Watershed Protection Plan Development for the Pecos River
Texas State Soil and Water Conservation Board
Project #04-11
Nonpoint Source Summary Page

1. Title of Project: Watershed Protection Plan Development for the Pecos River

2. Project Goals/Objectives: (1) To assess the Pecos River Basin; (2) Increased landowner and stakeholder involvement through educational efforts; (3) A Watershed Protection Plan based on the river basin assessment.

3. Project Tasks: (1) Assess the current conditions of the Pecos River Basin; (2) Facilitate educational programs and stakeholder involvement; (3) Create and maintain a project website; (4) Establish a monitoring program; (5) Conduct a fate analysis for water salvaged by the saltcedar control; (6) Develop a Watershed Protection Plan

4. Measures of Success: (1) Coordination of a watershed stakeholder committee; (2) Dissemination of educational material developed through the project; (3) The development of a Watershed Protection Plan for the Pecos River Basin

5. Project Type: Statewide ( ); Watershed (X); Demonstration ( )

6. Waterbody Type: River (X); Groundwater ( ); Other ( )

7. Project Location: Pecos River Basin in Texas

8. NPS Management Program Reference: State of Texas Agricultural/Silvicultural Nonpoint Source Management Program approved November 1994; to be updated FY98-99

9. NPS Assessment Report Status: Impaired ( ); Impacted (X); Threatened ( ); Other ( )

10. Key Project Activities: Hire Staff ( ); Monitoring (X); Regulatory Assistance ( ); Technical Assistance ( ); Education (X); Implementation ( ); Demonstration ( ); Other ( )

11. NPS Management Program Elements: Milestones from the "1999 Texas Nonpoint Source Pollution Assessment Report and Management Program", which will be implemented include:
(1) Coordinating with Federal, State, and Local Programs (2) Committing to technology transfer, technical support, administrative support and cooperation between agencies and programs for the prevention of NPS pollution.

12. Project Costs: Federal ($709,381); Non-Federal Match ($628,686); Total ($1,365,067)

13. Project Management: Texas State Soil and Water Conservation Board Cooperating entities:

Project Period: 3 years from start date

**Watershed Protection Plan for the Pecos River
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Project #04-11**
WORKPLAN

Problem/Need Statement: The Pecos River is a greatly depleted western river flowing 418 winding miles through hot, dry, semi-arid landscapes in Texas. It is the largest river sub-basin flowing into the Rio Grande River in Texas. As such, its importance historically, biologically and hydrologically to the future of the Rio Grande Basin is huge. The flows of the once great Pecos River have dwindled to a mere trickle due to many causes – some natural and some man-induced. Its upper reaches in Texas now resemble a very poor quality creek rather than a river. If the integrity of the entire Rio Grande basin below the Pecos is to be improved and maintained, then it is crucial that both the water quality and quantity of Pecos flows be drastically upgraded and stabilized within a natural flow regime to a viable level of in-stream flows.

Due to the lowered water quality and stream flows, the aquatic community of the Pecos River has been drastically altered according to fishery biologists and to local users of the river.   No longer does it have a healthy diverse community of aquatic plants, invertebrates, microorganisms, fish and amphibians. The greatly reduced aquatic diversity has been negatively affected by changes in river hydrology, riparian community destruction, oil and gas activities, irrigation demands, long and short-term droughts, damming of the river and the desertification of the upland watershed due to grazing mismanagement. These factors, both natural and man-made, have allowed introduced plant species, such as saltcedar, to dominate the riparian systems within the watershed.

According to the data of IBWC, the Pecos River contributes to the flow of the Rio Grande at an average rate of 274 million m^3, which accounts for 11% of the stream inflow into Amistad. However, it also contributes to salt loading into Amistad at an annual rate of 0.54 million tons or 29.5% of the total salt loading. Salinity of the Amistad exceeded 1000 ppm for a month in 1988, and has fluctuated since. It is important to control salt loading from the Pecos to Rio Grande if we are to be successful in keeping salinity of the reservoir below 1000 ppm.

The decreasing water quality in the Pecos River has negatively affected the Rio Grande River. Being an international river, the Rio Grande is relied upon by both Mexico and the United States for drinking water, irrigation and industry and as such, it depends heavily upon its major Texas tributary – the Pecos River. The Pecos River itself is also the lifeblood of many communities within its reaches, mainly as an irrigation source, recreational uses, and as recharge for underlying aquifers. The environmental condition of both the Pecos and the lower Rio Grande River is extremely crucial to hundreds of thousands of residents of both Mexico and the U.S.

General Project Description: This project will assess the physical features of the Pecos River basin, facilitate communications with stakeholder groups and landowners in eight neighboring counties, and monitor the water quality of the Pecos River. Through this project a Watershed Protection Plan will be developed to assess current management measures as well as determine what future management measures need to be implemented in the river basin to protect the water quality of the Pecos River.

