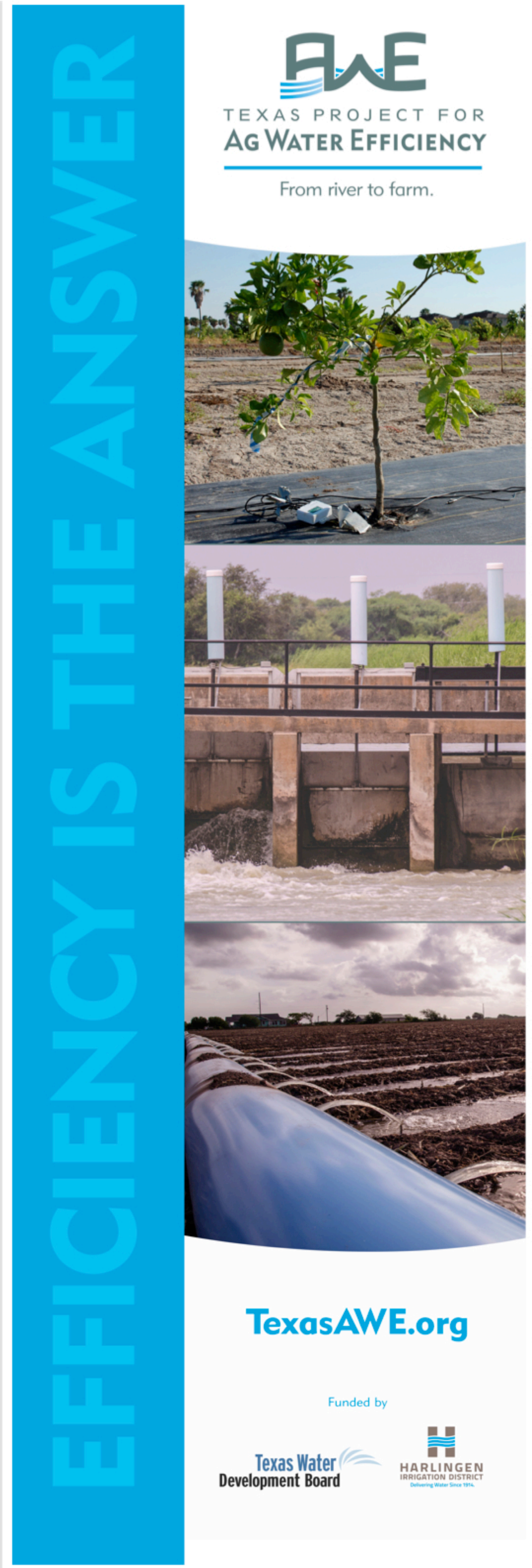


2012 Annual Report

Agricultural Water Conservation Demonstration Initiative

February 16, 2012 – February 15, 2013

submitted to the Texas Water Development Board
by Harlingen Irrigation District, Cameron County No. 1

Outreach banner showcases the dual emphases of the Texas Project for Ag Water Efficiency: water conservation & efficiency on-farm & in-district.

photos and graphics by WaterPR

August 1, 2013

Comer Tuck
Director, Conservation Division
Texas Water Development Board
1700 N. Congress Ave.
Austin, TX 78711

Re: TWDB Contract #2005-358-013

Dear Comer:

The Harlingen Irrigation District, Cameron County No. 1, is pleased to submit this Annual Report of activities and achievements associated with its Agricultural Water Conservation Demonstration Initiative grant for the period February 16, 2012 – February 15, 2013.

In 2012, the District and our partners in the ADI project have shifted the focus from trying out and verifying technologies and methodologies for conserving water on-farm and in-district to new activities focused on outreach and education. We've made greats strides in developing outreach mechanisms for the Texas Project for Ag Water Efficiency, including a growing library of material that will continue to encourage water efficiency past the end of our activities. We've also stepped up our efforts to leverage resources by partnering with other groups similarly focused on water issues in the Lower Rio Grande Valley.

In particular, we're proud to report that Texas AWE will be providing in-kind services to the Rio Grande Regional Water Authority to help match a U.S. Bureau of Reclamation WaterSMART grant that will subsidize the cost of surge valves for irrigation and training in their use to about 32 producers in the Valley. This partnership developed precisely because of our research findings that surge valve technology can significantly reduce water consumption across a variety of crops in the region. Texas AWE assisted in writing the grant application submitted in January 2012 and will be providing outreach, training, analysis, and reporting services to the project.

In these final years of Texas AWE, we will be focusing on similar types of opportunities to work together with other organizations to not only get the word out about ways to conserve water but also to put into practical application in our region the information we've compiled about agricultural water conservation and efficiency.

Very best regards,

Tom McLemore
Project Manager
Harlingen Irrigation District
301 E. Pierce Ave.
Harlingen, TX 78550

HARLINGEN
IRRIGATION DISTRICT
Delivering Water Since 1914.

Foreword: A Message from the General Manager

In 2004, the Harlingen Irrigation District received funding from the Texas Water Development Board to demonstrate a variety of different strategies and techniques for conserving water and using it more efficiently in the Lower Rio Grande Valley, both on-farm and in-district. Eight years later, we've proved what does and doesn't work in terms of making our surface water districts and our farmers more efficient when it comes to water. Now Job #1 is spreading the word about our findings so that the results can be replicated on a large scale throughout the region, ensuring that the project lives on past its funding through the Agricultural Water Conservation Demonstration Initiative.

As this report describes, much of our activity in 2012 has been concentrated on ramping up that communication effort . . . and with very productive results. Project Manager Tom McLemore and I have been meeting ourselves coming and going on the road en route to one speaking engagement after another about the initiative, newly renamed the Texas Project for Ag Water Efficiency (Texas AWE). With us, we carry a whole toolkit of information instruments and apparatus: fact sheets, videos, brochures, workshop flyers. And "Texas AWE dot org" has become one of our most common expressions.

Ongoing drought throughout most of Texas and the special regional water supply issues created by Mexico's failure to deliver water to the Rio Grande mean our messages and our efforts are being heard. We are realizing new opportunities to work in partnership with other entities to leverage resources and reach a wider audience. Our biggest success to date on that front is the Surge Valve Cooperative just awarded a U.S. Bureau of Reclamation WaterSMART grant. We are proud that Texas AWE on-farm demonstrations with this technology served as impetus for the application and we are honored to be providing support services to the Rio Grande Regional Water Authority on the Cooperative.

We see this partnership as the next step in addressing our water supply needs: bring together people from all sectors of economic activity in a proactive way to find workable solutions and the funding needed to deliver those solutions.

Sincerely,

Wayne Halbert
General Manager
Harlingen Irrigation District

HARLINGEN
IRRIGATION DISTRICT
Delivering Water Since 1914.

Table of Contents

Section 1: Executive Summary

In 2012, drought continued its grip on the Lower Rio Grande Valley.

The National Weather Service Station in Brownsville summarized the year with this succinct description: "Record Warmth, Persistent Drought, and Memorable Thunderstorms."

> "Most locations [in the region] surpassed prior warmest annual temperature peaks, including records set in recent years. For each month, temperatures across the Valley were above the most recent 30-year averages (1981–2010). With the heat came persistent drought. Though the drought was dented a little bit at varying locations during the spring and summer, what began in in record fashion in 2011 persisted into 2012; by year's end, reservoir levels at Amistad and Falcon International had dropped to values not seen since the turn of the century."
> *Annual Weather Capsule for 2012 for the Rio Grande Valley*
> *(at http://www.srh.noaa.gov/bro/?n=2012event_annualsummary)*

The silver lining to the ongoing drought came in the form of heightened awareness of water issues throughout the region as well as the state as a whole.

At the Harlingen Irrigation District, improvements to in-district operations were transitioning from large-scale retrofitting of conveyance system components to fine-tuning of new technology used to monitor and manage processes. Meanwhile, on-farm studies and demonstrations nearing completion were verifying the results of earlier efforts: modifications to traditional flood and continuous irrigation practices in the Lower Rio Grande Valley can reduce considerably the amount of water used without requiring substantial changes in irrigation practices or major investments in equipment.

A picture's worth a thousand words: irrigation via traditional flood (above) versus narrow border flood (below).

Producers, districts, policymakers, and the public at large needed to know the impressive facts and good news about water savings that could be achieved through such methods as narrow border flood in citrus irrigation and surge in row crops.

The timing was right for education and outreach on the results of the district's Agricultural Water Conservation Demonstration Initiative, funded by the Texas Water Development Board.

Enter Texas AWE.

OUTREACH & EDUCATION

In 2012, the Valley's ADI project became the Texas Project for Ag Water Efficiency– a memorable identity reflecting the intent of the investment being made by Texas Water Development Board. Outreach consultant WaterPR also developed collateral material to support that identity: logo and tagline, stand-alone website(www.TexasAWE.org), brochure, customizable presentation complete with talking points and slides, a series of videos, and the foundation for a library of succinct resource materials titled "AWEsome Facts."

WaterPR scheduled HID managers to speak at relevant statewide as well as regional and local meetings and conferences: Texas Water Conservation Association, Texas Farm Bureau Leadership Conference, Valley Water Awareness Forum, Texas Ag Water Forum, to name just a few.

