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

***Pond Creek Watershed Characterization for Future WPP Development***

**TSSWCB Project # 23-04**

# Quality Assurance Project Plan

# Texas State Soil and Water Conservation Board

Revision #0

Prepared by:

Texas A&M AgriLife Research
Texas Water Resources Institute

Effective Period: Upon EPA approval through September 30, 2025

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

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2118 TAMU
College Station, TX 77840-2118

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## Section A1: Approval Sheet

Quality Assurance Project Plan (QAPP) for the *Pond Creek Watershed Characterization* project.

**United States Environmental Protection Agency (USEPA), Region VI**

Name: Nelly Smith

Title: USEPA Chief State/Tribal Programs Section

Signature:_____ Date:_____

Name: Anthony Suttice

Title: USEPA Texas Nonpoint Source Project Officer

Signature:_____ Date:_____

**Texas State Soil and Water Conservation Board (TSSWCB)**

Name: Dakota Massey

Title: TSSWCB Project Manager (PM)

Signature:_____ Date:_____

Name: Mitch Conine

Title: TSSWCB Quality Assurance Officer (QAO)

Signature:_____ Date:_____

**Texas AgriLife Research – Texas Water Resources Institute (TWRI)**

Name: Ed Rhodes

Title: TWRI Project Lead

Signature:_____ Date: _____

Name: Amanda Tague

Title: TWRI Project Manager and Data Manager (DM)

Signature:_____ Date: _____

Name: Stephanie deVilleneuve

Title: TWRI QAO

Signature:_____ Date: _____

## Section A2: Table of Contents

**Section: Title**

List of Acronyms and Abbreviations

| | |
|---|---|
| CAR | Corrective Action Report |
| CRP | Clean Rivers Program |
| DEM | Digital Elevation Model |
| DM | Data Manager |
| DMRG | Data Management Reference Guide |
| DQO | Data Quality Objectives |
| FDC | Flow Duration Curve |
| GBRA | Guadalupe-Blanco River Authority |
| GIS | Geographic Information System |
| LDC | Load Duration Curve |
| NHD | National Hydrography Dataset |
| NLCD | National Land Cover Database |
| NRCS | Natural Resource Conservation Service |
| OSSF | On-Site Sewage Facility |
| PM | Project Manager |
| NWS | National Weather Service |
| QA | Quality Assurance |
| QAO | Quality Assurance Officer |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control. |
| QPR | Quarterly Progress Report |
| SEG | Segment |
| SWQM | Surface Water Quality Monitoring |
| SWQMIS | Surface Water Quality Monitoring Information System |
| SSO | Sanitary Sewer Overflow |
| TCEQ | Texas Commission on Environmental Quality |
| TMDL | Total Maximum Daily Load |
| TNRIS | Texas Natural Resources Information System |
| TPWD | Texas Parks and Wildlife Department |
| TSSWCB | Texas State Soil and Water Conservation Board |
| TWDB | Texas Water Development Board |
| TWRI | Texas AgriLife Research, Texas Water Resources Institute |
| TXDOT | Texas Department of Transportation |
| USDA | United States Department of Agriculture |
| USEPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |

## Section A3: Distribution List

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

**United States Environmental Protection Agency Region 6**
Water Division (WDAS)
1201 Elm Street
Dallas, TX 75270

Name: Anthony Suttice
Title: USEPA Texas Nonpoint Source Project Officer

Name: Nelly Smith
Title: USEPA Chief State/Tribal Programs Section

**Texas State Soil and Water Conservation Board**
1497 Country View Lane
Temple, TX 76504-8806

Name: Dakota Massey
Title: TSSWCB PM

Name: Mitch Conine
Title: TSSWCB QAO

**Texas AgriLife Research - Texas Water Resources Institute**
1001 Holleman Drive East,
2118 TAMU
College Station, TX 77840-2118

Name: Ed Rhodes
Title: TWRI Project Lead

Name: Amanda Tague
Title: TWRI Project Manager/ Data Manager

Name: Stephanie DeVilleneuve
Title: TWRI QAO

## Section A4: Project/Task Organization

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

**USEPA** – United States Environmental Protection Agency, Region VI. Provides project oversight and funding at the federal level.

Anthony Suttice, USEPA Texas Nonpoint Source Project Officer

Responsible for overall performance and direction of the project at the federal level. Ensures that the project assists in achieving the goals of the Clean Water Act (CWA). Reviews and approves the QAPP, project progress, and deliverables.

**TSSWCB** – Texas State Soil and Water Conservation Board, Temple, Texas. Provide state oversight and management of all project activities and ensure coordination of activities with related projects and TCEQ.

Dakota Massey, TSSWCB PM

Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Provides the primary point of contact between TSSWCB and TWRI. Tracks and reviews deliverables to ensure that tasks in the work plan are completed as specified. Reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB participants. Notifies TSSWCB QAO of any project non-conformances or corrective actions reported or taken by TWRI.

Mitch Conine, TSSWCB QAO

Reviews and approves QAPP and any amendments or revisions. Responsible for verifying that the QAPP is followed by project participants. Monitors implementation of corrective actions. Coordinates or conducts audits of field and laboratory systems and procedures. Determines that the project meets the requirements for planning, quality assurance (QA), quality control (QC), and reporting under the TSSWCB Nonpoint Source Management Program.

**TWRI** – Texas Water Resources Institute, College Station, Texas. Responsible for general project oversight, coordination and administration, project reporting, acquisition of water quality data, data assessment, stakeholder facilitation, development of data quality objectives (DQOs) and a QAPP.

Ed Rhodes, TWRI Project Lead

Responsible for supporting the development and ensuring the timely delivery of project deliverables, ensuring cooperation between project partners, providing fiscal oversight, and completing project reporting.