Tasks, Objectives, Subtasks, Schedules, Deliverables and Estimated Costs:

TASK 1: Basin Assessment

Objectives: The purpose of this task is to set a baseline assessment on the Pecos River basin with regards to stream channel morphology, riparian vegetation, land use, salinity mapping, water inflows and outflows, aquatic habitats, historical perspectives, and economic modeling. This phase of the project is absolutely critical to identifying and evaluating potential problems and solutions. Aspects will be viewed from a historical perspective as well as current conditions. Six subtasks are identified and described.

Subtask 1.1 Aerial photography, delineation, and characterization.
High resolution, geo-processed, ortho-rectified aerial photography will be utilized along the main channel of the Pecos River. Remote sensing techniques will be used to identify and characterize stream channel locations, vegetation dynamics including a detailed analysis of saltcedar infestations, current land use, and potential gaining and losing segments of the river. The area will be flown during the fall of the year just prior to saltcedar leaf senescence to assist in determining saltcedar from mesquite and other trees and shrubs. This cannot be accomplished with current DOQQ photography, as they were flow during dormant season "leaf off" or winter months. An evaluation of past saltcedar control efforts will also be conducted to help in future planning efforts. Information from this subtask will also be used in subtasks 1.4, 1.5, and 1.7. (Months 1-24)

Additional data processing and mapping will be conducted by Zhuping Sheng and Joshua Villalobos of Agricultural Research and Extension Center at El Paso as follows:
1. Collect images (satellite and aerial photos) and shape files available for the Pecos River project area;
2. Process images and overlay different layers;
3. Develop maps over the base map (DEM, political boundary, aerial photos or transportation) in tiff or jpeg format to be shared by the project team through the project website:
     a. Watershed boundary;
     b. River channel, gage stations, flood plain, and riparian zone;
     c. Locations of test sites and boreholes;
     d. Saltcedar distribution (treated and untreated); and
     e. Groundwater well locations from TWDB/USGS.

Deliverables:
Aerial photography of the Pecos River for remote sensing
Document current stream channel location
Determination of saltcedar and other important riparian vegetation
Land use classification along the river
Shape files available via download from the website, and/or provided to the project team upon request.

Budget narrative: Dr. Charles Hart, Assoc. Professor and Extension Range Specialist will provide 15% of his time during year one toward this task. Dr. Zhuping Sheng, Assistant

Professor will provide one half month of his time toward this task. Funding will be provided for low-level, high-resolution aerial digital photography and delineation of variables. This task will be contracted with a commercial entity. Funding is provided for Joshua Villalobos.

Subtask 1.2 Historical water quality, irrigation delivery, rainfall, Red Bluff Lake levels, and groundwater monitoring
Water data from state and federal agencies as well as the irrigation districts will be compiled and routinely updated so that water quality and quantity in the Texas segment of the Pecos River may be characterized. Groundwater well data will be collected from Texas Water Development Board. (Months 1-36)

Deliverable
Current database of water quality and quantity data

Budget narrative: Mr. Mike Mecke, Extension Program Specialist – Water Conservation, with assistance from a technician and student worker from the project will be working on this task. It is anticipated Mr. Mecke will spend 9.2% of his time collecting and analyzing data for this task. Time will be utilized gathering data from many sources in the Pecos River, Texas region. Travel will be to Red Bluff Water and Power Control District office, Irrigation District offices, NRCS offices, and other area agencies as needed. Considerable time will also be spent on Internet, publications, and phone research collecting data and summarizing.

Subtask 1.3 Aquatic life and habitat inventory
Traditionally, water quality monitoring has been focused on chemical attributes such as mineral content, metals, and other contaminants. Biological monitoring is becoming more frequently utilized to assess overall ecological integrity of the water body. Biological monitoring is particularly useful in assessing the effects of nonpoint sources of pollution such as nutrient enrichment and sedimentation. Biological monitoring data collected during this project will provide baseline data that will allow comparisons to be made between sites on the Pecos River as well as comparisons to similar rivers in the state. Monitoring efforts will also provide a baseline for sites along the Pecos River. This data can be used to assess trends and future changes that may occur as conditions in the river change.

The development of a sustainable Pecos River Basin water management plan would be a giant first step forward and a great aid to maintaining or increasing populations of Endangered Species found in the Basin. A healthy, natural watershed and riparian zone is critical to life, especially in semi-arid and desert regions. A listing of those Endangered Species is attached as Appendix B.

The U.S. Section International Boundary and Water Commission (USIBWC) Clean Rivers Program (CRP) will coordinate the biological assessment with assistance from other entities participating in the study. Ten sites will be selected along the Pecos River in Texas. At those sites, data on benthic organisms, fish, and physical habitat characteristics of the river will be collected and catalogued according to protocols previously published by the Texas Commission on Environmental Quality (TCEQ). Additionally, riparian vegetation and habitat will be described. (Months 1-24) Results will be reported within 12 months of the completion of data collection. (Months 24-36)

Deliverable
Biological data will be incorporated into a Pecos River Basin water quality assessment database along with other data collected during the study.

Budget narrative: Mr. Wayne Belzer with the Texas Clean Rivers Program through International Boundary and Water Commission will be providing the guidance to this task. Funding is requested for travel to sampling sites and misc. sampling supplies. Contracts will be made for data processing.