Section 2 of this report details all outreach activities supporting Texas AWE in FY 2012. Electronic files for print materials and videos developed in FY 2012 are included with this annual report. The goal of these initial and ongoing efforts encompasses more than just information-sharing information. Texas AWE outreach efforts additionally are aimed at building partnerships to help implement the findings from the previous eight years of studies and demonstrations.

In late 2012, these efforts produced a partnership with the Rio Grande Regional Water Authority seeking U.S. Bureau of Reclamation WaterSMART funding for a large-scale demonstration of the water-conserving benefits of surge valve technology. The grant application, supported by the project's impressive statistics on water efficiencies that can be realized with this technology, was submitted in January 2013 and approved in May 2013; a campaign to recruit participants is already under way. The Executive Summary of the successful application – written by WaterPR – is provided in Appendix B.

The Surge Valve Cooperative will be a distinguishing feature of the final years of Texas AWE. Workshops to train cooperators in the technology are scheduled for September 2013, the valves will be placed in the fields in early 2014, and results will be compiled following harvest in late 2014.

Other tactics for translating Texas AWE research into action include capitalizing on the facilities and capabilities of the Rio Grande Center for Ag Water Efficiency (also known as the Flow Meter Calibration Facility). Plans for 2013 and 2014 include workshops for producers on such topics as soil moisture sensing and irrigation scheduling and for district personnel on automation and water management. The center's meter-calibration services also will be vigorously promoted; given ongoing drought and dwindling water supplies, the need to calibrate and verify meters for Valley districts is becoming increasingly important.

ON-FARM IRRIGATION DEMONSTRATIONS & EVALUATIONS

In 2012, Texas AWE partners continued research and evaluation activities focused on major crops and irrigation techniques with strong potential for substantial water savings in the Lower Rio Grande Valley. This continues the fundamental strategy of looking at methods of modifying traditional methods of irrigation in the region in ways that will reduce water consumption without requiring the producer to make wholesale changes in farming habits and/or invest in expensive equipment.

Water Savings in Citrus

Previously, Dr. Shad Nelson and colleagues at the Texas A&M University – Kingsville Citrus Center demonstrated that conventional large-pan flood irrigation of citrus orchards used about 6 inches of water per acre per irrigation event. Raising berms between tree rows allows growers to adapt their irrigation method to "narrow border flood" (NBF) and reduce their water application to only 4 inches per acre per irrigation event. (See *Texas Project for Ag Water Efficiency 2011 Annual Report*.)

To better evaluate actual water savings from narrow border flood over large pan flood, the researchers in 2012 metered the total amount of water required to irrigate tree rows by each method in three separate irrigation events for three rows of trees occupying the same area. As shown in Exhibit 1.1 below, narrow border flood used 36 percent less water. The technique also moved water more efficiently across the field.

Exhibit 1.1. Narrow Border Flood Saves 36% Water Over Traditional Large-Pan Flood Irrigation

Flood Irrigation Method	Irrigated 3-Row Area (Acres)	Time to Irrigate Area (Hours)	Water Applied (Gallons)	Water Applied (Ac-Ft)	Water Applied (Ac-Ft/Ac)
Traditional (TF)	0.73	1.87 (±0.29)	31,738	0.50 (±0.09)	0.68
Narrow Border (NBF)	0.59	0.69 (±0.12)	25,818	0.32 (±0.07)	0.44
Difference (TF-NBF)	0.14	1.18	5,920	0.18	0.24

Preliminary analysis of 2012 harvest results for Rio Red grapefruit support previous findings that NBF uses less water than other irrigation methods with the potential of producing high yields.

Exhibit 1.2. Yield and Water Use for 2012 Rio Red Grapefruit Harvest

Grower/Area	Irrigation Method	Water to Crop (inches)			Excess Water over NBF	Yield (tons/ac)
		Irrigation	Rain	Total		
"A" North/McAllen	Narrow Border Flood	36	5.7	41.7		**27.8**
"A" South/McAllen	Narrow Border Flood	36	5.7	41.7		18.2
"B"/Edinburg	Microjet	45	1.2	46.2	10%	**26.3**
"C"/ Edinburg	Microjet	47	1.7	48.7	14%	18.1
"C"/ Edinburg	Dual Line Drip	48	1.7	49.7	16%	16.3
"B"/Edinburg	Dual Line Drip	50	1.2	51.2	19%	**26.0**
"D"/Weslaco	Traditional Flood	54	2.1	56.1	26%	20.0
"C"/Edinburg	Traditional Flood	60	1.7	61.7	32%	17.0

Microjet and dual line drip irrigation also can produce high yields but with higher volumes of water. Higher yields are typically for fully mature, yet younger-aged grapefruit trees for all irrigation methods (bolded yields). Fields irrigated via microjet in the demonstrations used 10 percent and 14 percent more water than NBF; those using double line drip used 16 percent and 19 percent more water. Fields irrigated via traditional flood used 26 percent and 32 percent more water than NBF.

Section 3 of this report provides details on narrow border flood and other citrus research projects.

Water-Savings with Surge Irrigation

Dr. Juan Enciso and associates from the Texas A&M AgriLife Research Center similarly have been researching alternatives to traditional methods of continuous irrigation.

Pressured irrigation systems, such as LESA (Low Elevation Spray Application) and LEPA (Low Energy Precision Application), are options. However, while these systems use less water more efficiently and with a lower labor cost than continuous irrigation, they have high initial costs for equipment and substantial energy demands. Surge irrigation, on the other hand, appears to be a more efficient form of furrow irrigation that yields considerable benefits without the expenses that accompany pressurized systems.

The research team compared continuous to surge irrigation on a 30-acre field planted in sugarcane in four different irrigation events. The findings were unequivocal:

> "[T]he field was watered faster, irrigation time was shorter, and, consequently, less water was applied during the surge irrigations. Surge reduced the irrigation amounts applied on the field and the volumes of runoff generated and may have created more uniform distribution of water across the field."
> *Surge Irrigation as a Water-Saving Option for Surface Irrigation in the Lower Rio Grande Valley (Section 4, following)*

As noted in Exhibit 1.3, below, the study also found that considerably less water infiltrated with surge irrigation. The maximum amount infiltrated totaled 3.5 inches per acre with surge, compared to 4.4 inches per acre with continuous irrigation.

Exhibit 1.3. Continuous vs. Surge Irrigation in Four Plots

Event	Application Rate		Input Volume		Runoff		Infiltrated Volume	Application Depth (inches)	Application Efficiency (%)
	GPM	Ac-in/hr	Hours	Ac-ft	Hours	Ac-ft	Ac-ft		
Cont. 1	1580	3.5	84	12.53	47	1.58	10.95	4.4	87.4
Cont. 2	1361	3.0	43	10.32	38	0.44	9.88	4.0	95.7
Surge 1	1454	3.2	27	7.08	25	0.84	6.24	2.5	88.1
Surge 2	1331	2.9	21	8.96	33	0.30	8.66	3.5	96.6

Section 4 of this report presents full information on the surge irrigation study.

Economic Evaluations of Irrigation Practices

Mac Young with Texas A&M AgriLife Extension Service's FARM (Financial And Risk Management) Assistance Program completed economic analyses of 14 demonstration sites, all but two involving citrus irrigation. Those 2012 evaluations continued to support the major findings of previous analyses conducted beginning in 2005 that show "economic incentives to adopt alternatives to traditional large pan flood irrigation."

> "[O]ur evaluation of differences in fruit quality and yields show clear economic incentives to adopting microjet spray, drip, and, in particular, narrow border flood technologies. And given the ease with which producers can adopt narrow border flood management practices, this practice may offer the best economical option for water savings, assuming 2010 water pricing.
>
> "As noted in earlier reports, NBF has the economic advantage over microjet and drip systems due to their costs and over traditional flood because of NBF produces higher yields and pack-out quality, which is reflected in price."
> *Economic Evaluation of Demonstrated Irrigation Practices & Technologies (Section 5, following)*

Section 5 of this report presents full results of the 2012 economic analyses.

