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

Arroyo Colorado Agricultural Nonpoint Source Assessment
TSSWCB Project Number 06-10
Revision #1

Quality Assurance Project Plan

Texas State Soil and Water Conservation Board

prepared by

Texas A&M AgriLife, Texas Water Resources Institute

Effective Period: Upon EPA Approval through February 2011
(with annual updates required)

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A1 APPROVAL PAGE

Quality Assurance Project Plan for *Arroyo Colorado Agricultural Nonpoint Source Assessment.*

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Name: Don Marek
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A3 DISTRIBUTION LIST

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

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Name: Venki Uddameri
Title: Investigator and Lab Manager

Name: Don Marek
Title: Laboratory Quality Assurance Officer

List of Acronyms

APHIS	Animal and Plant Health Inspection Service
AWRL	Ambient Water Reporting Limit
BMP	Best Management Practice
BOD5	Biological Oxygen Demand, 5-day
CAR	Corrective Action Report
COC	Chain of Custody
CWA	Clean Water Act
DO	Dissolved Oxygen
DOQ	Digital Orthophoto Quadrangles
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
LCS	Laboratory Control Standard
LCSD	Laboratory Control Standard Duplicate
LRGV	Lower Rio Grande Valley
MRLC	Multi-Resolution Land Characteristics
NO_2+NO_3	Nitrite plus Nitrate
NH_3	Ammonia Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
PM	Project Manager
PO_4	Orthophosphate phosphorus
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QMP	Quality Management Plan
RL	Laboratory Reporting Limit
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
SSL	Texas A&M University Spatial Sciences Laboratory
SWAT	Soil and Water Assessment Tool
TAMU	Texas A&M University
TAMUK	Texas A&M University - Kingsville
TCEQ	Texas Commission on Environmental Quality
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
TSSWCB	Texas State Soil and Water Conservation Board
TWRI	Texas Water Resources Institute
USDA-FSA	United States Department of Agriculture Farm Services Agency
WPP	Watershed Protection Plan
WQMP	Water Quality Management Plan

A4 PROJECT/TASK ORGANIZATION

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

U.S. Environmental Protection Agency Region 6

Henry Brewer, EPA Project Officer

Responsible for managing the project for EPA. Reviews project progress and reviews and approves QAPP and QAPP amendments.

Texas State Soil and Water Conservation Board (TSSWCB)

Pamela Casebolt, TSSWCB Project Manager

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 the TWRI and the TSSWCB. Tracks and reviews deliverables to ensure that tasks in the work plan are completed as specified in the contract. Responsible for verifying that the QAPP is followed by the TWRI. Notifies the TSSWCB QAO of significant project nonconformances and corrective actions taken as documented in quarterly progress reports from TWRI Project Lead.

Donna Long, TSSWCB Quality Assurance Officer

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

Texas A&M AgriLife, Texas Water Resources Institute (TWRI)

B.L. Harris, TWRI Acting Director; Project Lead

The TWRI Project Lead is responsible for ensuring that tasks and other requirements in the contract are executed on time and with the quality assurance/quality control 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 Project Manager. Responsible for ensuring adequate training and supervision of all activities involved in generating analytical and field data.

Allen Berthold, TWRI Project Manager

The TWRI Project Manager is responsible for overseeing the completion of tasks and other requirements in the contract in a timely manner and within the quality assurance/ quality control requirements as defined by the contract and in QAPP; assessing the quality of subcontractor/participant work; submitting accurate and timely deliverables to the TSSWCB Project Manager; and coordinating attendance at conference calls, training, meetings, and related project activities with the TSSWCB. Responsible for verifying that the QAPP is distributed and followed by the TWRI and all subcontractors and that the project is producing data of known and acceptable quality. TWRI and AgriLife Research will conduct annual Project Coordination Meetings to discuss the QAPP and other guidance documents necessary for the project.

Lucas Gregory, TWRI Quality Assurance Officer

Responsible for coordinating development and implementation of TWRI's QA program. Responsible for writing and maintaining QAPPs and monitoring its implementation. Responsible for QAPP distribution, including appendices and amendments. Ensures the data collected for the project is of known and acceptable quality and adheres to the specifications of the QAPP. Responsible for identifying, receiving, and maintaining project quality assurance records. Responsible for coordinating with the TSSWCB QAO to resolve QA-related issues. Notifies the TWRI Project Manager and TSSWCB Project Manager of particular circumstances which may adversely affect the quality of data. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Conducts assessments of participating organizations during the life of the project as noted in Section C1. Implements or ensures implementation of corrective actions needed to resolve nonconformances noted during assessments. TWRI and AgriLife Research will conduct annual Project Coordination Meetings to discuss the QAPP and other guidance documents necessary for the project.

Texas AgriLife Research-Weslaco

Juan Enciso, Investigator

Responsible for evaluating BMPs to reduce NPS Pollution at the farm level (Task 7) and serve as member of the Monitoring Oversight Committee. Responsible for supervising all aspects of the sampling and measurement of edge-of-field runoff. Responsible for the collection of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A7.2), as well as the requirements of Sections B1 through B8. Responsible for field scheduling, staffing, and ensuring that staff are appropriately trained. Reports status, problems, and progress to TWRI Project Manager.

Texas AgriLife Research-Temple

Narayanan Kannan, Investigator

Responsible for the inventory of Conservation Practice Implementation (Task 3) and serving as a member of the Oversight Committee.

Texas AgriLife Research – Spatial Sciences Lab

Raghavan Srinivasan, Investigator

Responsible for Updating Land Use / Land Cover Data.

Texas A&M University – Kingsville (TAMUK)

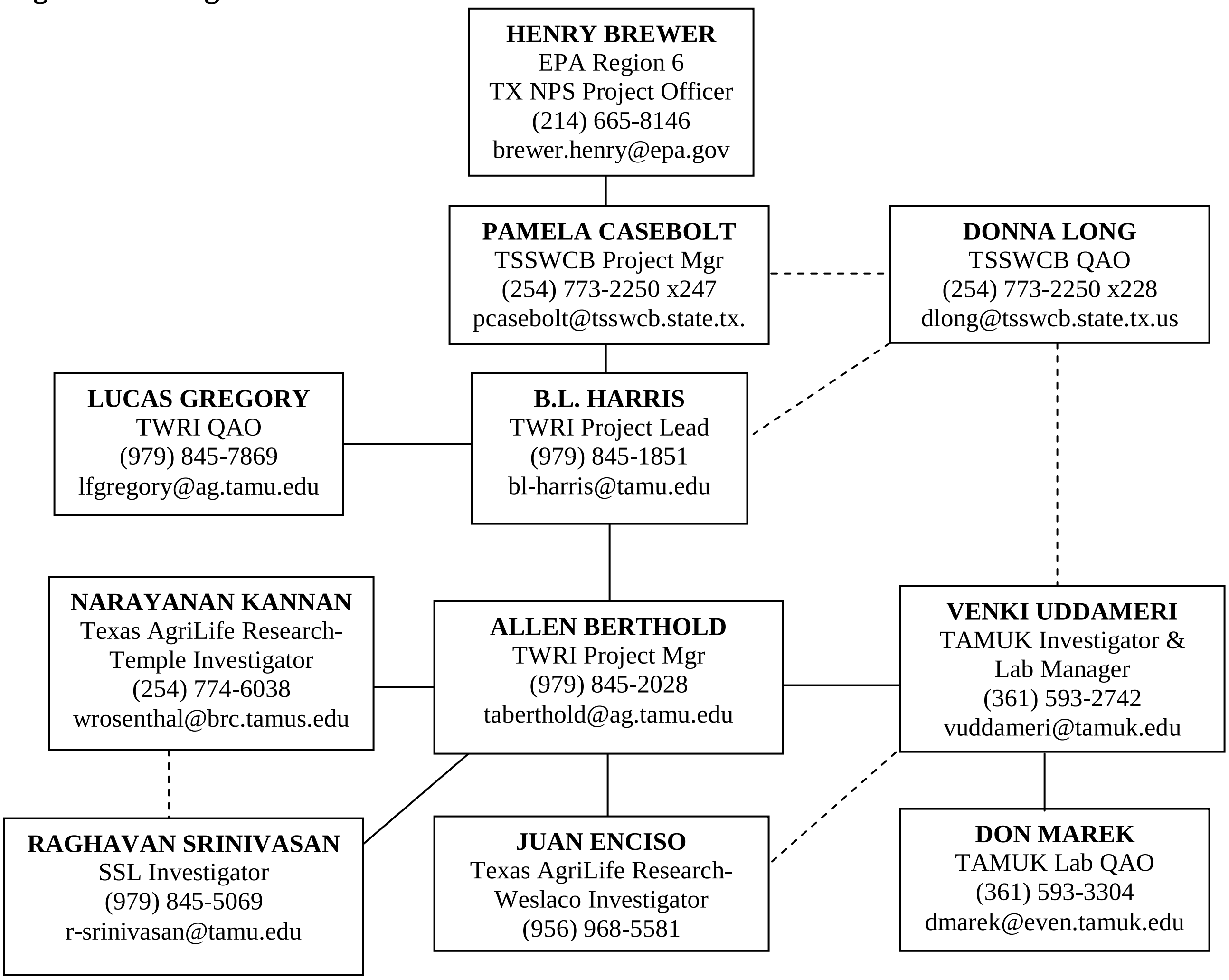
Venki Uddameri, Investigator and Lab Manager

Responsible for performing sub-watershed monitoring, measuring pollutant attenuation in drainage ditches (Task 6), and serving as a member of the Oversight Committee. Responsible for supervision of laboratory personnel involved in generating analytical data for the project. Responsible for ensuring that laboratory personnel involved in generating analytical data have adequate training and a thorough knowledge of the QAPP and all SOPs specific to the analyses or task performed and/or supervised. Responsible for oversight of all laboratory operations ensuring that all QA/QC requirements are met, documentation related to the analysis is complete and adequately maintained, and that results are reported accurately. Responsible for ensuring that corrective actions are implemented, documented, reported and verified.

Mr. Don Marek, Laboratory Quality Assurance Officer

Monitors the implementation of the QMP within the South Texas Environmental Laboratory to ensure complete compliance with project data quality objectives as defined by the contract and in the QAPP. Conducts in-house reviews to ensure compliance with written SOPs and to identify potential problems. Responsible for supervising and verifying all aspects of the QA/QC in the laboratory. Performs validation and verification of data before the report is sent to the TWRI. Ensures that all QA reviews are conducted in a timely manner from real-time review at the bench during analysis to final pass-off of data to the QA Officer.

