceeding established trigger level(s) defined in the appropriate Project Plan. The stations are currently serviced quarterly under a revised SOP by TCEQ Central Office staff to confirm operation and, to the extent possible, to ensure the stations are producing data of known quality at the completion of the service.

Two stations in the Middle Rio Grande between Amistad Reservoir and Falcoń Reservoir are inactive due to flood damage and one station between Falcoń Reservoir and Anzalduas Dam is in active due to site erosion.

Table A7.1.7
Quality Objectives
TCEQ Multiprobe CAMSs 736, 767, 789, 791, 792, 793, 796, 800, and 801

The following instrument and project-specific SOP is used for the project: *In Situ Analysis of Electrical Conductivity and Water Temperature in Ambient Surface Water for the Lower and Middle Rio Grande Using Hydrolab-Hydrotech Compact Minisondes*

QC Check	Purpose	Frequency	Acceptance Criteria
Laboratory Temperature Sensor Check	To Assess Thermistor Accuracy	Prior to Quarterly SC Calibrations	±0.5 °C

°C = degrees centigrade

A7.2 USGS Stream Stage and Discharge Quality Objectives

The TCEQ has contracted with the USGS to provide stream discharge and water quality measurement data at various stations around the state. See Table A5.1 for USGS station locations and parameters and Section/Table A2.5 for a list of USGS/TCEQ Project Plans and internet address for data access. These Project Plans contain information about USGS stage and discharge measurement methods and quality objectives, and criteria for stage and discharge measurements.

A7.3 Representativeness

By design, the CWQMN measures water quality in greater temporal detail and resolution than is possible with grab samples or short term deployments of monitoring instrumentation. Areas of excessive vegetation, turbulence, and shifting stream bottoms should be avoided. Backwater areas with little flow should be avoided unless this type of area is representative of the water body.

A7.4 Comparability

CWQMN water quality measurements 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.

As previously discussed in Section A7.1, USGS is correcting data records collected in the Rio Grande River, Pecos River, and Arroyo Colorado basin stations based on multiprobe fouling and drift measurement results, whereas TCEQ is not correcting data records.

A7.5 Bias

Definitions for bias are provided in Appendix A. Determining and calculating bias for the purposes of this quality assurance project plan is discussed in Section B5.

A7.6 Completeness

A general requirement for data completeness has been set at 75 percent data return. Periods of no flow or dry conditions necessitate shutdown of some instrumentation and

these times are not considered in the goal for data completeness. Data completeness is discussed in Section C.

A8 Special Training/Certification

Work conducted for this project is covered under a documented quality management system. Personnel conducting work associated with this project are deemed qualified to perform their work through educational credentials, specific job/task training, demonstrations of competency, and internal and external assessments.

The TCEQ has contracted with the USGS to provide stream discharge and water quality measurement data at sites on the Upper Rio Grande River, Pecos Rivers, and Arroyo Colorado basins. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A6.2 and are available upon request.

Personnel covered by this QAPP may be TCEQ employees or external contractors. Agency organizations and staff and external contractors are bound by the requirements delineated the TCEQ QMP. TCEQ training records are maintained according to TCEQ agency policy. Contractor training records are maintained by their respective employers, and are available for review.

Position descriptions for key personnel detail major responsibilities and qualifications for TCEQ staff and external contractors. The network maintains quality assurance project plans for data collection activities for water quality monitoring, as well as Standard Operating Procedures for the use of monitoring instruments and station operation.

Project Readiness Reviews may be conducted when a new contractor begins work or a new station is installed to ensure that personnel are competent to produce data for the network. Technical Systems Audits and Performance Evaluation Audits are periodically conducted and on an as-needed basis as described in Section C1 and in Table C2.1.

Currently, all participants in the network have been successful, ongoing contributors for several years. Work conducted under this revision of the QAPP is similar or identical to the work performed by these participants in the past.

A9 Documents and Records

The 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 CWQMN website. Instrument calibration and calibration verification forms, Post Deployment Worksheets, instrument logbooks, and certificate of analysis are filed and maintained by site operators.

Each site operator is expected to maintain 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 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 analyses are documented in operator logs to clearly indicate the affected measurements.

The TCEQ has contracted with the USGS to provide stream discharge and water quality measurement data at sites on the Upper Rio Grande, Pecos Rivers, and Arroyo Colorado basins. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A6.2 and are available upon request.

A9.1 Documentation of Procedures and Objectives

1. Published guidance (Code of Federal Regulations EPA, and EPA Quality Assurance Handbook)
2. CWQMN Project Plans
3. Project/instrument specific SOPs
4. Instrument manufacturer's technical support manuals
5. TCEQ QMP, SOPs, and the CWQMN Quality Assurance Project Plan
6. TCEQ SWQM Procedures, Volume 1
7. *United States Geological Survey* – Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting TM1D3
8. USGS/TCEQ - *Adaptation of Data Validation and Fouling Correction Procedures for Water-Quality Monitoring Stations on the Upper Rio Grande and Pecos River (May 2013)*

A9.2 Record Keeping

CWQMN written records are kept for five years. Electronic records are kept indefinitely or for a life of a project. Please see Table A9.1 for type of record and location.

Table A9.1

CWQMN Record Location

Record	Location
Sampling Information	TCEQ Website
Project/Instrument-specific SOP data forms	TCEQ Regional offices/Cooperators/Contractors
Certificate of Analysis for pH and Conductivity standards	TCEQ Regional offices/Cooperators/Contractors
Instrument and equipment logbooks	Should be located with instrumentation if possible
LEADS electronic Operator logs Validator logs	CFEP
Validators notes	Data Validators office/LEADS
Post Deployment Excel Spreadsheets	WQPD Austin Server
CWQMN Project Plans	SWQM Central Office
Standard Operating Procedures	www.texaswaterdata.org
Finding Summary Reports	SWQM Central Office
Technical systems, performance evaluation audits, and readiness reviews	SWQM Central Office

CFEP = Comms Front-End Processor computer located at TCEQ headquarters in Austin, Texas
WQPD = Water Quality Planning Division

A9.3 Data Reporting

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

A9.4 Documentation Control Plan

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

All SOPs must have a document title, a revision number, approval signatures, and effective date. SOPs are formally reviewed and re-signed on an as needed basis. SOPs 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.

The current QAPP and official SOPs are available via the internet at: (www.texaswaterdata.org). Project Plans are available upon request.

It is the responsibility of each CWQMN participant to ensure they are properly following the most current revision of these documents.

Standard Operating Procedure Approval Signatures

Water Quality Planning SOPs require the following signatures: Section Manager, CWQMN Program Manager, Team Leader (if applicable), and QC Officer.

Instrument-Specific Logbooks

Each site operator has the responsibility of maintaining instrument-specific logbooks for a minimum of 5 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 5 years, unless otherwise required by a project or regulation.

Hand Written Documents

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

B1.1 Network Design/Siting Rationale

The CWQMN measurement parameters are outlined in Tables A5.1 – A5.4

B1.2 CWQMN Site Proposals

The TCEQ continues to improve the CWQMN. TCEQ accepts suggestions for new CWQMN stations. Interested parties may download the CWQMN Pre-Proposal Form (link to Pre-Proposal Form), complete the form and submit it to swqm@tceq.texas.gov. Pre-Proposals will be evaluated by a TCEQ panel familiar with the project river basin. TCEQ will consider the data need and expected use, the availability of instruments to monitor the water quality parameter of concern, and the availability of TCEQ and/or in-kind resources for deployment, operation, maintenance, and/or data validation when evaluating project proposals. TCEQ will evaluate each proposal submitted and may, or may not, develop and deploy the proposed project. TCEQ will consider the information submitted, the data need/use to be addressed, the availability of TCEQ and in-kind resources in the evaluation of the proposed project. Project proposals may be submitted at: (www.texaswaterdata.org).

United States Geological Survey Sites

The USGS has been contracted by TCEQ to collect, validate, and report water quality and discharge monitoring data from sites in the Upper Rio Grande, Pecos River, and Arroyo Colorado basins (See Section A5.1).. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A6.2 and are available upon request.

B2 Sampling Methods

Continuous monitoring multiprobe sensors measure water quality *in situ*. Table B2.1 lists equipment, sampling method, and telemetry methods for each CWQMN station.

The USGS has been contracted by TCEQ to collect, validate, and report water quality and discharge monitoring data from sites in the Upper Rio Grande, Pecos River, and Arroyo Colorado basins (see section A5.1) following USGS guidelines and procedures. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A6.2 and are available upon request.

B2.1 Monitoring Methods and Equipment

TCEQ Multiprobe Stations

Multiprobe instruments are typically deployed in a four inch diameter PVC tubes that extends into the water body via a support structure. Deployment tubes include 48 evenly spaced one-inch holes per linear foot for at least the lower two feet of the deployment tube to allow water to flow across the sensors. As part of station service, deployment tubes are cleaned with chimney brushes.

For Bosque River SC EMRS stations, multiprobes are deployed in dry rainfall-dependent creek channels. During rainfall run-off events water quality is measured *in-situ*. When no water is present, measurements are collected from dry creek channels.

Support equipment are installed in weather-tight aluminum “Traffic Box” containing a data logger, wireless cellular modem or GOES communications equipment, and a deep cycle battery. Solar panels are installed for battery charging purposes. If wireless cellular service is available at the monitoring site a wireless modem is used to transmit data to TCEQ. In remote areas, equipment can be installed that will relay data using GOES.

In-situ water quality and sample depth measurements are logged once every 15 minutes by the data logger. The data are transmitted via telephone land line, wireless modem, or GOES 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 specific CWQMN stations.

USGS Operated Multiprobe Stations

In-situ water quality measurements are logged once every 15 minutes by the data logger. The data are transmitted by GOES telemetry to the USGS National Water Information System, and then delivered to MeteoStar/LEADS system in Austin, Texas where the discrete data are stored. Vertical profile data from the Arroyo Colorado are not delivered to the MeteoStar/LEADS system. Data are averaged into one-hour averages and displayed on the external TCEQ web pages and on an external USGS web display (NWIS Web). Vertical profile data from the Arroyo Colorado are not delivered to the MeteoStar/LEADS system.

