

Texas Water Resources Institute

**Arroyo Colorado Agricultural Nonpoint Source Assessment
FY 06 CWA 319(h)
TSSWCB Agreement No. 06-10-07-05**

Quarter no. 14 From 4/1/10 Through 6/30/10

I. Abstract

Work this quarter consisted of the continuation of sampling and data will be presented at the next Ag Issues Workgroup meeting. The SWAT QAPP was completed and currently signature pages are being routed. Work next quarter will consist of an Ag Issues Workgroup meeting on July 13, 2010, as well as the continuation of SWAT modeling.

II. Overall Progress and Results by Task

TASK 1: Project Coordination and Administration

Subtask 1.1: TWRI will organize an Ag Monitoring Oversight Committee to coordinate project efforts with all project participants. This Committee will be composed of Research, TAMUK, Extension, TCEQ, TDA, Texas Sea Grant, TSSWCB, Nueces River Authority, producer groups, irrigation districts, and drainage districts. This Committee will meet at least semi-annually to discuss project status, provide input on monitoring design, coordinate project activities, and coordinate monitoring efforts with educational activities.

The following actions have been completed during this reporting period:

- a. The next meeting was organized and will be held on July 13, 2010.

88% Complete

Subtask 1.2: TWRI will prepare electronic quarterly reports for submission to the TSSWCB. All progress reports will be provided to the Ag Monitoring Oversight Committee [Final report provided under Task 8].

The following actions have been completed during this reporting period:

- a. Submitted Year 4, Quarter 4 Report on July 15, 2010.

88% Complete

Subtask 1.3: Monitoring results will be transferred to Extension and Research for development of educational materials and presentation to stakeholders. Based on the results of the monitoring, Extension will hold workshops demonstrating the impacts of implementing BMPs in the watershed and coordinate periodic meetings of ag producers to bring awareness concerning the impact of the drainage ditches on the mitigation of pollutants from the fields (the educational activities are funded under a FY05 project).

The following actions have been completed during this reporting period:

- a. Nothing to report at this time.

0% Complete

Subtask 1.4: TWRI will attend meetings with the TSSWCB project manager and other meetings, as needed, to review project status, deliverables, etc. During quarters when no Ag Monitoring Oversight Committee are scheduled, TTVN meetings will be conducted with project participants to discuss project activities, project schedule, lines of responsibility, communication needs, and other requirements

The following actions have been completed during this reporting period:

- a. TWRI and TSSWCB continued to communicate during the quarter.

88% Complete

Subtask 1.5: TWRI will participate in Arroyo Colorado Partnership and Arroyo Colorado Agricultural Issues Work Group Meetings.

The following actions have been completed during this reporting period:

- a. An update of project activities will be given at an Ag issues work group meeting on July 13, 2010.

88% Complete

Subtask 1.6: TWRI will submit appropriate Reimbursement Forms.

The following actions have been completed during this reporting period:

- a. Total funds expended on the project thus far are \$255,587.77 which accounts for 59% of total project funds.

59% Complete

Subtask 1.7: TWRI will develop (Months 1-3), host and maintain (Months 3-36) an internet website for the dissemination of information on educational, monitoring and demonstration activities taking place across the Arroyo Colorado watershed. Website delivery of information will be the most time and cost effective way to disseminate information to interested people or groups.

The following actions have been completed during this reporting period:

- a. The website continues to be updated with presentations pertaining to the project.

70% Complete

TASK 2: Compilation and Evaluation of Prior Studies and Data

Subtask 2.1: TWRI, with assistance from members of the Ag Monitoring Oversight Committee, will compile historical water quality data and information from previous studies and conduct a detailed analysis of the most significant water quality parameters to investigate the trends and the different biological and physical process taking place in the watershed that contribute to changes in water quality in the Arroyo

The following actions have been completed during this reporting period:

- a. **Still awaiting comments**
- b. TWRI requested written comments from TSSWCB regarding the compilation summary of historical data collected related to agricultural issues, which was submitted as a draft report on June 30, 2008.

30% Complete

Subtask 2.2: TWRI, with assistance from members of the Ag Monitoring Oversight Committee, will organize the results from the earlier non-point source pollution projects conducted in the Arroyo Colorado watershed and summarize the results and conclusions of these studies.

The following actions have been completed during this reporting period:

- a. **Still awaiting comments**
- b. Draft report of summarized data was submitted to TSSWCB on June 30, 2008.