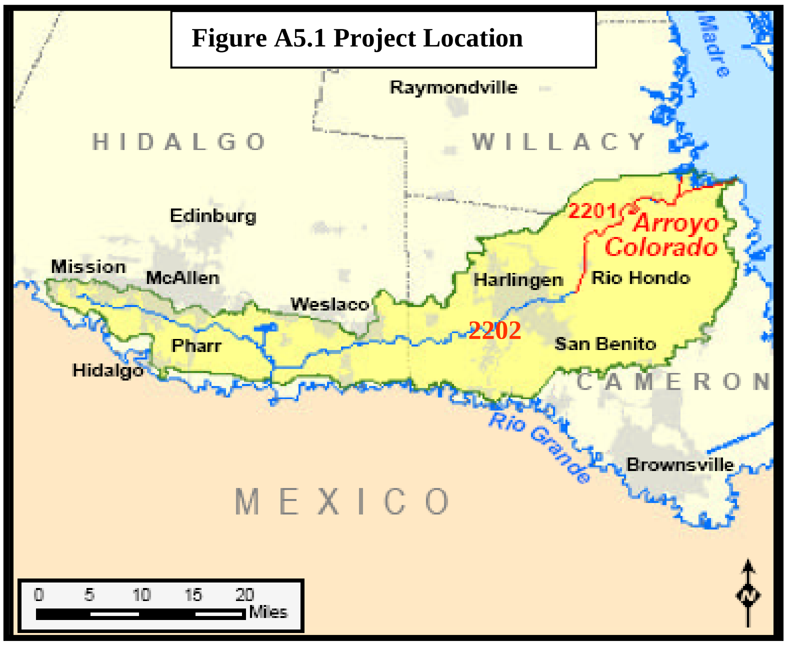
Figure A4.1 Organization Chart



A5 PROBLEM DEFINITION/BACKGROUND

The Arroyo Colorado flows through Hidalgo, Cameron and Willacy Counties in the Lower Rio Grande Valley of Texas into the Laguna Madre (Figure A5.1). Flow in the Arroyo Colorado is sustained by wastewater discharges, agricultural irrigation return flows, urban runoff, and base flows from shallow groundwater. The Arroyo is the major source of fresh water to the lower Laguna Madre, an economically and ecologically important resource to the region. The Laguna Atascosa National Wildlife Refuge and several county and city parks are located within the Arroyo watershed. The mild climate, semi-tropical plants and animals, and many recreational opportunities draw large numbers of people to the Arroyo Colorado watershed. One third of the stream is also used for shipping from the Gulf Intracoastal Waterway to the Port of Harlingen.

Figure A5.1 Project Location



As a result of low dissolved oxygen levels, the tidal segment of the Arroyo Colorado (2201), does not currently meet the aquatic life use designated by the State of Texas and described in the Water Quality Standards. This has been the case for every 303(d) list prepared by the state since 1986. There have also been concerns for high nutrient levels in this river as documented on every 305(b) assessment prepared by the state since 1988. In order to meet the dissolved oxygen criteria (24-hour average of 4.0 mg/L and minimum of 3.0 mg/L) at least 90% of the time between the critical period of March through October, TCEQ (2003) estimates a 90% reduction in nitrogen, phosphorous, oxygen demanding substances and sediment will be necessary.

In response to this impairment, a local steering committee, working with the TSSWCB, TCEQ, and other agencies, devised and is now implementing strategies outlined in the watershed protection plan (WPP) to increase dissolved oxygen in the Arroyo Colorado and improve its environmental condition.

A6 PROJECT/TASK DESCRIPTION

The primary focus of this 319(h) project is to better characterize agricultural runoff in the Arroyo Colorado, assess and demonstrate the effects of BMP implementation at the field and sub-watershed level, and measure progress towards meeting WPP goals. A secondary focus is to evaluate the natural phosphorus reduction capabilities of drainage ditches on runoff from irrigated cropland in the Arroyo Colorado watershed.

This project will provide storm and routine monitoring of drainage ditches that contribute nonpoint source loadings to the Arroyo Colorado in order to better assess agricultural NPS loadings and reductions resulting from BMP implementation. Monitoring will primarily be directed at evaluating areas with significant irrigated cropland acreage to evaluate nonpoint source pollution (NPS) contributions and determine NPS reductions resulting from BMPs.

A final report will be developed assessing the effects of the conservation practices. Soil sampling and water quality monitoring will be utilized to gauge the impacts on water quality.

This project will be consistent with the Watershed Protection Plan and highly coordinated with the Arroyo Partnership and the Arroyo Colorado Agricultural Issues Workgroup as well as the educational and implementation projects already underway in the watershed. These groups and projects will provide for a great deal of public participation and many opportunities for public input.

In this project, TAMUK will provide assessment activities at 4 sub-watershed sites. These sub-watersheds represent predominately irrigated cropland within the Arroyo watershed with two sites being located in Cameron County and two sites in Hidalgo County. The two sites in Cameron County were monitored from 2000 to 2002. The historical water quality data available at these sites will be made available as non-direct data to this project for use in the assessment of water quality.

The monitoring effort will make use of numerous automated sampling systems in TAMUK's possession that will be made available to this project. Historical or nondirect data obtained from other projects with QAPPs approved by EPA or the State of Texas will also be used to supplement this project. The data collected for this project will be used to determine the reduction of NPS pollution associated with implementation efforts and provide data to inform TSSWCB of areas where focused reduction efforts are most needed. This project will also support the educational efforts in the watershed.

The sub-watershed monitoring activities of this project will consist of automated stormwater sampling, monthly ambient grab sampling, and instantaneous streamflow measurements. Field measurements of dissolved oxygen, water temperature, specific conductance, and pH will occur with all grab sampling. Stormwater samples will be retrieved on a daily basis during storm events and flow composited into a single sample. All water samples will be analyzed for total phosphorus, dissolved orthophosphate phosphorus, total Kjeldahl nitrogen, dissolved ammonia, dissolved nitrite plus nitrate, and total suspended sediments (TSS). In addition, monthly grab samples will be analyzed for BOD5.

The various nutrient forms are included in the laboratory analyses to provide a more complete indication of macronutrient conditions in the watershed, evaluate whether agricultural BMPs are reducing both nutrients (nitrogen and phosphorus), and ensure that efforts to reduce one nutrient is not inadvertently increasing another.

Texas AgriLife Research will provide result demonstrations to landowners in the Arroyo Colorado watershed. This edge of field monitoring will represent both tiled and non-tiled irrigated cropland fields that drain to both drainage ditches and directly into the Arroyo. Surface runoff, along with outflow from the tile drainage system, will be monitored on selected irrigation events. All water samples will be analyzed for total phosphorus, dissolved orthophosphate phosphorus, total Kjeldahl nitrogen, dissolved ammonia, dissolved nitrite plus nitrate, total suspended sediments (TSS) and BOD5.

Project staff will maintain equipment to record instantaneous water level information and gather the required physical measurements and flow data needed to develop, maintain and update, as needed, the stage-discharge relationships (rating curves) at all stations.

This project is dependent upon and an important component of the larger Arroyo Colorado effort described above. It is closely linked to the CWA §319 funded FY05 Arroyo BMP Education Project being conducted by TWRI and Texas AgriLife Extension Service, the FY05 Arroyo WQMP Implementation Project being conducted by the TSSWCB and Hidalgo and Southmost SWCDs, and the Arroyo WPP Implementation Project being conducted by TCEQ and TWRI. The results of this study will be used to support ongoing educational and implementation efforts and future modeling efforts planned for the watershed. Project milestones are summarized in Table A6.1.

Table A6.1. Project Plan Milestones

Task	Project Milestones	Agency	Start	End
1.1	Organize Ag Monitoring Oversight Committee	TWRI	01/07	02/11
1.2	Prepare quarterly reports submitted electronically to TSSWCB and distributed to project participants	TWRI	01/07	02/11
1.3	Technical transfer of monitoring results to Texas A&M AgriLife	TWRI	01/07	02/11
2.1	Compile and assess historical water quality data	TWRI	01/07	06/08
2.2	Summarize results of past NPS studies	TWRI	01/07	06/08
2.3	Identify data gaps	TWRI	01/07	06/08
2.4	Technical transfer of results to Texas A&M AgriLife	TWRI	01/07	01/10
3.1	Identify producers in watershed	Research-Temple	01/07	06/08
3.2	Compile data on BMPs implemented and location	Research-Temple	01/07	01/09
3.3	Assemble geo-referenced database and map	Research-Temple	01/08	06/09
3.4	Technical transfer of results to Texas A&M AgriLife	Research-Temple	01/08	06/09
3.5	Identify priority areas for implementation	Research-Temple	01/08	02/11
4.1	Obtain 1998 LULC data	SSL	01/08	06/08
4.2	Obtain 2003 LANDSAT ETM+ Data & classify	SSL	01/08	06/08
4.3	Obtain digital cropland data & add to classification	SSL	01/08	06/08
4.4	Obtain digital citrus production data & add to classification	SSL	01/08	06/08
4.5	Obtain digital sugarcane data & add to classification	SSL	01/08	06/08
4.6	Obtain 2004 1 m DOQ to upgrade classification	SSL	01/08	06/08
4.7	Obtain digital irrigation district data to upgrade classification	SSL	01/08	06/08
4.8	Obtain digital 1998 tile drainage data and update	SSL	01/08	06/08
4.9	Obtain digital 1998 colonia data and update	SSL	01/08	06/08
4.10	Obtain 1998 non-colonia septic system data and update	SSL	01/08	06/08
4.11	Obtain 1998 land application data and update	SSL	01/08	06/08
5.1	Develop QAPP	TWRI	01/07	02/11
5.2	QAPP Annual Revisions	TWRI	01/08	11/10
6.1	Perform routine grab & storm event water quality assessment	TAMUK	05/08	02/11
6.2	Determine pollutant assimilation capacity of drainage ditches	TAMUK	05/08	02/11
7.1	Select suitable demonstration sites	Research-Weslaco	10/07	01/08
7.2	Install sensors	Research-Weslaco	01/08	02/08
7.3	Collect and analyze data	Research-Weslaco	01/09	02/11
7.4	Technical transfer through field days & demonstrations	Research-Weslaco	01/09	02/11

A7 QUALITY OBJECTIVES AND CRITERIA

The primary objectives of this project are to better characterize agricultural runoff in the Arroyo Colorado, assess and demonstrate the effects of BMP implementation at the field and sub-watershed level, and measure progress towards meeting WPP goals. Secondary objectives include evaluating the natural phosphorus reduction capabilities of drainage ditches on runoff from irrigated cropland in the Arroyo Colorado watershed and collecting data for future recalibration of the SWAT model to better estimate the total nonpoint source loading into the Arroyo Colorado. To achieve these objectives, the project will collect both geospatial and water quality data.

Geospatial Data Quality Objectives

Geospatial data on landuse and conservation practice implementation will be collected to assist with future recalibration of the SWAT model. Texas AgriLife Research-Temple with assistance from Texas AgriLife Extension Service, USDA-NRCS, USDA-FSA, the TSSWCB Harlingen Regional Office, and the SWCDs, will compile digital data on the location and types of Conservation Practices implemented in the Arroyo Colorado Watershed since 1995. This will include, but not be limited to, practices implemented through the Environmental Quality Incentives Program (EQIP) and the Water Quality Management Plan (WQMP) Program. Texas AgriLife Research-Temple will assemble a geo-referenced database and develop a map (hard copy and electronic) displaying conservation practice implementation.