USGS Stage and Discharge Measurements

For stream discharge, USGS hydrographers develop and maintain a stage to discharge rating. A "Look-up Table" is developed for each site, this table is used to provide discharge values for a given stage measurement. Stream discharge data is periodically uploaded from USGS to the TCEQ LEADS system.

Stage and water quality 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 and on an external USGS web page (NWISWeb).

Limitations and Performance Criteria

See Section A7 for performance criteria for the network.

Table B2.1

Monitoring Methods and Equipment

CAMS	Station Location	Measurement Method	Measurement Equipment	Telemetry	Station Parameters
759	Rio Grande at Fosters Ranch upstream of Amistad Reservoir	Sonde: *In situ*	YSI 6600 EDS (optical DO)	GOES	Surface Water Temperature* SC* DO* pH*
757	Rio Grande upstream of the confluence of Rio Conchos near Presidio, TX				
758	Rio Grande downstream of the confluence of Rio Conchos near Presidio, TX				
802	Rio Grande River at Santa Helena Canyon, Big Bend National Park	Sonde: *in-situ*, Bubbler	YSI 6600 EDS (optical DO) DA H350/355		Gage Height Discharge (Full Range)* Surface Water Temperature* SC* DO* pH*
721	Rio Grande River at Rio Grande Village, Big Bend National Park	Sonde: *in-situ*, swing pipe installation, Bubbler			
788	Pecos River near Red Bluff New Mexico	Sonde: *In situ*	YSI 6920 V2		Surface* Water Temperature* SC*
798	Pecos River near Orla, TX	Bubbler	YSI 6920 V2 (optical DO) DA H350/355		Surface* Water Temperature* SC* DO* pH* CAMS 709, 785, 710, and 729 Gage Height Discharge (Low Range)*
709	Pecos River at FM 1776 near Coyanosa, TX				
785	Pecos River near Girven upstream of US 67/385				
710	Pecos River at Business 20, west of Pecos, TX				
729	Pecos River near the Terrel/Val Verde/ Crocket County lines				
799	Lower Pecos at IBWC discharge monitoring location near Langrty, TX				

Table B2.1

Monitoring Methods and Equipment (continued)

CAMS	Station Location	Measurement Method	Measurement Equipment	Telemetry	Station Parameters
735	Pecos River near US Hwy 290 Southeast of Sheffield, TX				
730	Arroyo Colorado Tidal at Rio Hondo FM 106 Bridge	Sonde: *In situ* OTT Vented Pressure Transducer	YSI 6920 V2	GOES & Wireless Modem	Vertical Profile Water Temperature DO SC Gage Height
801	Rio Grande at Eagle Pass, Texas	Sonde: *In situ*	Hydrolab-Hydrotech	Wireless Modem	Surface Water Temperature SC/TDS
800	Rio Grande near at Rio Bravo, Texas				
767	Rio Grande at Roma, Texas				
796	Rio Grande downstream of Arroyo Los Olmos				
789	Rio Grande ~3.45 miles upstream of the of the bridge at County Rd. 409 (Harlingen Irrigation DST #1)				
791	Rio Grande ~2.7 miles upstream of the confluence with El Morillo Drain (United Irrigation DST)				
792	Rio Grande ~2.5 miles downstream of the confluence of El Morillo Drain (Hidalgo County Irrigation DST#18)				
793	Rio Grande ~5.0 miles downstream of FM 1015 (Hidalgo County and Cameron County Irrigation District #9)				
736	Rio Grande (Anzalduas Dam) near Pier 7				
768	Devils River downstream of (SH 163) Baker's Crossing	Sonde: *In situ*	YSI 6920 V2 (optical DO)	GOES	Surface Water Temperature SC DO pH
764	Independence Creek at Caroline Springs (T-5) on the Nature conservancy's Independence Creek Preserve south of Sheffield, TX	Sonde: *In situ*	YSI 6920 V2 (optical DO)		Surface* Water Temperature* SC* DO* pH*

Table B2.1

Monitoring Methods and Equipment (continued)

CAMS	Station Location	Measurement Method	Measurement Equipment	Telemetry	Station Parameters
716	Beals Creek Pump Station southeast of Big Spring, TX	Sonde: *In situ*	YSI 600 XLM	Wireless Modem	Surface Water Temperature SC/TDS Sample Depth
717	Colorado River Pump Station northwest of Colorado City, TX				
804	Upper Green Creek near the intersection of CR 385 and 382	Sonde: *In situ. Sondes located in dry rainfall-dependent creek channels*	In-Situ Aqua TROLL 200		SC Temperature Sample depth
805	Indian Creek just east of U.S. Hwy 281				
728	Little Duffau Creek near FM 1824				
765	Un-Named Tributary of Little Duffau Creek near FM 1824				
726	Scarborough Creek at CR 423				
806	North Bosque River at CR 454	Sonde: *In situ.*	In-Situ Aqua TROLL 200		Surface SC Temperature Sample depth
749	Pine Island Bayou at Lower Neches Valley Authority Pump Station near U.S. Hwy 69	Sonde: *In situ*	6920 V2-2 (optical DO)		Surface Water Temperature SC/TDS DO pH Turbidity Sample Depth
773	North Concho River at Celebration Bridge upstream of S. Oakes St Bridge in San Angelo, TX	Sonde: *In situ*	6920 V2-2 (optical DO)		Surface Water Temperature SC DO pH Sample Depth

*With exception of CAMS 798 and 799, Sites operated by USGS under a TCEQ / USGS contract. CAMS 798 and 799 operated by USGS under a Texas State Soil and Water Conservation Board/USGS contract.
DA = design analysis
DO = dissolved oxygen
GOES = Geostationary Operational Environmental Satellite
SC = specific conductance
TDS = total dissolved solids
USGS = United States Geological survey
YSI = Yellow Springs Instrument

B2.2 Sampling/Measurement System Corrective Action

Corrective action measures in the CWQMN will be taken to ensure the DQOs are attained. The site operator is responsible for monitoring the performance of the measurement and support equipment and identifying problems or potential problems.

It is expected that any individual in the 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 QC Officer and Network Coordinator must be notified of any proposed corrective action that can affect data quality and/or CWQMN protocols. When problems are identified that cannot be resolved by the site operator, the site operator notifies the Network Coordinator. The Network Coordinator is responsible for coordination with appropriate personnel to resolve the problems.

The MD stocks various consumable and replacement items for the CWQMN. The project lead is responsible for coordinating the necessary supply and parts shipments to the site operator. When necessary, personnel from MD travel to a particular site to repair or replace support equipment that cannot be repaired or replaced by the site operators. Monitoring equipment that cannot be repaired by TCEQ staff is sent to the manufacturer for repair. If monitoring equipment cannot be repaired or if it is not economical to repair a piece of equipment, the equipment may be surplused.

Some CWQMN sites are located in or near flood plains. Consequently, various CWQMN sites have the potential to be damaged or destroyed by flood waters during severe floods. Potential flooding is a consideration in the site development process. Additionally, multiprobes, sampling and/or support equipment are located in stream beds and are subject to frequent flooding. These components are secured to the stream banks and have proved capable of surviving a given flood. However, it is accepted that the support systems and components will need periodic replacement and repair.

B3 Sample Handling and Custody

See Section B10 for electronic managing of CWQMN data. Water quality is measured *in situ* for the multiprobe instrumentation.

B4 Analytical Methods

Water quality measurement methods used by the CWQMN are based on the *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998, unless otherwise noted.

Section A7 summarizes and list procedures and quality objectives for the various CWQMN projects/CAMSs. CWQMN measurement equipment and analytical methods are listed in Tables B4.1, and B4.2.

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

For sites following TCEQ procedures, instrument and project-specific analytical SOPs are used to document exact procedures necessary to perform the method and to operate a specific instrument.

The TCEQ has contracted with the USGS to provide stream discharge and water quality measurement data at sites on the Upper Rio Grande, Pecos River, and Aroyo Colorado Basins. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A6.2 and are available upon request. The TCEQ and USGS use water quality measurement methods found in Table B4.1.

Table B4.1

CWQMN Multiprobe Analytical Methods

Parameter	LEADS Parameter Code	Units	Measurement Equipment	Method
pH	10400	pH/units	YSI 6-Series	Glass electrode, Standard Method 4500-H+B
DO*^	10300	mg/L	YSI 6-Series	Optical (luminescence quenching) ASTM D888-05
SC^^	10095	µS/cm	YSI 6-Series In-Situ Aqua TROLL 200 Hydrolab-Hydrotech	Conductivity cell, Standard Method 2510B
Turbidity*	10104	NTU**	YSI 6-Series	Method number ISO 7027
Temperature	10010	ºC	Thermistor	Standard Method 2550 B
Sample Depth	10078	Feet	YSI 6-Series In-Situ Aqua TROLL 200	Pressure Transducer
TDS	10294	mg/L	YSI 6-Series In-Situ Aqua TROLL 200 Hydrolab-Hydrotech	Calculated by LEADS. SC measurements are multiplied by TCEQ's Statewide conversion factor 0.65

*Method not based on *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998. U. S
^Environmental Protection Agency (EPA) Region 6 has approved Optical DO methods for use in the CWQMN.
**LEADS reports turbidity measurements in NTUs. USGS reports FNU (parameter code 63680) and TCEQ will recode the unit values as NTU (LEADS parameter code 10104) in order to populate the LEADS database until an appropriate Surface Water Quality Monitoring Information System (SWQMIS)/EPA Storage and Retrieval Database (STORET) code can be identified.
^^ Modern conductivity sensors utilize auto-ranging sensors.
°C = degrees centigrade
mg/L = milligrams per liter
µS/cm = micro siemens per centimeter
ASTM = American Society for Testing and Materials
DO = dissolved oxygen
FNU = Formazin Nephelometric Units
ISO = International Organization for Standardization
LEADS = Leading Environmental Analysis and Display System
NTU = Nephelometric Turbidity Unit
TDS = total dissolved solids
YSI = Yellow Springs Instrument

Sample Depth Measurement Methods

YSI multiprobes utilize non-vented pressure sensors to measure sample depth. Aqua TROLL 200 multiprobes utilize vented pressure sensors. Vented sensors correct sample depth measurements for changes in barometric pressure.