Subtask 1.4: **Identify and characterize volume and quality of tributaries and springs**
In order to identify potential salinity sources, it will be necessary to locate and characterize selected tributaries into the Pecos River, whether perennial or intermittent, to determine water quantity, quality, and point of impacts from sources outside of the main stem. The first phase involves the review of information available such as U.S. Geological Survey (USGS) hypsography and hydrography maps to determine potential tributary locations. This data will then be compared to satellite imagery to locate active water runoff into the Pecos River. The second phase would include fieldwork and ground truthing, which will be necessary to locate each tributary and to acquire water and sediment samples, determine flow volume, and submit samples for laboratory analysis. In the case of dry streambeds that could potentially carry water during storm events, sediment samples will be collected for laboratory analysis and passive samplers will be installed to collect water from the tributaries during rain events. The USIBWC Clean Rivers Program personnel will oversee this effort and support additional Task 1 objectives by coordinating with the Texas Cooperative Extension (TCE) and Texas Agricultural Experiment Station (TAES). (Months 1-27)

Deliverables
- Hydrography and hypsography maps of the Pecos River Basin
- Satellite images of the Pecos River Basin
- Assessment and summary of laboratory data

Budget narrative: Mr. Wayne Belzer with the Texas Clean Rivers Program through International Boundary and Water Commission will be providing the guidance for this task. Funding for equipment will include dataloggers, sensors, and monitors for evaluating stream flows and quality. Funding will also include satellite imagery for documenting location of tributaries and sub-basins. This photography will be on a much larger scale than in task 1.1.

Subtask 1.5 Identify and Characterize Saline Water Sources Entering the Pecos River
The goal of the proposed work is to identify the location(s) and the magnitude of saline water sources entering the Pecos river below Red Bluff. Detailed investigation of individual sources entering the River is beyond the scope of the current study. Although the Pecos is known to be highly saline, little information is available as to the saline water sources entering the river. The suspected sources include saline creek, saline seeps, some of which may be aggravated by irrigation activities, and river seepage upstream which may produce saline seepage downstream, as the percolated water moves through salted sediments and halite beneath the river channel. The first phase of this subtask will be a review of existing reports on geology, hydrology, soils, surface and subsurface saline water sources, and ground water quality in coordination with subtasks 1.2 and 1.4. The purpose of this review is to develop a broad understanding of the basin and saline water sources. (Months 1 – 18)

The second phase is to identify saline water sources entering the river below Red Bluff, but above Girvin, which is a distance of about 150 river miles where saline inflow is believed to occur. Sources of saline water inflow will be identified by surveying streamflow salinity, pH and

temperatures. Any substantial spatial changes in salinity, pH and/or temperature of the streamflow will be considered a potential site for inflow. The water sources to be examined include surface water from Red Bluff, saline seep, ground water, and selected creeks and tributaries. Chemical markers and isotopes will be used to trace sources to their origin.

Volume and salinity of inflow sources will be determined by the mass-balance calculation based on flow and salinity measurements above and below the entry points or segments. A potable acoustic velocimeter will be used for flow measurements. Water sampling and analyses will be performed in March, prior to the release of water from Red Bluff and again in August when agricultural drainage water usually peaks. This source tracking activity will be conducted in cooperation with Tasks 1.4 and 3.2 headed by Texas Clean Rivers Program/IBWC. The water samples collected are planned to be analyzed by the established IBWC contract lab in order to maintain continuity and analytical quality control (6 – 18 months). Surface water inflow into the Pecos is covered under Task 1.4.

Salts stored in the river bank and floodways can result in increased salinity downstream due to flushing during bank overflow. This scenario occurs in the Middle Rio Grande below Ft. Quitman, and there is an indication that this may also apply to the lower Pecos. If resources permit, we will collect exploratory bank soil samples and will analyze for salinity in the reach between Girvin and Langtry.

Once the major sources of saline water entering the Pecos are identified, we will be in a position to develop a detailed plan to investigate the individual sources. An additional proposal will be submitted at that point.

Deliverable
- A reconnaissance survey of saline water sources entering the Pecos below Red Bluff (In coordination with subtasks 1.4 and 3.2)

Budget narrative: Dr. Seiichi Miyamoto, Texas Agricultural Experiment Station in Elpaso, will be providing direction for this subtask. He has allocated 5.4% of his time in years 1 and 2 to this subtask. Funding is also requested for partial funding of a technician and a student worker for collecting and analyzing data. Travel is requested for project meetings and data collection and field work trips to the Pecos River. Funding for supplies are requested for sampling tools, measuring devices, flow meters and other general field supplies. Miscellaneous funding is also requested for isotope analysis, EM 34 sensor rental, and data analysis.