The Texas AgriLife Research-Spatial Sciences Lab will obtain the 1998 LULC for the Arroyo Colorado Watershed from TCEQ and all data used to produce it and update it using:

- 2003 LANDSAT ETM+ Data, Path 26/ Row 42 and Path 27/ Row 42
- digital data on cropland from USDA – FSA
- digital location data on citrus production from USDA-APHIS
- digital data on locations of sugarcane fields from sugar mill
- 2004 1m DOQ for Cameron, Hidalgo and Willacy counties
- digital data from irrigation districts
- 1998 tile drain data and if available, updated data from TSSWCB and AgriLife Extension
- 1998 data on colonia and if available, obtain updated data from TWDB
- 1998 data on non-colonia septic systems and if available, obtain updated data from Lower Rio Grande Valley Development Council (LRGVDC)
- 1998 data on land Application and if available, obtain updated data from NPDES Permits

This will be done using ESRI's ArcGIS 9.x software. Individual land use/cover classes will be identified and delineated in shapefile format with a minimum mapping unit of 0.5 ac on screen and verified through field sampling to an accuracy of 80% or greater. Ground control points used in the field sampling will be collected for at least ten locations per land use type using GPS units with an accuracy of 1-10 m. The landuse classification scheme to be used will include the categories described in Table A7.1. Further, detailed cropping information will be included within the Planted/Cultivated Herbaceous category.

Table A7.1 – Land Use Categories

CATEGORY	DESCRIPTION
WATER	Area covered by water, snow, or ice with less than 25% vegetated or developed cover, unless specifically included in another category
Open Water	All areas of open water with less than 25% vegetative or developed cover
Stream/river	A natural body of flowing water. Includes streams and rivers that have been channelized in order to control flooding or erosion or to maintain flow for navigation.
Canal/ditch	A man made open waterway constructed to transport water, to irrigate or drain land, to connect two or more bodies of water, or to serve as a waterway for water craft
Lake/pond	A non flowing, naturally existing, body of water. Includes water impounded by natural occurrences and artificially regulated natural lakes. The delineation of a lake is based on the areal extent of water at the time the imagery was acquired.
Reservoir	Any artificial body of water, unless specifically included in another category. It can lie in a natural basin or a man constructed basin. The delineation of a reservoir is based on the areal extent of water at the time the imagery was acquired. (The water control structures are classified as Communications/Utilities)
Bay/estuary	The inlets or arms of the sea that extend inland
DEVELOPED	Areas of the earth which have been improved by man. Includes all "built up" and urban areas of the landscape. Does NOT include mining lands, crop lands, or waste disposal areas (dumps). This land use category takes precedence over a land cover category when the criteria for more than one category are met.
Residential	Lands containing structures used for human habitation
Single family Residential	Lands used for housing residents in single family dwelling units. Includes trailer parks, mobile home parks, and entire "farmsteads" when there is a home in the complex. (If no home is in the complex, it should be classified as Agricultural Business.) Single family residential buildings located within another category, such as military family housing, should be identified in this category.
Multi family Residential	All lands devoted to housing more than one family on a permanent or semi permanent basis, group living situations, and their associated grounds. Includes apartments, apartment complexes, duplexes, triplexes, attached row houses, condominiums, retirement homes, nursing homes, and residential hotels. Residential building located within another category such as barracks and dormitories, should be identified in this category when possible.
Non residential Developed	Any "developed" area or feature which is used for a purpose other than habitation.
Commercial/Light Industry	Structures and associated grounds used for the sale of products and services, for business, or for light industrial activities. Includes all retail and wholesale operations. Include "industrial parks" and other features which cannot be clearly classified as either a retail service or light industry, such as heavy equipment yards, machinery repair, and junkyards.
Heavy Industry	Structures and their associated grounds used for heavy fabrication, manufacturing and assembling parts which are, in themselves, large and heavy; or for processing raw materials such as iron ore, timber, and animal products. Accumulated raw materials are subject to treatment by mechanical, chemical, or heat processing to render them suitable for further processing, or to produce materials from which finished products are created. Heavy industries generally require large amounts of energy and raw materials and produce a significant amount of waste products. Indicators of heavy industry may be stock piles of raw materials, energy producing sources and fuels, waste disposal areas and ponds, transportation facilities capable of handling heavy materials, smokestacks, furnaces, tanks, and extremely large buildings which are complex in outline and roof structure. Include associated waste piles and waste ponds. Heavy industry is usually located away from residential areas. Includes steel mills, paper mills, lumber mills, chemical plants, cement and brick plants, smelters, rock crushing machinery, and ore processing facilities associated with mining.

Communications and Utilities	Structures or facilities and associated grounds used for the generation and transfer of power and communications, the treatment or storage of drinking water, waste management, flood control, or the distribution and storage of gas and oil not associated with a unique feature. Includes pumping stations (oil, gas, or water), tank farms, power plants, electric substations, sewage treatment facilities and ponds, garbage collection facilities (not the final dumping ground these are included in Bare), dams, levees, and spillways of appropriate dimensions, filtration plants, and heavy concentrations of antennas or satellite dishes; along with the related operational buildings.
Institutional	Specialized government or private features which meet the educational, religious, medical, governmental, protective, and correctional needs of the public. Parking lots and associated grounds are included with these features. Includes public and private schools (not day care), cemeteries, state capitols, city halls, courthouses, libraries, churches, convents, monasteries, hospitals and training hospitals, post offices, police and fire departments, prisons, and military bases. Only the military business areas of a military base are classified here; residential, airport, athletic fields, and vegetated areas are classified in the appropriate category.
Agricultural Business	Structures and all associated grounds used for raising plants or animals for food or fiber. Includes fish farms and hatcheries, feedlots, poultry farms, dairy farms, temporary shipping and holding pens, animal breeding or training facilities, and greenhouses. (Farmsteads including a dwelling are classified as Residential, not Agricultural Business.)
Transportation	Roads, railroads, airports, port facilities, and their associated lands. Roads and railroads include the right of way, interchanges, and median strips. Category includes railroad stations, railroad yards, bus stations, highway maintenance yards, school bus parking and service yards, and park and ride lots. Port facilities include loading and unloading facilities, docks, locks and, temporary storage areas. Associated warehousing and transfer stations for truck or rail are included only if they appear to be an integral part of the airport or port facility. Nearby but separate warehouses will be classified as light industry.
Entertainment and Recreational	Areas and structures used predominantly for athletic or artistic events, or for leisure activities, and all associated lands and developed parking areas. Includes outdoor amphitheaters, drive in theaters, campgrounds, zoos, sports arenas (including indoor arenas), developed parks and playgrounds, community recreation centers, museums, amusement parks, public swimming pools, fairgrounds, and ski complexes (not the ski slopes). Marinas with over 25% of water surface covered by docks and boats are included here.
Mixed Urban	Developed areas which have such a mixture of residential and non residential features where no single feature meets the minimum mapping unit specification. This category is used when more than one third of the features in an area do not fit into a single category. Often applicable in the central, urban core area of cities.
BARE	Undeveloped areas of the earth not covered by water which exhibit less than 25% vegetative cover or less than 5% vegetative cover if in an arid area. The earth's surface may be composed of bare soil, rock, sand, gravel, salt deposits, or mud.
Transitional Bare	Areas dynamically changing from one land cover/land use to another, often because of land use activities. Includes all construction areas, areas transitioning between forest and agricultural land, and urban renewal areas which are in a state of transition.
Quarries/Strip Mines/Gravel Pits	Areas of extractive mining activities with significant surface disturbance. Vegetative cover and overburden are removed for the extraction of deposits such as coal, iron ore, limestone, copper, sand and gravel, or building and decorative stone. Current mining activity does not need to be identifiable. Inactive or unreclaimed mines and pits are included in this category until another land cover or land use has been established. Includes strip mines, open pit mines, quarries, borrow pits, oil and gas drilling sites, and gravel pits with their associated structures, waste dumps, and stockpiles.
Bare Rock/Sand	Includes bare bedrock, natural sand beaches, sand bars, deserts, desert pavement, scarps, talus, slides, lava, and glacial debris.

Flats	A level landform composed of unconsolidated sediments of mud, sand, gravel, or salt deposits. Includes coastal tidal flats and interior desert basin flats and playas.
Disposal	Designated areas where refuse is dumped or exists, such as landfills, trash dumps, or hazardous waste disposal sites. Reclaimed disposal areas or those covered with vegetation do not qualify.
VEGETATED	Areas having generally 25% or more of the land or water with vegetation. Arid or semi arid areas may have as little as 5% vegetation cover.
Woody Vegetation	Land with at least 25% tree and (or) shrub canopy cover
Forested	Land where trees form at least 25% of the canopy cover
Shrub land	Areas where trees have less than 25% canopy cover and the existing vegetation is dominated by plants that have persistent woody stems, a relatively low growth habit, and which generally produce several basal shoots instead of a single shoot. Includes true shrubs, trees that are small or stunted because of environmental conditions, desert scrub, and chaparral. In the eastern US, include former cropland or pasture lands which are now covered by brush to the extent that they are no longer identifiable or usable as cropland or pasture. Clear cut areas will exhibit a stage of shrub cover during the regrowth cycle. Some common species which would be classified as shrub land are mountain mahogany, sagebrush, and scrub oaks.
Planted/Cultivated Woody	Areas containing plantings of evenly spaced trees, shrubs, bushes, or other cultivated climbing plants usually supported and arranged evenly in rows. Includes orchards, groves, vineyards, cranberry bogs, berry vines, and hops. Includes tree plantations planted for the production of fruit, nuts, Christmas tree farms, and commercial tree nurseries. Exclude pine plantations and other lumber or pulp wood plantings which will be classified as Forest.
Citrus	Trees or shrubs cultivated in orchards or groves that bear edible fruit such as orange, lemon, lime, grapefruit, and pineapple.
Non managed Citrus	Orchards or groves containing fruit bearing trees or shrubs which are no longer maintained or harvested by humans. Evidence of non managed citrus includes the growth of non citrus shrubs, trees, and grasses within a orchard or grove.
Herbaceous Vegetation	Areas dominated by non woody plants such as grasses, forbs, ferns and weeds, either native, naturalized, or planted. Trees must account for less than 25% canopy cover while herbaceous plants dominate all existing vegetation.
Natural Herbaceous	Areas dominated by native or naturalized grasses, forbs, ferns and weeds. It can be managed, maintained, or improved for ecological purposes such as weed/brush control or soil erosion. Includes vegetated vacant lots and areas where it cannot be determined whether the vegetation was planted or cultivated such as in areas of dispersed grazing by feral or domesticated animals. Includes landscapes dominated by grass like plants such as bunch grasses, palouse grass, palmettoprairie areas, and tundra vegetation, as well as true prairie grasses.
Planted/Cultivated Herbaceous	Areas of herbaceous vegetation planted and/or cultivated by humans for agronomic purposes in developed settings. The majority of vegetation in these areas is planted and/or maintained for the production of food, feed, fiber, pasture, or seed. Temporarily flooded are included in this category. Do not include harvested areas of naturally occurring plants such as wild rice and cattails.
Sugar Cane	A very tall tropical grass up to 15 feet high with thick tough stems that is cultivated as the main source of sugar. It can be found in tropical and sub tropical areas of the United States such as Louisiana, Florida, Hawaii, and Texas.