IN-DISTRICT OPERATIONS

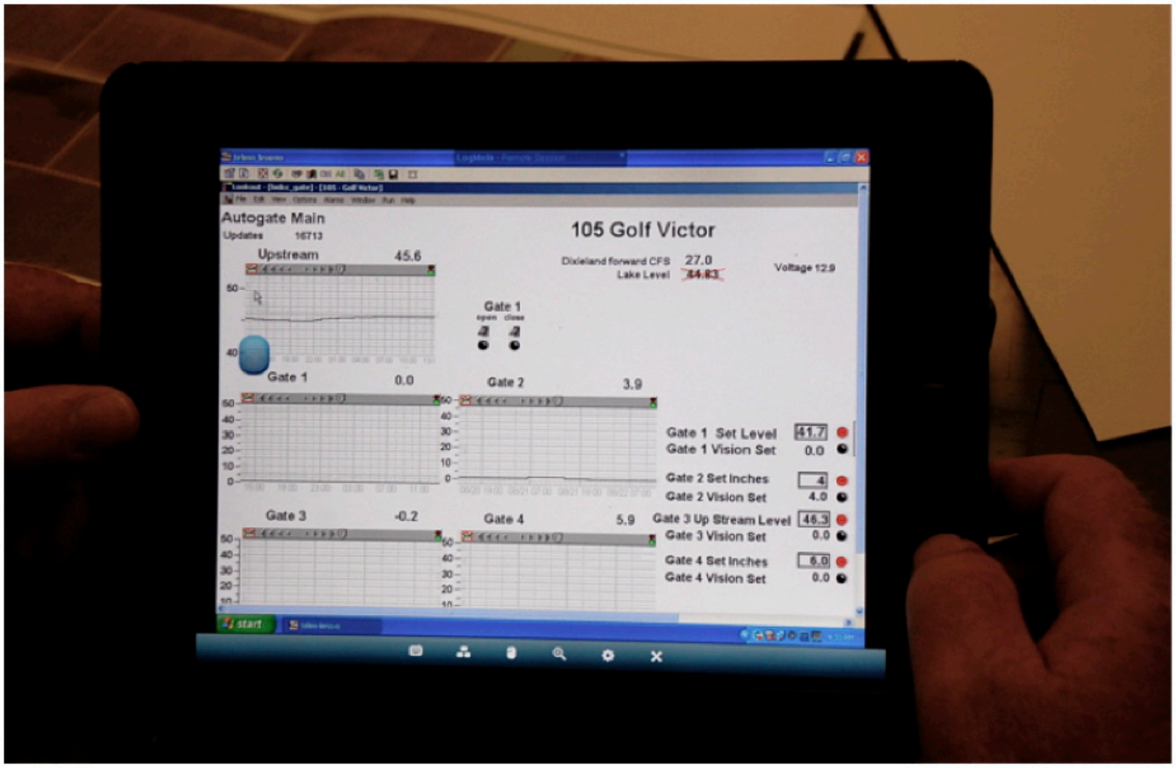
The Harlingen Irrigation District's custom-made yet economical automated system of telemetry and SCADA continues to serve as a robust mechanism for monitoring and managing water deliveries.

In 2012, HID replaced the application previously used for displaying district maps and water use information with ESRI's ArchGIS for desktop (Arch Map). This software enables the district to catalog, map, and analyze its geographic information and publish maps and data in a way that makes them easily accessible to its canal riders. The easy-to-use web maps turn data into information that staff can use in real-time on the job from any secure telecommunications device. ArchGIS also allows HID to control data storage in addition to creating and maintaining all maps in house.

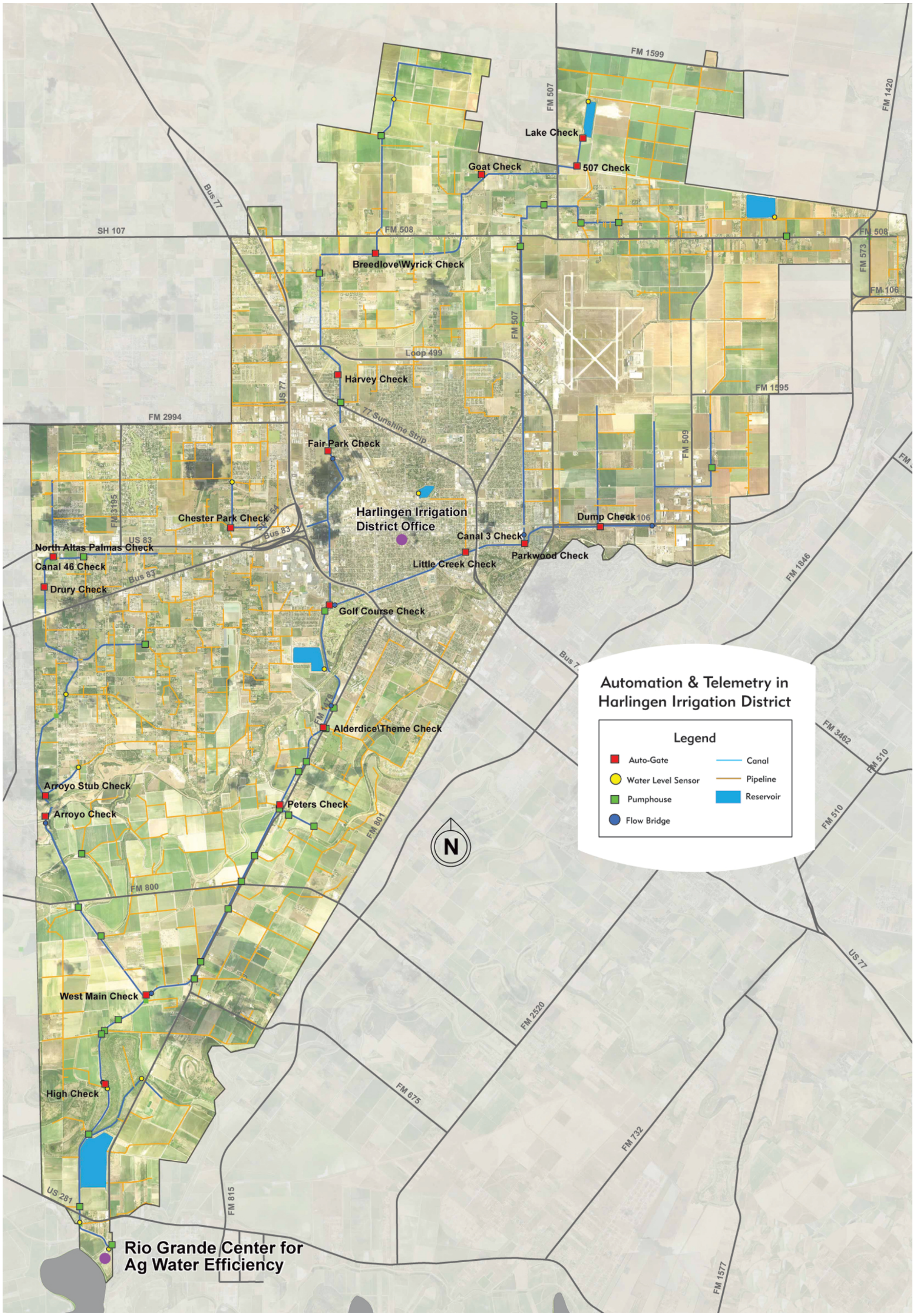
A full-time district employee has primary responsibility for building the maps and inputting data into the geographical information system (GIS) database. The main map and database are updated and shared online daily. The ArchGIS license cost $2,500 and is good for up to five users.

With ArchGIS, canal riders also can mark and post locations of leaks directly to the district map as well as post and view pictures of trouble areas.

In addition, the district replaced with iPads the net books that canal riders had previously used to monitor operations. The iPad has proven to be a much more efficient platform for ArchGIS. With their iPads, the canal riders can access the telemetry system to adjust gates and view canal information, as well as act on water tickets.



iPads linked to HID's automated water-delivery network allow canal riders ready access to information and enable immediate changes to the system.


Automation & Telemetry in Harlingen Irrigation District
Legend
Auto-Gate
Water Level Sensor
Pumphouse
Flow Bridge
Canal
Pipeline
Reservoir
N
Harlingen Irrigation District Office
Rio Grande Center for Ag Water Efficiency
Lake Check
507 Check
Goat Check
Breedlove\Wyrick Check
Harvey Check
Fair Park Check
Chester Park Check
North Altas Palmas Check
Canal 46 Check
Drury Check
Canal 3 Check
Parkwood Check
Little Creek Check
Dump Check
Golf Course Check
Alderdice\Theme Check
Arroyo Stub Check
Arroyo Check
Peters Check
West Main Check
High Check
FM 1599
FM 507
FM 1420
Bus 77
SH 107
FM 508
FM 573
FM 106
Loop 499
US 77
77 Sunshine Strip
FM 1595
FM 2994
FM 509
FM 3195
US 83
Bus 83
FM 1846
FM 3462
FM 510
FM 800
FM 801
US 281
FM 815
FM 675
FM 2520
FM 732
FM 1577

Section 2: Education & Outreach on Texas AWE

Linda Fernandez & Karen Ford, WaterPR

In early 2012, the Harlingen Irrigation District ramped up education and outreach efforts on its Agricultural Water Conservation Demonstration Initiative. With pervasive drought plaguing the region, the time was ripe to begin sharing the results of ADI-supported on-farm research and data collection, as well as the findings from technology improvements within HID district operations.

HID contracted with WaterPR, an Austin-based communications firm, to help spread the good news of ag water conservation and surface water irrigation efficiencies, both on farm and in district.

Members of the WaterPR team were familiar with the realities and challenges of Valley agriculture, having produced the ADI-funded Texas Irrigation Expos in 2010 and 2011, but there was a lot to learn about the results from eight years of work. The first months of the contract were spent on intensive research – reading past reports and technical papers, conducting on-site visits, meeting project partners, and learning about the district's application of telemetry and SCADA.