Table B4.2

Water level and Sample Depth Analytical Methods

Instrument/Parameter	LEADS Parameter Code	Units	Range	Method
(YSI 6-Series Multiprobes) Sample Depth	10078	Meter	Model Dependent	Non-vented Pressure Transducer
(Aqua TROLL 200)- Sample Depth	10078	Meter	0 -10.67 meters	Vented Pressure Transducer

LEADS = Leading Environmental Analysis and Display System

CWQMN Turbidity Method

Pine Island CAMS 749 turbidity measurement methods are not based on *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998. The turbidity data generated by this method are not appropriate for regulatory purposes. 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. Turbidity measurements are made using near-infrared (780 – 900 nanometers) or monochrome light source with single-detector nephelometry at a 90-degree angle making it compliant with ISO Method 7027. Formazin Nephelometric Units (FNU) are the designated measurement units for data collected using this ISO method. The CWQMN uses NTUs to report turbidity data collected by the ISO Method 7027 until the appropriate SWQMIS/Parameter code can be identified. All CWQMN turbidity data stored in LEADS is coded as NTU. When the appropriate parameter code is identified, the parameter code will be updated for all CWQMN turbidity data.

B5 Quality Control (QC)

Quality Control 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 measured, assessed, and controlled, according to procedures and criteria in TCEQ instrument/project-specific SOPs. Audits can also be used to assess data quality. Project/station-defined quality objectives are specified in Section A7.

The TCEQ has contracted with the USGS to provide stream discharge and water quality measurement data at sites on the Upper Rio Grande, Pecos River, and the Arroyo Colorado basins. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A6.2 and are available upon request.

B5.1 TCEQ Multiprobe Quality Control

TCEQ instrument/project-specific SOPs detail QC procedures, criteria, and frequency. Section B5.1 is intended to summarize TCEQ CWQMN QC activities, for complete details see TCEQ SOPs. SOPs can be found at the following web link: http://www.tceq.texas.gov/waterquality/monitoring/cwqm_sops.html

TCEQ stations include EMRS and non-EMRS stations. Data from EMRS stations are used on a near-real basis to screen water quality and data records are not validated. Non-EMRS station data records are validated using results from QC checks. Data from the Lower & Middle Rio Grande stations are not validated or used for EMRS purposes. See Table B5.1.1 for CAMS designations and TCEQ SOPs followed at each station.

Table B5.1.1

CAMS Designations and SOPs

CAMS	Station Designation	Measurement Equipment	SOP
749, 768	Non-EMRS	YSI 6-Series	TCEQ AMPM-011, Rev. 3
736, 767, 789, 791, 792, 793, 796, 800, 801	EMRS	Hydrolab-Hydrotech	TCEQ LRG and MRG SOP, Rev 0
716, 717	EMRS	YSI 6-Series	TCEQ AMPM-011, Rev. 3 (minus fouling measurement procedures)
728, 765, 726, 804, 805, 806	EMRS	Aqua TROLL 200	TCEQ - Analysis of In-Situ Specific Conductance, Water Temperature, and Sample Depth for the Bosque River Environmental Monitoring Response System Using Aqua TROLL 200 Multi-probes, Rev 1
749	EMRS	YSI 6-Series 6136 Turbidity Sensor	Analysis of In-Situ Turbidity at Pine Island Bayou for Environmental for Monitoring Response System using YSI 6-Series Multiprobes, Rev 0
773	EMRS	YSI 6-Series	TCEQ AMPM-011, Rev. 3 (minus fouling measurement procedures)

EMRS = Environmental Monitoring Response system
LRG = Lower Rio Grande
MRG = Middle Rio Grande

Non-EMRS Multiprobe Quality Control

Quality control consists of measuring sensor fouling and calibration drift at the conclusion of deployments. Sensor fouling is measured using USGS-based procedures. Multiprobe temperature sensors are checked at the conclusion of deployment periods. Results from these QC checks are used to validate the station's data records.

The sum (Total Error) and individual fouling and drift measurements are compared against project quality objectives. See Section A7 for quality objective criteria. Multiprobe fouling and drift measurement results are entered into TCEQ's Post Deployment Excel Worksheet. The spreadsheet calculates and compares fouling and drift measurement results to a project's quality objectives.

The USGS-based fouling measurement procedures are designed to measure the potential combined effects 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 in the water body. As part of the procedure, an additional multiprobe/field meter is deployed at the same location as the deployed multiprobe. Field meter (another multi-probe) 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.

Total Error

1.0 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.

Change in Water Quality Criteria

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*". Change in water quality results are compared against USGS criteria found in Table B5.1.2. If changes in water quality exceed criteria found in Table B5.1.2 for a given parameter(s) the fouling measurement is not considered valid and the corresponding data are invalidated (AQI).

2.0 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 correct fouling measurements for changes in water quality.

$$C_w = F_i - F_f$$

Where:

F_i = field meter response initial; and

F_f = field meter response final.

Table B5.1.2

USGS Change in Water Quality Criteria

Parameter	USGS Criteria
SC	±5 µS/cm or 3% use greatest
DO	±0.3 mg/l
pH	±0.2 pH units

Sensor Fouling

3.0 Multiprobe conductivity sensor fouling (F) over the deployment period is evaluated during field service events by using RPE to compare not cleaned and cleaned conductivity sensor responses:

$$F = \left(\frac{\left(S_i - S_f\right) - \left(F_i - F_f\right)}{S_f} \right) 100$$

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.

4.0 Multiprobe temperature, DO (mg/l), and pH (SU) sensor fouling (F) over the deployment period is evaluated during field service events by using AE to compare not cleaned and cleaned sensor responses:

$$F = \left(S_i - S_f\right) - \left(F_i - F_f\right)$$

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

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

5.0 Multiprobe conductivity sensor calibration drift (C_d) over the deployment period is evaluated using RPE:

$$C_d = \frac{(S_r - S_v)}{S_v}(100)$$

Where:

S_r= sensor response; and

S_v = specific conductance KCl standard value.

6.0 DO and pH C_d over the deployment period is evaluated using AE:

$$C_d = (S_r - S_v)$$

Where:

S_r = DO or pH sensor response; and

S_v = DO mg/l theoretical value; pH buffer standard value

Multiprobe Fouling Measurement Limitations

Fouling measurements are estimates of environmental effects on sensor performance. In some water bodies, stream scouring events can clean sensor interfaces and deployment tubes prior to performing the procedure; this 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 that can result from 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 B5.1.2 criteria as measured by the field meter.

EMRS Quality Control

EMRS multiprobe data are used on a near real-time basis. Data records for these stations are not validated. For high quality data, sensors and deployment tubes must be kept free of fouling.

Upper Colorado River (stations 716 and 717), North Concho river (station 773), Bosque River (stations 804, 805, 726, 728, 765, 806), and Pine Island (station 749)

Multiprobe exchanges occur at a minimum of once a month, Quality control consists of monthly SC sensor calibrations, measuring sensor calibration drift, deployment tube cleanings, and checking temperature sensors at the conclusion of deployment periods. These checks are conducted to ensure the multiprobes are operating within limits

Lower and Middle Rio Grande (stations 801, 800, 767, 796, 789, 791, 792, 793, and 736)

Multiprobe exchanges at the Lower and Middle Rio Grande stations occur at a minimum of once every quarter. Quality control consists of quarterly SC sensor calibrations, temperature sensor checks, and deployment tube cleanings.

Multiprobe Temperature Checks

After every deployment period (EMRS and no-EMRS stations), multiprobe temperature sensors are checked in the laboratory against NIST-traceable thermometers and thermistors. The criterion for this check is ±0.50 ºC. For non-EMRS stations, when a multiprobe fails this check DO and SC data collected during the deployment are invalidated. Calculated TDS concentrations are also invalidated.

Multiprobe Deployment Tube Cleaning

A variety of organisms and sediment can foul multiprobe deployment tubes. Deployment tube fouling can compromise data quality. Every multiprobe deployment tube in the network must be cleaned with a chimney brush (inside and out) as part of every routine service event.

Multiprobe Anti-Fouling Measures

Multiprobes can be equipped with various anti-fouling measures. Anti-fouling measures can improve data quality and increase deployment periods. USGS-based fouling measurement procedures can 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.

Multiprobe Sample Depth Measurements

CWQMN sample depth measurements are used qualitatively. Data from these measurements are not assessed for accuracy.

Station Monitoring

Every business day, all CWQMN station operators must monitor and screen water quality measurements, sample depth measurements, and station communications for

anomalies. If problems are identified, a station visit may be needed to correct any problems.

B5.2 Corrective action Related to QC

Any deviation from the procedures documented in the SOP should be documented in the operators log by the site operator. The log entry should contain a description of the exception, the cause (if possible), the affected data, and the impact on the data 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 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 the QC sample is representative of ambient measurements. QC sample anomalies should be documented.

B6 Instrument/Equipment Testing, Inspection and Maintenance

Instruments and equipment for specific projects included in the *CWQMN QAPP* may be funded by any combination of federal funds (Clean Water Act Sec 106 or other federal grants) and/or non-federal funds (state and local funds).

Instrument maintenance activities are documented in equipment dedicated logbooks. PMA records contain information on periodic routine maintenance, symptoms, troubleshooting effort descriptions, results and follow-up observations. Records should include the date, time, and the name or initials of the site operator performing the maintenance. These records are vital tools in historic instrument performance and are an aid to future troubleshooting. TCEQ maintenance documents are based on manufacturers' recommendations. See Section B2 on how critical spare parts will be supplied and stocked.

The TCEQ has contracted with the USGS to provide stream discharge and water quality measurement data at sites on the Upper Rio Grande, Pecos River, and Arroyo Colorado Basins. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A6.2 and are available upon request.

Multiprobes

Currently, the instruments' operation manuals are being used as guidance for maintenance activities.

Multiprobe Optical DO Membranes (YSI)

The manufacturer recommends replacing optical DO membranes on an annual basis. Among the reasons for replacing membranes provided by the manufacturers is degradation of the luminescence dye in the sensing element due to photo-bleaching and membrane age.

Optical DO calibration adjustments are automatically tracked through changes in sensor gain. YSI recommends DO calibrations be rejected and the sensor not be used to collect data when a calibration causes the gain to exceed their criteria (0.85 – 1.15). When a sensor exceeds gain criteria, the problem can be the result of the membrane or other sensor components. CWQMN YSI optical DO gains must checked after each calibration to ensure they are within YSI criteria.