Pasture/Hay	Areas of cultivated perennial grasses and/or legumes (e.g., alfalfa) used for grazing livestock or for seed or hay crops. Pasture lands can have a wide range of cultivation levels. It can be managed by seeding, fertilizing, application of herbicides, plowing, mowing, or baling. Pasture land has often been cleared of trees and shrubs, is generally on steeper slopes than cropland, is intended to graze animals at a higher density than open rangeland, and is often fenced and divided into smaller parcels than rangeland or cropland. Hay fields may be more mottled than small grain fields as they are not plowed annually and may be harvested and baled two or three times a year in some locations. On the Arroyo Colorado Project, this category also contains turf farms and maintained lawn grasses.
Vegetated Wetland	Areas where the water table is at, near, or above the land surface for a significant part of most years and vegetation indicative of this covers more than 25% of the land surface. Wetlands can include marshes, swamps situated on the shallow margins of bays, lakes, ponds, streams, or reservoirs; wet meadows or perched bogs in high mountain valleys, or seasonally wet or flooded low spots or basins. Do not include agricultural land which is flooded for cultivation purposes.
Woody Wetland	Areas dominated by woody vegetation. Includes seasonally flooded bottom land, mangrove swamps, shrub swamps, and wooded swamps including those around bogs. Wooded swamps and southern flood plains contain primarily cypress, tupelo, oaks, and red maple. Central and northern flood plains are dominated by cottonwoods, ash, alder, and willow. Flood plains of the Southwest may be dominated by mesquite, saltcedar, seepwillow, and arrowweed. Northern bogs typically contain tamarack or larch, black spruce, and heath shrubs. Shrub swamp vegetation includes alder, willow, and buttonbush.
Emergent Herbaceous Wetlands	Areas dominated by wetland herbaceous vegetation which is present for most of the growing season. Includes fresh water, brackish water, and salt water marshes, tidal marshes, mountain meadows, wet prairies, and open bogs.

Water Quality Data Quality Objectives

To ensure that quality data is collected to achieve project objectives, water samples will be analyzed if they meet preservation requirements and holding times (see Table B2.1 for more detail). The measurement performance specifications to support the project objectives are specified in Table A7.2.

Table A7.2 - Measurement Performance Specifications

Parameter	Units	Method	AWRL	Lab Reporting Limits (RL)	Recovery at RL	Precision (RPD of LCS/LCSD)	Bias (% Rec. LCS/LCSD mean)	Lab
Field Parameters								
pH	*Standard Units*	*EPA 150.1 TCEQ SOP*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
DO	*mg/L*	*EPA 360.1 TCEQ SOP*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Conductivity	*uS/cm*	*SM 2520B*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Temperature	*C*	*EPA 170.1 TCEQ SOP*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Flow	*cfs*	*TCEQ SOP*	*NA*	*NA*	*NA*	*NA*	*NA*	*field*
Conventional Parameters								
TSS	*mg/L*	*EPA 160.2*	*4.0*	*4.0*	*75-125*	*20*	80-120	*TAMUK*
Ammonia-Nitrogen, Total	*mg/L*	*EPA 350.3*	*0.02*	*0.02*	*75-125*	*20*	*80-120*	*TAMUK*
Ortho-Phosphate	*mg/L*	*SM 4110 B SM 4500-P E**	*0.04*	*0.04*	*75-125*	*20*	*80-120*	*TAMUK*
Total Phosphorus	*mg/L*	*SM 4500-P E*	*0.06*	*0.06*	*75-125*	*20*	*80-120*	*TAMUK*
Nitrate/nitrite-Nitrogen, Total	*mg/L*	*SM 4110 B SM 4500-NO2 B* SM 4500-NO3 D**	*0.04*	*0.04*	*75-125*	*20*	*80-120*	*TAMUK*
Total Kjeldahl Nitrogen	*mg/L*	*EPA 351.3*	*0.2*	*0.2*	*75-125*	*20*	*80-120*	*TAMUK*
BOD, 5-day	*mg/L*	*SM 5210B*	*2.0*	*2.0*	*NA*	*20*	*70-130*	*TAMUK*

** Alternate methods to be used in case of equipment failure to ensure holding times are met and data is not lost.*
Methods from:

- *United States Environmental Protection Agency (USEPA), "Methods for Chemical Analysis of Water and Wastes," Manual #EPA-600-4-79-020*
- *American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), "Standard Methods for the Examination of Water and Wastewater," 21st Edition, 2005*
- *TCEQ SOP v1 - Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue, October 2008 (RG-415)*

Ambient Water Reporting Limits and Laboratory Reporting Limits

Ambient water reporting limits (AWRLs) are the specifications at or below which data for a parameter must be reported to be compared with the freshwater screening criteria. The AWRLs specified in Table A7.2 are the reporting specifications for each analyte to yield data acceptable to meet the project objectives. The laboratory reporting limit (RL) is the lowest concentration at which the laboratory will report quantitative data within a specified recovery range. Ongoing ability to recover an analyte at or below the AWRL is demonstrated through analysis of a calibration or check standard at the laboratory's RL. The AWRL and RL for target analytes and performance limits for RLs are set forth in Table A7.2. Acceptance criteria are defined in Section B5. The laboratory is required to meet the following:

- The laboratory's reporting limit for each analyte will be at or below the AWRL.
- The laboratory will demonstrate and document on an ongoing basis the laboratory's ability to quantitate at its reporting limits.

Precision

The precision of laboratory data is a measure of the reproducibility of a measurement when a collection on an analysis is repeated and includes components of random error. It is strictly defined as a measure of the closeness with which multiple analyses of a given sample agree with each other. Laboratory precision is assessed by comparing replicate analyses of laboratory control standards in the sample matrix. Precision results are plotted on quality control charts which are based on historical data and used during evaluation of analytical performance. Performance limits for laboratory control standard/laboratory control standard duplicates (LCS/LCSD) are specified in Table A7.2.

Field splits are used to assess the variability of sample handling, preservation, and storage, as well as the analytical process, and are prepared by splitting samples in the field. Control limits for field splits are defined in Section B5.

Bias

Bias is a statistical measurement of correctness and includes components of systemic error. A measurement is considered unbiased when the value reported does not differ from the true value. Lab bias is verified through the analysis of laboratory control standards (LCS) prepared with known and verified concentrations of analyte in the sample matrix and by calculating percent recovery. Bias of the mean of LCS and LCSD results are assessed at a frequency of one per batch. Results are plotted on quality control charts which are calculated based on historical data and used during evaluation of analytical performance. Performance limits for the mean results of laboratory control standards (LCS/LCSD) and results of calibration control standards at laboratory RLs are specified in Table A7.2. Performance limits for blank analyses are discussed in Section B5.

Representativeness

This data collection effort involves monitoring both irrigation water inflows and outflows from agricultural fields as well as in-stream (drainage ditch) water quality data for the purpose of aiding evaluation of BMP effectiveness and assessment of agricultural loadings. Drainage ditch sites were carefully selected to represent agricultural production areas in the Arroyo and have very little or no urban or residential development. In order to ensure representativeness of the data, samples will be collected and analyzed over a two year period in accordance with approved sampling and analysis methods as described in this QAPP. Further, the following general guidelines adhered to in selection of the BMP demonstration/evaluation sites:

- Sites are irrigated;
- Sites represent the primary production crops raised in the Lower Rio Grande Valley (LRGV), i.e., grain/sorghum, cotton, corn, and sugar cane;
- Sites represent both conventional and innovative irrigation BMPs in the LRGV;
- Sites are farmed by willing participants in the study; and
- Sites are within the Arroyo Colorado Watershed.

Comparability

In order to ensure comparability of data, project staff will use only approved sampling and analysis methods and QA/QC protocols in accordance with this QAPP. Project staff will report data in standard units, use accepted rules for significant figures, and report data in a standard format as specified in this QAPP.

Completeness

Project staff will strive to have 100% of the data available for completing project objectives. However, the possibility of unavailable data due to inclement weather, instrument malfunctions, accidents, insufficient sample volume, broken or lost samples, and other unforeseen circumstances is to be expected. Therefore, it will be a general goal of the project that 90% data completion is achieved. Should less than 90 percent data completeness occur, the TWRI Project Manager will initiate corrective action. Data completeness will be calculated as a percent value and evaluated with the following formula:

% completeness = (SV x 100) / ST

where: SV = number of samples with a valid analytical report
ST = total number of samples collected

A8 SPECIAL TRAINING/CERTIFICATION

No special certifications are required. However, field personnel will receive training in proper sampling and field analysis. Before actual sampling occurs, field personnel will demonstrate their ability to properly perform field sampling procedures. Laboratory analysts have a combination of experience, education, and training to demonstrate knowledge of their function. To perform analyses for the project, each laboratory analyst must demonstrate their capability to conduct each test that the analyst performs to the Lab Quality Assurance Officer. This demonstration of capability is performed before analyzing samples and annually thereafter.

A9 DOCUMENTS AND RECORDS

The document and records that describe, specify, report, or certify activities, requirements, procedures, or results for this project and the items and materials that furnish objective evidence of the quality of items or activities are listed in Table A9.1. 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	Paper/Electronic
QAPP distribution documentation	TWRI	5 years	Paper/Electronic
Field notebooks or field data sheets	TAMUK/Research*	5 years	Paper/Electronic
Field equipment calibration/maintenance logs	TAMUK/Research*	5 years	Paper/Electronic
Chain of custody records	TAMUK/Research*	5 years	Paper/Electronic
Field SOPs	TAMUK/Research*	5 years	Paper/Electronic
Field corrective action documentation	TWRI/TAMUK/Research*	5 years	Paper/Electronic
Field sample logs	TAMUK/Research*	5 years	Paper/Electronic
Laboratory sample reception logs	TAMUK	5 years	Paper/Electronic
Laboratory QA manuals	TAMUK	5 years	Paper/Electronic
Laboratory SOPs	TAMUK	5 years	Paper/Electronic
Laboratory internal/external standards	TAMUK	5 years	Paper/Electronic
Instrument raw data files	TAMUK	5 years	Electronic**
Instrument readings/printouts	TAMUK	5 years	Paper/Electronic
Laboratory data reports	TAMUK	5 years	Paper/Electronic
Lab data verification for integrity/precision/bias/validation	TAMUK/TWRI	5 years	Paper/Electronic
Laboratory equipment maintenance logs	TAMUK	5 years	Paper/Electronic
Laboratory calibration records	TAMUK	5 years	Electronic**
Laboratory corrective action documentation	TAMUK/TWRI	5 years	Paper/Electronic
Data verification/validation	TWRI	5 years	Paper/Electronic**
Data files	TWRI/TSSWCB	3 years	Paper/Electronic**
Progress report/final report/data	TWRI/TSSWCB	3 years	Paper/Electronic**

**Texas AgriLife Research-Weslaco*
***Electronic files should be ASCII (DOS) pipe delimited text files.*

QAPP Revision

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually at least 60 days prior to 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