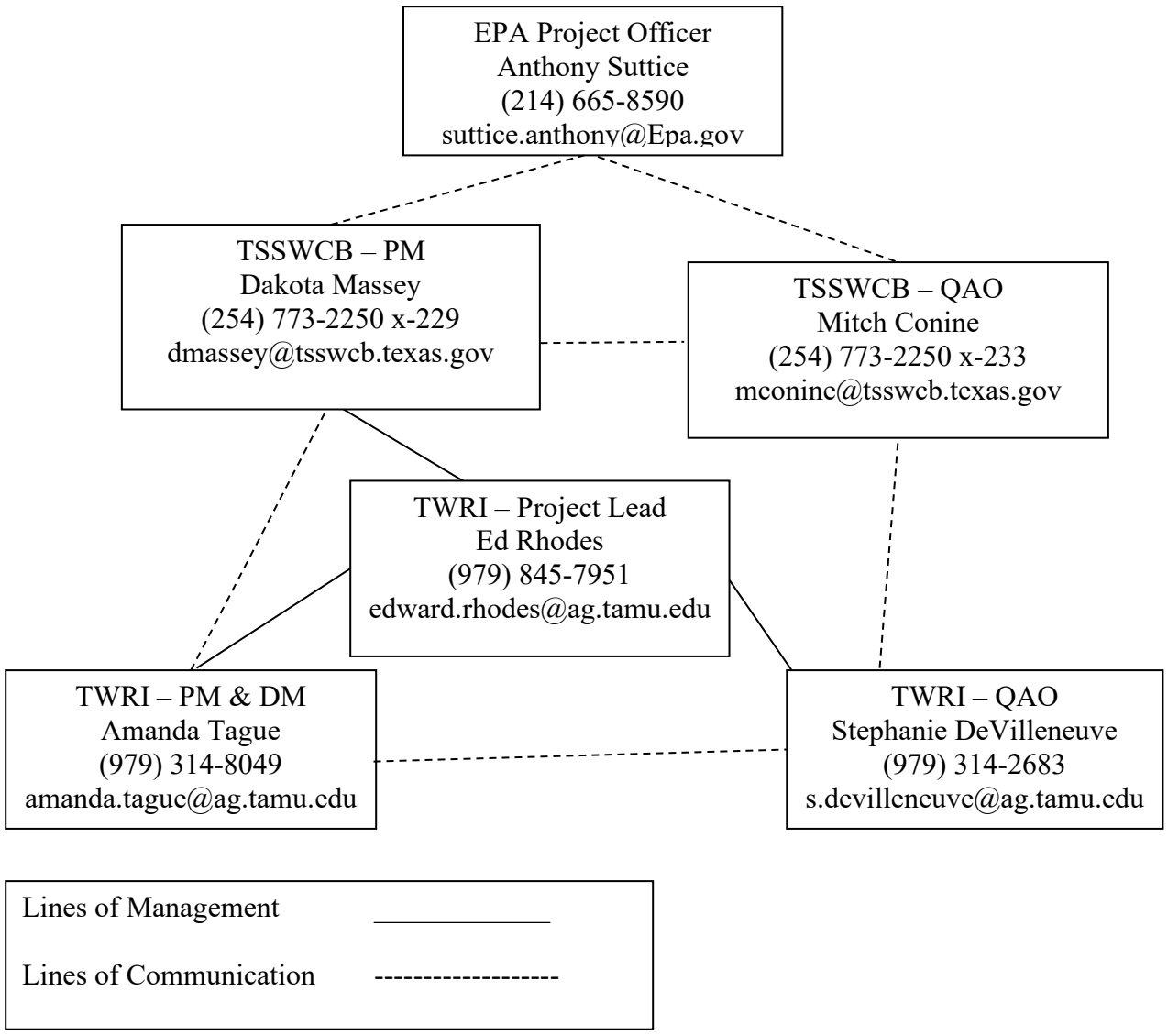
Amanda Tague, TWRI PM & DM

The TWRI PM is responsible for ensuring that tasks and other requirements in the contract are executed on time and with the QA/QC requirements in the system as defined by the contract and in the project QAPP; assessing the quality of subcontractor/participant work; and submitting accurate and timely deliverables to the TSSWCB PM. DM is responsible for acquisition, verification, and transfer of data to the TSSWCB PM. Oversees data management for the project and assumes responsibility for the correction of any data errors.

Stephanie DeVilleneuve, TWRI QAO

Responsible for determining that the QAPP meets the requirements for planning, QA, and QC. Responsible for maintaining the official, approved QAPP, as well as conducting quality assurance audits in conjunction with TSSWCB personnel. Provides the point of contact for the TSSWCB PM to resolve issues related to the data and assumes responsibility for the correction of any data errors.

Figure A.4-1. Project Organization Chart



## Section A5: Problem Definition/Background

The Pond Creek Watershed covers 146,758 acres in central Texas within Bell, Falls, and Milam counties, connecting directly to the Brazos River. It is listed as impaired for bacteria (*E. coli*) on the *2022 Texas Integrated Report*, having first been listed in 2010. Water quality in Pond Creek currently exceeds recreational use standards and, as a result, a Recreational Use Attainability Analysis was conducted in 2012. The report shows that primary contact recreation occurs "frequently" on the waterbody (Tables 4 & 7: https://www.tceq.texas.gov/assets/public/waterquality/standards/ruaa/brazos5/Brazos5Report.pdf) indicating that standards will not change. In regard to bacteria impairments, common sources of bacteria may result from OSSFs, permitted outfalls, livestock, and wildlife amongst others.

Due to the high instances of primary contact, stakeholder engagement is important to the implementation and success of water quality mitigation measures. A coordinated education program in the watershed stimulates broader understanding of water quality in the watershed and encourages future participation in stakeholder meetings. Previous and ongoing projects in the Pond Creek Watershed have sought to fill in data gaps through monthly routine monitoring. This project will take the next step in the watershed management process by collating and analyzing available tabular and geospatial data to develop a characterization report of the Pond Creek Watershed. This will include potential sources of *E. coli*, as well as loadings and load duration curves (LDCs).

Two public events will be held in the watershed to educate landowners about proper watershed functioning, as well as to inform them of the characterization report. Development of a watershed characterization report is critical to the future development of a WPP.

A key component of any environmental planning process is the characterization of the study area. Characterizing the sources and causes of impairments is a critical step in determining appropriate and effective methods and locations of management strategies aimed at restoring water quality.

## Section A6: Project Goals and Task Description

The objectives of this project are to characterize the Pond Creek watershed, by describing elements of the watershed having the greatest potential to impact water quality and/or quantity, and, to meet with key stakeholders in the watershed to discuss water quality impairments, convey options for addressing the impairments, and solicit feedback regarding local preferences for addressing the impairments.

The project shall consist of:

1. Project administration - administer, coordinate, and monitor all work performed under this project including technical and financial supervision, and preparation of status reports.
2. QAPP - describe general method and sources of acquired data and document data quality objectives (DQOs) and quality assurance/control (QA/QC) activities to ensure data of known and acceptable quality are generated through this project.
3. Public outreach, education, information – educate, identify, engage, and gain stakeholder support for the characterization of Pond Creek watershed
4. Watershed characterization - collect data and information to identify the causes of water quality impairments and issues in the watershed and to identify the sources of pollution contributing to water quality impairments and issues.

This QAPP covers activities in Task 4 (Watershed characterization) (Table A6-1) in the Pond Creek watershed (Figure A6-1).

TWRI will collect data and information to identify causes of water quality impairments and issues in the watershed and identify sources of pollution contributing to water quality impairments and issues. This will involve (i) assembling existing data and information pertaining to water quality impairments and issues in the watershed, (ii) analyzing existing data and information and, to the extent possible, characterize water quality conditions, watershed conditions, and sources of pollution contributing to water quality impairments and issues, (iii) comparing qualitative streamflow estimation methods to determine the method best suited for estimating streamflow for ungaged segments, and (iv) submitting a watershed characterization report to TSSWCB.

Data aggregation and assessment will focus on compiling existing watershed data that allows pollutant sources to be identified and their potential influence to be quantified. Data gathered will include previously collected water quality data, streamflow records, wildlife densities and livestock estimates. If available, data regarding the number of septic systems and the extent of wastewater and stormwater infrastructure will be collected. Collectively, information will be assessed to provide a general description of watershed pollutant contributors. Geographic information systems (GIS) will be utilized significantly where appropriate to aid in identifying watershed areas where potential causes and sources of pollutant contributors exist. This platform will allow visualization of pollutant loadings in relation to potential source locations across the watershed.