Subtask 1.6 Simulate Flow and Salinity of the Pecos for Evaluating River Management Options
This subtask is to simulate flow and salinity of the Pecos River below Red Bluff for evaluating river management options and will be approached in three phases. The first phase is to develop and validate a simple mass balance model useful for assessing the effect of inflow from the Pecos River on salinity of Amistad Reservoir. Salinity of the reservoir has been increasing since construction in 1968. Salinity levels reached the drinking water limit of 1000 ppm during February 1988 and have continued to fluctuate. A simple model, which is largely based on salt balance analysis, is currently being developed under a separate program funded by the Texas Higher Education Coordinating Board. Existing complex models demand input data which are not readily available and do not consider site-specific salt problems. Our simple model will be used to analyze the impact of the Pecos River on reservoir salinity on both short and long time scales, using the historical flow and salinity data available at Foster Ranch, Langtry and Amistad.

These analyses include the development of a program useful for estimating salinity of the lake outflow from inflow data. We will also examine probable scenarios for reservoir salinity to exceed 1000 ppm, and how the inflow from the Pecos may affect the scenario. (Months 1-18)

The second phase is to collect or generate the data needed to develop and verify a water and salt transport model (which is described later). The data needed are two-types. The first type is the current river dimensions such as river cross-sections at various reaches, slope, the extent and the types of riparian zones, floodway dimensions, salinity and depth of water tables, permeability and soil type distribution, weather data and physical data of the catchment areas which yields surface or subsurface inflow into the Pecos. These data will be collected in conjunction with other tasks, especially Tasks 1.4 and 1.5. The second type of data is the historical records of flow and salinity at various reaches of the Pecos. These data are scattered among different agencies and unfortunately rather limited, except at Langtry. If the historical data are sufficient to analyze, we will examine the impact of irrigation on river salinity in a historical context. If not, we will use the historical records solely for calibrating our model. (Month 12-24)

The third phase is to develop a water and salt transport model for the main flow of the Pecos River below Red Bluff. The model is to be used for assessing river management options on flow and salinity of the Pecos at various segments, as well as for assessing salt loading into the Rio Grande, then to Amistad. Such a model is currently being developed for the Middle Rio Grande, and includes submodels needed to evaluate the impact of riparian zones on flow, salt storage, and release into the stream during bank overflow. The model also accounts for two-dimensional seepage losses from the steam beds as well as seepage into the river, which is undoubtedly an important process in the case of the Pecos River. The model will be calibrated using the historical records and will be validated against the monitoring data from Task 3.2. The projected time requirement would be approximately 12 to 24 months.

Deliverables
- Impact of saline water flow from the Pecos River on salinity of the Amistad International Reservoir
- A model for simulating flow and salinity of the Pecos River below Red Bluff

Budget narrative: Dr. Seiichi Miyamoto, Texas Agricultural Experiment Station Elpaso, will be providing direction for this subtask. He has allocated 13.3% of his time in years 1 and 2 and 6.6% in year three to this subtask. Funding is also requested for a research associate and student worker for collecting and analyzing data. Travel is requested for project meetings and data collection and field work trips to the Pecos River. Funding for supplies and miscellaneous expenses are requested for computer hardware, software, and general computer supplies.

Subtask 1.7 Economic modeling of Pecos river basin and assessment of saltcedar control activities
Objectives of this subtask are to (1) Create a crop acreage optimization model for surface water irrigation district producers using localized production budgets and salinity tolerance coefficients, (2) measure economic effects of saltcedar control on associated rangelands and riparian areas, and (3) use IMPLAN input/output model to measure indirect changes on the basin wide economy caused by saltcedar control.

The effects of saltcedar invasion are known. Costs of control can be easily measured. These cost are borne by landowners/operators and the taxpaying public. Both federal and state funds have been used for saltcedar control. Benefits from a technical standpoint may consist of additional streamflow, recharge into shallow aquifers, increased bank storage and improved water quality

(decrease in salinity). The economic benefits of all these anticipated results are difficult to entirely quantify.

A linear programming model will be developed to estimate irrigated crop producer responses to changes in the availability and quality of irrigation water within surface water irrigation districts in the Pecos river basin. Historical acreage allocations by crop, localized production budgets developed by Texas Cooperative Extension and water use efficiencies for the identified crops will be used to identify possible scenarios. Crop yields will adhere to historical averages in conjunction with crop salinity tolerance coefficients. It is assumed that individual producers will seek to maximize their net income. Thus, the objective function of the model will be to maximize net returns for the basin within the constraints of available irrigated land, irrigation water with varying levels of quality and the availability of packing sheds and cotton gins. (Months 24-36)

The impact to associated rangelands will be assessed separately. Recovery of the riparian area will be monitored for increases in managed, sustainable grazing capacity. Surveys of appropriate stakeholders will be used to quantify increased usage as well as perceived impacts to wildlife. (Months 29-30)

Basin wide impacts of saltcedar control or other BMPs will be analyzed using the input-output model IMPLAN. This type of input-output model can be used to analyze the interrelationships between the agricultural sector and other sectors of the regional economy. Results from the separate LP models for surface and groundwater irrigators will be input into the IMPLAN model. In this case, increased availability or quality of irrigation water can be expected to increase demand for products in other sectors of the economy than just the agricultural sector. It is this ancillary increase in economic activity across all sectors of the Pecos River basin that will be measured and compared to the relative cost of BMPs. (Months 28-36)