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

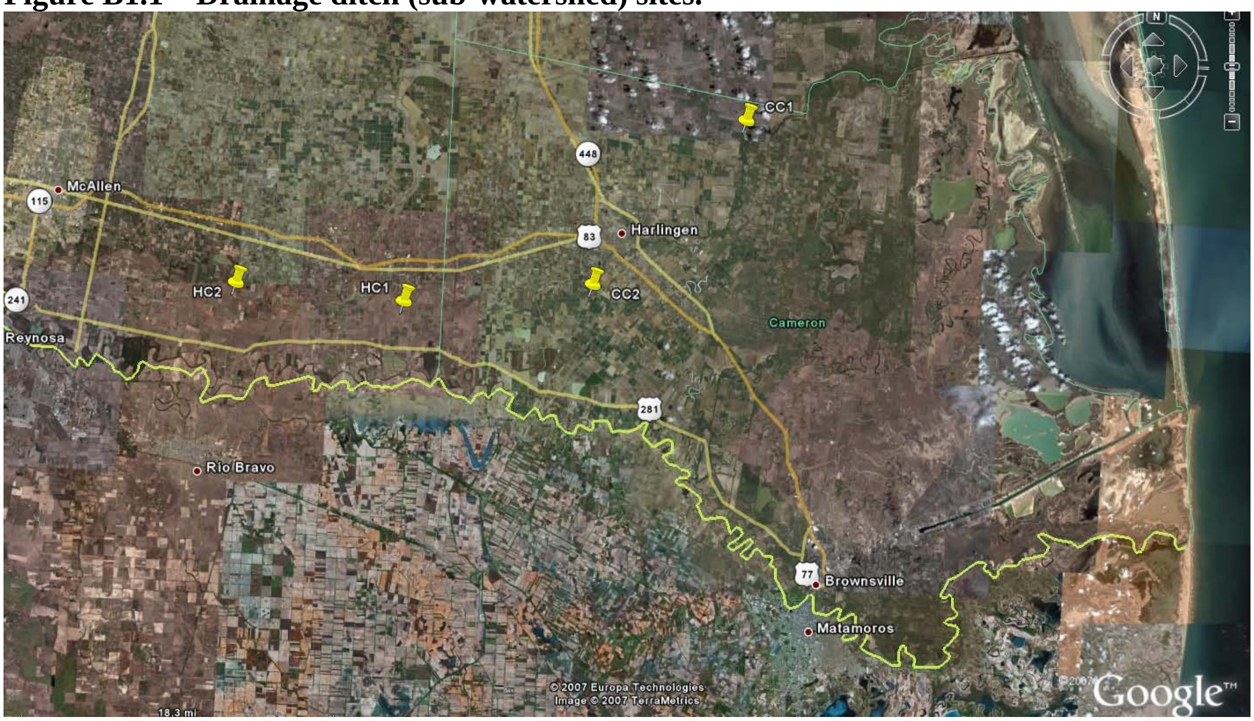
B1 SAMPLING PROCESS DESIGN

The sampling objectives are to better characterize agricultural runoff in the Arroyo Colorado, assess and demonstrate the effects of BMP implementation at the field and sub-watershed level, measure progress towards meeting WPP goals, and evaluate the natural phosphorus reduction capabilities of drainage ditches on runoff from irrigated cropland in the Arroyo Colorado watershed. In addition to aiding education programs and evaluation of progress, this project will provide data for future modeling activities. Thus, all monitoring data collected for the TSSWCB are considered critical. To achieve these objectives, both sub-watershed monitoring and edge-of-field monitoring will be required.

Sub-watershed Monitoring

In this project, TAMUK will provide assessment activities at 4 drainage ditches within the Arroyo Colorado (Figure B1.1). The four drainage ditches chosen for this study represent predominately irrigated cropland within the Arroyo watershed with two sites being located in Cameron County (CC1 and CC2) and two sites in Hidalgo County (HC1 and HC2). The two sites in Cameron County were monitored from 2000-02.

Figure B1.1 Drainage ditch (sub-watershed) sites.



Monitoring of these drainage ditches will consist of employing automated storm water sampling equipment for 4 events per year and collecting grab samples and instantaneous stream flow measurements on a monthly basis (Table B1.1). When flow is present, two grab samples will be collected monthly at each drainage ditch – one upstream and one downstream – to allow both the evaluation of pollutant attenuation in the drainage ditches and pollutant levels in the ditches.

Field measurements of dissolved oxygen, water temperature, specific conductance, and pH will occur with all monthly grab sampling using a YSI 6000 multi-probe. Storm-water samples will be retrieved on a daily basis during storm events and flow composited into a single sample for each storm event. All water samples will be analyzed for total phosphorus, dissolved orthophosphate phosphorus, total Kjeldahl nitrogen, dissolved ammonia, dissolved nitrite plus nitrate, and total suspended sediments (TSS). In addition, monthly grab samples will be analyzed for BOD5. The nutrient forms are included in the laboratory analyses to provide a more complete indication of macronutrient conditions in the watershed, to evaluate whether agricultural BMPs are reducing both nutrients (nitrogen and phosphorus), and to ensure that efforts to reduce one nutrient is not inadvertently increasing another.

Table B1.1. Drainage ditch sites and monitoring frequencies.

Site ID	Site Description	Lat/long	Nutrients	BOD5	TSS	Field	Flow
Hidalgo County							
HC1	Mile 4 North FM 491	26° 6'46.57"N / 97°54'4.41"W	Monthly + 8 storm events	Monthly	Monthly + 8 storm events	Monthly	Monthly
HC2	3 mi N of US Military Hwy 281 & 493	26° 7'19.45"N / 98° 3'39.49"W	Monthly + 8 storm events	Monthly	Monthly + 8 storm events	Monthly	Monthly
Cameron County							
CC1	Harding Ranch Rd (3 mi N. of 508 & 1420	26°16'47.77"N / 97°35'12.56"W	Monthly + 8 storm events	Monthly	Monthly + 8 storm events	Monthly	Monthly
CC2	Theme Rd W. of Rangerville Rd.	26° 8'24.82"N / 97°43'33.23"W	Monthly + 8 storm events	Monthly	Monthly + 8 storm events	Monthly	Monthly

Nutrients = NO_2+NO_3, TKN, NH_3, PO_4, TP
Field = dissolved oxygen, pH, conductivity, temperature, turbidity

BMP Demonstration/Evaluation

This project will also provide result demonstrations to landowners in the Arroyo Colorado watershed. This data collection effort involves monitoring irrigation water inflow and outflow (via either tile drains or shallow groundwater) from agricultural fields for the purpose of aiding evaluation of BMP effectiveness and assessment of agricultural loadings. Monitoring will be conducted to represent both tiled and non-tiled irrigated cropland fields that drain to both drainage ditches and directly into the Arroyo. General guidelines followed in selection of the six fields are as follows:

- Sites are irrigated,
- Sites represent the primary production crops raised in the Lower Rio Grande Valley (LRGV), i.e., grain/sorghum, cotton, corn, and sugar cane;
- Sites represent both conventional and innovative irrigation BMPs in the LRGV;
- Sites are farmed by willing participants in the study; and
- Sites are within the Arroyo Colorado Watershed

The six fields selected for the evaluation of agricultural BMPs are shown in Table B1.2. The fields will be physically characterized to determine general topography (slope), coordinates, soil texture, salinity and fertility levels, and water quality. Cultural practices such as irrigation timing, crop fertilization, and pest management used by the cooperating farmers in the recent past will also be documented.

Table B1.2. Field identification and description for BMP demonstration/evaluation.

Station ID	Location	Farm	Management Practices
Field A (FA)	Rangerville: FM 800	Danny Allen	Land leveled, IPM, poly-pipe, furrow irrigation
Field B (FB)	Rangerville: FM 800	Tom McLemore	Land leveled, poly-pipe, furrow irrigation
Field C (FC)	Simmons Rd/ FM 1479	Leonard Simmons	Reduced till, poly-pipe, furrow irrigation, irrigation scheduling, Doppler meter
Field D (FD)	South of San Juan. Hwy 281	Steve Cofoid	Poly-pipe, furrow irrigation, drain tile
Field E (FE)	South of Weslaco (FM 1015)	Wyatt-Hidalgo farms	Poly-pipe, furrow irrigation
Field F (FF)	San Benito (26 05' 52 / 97 35' 21)	Russell Plantation	Poly-pipe, furrow irrigation, tile drained

Irrigation water applied to each field, along with surface runoff and outflow from the tile drainage system or shallow groundwater, will be monitored on selected irrigation events. The irrigation dates are not currently known because (1) fields will have different crops with different water requirements, (2) fields are operated under different water management schemes, and (3) irrigation dates are highly dependent on climate, growth stage, and the operation of the irrigation district. The crop will be monitored continuously to determine the optimum time for sampling. Two irrigation events will be selected for sampling each year. Sample numbers and frequency for the BMP demonstration and evaluation are shown in Table B1.3.

Table B1.3. Sample type & frequency for demonstration and evaluation of BMPs.

Sample Type	Number of Sites	Sampling Frequency	Total # Samples (2 years)
Surface water runoff into Drainage Ditch for specific crops	6	2 samples per event, 2 different irrigation events per year	48
Subsurface drainage from different crops (tile drain outlet)	2	2 per year	8
Irrigation water	6	2 per year	24
Shallow ground water (access tube)	4	2 per year	16

Irrigation return flows will be measured at the lowest elevation point of the field where water from the field flows into a drainage ditch and/or the Arroyo Colorado. A circular flume made of PVC pipe will be placed at this location and flow will be measured using a pressure transducer that has an internal logger. See Figure B1.2 for schematic of the flume to be used to measure irrigation return flows.

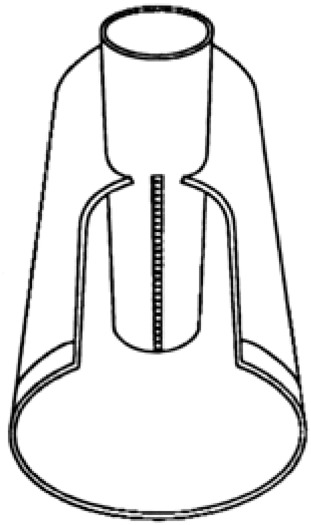


Figure B1.2. Circular Flume
Figure courtesy of Samani, Zohrab Herrera, Esteban, 1998. "A Low Cost Water Measuring Device", College of Agriculture and Home Economics New Mexico State University, Guide M-226 <http://cahe.nmsu.edu/pubs/_m/m-226.html>

Two samples will be collected per irrigation event; the first sample collected during the early stage of the runoff event and the second sample will attempt to capture the peak flow. This is done because of the variability in runoff due to changing soil moisture conditions.

The field sites with tile drains will be sampled during selected irrigation events for surface runoff and from the tile drains associated with that field. Shallow ground water will be sampled from the project fields with no tile drains. Two inch (2") PVC pipes will be pushed into the soil to create a well to access the shallow groundwater and will be purged and sampled. A method specific SOP (entitled "Field Sampling SOP" is available upon request.

Field parameters will be measured following TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (2003) using a portable hand-held YSI 85 meter for temperature, conductivity, DO, and salinity; and a YSI 60 meter for pH. Duplicate field measurements will be taken and recorded. After water quality samples have been collected, another sample will be collected in a clean LDPE bottle or other container, rinsed and measured for pH, temperature, conductivity, DO, and salinity. Immediately after recording those measurements, the sample will be discarded and another sample collected and measured. This is done to monitor potential water and meter variability. All samples collected will be shipped to Kingsville for analysis of total phosphorus, dissolved orthophosphate phosphorus, total Kjeldahl nitrogen, dissolved ammonia, dissolved nitrite plus nitrate, total suspended sediments (TSS) and BOD5 (Table B1.4).

Table B1.4. Monitoring frequency for BMP demonstration/evaluation.