Data analysis will be conducted to improve knowledge regarding existing instream water quality conditions and hydrological influences on overall pollutant loading. Water quality data assessments will also be conducted using proven statistical methods to determine the presence of other trends or correlations in water quality and/or watershed characteristics.

Table A6-1. Project Plan Milestones

| Task | Project Milestones - | Agency | Start Month | End Month |
|---|---|---|---|---|
| 4 | Watershed Characterization – Data Evaluation | | | |
| 4.1 | Assemble Existing Data and Information. TWRI will gather existing data and information pertaining to water quality impairments and issues in the watershed. This data and information will, to the extent possible support:<br>• GIS analysis;<br>• Calculation of LDCs;<br>• Description of relevant watershed characteristics; and,<br>• Identification of causes and sources of water quality impairments and issues | TWRI | 6 | 18 |
| 4.2 | Analyze Existing Data and Information. TWRI will analyze the existing data and information and, to the extent possible, characterize water quality conditions, watershed conditions, and sources of pollution contributing to water quality impairments and issues. The analysis will:<br>• Lead to an understanding of where and when water quality impairments and/or issues occur and what could be causing the impairments and issues;<br>• Allow for data and information to be assembled into a data inventory for the watershed. The data and information will be presented in appropriate formats including graphs, tables, and maps. | TWRI | 6 | 18 |
| 4.3 | Flow Estimation. TWRI will compare qualitative streamflow estimation methods to determine the method best suited for estimating streamflow. An analysis of the comparison will be included in the Watershed Characterization Report. | TWRI | 6 | 18 |
| 4.4 | Watershed Characterization – Data Collection Report. TWRI will develop a report summarizing information developed under Task 4 to characterize the watershed and identify causes and sources of pollution. The report will be submitted for approval to the TSSWCB project manager. Once approved, the TSSWCB will submit to EPA a Final watershed characterization. | TWRI | 18 | 24 |

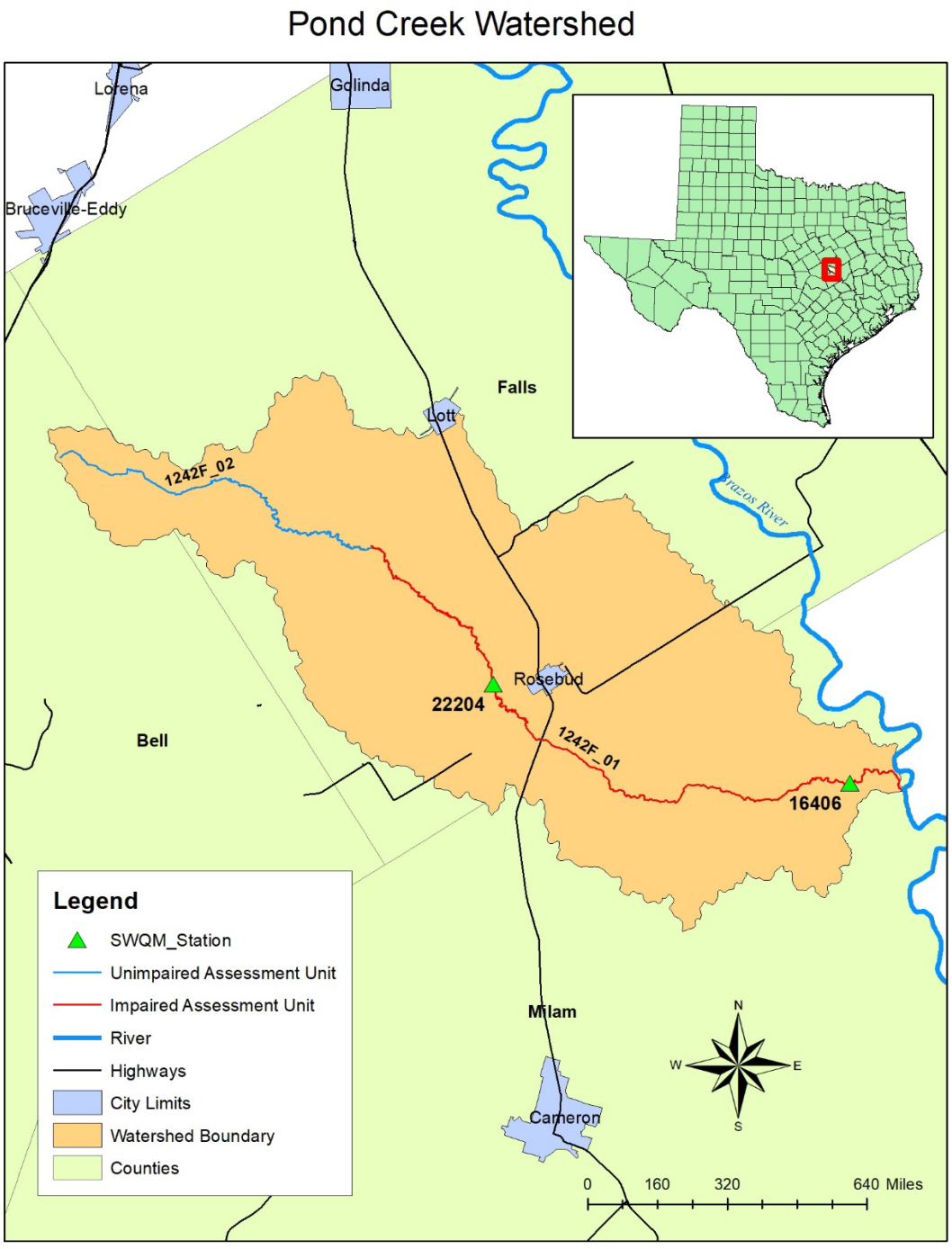



Figure A6-1. Segments and impairment status in the Pond Creek watershed

## Model Description

### LDCs

LDCs are a simple and effective methodology to obtain data-based Total Maximum Daily Loads (TMDLs) (Cleland, 2003; EPA, 2008). A duration curve is a graph that illustrates the percentage of time during which value of a given parameter is equaled or exceeded. For example, a flow duration curve (FDC) (Figure A6.2) typically uses observed mean daily streamflow records to calculate and depict the percentage of time (days) the flow values are equaled or exceeded.

An LDC (Figure A6.3), which is related to the FDC, shows the corresponding relationship between the contaminant loadings and stream flow conditions at the monitoring site. In this manner, it assists in determining patterns in pollution loading (point sources, nonpoint sources, erosion, etc.) depending on the streamflow conditions. Based on the observed patterns, specific restoration plans that target a particular kind of pollutant source can be implemented. For example, if the pollutant loads exceed the allowable loads (Figure A6.3) for low stream flow regimes, then the point sources, such as wastewater treatment plants, and direct deposition sources (wildlife, livestock) should be targeted for the restoration plans. Another main advantage of the LDC method is that it can also be used to evaluate the current impairment as some percentage of samples which exceed the standard, and therefore it allows for a more rapid development of TMDLs (EPA, 2008). Figures A6.2 and A6.3 are examples of a FDC and LDC from a project that focused on the Plum Creek watershed.