50% Complete

Subtask 2.3: TWRI, with assistance from members of the Ag Monitoring Oversight Committee, will identify critical data gaps that should be filled.

The following actions have been completed during this reporting period:

- a. **Still awaiting comments**
- b. Draft report of identified data gaps was submitted to TSSWCB on June 30, 2008.

50% Complete

Subtask 2.4: TWRI will transfer results to Extension to be used to develop educational material through the FY05 Arroyo Education Project.

The following actions have been completed during this reporting period:

- a. Nothing to report at this time.

0% Complete

TASK 3: Inventory Conservation Practice Implementation

Subtask 3.1: Research-Temple, with assistance from Extension, USDA-NRCS, USDA-FSA, the TSSWCB Harlingen Regional Office, and the SWCDs, will identify all producers in the watershed.

100% Complete

Subtask 3.2: Research-Temple, with assistance from Extension, USDA-NRCS, USDA-FSA, the TSSWCB Harlingen Regional Office, and the SWCDs, will compile information 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.

100% Complete

Subtask 3.3: Research-Temple will assemble a geo-referenced database and develop a map (hard copy and electronic) displaying conservation practice implementation information collected in Subtask 3.2.

The following actions have been completed during this reporting period:

- a. **Still awaiting comments**
- b. Maps are completed and files were submitted to TSSWCB on September 4, 2009 via email. Narayanan Kannan provided the GIS shape files and the maps simply as jpgs for review. Appendix A includes the image files of the maps.

100% Complete

Subtask 3.4: Research-Temple will transfer the information from Subtask 3.1 and Subtask 3.3 to Extension for use in targeting educational activities.

The following actions have been completed during this reporting period:

- a. Nothing to report

0% Complete

Subtask 3.5: Research-Temple will identify areas needing priority implementation work through correlation with Task 4 and the results from Tasks 6-9.

The following actions have been completed during this reporting period:

- a. Nothing to Report

0% Complete

TASK 4: Update Land Use/Land Cover Data

Subtask 4.1: The Spatial Sciences Lab (SSL) will obtain 1998 LULC for the Arroyo Colorado Watershed from TCEQ and all data used to produce it. Coordinate with TPWD and the Habitat Work Group to obtain relevant recent LULC data. Identify the major changes from 1998 to 2005.

The following actions have been completed during this reporting period:

- a. **SSL is awaiting approval from TSSWCB to finalize the LU/LC map.**

90% Complete

Subtask 4.2: SSL will obtain 2003 LANDSAT ETM+ Data, Path 26/ Row 42 and Path 27/ Row 42. Proceed to image classification at a level equivalent to the MRLC classification to level 2.

The following actions have been completed during this reporting period:

- a. **SSL is awaiting approval from TSSWCB to finalize the LU/LC map.**

90% Complete

Subtask 4.3: If available, SSL will obtain applicable digital data on cropland from USDA – FSA and add up to level 2 classification.

The following actions have been completed during this reporting period:

- a. **SSL is awaiting approval from TSSWCB to finalize the LU/LC map.**

90% Complete

Subtask 4.4: If available, SSL will obtain digital location data on citrus production from USDA-APHIS and add up to level 2 classification.

The following actions have been completed during this reporting period:

- b. **SSL is awaiting approval from TSSWCB to finalize the LU/LC map.**

90% Complete

Subtask 4.5: If available, SSL will obtain digital data on locations of sugarcane fields from sugar mill and add up to level 2 classification.

The following actions have been completed during this reporting period:

- a. **SSL is awaiting approval from TSSWCB to finalize the LU/LC map.**

90% Complete

Subtask 4.6: SSL will obtain 2004 1m DOQ for Cameron, Hidalgo and Willacy counties. Improve the level 2 classification to a level 4 classification by manual digitalization.

The following actions have been completed during this reporting period:

- a. **SSL is awaiting approval from TSSWCB to finalize the LU/LC map.**

90% Complete

Subtask 4.7: SSL will obtain most recent digital data from irrigation districts and add up to level 4 classification.

The following actions have been completed during this reporting period:

- a. **SSL is awaiting approval from TSSWCB to finalize the LU/LC map.**

90% Complete

Subtask 4.8: SSL will obtain 1998 tile drainage data and if available, obtain updated data from TSSWCB and Extension.