Station ID	Monitoring Frequencies (per year) for each Parameter Group			
	Nutrients	Sediment	Field	Flow Measurement
FA-I	2 per year	2 per year	2 per year	Continuous 2 per year
FA-S	4 per year	4 per year	4 per year	Continuous 2 per year
FA-GW	2 per year	2 per year	2 per year	NA (well sample)
FB-I	2 per year	2 per year	2 per year	Continuous 2 per year
FB-S	4 per year	4 per year	4 per year	Continuous 2 per year
FB-GW	2 per year	2 per year	2 per year	NA (well sample)
FC-I	2 per year	2 per year	2 per year	Continuous 2 per year
FC-S	4 per year	4 per year	4 per year	Continuous 2 per year
FC-GW	2 per year	2 per year	2 per year	NA (well sample)
FD-I	2 per year	2 per year	2 per year	Continuous 2 per year
FD-S	4 per year	4 per year	4 per year	Continuous 2 per year
FD-TD	2 per year	2 per year	2 per year	NA (well sample)
FE-I	2 per year	2 per year	2 per year	Continuous 2 per year
FE-S	4 per year	4 per year	4 per year	Continuous 2 per year
FE-GW	2 per year	2 per year	2 per year	Instantaneous 2 per year depending on conditions (submerged or not)
FF-I	2 per year	2 per year	2 per year	Continuous 2 per year
FF-S	4 per year	4 per year	4 per year	Continuous 2 per year
FF-TD	2 per year	2 per year	2 per year	Instantaneous 2 per year depending on conditions (submerged or not)
F=Field, I=Irrigation Inflow, S=Surface Water, GW=Ground Water, TD=Tile Drain				

Nutrients = NO_2+NO_3, *TKN,* NH_3, PO_4, *TP*
Sediment = TSS
Field = dissolved oxygen, pH, conductivity, temperature, turbidity

B2 SAMPLING METHODS

Sub-watershed Monitoring Sampling Procedures

To assess water quality in the four drainage ditches, TAMUK will follow the field sampling procedures documented in the TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (2003). Monitoring of these drainage ditches will consist of employing automated stormwater sampling equipment for 4 events per year and collecting grab samples and instantaneous streamflow measurements on a monthly basis. When flow is present, two grab samples will be collected monthly at each drainage ditch – one upstream and one downstream – to allow both the evaluation of pollutant attenuation in the drainage ditches and pollutant levels in the ditches. Field measurements of dissolved oxygen, water temperature, specific conductance, and pH will occur with all monthly grab sampling using a YSI 6000 multiprobe. Stormwater samples will be retrieved on a daily basis during storm events and flow composited into a single sample for each storm event. Sample containers, volumes, preservation methods, and holding times used by Texas AgriLife Research-Weslaco and TAMUK for each parameter are listed in Table B2.1.

Table B2.1 Sample Volume, Container, Preservation, and Holding Time Requirements.

Parameter	Matrix	Container	Preservation	Sample Volume	Holding Time
TSS	Water	Pre-cleaned LDPE bottle or Cubitainer	4^{o}C, dark	400 mL	7 days
Ammonia-Nitrogen, Total	Water	Pre-cleaned LDPE bottle or Cubitainer	4^{o}C, dark, pH<2 with H^2SO_4	150 mL	28 days
*Ortho-Phosphate Phosphorus – field filtered < 15 min.**	Water	Pre-cleaned LDPE bottle or Cubitainer	4^{o}C, dark	150 mL	Filter ASAP 48 hrs until analysis
Total Phosphate-Phosphorus	Water	Pre-cleaned LDPE bottle or Cubitainer	4^{o}C, dark, pH<2 with H^2SO_4	150 mL	28 days
Nitrate/nitrite-Nitrogen, Total	Water	Pre-cleaned LDPE bottle or Cubitainer	4^{o}C, dark	150 mL	48 hours
Total Kjeldahl Nitrogen	Water	Pre-cleaned LDPE bottle or Cubitainer	4^{o}C, dark, pH<2 with H^2SO_4	200 mL	28 days
BOD, 5-day	Water	BOD Bottles	4^{o}C, dark	150 mL	5 days

BMP Demonstration / Evaluation Sampling Procedures

Irrigation water inflow, surface runoff and outflow from the tile drainage system or through shallow groundwater, will be monitored by Texas AgriLife Research-Weslaco on selected irrigation events. Two samples will be collected per irrigation event; the first sample collected during the early stage of the runoff event and the second sample will attempt to capture the peak flow. Field parameters will be measured using a portable hand-held meters. Irrigation return flows will be measured at the lowest elevation point of the field where water from the field flows into a drainage ditch and/or the Arroyo Colorado.

Two samples will be collected per irrigation event; the first sample collected during the early stage of the runoff event and the second sample will attempt to capture the peak flow. This is done because of the variability in runoff due to changing soil moisture conditions.

The field sites with tile drains will be sampled during selected irrigation events for surface runoff and from the tile drains associated with that field. Shallow ground water will be sampled from the project fields with no tile drains. Two inch (2") PVC pipes will be pushed into the soil to access the shallow ground and will be purged and sampled using EPA standard methods.

Field parameters will be measured using a portable hand-held YSI 85 meter for temperature, conductivity, DO, and salinity; and a YSI 60 meter for pH. Duplicate field measurements will be taken and recorded. After water quality samples have been collected, another sample will be collected in a clean LDPE bottle, rinsed and measured for pH, temperature, conductivity, DO, and salinity. Immediately after recording those measurements, the sample will be discarded and another sample collected and measured. This is done to monitor potential water and meter variability.

Processes to Prevent Cross Contamination

To prevent cross-contamination of samples, field staff will collect samples directly into sample containers when possible. Field QC samples as discussed in Section B5 are collected to verify that cross-contamination has not occurred.

Documentation of Field Sampling Activities

Field sampling activities, including flow measurements and calibration records, are documented in field notebooks. For all site visits, station ID, sampling date and time, preservatives added to samples and sample collector's name/signature are recorded. Values for all measured field parameters are also recorded. Detailed observational data are recorded including water appearance, weather, biological activity, stream uses, unusual odors, specific sample information, missing parameters (items that were to have been sampled that day, but were not), days since last significant rainfall, and flow severity.

Recording Data

All field and laboratory personnel follow the basic rules for recording information as documented below:

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

Deviations from Sampling Method Requirements or Sample Design, and Corrective Action

Deviations from sampling method requirements or sample design (including inadequate sample volume due to spillage or container leaks, failure to preserve samples appropriately, contamination of a sample bottle during collection, storage temperature and holding time exceedance, and sampling at the wrong site) may invalidate resulting data and will require corrective action. Corrective action may include for samples to be discarded and re-collected. It is the responsibility of the TWRI Project Manager, 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 will be conveyed to the TSSWCB Project Manager both verbally and in writing in the project progress reports and by completion of a corrective action report (CAR).

Corrective Action Reports (CARs) document: root cause(s); programmatic impact(s); specific corrective action(s) to address any deviations; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and the means by which completion of each corrective action will be documented. CARs will be included with project 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 both verbally and in writing.

B3 SAMPLE HANDLING AND CUSTODY

Chain-of -Custody

The chain-of-custody (COC) form is used to document sample handling during transfer from the field to the laboratory. The sample number, location, date, changes in possession and other pertinent data will be recorded in indelible ink on the COC. The sample collector will sign the COC and transport it with the sample to the laboratory. At the laboratory, samples are inventoried against the accompanying COC. Any discrepancies will be noted at that time and the COC will be signed for acceptance of custody. In the instance that the field sample collector and laboratory sample processor are one in the same, a field-to-lab COC will be unnecessary. A copy of a blank COC form used on this project is included as Appendix B.

Sample Labeling

Samples will be labeled on the container with an indelible, waterproof marker. Label information will include site identification, date, sampler's initials, and time of sampling. The COC form will accompany all sets of sample containers.

Sample Handling

Following collection, samples will be placed on ice in an insulated cooler for transport to the laboratory. At the laboratory, samples will be placed in a refrigerated cooler dedicated to sample storage. The Laboratory Manager has the responsibility to ensure that holding times are met with water samples. The holding time is documented on the COC. Any problem will be documented with a CAR.

Failures in COC and Corrective Action

All failures associated with COC procedures as described in this QAPP are immediately reported to the TWRI Project Manager. These include delays in transfer resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; and broken or spilled samples. The TWRI Project Manager in consultation with the TWRI QAO will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data validity will invalidate data and the sampling event will be repeated if possible. The resolution of the situation will be reported using corrective action reports prepared by the TWRI QAO and submitted to the TSSWCB Project Manager with quarterly progress reports.

B4 ANALYTICAL METHODS

Geospatial Methods

Geospatial data on landuse and conservation practice implementation will be collected to assist with future recalibration of the SWAT model. Texas AgriLife Research-Temple with assistance from Texas AgriLife Extension Service, USDA-NRCS, USDA-FSA, the TSSWCB Harlingen Regional Office, and the SWCDs, will compile digital data on the location and types of Conservation Practices implemented in the Arroyo Colorado Watershed since 1995. This will include, but not be limited to, practices implemented through the Environmental Quality Incentives Program (EQIP) and the Water Quality Management Plan (WQMP) Program. Texas AgriLife Research-Temple will assemble a geo-referenced database and develop a map (hard copy and electronic) displaying conservation practice implementation.

The Texas AgriLife Research-Spatial Sciences Lab will obtain the 1998 LULC for the Arroyo Colorado Watershed from TCEQ and all data used to produce it and update it using:

- 2003 LANDSAT ETM+ Data, Path 26/ Row 42 and Path 27/ Row 42
- digital data on cropland from USDA – FSA
- digital location data on citrus production from USDA-APHIS
- digital data on locations of sugarcane fields from sugar mill
- 2004 1m DOQ for Cameron, Hidalgo and Willacy counties
- digital data from irrigation districts
- 1998 tile drain data and if available, updated data from TSSWCB and AgriLife Extension
- 1998 data on colonia and if available, obtain updated data from TWDB
- 1998 data on non-colonia septic systems and if available, obtain updated data from Lower Rio Grande Valley Development Council (LRGVDC)
- 1998 data on land Application and if available, obtain updated data from NPDES Permits

This will be done using ESRI's ArcGIS 9.x software. Individual land use/cover classes will be identified and delineated in shapefile format with a minimum mapping unit of 0.5 ac on screen and verified through field sampling to an accuracy of 80% or greater. Ground control points used in the field sampling will be collected for at least ten locations per land use type using GPS units with an accuracy of 1-10 m. The landuse classification scheme to be used will include the categories described in Table A7.1. Further, detailed cropping information is included within the Planted/Cultivated Herbaceous category.

Water Quality Data Collection Analytical Methods

The analytical methods are listed in Table A7.2 of Section A7. Procedures for laboratory analysis will be in accordance with the most recently published edition of *Standard Methods for the Examination of Water and Wastewater*, the TCEQ *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (2008), *Methods for Chemical Analysis of Water and Wastes* (EPA-600-4-79-020) and *Hach DR-2000 Method Manual*. Analytical methods used by the TAMUK laboratory are consistent with EPA requirements as specified in the method.