The current TCEQ policy is to routinely replace optical DO membranes every twelve months. The date the membrane is installed on the DO sensor is considered the starting date for the twelve month replacement frequency. See TCEQ YSI SOP AMPM-011, Rev. 3 for replacement and documentation instructions.

Optical DO membranes are coated with a black material to keep ambient light from causing sensor measurement interferences. In abrasive stream deployment environments, DO wiper pads can trap abrasive particles and damage membrane coatings. If coatings are scratched off by more than 25% the membrane must be replaced.

B7 Instrument Calibration and Frequency

Before multiprobe deployments, calibration standards are analyzed to establish instrument response. Concentrations or constituents are calculated using single-point and multi-point calibration responses.

Standards

Calibration and CVSs shall be National Institute of Standards and Technology (NIST) - traceable standards. All CWQMN multiprobe conductivity and pH standards must have a Certificate of Analysis (COA) that contains traceability and accuracy statements. Expired standards cannot be used.

Pine Island Bayou CAM749 Formazin Standards

Turbidity sensors are calibrated using Hach Formazin standards and reagent grade water. Class A pipettes are used to dilute a 4000 NTU Formazin standard.

Instrument Calibrations

Single-point or multi-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.

Multiprobe Temperature Checks

After every deployment period, network multiprobe temperature sensors are checked against NIST- traceable thermometers and thermistors; the TCEQ employs single-point checks using tap water in a temperature controlled environment.

The TCEQ site operators and cooperators have been issued digital thermometers. These thermometers must be re-certified/calibrated every two years. The stated accuracy of these thermistors is ± 0.05 °C. Since the checks are not conducted in a circulated vessel of water, there can be an additional 0.05 °C approximate error with the method.

USGS site operators use NIST traceable thermistors. The thermistors are calibrated annually against NIST-calibrated or traceable thermometer.

USGS Instrument Calibration and Frequency

The TCEQ has contracted with the USGS to provide stream discharge and water quality measurement data at sites on the Upper Rio Grande, Pecos River, and Arroyo Colorado basins. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A2.6 and are available upon request.

As part of TCEQ's contracts with USGS, multiprobes must be calibrated in a temperature controlled environment at a minimum of once a month.

B8 Inspection/Acceptance of Supplies and Consumables

The MD procures, stores, and dispenses various spare parts, equipment, consumable items, and other items to CWQMN TCEQ staff and Cooperators.

The TCEQ has contracted with the USGS to provide stream discharge and water quality measurement data at sites on the Upper Rio Grande, Pecos River, and Arroyo Colorado basins. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A6.2 and are available upon request.

B8.1 Spare Parts

TCEQ spare parts are tracked in an inventory management database. Restock orders are automatically posted when the stock levels go below a certain level that has been established for each inventoried item.

B8.2 Standards

The TCEQ provides SC and pH standards that are purchased through the state contract system or through inter-agency contracts.

B9 Non-Direct Measurements

This QAPP does not include the use of routine data obtained from non-direct measurement sources.

B10 Data Management

Water quality data and sample depth data are sent to TCEQ by wireless cellular modem and GOES. See Table B2.1 for telemetry methods for specific sites.

Near real-time data are transferred to the TCEQ Headquarters (Austin, Texas) Via the LEADS communications server that automatically download a discrete measurement from Zeno and Sutron data loggers every 15 minutes. The data are secured from tampering or corruption over the carrier line through an unlisted telephone number, pass code protection, and error checking protocol. Operator logs may be entered on-site or remotely via the data loggers. Operator logs may also be entered via TCEQ's web based RHONE page (for those operators who have access to the page).

For sites that utilize GOES, stage and water quality measurements are logged once every 15 minutes by a Sutron Datalink2 data logger and relayed to the GOES once every hour. The data is then decoded and ingested from the NOAA Port and ingested into the LEADS communications server.

Measurement instrumentation is connected to the data logger systems. The data logger systems record the analog output voltage of each instrument once every 15 minutes, digitize it, and store the data. Data is available as discrete 15-minute samples and 15-minute samples are averaged into 1-hour averages. A record consists of sequential fields of data for as many channels as are activated for each monitoring station.

If the telemetry method fails at a given site, the data loggers are 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 LEADS communications server. The site operator and data validator should check the operational status of the station every business day via the TCEQ website. If communication problems are detected, the site operator needs to initiate corrective action in a timely manner or data can be lost. The site operator should alert the Network Coordinator, QC officer, and MD Data Collection Team staff to initiate corrective action. Once MD staff has been notified, MD will ensure that corrective action was taken and that the action was effective.

The CRMWD checks the operational status of their multiprobe (see Table A6.1) via hardwire connections. Consequently, data communication problems to the TCEQ will not be detected by CRMWD.

The MeteoStar/LEADS processing program checks for correct date, time, sampling site number, and proper formatting of raw data fields. For the water quality parameters it then calculates hourly averages, converting voltages to engineering units. The data are stored in a temporary disk file. CWQMN data validators work from this file through their personal computer on a graphical interface. Data validators obtain station operation information from the Operator Log external webpage, which is typically entered by site operators and cooperators/contractors. TCEQ site operators access the web page operator log at http://tceqwatercal.ipsmtx.com/. A password is needed to access the external web page. Network participants can obtain passwords from the Network Coordinator.

USGS Near Real-time Provisional Data Submissions

For USGS Upper Rio Grande and Pecos River stations, USGS submits formatted continuous water quality and gage height data hourly to TCEQ LEADS using an automated script that extracts the data from the USGS data base, formats it and sends the data to a file transfer protocol (FTP) site.

Data from the Arroyo Colorado vertical profiler station is not sent to the LEADS. Data from the Arroyo Colorado station (CAMS 730) is available via the web from USGS's National Water Information (NWIS) data base. Below is a link to NWIS Arroyo Colorado website data.

http://waterdata.usgs.gov/tx/nwis/uv/?site_no=08470500&PARAmeter_cd=00065,00060,00300,00400,00095,00010,63680

USGS Multiprobe Water Quality Measurements

For USGS Upper Rio Grande and Pecos River-operated sites, two data sets are regularly delivered to TCEQ.

USGS uses an automated water quality data ingest system that retrieves, formats, and scans incoming data for errors. When USGS transmits this data to TCEQ, it is "provisional." This provisional data is coded as parameter occurrence code (POC) 1 and is subject to change as the data is validated by USGS. The data transmission is received by TCEQ and loaded into the LEADS database.

Within 150 days of data collection, USGS staff will review the data and compute unit values based on the fouling and drift documented at the time the sensors are retrieved from the deployment site. When USGS has completed their review and the results approved by USGS management, the data is transmitted to TCEQ by FTP with the data coded as POC 3 indicating that the data has been validated. This process retains the provisional data (POC 1) and the validated computed unit values (POC 3) in the LEADS database
The USGS reviews data on an on-going basis. If problems with data are identified as part of this review, the USGS may re-submit data to TCEQ. Data submitted as the result of changes to approved POC3 data will be submitted by FTP flagged as POC4.

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. These data may be requested from the Water Data Management & Analysis team.

Currently, WDMA is in the process of migrating to Aquatic Informatics AQUARIUS software. AQUARIUS software will facilitate validation of CWQMN data, allow for more complex analyses, and provide storage of data in a data cloud that has been created at the State of Texas Data Center

Calculated parameters such as total dissolved solids 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 parameters 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	ºC
Specific Conductance	10095	00094	µS/cm
Dissolved Oxygen	10300	00300	mg/L
Dissolved Oxygen, Percent Saturation	10301	00301	%
pH	10400	00400	pH units
Turbidity	10104	NA*	FNU
Total Dissolved Solids (grab)	Not applicable	70300	mg/L

*SWQMIS parameter code for CWQMN turbidity measurements being requested. Units associated with the new parameter code will be Formazin Nephelometric Units.
FNU = Formazin Nephelometric Units
NA = not available
mg/L = milligrams/Liter
µS/cm = micro Siemens / centimeter
ºC = Degrees Centigrade

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 Water Data Management & Analysis Team. Non-validated data may 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 data server. Internal and external reports and summaries are compiled from data hosted on this server.

Data collected with multiprobes 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 stations. 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 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 CWQMN.

The TCEQ has contracted with the USGS to provide stream discharge and water quality measurement data at sites on the Upper Rio Grande and Pecos Rivers. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A6.2 and are available upon request. These documents contain information about USGS stage and discharge assessments and response actions. TCEQ does not currently have staff with required expertise to conduct assessments of stage and discharge monitoring related activities.

The Texas State Soil and Water Control Board (TSSWCB) contracted with USGS to install, operate, maintain, and validate Pecos River CAMSs 798 and 799 according to USGS procedures *(TM1D3)*. TCEQ and TSSWCB have developed a Memorandum of Agreement (MOA) whereby, TCEQ will maintain technical oversight for the two CAMSs according to the CWQMN QAPP and Pecos Project Plan. The agreement specifies that TSSWCB will coordinate with TCEQ and USGS to ensure responses to any TCEQ-identified audit finding are addressed within 30 days and ensure implementation of the agreed corrective action.

Based upon audit reports, the Network Coordinator, QA Officer, and QC Officer will work collaboratively on recommendations to the appropriate Manager(s) to stop work if necessary to safeguard programmatic objectives, worker safety, public health, or environmental protection.

CWQMN Participant-Initiated Corrective Action

It is expected that any individual in the 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 QC Officer and Network Coordinator 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
- Readiness Reviews
- Monitoring Station TSAs and PEAs
- Data Management Assessments
- Annual Multiprobe Data Completeness Assessments for non EMRS stations

The program has a goal of conducting a total of two assessments each fiscal year (Readiness Reviews and/or Monitoring Station TSAs and PEAs).

Readiness Reviews

Station readiness reviews may be conducted at the beginning of a new project to ensure a project is a functioning correctly. Readiness reviews may also be conducted after a major change to an existing project.

Monitoring Station TSAs and PEAs

The TCEQ staff conducts monitoring station TSAs/Performance Evaluation Audits (PEAs) and readiness reviews for CWQMN water quality monitoring related activities.