With background research well underway, WaterPR began mapping out the needs and opportunities for a robust education and outreach program. Primary audiences were other irrigation districts, ag producers, and region and state policy makers. Key messages were developed to revolve around efficiencies realized through district management and delivery of water, on-farm savings through irrigation technologies, and the future of irrigated agriculture in the Rio Grande Valley.

In April 2012, WaterPR delivered a budget and work plan to HID and then went to work to turn that plan into reality. First up was branding the project with a name, graphic identity, tagline, and a visual look that would be clean, clear, user-friendly, relevant, and memorable. The Texas Project for Ag Water Efficiency, Texas AWE for short, was the program's new moniker reflecting the intention of the Texas Water Development Board grant.

Every trip to the Valley by the WaterPR team has contributed to a growing library of photographic images that helps tell the story of Texas AWE. These photographs are used to support and enhance all education and outreach materials and have now become part of the TWDB image library as well.

All members of the Texas AWE team have helped support education and outreach on the project. Texas A&M partners and Dr. Al Blair have reviewed fact sheets and newsletters and presented at workshops. They, along with several cooperating producers, also participated in the video production. In addition, these partners have undertaken their own outreach and education efforts in the academic realm, as detailed in following sections of this report. WaterPR wishes to thank the entire Texas AWE team as well as the staff of the Harlingen Irrigation District for tremendous assistance in spreading the good news of Texas AWE.

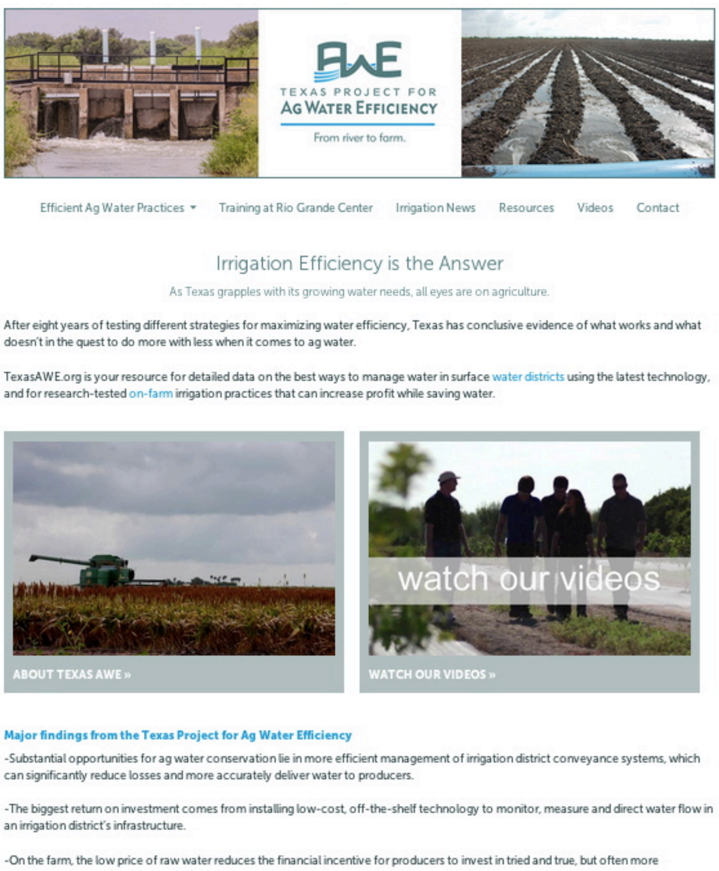
Exhibit 2.1 following provides a full overview of 2012 education and outreach materials and activities developed during the 2012 grant year based on key outreach strategies designed and executed by WaterPR in partnership with the Harlingen Irrigation District.

Exhibit 2.1. Education & Outreach Activities & Results
A compact disc enclosed with this Annual Report provides high-resolution files for all education and outreach materials developed in FY 2012.

COMMUNICATION TOOLS & MATERIALS

Project Branding:
naming, tagline and graphic identification

TEXAS PROJECT FOR
AG WATER EFFICIENCY
From river to farm.


TEXAS PROJECT FOR
AG WATER EFFICIENCY
From river to farm.

Efficient Ag Water Practices ▾ | Training at Rio Grande Center | Irrigation News | Resources | Videos | Contact

Irrigation Efficiency is the Answer

As Texas grapples with its growing water needs, all eyes are on agriculture.

After eight years of testing different strategies for maximizing water efficiency, Texas has conclusive evidence of what works and what doesn't in the quest to do more with less when it comes to ag water.

TexasAWE.org is your resource for detailed data on the best ways to manage water in surface water districts using the latest technology, and for research-tested on-farm irrigation practices that can increase profit while saving water.

watch our videos

ABOUT TEXAS AWE »

WATCH OUR VIDEOS »

Major findings from the Texas Project for Ag Water Efficiency

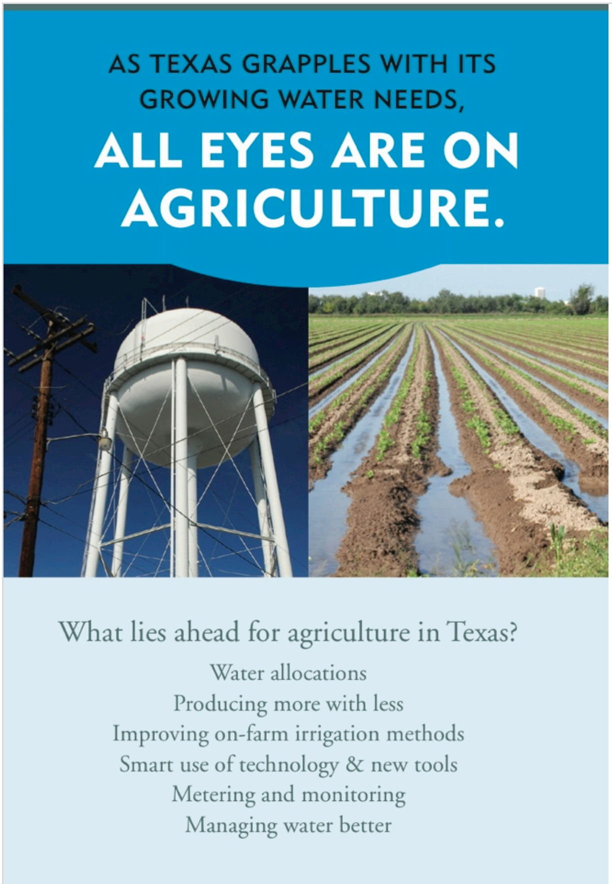
-Substantial opportunities for ag water conservation lie in more efficient management of irrigation district conveyance systems, which can significantly reduce losses and more accurately deliver water to producers.

-The biggest return on investment comes from installing low-cost, off-the-shelf technology to monitor, measure and direct water flow in an irrigation district's infrastructure.

-On the farm, the low price of raw water reduces the financial incentive for producers to invest in tried and true, but often more

TexasAWE.org: dedicated website serves as repository and user-friendly delivery vehicle for all Texas AWE research, findings, educational materials, technological reports, and news for both producers and other irrigation districts.

Between its launch in mid-October 2012 until the end of February 2013, TexasAWE.org received 551 visits and 1,623 page views. Most visitors came to the site from the United States, but Google Analytics show that viewers also came from Mexico, Panama, Brazil, Canada, Australia, India, United Arab Emirates, and even China.



Overview Brochure with foldout map of HID conveyance & telemetry system

Video Series: aid in public presentations & for delivery through the Texas AWE website:

Why Texas AWE? The many partners involved in the Texas Project for Ag Water Efficiency talk about the compelling reasons behind the project and some key results of their efforts. (RT 11:10)

In-District Water Management Efficiencies. One of the best ways to conserve water in irrigated agriculture is to create efficient delivery systems in the irrigation district; automation is a win-win proposition for both producers and irrigation districts. (RT 3:15)

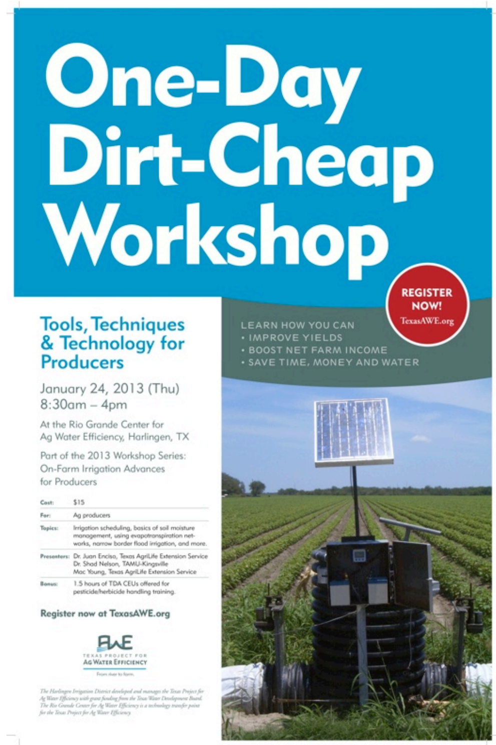
On-Farm Irrigation Efficiencies. Water efficient irrigation methods and technology include poly pipe, surge, drip, and soil moisture monitoring. (RT 4:29)