Standards Traceability

All standards used in the field and laboratory are traceable to certified reference materials. Standards preparation is fully documented and maintained in a standards log book. Each documentation includes information concerning the standard identification, starting materials, including concentration, amount used and lot number, date prepared, expiration date and preparer's initials or signature. The reagent bottle will be labeled in a way that will trace the reagent back to preparation.

Analytical Method Modification

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

Failures in Measurement Systems and Corrective Actions

Failures in field and laboratory measurement systems may include instrument malfunctions, failures in calibration, blank contamination, and quality control samples outside QAPP defined limits. In many cases, the field technician or lab analyst will be able to correct the problem. If the problem is resolvable by the field technician or lab analyst, then they will document the problem in the field notebook or laboratory record and complete the analysis. If the problem is not resolvable, then it is conveyed to the TAMUK Laboratory Manager, who will make the determination and notify the TWRI QAO. If the analytical system failure may compromise the sample results, the resulting data will not be reported to the TSSWCB as part of this project. The nature and disposition of the problem is reported on a corrective action report which is sent to the TWRI Project Manager for submission with the quarterly progress report to the TSSWCB Project Manager.

B5 QUALITY CONTROL

Geospatial Data Quality Control

Geospatial data will be analyzed using ESRI's ArcGIS 9.x software. Land use data will be projected in UTM zone 14. Individual land use/cover classes will be identified and delineated in shapefile format with a minimum mapping unit of 0.5 ac on screen and verified through field sampling to an accuracy of 80% or greater. Ground control points used in the field sampling will be collected for at least 10 locations per land use type using GPS units with an accuracy of 1-10 m.

Water Quality Data Control

General field QC requirements that will be followed by field staff are outlined in the *TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (2008). General laboratory QC requirements are contained within the *South Texas Environmental Institute Quality Management Plan*. Specific requirements for this project are outlined below.

AWRL/Reporting Limit Verification

The laboratory's reporting limit for each analyte will be at or below the AWRL. To demonstrate the ongoing ability to recover at the reporting limit, the laboratory will analyze a calibration standard (if applicable) at or below the reporting limit on each day samples are analyzed. Two acceptance criteria will be met or corrective action will be implemented. First, calibrations including the standard at the reporting limit will meet the calibration requirements of the analytical method. Second, the instrument response (e.g., absorbance, peak area, etc.) for the standard at the reporting limit will be treated as a response for a sample by use of the calibration equation (e.g., regression curve, etc.) in calculating an apparent concentration of the standard. The calculated and reference concentrations for the standard will then be used to calculate percent recovery (%R) at the reporting limit using the equation:

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

Where CR is the calculated result and SA is the reference concentration for the standard. Recoveries must be within 75-125% of the reference concentration.

When daily calibration is not required, or a method does not use a calibration curve to calculate results, the laboratory will analyze a check standard at the reporting limit on each day samples are analyzed. The check standard does not have to be taken through sample preparation, but must be recovered within 75-125% of the reference concentration for the standard. The percent recovery of the check standard is calculated using the following equation in which %R is percent recovery, SR is the sample result, and SA is the reference concentration for the check standard:

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

If the calibration (when applicable) or the recovery of the calibration or control standard is not acceptable, corrective actions (e.g., re-calibration) will be taken to meet the specifications before proceeding with sample analyses.

Laboratory Duplicate

Laboratory duplicates are used to assess precision. A laboratory duplicate is prepared by splitting aliquots of a single sample (or a matrix spike or a laboratory control standard) in the laboratory. Both samples are carried through the entire preparation and analytical process.

Laboratory duplicates are run at a rate of one per batch. Performance limits and control charts are used to determine the acceptability of duplicate analyses. Precision limits and acceptability criteria are outlined in Table A7.2.

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

$$\mathbf{RPD} = \frac{(X_1 - X_2) \times 100}{(X_1 + X_2) \div 2}$$

Laboratory Control Standard (LCS)/Laboratory Control Standard Duplicate (LCSD)

LCS/LCSD pairs are analyte-free water samples spiked with the analyte of interest prepared from standardized reference material. The LCS/LCSD pairs are generally spiked into laboratory pure water at a level less than or equal to the mid-point of the calibration curve for each analyte. They are carried through the complete preparation and analytical process. The LCS/LCSD pairs are used to document the bias of the method due to the analytical process. Bias is assessed by measuring the percent recovery of LCSs and LCSDs, and precision is assessed by comparing the results of LCS/LCSD pairs. LCS/LCSD pairs are run at a rate of one each per analytical batch. Precision and bias criteria for LCS/LCSD pairs are specified in Table A7.2.

Bias of LCSs and LCSDs is expressed by percent recovery (%R) where SR is the observed spiked sample concentration, and SA is the spike added:

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

The mean bias of LCS/LCSD pairs is expressed by $\%R_{mean}$, where $\%R_{LCS}$ is the percent recovery of the LCS and $\%R_{LCSD}$ is the percent recovery of the LCSD:

$$\%R_{mean} = (\%R_{LCS} + \%R_{LCSD})/2$$

Precision between LCS/LCSD pairs is expressed by relative percent difference (RPD). For LCS/LCSD results, X_1 and X_2, the RPD is calculated from the following equation:

$$\mathbf{RPD} = \frac{(X_1 - X_2) \times 100}{(X_1 + X_2) \div 2}$$

Matrix spikes (MS)

A matrix spike is an aliquot of sample spiked with a known concentration of the analyte of interest. Percent recovery of the known concentration of added analyte is used to assess accuracy of the analytical process. The spiking occurs prior to sample preparation and analysis. Matrix spike samples are routinely prepared and analyzed at a rate of 10% of samples processed or one per preparatory (if applicable) and analytical batch whichever is greater.

The MS is spiked at a level less than or equal to the midpoint of the calibration or analysis range for each analyte. The MS is used to document the accuracy of a method due to sample matrix and not to control the analytical process. Percent Recovery (%R) is defined as 100 times the observed concentration, minus the sample concentration, divided by the true concentration of the spike. MS recoveries are indicative of matrix-specific biases and are plotted on control charts maintained by the laboratory. Measurement performance specifications for matrix spikes are not specified in this document, and MS data should be evaluated on a case-by-case basis.

The formula used to calculate percent recovery of the MS, where %R is percent recovery; SSR is the observed spiked sample concentration; SR is the sample concentration; and SA is the spike added is:

$$\%R = [(SSR - SR)/SA] \times 100$$

Method Blank

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in the sample processing and analyzed with each batch. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination from the analytical process. The analysis of method blanks should yield values less than the laboratory's reporting limit. For very high level analyses, blank value should be less than 5% of the lowest value of the batch or corrective action will be implemented.

Additional method specific QC requirements

Additional QC samples are run (e.g., surrogates, internal standards, continuing calibration samples, interference check samples) as specified in the methods. The requirements for these samples, their acceptance criteria, and corrective action are method-specific.

Failures in Quality Control and Corrective Action

Quality control excursions are evaluated closely by the project Investigators and Lab Manager, in close consultation with the TWRI Project Manager and TWRI QAO. In that differences in sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on pre-determined limits is not practical. Therefore, the professional judgment of the Lab Manager and Project Investigators, in conjunction with the TWRI Project Manager and QAO, will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility.

Corrective action will involve identification of the cause of the failure where possible. Response actions will typically include re-analysis of questionable samples. In some cases, a site may have to be re-sampled to achieve project goals. The disposition of such failures and conveyance to the TSSWCB are discussed in Section B4 under Failures in Measurement Systems and Corrective Actions.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

To minimize downtime of all measurement systems, spare parts for field and laboratory equipment will be kept in the laboratory, and all field measurement and sampling equipment, in addition to all laboratory equipment, must be maintained in a working condition. All field and laboratory equipment will be tested, maintained, and inspected in accordance with manufacturer's instructions and recommendation in Standard Methods for the Examination of Water and Wastewater, 20th Edition. Maintenance and inspection logs will be kept on each piece of laboratory equipment and general maintenance checklists will be filled out for field sampling equipment, by the field technician, prior to each sampling event. These logs will be subject to random inspections by the TWRI project manager and/or QA Officer. The following information will be recorded in calibration logs:

- The name and model number of the instrument should be clearly visible on the log designated for that instrument
- The date, time, and initial of the person performing the calibration should be included in the log
- The battery voltage should be noted in the log when performing a calibration
- Initial instrument readings during immersion in the calibration standard before calibration (temperature, value of standard and initial reading) should be noted in the log
- The “calibrated to” value obtained after adjusting the instrument to the calibration standard value.
- Any factory maintenance should be recorded in the log, including the date shipped for any repairs, the date returned, and a description of the repair work
- Any in-house instrument maintence should be recorded in the log, including the date and a description of any maintenance activity (i.e., battery replacement, probe cleaning, membrane replacement, or reference solution-replacement)

Records of all tests, inspections, and maintenance will be maintained and log sheets kept showing time, date, and analyst signature. These records will be available for inspection by the TSSWCB.

Failures in any testing, inspections, or calibration of equipment will result in a CAR and resolution of the situation will be reported to the TSSWCB in the quarterly report. The CARs will be maintained by the TWRI Project Manager and the TSSWCB PM.

B7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

All instruments or devices used in obtaining environmental data will be calibrated prior to use unless otherwise stated. Each instrument has a specialized procedure for calibration and a specific type of standard used to verify calibration. Calibration of the YSI multi-probe will be carried out once per month while in use or when equipment malfunction is suspected. An SOP for calibration of the YSI multi-probe is available upon request.

All calibration procedures will meet the requirements specified in the EPA approved methods of analysis. The frequency of calibration as well as specific instructions applicable to the analytical methods recommended by the equipment manufacturer will be followed. All information concerning calibration will be recorded in a calibration logbook by the person performing the calibration and will be accessible for verification during either a laboratory or field audit.

All instruments or devices used in obtaining environmental data will be used according to appropriate laboratory or field practices. Written copies of SOPs are available for review upon request.

Standards used for instrument or method calibrations shall be of known purity and be National Institute of Standards and Technology (NIST) traceable whenever possible. When NIST traceability is not available, standards shall be of American Chemical Society (ACS) or reagent grade quality, or of the best attainable grade. All certified standards will be maintained traceable with certificates on file in the laboratory. Dilutions from all standards will be recorded in the standards log book and given unique identification numbers. The date, analyst initials, stock sources with lot number and manufacturer, and how dilutions were prepared will also be recorded in the standards log book.

Failures in any testing, inspections, or calibration of equipment will result in a CAR and resolution of the situation will be reported to the TSSWCB in the quarterly report. The CARs will be maintained by the Project Leader and the TSSWCB PM.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All standards, reagents, filters, and other consumable supplies are purchased from manufacturers with performance guarantees, and are inspected upon receipt for damage, missing parts, expiration date, and storage and handling requirements. Labels on reagents, chemicals, and standards are examined to ensure they are of appropriate quality, initialed by staff member and marked with receipt date and in-use date when they are place on the bench for use. Volumetric glassware is inspected to ensure class "A" classification, where required. All supplies will be stored as per manufacturer labeling and discarded past expiration date.

B9 NON-DIRECT MEASUREMENTS

Water quality determinations at sampling sites will be based upon data collected during the time frame of this project. However, data collected within the Arroyo Colorado watershed under approved QAPPs, will be used as supplemental information to meet data quality objectives (see Section A7). The data collected under approved QAPPs from other projects will be referred to as historical data.