Monitoring station TSAs/PEAs focus on project objectives, station operations, and measurement systems.

TSAs include a thorough systematic, on-site qualitative audit of station operation, equipment, training, personnel, documentation, sampling and measurement systems, QC procedures, and safety of a system. TSAs focus on conformance to procedures, if available.

PEA audit procedures test the ability of measurement systems to obtain acceptable results. Audit results are compared against applicable quality control acceptance criteria. 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 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 Assessments

Data Management has developed assessment procedures for 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 SOP, "Quality Assurance of External Party Continuous Water Quality Data Validation."

Data Completeness Assessments

The CWQMN has a general data completeness requirement of 75% data return. Data completeness is defined as data meeting QC performance criteria described in Sections A7 and B5.

Sites in the CWQMN may be located in intermittent streams. Suspension of water monitoring can occur in times of drought.

TCEQ Data completeness is calculated as follows for stream sites:

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

TCEQ data completeness reports for Non-EMRS stations are submitted by Data Management & Analysis on an annual basis (end of the FY).

USGS Data Completeness Reports

Periodically, USGS provides TCEQ data completeness reports for TCEQ/USGS contract sites. As part of the contract, a data completeness requirement of 75% data return meeting at least a USGS "fair" data rating was established.

TCEQ 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, multiprobe deployments, or are process related. Project findings are typically associated with the site operator not following procedures. It is the responsibility of the Network Coordinator to respond to program findings. Responses to Project findings are the responsibility of TCEQ site operators. TCEQ Management may respond / provide comments as appropriate for site operators.

It is the responsibility of the 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 subsequent 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 root cause of the finding (nonconformance);
2. The nature and extent of the finding's impact on data quality;
3. The specific corrective actions taken or planned to address the finding;
4. Actions taken or planned to prevent recurrence;
5. The timetable for completing each action; and
6. The means to be used to document and verify completion of each action.

The Network Coordinator is responsible for executing TCEQ corrective actions when findings are program related. The TCEQ site operator's management is responsible for executing TCEQ corrective actions when findings are project related.

For sites operated by a contractor, the Network Coordinator is responsible for applying applicable contractual authority to resolve corrective actions.

The Network Coordinator is responsible for documenting and verifying completion of all corrective actions.

Audit findings will remain open until an acceptable response has been received for negative findings. Audit finding responses may be submitted via email to the CWQMN QC Officer, Ed.Ragsdale@tceq.texas.gov.

C2 Reports to Management

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

Audit Reports

Final reports are submitted to the auditee and the various TCEQ managers who support the CWQMN, team leaders, Categorical 106 Grant Project Manager, and to the QA Officer. Audit reports and audit responses are available upon request.

USGS Water Quality and Discharge Data

The USGS must notify TCEQ CWQMN Network Coordinator in writing if any USGS collected data that has been subsequently identified by USGS and/or TCEQ as not meeting USGS/TCEQ quality objectives or criteria.

Reports to TCEQ Project Management

USGS will provide TCEQ with a report providing the following information when any USGS validated data does not meet quality objectives or criteria:

- Specific data not meeting quality objectives or criteria.
- The quality objective or criteria not met.
- An explanation of impact to data.
- Corrective action

USGS Monthly Progress Reports

The USGS submits monthly progress reports to the CWQMN Network Coordinator for all USGS-operated stations. These reports document activities from the first day of the subject month to the last day of the subject month and are due on the 15th of the subsequent month. Each monthly report details each station service event, fouling and drift measurements, issues encountered and the resolution of issues.

Table C2.1

Reports to Management and Actions Taken

Report Title	Frequency	Originator	Recipient	Actions To be Taken
Monitoring Station TSA (partial) and PEA or Readiness Reviews	A goal of a total of two assessments each fiscal year	QC Officer	Network Coordinator TCEQ Regional Manager CWQMN Program Manager 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 operator to determine 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 Management & Analysis Team		
Multiprobe Data Completeness Reports	Annual (end of fiscal year)	Data Management	Network Coordinator TCEQ Regional Manager CWQMN Program Manager Site Operator/Cooperator CWQMN QA Officer CWQMN QC Officer Categorical 106 Grant Project Manager WQPD Quality Assurance & Data Management Team Leader	
Annual QA Report	Annual	QA Officer	EPA	NA
CWQMN site update and progress reports	Biannual	Network Coordinator	Categorical 106 Grant Project Manager	NA

Currently data completeness reports not being generated.
DQO = Data Quality Objective
EMRS = Environmental Monitoring Response System
EPA = U.S. Environmental Protection Agency
MQO = Monitoring Quality Objective
NA = Not Applicable
PEA = performance evaluation audit
SOP = standard operating procedure
TBD = to be determined
WQPD = Water Quality Planning Division

D1 Data Review, Verifications, and Validation

The TCEQ WQPD staff and contractors review and validate water quality data generated by the CWQMN. See Table A6.1 for CWQMN data validators.

USGS Operated Stations

The TCEQ has contracted with the USGS to provide stream discharge and water quality measurement data at sites on the Upper Rio Grande, Pecos Rivers, and Arroyo Colorado Basins. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A6.2 and are available upon request.

For the Upper Rio Grande and Pecos River stations, the USGS is validating and processing data according to procedures found in Appendix F. *Adaptation of Data Validation and Fouling Correction Procedures for Water-Quality Monitoring Stations on the Upper Rio Grande and Pecos River*, 2013.

D1.1 Data Reviews and Validation for Stations Following TCEQ Procedures

Only data that data validators designate as acceptable will be identified as valid data in the MeteoStar/LEADS database. For a complete list of Data Validation flags, see Table D2.1. TCEQ data is validated based on various data reviews and when applicable QC sample results are compared against project/CAMS quality objectives found in Section A7. The WQPD Data Management & Analysis Team is responsible for assigning data validation flags.

TCEQ Data Reviews

For each CAMS, data are reviewed by station operators, electronically by MeteoStar/LEADS, and manually by WQPD data validators. See Table D1.1 for TCEQ data reviews.

Table D1.1

Data Reviews

Data Reviews	Responsibility
The station operator documents any problems identified during a station visit in LEADS operator logs that detail any anomalies and affected data (see Appendix E for operator log content). Data validators may qualify data based on this information.	Station Operators
Every business day, station operators and the assigned data validator (or designees) monitor (via TCEQ daily report on Rhone web station) and screen water quality measurements, sample depth measurements, and station communications for anomalies. Data validators may qualify data based on this information.	Station Operators and Assigned WQPD Data Validator
The MeteoStar/LEADS system automatically flags data when values exceed station-specific pre-defined ranges. Limit Exceeded (LIM) – Flags are automatically assigned to any data that fall above or below station-specific pre-defined ranges. Data are automatically flagged Lost Data (LST) when data is not retrieved by the data logger because of power outages, equipment malfunction, etc.	MeteoStar/LEADS

On a weekly basis, data validators perform data review using the MeteoStar/ LEADS interface to graphically display the data. Data are reviewed for integrity, continuity, and reasonableness. Any data deemed questionable by the data validator due to inexplicable extreme values, data dropouts, flat-lined data, etc. may be qualified Ambient Quality Invalidated (AQI).	Data Validator

During data validator data reviews, certain issues or questions may arise about particular data point(s); in these cases, the data validator will refer to the operator logs. If no logs exist, or the log does not identify a source for the questionable data, the validator contacts the station operator via phone or email to try to resolve any issues and verify affected data. Additionally, data validators may use multiprobe sample depth, water level, and discharge measurement data as a source of additional information for data qualifying decisions.

TCEQ non-EMRS Multiprobe Data Validation Using QC Sample Results

For each project/CAMS, Section A7.1 lists quality objectives used to accept or reject project data. Compliance with Section A7.1 quality objectives are based on QC sample results.

CAMSs: 749, and 768

Data validations for these stations are based on the following QC results:

1. Calibration Verification Sample (calibration drift) results
2. Sensor/deployment tube fouling measurement results
3. Change in water body measurement results
4. Laboratory multiprobe temperature check results

After each multiprobe deployment period, station operators enter fouling and CVS measurements into the Post Deployment Worksheet (PDW) Excel spreadsheets. The PDW calculates results based on equations and change in water body criteria found in Section B5.1.

Spreadsheet Pass/Fail fields include the following:

5. The sum (Total Error) of fouling and calibration drift results
6. Individual fouling and drift results
7. Change in water body results

If any of these fields indicate “Fail” for a given parameter(s), the corresponding data (including TDS calculated from SC) back to the last passing multiprobe exchange are invalidated using the Ambient Quality Invalidated flag (AQI).

Multiprobe temperature checks are done at the conclusion of deployment periods, if the check fails the ±0.5 º Celsius criterion, the corresponding temperature, DO, SC, and calculated TDS data are invalidated (flagged as AQI) back to the last passing multiprobe exchange.

TCEQ EMRS Multiprobe Stations

Data records for EMRS stations are not validated; CVS and temperature check criteria are used as guidelines to ensure measurement equipment are operating within limits

Colorado River Municipal Water District EMRS Project CAMSs 716 and 717

The Municipal Water District uses near-real time SC measurements to manage water diversions.

Lower Neches Valley Authority Turbidity CAMS 749

The LNVA uses turbidity data on a near real-time basis for water management decisions.

Bosque River SC EMRS Project (CAMS: 804, 805, 806, 726, 728, and 765)

The TCEQ uses data from these stations to provide timely run-off SC data for screening and targeting field responses and investigations for the EMRS Pilot Program.

Upper Colorado River Authority CAMS 773

The station provides UCRA with near real-time data to monitor water quality for potential fish kills.

TCEQ Lower Rio and Middle Rio Grande Project (CAMS: 736, 767, 789, 791, 792, 793, 796, 800, and 801) Data Review Reports

Every business day, WQPD staff remotely monitors and reviews the general operational status of all stations in the lower Rio Grande and emails a daily Data Review Report to interested parties. The report contains the following information:

- Stations on-line
- Stations reporting data
- Reasonableness of the data
- Data concerns
- Other comments

D2 Verification and Validation Methods

USGS Operated Sites

The TCEQ has contracted with the USGS to provide stream discharge and water quality measurement data at sites on the Upper Rio Grande, Pecos Rivers, and Arroyo Colorado stations. See Table A2.5 for a list of USGS/TCEQ Project Plans and Section A2.6 for the internet locations of USGS Guidelines and Procedures. USGS Texas Water Science Center QAPPs are also listed in Section A6.2 and are available upon request.