The following actions have been completed during this reporting period:

- a. Tile drainage data was unavailable.

100% Complete

Subtask 4.9: SSL will obtain 1998 data on colonia and if available, obtain updated data from TWDB. Superpose colonia data to level 4 classification.

The following actions have been completed during this reporting period:

- a. **SSL is awaiting approval from TSSWCB to finalize the LU/LC map.**

90% Complete

Subtask 4.10: SSL will obtain 1998 data on non-colonia septic systems and if available, obtain updated data from Lower Rio Grande Valley Development Council (LRGVDC). Superpose non-colonia septic systems data to level 4 classification.

The following actions have been completed during this reporting period:

- a. Non-colonia septic systems data unavailable from the LRGVDC.

100% Complete

Subtask 4.11: SSL will obtain 1998 data on land Application and if available, obtain updated data from NPDES Permits. Superpose land application data to level 4 classification.

The following actions have been completed during this reporting period:

- a. **SSL is awaiting approval from TSSWCB to finalize the LU/LC map.**

90% Complete

TASK 5: Develop Quality Assurance Project Plan

Subtask 5.1: TWRI will develop a Quality Assurance Project Plan (QAPP) that will detail project goals and objectives relating to water quality monitoring activities; identify the data needed to fulfill those objectives; list field and laboratory methods; describe procedures and schedules to be followed; and specify a data management structure and the quality assurance protocols.

100% Complete

Subtask 5.2: TWRI will provide annual revisions and necessary amendments to the QAPP to the TSSWCB and EPA.

The following actions have been completed during this reporting period:

- a. The QAPP is in the progress of being amended and was submitted to TSSWCB in May of 2010.

100% Complete

TASK 6: Perform Sub-Watershed Monitoring and Measure Pollutant Attenuation in Drainage Ditches

Subtask 6.1.1: TAMUK will perform routine monthly grab sampling at four drainage ditch sites.

The following actions have been completed during this reporting period:

- a. Three sampling events (one in each month) were carried out to collect samples at the drainage ditches. (Apr. May and June)
- b. The drainage ditch at 3 Mi S of Military Highway Site had little flow
- c. Sample analysis is currently being carried out for the June sampling event following the QAPP holding time and analysis protocol guidelines.
- d. The results will be presented at the Ag. Workgroup Meeting on July 13 in Weslaco, TX

90% Complete

Subtask 6.1.2: TAMUK will periodically operate automated samplers and water-level recorders at all four drainage ditch sites to characterize the effects of run-off generated by high storm flow pulses.

The following actions have been completed during this reporting period:

- a. We are waiting on appropriate rainfall events for deployment. The Hurricane in June precluded the planned deployment
- b. Further deployments are planned for Fall 2010.

50% Complete



Figure 1. A student Programming the Autosampler at Harding Ranch Rd. Drainage Ditch

Subtask 6.1.3: Stage-discharge relationships will be developed, maintained and updated, as necessary, for all drainage ditch sites.

The following actions have been completed during this reporting period:

- a. Three Additional Data points for establishing the stage-discharge relationship have been obtained at all four sampling sites. These measurements were carried out using the Marsh-McBirney flowmate. The depth area velocity method is being applied to obtain the required stage discharge relationships.
- b. The flow rates in the some of the ditches have been close to zero in one ditch (HC-2). Flows among ditches have been variable ranging from 3.34 cfs to 11.2 cfs on average.

95% Complete

Subtask 6.1.4: TAMUK will conduct routine general maintenance of all automated sampling and water level equipment to help ensure that these instruments will operate properly during storm flow conditions.

The following actions have been completed during this reporting period and will continue in subsequent project periods:

- a. A routine maintenance of all field equipment were carried out and calibrated prior to each sampling event.
- b. The procured field equipment was calibrated per manufacturer's specifications to ensure proper operations.

95% Complete

Subtask 6.1.5: TAMUK will develop a report summarizing the monitoring data.

The following actions have been completed during this reporting period:

- a. A project update summarizing the data collected will be presented on July 13 at the Arroyo Colorado Agriculture Issues Workgroup Meeting in Weslaco.
- b. Another update will be provided in the January 2011 meeting of the Arroyo Colorado Agricultural Issues Workgroup Meeting

75% Complete

Subtask 6.2.1: In coordination with the sub-watershed monitoring sites discussed in Task 6.1, TAMUK, with assistance from Research, will assess nitrogen and phosphorous mitigation processes in drainage ditches.