Historical water quality data and information from previous studies in the Arroyo Colorado watershed will be compiled and analyzed to investigate water quality trends, evaluate the biological and physical process contributing to changes in water quality, and identify data gaps. This, along with the results from earlier non-point source pollution projects conducted in the Arroyo Colorado watershed, will be organized and summarized to develop fact sheets, presentations, and other educational materials.

Information on the location and types of Conservation Practices implemented in the Arroyo Colorado Watershed since 1995 will be compiled and assembled into a geo-referenced database and displayed as a map. This will include, but not be limited to, practices implemented through the Environmental Quality Incentives Program (EQIP) and the Water Quality Management Plan (WQMP) Program.

In order to identify the major land use changes from 1998 to 2005, SSL will obtain 2003 LANDSAT ETM+ Data, Path 26/ Row 42 and Path 27/ Row 42 and classify the image at a level equivalent to the MRLC classification to level 2. SSL will obtain applicable digital data on cropland from USDA – FSA and add up to level 2 classification. SSL will obtain digital location data on citrus production from USDA-APHIS and add up to level 2 classification. SSL will obtain digital data on locations of sugarcane fields from sugar mill and add up to level 2 classification. SSL will obtain 2004 1m DOQ for Cameron, Hidalgo and Willacy counties and improve the level 2 classification to a level 4 classification by manual digitalization. SSL will obtain most recent digital data from irrigation districts and add up to level 4 classification. SSL will obtain 1998 tile drainage data and update it with data from TSSWCB and Texas AgriLife Extension Service. SSL will obtain 1998 data on colonia, update it with data from TWDB, and superpose colonia data to level 4 classification. SSL will obtain 1998 data on non-colonia septic systems, update it with data from Lower Rio Grande Valley Development Council (LRGVDC), and superpose non-colonia septic systems data to level 4 classification. SSL will obtain 1998 data on land application, update it with data from NPDES permits, and superpose land application data to level 4 classification.

B10 DATA MANAGEMENT

A field notebook is filled out in the field for each site visit. If no flow is observed at a site, samples will not be collected but information about the site visit will be recorded in the field notebook.

Samples collected at the site will be labeled and a COC form will be used if the collecting technician is in fact not the same person receiving samples into the lab. Site name, time of collection, comments, and other pertinent data are copied from the field notebook to the COC. The COC and accompanying samples are submitted to laboratory analyst, with relinquishing and receiving personnel both signing and dating the COC. All samples transported or mailed to the South Texas Environmental Institute Lab will be accompanied by COC sheets filled out by the field technician.

All COC, field observations, and laboratory data will be manually entered into an electronic spreadsheet. The electronic spreadsheet will be created in Microsoft Excel software on an IBM-compatible microcomputer with a Windows XP Operating System. The project spreadsheet will be maintained on the computer's hard drive, which is also simultaneously saved in a network folder. All pertinent data files will be backed up monthly on an external hard drive. Current data files will be backed up on r/w CD's weekly and stored in separate area away from the computer.

Original data recorded on paper files will be stored for at least five years. Electronic data files will be archived to CD after approximately one year, then stored with the paper files for the remaining 4 years.

Geospatial Data

Texas AgriLife Research-Temple and SSL use ArcGIS 9.x software for spatial data collection, management, and analysis.

Laboratory Data

All field samples will be logged upon receipt, COC's (if applicable) will be checked for number of samples, proper and exact I.D. number, signatures, dates, and type of analysis specified. The field technician will be notified if any discrepancy is found and proper corrections made. All samples will be stored at 4ºC until analysis. Samples will be given a unique identification number and logged into an electronic spreadsheet. Enumerated sample data will be manually entered into the spreadsheet for electronic storage. The electronic spreadsheet will be created in Microsoft excel software on an IBM-compatible microcomputer with the Windows XP Operating System The project spreadsheet will be maintained on the computer's hard drive, which is also simultaneously saved in an external network folder.

Backup and Disaster Recovery

All pertinent data files will be backed up monthly on an external hard drive. Current data files will be backed up on r/w CD's monthly and stored in separate area away from the computer. At least 10% of all data manually entered in the database will be reviewed for accuracy by the TAMUK Investigator or his designee to ensure that there are no transcription errors. Hard copies of data and associated documentation will be printed and housed in the laboratory for a period of five years.

Data Validation

Following review of laboratory and geospatial data, any data entry that is not representative of environmental conditions because it was generated through poor field or laboratory practices will not be submitted to the TSSWCB. This determination will be made by the Project Investigators, TWRI Project Manager, and TWRI QAO, in consultation with the TSSWCB QAO and other personnel having direct experience with the data collection effort. This coordination is essential for the identification of valid data and the proper evaluation of that data.

Data Dissemination

At the conclusion of the project, the TWRI Project Manager will provide a copy of the complete project electronic spreadsheet via recordable CD media to the TSSWCB PM, along with the final report. The TSSWCB may elect to take possession of all project records. However, summaries of the data will be presented in the final project report.

C1 ASSESSMENTS AND RESPONSE ACTIONS

The following table presents types of assessments and response actions for data collection activities 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 Project Manager	Monitoring of project status and records to ensure requirements are being fulfilled. Monitoring and review of contract laboratory performance and data quality	Report to TSSWCB in Quarterly Report. Ensure project requirements are being fulfilled.
Laboratory Inspections	Dates to be determined by TSSWCB lab inspector	TSSWCB Laboratory Inspector	Analytical and quality control procedures employed at laboratory and contract laboratory	45 days to respond in writing to TSSWCB to address corrective actions
	Annually	TWRI QAO		Implements corrective action. Report sent to TSSWCB Project Manager.
Monitoring Systems Audit	Dates to be determined by TSSWCB	TSSWCB QAO	Field sampling, handling and measurement; facility review; and data management as they relate to project	45 days to respond in writing to TSSWCB to address corrective actions
	Annually	TWRI QAO		Report sent to TSSWCB Project Manager. Resolves any deficiencies.

Corrective Action

The TWRI Project Manager is responsible for implementing and tracking corrective action procedures as a result of audit findings. Records of audit findings and corrective actions are maintained by the TSSWCB Project Manager and TWRI QAO. Corrective action documentation will be submitted to the TSSWCB Project Manager 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.

C2 REPORTS TO MANAGEMENT

Laboratory Data Reports

Laboratory data reports contain the results of all specified QC measures listed in section B5, including method blanks, laboratory duplicates, laboratory control standards, and matrix spikes. This information is reviewed by the TAMUK QAO and compared to the pre-specified acceptance criteria to determine acceptability of data before forwarding to the TWRI Project Manager. This information is available for inspection by the TSSWCB.

Reports to TSSWCB Project Management

Quarterly progress reports summarize the activities for each task; reports problems, delays, and corrective actions; and outlines the status of each task's deliverables.

Monitoring Systems Review Audit Report/Laboratory Audit Report and Response are written following any audit performed by the TWRI to report findings, recommendations and responses. These are sent to the TSSWCB Project Manager in the quarterly progress report.

Copies of all corrective action reports for this project will also be included with the project final report. The final report will contain a quality assurance section to address accuracy, precision and completeness of the measurement data. The final report will also discuss any problems encountered and solutions made. The final report is the responsibility of the Project Leader, Investigators, TWRI Project Manager, and TWRI Quality Assurance Officer

D1 DATA REVIEW, VERIFICATION AND VALIDATION

All data obtained from field and laboratory measurements will be reviewed and verified for conformance to project requirements, and then validated against the data quality objectives which are listed in Section A7. Only those data which are supported by appropriate quality control data and meet the data quality objectives defined for this project will be considered acceptable. This data will be submitted to the TSSWCB.

The procedures for verification and validation of data are described in Section D2, below. The TAMUK and Texas AgriLife Research-Weslaco Investigators are responsible for ensuring that field data are properly reviewed and verified for integrity. The TAMUK Laboratory QAO is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and accuracy, and reviewed for integrity. The TWRI Project Manager and QAO will be responsible for ensuring that all data are properly reviewed, verified, validated, and submitted in the required format as described by the TSSWCB Project Manager.

D2 VERIFICATION AND VALIDATION METHODS

All field and laboratory data will be reviewed, verified and validated to ensure they conform to project specifications and meet the conditions of end use as described in Section A7. The staff and management of the respective field, laboratory, and data management tasks are responsible for the integrity, validation and verification of the data each task generates or handles throughout each process. The field and laboratory tasks ensure the verification of raw data, electronically generated data, and data on chain-of-custody forms and hard copy output from instruments.

Verification, validation and integrity review of data will be performed using self-assessments and peer review, as appropriate to the project task, followed by technical review by the Investigator of the task. The data is evaluated against project specifications (Section A7) and are checked for errors, especially errors in transcription, calculations, and data input. Potential outliers are identified by examination for unreasonable data. If a question arises or an error or potential outlier is identified, the Investigator of the task responsible for generating the data is contacted to resolve the issue. Issues which can be corrected are corrected and documented electronically or by initialing and dating the associated paperwork. If an issue cannot be corrected, the Investigator responsible for the respective task consults with the TWRI Project Manager and QAO to establish the appropriate course of action, or the data associated with the issue are rejected.

The TWRI Project Manager and QAO are each responsible for ensuring that the data is validated and that the verified data are scientifically valid, legally defensible, of known precision, accuracy, integrity, meet the data quality objectives of the project, and are reportable to TSSWCB. One element of the validation process involves evaluating the data for anomalies. The TWRI QAO or Project Manager may designate other experienced water quality experts familiar with the water bodies under investigation to perform this evaluation. Any suspected errors or anomalous data must be addressed by the Investigator responsible for the task associated with the data, before data validation can be completed.

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

D3 RECONCILIATION WITH USER REQUIREMENTS

These data, and data collected by other organizations may be subsequently analyzed and used for educational purposes supporting BMP implementation, recalibration of the SWAT model to better estimate nonpoint source loading into the Arroyo Colorado, and evaluation of progress towards meeting the goals of the watershed protection plan. No other decisions will be made by the project team based on the data collected. Data which do not meet requirements will not be submitted to the TSSWCB nor will be considered appropriate for any of the uses noted above.

APPENDIX A. CORRECTIVE ACTION REPORT

Corrective Action Report

CAR #:______________

Date:_____________________ Area/Location:______________________

Reported by:_____________________ Activity:___________________________

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

____
____
____
____
____

Possible causes:

____
____
____

Recommended corrective action:

____
____
____

CAR routed to:_________________________________

Received by:____________________________________

Corrective Actions taken:

____
____
____
____

Has problem been corrected? YES NO

Immediate Supervisor:________________________________

Project Leader:____________________________________

Quality Assurance Officer:____________________________

APPENDIX B. CHAIN-OF-CUSTODY FORM

TEXAS A&M UNIVERSITY – KINGSVILLE
SOUTH TEXAS ENVIRONMENTAL INSTITUTE
CHAIN OF CUSTODY RECORD

Project Name:					# of containers	Analyses Required											
Station ID	Date	Time (24hr)	Matrix	Description													Sample ID

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:	Laboratory remarks:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:	Lab log #
Relinquished by: (Signature)	**Date:**	**Time:**	**Received for lab by: (Signature)**	**Date:**	**Time:**	**Laboratory Name:**