D2.1 Data Verification and Validation Methods for Sites Following TCEQ Procedures

Data Validation Notes and Audits

After validating any data, and for MeteoStar/LEADS to consider the data as being validated, the data validator must enter validator notes. These notes document and explain any data qualifications made, other than valid (VAL flag), and why the qualification was made. In addition to the electronic validator notes, each validator also keeps a hard copy Validator Notebook containing the same information. Data validators keep these notebooks on file for 5 years and make them available for audits upon request.

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. For stations where data is validated, 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 reviewed and validated 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 the data validator.
PMA*	Preventive Maintenance – Flag manually assigned when site operator is performing maintenance on analytical equipment.
VAL	Valid – Flag automatically assigned to any data that does not fall above or below pre-defined limits. Valid – Flag manually assigned to any data that was previously automatically assigned a Limit Exceeded (LIM) flag that was later deemed valid by the data validator.
LIM	Limit Exceeded – Flag automatically assigned to any data that fall above or below a 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.

*All data within one hour after any PMA flag is qualified as invalid (AQI). This 1-hour time period allows the multiprobe to equilibrate/stabilize to ambient water quality conditions before data may be considered valid.

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 stations or by the site operators, 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 mechanisms for communication between the producers and the users of the data are telephone, e-mail, and the operator's log.

The auditors, validators, site operators, project leads, 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 quality objectives and measurement quality objectives as discussed in Section A7.

Appendix A - Definitions

Quality Control Samples

Calibration standard (CS)

Definition - A mixture prepared from the primary standard mixture or stock standard mixture and, when appropriate, containing the internal standards and surrogates.

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

Calibration verification sample (CVS)

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

Application - Used to verify analytical system calibration.

Performance evaluation (PE) sample

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

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.

General Quality Control

Chain-of-custody (COC)

Definition - An unbroken trail of accountability that documents the possession of samples, data, and records.

Application - Provides documentation to establish sample integrity.

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.

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.

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).

Comparability - A measure of the confidence with which one data set can be compared to another.

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.

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.

Deficiency - An unauthorized deviation from acceptable procedures or practices, or a defect in an item.

Matrix - Substance being tested.

Measurement Quality Objective (MQO) - The desired sensitivity, range, precision, and bias of a measurement.

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.

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.

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.

Quality Assurance Project Plan (QAPP) - A formal document describing in comprehensive detail the necessary QA, QC, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria.

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

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.

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.

Sample Depth - Depth of multi-probe 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 the method for performing certain routine or repetitive tasks.

Water Level (also known as stage) - Height of water in the stream above a reference point. (USGS)

Appendix B - Acronyms

A

AE	Absolute Error
AQI	Ambient Quality Invalid
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
CRMWD	Colorado River Municipal Water District
CRP	Clean Rivers Program
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

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

F

FNU	Formazin Nephelometric Units
FTP	File Transfer Protocol
ft/s	Feet per Second
FY	Fiscal Year

G

GOES	Geostationary Operational Environmental Satellite

H

HC&CC	Hidalgo & Cameron County Irrigation District

I

ISO	International Organization for Standards

K

KCl	Potassium Chloride

L

LEADS	Leading Environmental Analysis and Display System
LIM	Limit Exceeded
LNVA	Lower Neches Valley Authority
LRG	Lower Rio Grande

M

MA	Monitoring and Assessment Section
MD	Monitoring Division
mg/L	milligram per liter
MOA	Memorandum of Agreement
MQO	Measurement Quality Objective

N

NA	Not Applicable
NIST	National Institute of Standards and Technology
NOAA	National Oceanic & Atmospheric Administration
NTU	Nephelometric Turbidity Units
NWIS	USGS's National Water Information data base

P

PC	Personal Computer
PDW	Post Deployment Worksheet
PEA	Performance Evaluation Audit
PMA	preventative maintenance
ppb	parts per billion
ppm	parts per million
PSS	Program Support Section
PVC	Polyvinyl Chloride

Q

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

R

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
SWQMIS	Surface Water Quality Monitoring Information System

T

T	Temperature
TBD	To Be Determined
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TPWD	Texas Parks & Wildlife Department
TSA	Technical System Audit
TSSWCB	Texas State Soil and Water Control Board
TSWQS	Texas Surface Water Quality Standards
TWRI	Texas Water Resource Institute

U

µS	micro Siemens
UCRA	Upper Colorado River Authority
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USIBWC	United States International Boundary Water Commission

W

WDMA	Water Data Management and Analysis
WPP	Watershed Protection Plan
WQPD	Water Quality Planning Division

Y

YSI	Yellow Springs Instrument

Misc.

^{o}C	Degrees Centigrade
µS/cm	micro Siemens/centimeter

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

(Project Name)

CONTINUOUS WATER QUALITY MONITORING

PROJECT PLAN

(Note to user: This form provides some of the text to be used in the project plan. Instructions are provided in italics, and should be deleted during completion of the form.)

A1 APPROVAL PAGE

_____ _____
Charles Dvorsky Date
CWQMN Network Coordinator, TCEQ SWQM

_____ _____
Andrew Sullivan Date
SWQM Team Leader, TCEQ SWQM

_____ _____
Patricia Wise Date
Section Manager, TCEQ Monitoring & Assessment Section

_____ _____
Daniel Burke Date
CWQMN Quality Assurance Officer

_____ _____
Name Date
Project Lead, TCEQ SWQM Program

_____ _____
Edward Ragsdale Date
CWQMN Quality Control Officer, TCEQ SWQM

_____ _____
Cathy Anderson Date
Team Leader Data Management and Analysis Section

_____ _____
Other Project Participants Date

This plan documents specific details for new continuous water quality projects. Critical project-specific details for new CWQMN stations are not covered in the CWQMN QAPP. Please see the CWQMN QAPP for other network details.

A2 TABLE OF CONTENTS

TABLES:

LIST OF ACRONYMS (common Acronyms)

CAMS	Continuous Ambient Monitoring Station
CFS	Cubic Feet per Second
CVS	Calibration Verification Sample
CWQMN	Continuous Water Quality Monitoring Network
DO	Dissolved Oxygen
EC	Electrical Conductance (Reported as Specific Conductance)
FY	Fiscal Year
LEADS	Leading Environmental Analysis and Display System

MDL	Method Detection Limit
mg/L	Milligram per Liter
NA	Not Applicable
NIST	National Institute of Standards and Technology
NTU	Nephelometric Turbidity Units
ppm	parts per million
PSS	Program Support Section
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
RPE	Relative Percent Error
SC	Specific Conductance
SOP	Standard Operating Procedure
SWQM	Surface Water Quality Monitoring Team
T	Temperature
TBD	To Be Determined
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TSWQS	Texas Surface Water Quality Standards
µS/cm	micro Siemens per centimeter
WQPD	Water Quality Planning Division
°C	Degrees Centigrade

A3 DISTRIBUTION LIST

Include project participants (e.g., site operators, contractors, etc.).

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Katherine Nelson, Assistant Division Director, Water Quality Planning Division
Patricia Wise, Manager, Monitoring & Assessment Section, Water Quality Planning Division
Richard C. Chism, Division Director, Monitoring Division
Andrew Sullivan, Team Leader, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Charles Dvorsky, Network Coordinator, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Cindy Maresh, Manager, Data Management Section, Monitoring Division
James Janysek, Team Leader, Data Collection Team, Data Management Section, Monitoring Division
Daniel Burke, CWQMN Quality Assurance Officer, Laboratory & Quality Assurance Section, Monitoring Division
Patricia De La Cruz, Manager, Ambient Monitoring Section Section, Monitoring Division

A3 Distribution List (continued)

Holly Landuyt, Team Leader, Network Implementation Team, Monitoring Division
Laura Roberts, Data Collection Team, Monitoring Division
Keith Talley, Network Implementation Team,, Monitoring Division
Lloyd Lawrence, Data Collection Team, Monitoring Division
Robert Hernandez, Data collection Team, Monitoring Division
Michele Blair, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Edward Ragsdale, CWQMN Quality Control Officer, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Robin Cypher, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Pat Bohannon, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Bill Harrison, Surface Water Quality Monitoring Team, Monitoring & Assessment Section, Water Quality Planning Division
Peter Bohls, Data Management & Analysis Team, Monitoring & Assessment Section, Water Quality Planning Division
Cathy Anderson, Data Management & Analysis Team, Monitoring & Assessment Section, Water Quality Planning Division
Debbie Peters, Division Support Section, Water Quality Planning Division

List other TCEQ staff if applicable. Also list contractors if applicable.

A4 PROJECT/TASK ORGANIZATION

This section is intended to identify individuals and organizations that will be responsible for developing and/or supporting new CWQMN projects. For a list of additional project/task and responsibilities please refer to section A4 of the CWQMN QAPP.

The Project Lead is responsible for the development of the Project Plan.

A4.1 TCEQ CWQMN Coordinator (Charles Dvorsky)
A4.2 TCEQ SWQM Project Lead *(Name)*

X Develop Project Plan

A4.3 Site Operator (Name and Agency)

X Site Operation and Maintenance

A4.4 (Name and Agency)

X Data Validation

A4.5 Project Participant (Name and Agency)
A4.6 Contractor (Name)

A5 PROBLEM DEFINITION/BACKGROUND

State the specific problem to be solved or decision to be made, or the outcome to be achieved. Include enough background information to provide a historical perspective and scientific perspective.

The discussion should include enough information (i.e., past history, regulatory context, and previous work) to understand the project objective.

A6 PROJECT/TASK DESCRIPTION

Summarize the work to be performed and the schedule for implementation as well as monitoring site geographic location(s) and TCEQ segment numbers.

In some CWQMN projects, project/task descriptions are laid out **in detail** in contractual/ subcontractual work plans. If the work plan addresses the following information **in detail**, then the contractual/subcontractual work plan may be attached and referenced.

See Appendix C of the CWQMN QAPP for Site Selection, Preparation, and Deployment of Continuous Water quality Monitoring Stations, SOP MANP-001, Revision 2.

