

Project Narrative

Name of the Project: Potential for Water Conservation Through Lining Canals in the Rio Grande Project

Geographic Area of the Project: Rio Grande Project Area: Far West TX and Southern NM

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Amount of Funding Requested: \$20,000

Project Need, Description and Expected Outcomes

Background

The Rio Grande delivers water for agriculture, municipalities and industry for both Mexico and the United States. In the Elephant Butte reservoir of the Rio Grande Project area, water supplies have historically been severely impacted by prevalent drought conditions. For the first time in twenty-two years, the water storage in the Elephant Butte Reservoir has dropped below one million acre-feet and a reduction in surface water allotment is expected for the coming irrigation season. ***Implementation of significant improvements to irrigation conveyance systems, aggressive water conservation programs, improved water management are critical needs, which must be addressed in the next few years*** (US Bureau of Reclamation, 2001). The Paso del Norte region, composed of Ciudad Juarez, El Paso and Las Cruces, is expected to face a severe municipal water shortage due to depletion of fresh groundwater resources, which force local entities to look for more intensive water conservation measures, such as lining canals to save surface water for M&I users. Two irrigation districts, El Paso County Water Improvement District No. 1 (EPCWID#1) and Elephant Butte Irrigation District (EBID) in the Paso del Norte region between Elephant Butte Reservoir and above Fort Quitman deliver all of US portion of the Rio Grande water for irrigation and part of M&I uses in accordance with the Congressional Authorization of the Bureau of Reclamation's Rio Grande Project.

Although regional surface water users in the region enjoyed full allotments for the last twenty two-years, ***they have worked on and will continue to work on improvement of water conveyance and irrigation efficiency because of need of M&I use and preparation for droughts with more efficient delivery systems***. A recent US Geological Survey (USGS) study indicated that lining the American Canal Extension saved approximately 30,000 ac-feet water per irrigation season (Heywood, 2001), which can be converted for M&I use under the third party agreement established among USBR, EPCWID#1 and EPWU. Preliminary studies also indicated that there is more potential for water savings through lining canals in El Paso and Las Cruces areas (Meyers, 1976, Knowles and Alvarez, 1979, Land and Armstrong, 1985, Nickerson, 1995, Ortiz et al, 1998, Weeden and Maddock, 1999, White et al, 1997). However, it is still not clear how much water can eventually be saved for each

canal and lateral by lining them, and how the canal lining will affect water operations and water resources management, and what incentives exist for lining the canals and laterals in different areas. Lack of such knowledge is an important deficiency, because without it, system operation and management is based on guesswork. Both of these two irrigation districts are eager to obtain such information so that they can manage water resources more efficiently. Both districts thus support this proposal and will collaborate in this research.

Project Objective

The objective of this project is to determine how much water is lost through seepage flow between canals and shallow aquifer for irrigation and non-irrigation seasons. Our long-term goal is to understand how surface water and groundwater interacts with each other in the Rio Grande basin and what is the implication of seepage losses in water conservation. The proposed project will explore current status of seepage losses in delivery systems of both EPCWID #1, TX and EBID, NM, develop new measurement methods for seepage loss estimation, and estimate potential water savings by lining the canals. It is a joint collaborative research project between irrigation districts and universities. This project will also evaluate incentives for water conservation in the region as an alternative source, and explore its implication in water operation management. Two canals, one in Texas and one in New Mexico will be selected based on preliminary study results. Flows will be measured at selected locations. Specific conductance, pH, and water temperature will be measured during flow measurements. Water samples will be collected at selected locations for chemical analysis to determine dissolved solids and concentration of major ions, selected nutrients, and selected trace elements. Water levels will also be measured at the selected shallow observation wells. This project addresses three specific issues: agricultural irrigation efficiency, water management and conservation, and water resources in terms of quantity and quality as detailed in the next section.

Outcomes and Benefits

Lining canals and laterals will provide additional water supply for the region to meet its growing water demand. The proposed work is innovative, because it will explore new methods of measuring the seepage losses and new concepts in interaction between surface water and groundwater. It is our expectation that the resultant approach will identify the key factors in determination of water savings by lining canals and laterals, whether it is fully controlled by hydraulic property of canal beds or varies with flow. These results are significant, because they are expected to provide new insights into roles of water conservation in the long-term management of regional water resources, and provide irrigation districts guidelines for implementation of water conservation measures. It will also advance in the field of water conservation and agricultural irrigation efficiency

This project will provide following benefits to the region.