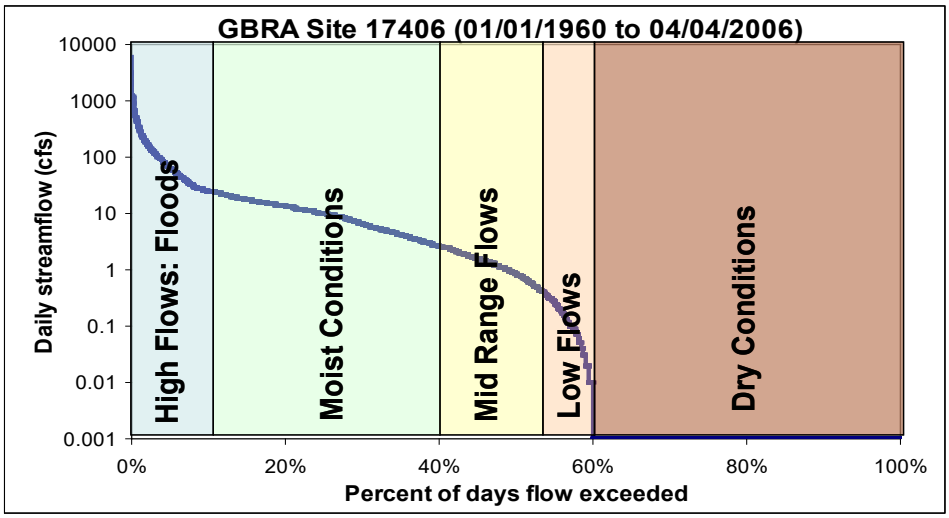



Figure A6-2. FDC for streamflow conditions at Guadalupe-Blanco River Authority (GBRA) monitoring station 17406 on Plum Creek, near Uhland, TX. The flow data at 17406 was obtained from the nearest USGS gage station 08172400, after adjusting for subwatershed aerial contribution during runoff events.

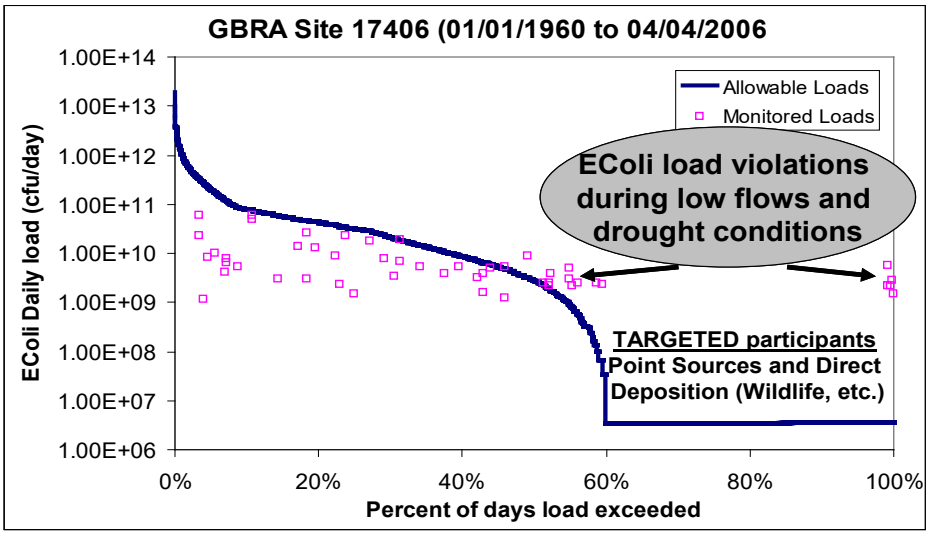



Figure A6-3. LDC for E. coli at GBRA monitoring station 17406 on Plum Creek, near Uhland, TX. The flow data at 17406 was obtained from the nearest USGS gage station 08172400, after adjusting for subwatershed aerial contribution during runoff events.

## Section A7: Quality Objectives and Criteria for Data Quality

Personnel at TWRI will conduct a phased data assessment effort to identify pollutant sources and estimate needed bacteria load reductions by streamflow condition. The objectives of the water quality assessment for this project are as follows:

The objectives for this project are as follows:

1) Spatially characterize and rank sources of pollutants within the watershed. Divide the area into sub-watersheds and identify, quantify, and rank pollutant loads from various sources, i.e., wildlife, livestock, and other sources in the study area.

2) Develop LDCs that utilize historical streamflow records and historical *E. coli* data to develop the pollutant load allocation required for meeting water quality standards. Data acquired for the LDC development will be reviewed to ensure that data and monitoring types are appropriate for the LDC development. Comments and qualifier codes will also be reviewed to ensure the suitability of data for LDC development.

**LDCs**

This approach has been utilized in several TMDL projects as an initial screening-tool to evaluate the actual temporal load trends in streams (Cleland, 2003; Stiles, 2001). In cases of violations, it is necessary to determine the required load-reduction in that region near the monitoring station. Load reductions should be calculated for all flow-regimes of the stream. In order to do this continuous monitoring data will be simulated using the actual monitoring data by regression methods. Uncertainty of the model will be estimated via residual error analysis. The straight line passing through residual error plot should have a slope of zero.

## Section A8: Special Training Requirements/Certification

### LDCs

All personnel involved in model calibration, validation, and development will have the appropriate education and training required to adequately perform their duties. No special certifications are required.

## Section A9: Documentation and Records

The document and records that describe, specify, report, or certify activities, requirements, procedures, or results for this project are provided below.

### LDC

All records, including modeler's notebooks and electronic files, will be archived by TWRI for LDCs for at least five years. Electronic data on the project computers and the network server are backed up daily to the network drive and weekly to an external hard drive and the principal investigator's computer. In the event of a catastrophic systems failure, the tapes can be used to restore the data in less than one day's time. Data generated on the day of the failure may be lost but can be reproduced from raw data in most cases.

### General Project Documentation

Quarterly progress reports (QPRs) disseminated to the individuals listed in section A3 will note activities conducted in connection with the project, items or areas identified as potential problems, and any variations or supplements to the QAPP. Final reports on the project will be developed.

Corrective action reports (CARs) will be utilized when necessary (Appendix A). CARs will be maintained in an accessible location for reference at TWRI and will be disseminated to the individuals listed in section A3. CARs resulting in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in updates or amendments to the QAPP.

All electronic data are backed up routinely. A blank CAR is presented in Appendix A. The TSSWCB may elect to take possession of records at the conclusion of the specified retention period.

Table A9-1. Project Documents and Records

| Document/Record | Location | Retention | Form |
|---|---|---|---|
| QAPP, amendments, and appendices | TWRI | 5 years | Electronic |
| QAPP distribution documentation | TWRI | 5 years | Electronic |
| Corrective Action Reports (CARs) | TWRI | 5 years | Electronic |
| Progress reports, final reports, data | TWRI/TSSWCB | 3 years | Paper/Electronic |

### Data Transfer between Entities

Data transfer between entities occurs via electronic means. The specific format of the data transferred depends on the specific data and includes ArcPro, MS Office, and PDF formats.