Deliverables
- Development and publication of localized production budgets for irrigated crops in the Pecos river basin
- Development and documentation of irrigated acreage optimization models Reports summarizing results of modeling work will also be delivered
- Survey instruments for rangeland and/or riparian area owners/operators on perceived impacts of saltcedar control on wildlife or livestock
- Documentation and analysis of returned rangeland/riparian surveys from owner/operators
- Report on IMPLAN analysis of impact to Pecos river basin economy

Budget narrative: This subtask leader will be William J. Thompson, Assistant Professor and Extension Economist, Fort Stockton, TX. Mr. Thompson will spend approximately 10 percent of his time in year one collecting data and developing production budgets and historical crop acreage allocations. Mr. Thompson will then spend 15% of his time in year two through the conclusion of the project in year three. Year two activities will include the development and documentation of an irrigated acreage optimization model. Travel to farm sites across the Pecos river basin in years one and two is expected to require 7,500 miles at a cost of $1,050 per year. Miscellaneous office supplies of $750 per year will also be purchased. A graduate student will be hired in year 3 to assist with processing of LP model results through the input/output model. Dr. Lonnie Jones, Professor and Resource Economist, Texas Agricultural Experiment Station, will also contribute one month of his time in fitting the IMPLAN model to the Pecos river basin of west Texas. County level economic data will need to be acquired and verified. Site licenses and economic data are expected to cost $1,500. A total of 16,250 miles of travel at a cost of $2,275 is

anticipated for Dr. Jones, a graduate student and Mr. Thompson in year 3. Per Diem costs of $700 are anticipated for the graduate student when working in the Pecos river basin from College Station, TX.

Task 2. Educational Programming

Objectives: TCE will work with various state and local agencies to assemble a series of three written publications targeted at landowners, stakeholders and policymakers. These publications will consist of (1) A description of the historical progression of the Pecos river basin to its current condition, (2) A summary of the multi-disciplinary approach which will be employed to monitor the river and the basin, (3) A detailed summary of the watershed plan developed though the course of this project. Additionally, TCE will work with various state and local agencies to organize, promote and conduct a series of educational meetings in each county within the Pecos river basin. The particular content of individual meetings will vary depending on the relationship between local landowners, operators and other interested parties and the Pecos river basin. An interactive internet website will also be created and maintained to provide the most current progress.

Subtask 2.1 Publish written informational materials to educate private landowners, stakeholders and policy makers about the Pecos River and effects of saltcedar
A series of three written publications will be developed, published and distributed to landowners, stakeholders, policymakers and other interested parties. The first publication in this series will present the historical progression of the Pecos river basin to its current condition and will be used to inform landowners, stakeholders and policymakers of the threats facing the basin. This historical view will put into perspective the size of the Pecos river basin and the size and type of issues being addressed. A description of the specific effects of saltcedar and a thorough summary of past saltcedar management efforts along the Pecos river will be presented in this educational publication. (Months 11-13)

The second publication will review the multi-disciplined, multi-agency efforts to monitor and assess the Pecos river basin. This will include:
- The Quality Assurance Project Plan (QAPP) sampling protocol developed by IBWC
- Water quality sites being monitored by the IBWC- CRP
- Saltcedar water use studies and monitoring being performed by TCE and TAES
- The study of the fate and influence of salvaged water being performed by TCE and TAES
- An aquatic life and habitat inventory performed by the IBWC and TCEQ.

The purpose of this publication is to illustrate the extensive study of the Pecos river basin and the need for the development of a watershed plan for the entire basin. This publication will also be available to interested parties when public comment on the proposed watershed plan is solicited. (Months 20-24)

The final publication will address the watershed plan for the Pecos river basin. This publication will include a detailed summary of the watershed plan, some likely consequences of not adopting a basin wide management plan and the anticipated changes to current management practices. The manner in which producer and landowner issues were addressed and possible conflicts resolved as well as how the watershed plan will be implemented and the time line for implementation will be summarized. An update on continuing monitoring activities and recourse for necessary adjustments to the watershed plan will also be included. This publication will

incorporate inputs and comments received from stakeholders at public meetings as described in Task 2.2. (Months 30-34)

Deliverables
- A description of the historical progression of Pecos River basin to its current condition
- A review of the multi-disciplinary approach which will be employed to monitor the River
- A detailed summary of the watershed plan developed though the course of this project
- Develop and maintain an interactive website

Subtask 2.2 Educational meetings of interested parties for input and organizational support
Texas Cooperative Extension, with input from various state and local agencies, will organize, promote and conduct meetings in each of the eight counties encompassed in the Pecos river basin. County level Extension personnel have the ability, contacts, facilities and equipment to effectively facilitate meetings. Four categories of meetings will be hosted; (1) informational, (2) skill developing, (3) discovery meetings, and (4) public comment meetings.