The following actions have been completed during this reporting period:

- a. The data collected to date demonstrate the removal of phosphorus in Drainage ditches, particularly when the flows are slow for transformation to occur.
- b. Channel and vegetation management (widening and deepening) for slowing down flows is seen as a good strategy for removal of phosphorus.
- c. Nitrogen removal has also been noted in the last six months of sampling. These results are being currently analyzed

75% Complete

Subtask 6.2.2: TAMUK, with assistance from Research, will develop a suite of suitable BMPs that incorporates the information obtained from the investigation of agricultural drainage ditches described in Subtask 6.2.1 above.

The following actions have been completed during this reporting period:

- a. The effects of using Baffles for DO enhancement is being evaluated using Harding Ranch Road Site as a test case
- b. The effects of vegetation (wetlands) on nutrient dynamics is being evaluated at other sites.
- c. Vegetative changes during summer months will be studied using the data collected during the sampling period.

60% Complete

TASK 7: Evaluate BMPs to Reduce NPS Pollution at the Farm Level

Subtask 7.1: Selection of sites. AgriLife Extension (Extension), AgriLife Research -Weslaco (Research-Weslaco), and Texas A&M University-Kingsville (TAMUK) will select suitable demonstration sites to assess loadings from agricultural runoff and leachate produced by different BMPs and compare traditional practices with innovative BMP for the three (3) most representative crops of the watershed. Six (6) representative sites will be characterized and physical characteristics of such as topography, soil texture, salinity and fertility levels, water quality and crops will be obtained and evaluated

100% Complete

Subtask 7.2: Installation of sensors. Flow meters, rain gauges, piezometers, soil water sensors will be installed by Research-Weslaco in the demonstration sites

The following actions have been completed during this reporting period:

- a. All sensors, meters, etc. are installed. 2 new sites have been selected and approved in order to overcome the drain tile access issues that we had previously; they are still called FD and FF but are different fields on different farms (FD for Krenmueller farms in South Pharr, and FF for Russell plantation in San Benito). Both of the drain outlets are easy to access and sample.
- b. AgriLife Research installed signs at all of the participating producer sites (in English and Spanish) to notify the producers to contact AgriLife Research before irrigating.
- c. AgriLife Research has completed sampling of sites FA, FB, FC, FE and FF for 2009. Site FD was planted with onions during fall of 2009. AgriLife Research continues to notify TAMUK regarding their intent to send TAMUK samples. For 2010, sites FA, FC, FD, and FE are completed

100% Complete

Subtask 7.3: Collection and analysis of Data. Runoff and leachate samples will be collected by Research-Weslaco for the different practices and laboratory analyses will be performed to determine agricultural loadings such as nutrients and solutes. BMPs and traditional practices will be compared economically and their relationship with nutrient loadings will be established

The following actions have been completed during this reporting period:

- a. Sampling for sites FC occurred on 4/7/10 (3/4) and 5/5/10 (4/4). Site FE was also sampled twice this quarter (5/1 – 3/4, and 5/31/10 – 4/4). Site FA was sampled on 6/3/10 (4/4) and FF (3/4) on 6/15/10.
- b. Depending on the sites, and on the water management at the time, data collection revealed that surface runoff accounted for 4.5 to 66.0% of the water that was applied by irrigation (Figure 2). It is important to note that 66% runoff is not the norm and was a unique situation where the producer likely inadvertently left the pump on.
- c. Preliminary data analysis (presented in figures) also led to the following observations.