### QAPP Revision and Amendments

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually on the anniversary date or revised and reissued within 120 days of significant changes, whichever is sooner. The last approved versions of QAPPs shall remain in effect until revised

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

Amendments to the QAPP may be necessary to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and non-conformances; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests or amendments are directed from the TWRI PM to the TSSWCB PM in writing. The changes are effective immediately upon approval by the TSSWCB PM and QAO, or their designees. Amendments to the QAPP and the reasons for the changes will be documented, and copies of the approved QAPP Expedited Amendment form will be distributed to all individuals on the QAPP distribution list by the TWRI QAO. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process.

## **Section B1:** Sampling Process Design (Experimental Design)

Elements B1 – B8 address various quality aspects of the design and procedures for collecting, handling, and analyzing new environmental data. Since this project uses existing data sources, these sections do not apply to this QAPP.

## **Section B2:** Sampling Methods

Does not apply to this QAPP. See B1 for more information.

## **Section B3:** Sample Handling and Custody

Does not apply to this QAPP. See B1 for more information.

## **Section B4:** Analytical Methods

Does not apply to this QAPP. See B1 for more information.

## **Section B5:** Quality Control

Does not apply to this QAPP. See B1 for more information.

## **Section B6:** Instrument/Equipment Testing, Inspection and Maintenance

Does not apply to this QAPP. See B1 for more information.

## **Section B7:** Instrument/Equipment Calibration and Frequency

Does not apply to this QAPP. See B1 for more information.

## **Section B8:** Inspection/Acceptance of Supplies and Consumables

Does not apply to this QAPP. See B1 for more information.

## **Section B9:** Data Acquisition Requirements (Non-direct Measurements)

Any non-direct measurements will comply with all requirements under this QAPP.

Water quality data available in TCEQ's SWQMIS will be used as historical references for instream water quality and conditions. US Geologic Survey (USGS) flow data available in the watershed may also be useful for evaluating instream conditions. The collection and qualification of TCEQ and USGS data are addressed in the TCEQ Surface Water Quality Monitoring QAPP (https://www.tceq.texas.gov/waterquality/monitoring/swqm_guides.html). The collection and qualification of the Texas CRP data are addressed in their QAPPs (www.tceq.texas.gov/waterquality/clean-rivers/qa/index.html). Potential sources where data will be acquired from are included in Table B9.1. No limitations will be placed on these data as they have been vetted by the TCEQ SWQM Data Management and Assessment Team and were collected under a TCEQ approved QAPP.

Table B9.1. Monitoring Data Sources

| **Data Type** | **Monitoring Project/Program** | **Collecting Entity** | **Dates of Collection** | **QA Information** | **Data Use(s)** |
|---|---|---|---|---|---|
| Monitoring Data | TCEQ SWQM Program | TCEQ | 01/01/2000 – Current at station historically monitored by TCEQ in Table A6.2 | TCEQ SWQM QAPP; SWQMIS database | summary statistics, trend analysis |
| Flow Data | USGS Water Data for the Nation | USGS | For the period of record collected by the USGS at stations in Table A6.2 | USGS QAPP; USGS database | Flow measurements |

Other data that is compiled and published by other entities may also be used in preparing project reports. This may include long-term precipitation, census, ecoregion, land use and land cover, historic water quality and stream flow data. Sources of these data are the USGS, National Weather Service, US Census Bureau, USDA NRCS, TCEQ, and TPWD. Data collected by these entities are assumed to have been verified and validated according to the requirements of the respective programs. Data compilations created for this project will be visually screened for errors. Data will be cited in reports.

Geospatial data available from various local, regional, state, and federal organizations may be used for cartographic purposes. Maps developed for reports will be for illustrative purposes. Geospatial data utilized in maps of the study area may include land use, precipitation, soil type, ecoregion, TCEQ monitoring location, TCEQ permitted outfall, gage location, city/county/state boundary, stream hydrology, reservoir, drought, road, watershed, municipal separate storm sewer system, urbanized area, basin, railroad, recreational area, area landmark, aerial photography, and park information. The above data comes from the following reliable sources: USGS, TNRIS, TCEQ, TXDOT, TSSWCB, TWDB, and US Census Bureau. Geospatial data from these sources are accepted for use in updating these project maps based on the reputability of these data sources and the fact that there are no known comparable sources for these data. Geospatial data will be cited in reports. Table B9.2 lists the type of measurement, data, units, source, QA documentation use and data range of each acquired data set where applicable.

**LDCs**

The LDCs will be created using currently existing water quality and flow data available from the TCEQ SWQMIS Database, USGS (where available) and data generated through this project.

All data used in the assessment procedures for this project are collected in accordance with approved quality assurance measures under TCEQ, Texas Water Development Board (TWBD), USDA, National Weather Service (NWS), or USGS.

Table B9.2. Non-Direct Data Types and Data Sources for planned acquisition

| Type of Measurement or Analysis | Type of Data (time series, rate, constant, statistic, taxa, etc.) | Units | Source (Weblink when available) | Quality Assurance Documentation | Use | Date Range |
|---|---|---|---|---|---|---|
| Streamflow | Time series, daily streamflow | Average daily (cfs) | USGS http://waterdata.usgs.gov/tx/nwis/sw | Data noted as "Approved" (quality-assured data) or "Provisional" (of unverified accuracy and subject to revision). More recent "provisional" data may be used in the project after thorough review. "Approved" data have successfully undergone USGS quality assurance. | Flow and water quality analysis | All data available |
| Bacteria, conventional water quality, field, and flow parameters | Concentration/ quantity at various points in time | CFU or MPN/100mLf or bacteria; µmhos/cm, mg/L, ppm as appropriate for conventional; cfs for flow | TCEQ SWQMIS https://www80.tceq.texas.gov/SwqmisPublic/index.htm | Data requested will include only data that met quality assurance/quality control (QA/QC) requirements as outlined under the SWQM Data Management Reference Guide. | Flow and water quality analysis | All data available |
| TCEQ SWQM Stations | Spatial data, location of active and historical SWQM stations | Shapefile – Points | TCEQ GIS Data Hub https://gis-tceq.opendata.arcgis.com/ | Data Management Reference Guide (DMRG) for SWQM http://www.tceq.texas.gov/waterquality/data-management/dmrg_index.html | Map development | Various |
| TCEQ Segments and Assessment Units | Spatial data, official TCEQ Segments | Shapefile - Polylines | TCEQ GIS Data Hub https://gis-tceq.opendata.arcgis.com/ | Non accessible. TCEQ data. | Map development | Various |
| County Boundaries, City Boundaries | Spatial data, StratMap Boundaries | Shapefile - Polygons | TxGIO Data Search & Download http://www.tnris.org/ | Metadata available with download | Map development | N/A |
| Watershed topography | Spatial GIS data, Digital Elevation Models (DEMs) | Raster- 10-meter resolution | Hydroenforced DEM from the National Hydrography Dataset (NHD) Plus Version 2 https://nhdplus.com/NHDPlus/NHDPlusV2_data.php | NHDPlusV2 Documentation https://nhdplus.com/NHDPlus/NHDPlusV2_documentation.php | Delineation of watershed and subwatershed boundaries for maps | N/A |