Informational Meetings – This type of meeting is intended to inform landowners, operators and other interested parties about conditions within the basin and proactive efforts to monitor, correct or improve conditions. These types of meetings can be held before and after adoption of a basin wide watershed plan. An estimated measure of the impact of these educational programs with respect to Pecos river basin issues may be attained by comparing responses to similar questionnaires delivered before adoption of a watershed plan, and after a watershed plan has been developed and implemented. (Months 8-14)

Skill Level Meetings – Skill level programs will be intended to provide landowners/managers with new skills or to acquaint them with new technology. (Months 12-36)

Possible meeting topics include:
- Chemical, mechanical, and biological control of saltcedar and saltcedar regeneration issues.
- Salinity management of soil and irrigation water and crop salinity tolerances.
- Riparian management issues; recovery, diversity (replacement of saltcedar monoculture).
- Livestock and wildlife management techniques under high salinity conditions.

Discovery Meetings – A series of meetings in each of the counties within the Pecos river basin will be held to solicit input from landowners, operators, local policymakers and other interested parties on the development of a basin wide watershed plan. The status of monitoring and assessment efforts will be presented in the context of how a watershed plan will promote recovery or proper functions of the Pecos river basin watershed. (Months 24-30)

Public Comment Meetings – After development of the plan, but before implementation, a series of meetings will be hosted to present the proposed watershed plan and to allow interested or affected parties to comment on the proposed watershed plan. Much like the earlier meetings soliciting input from interested parties, the status of monitoring and assessment efforts will be presented in the context of how components of the watershed plan address specific issues or problems within Pecos river basin. Comments will be considered before the final watershed plan is released. (Months 30-36)

Deliverables

- TCE with input from various state and local agencies will conduct meetings in each of the counties encompassing the Pecos river basin. Four categories of meetings will be hosted; (1) informational, (2) skill developing, (3) discovery meetings, and (4) public comment meetings
- Meeting attendance and contact data will be reported
- A measure of the effectiveness of the programs in educating the public on environmental issues within the Pecos river basin will also be reported

Subtask 2.3 Develop a web site for dissemination of information
TCE will develop (Months 1-3), host and maintain (Months 3-36) an internet website for the dissemination of information on educational, monitoring and research activities taking place across the Pecos river basin. Website delivery of information will be the most time and cost effective way to disseminate information to any interested people or groups.

Information presented through the website will include:
- Review of individual research projects on Pecos river basin.
- Review of individual monitoring projects on Pecos river basin.
- PDF version of all reports, journal articles, faculty papers and presentations generated from this project.
- Links to all cooperating and/or participating agencies.
- Links to all project primary investigators.
- Links to University academic departments that are involved in the project.
- Links to other related websites
    - Texas State Soil and Water Conservation Board
    - Texas Water Resource Institute.
    - Rio Grande Basin Initiative.
    - Environmental Protection Agency-Office of Water, CWA Section 319
    - Etc.
    - Schedule of upcoming meetings/programs dealing with this project.

Deliverables
- Web site to publish results, bulletins, and reports.

Budget narrative: Co-leaders for this Task are Dr. Charles Hart, Michael Mecke and William J. Thompson. In year one, Dr. Hart will contribute 1.2 months and Mr. Mecke will contribute .6 of a month to this task. In year two, Dr. Hart, Mr. Mecke and Mr. Thompson will contribute 1.2 months, .95 month, and .6 month respectively. In year three, Dr. Hart, Mr. Mecke and Mr. Thompson will contribute .6 month, .95 month, and 1.2 months respectively.

Development of extension publications will cost $1,500 in each of the three years of the project ($4,500 total). A series of educational and public comment meetings will be held in each of the seven counties comprising the Pecos river basin. County level Cooperative Extension Agents in each of these counties will be contributing time and effort to this task. A total of 4.2 months per year will be contributed by these County Agents. A total of 20,000 miles of travel at a cost of $2,800 for each year will be used by the task co-leaders, county agents and required presenters to commute to each of these meetings. $500 per year ($1,500 total) for miscellaneous office and meeting supplies are also expected.

A website will be developed in year one at a cost of $3,000. An existing web domain will be utilized to reduce overall costs. Costs for maintaining the structure and content of this website are expected to be $1,000 per year for a total of $3,000.

Task 3: Establish Monitoring Program

Objectives: To develop Data Quality Objectives (DQOs) and QAPP, estimate the effect of salt concentration(s) in the Pecos River watershed through data collection and analysis and water use studies, and study fate of and influence of salvaged water. The TCE will work with various state and local agencies to implement a monitoring program to determine the extent of high salt levels in the Pecos River due to NPS. The TCE will collaborate with the USIBWC –CRP as well as other local and state agencies to utilize and expand the current monitoring program in place. Findings from the data collection efforts in Task 3 will provide information necessary to develop best management practices (BMPs) and will form the basis of a watershed management plan for the Pecos River watershed in Texas. TCE will produce a report describing the results of the monitoring effort and the locations of sources that are impacted by high salt in the Pecos River.

Subtask 3.1 Develop QAPP for sampling protocol
CRP will oversee the development of DQOs and a QAPP as specified under EPA QA/R-5, EPA Requirements for Quality Assurance Project Plans. (Months 1-3)

The surface water quality monitoring program conducted through the CRP will serve as a baseline to identify areas considered to be impacted by NPS for salinity. Portable sampling and flow measuring equipment, data sonde(s), and passive samplers will be utilized to monitor specific reaches to collect additional data. Aside from routine monitoring, intensive reconnaissance efforts will be utilized to identify and target specific areas of concern within the basin. All of the analyses in the monitoring program will be detailed in an EPA/TCEQ approved Quality Assurance Project Plan (QAPP).