- Correlation between DO concentration in the runoff and fertilization (represented by fertilizer bag) that occurred prior to the irrigation event (Figure 3).
 - Correlation between EC of the drain or ground water and fertilization (represented by fertilizer bag) that was applied prior to the irrigation event (Figure 4).
 - Nitrates + Nitrites concentrations found in the runoff cumulated to an equivalent of 0.1 to 24.5 lb/ac, depending on the site and on the irrigation event. Additionally, injection of N32 directly into the poly-pipe (fertigation), during the 2nd irrigation event for site FA, resulted in significant levels of Nitrates into the irrigation, runoff, and ground water (Figure 5)
 - Correlation between BOD of the runoff water and the fertilization that was applied prior irrigation (Figure 6)
 - Total phosphorus and ortho-P concentrations found in the runoff cumulated to an equivalent of 0+ to 2.3 lb/ac, depending on the site and on the irrigation event.
 - Regarding TSS, higher concentrations during the first irrigation events of the season were observed, as the initial runoff carries a great amount of harvest residues (Figure 7).
- d. In conclusion of preliminary data:
- Surface runoff could have been significant reduced on site FF by improved tail water management
 - The more runoff, the greater chance for losing N compounds through the drop-off structures and drain-tiled outlet due to deep percolation (site FF)
 - The practice that affected more the amount of nitrogen on the surface runoff was fertigation as noted on site FA during the second irrigation event.
 - BOD is significantly increased with higher concentration of fertilizer compounds found in the return flows (site FE)
- e. Research also conducted an informal survey to identify the BMPs in place for each site. Table 1 lists identified BMPs for each demonstration site. It is important to note though, that this survey was done without the input of TSSWCB or USDA-NRCS so nomenclature of BMPs were likely confused. For example, nutrient management is a BMP followed by all WQMP holders. All six of these sites are WQMP holders. Therefore, all six sites should follow nutrient management, but likely did not understand the technical name of the BMP. The graphs below have been updated in the last quarter to show FD1 data.

83% Complete

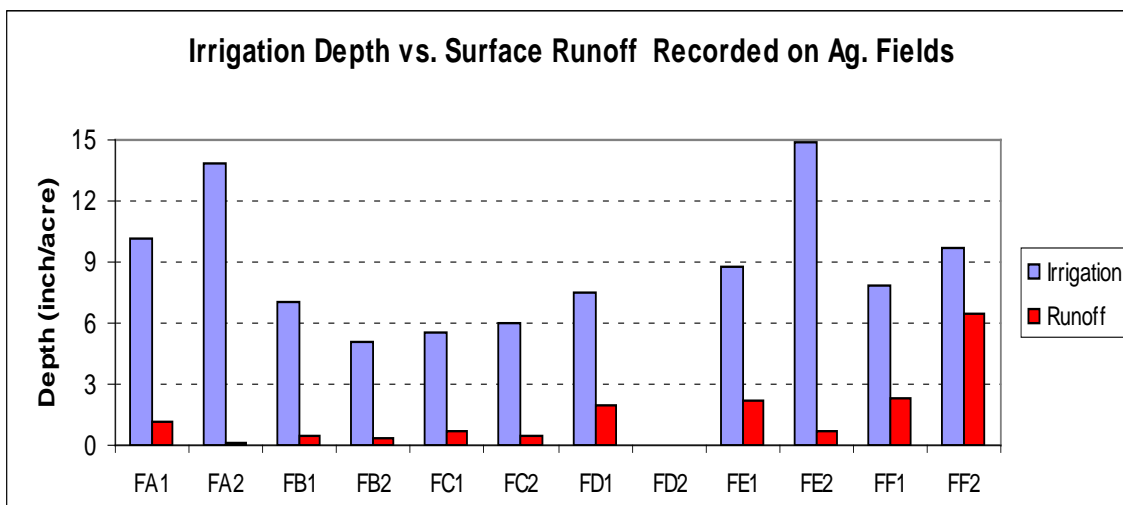


Figure 2. Irrigation depth versus surface runoff recorded on the six demonstration sites.