| Type of Measurement or Analysis | Type of Data (time series, rate, constant, statistic, taxa, etc.) | Units | Source (Weblink when available) | Quality Assurance Documentation | Use | Date Range |
|---|---|---|---|---|---|---|
| Watershed Boundary Dataset | Spatial GIS data, GIS shapefiles | 1:24,000 or better | https://gdg.sc.egov.usda.gov/ | https://pubs.usgs.gov/tm/11/a3/pdf/tm11-a3_1ed.pdf | Subwatershed delineation | N/A |
| Land Use/Land Cover | National Land Cover Data set – GIS raster data set | Raster – 30 m resolution | National Land Cover Database 2021 (NLCD2021) from MRLC Consortium Viewer: https://www.mrlc.gov/data/nlcd-2021-land-cover-conus | Wickham, J., Stehman, S.V., Sorenson, D.G., Gass, L., Dewitz, Jon A., Thematic accuracy assessment of the NLCD 2019 land cover for the conterminous United States, v. 60, no. 1, at https://doi.org/10.1080/15481603.2023.2181143 | Map development | Based on Landsat imagery between 2001 and 2021 |
| Land Use/Land Cover | Crop Data Layer – GIS raster dataset | Raster – 30 m resolution | Cropland Data Layer - National Download https://www.nass.usda.gov/Research_and_Science/Cropland/Release/index.php | CropScape and Cropland Data Layer – Metadata https://www.nass.usda.gov/Research_and_Science/Cropland/metadata/meta.php | Map development | 2008-2022 |
| Land Use/Land Cover | Ecological mapping coverage | Raster – 10 m resolution | TPWD Ecological Mapping Systems https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/ | TPWD Ecological Mapping Systems supporting documents https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/ | Map development | 2016 or most recent available |
| Soil Map Unit Boundaries and Properties | Spatial GIS data, Soils | Shapefile - polygons | USDA Natural Resources Conservation Service (NRCS) Geospatial Data Gateway http://datagateway.nrcs.usda.gov/ | Metadata available with download | Map development | Most recent available |
| Sanitary Sewer Overflows (SSOs) | Individual events | Location and amount (gallons) | TCEQ Regions Excel database provided upon request by regional staff | Data entry based on reported occurrences, Level of QA unknown | Quantify reported SSOs | Most recent 7 years |

| Type of Measurement or Analysis | Type of Data (time series, rate, constant, statistic, taxa, etc.) | Units | Source (Weblink when available) | Quality Assurance Documentation | Use | Date Range |
|---|---|---|---|---|---|---|
| Municipal & Industrial WWTF Permits | Individual permit location, limits, effluent types, and outfall locations | Tabular | TCEQ Central Registry https://www15.tceq.texas.gov/crpub/index.cfm?fuseaction=addnid.IdSearch | None accessible; TCEQ databases | Source analysis | Most recent 7 years |
| General permits involving regulation of stormwater | Regulated entities | N/A | TCEQ Central Registry https://www2.tceq.texas.gov/wq_dpa/index.cfm | None accessible; TCEQ databases | Source analysis | Most recent 7 years |
| Water Rights Diversion Points | Spatial GIS and Tabular Data | N/A | TCEQ https://www.tceq.texas.gov/permitting/water_rights/wr-permitting/wrwud<br><br>TCEQ - WRAP Input files and GIS files by River Basin https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/wam.html/#GIS | None accessible; TCEQ databases | Understanding uses of surface water in the watershed | Most recent available |
| Waste Application Field Data | Spatial GIS or physical description | Currently Unknown | TCEQ Central Registry http://www15.tceq.texas.gov/crpub/ or TCEQ Public Drinking Water Section | None accessible; TCEQ databases | ID municipal and OSSF sludge application fields | Most recent available |
| Urbanized Areas | Spatial GIS | Geodatabases/ Shapefiles | TIGER Data Products Guide https://www.census.gov/programs-surveys/geography/guidance/tiger-data-products-guide.html | TIGER/Line Shapefiles and TIGER/Line Files Technical Documentation https://www.census.gov/programs-surveys/geography/technical-documentation/complete-technical-documentation.html | Map development; define regulated stormwater | 2022 or most recent available |

| Type of Measurement or Analysis | Type of Data (time series, rate, constant, statistic, taxa, etc.) | Units | Source (Weblink when available) | Quality Assurance Documentation | Use | Date Range |
|---|---|---|---|---|---|---|
| Population | Spatial GIS and tabular data | Geodatabases/ Shapefiles/ Tabular data | TIGER Data Products Guide https://www.census.gov/programs-surveys/geography/guidance/tiger-data-products-guide.html ; Tabular data from US Census Bureau, Data Explorer https://data.census.gov/ | TIGER/Line Shapefiles and TIGER/Line Files Technical Documentation https://www.census.gov/programs-surveys/geography/technical-documentation/complete-technical-documentation.html; Metadata available with download | Map and source development | 2020 or most recent |
| Address locations | Spatial GIS, point data | Shapefile - points | StratMap Address Points https://tnris.org/stratmap/address-points/ | None accessible; TxGIO database. | Map and source development, OSSF estimations | 2021 or most recent available |
| Hydrography | Vector GIS data | Geodatabase – points, polylines, polygons | National Hydrography Data set (NHD) Pre-staged Subregions http://nhd.usgs.gov/data.html | NHD Program Documentation http://nhd.usgs.gov/program_documentation.html | Map development | N/A |
| Livestock population estimates | County-level livestock density | County level individual animals | USDA Census of Agriculture https://www.nass.usda.gov/Publications/AgCensus/2017/index.php | Regulations Guiding NASS http://www.agcensus.usda.gov/About_the_Census/Regulations_Guiding_NASS/index.php | Map and source development | 2022 or most recent |
| Deer | Wildlife planning areas, Wildlife density | Shapefiles, Density (animal per unit area) | Texas Parks & Wildlife Department GIS data, https://tpwd.texas.gov/gis/#data surveys and/or information from biologists | Metadata available with download/ supplied data | Source development | N/A |