Deliverable
- Approved QAPP

Budget narrative: Texas Water Resources Institute will provide guidance on this task. Funding for one month of salary will be provided to TWRI for development of the protocol. A small amount of funding is requested for printing costs. All funding for this task will be provided in year 1.

Subtask 3.2 Water quality monitoring, including Total Dissolved Solids (TDS), Total Suspended Solids (TSS), parts Hydrogen (pH), Dissolved Oxygen (DO) and electrical conductivity (EC)
CRP will oversee the collection of data at established sites along the Pecos River to establish baseline information. Parameters required to assess the effects of high salt conditions will be added to the monitoring schedule. Routine and intensive monitoring will be conducted as needed in determining areas impacted by high salt conditions and will be coordinated with the TCE and TAES to support other project tasks. (Months 4-27)

Deliverable
- Quarterly Data Reports

Budget narrative:
Mr. Wayne Belzer will provide direction for this task. Funding is requested for sampling equipment to compliment existing equipment provided by the CRP through IBWC. Water quality sampling equipment and supplies will be purchased and sampling sites established during the first two years of the project.

Subtask 3.3 Quantity and fate of water salvage as a result of saltcedar control
A study was initiated in 1999 using shallow groundwater monitoring wells and water level loggers to estimate net drawdown or recharge along the Pecos River under saltcedar infestations. Wells were installed at two sites within a study area and monitored for one growing season, then saltcedar was killed on one site. Water salvage from saltcedar control is estimated by comparing pre treatment water level data to post treatment water level data for both sites using the EPA Paired Watershed Study Design protocol. Preliminary analysis indicates saltcedar control may yield a 60-70% reduction in water loss at the study site.

This task will further explore the effects of saltcedar control on the fate of salvaged water and determine amount of water released to downstream flow and groundwater recharge. TCE and TAES will: (1) characterize the aquifer beneath treated and untreated sites with borehole exploration; (2) install additional monitoring wells to configure subsurface flow patterns, and (3) conduct flow measurements with designated releases from Red Bluff Reservoir. (Months 1-27)

First, a map of alluvial sediments will be developed to diagram subsurface flow patterns. Previous borehole exploration revealed a clay layer, which may limit vertical water flow within the shallow aquifer. This task is to delineate the extent of the shallow aquifer by drilling additional boreholes at untreated and treated plots along the Pecos River. Soil and water samples will be collected and analyzed, as needed, to determine spatial variation in hydrological properties. Second, additional monitoring wells will be installed. There are 5 existing monitoring wells at each site on one side of the river. In order to better understand flow regimes, additional wells will be drilled on the other side of the river from the existing well network. Dataloggers will be used to record hourly changes in the water level in each of the new wells. Collected water level information will be processed to construct a flow net within the shallow aquifer. The flow net will be used to define the interaction between surface water and ground water, which will be used to assess volume and direction of flow.

Finally, to establish the relationship between surface water and ground water, designated releases from Red Bluff Reservoir will be scheduled. Multiple releases will be monitored for a period of several days during the project period to detect any seasonal changes in the shallow aquifer response to saltcedar control. Seepage losses, or gains, by the river will be calculated and the factors that influence seepage losses and gains will be assessed.

During the releases, surface water flow will be measured at the upstream boundary of the untreated site, at the divide between untreated and treated sites and at the downstream boundary of the treated site. At the same time, hourly water level in each of the wells will be recorded to determine impacts of increased river flow on the shallow aquifer flow.

In general, river inflows are precipitation, runoff, groundwater discharge and release from Red Bluff Reservoir. River outflows include seepage into aquifers, evaporation, transpiration, and irrigation diversion. The proposed tasks will allow us to evaluate flows between the river and the aquifer. Other inflows and outflows will be addressed using funds form other sources. Ultimately, this data will be used with water quality/quantity data collected to predict the effect of

saltcedar control on river water quality and quantity in the Pecos River Basin. Data will be used in the model presented in task 1.6 to predict changes in salinity of the river.

Deliverables
- Well monitoring schedule
- Map of soil physical properties within the study area
- Flow net, illustrating velocity and direction of subsurface flow
- Water balance analyses for seasonal seepage runs
- Prediction of impacts of the saltcedar control on the interaction of stream flows and groundwater.

Budget narrative: Drs. Charles Hart and Zhuping Sheng will act as co-principle investigators on this task. An Extension Assistant, will conduct water well monitoring, borehole exploration, and soil analyses. Funds are requested for travel from Ft. Stockton District Center to the study area in Reeves County. Funding for equipment will be used to purchase water level sensors and loggers, a portable flow meter and a portable HydroLab water quality instrument. Funds are also requested for supplies to purchase laboratory supplies such as glassware and reagents.