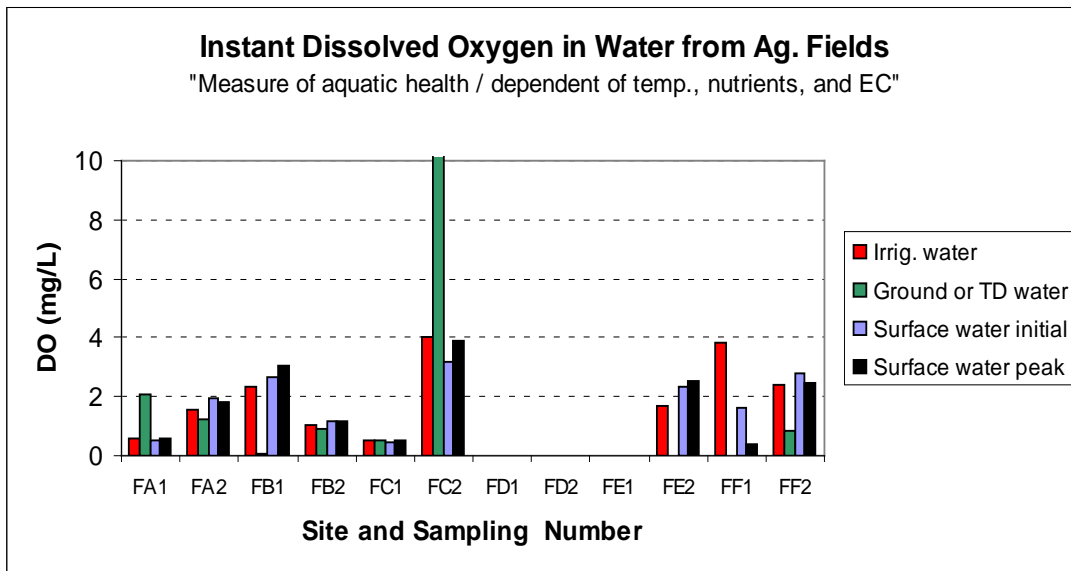


Figure 3. Instant DO in water from demonstration sites.

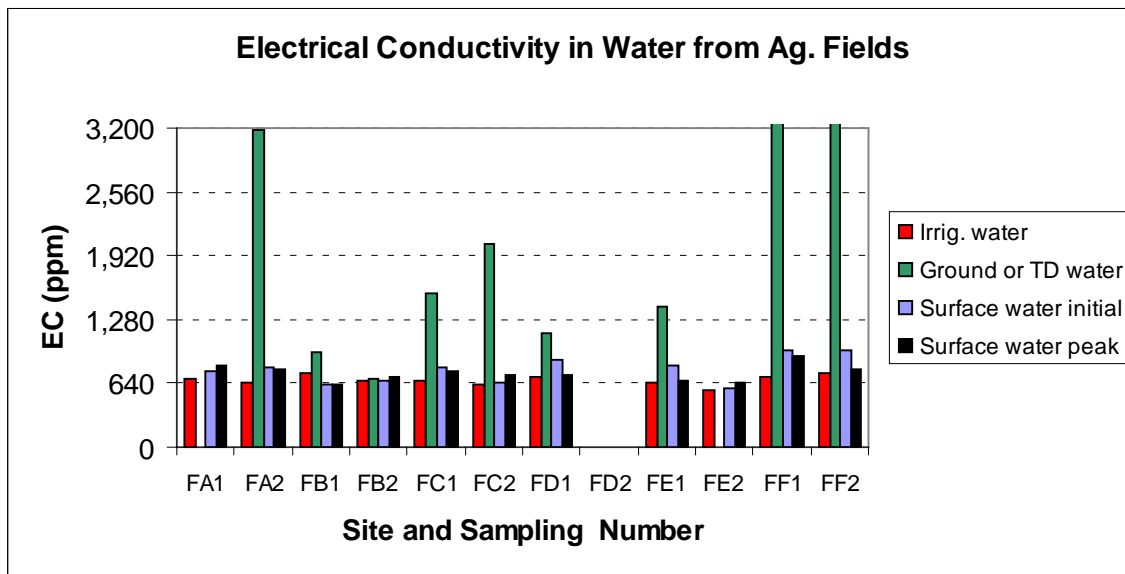


Figure 4. Electrical Conductivity in water from demonstration sites.