Rio Grande Center for Ag Water Efficiency. The Rio Grande Center for Ag Water Efficiency offers training and technology demonstrations for farmers and irrigation district personnel plus meter calibration services. (RT 2:19)

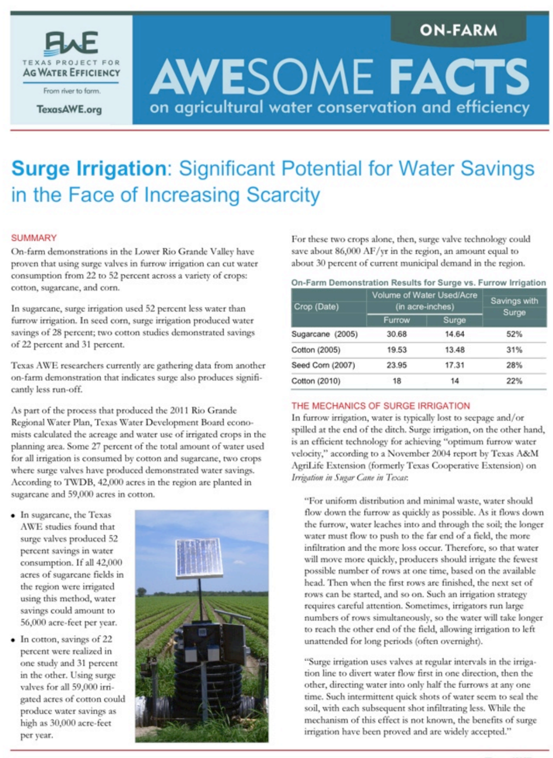
The Future of Irrigated Agriculture in Texas. The importance of Texas AWE and other ag water efficiency and conservation projects for the future. (RT 3:08)

.

Pop Up Banner for use at industry conferences and public events.



Flyers and Posters promoting training events at the Rio Grande Center for AWE



Surge Irrigation: Significant Potential for Water Savings in the Face of Increasing Scarcity

SUMMARY

On-farm demonstrations in the Lower Rio Grande Valley have proven that using surge valves in furrow irrigation can cut water consumption from 22 to 52 percent across a variety of crops: cotton, sugarcane, and corn.

In sugarcane, surge irrigation used 52 percent less water than furrow irrigation. In seed corn, surge irrigation produced water savings of 28 percent; two cotton studies demonstrated savings of 22 percent and 31 percent.

Texas AWE researchers currently are gathering data from another on-farm demonstration that indicates surge also produces significantly less run-off.

As part of the process that produced the 2011 Rio Grande Regional Water Plan, Texas Water Development Board economists calculated the acreage and water use of irrigated crops in the planning area. Some 27 percent of the total amount of water used for all irrigation is consumed by cotton and sugarcane, two crops where surge valves have produced demonstrated water savings. According to TWDB, 42,000 acres in the region are planted in sugarcane and 59,000 acres in cotton.

- In sugarcane, the Texas AWE studies found that surge valves produced 52 percent savings in water consumption. If all 42,000 acres of sugarcane fields in the region were irrigated using this method, water savings could amount to 56,000 acre-feet per year.
- In cotton, savings of 22 percent were realized in one study and 31 percent in the other. Using surge valves for all 59,000 irrigated acres of cotton could produce water savings as high as 30,000 acre-feet per year.

For these two crops alone, then, surge valve technology could save about 86,000 AF/yr in the region, an amount equal to about 30 percent of current municipal demand in the region.

On-Farm Demonstration Results for Surge vs. Furrow Irrigation

Crop (Date)	Volume of Water Used/Acre (in acre-inches)		Savings with Surge
	Furrow	Surge	
Sugarcane (2005)	30.68	14.64	52%
Cotton (2005)	19.53	13.48	31%
Seed Corn (2007)	23.95	17.31	28%
Cotton (2010)	18	14	22%

THE MECHANICS OF SURGE IRRIGATION

In furrow irrigation, water is typically lost to seepage and/or spilled at the end of the ditch. Surge irrigation, on the other hand, is an efficient technology for achieving "optimum furrow water velocity," according to a November 2004 report by Texas A&M AgriLife Extension (formerly Texas Cooperative Extension) on *Irrigation in Sugar Cane in Texas*:

> "For uniform distribution and minimal waste, water should flow down the furrow as quickly as possible. As it flows down the furrow, water leaches into and through the soil; the longer water must flow to push to the far end of a field, the more infiltration and the more loss occur. Therefore, so that water will move more quickly, producers should irrigate the fewest possible number of rows at one time, based on the available head. Then when the first rows are finished, the next set of rows can be started, and so on. Such an irrigation strategy requires careful attention. Sometimes, irrigators run large numbers of rows simultaneously, so the water will take longer to reach the other end of the field, allowing irrigation to left unattended for long periods (often overnight).
>
> "Surge irrigation uses valves at regular intervals in the irrigation line to divert water flow first in one direction, then the other, directing water into only half the furrows at any one time. Such intermittent quick shots of water seem to seal the soil, with each subsequent shot infiltrating less. While the mechanism of this effect is not known, the benefits of surge irrigation have been proved and are widely accepted."

TexasAWE.org

AWEsome Facts series launched with the first one-sheet about on-farm practices: *Surge Irrigation: Significant Potential for Water Savings in the Face of Increasing Scarcity*.

PowerPoint template, fact slides, graphics and talking points for presentations .

Outreach Tools for expanding awareness of Texas AWE and putting information in the hands of the targeted audiences: branded ball caps and flash drives, DVDs with overview video.

TRAINING WORKSHOPS @ RIO GRANDE CENTER FOR AWE

District Technology Enhancements: Introduction to Flow Measurement for Ag Water Conservation. Nov. 7-8, 2012; 12 attendees from area irrigation districts.

Tools, Techniques and Technology for Producers. Jan. 24, 2013; 25 attendees

PRESENTATIONS & EVENT OUTREACH

United States Committee on Irrigation & Drainage (USCID) conference, Austin, April 2012 (Halbert, McLemore, Blair)

Lower Rio Grande Valley Water District Managers Association meeting, Weslaco, August 2012 (McLemore)

Rio Grande Regional Water Authority meeting, Weslaco, Sept 2012 (McLemore)

Rio Grande Regional Water Planning Group meeting, Weslaco, Oct 2012 (McLemore)

Texas Water Conservation Association conference, San Antonio, Oct 2012 (Halbert, McLemore)

Amarillo Farm & Ranch Show booth, Amarillo, Nov 2012 (McLemore and Jones)

Beltwide Cotton Conference, San Antonio, Jan 2013 (handouts distributed courtesy of Dr. Dana Porter)

Texas Farm Bureau YF&R Leadership Conference, Waco, Jan 2013 (Halbert)

Rio Grande Valley Water Awareness Summit, Brownsville, Feb 2013 (McLemore)

AWARDS & RECOGNITION

Texas AWE cited as one of nine global "good practice" projects in *A Catalogue of Good Practices in Water Use Efficiency* prepared by the Stockholm International Water Institute. (January 2012)

District: Harlingen
Province: Texas
Country: USA

Traditionally, the gate is raised or lowered manually in order to achieve a target flow rate within a specific time period. The automation enables canal gates to be raised or lowered without visiting the site and also enables frequent adjustments to maintain flow rates within a target range as water levels fluctuate within the system. Automatic gates are commercially available but are often too expensive to be economically viable. This project has resulted in the design of automatic gates that can be readily manufactured locally, assembled, and installed[4].

The software of the SCADA system used for the automated gate control was uniquely designed by Harlingen Irrigation District using an open source program; hence the design and maintenance of the software entails lower costs than the privately designed SCADA system. Furthermore, the program allows for easy maintenance that suits the local context.

The device for water level measurement is used as a controller for the automatic gates and as a transmitter for the data on field level soil moisture. Ten devices were installed in the field and the associated SCADA system software was modified accordingly. Each of the devices is powered with an external solar panel that recharges its battery system.[5]

The soil moisture management uses low-cost PLC and score board. The information is linked to the telemetry and then provided in real-time and can be controlled from a central office.

Texas AgriLife Extension Services, Axiom Blair Engineering, and Texas A&M University Kingsville provided consulting services for the projects. Technology providers engaged in the projects are Axiom Blair Engineering for the design, engineering, and production of the automatic gate control; and USDA's EPANET software for analysing the hydraulic and water quality behaviour of pressurised pipe networks.

COSTS

The ADI was launched with a USD 3.7 million grant funded by the Bureau of Reclamation and NAD Bank along with the matching funds from the district.[6] As of 2009, USD 1.63 million of funds and USD 2.54 million of matching funds have been secured to implement the projects. These matching funds have been provided by the Harlingen Irrigation District, Texas A&M University Kingsville, Delta Lake Irrigation District, USDA-EQIP, Netafim, and Axiom-Blair Engineering. The ITA program was supported with a USD 249,000 grant from the Texas Water Development Board and matching funds of USD 249,000 from the Harlingen Irrigation District.

As shown by the funds committed to projects, the estimated cost efficiency is USD 0.13 per m^3 of water savings[7].