A7 QUALITY OBJECTIVES AND CRITERIA

The measurement performance specifications to support the project objectives are specified in Table(s) A7.1 – x.

Add tables as needed. Reference applicable CWQMN analytical SOPs if available.

Methods used are based on Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998 unless otherwise noted.

Table A7.1
Quality Objectives
TCEQ Multiprobe CAMS

Parameter	Fouling & Drift/(CVS) Acceptance Limits (sum and individual fouling & drift acceptance limits)	Temperature Acceptance Limit	Instrument/SOP
Specific Conductance/ Total Dissolved Solids	±5%	±0.5 º C*	*Add instrument and applicable SOP*
Dissolved Oxygen	±0.5 mg/l		
pH	±0.5 units		
Temperature		±0.5 º C	
Sample Depth	NA		

*If temperature sensor checks do not meet the ±0.5 º C criterion, the corresponding temperature, DO, SC, and calculated total dissolved solids data are considered invalid
CVS = calibration verification sample
NA = not applicable, sample depth measurements not assessed for accuracy
ºC = degrees centigrade
mg/l = milligrams per liter

Ambient Water Reporting Limits (AWRLs)

As described in Section A7 of the CWQMN QAPP. (*If applicable)*

Precision

As described in Section A7 of the CWQMN QAPP. (*If applicable)*

Bias

As described in Section A7 of the CWQMN QAPP. (*If applicable)*

Representativeness

As described in Section A7 of the CWQMN QAPP. (*If applicable)*

Comparability

As described in Section A7 of the CWQMN QAPP. (*If applicable)*

Completeness

As described in Section A7 of the CWQMN QAPP. (*If applicable)*

A8 SPECIAL TRAINING/CERTIFICATION

Indicate who will train site operators, and how.
Discuss training schedule for site operators, data validators or other needed project training.
Provide any other training requirements.

A9 DOCUMENTS AND RECORDS

As described in sections A9 of the CWQMN QAPP. (*If applicable)*

B1 SAMPLING PROCESS DESIGN

Site Selection Criteria

Describe the rationale for selecting monitoring site(s).

Monitoring Station Design

Describe how monitoring equipment will be configured (including measurement frequencies) to collect data that will answer project objectives.

List specific monitoring and support equipment: measurement equipment, data logger, telemetry, modems, trailer, traffic box, etc.

Detail site developmental needs; pad, electricity, fence, phone, special items, etc. Discuss site development schedule.

Indicate who will be responsible for site operation and maintenance.

B2 SAMPLING METHODS

As described in sections B2 of the CWQMN QAPP. (*If applicable)*

Sampling/Measurement System Corrective Action

As described in sections B2.2 of the CWQMN QAPP.

B3 SAMPLE HANDLING AND CUSTODY

As described in Section B3 of the CWQMN QAPP. (*If applicable)*

B4 ANALYTICAL METHODS

Analytical methods and analytical SOPs are listed in Section A.7.

B5 QUALITY CONTROL

As described in Section B5 of the CWQMN QAPP. (*If applicable)*

Analytical method SOPs are listed in Section A.7 detailing QC procedures. *If SOPs are not available describe QC program for project.*

Corrective Action Related to Quality Control

As described in Section B5 of the CWQMN QAPP. (*If applicable)*

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

As described in CWQMN QAPP. (If applicable)

List the equipment and/or systems needing periodic maintenance, testing, or inspection, and the schedule for such.

List all applicable equipment maintenance SOPs or equipment manuals.

B7 INSTRUMENT CALIBRATION AND FREQUENCY

As described in CWQMN QAPP. (*If applicable)*

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

As described in CWQMN QAPP. (If applicable)

Describe how spare parts, standards and reagents will be obtained by site operators.

B9 NON-DIRECT MEASUREMENTS

There are no non-direct measurements used in this project. (*If applicable)*

B10 DATA MANAGEMENT

Indicate who will manage project data, and how, including communication, telemetry, data processing, and depository. State who is performing data analysis (and how) and what action will be taken with data results.

As described in CWQMN QAPP. (If applicable)

C1 ASSESSMENTS AND RESPONSE ACTIONS

As described in CWQMN QAPP. (*If applicable)*

Corrective Action

As described in Section C1 of the CWQMN QAPP. (*If applicable)*

C2 REPORTS TO MANAGEMENT

As described in Section C2 of the CWQMN QAPP.

Reports to TCEQ Project Management

As described in Section C2 of the CWQMN QAPP.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

As described in Section D1 of the CWQMN QAPP.

List the TCEQ data validation SOPs that will be used.

Indicate who will be responsible for validating station data, and if the person(s) will require training.

D2 VERIFICATION AND VALIDATION METHODS

As described in Section D2 of the CWQMN QAPP.

D3 RECONCILIATION WITH USER REQUIREMENTS

As described in Section D2 of the CWQMN QAPP.

Appendix D - References

1. Texas Commission on Environmental Quality, *Quality Management Plan, Rev. 18,* January 2013
2. United States Geological Survey – *Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting TM1D3*
3. United States Geological Survey – *Turbidity 6.7, Version 2.1* (9/2005)
4. United States Environmental Protection Agency, *Requirements for Quality Assurance Project Plans QA/R-5,* March, 2001, reissued May, 2006.
5. *Standard Methods for the Examination of Water and Wastewater*. American Public Health Association, Washington, DC, 20th edition, 1998.
6. *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.
7. The NELAC Institute, *2009 TNI Standard,* Vol. 1.
8. *American National Standard Institute* [ANSI]/*American Society for Quality Control* [ASQC]*Z1,* Standard E4-19.
9. *Surface Water Quality Monitoring Quality Assurance Project Plan*. Texas Commission on Environmental Quality, Rev. 13, January 2010.
10. *Surface Water Quality Monitoring Procedures, Volume1: Physical and Chemical Monitoring Methods,* October 2008, RG-415
11. *Chemical Hygiene Plan*. Texas Commission on Environmental Quality, November 2000

Appendix E

Multiprobe Operator Log Entry and Excel Post Deployment Worksheets (Revision 2)

Station Operator Logs are required for non-EMRS CWQMN stations. Station Operator Logs are electronic logs entered into LEADS by the station operator after routine and non-routine station service visits. USGS is not required to enter Station Operator Logs for USGS operated CWQMN stations.

Station Operator Logs can be entered at the station via the station's data logger or after the station service via TCEQ's web page (http://tceqwatercal.ipsmtx.com). This website was originally designed for the entry of multiprobe calibration drift results and operator logs. Entering multiprobe calibration drift and temperature check results at this website is no longer required. This website can be used to enter Station Operator Logs rather than using the station's data logger to enter Operator Logs.

For TCEQ non-EMRS stations, quality control measurement and multiprobe information are not entered into the Station Operator Logs. This information is entered into Post Deployment Worksheets (PDW). PDWs are Excel spreadsheets developed to document fouling, drift, and multiprobe exchanges at TCEQ non-EMRS stations.

TCEQ Operator Log Content Instructions

TCEQ Non-EMRS Stations CAMS 749, and 768

At a minimum, routine Operator Logs must list the following information:

1. Name, date, and time
2. Cleaned deployment tube with chimney brush
3. Exchanged multiprobes
4. Note field observations: water conditions, meteorological conditions, drought, flood etc.

When applicable, Station Operator Log entries must contain the following:

1. Name, date, and time
2. Any problems with data collection that can affect data quality.
3. Change in operating procedures, data collection circumstances, or measurement equipment.
4. Station equipment/communication problems and any troubleshooting activities
5. Station either being taken off-line or being brought on-line.
6. Non-routine station service events.
7. Date and time (or exact time frames) of the event must be included in Operator Logs

CRMWD EMRS CAMS 716 and 717

CRMWD is not required to enter routine Operator Logs. CRMWD enters Operator Logs under the following circumstances.

1. Station equipment/communication problems and any troubleshooting activities
2. Station either being taken off-line or being brought on-line.
3. Name, date, and time are included in the Operator Logs.

TCEQ Post Deployment Worksheets

For TCEQ non-EMRS stations (CAMS 749, and 768), after each routine station visit, station operators enter the following information into Post Deployment Worksheets (PDW):

1. CAMS Number and Location
2. Operator
3. Date
4. Service Start/Stop time
5. Multiprobe, SN/asset number, Model, pH sensor type
6. Multiprobe Retrieval Date
7. Multiprobe Deployment Data
8. Field Meter SN/asset number
9. Flow at Deployment Tube
10. Description of Debris cloud
11. Multiprobe Fouling and Drift Measurements
12. Any Observed Sensor Fouling
13. Multiprobe NIST temperature Check

The PDWs calculates results for fouling and drift and compares these results to project DQO's. After each station service event, the station operator emails the PDW to their TCEQ data validator. The PDW is used by the data validator to validate project data.

PDW workbooks for each station and calendar year are labeled using the following naming convention (PDW_CAMSXXX_CalendarYear). When a new calendar year starts a new PDW workbook will be started. Tabs within the workbook contain individual PDWs and are labeled with the month, day, and year station service occurred.

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

> Workbook Naming Convention Example:
> PDW_CAMS787_2011
>
> Workbook Tab Naming Convention Example:
> March 13, 2011

The TCEQ data validator will store the Post Deployment Workbook on their team's electronic folder for CWQMN documents.

Optional Photos of multiprobes and Sensors

It is preferred that photos be taken during each site visit of the multiprobe and its sensors. The purpose of the photos is to photo-document fouling conditions of the probe and other pertinent areas at the CAMS. These optional photos will be emailed to the Station's data validator along with the required PDW.

Adaptation of Data Validation and Fouling Correction Procedures for Water-Quality Monitoring Stations on the Upper Rio Grande and Pecos River

Working Draft for Implementation

Effective Date: May 2013 (rev. 0), Document Modified December 2013 (rev.1), See Section 7.0.

1.0 Purpose/Scope

This document is an adaptation and interpretation of guidelines and standard procedures for continuous water-quality monitors published by USGS: "Station operation, record computation, and data reporting: U.S. Geological Survey (USGS) Techniques and Methods 1–D3 (TM1D3) for the application of fouling corrections and validating data when water-quality monitors are silted in by sediment, when monitors are partially silted in, when monitor fouling conditions change over time, and when fouling is caused by aquatic insect activity. These procedures are for USGS-operated Texas Commission of Environmental Quality (TCEQ) Continuous Water Quality Monitoring Network stations on the Upper Rio Grande. These procedures will also be applied to similar monitor fouling situations that can occur at USGS-operated TCEQ Pecos River Stations.