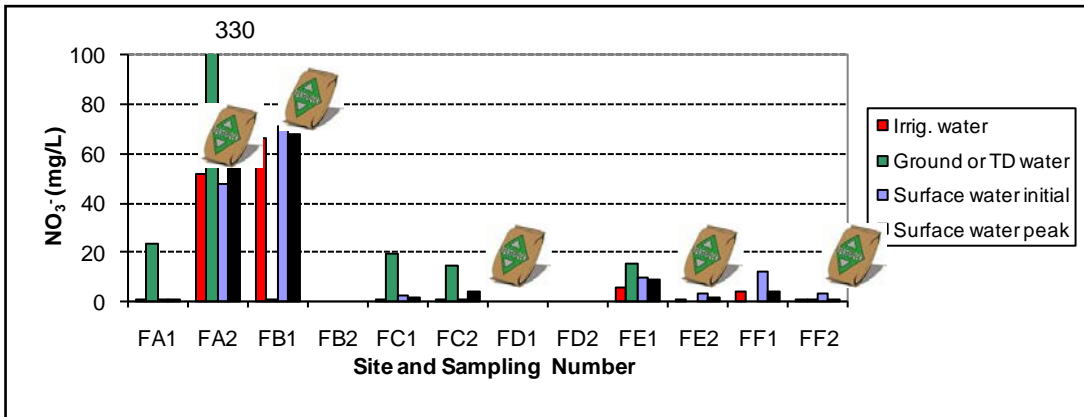


Figure 5. Nitrate levels in water from demonstration sites

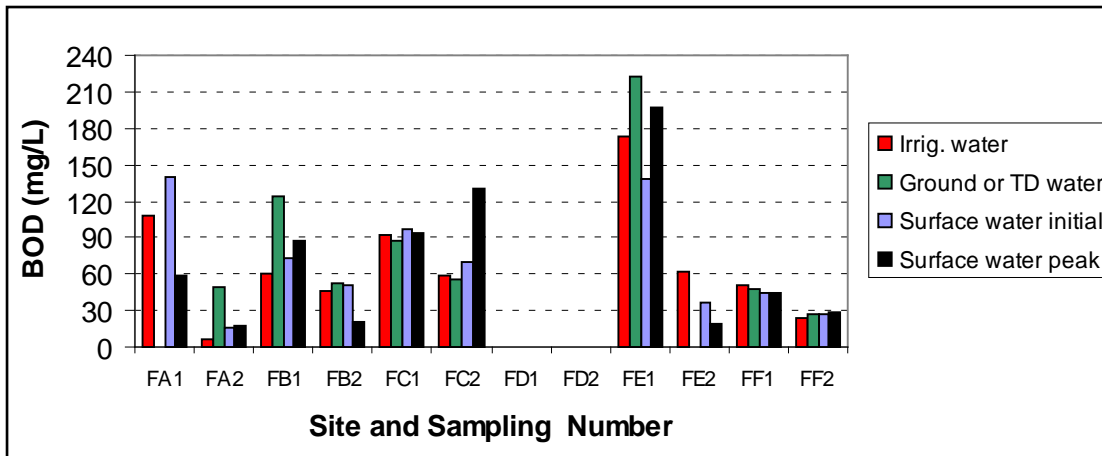


Figure 6. BOD in water from demonstration sites.

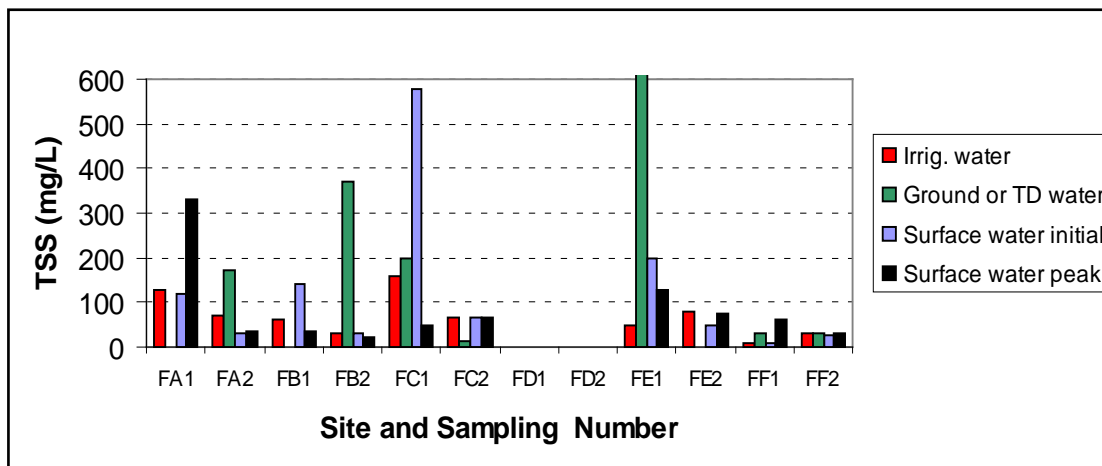


Figure 7. Total suspended soils in water from demonstration sites

Table 1. Survey of BMPs followed at the six demonstration sites.