RESULTS

The ADI program has demonstrated that it is possible to conserve water without losing money or impacting the quality of a crop. On-farm level surveys conducted in 2009 and 2010 revealed that those various water conservation technologies have resulted in an average of 32.5 per cent reduction in irrigation water and 48.2 per cent reduction of surface run-off. In total, 34.8 per cent of water savings were achieved[8].

The success of the automatic gates for irrigation canals has generated a demand from other irrigation districts, such as El Paso County and Lower Colorado Region. As a result, the technology has now been delivered or adopted by other irrigation districts.

The performance of the soil management system is still presently being evaluated.

[4] Awblair Engineering, 2010, Draft Report: Low Cost Automatic Gates for Irrigation Canals. Prepared for the Harlingen Irrigition District under a Texas Water Development Board Grant. Innovative Technologies for Agricultural Water Management and Flow Measurement.
[5] Awblair Engineering, 2010. Draft Report: Low Cost RTU for Water Level Measurement. www.hidcc1.org/files/TWDB-ITALC-RTU_red.pdf
[6] Harlingen Irrigation District Newsletter Volume no. 7, December 2007. www.hidcc1.org/files/Newsletter%20December%202007.pdf
[7] The cost efficiency is estimated with 5 per cent interest rate and 10 years lifetime of the devices.
[8] Harlingen Irrigation District Newsletter Volume no. 11-1, April 2011. www.hidcc1.org/files/News%20Letter%20April2011_FINAL_For%20Web.pdf

HID recognized for its ADI efforts in *The Environmental, Economic and Health Status of Water Resources in the U.S.-Mexico Border Region*, Good Neighbor Environmental Board report to the President and Congress. (December 2012)

Case Study: **Development of Improved Irrigation Scheduling for Freshwater Conservation in Pecan Fields of El Paso County**

Pecan production is a major economic activity in southern New Mexico and Texas. In 2009, New Mexico ranked first in value of pecan production with approximately $133 million in net sales.[78] In recent years, the number of pecan groves in the New Mexico-Texas border area near El Paso, Texas, has increased significantly; pecan production in New Mexico increased 63 percent between 2008 and 2009.

Pecan trees, however, need more water per acre than most other crops. Conserving water in pecan fields can reduce greatly the overall water consumption of the El Paso County Water Improvement District #1. Currently, flood irrigation used by most pecan growers in El Paso County not only flushes nutrients out of the root zone but also uses large quantities of water. Because most of the soils have an elevated salt content, they require flood irrigation.

Texas A&M University is working with the pecan growers to reduce water consumption by installing moisture sensors in the pecan groves and irrigating the fields only when water is needed by the trees. The university has received a grant of $64,700 from the Water Conservation Field Services program of the Bureau of Reclamation to evaluate the best moisture sensors and method to determine the water requirements of the pecan trees. Texas A&M University has provided an additional $65,000 in funding for the project. Readings from the sensors will be transmitted wirelessly to farmers' computers and the university data collectors.

At the conclusion of the program, Texas A&M University will deliver a final report to the Bureau of Reclamation describing the methodology for determining a better process for irrigating pecan groves. Further, Texas A&M University will work with the Pecan Growers Association and others to conduct seminars with pecan growers in the area to disseminate the information.

Case Study: **Agricultural Water Conservation Demonstration Initiative**[79]

Harlingen Irrigation District Cameron County # 1 (District) in the Lower Rio Grande Valley of Texas developed an Agricultural Water Conservation Demonstration Initiative to illustrate how the District could save water.

Established in May 1914, the District covers 38,000 acres within Cameron County. The Rio Grande serves as the only water source in the area. Average annual water diversion is 52,000 acre-feet per year for irrigation and 15,000 acre-feet per year for municipal and domestic use. The District reports an estimated water delivery efficiency of about 80 percent.

The Rio Grande Valley suffered unprecedented water shortages in the late 1990s. These shortages were exacerbated by Mexico's deficit in water deliveries to the United States under the 1944 Water Treaty, drier than normal weather conditions, and booming urbanization trends, making water conservation a priority. Lower Rio Grande water districts sought state and federal assistance for water conservation projects and received funding for the Lower Rio Grande Valley Water Conservation program and the 2025 Western Water Initiative Challenge Grant, as well as the Agricultural Water Conservation Demonstration Initiative. The latter was a BECC priority area and the District's project was certified for $3.56 million; 50 percent of its total funding came from NADB, and the remainder came mostly from the District, with about 10 percent from the State of Texas.

The Water Conservation program had two main accomplishments: installation of canal lining and a pipeline, and meters and telemetry advances. The Water Initiative Challenge Grant helped establish nine flow-metering bridges with remote telemetry units to assist farm deliveries. The Agricultural Water Conservation Demonstration Initiative brought together multiple participants from the area and provided many helpful technologies and system improvements to achieve higher rates of water conservation. These improvements included a variable speed pump, metering technologies, semi-automated calibration tanks, Internet-based information for real-time flows, surge and automated surface irrigation, and a water user accounting system. The Texas Water Resources Institute of the Texas A&M University found that, according to the Economic and Conservation Evaluation of Capital Renovation Projects for the Harlingen Irrigation District, the initiative would create estimated water savings of 13,092 acre-feet per year, on an average annual basis.

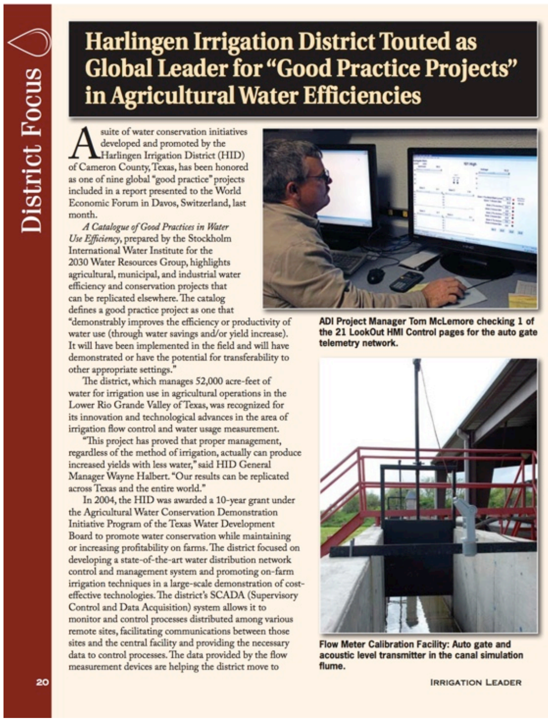
The next steps for the Lower Rio Grande Valley include a continued push for district-wide conservation improvements. The conservation programs will seek to continue to improve and expand the telemetry system and seek funds for canal rehabilitation projects, as well as for the development of low-cost level measurement devices, low-cost automatic canal control gates, and telemetry-supported soil moisture measurement devices. The total water savings from the entire project, once completed, are expected to be about 138,000 acre-feet per year.

Case Study: **The City of El Paso, Texas**

El Paso, Texas, instituted aggressive water conservation strategies to decrease water use. In 1990, El Paso was using 183 gallons per person per day (expressed as gallons per capita per day).[80] By 2008, however, it had reduced this to 137 gallons per capita per day,[81] a decrease of 33 percent. El Paso accomplished this through an aggressive water conservation and education program, including incentivizing people to xeriscape their yards, providing low-flow shower heads and low-flow toilets, developing a city water conservation ordinance, encouraging residents to report water waste, and promoting public awareness. During the summer of 2012, El Paso used 500 million gallons less than the amount used during the same period in 2011.[82]

MEDIA OUTREACH

Press Release on HID's recognition as a global leader to good practices in agricultural water efficiency by the Stockholm International Water Institute generates key story in the March 2012 issue of *Irrigation Leader* and on-air interview with Tom McLemore on McAllen-based KURV news talk radio show.



District Focus

Harlingen Irrigation District Touted as Global Leader for "Good Practice Projects" in Agricultural Water Efficiencies

A suite of water conservation initiatives developed and promoted by the Harlingen Irrigation District (HID) of Cameron County, Texas, has been honored as one of nine global "good practice" projects included in a report presented to the World Economic Forum in Davos, Switzerland, last month.

A Catalogue of Good Practices in Water Use Efficiency, prepared by the Stockholm International Water Institute for the 2030 Water Resources Group, highlights agricultural, municipal, and industrial water efficiency and conservation projects that can be replicated elsewhere. The catalog defines a good practice project as one that "demonstrably improves the efficiency or productivity of water use (through water savings and/or yield increase). It will have been implemented in the field and will have demonstrated or have the potential for transferability to other appropriate settings."

The district, which manages 52,000 acre-feet of water for irrigation use in agricultural operations in the Lower Rio Grande Valley of Texas, was recognized for its innovation and technological advances in the area of irrigation flow control and water usage measurement.

"This project has proved that proper management, regardless of the method of irrigation, actually can produce increased yields with less water," said HID General Manager Wayne Halbert. "Our results can be replicated across Texas and the entire world."