- Meet the local irrigation districts' need for better understanding potentials and benefits of water conservation by lining canals. Water conservation measures help water districts to prepare for drought because it provides a more efficient delivery system for the limited water resource during the droughts, which will eventually reduce damages caused by severe droughts or eliminate some damages that may otherwise experience during droughts.
- Identify an alternative water resource for M&I water users. Water salvaged by lining canals and laterals can improve the potential irrigation capacity or be converted for M&I uses.
- Strengthen the cooperation between New Mexico State University and Texas A&M University by sharing research resources and promote partnership.
- Attract external funds in developing new concepts, methodologies and technologies for water conservation and water resources management.

Specific Issues Addressed

This project is to address water conservation concerns for agricultural and urban communities in following three aspects.

1. Agricultural Irrigation Efficiency

This project will address one of the major water conservation components in improvement of agricultural irrigation efficiency, specifically the conveyance efficiency. Current conveyance losses amount to 30 or 40 percent of the head diversion. Such losses can be prevented through concrete lining of the canals and laterals. This project will first identify the seepage losses by field measurements of flows and data review. Evaporation losses from both lined and unlined canals will be estimated using meteorological methods and stream surface area. By comparing water losses for different lining alternatives, water savings can be calculated for each alternative.

2. Water Management and Conservation

This project will also study implication of water conservation in water operation management. This project will explore following issues:

- a) What water operations management issues should be addressed for water conservation by lining the canals?
 - b) What kinds of cooperation and policy are required to foster the improvement of efficiency of the delivery systems for both Texas and New Mexico?
 - c) What are incentives for water conservation for both Texas and New Mexico?
- Guidelines for water operations management will be developed based on the findings of this study.

3. Water Resources - Quantity and Quality

This project is to evaluate water flow between the surface water system, such as canals and laterals, and the shallow aquifer system. It is also expected that water quality samples are used to verify the interaction between surface water and groundwater. Three what-if scenarios, full coverage concrete lining, partial coverage, and no concrete lining, will be evaluated to determine what implications of canal lining in regional water resources planning. It will also evaluate pros and cons of canal lining for the region. In New Mexico and Texas, surface water rights belong to the state and are allocated to land owners by state offices. In Paso del Norte Region, surface water rights are derived from the Rio Grande Project. However, groundwater in New Mexico belongs to the State and is granted for land owners to use by the State, while in Texas, each land owner has the right to capture groundwater that lies beneath his or her property without applying for a permit from the State. This project will evaluate what impacts of canal lining on surface and ground water resources planning and management for both states.

Although the study will be conducted in the Far West Texas and Southern New Mexico area, concepts and methodology can be used for the Lower Rio Grande Valley and other areas in the southwest United States. As continuation of this project, it is expected that this study will be extend into the Lower Rio Grande Valley. More new concepts and methodologies can be developed in water conservation by lining the canals and laterals.

Collaboration

This projected will be conducted at El Paso Agricultural Research and Extension Center, TA&MU and the Department of Civil, Agricultural, and Geological Engineering, New Mexico State University. TA&MU Faculty teaming with New Mexico State University Faculty will work together with irrigation districts to conduct field measurements and analyses (*see attached support letters from both irrigation districts*). The functions for each group are listed below. It covers multiple disciplinary areas: *agricultural engineering, hydrogeology, and water resources management and policy*.

Collaborators and Their Functions

Texas A&M University, El Paso Research and Extension Center (Zhuping Sheng): coordinate project, conduct field investigation in Texas, analyze measurement data, and publish results.

Department of Civil, Agricultural, and Geological Engineering, New Mexico State University (Phillip King, and Graduate Assistant): conduct field investigation in New Mexico, analyze measurement data, and publish results.

El Paso County Water Improvement District No. 1 (Edd Fifer): provide facilities and equipment for field measurement on canals and laterals in Texas, participate in field measurement.

Elephant Butte Irrigation District (Gary Esslinger): provide facilities and equipment for field measurement on canals and laterals in New Mexico, and participate in field measurement.