| Type of Measurement or Analysis | Type of Data (time series, rate, constant, statistic, taxa, etc.) | Units | Source (Weblink when available) | Quality Assurance Documentation | Use | Date Range |
|---|---|---|---|---|---|---|
| Cats and dogs | Pet density | number per household | American Veterinary Medical Association. U.S. pet ownership statistics https://www.avma.org/resources-tools/reports-statistics/us-pet-ownership-statistics#formulas | American Veterinary Medical Association 2022 Pet Ownership and Demographic Sourcebook https://ebusiness.avma.org/files/ProductDownloads/eco-pet-demographic-report-22-low-res.pdf | Source development | N/A |
| Feral hogs | Spatial feral animal density | Feral hog density (animals per unit area) | AgriLife Extension (2012). *Feral Hog Population Growth, Density and Harvest in Texas.* SP-472. College Station. https://nri.tamu.edu/media/3203/sp-472-feral-hog-population-growth-density-and-harvest-in-texas-edited.pdf literature values and stakeholder input | AgriLife Extension (2012). *Feral Hog Population Growth, Density and Harvest in Texas.* SP-472. College Station. https://nri.tamu.edu/media/3203/sp-472-feral-hog-population-growth-density-and-harvest-in-texas-edited.pdf | Source development | 2012 |
| Water and sewer service areas | Spatial GIS data | Shapefile - polygons | TCEQ GIS Regulatory/ Administrative Boundaries, Water & Sewer Certificates of Convenience and Necessity Service Areas, https://www.puc.texas.gov/industry/water/utilities/gis.aspx | None accessible; PUC databases | Map and source development | Present |
| Population projections | Tabular data, organized by region, includes Census 2010 data and population projections for 2020 - 2070 | Counts | TWDB Water Planning, 2022 State Water Plan Projections Data, https://www.twdb.texas.gov/waterplanning/data/projections/2022/popproj.asp | Projection Methodology – Draft Population and Municipal Water Demands, https://www.twdb.texas.gov/waterplanning/data/projections/methodology/index.asp | Source development | 2020 - 2070 |

| Type of Measurement or Analysis | Type of Data (time series, rate, constant, statistic, taxa, etc.) | Units | Source (Weblink when available) | Quality Assurance Documentation | Use | Date Range |
|---|---|---|---|---|---|---|
| Air temperature and precipitation | Daily time series and monthly and annual normal values | Air Temperature (ºC or ºF), Precipitation (mm or inches) | National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) http://www.ncdc.noaa.gov/cdo-web/ | NOAA Information Quality Guidelines, http://www.cio.noaa.gov/services_programs/info_quality.html | Summarize past and current weather conditions for reports | 1972 – to present |
| Average annual air temperature and precipitation | Spatial GIS data | Raster | PRISM Climate Group, 30 year NORMALS http://www.prism.oregonstate.edu/ | PRISM Climate Group, Documentation FGDC Metadata http://prism.oregonstate.edu/documents/PRISM_datasets.pdf | Map development, weather/ climate analysis | 1991 - 2020 |
| Permit files | Hardcopy applications, compliance investigation reports, maps, reports | N/A | TCEQ Central Records | None available | Regulated stormwater area calculations, discharge locations and routes, map development | Various |

## **Section B10:** Data Management

### Personnel

Ed Rhodes is the TWRI Project Lead and is responsible for overseeing and supervising the project as well as the rest of the project team at TWRI.

Amanda Tague is the TWRI PM and will provide overall project management for TWRI. She is responsible for ensuring that the data are managed according to the data management plan and QAPP. Amanda Tague is also the TWRI DM and is responsible for oversight of all acquired data and confirming that all data were appropriately obtained and documented. She is responsible for overseeing all required data control checks on the data.

Stephanie DeVilleneuve is the QAO responsible for ensuring that project data are scientifically valid, legally defensible, of known precision, accuracy, integrity, meet the data quality objectives of the project, and are reportable to TSSWCB.

TWRI project staff and students work with the TWRI DM to acquire data and perform analysis.

### Systems Design

TWRI uses laptop and desktop personal computers. The computers run Windows 10 operating system or newer. Software includes Microsoft® Word, Microsoft® Excel, and Program R Statistical Software. All GIS analysis will be performed using ArcGIS Pro or newer.

TWRI utilizes Microsoft Teams, OneDrive, and SharePoint for enterprise file services. The enterprise file system utilizes the Microsoft Cloud to ensure secure data storage of critical operational and project files, automated and distributed data backup that meets AgriLife system policies, and automated file versioning.

Table B10.1. Hardware and Software used to Support Data Processing

| Equipment & software name | Type | Specification | Use |
|---|---|---|---|
| HP PC Computers | Hardware | Intel Core Processor, 8 GB Ram or more, Windows 10/11 Enterprise | Support data gathering, data analysis, and report generation. |
| Microsoft Teams and OneDrive | Software | Enterprise managed software | Project file management and data backup. |
| ArcGIS Pro or higher | Software | Window interface | Development of maps and spatial analyses |
| Program R 3.5 or higher and R-Studio | Software | Window interface | Statistical analysis and figure development. |
| Microsoft Office 365 Software (Excel, Word, PowerPoint) | Software | Windows platform | Data preparation, report writing, presentations |

### Data Migration/Transfer/Conversion

Data is processed using Microsoft Excel, ArcGIS Pro, and/or Program R. The TWRI DM is responsible for the oversight of the transfer of electronic data files from the Internet to the project directory, which is located on the TWRI Intranet. The various types of data to be

downloaded from the Internet are included in Table B9.2. GIS data (e.g., shapefiles, raster datasets, DEMs, etc.) will be downloaded into a GIS project directory. All files created from GIS analyses will be stored in the GIS project directory.

Databases on the Internet are stored in a variety of formats. Some data or files required for the project can be downloaded from the Internet into text or Excel files, where they can be manipulated to create text files or other types of data files that can be used directly in a meta-analysis. Data is downloaded into Excel, R and R-Studio for data management, calculations, and statistical tests prior to being moved into Excel workbooks.

**Backup/Disaster Recovery**

Microsoft Cloud services utilize multiple geographic redundancies that ensure 99.99% data availability in the event of data loss. Any information deleted is also recoverable within 93 days of deletion. File versioning is enabled to automatically save the previous 25 versions of a file so they can be rolled back in the event of file corruption or unintended changes. Microsoft Enterprise Cloud services are described in detail at: https://docs.microsoft.com/en-us/office365/Enterprise/office-365-data-resiliency-overview.

**Archives and Data Retention**

Complete original data sets are archived on permanent paper and electronic media and retained on-site by TWRI for a retention period specified in section A9.

**Information Dissemination**

Project updates will be provided to the TSSWCB PM in progress reports and the information will be made available at stakeholder meetings as appropriate. Data collected through this project will be synthesized into a project final report delivered to TSSWCB at the end of the project. No environmental data collected will be collected as part of the project.

## Section C1: Assessments and Response Actions

The following table presents types of assessments and response actions applicable to the QAPP.

Table C1.1. Assessments and Response Actions

| Assessment Activity | Approximate Schedule | Responsible Party | Scope | Response Requirements |
|---|---|---|---|---|
| Status Monitoring Oversight, etc. | Continuous | TWRI | Monitor project status and records to ensure requirements are being fulfilled. Monitoring & review performance & data quality | Report to TSSWCB in QPR. |
| Technical systems audit | As needed | TSSWCB | Assess compliance with QAPP; review facility and data management as they relate to the project | 45 days to respond to TSSWCB with corrective actions |

In-house review of data quality and staff performance to assure that work is being performed in compliance with the QAPP will be conducted by all entities as needed. If review shows that the work is not being performed according to standards, immediate corrective action will be implemented. CARs will be submitted to TSSWCB and documented in the project QPRs.