In 2004, the HID was awarded a 10-year grant under the Agricultural Water Conservation Demonstration Initiative Program of the Texas Water Development Board to promote water conservation while maintaining or increasing profitability on farms. The district focused on developing a state-of-the-art water distribution network control and management system and promoting on-farm irrigation techniques in a large-scale demonstration of cost-effective technologies. The district's SCADA (Supervisory Control and Data Acquisition) system allows it to monitor and control processes distributed among various remote sites, facilitating communications between those sites and the central facility and providing the necessary data to control processes. The data provided by the flow measurement devices are helping the district move to

ADI Project Manager Tom McLemore checking 1 of the 21 LookOut HMI Control pages for the auto gate telemetry network.

Flow Meter Calibration Facility: Auto gate and acoustic level transmitter in the canal simulation flume.

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volumetric pricing of irrigation water.

Supporting the SCADA system are several other initiatives:

- A Flow Meter Calibration and Demonstration Facility—the first in Texas—that can simulate various options for irrigation systems, allowing for more informed decisions about irrigation techniques, and thus, water conservation. It also serves as a training center where operators can learn about pumps, automated controls, calibration of measuring tools, and water use data collection.
- Collection of on-farm flow measurement data through automatic meters installed throughout the district's 250-mile irrigation system. The meters are tied to a telemetry system that reports pumping and flows in real time.
- A demonstration of a web-based information system that reports weather, real-time flows, and a user accounting system.
- Design of low-cost automatic gates for irrigation canals and low-cost remote telemetry units to measure water levels and soil moisture.

The HID has demonstrated it is possible to conserve water without losing money or affecting the quality of a crop. Surveys conducted in 2009 and 2010 showed that these innovative irrigation system controls and data streams achieved water savings of nearly 35 percent.

AW Blair Engineering, Texas AgriLife Extension Services, and Texas A&M University Kingsville provide consulting services for the various projects. Additional funding has been provided by U.S. Bureau of Reclamation and the North American Development Bank, and by the district and consulting partners Delta Lake Irrigation District, Netafim, and USDA-EQIP.

The HID was honored with a Texas Environmental Excellence Award in 2011 for its water conservation initiatives.

The Catalogue of Good Practices in Water Use Efficiency *is available on the district's website at http://www.hidcc1.org/node/16.*

Wind generator used to power auto gate and related SCADA electronics at the Theime Road check.

Flow Meter Calibration Facility: Acoustic level transmitter and sharp crested weir in the 140-foot canal simulation flume.

Flow Meter Calibration Facility: Mag meter (blue and white box in the foreground) and control valves for the meter testing manifold.

IRRIGATION LEADER 21

Press releases and alerts developed and distributed to promote November and January training workshops for producers and district personnel.

PARTNERSHIP BUILDING

WaterSMART grant application submitted to U.S. Bureau of Reclamation in partnership with Rio Grande Regional Water Authority for Surge Valve Cooperative (January 2013).

RGRWA
RIO GRANDE REGIONAL WATER AUTHORITY

RECLAMATION
Managing Water in the West

Section 3: New Water-Saving Developments in On-Farm Irrigation of Citrus Crops

Texas A&M University-Kingsville, Citrus Center
Dr. Shad D. Nelson, SDN Consulting, Inc.

In 2012, researchers from the Citrus Center at Texas A&M University-Kingsville involved in the Texas Project for Ag Water Efficiency continued to follow-up on promising developments in managing citrus irrigation to increase efficiencies and water conservation. Some irrigation techniques – including narrow border flood – continue to show positive results. Other techniques – such as real-time soil moisture monitoring – have encountered problems with calibration and related issues. The research team is continuing to build on results, developing new demonstration sites for testing alternative irrigation strategies.

Summaries of past-year activities and studies planned for 2013 are presented below.

RESEARCH INITIATIVES, EVALUATIONS & ANALYSES

2012 Results

1. Alternatives to Traditional Flood Irrigation
Earlier demonstration projects have shown that traditional large-pan flood (TF) irrigation applies about 6 inches of water per acre per irrigation event. In contrast, raising berms between tree rows to allow for narrow border flood (NBF) irrigation is estimated to reduce water application to a 4-inch irrigation event.

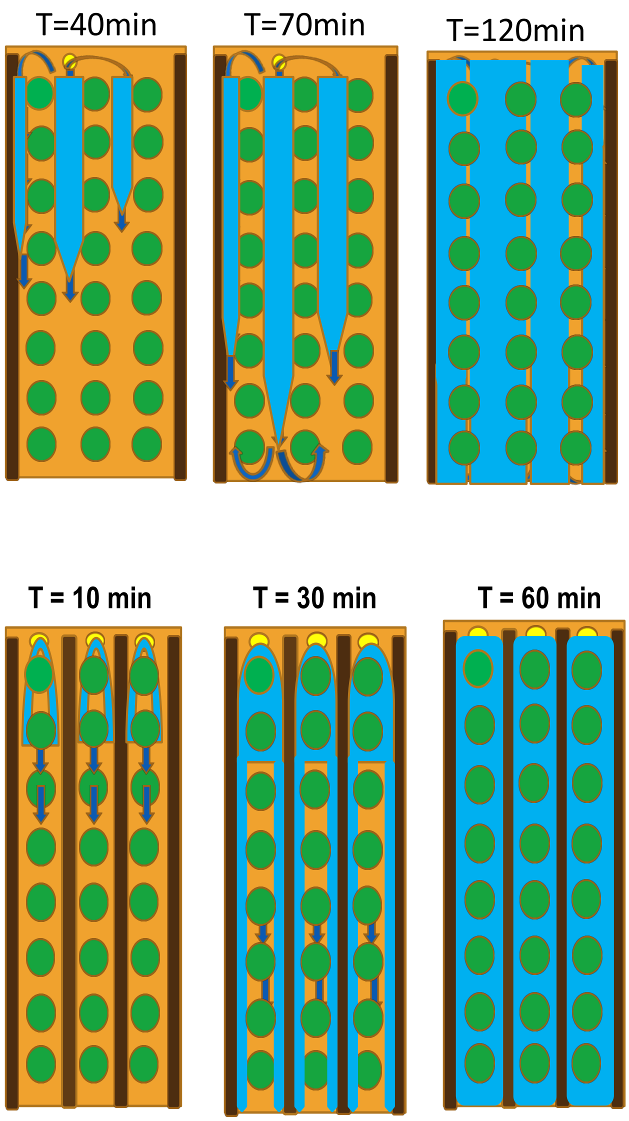
To better evaluate the water savings from NBF irrigation compared to TF irrigation, we metered the total amount of water required to irrigate tree rows by each method in three separate irrigation events for three rows of trees occupying the same sized area. As shown in Exhibit 3.1, NBF used 36 percent less water.

Exhibit 3.1. Narrow Border Flood Saves 36% Water Over Traditional Large-Pan Flood Irrigation

Flood Irrigation Method	Irrigated 3-Row Area (Acres)	Time to Irrigate Area (Hours)	Water Applied (Gallons)	Water Applied (Ac-Ft)	Water Applied (Ac-Ft/Ac)
Traditional (TF)	0.73	1.87 (±0.29)	31,738	0.50 (±0.09)	0.68
Narrow Border (NBF)	0.59	0.69 (±0.12)	25,818	0.32 (±0.07)	0.44
Difference (TF-NBF)	0.14	1.18	5,920	0.18	0.24

We also paid attention to how water moved in the field and the time necessary to establish a continuous flat layer of water covering the soil surface. In the TF irrigated field, water moved between the tree rows but did not move laterally underneath tree canopy until lower soil elevations between tree rows were covered with water. In contrast, water movement in the NBF irrigated field moved more efficiently. Exhibit 3.2 simulates overhead views of water movement in TF (top display) and NBF (bottom display).

Exhibit 3.2. Narrow Border Flood Provides More Efficient Water Movement



Top: Traditional Large Pan Flood irrigation

Bottom: Narrow Border Flood Irrigation

Preliminary analysis of 2012 harvest results for Rio Red grapefruit support previous findings that NBF uses less water than other irrigation methods with the potential of producing high yields, as shown in Exhibit 3.3, following.

Exhibit 3.3. Yield and Water Use for 2012 Rio Red Grapefruit Harvest

Grower/Area	Irrigation Method	Water to Crop (inches)			Excess Water over NBF	Yield (tons/ac)
		Irrigation	Rain	Total		
"A" North/McAllen	Narrow Border Flood	36	5.7	41.7		**27.8**
"A" South/McAllen	Narrow Border Flood	36	5.7	41.7		18.2
"B"/Edinburg	Microjet	45	1.2	46.2	10%	**26.3**
"C"/ Edinburg	Microjet	47	1.7	48.7	14%	18.1
"C"/ Edinburg	Dual Line Drip	48	1.7	49.7	16%	16.3
"B"/Edinburg	Dual Line Drip	50	1.2	51.2	19%	**26.0**
"D"/Weslaco	Traditional Flood	54	2.1	56.1	26%	20.0
"C"/Edinburg	Traditional Flood	60	1.7	61.7	32%	17.0

Microjet and dual line drip irrigation also can produce high yields but with higher volumes of water. Higher yields are typically for fully mature, yet younger-aged grapefruit trees for all irrigation methods (bolded in the "Yield" column). Fields irrigated via microjet in the demonstrations used 10 percent and 14 percent more water than NBF; those using double line drip used 16 percent and 19 percent more water. Fields irrigated via traditional flood used 26 percent and 32 percent more water than NBF.