BMPs in place	FA	FB	FC	FD	FE	FF
Conservation Crop Rotation	X	X	X	X	X	X
Residue Management			X			
Nutrient Management			X	X		X
Pest Management	X	X	X	X		
Irrigation Land Leveling	X	X	X	X	X	X
Irrigation Water Management	X	X				
Irrigation with Poly-pipe	X	X	X		X	X
Subsurface Drain				X		X
Filter Strip			X			

Subtask 7.4: Field Days and Result Demonstrations. Extension will conduct one field day and one result demonstration per year to demonstrate and transfer the result to farmers and interested persons. Newspaper and communications media will be used to divulge the results

The following actions have been completed during this reporting period:

- a. A field tour was organized to show the selected sites for Arroyo Colorado steering committee and ag issues workgroup members in January 2009.
- b. A future field day and result demonstration will be programmed for farmers and technicians during the Irrigation Expo planned for October 20-22, 2010.

25% Complete

TASK 8: SWAT Model Simulation of the Arroyo Colorado watershed

Subtask 8.1: AgriLife Research – Temple will simulate load reduction scenarios for a suite of management measures based on the Arroyo Colorado WPP for period after the calibration and validation periods. Selected scenarios will be specified in the QAPP. Scenarios to be modeled will be determined by TSSWCB in consultation with TWRI, AgriLife Research – Temple, TCEQ, and other stakeholders, as appropriate, from the Arroyo Colorado Steering Committee and various work groups.

The following action have been completed during this reporting period:

- a. The SWAT QAPP was completed during the last quarter and will be submitted to TSSWCB in April of 2010.

20% Complete

Subtask 8.2: AgriLife Research – Temple will provide TSSWCB the flow and watershed loadings to the Arroyo Colorado, as determined by SWAT, for input by TCEQ into the EFDC model. SWAT output will include time series of average daily flow (in CMS) and sediment, BOD, NH3-N, NO2+NO3, TN, OP and TP loadings (in metric units of mass) at the Port of Harlingen and for each sub-basin (10-14) downstream of the Port of Harlingen (flow to be reported as flow volume for the sub-basins).

Through TSSWCB project 02-21, the SWAT model was to be calibrated to measured flow and in-stream measurements of sediment, BOD, and nutrient concentrations for the period of 1999-2003 (with 1999 as warm-up period). Subsequent to calibration, the model was to be

Scenario	Targeted year	Analysis of results for	Prior requirements
Current	2010	Current state of all BMPs for the Arroyo Colorado Watershed	Estimate land cover for 2010/or use existing land cover.
Long-term	2011-2015	<ul style="list-style-type: none"> • Implementation of all BMPs for all sources. That would include near term and long term goals of the WPP (pp 75-88). <ul style="list-style-type: none"> ○ Base this off of the priority sub-watershed, need to know how many more WQMPs need to be implemented to meet the load reduction for Ag ○ Equal distribution of Ag BMPs across the watershed 	Estimate land cover for 2015
The future	2025	The changed land cover with same BMPs as Long-term goals of WPP	Estimate land cover for 2025

validated using measured flow and in-stream measurements of sediment, BOD, and nutrient concentrations for the period of 2004-2006.

The following action have been completed during this reporting period:

- a. After calibration and validation the flow and water quality results were given to TSSWCB and TCEQ.
- b. The ‘Current’ scenario from the table above is currently in progress.

70% Complete

TASK 9: Develop Final Report

Subtask 9.1: TWRI, with assistance from Research and TAMUK, will prepare final report for submittal to the TSSWCB.

- a. Nothing to report at this time.

0% Complete

III. Related Issues/Current Problems and Favorable of Unusual Developments

- No issues to report at this time

IV. Projected Work for Next Quarter

Task 1

- Year 5, Quarter 1 Report will be submitted.
- Participate in the Arroyo Colorado Steering Committee Meeting (on July 22, 2010) and provide a project update to the Steering Committee.

Task 2

- Address written comments from TSSWCB.

Task 3

- Map files will be reviewed during the next quarter to better assess and locate education and outreach needs.
- Map files will be reviewed during the next quarter to better assess and locate implementation needs.

Task 4

- Address written comments from TSSWCB to finalize and post LULC map.

Task 5

- Complete signature page routing.

Task 6

- Sub-watershed monitoring will continue.
- Auto-Sampler deployment campaign is scheduled for months of February - April.

Task 7

- Continue and complete drainage ditch monitoring.
- Focus on rainstorm sampling events.

Task 8

- Submit QAPP to TSSWCB so that work can begin on this task.
- Based on finalized SWAT Scenarios, begin modeling work.

Task 9

- No activity planned for next quarter.