The TSSWCB QAO (or designee) will conduct an audit of technical systems activities for this project as needed. Each entity will have the responsibility for initiating and implementing response actions associated with findings identified during the on-site audit. Once the response actions have been implemented, the TSSWCB QAO (or designee) may perform a follow-up audit to verify and document that the response actions were implemented effectively. Records of audit findings and corrective actions are maintained by the TSSWCB PM and TWRI QAO. Corrective action documentation will be submitted to the TSSWCB PM with the progress report. If audit findings and corrective actions cannot be resolved, then the authority and responsibility for terminating work is specified in agreements or contracts between participating organizations.

### Corrective Action Process for Deficiencies

Deficiencies are any deviation from the QAPP, and procedures referenced herein. It is the responsibility of the TWRI PM, in consultation with the TWRI QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions may need to be conveyed to the TSSWCB PM in writing by completion of a CAR (Appendix A) within 30 days of the occurrence (or its discovery).

### Corrective Action

Corrective Action Reports (CARs) should:

- Identify the problem, nonconformity, or undesirable situation.
- Identify immediate remedial actions if possible.
- Identify the underlying cause(s) of the problem.
- Identify whether the problem is likely to recur or occur in other areas.

- Evaluate the need for Corrective Action
- Use problem-solving techniques to verify causes, determine solutions, and develop an action plan.
- Identify personnel responsible for action.
- Establish timelines and provide a schedule.
- Document the corrective action.
- Evaluate the need for qualification or exclusion of data.

The status of CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TSSWCB immediately.

The TWRI PM is responsible for implementing and tracking corrective actions. Records of audit findings and corrective actions are maintained by the TWRI PM. Audit reports and corrective action documentation will be submitted to the TSSWCB with the Progress Report.

## Section C2: Reports to Management

Quarterly progress reports developed by the TWRI PM will note activities conducted in connection with the project, items or areas identified as potential problems, and any variations or supplements to the QAPP. CAR forms will be utilized when necessary (Appendix A). CARs will be maintained in an accessible location for reference by all project personnel and at TWRI and disseminated to individuals listed in section A3. CARs that result in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in an update or amendment to the QAPP.

If the procedures and guidelines established in this QAPP are not successful, corrective action is required to ensure that conditions adverse to quality data are identified promptly and corrected as soon as possible. Corrective actions include identification of root causes of problems and successful correction of identified problems. CARs will be filled out to document the problems and the remedial action taken. Copies of CARs will be included with the project's quarterly reports. These reports will discuss any problems encountered and solutions made. These reports are the responsibility of the QAO and the PM and will be disseminated to individuals listed in section A3.

The final report for this project will include information describing water quality impairments/issues in the watershed, and elements of the watershed having the greatest potential to impact water quality and/or quantity. Items in this report will include a brief description of methodologies utilized and implications of the findings.

## Section D1: Data Review, Validation and Verification

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

Data collected by the TCEQ, the USGS, and the Texas CRP partners have been reviewed, verified, and validated according to the requirements of the respective programs prior to their use in this project. The sources of GIS data for the project, e.g., TCEQ, National Hydrography Dataset, National Land Cover Database, NRCS, and U.S. Census Bureau and others, undergo review, verification, and validation of the shapefiles and other spatial resources by their respective programs before the data and information are publicly available and prior to use in this project. Non-geospatial data include SSOs, livestock from the agricultural census, and regulated dischargers and are reviewed for consistency to identify potential errors prior to use.

## Section D2: Validation Methods

Data compilations created for this project will be visually screened for errors. Water quality and streamflow data collected by USGS and Texas CRP partners are verified and validated according to requirements of the respective programs prior to their use in this project. Data compilations created for this project will be visually screened for errors by TWRI Staff. To verify the correctness of FDCs/LDCs, the TWRI Staff will ensure that the methods for the development of FDCs/LDCs (EPA, 2008) are followed and will verify that data formatting and inputting were done correctly and that outputs were produced error free and appear to be reasonable based on current knowledge.

All other data for this portion of the project (e.g., land use, urban areas, population projections, DEMs, stream layers, and population projections) as provided in Table B9.1 and B9.2 have been collected and made publicly accessible by authoritative sources such as the USGS, USDA, EPA, and U.S. Census Bureau. Data from these sources are considered verified and validated by the agencies providing the data. Regardless, data compilations created for this project will be visually screened for errors. Errors detected by project staff will be reported to the TWRI PM and, if necessary, to the TSSWCB PM for resolution. Issues which can be readily corrected, e.g., removal of outlier data, will be documented and the data either removed or corrected prior to further analysis.

The TWRI PM and QAO are responsible for ensuring that project data used for LDCs are scientifically valid, legally defensible, of known precision, accuracy, integrity, meet the data quality objectives of the project, and are reportable to TSSWCB. The TWRI QAO and PM may designate other staff familiar with specific types of data to perform this evaluation. Any suspected errors or anomalous data must be addressed before data validation can be completed.

## Section D3: Reconciliation with User Requirements

### LDCs

The LDC framework utilized for this project will be used to evaluate bacteria loading in relation to flow regimes in the Proctor Lake watershed. This approach will aid in determining pollutant load allocations throughout the watershed.

The LDC results will be described in detail in the watershed characterization report and used for educational purposes as appropriate and will aid in making informed decisions about future action to address pollutant loading issues across the watershed. The limitations of LDCs produced will also be described in the report and conveyed to audiences when discussed.

### GIS Inventory

GIS inventory and maps developed for this project will be used for informational purposes only and will not be used exclusively to make any management decisions. Instead, these maps will aid the user by allowing them to visualize watershed features and influences within the watershed that could contribute to the overall bacteria and nutrient loadings. The limitations of maps produced will be described in the project deliverables and conveyed to audiences when discussed. Potential limitations may include accuracy and precision of the land use data and planning documents.

## References

BRA 2022. Brazos River Basin Summary Report 2022 us. https://brazos.org/Portals/0/Documents/CRP/Brazos-River-Basin-Summary-Report-2022.pdf

Cleland, B. 2003. TMDL Development from the "bottom up" – Part III: Duration Curves and Wet-Weather Assessments. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.566.9879&rep=rep1&type=pdf.

TCEQ 2022. 2022 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d). https://www.tceq.texas.gov/waterquality/assessment/22twqi/22txir

USEPA. 2008. "Development of Duration-Curve Based Methods for Quantifying Variability and Change in Watershed Hydrology and Water Quality." EPA/600/R-08/065. https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=185183

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**Appendix A:** Corrective Action Report

**SOP-QA-001**
**CAR #:_____**

Date:_____ Area/Location:_____

Reported by:_____ Activity:_____

State the nature of the problem, nonconformance or out-of-control situation:

_____
_____
_____
_____

Possible causes:

_____
_____
_____

Recommended Corrective Actions:

_____
_____
_____

CAR routed to:_____
Received by:_____

Corrective Actions taken:

_____
_____
_____
_____

Has problem been corrected? YES NO

Immediate Supervisor:_____

Program Manager:_____

TWRI Quality Assurance Officer:_____

TSSWCB Quality Assurance Officer: _____