Task 4: Watershed Protection Plan

Subtask 4.1 Final Report of Basin Assessment, Educational Programming and Monitoring. In addition, Annual reports will be submitted to the TSSWCB by project PIs at the end of years on and two, with the final report submitted at year 3 end.

Subtask 4.2. The subtask will produce the final Watershed Protection Plan for Pecos River Segments 2312, 2311, and 2310 based on criteria set forth in the FY 04 guidelines. A draft plan will be completed within year 2 of the project and available for public comment at stakeholder meetings.

Budget narrative: A technical writer will be provided through the Texas Water Resources Institute to summarize all quarterly reports and write the proposed plan in year three. Funding is requested for investigators travels to developmental meetings and meetings with TSSWCB. Dr. Charles Hart will provide overall guidance to this phase and will be providing 1.2 months FTE to the task.

Coordination, Roles and Responsibilities

Texas State Soil and Water Conservation Board: The TSSWCB will provide supervisory oversight to the project.

Texas Cooperative Extension: responsible for estimating saltcedar acreage, historical water quality and quantity (Subtasks 1.1 and 1.2); educational programming (Task 2), saltcedar water use estimates and fate of salvaged water (Subtasks 3.3 and 3.4)

U.S. Section, IBWC Clean Rivers Program: will identify and characterize inflows (Subtasks 1.4 and aquatic life and habitat Subtask 1.3) Development of QAPP (Subtask 3.1) and oversee water quality monitoring Subtask 3.2

Texas Agricultural Experiment Station: will be responsible for collecting, analyzing and modeling salt flow (Subtasks 1.5, 1.6) saltcedar water use, surface-ground water interactions and responses to saltcedar management (Subtasks 3.3 and 3.4)

Texas Water Resources Institute: Will assist in composing the QAPP (Subtask 3.1) and educational efforts (Task 2). TWRI will also be responsible for compiling/writing quarterly reports and final watershed management plan.

Measures of Success and Performance:
Coordination of a watershed stakeholder committee
Dissemination of educational material developed through the project
Develop a Watershed Protection Plan for the Pecos River Basin

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Basin Wide Management Plan for the Pecos River in Texas.
Texas Water Resources Institute
FY'04 CWA Section 319(h) Agricultural/Silvicultural Nonpoint Source Program
Project Budget
July, 2004 - June, 2007

	Federal	Non-Federal	Total
Personnel:	$300,367	$270,307	$570,674
Fringe Benefits	$82,988	$63,193	$146,181
Travel	$34,898	$56,144	$91,042
Supplies	$42,250	$7,000	$49,250
Contractual	$0	$41,000	$41,000
Construction	$0	$0	$0
Other	$156,350	$5,411	$161,761
TOTAL DIRECT COSTS	$616,853	$443,055	$1,059,908
INDIRECT COSTS	$92,528	$185,631	$278,160
TOTAL BUDGET	**$709,381**	**$628,686**	**$1,338,067**

Appendix A
Matrix of subtasks and respective watershed plan elements.

	a	b	C	d	e	f	g	h	i
1.1	x		x			x	x		
1.2	x	x	x			x	x	x	x
1.3	x					x	x	x	
1.4	x					x	x	x	
1.5	x					x	x	x	
1.6	x	x	x			x	x	x	
1.7				x					
2.1					x				
2.2					x	x	x		
2.3					x				
3.1								x	x
3.2								x	x
3.3		x	x					x	x
4.1	x	x	x	x	x	x	x	x	x
4.2	x	x	x	x	x	x	x	x	x

Appendix B

**Federally Listed Endangered (E) and Threatened (T) Species for the
Pecos River and Pecos Basin**

Bald Eagle (Haliaeetus leucocephalus)– T – occasional migrant and wintering bird along the river and at reservoirs in the basin.

Southwestern Willow Flycatcher (Empidonax traillii extimus) – E – rare to uncommon migrant along the river corridor, few confirmed records.

Pecos Gambusia (Gambusia nobilis, a mosquitofish) – E – occurs in springs and cienegas in the basin (Diamond Y and Balmorhea area).

Comanche Springs pupfish (Cyprinodon elegans) – E – extirpated at Comanche Springs, remnant populations persist in Balmorhea spring complex.

Leon Springs pupfish (Cyprinodon bovinus)– E – only natural population occurs in Diamond Y Draw on TNC preserve.

Rio Grande silvery minnow (Hybognathus amarus) – E – historic occurrence in Pecos in Carlsbad to Toyah reach, extirpated in Texas.

Interior Least Tern (Sterna antillarum)– E – known to nest on islands in Lake Amistad, recorded at Sand Lake in Reeves County, some may use Red Bluff Reservoir.

Black-capped Vireo (Vireo atricapilla) – E- nesting populations known along riparian corridors and arroyo shrublands from Iraan south.

Pecos Sunflower (Helianthus paradoxus) – T – scattered and isolated small populations at Diamond Y Draw and Sandia Spring, other historical sites not recently confirmed.

Little Aguja Pondweed (Potamogeton clystocarpus) – E – known only from Little Aguja Canyon (Davis Mountains) which is a Pecos tributary via Balmorhea drainages.

Compiled by:
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TNC
1 June 2004