On September 1, 2011, the USGS began operating TCEQ Upper Rio Grande and Pecos River stations according to guidelines and procedures in TM1D3. The procedures detailed in this document apply to all data collected at these stations beginning September 1, 2011. Excluding extreme events, a minimum of seventy-five percent (75%) of the scheduled data will be collected and validated, meeting at least the USGS "fair" data criteria as outlined in TM1D3.

As data are validated and processed, these procedures may be modified as needed. If significant changes to procedures are required, the USGS will contact the TCEQ for concurrence/approval. The USGS will track and update procedures within this SOP when changes are made. When changes are made, the USGS will provide TCEQ updated procedures. Section 7.0 is used to track changes to the SOP.

2.0 Background

Upper Rio Grande water-quality monitoring measurement sensors at USGS-operated Continuous Ambient Monitoring Stations (CAMS) 757 (upstream Rio Conchos), Station 720 (Castolon), and 721 (Rio Grande Village) in the Upper Rio Grande can be fouled and plugged by sediment due to sudden stream discharge pulses, existing degraded

monitoring equipment deployments locations, deployment location stream dynamics, and less than ideal deployment designs. Additionally, monitor fouling conditions can change over time during and after periods of dynamic stream discharge particularly when CAMS 720 in-stream deployment tube was located on a gravel bar. At CAMS 758 (downstream Rio Conchos), conductivity sensor cells are prone to fouling by aquatic insect activity.

The USGS is re-locating and re-designing monitoring equipment deployments at CAMS 757, 720, and 721. Monitors will be suspended vertically using swing-pipes. These improvements are expected to reduce sensor fouling/plugging. To immediately alleviate monitor fouling and fouling conditions changing over time at the existing CAMS 720 station, the USGS has moved CAMS 720 from a gravel bar to an area closer to the stream bank. The USGS is periodically modifying the stream channel/deployment at CAMS 757 with compressed water (trash pump) to aid sample collection. Data collection is further complicated due to the ephemeral nature of the stream at this location.

Water-quality monitors on the Upper Pecos may also become silted in as a result of rain fall run-off events, low base stream flows, and due to deployment tubes being deployed at angles (not vertically). Due to periods of low base flows and abundant sediment at Upper Pecos stations, the USGS is also using a trash pump to modify stream channels/deployments at CAMS 709 and 785.

The TCEQ, USGS Texas Water Science Center, and the National Water Quality Monitoring Council Methods Board met February 4 - 6, 2013, in Alpine, Texas, to discuss data validation and data processing issues related to water-quality monitor fouling. The team was able to develop a framework for the development of the following working draft procedures and to identify limitations associated with the procedures.

3.0 Procedural Summary

3.1 Water-quality monitor data collected when sensors/deployment tubes are silted in / isolated from the stream are invalidated and not reported to TCEQ. Data collected prior to the onset of a monitor silting in event can be reported to TCEQ. These data are not corrected using fouling measurement results and can be corrected for drift measurement results. These data are not assigned TM1D3 data ratings.

3.2 Data collected during changing or transient monitor fouling conditions are invalidated and not reported to TCEQ back to the onset of the initial event. Data collected prior to the onset of changing fouling conditions can be reported to TCEQ. These data are not corrected using fouling measurement results and can be corrected for drift measurement results. These data are not assigned TM1D3 data ratings.

3.3 When it is determined monitor sensors/deployment tubes are not completely silted in, pH and temperature fouling measurement results are used to validate data as described in Section 6.2.1.

3.4 When conductivity sensor cells are fouled by sediment at stations in the Upper Rio Grande, fouling measurement results are generally not used for data validation decisions.

3.5 Conductivity sensors can be significantly impacted by aquatic insect activity; affected data are invalidated and not reported to TCEQ.

3.6 Water-quality monitor sensor drift measurement results are applied to data records according to TM1D3 procedures.

3.7 Water-quality monitor temperature sensor fouling is calculated using the USGS TM1D3 pH and DO calculation method instead of the monitor-to-monitor comparison method (field monitor before cleaning minus deployed monitor dirty).

4.0 Limitations

4.1 No data quality fouling measurements are available for data reported prior to monitor silting in/isolation events and when data are reported prior to changing fouling conditions.

It is possible alternative methods may be developed to statistically characterize data quality prior to silting in events by comparing historical fouling measurement results against distinct stream flow regimes. Data for CAMS 721 was compiled and it was decided there were not enough data points to proceed. If USGS's time and budget allow, it may be ideal at a later date to determine if this approach is feasible.

4.2 When water-quality monitors are not found silted in/isolated during station service events and linear prorated fouling measurement corrections are applied to the data, computation errors will occur if fouling occurred at non-linear rates. These errors are limited to acceptance criteria listed in Section 6.2.1.

4.3 Sensor/deployment tube fouling can range from minimal to completely silt in/isolated from the stream. Individual sensor sedimentation can be dependent on the particular deployment, orientation of sensors in the deployment tube, stream sedimentation event type, stream flow etc.

4.4 Numeric data acceptance criteria for aquatic insect activity are not available. Best professional judgment is used by the hydrographer to accept data and apply fouling measurement computations to data affected by insect activity.

5.0 Field Procedures

5.1 Documenting Water-Quality Monitor Fouling Status and Station Operation

5.1.1 During station service events, the hydrographer will complete a set of detailed field notes describing the fouling status of the sensors. Pictures will be taken of the monitors and the sensor water interfaces. Field notes will document occurrences when the monitor is found buried in stream sediments and isolated from the stream.

5.1.2 When monitors are found silted in, the hydrographer will conduct station field service according to TM1D3 procedures.

5.1.3 When an event causes the monitor to become silted in, the Texas Water Science Center will service the station as soon as possible to minimize the loss of data.

6.0 Data Validation and Processing

Stage and discharge measurements collected by USGS or other entities may be used in this procedure. Station Analysis Notes will be used to document data validation and processing decision logic and data processing outcomes.

6.1 Monitors Silted in/Isolated from the stream

6.1.1 When field observations determine monitors are silted in/isolated from the stream data are invalidated/not reported back to a conservative point prior to the fouling event. When the fouling event occurred is determined by using stream stage/discharge and/or optical DO measurements. Typically, during a severe fouling event, optical DO measurements will rapidly decline and stay near zero mg/l. The rapid decline of DO measurements usually corresponds to a stream discharge pulse. However, at CAMS 757, the monitor can become suddenly silted in/isolated from the stream due to decreasing stream stage/discharge; the monitor's deployment tube is located at an incised pocket of the stream bank. Decreases in stream stage/discharge can cause sediment to deposit in this pocket. Stream bank collapses at this station can also cause the monitor to become suddenly silted in/isolated from the stream.

6.1.2 If the initial onset of fouling is determined, sensor drift corrections are applied as appropriate, no fouling corrections (zero correction) are applied to the data collected prior to the initial fouling/discharge event and no TM1D3 data ratings are applied to these data.

6.1.3 When it cannot be determined when the initial fouling event occurred, all data back to the last service event are invalidated.

6.1.4 Fouling measurement results collected while the monitors are silted in/isolated from the stream are considered invalid.

6.2 Monitor Partially Silted in

6.2.1 When field observations determines monitors are not completely silted in/isolated from the stream and DO measurement response does not go to zero, pH and temperature fouling measurement results are used to validate data. When pH fouling measurement results are greater than ±0.50 pH units and/or temperature fouling measurements are greater than ±0.50 °C, all monitor parameters (DO, pH, T, SC) are invalidated back to the last service event unless the onset of fouling can be determined.

6.2.2 If the initial onset of fouling is determined, sensor drift corrections are applied as appropriate, no fouling corrections (zero corrections) are applied to the data collected prior to the initial fouling/discharge event and no TM1D3 data ratings are applied to these data.

6.3 Changing Monitor Fouling Conditions

6.3.1 When the monitor experiences changing fouling conditions, all data are invalidated back to the initial fouling/discharge event. Fouling measurements collected during changing fouling conditions are considered invalid.

6.3.2 If the initial onset of fouling is determined, sensor drift corrections are applied as appropriate, no fouling corrections (zero correction) are applied to the data collected prior to the initial fouling/discharge event and no TM1D3 data ratings are applied to these data.

6.3.3 If it cannot be determined when the initial fouling event occurred, all data back to the last service event are invalidated.

6.4 Conductivity Sensor Insect Fouling

6.4.1 Data collected during periods of insect activity that causes major spikes will be deleted. Noisy data points and minor spikes will not

be deleted. Periods of erratic data will be deleted. The period prior to insect activity will not be deleted. Professional judgment will be used to determine what constitutes major / minor spikes and erratic data.

7.0 SOP Revision Tracking

This Section is used to track changes made to this SOP.

7.1 Revision 1 change (December 2013). Section 6.1.1 updated to include station-specific (CAMS 757) circumstances that can cause the monitor to become suddenly silted in / isolated from the stream.

Section 6.1.1 Revision: *At CAMS 757 the monitor can become suddenly silted in/isolated from the stream due to decreasing stream discharge/stage heights; stream flow decreases causing sediment to deposit. The monitor's deployment tube is located at an incised pocket of the stream bank. Stream bank collapses at this station can also cause the monitor to become suddenly silted in/isolated from the stream.*

In Section 6.1.1, the sentence below was modified to include "or" after "and" since stage/discharge measurements may not be usable as a collaborative piece of information to determine when the monitor became silted in. Rapidly declining DO measurements can be used to determine when the monitor was silted in.

*When the fouling event occurred is determined by using stream stage/discharge and/**or** optical DO measurements*

Appendix G

Example Letter to Document Adherence to the QAPP

TO: (name)
(organization)

FROM: (name)
(organization)

Subject: RE: Commitments to requirements contained in Continuous Water Quality Monitoring Network (CWQMN) Quality Assurance Project Plan (QAPP) Revision 6

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 Operator/Cooperator to the TCEQ CWQMN Network Coordinator within 60 days of TCEQ approval of the QAPP.