2. Raised-Bed Plantings to Improve Root Health in Drip Irrigation

In 2012, one-year old citrus trees were placed in raised beds in a new demonstration site at the Texas A&M University-Kingsville Citrus Center. The field site encompasses a mixture of crop management treatments, enabling thorough evaluation of different methods. Some trees are planted under raised bed conditions compared to flat ground (i.e., no elevated ground). Some of the trees are planted on bare ground and others with a water-permeable fabric tarp. This demonstration area allows citrus growers to see in practice alternative ways to grow citrus using low-flow irrigation strategies.

The new trees were irrigated using narrow border flood techniques. Rows of tarped and non-tarped trees within raised berms were flood irrigated, with minimal water coverage on the sides of the berms. In 2013, we plan to run a single drip irrigation line underneath all tarped areas down the center of the tree row. Evidence suggests that using drip irrigation on raised beds may reduce *Phytopthora*, a predominant soil-borne pathogen problem, as well as root rot, which is commonly spread in traditional flood irrigation and leads to tree decline and death.

Some of these young trees are planted at a higher density per acre than is currently common in the South Texas citrus industry. There also is evidence to suggest that high density planting of citrus may help growers avoid or manage another episode of the devastating "citrus greening" disease (HLB disease) that was encountered in Texas for the first time in January 2012.

3. Real-Time Soil Moisture Monitoring for Irrigation Water Management

On-farm soil moisture monitoring has been an integral part of agricultural water conservation efforts by citrus growers involved in Texas AWE. However, growers are challenged in adopting this method. In 2011, two citrus collaborators installed real-time remote soil moisture sensing technology on their demonstration sites so that data on soil moisture status could be sent directly to their office computers. Unfortunately, both growers encountered major difficulties in calibrating the sensors to the high clay soil typical of the Lower Rio Grande Valley and neither can recommend the current system for "real-time" monitoring or for irrigation scheduling

We expect better results in 2013 as we provide the growers with technology that they have used in the past from a company that has been involved in data logging and soil moisture sensing for several decades. The new equipment – from Decagon Devices, Inc. – uses cellular signals to send data to a main server that can be accessed by both researchers and growers using their own computers.

4. Citrus Demonstration and Research Irrigation Park

The planned research and demonstration park on land donated by Rio Queen Farms in Monte Alto, Texas, has been put on hold due to drought. The site was intended to enable long-term assessment of alternative irrigation methodologies to traditional large-pan flood irrigation of citrus orchards, including such technologies as drip irrigation, microjet spray irrigation, and various forms of border flood irrigation.

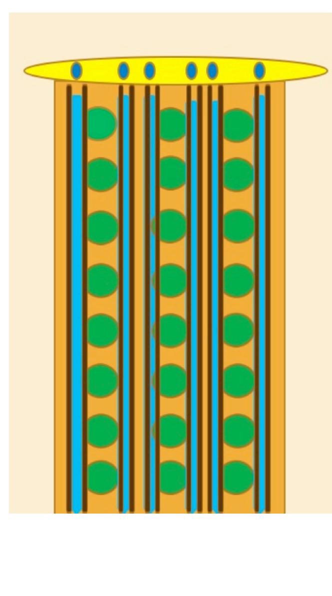
At the end of 2012, the Delta Lake Irrigation District, which serves the area, came under severe water restrictions that continue today. Lacking the allocations required to maintain a continuous level of water within the adjacent canals for drip and microjet irrigation needs, the site currently cannot sustain a demonstration project. An alternative site has been designated in Weslaco on the Citrus Center South Farm.

2013 RESEARCH ACTIVITIES

1. Alternative Border Flood Management Strategies

An alternative to the planned North Farm demonstration site has been established as of April 2013 at the Citrus Center South Farm for use in evaluating how different border flood irrigation methods can save water during drought. Results from using raised berms between bed rows or border flood (in which water is channeled underneath the entire tree canopy down the length of the row) will be compared to a "Furrow Flood" method of irrigation. This latter approach involves cutting a trench on each side of the tree along its drip line and then focusing irrigation within the furrow. Water will be allowed to run down the entire length of the furrow, or trench, until the furrow is full, then it will be allowed to percolate into the soil from the furrow.

Exhibit 3.4. Schematic of "Furrow-Flood" Alternative



We also plan to tweak this irrigation method to look at a range of additional possibilities. For example, instead of irrigating both sides of the tree, we can alternate irrigation events down the trenches in each tree row, in effect creating a "partial root-zone drying" trial. Alternative irrigation events on each side of the tree using a flood irrigation method may be more readily adaptable to mature trees already used to being flood irrigated and may be more economically feasible to growers over more expensive drip irrigation systems. The trees at this location are near a grove of the same variety and tree age being used for a study of "Partial Root-Zone Drying" (PRD) employing dual-line drip irrigation, thus enabling ready comparisons of water use efficiencies.

2. "Water Deficit Irrigation" Methods

Another demonstration project is now underway at the Texas A&M University-Kingsville Citrus Center with new grant funding acquired in 2012 from the Texas Water Development Board. Various alternative irrigation strategies – microjet spray, dual-line drip irrigation, and partial root-zone drying – using deficit irrigation methods will be demonstrated on mature, 25-year-old trees for their potential to conserve water while maintaining fruit yield, quality, and shape.

Using a dual-line drip system, one side of selected trees will be irrigated one week and the other side the following week. This "Partial Root-Zone Drying" (PRD) management strategy has been shown to conserve water while still providing yield amidst water stress conditions. The method will be compared to irrigating both sides of the tree under dual-line drip, and to microjet sprinkler spray irrigation. The site will be evaluated for a minimum of 2 to 3 production years.

LEVERAGING PROJECT RESOURCES

The Texas Water Development Board provided funding to continue alternative strategies at conserving water in citrus production through the funding of a three-year grant entitled "Developing and Promoting Water Saving Irrigation Strategies to Increase Water Use Efficiency in Citrus" to Drs. Melgar and Nelson in 2012. Activities such as these will allow for continued evaluation of water saving strategies beyond the termination date of the Texas Project for Ag Water Efficiency at year-end 2014.

Dr. Nelson's collaborative efforts with the Rio Grande Basin Initiative, Texas Water Resources Institute, Texas A&M AgriLife Research and Extension, Texas A&M University-Kingsville Citrus Center, Texas Citrus Producers Board, and TAMUK graduate students have helped to secure additional grant dollars beyond Texas AWE funding to provide the labor necessary for data collection, analysis, and results interpretation. As shown in Exhibit 3.5, these additional funds total almost $1.25 million.

The results of various on-farm management strategies were published in a variety of professional articles and presented at professional meetings and served as catalysts for obtaining those additional external grant funds to support the goals of Texas AWE. Topics included fertilization and water impacts on citrus, compost utilization on soil-water status and citrus yield, irrigation management and citrus pest control. Appendix A provides a complete list of publications and presentations.

Exhibit 3.5. 2012-13 External Grant Funds Supportive of Texas AWE Projects

$850,000 USDA- National Institute of Food and Agriculture, Hispanic Serving Institutions Collaborative Grants. STEP UP to USDA Career Success: Science, Technology and Environmental Programs for Undergraduate Preparation to USDA Career Success. PD: S.D. Nelson(TAMUK Lead), CoPDs: E. Louzada, R. Stanko, D. Ruppert; (DelMar College) J. Halcomb; (STC) Debbie Villalon; (TSTC) A. Duarte; (UTPA) M. Persans. 2012-13.

$150,000 USDA-National Institute of Food and Agriculture, Hispanic Serving Institutions Collaborative Grants. BGREEN: BuildinG Regional Energy and Educational alliances: A Partnership to Integrate Efforts and Collaboration to Shape Tomorrow's Hispanic Sustainable Energy Leaders. PD: (UTEP) H.A. Taboada, J.F. Espirtu, W.Hargrove, S.Hernandez, J. Noveron; (TAMUK) PD: S.D. Nelson, G.Schuster, R.D. Hanagriff; (TSU-San Marcos); (NMSU)T.Jin, L.Sun, R.Richarson D.Valles, H.Sohn, N.Khandan, R.Acharya. 2012-13.

$136,982 Texas Water Development Board. Developing and Promoting Water Saving Irrigation Strategies to Increase Water Use Efficiency in Citrus. J.C. Melgar (PD), and S.D. Nelson (Co-PD). (2012-2014).

$ 71,300 Texas Department of Agriculture-Crop Specialty Grant Funds. PD: I. Volder, S. King, Co-PD: C. Simpson, J. Franco, S. Nelson. Using Halophytes to Mitigate Salinity in Intercropping of Watermelons. (2012-13).

$ 14,960 Texas A&M Univ.-Kingsville. Developing Water Saving Irrigation Strategies to Increase Water Use Efficiency in Citrus. J.C. Melgar (PD), M. Setamou, S.D. Nelson and D. Ruppert (Co-PDs). (2012-13)

$ 10,000 Texas Citrus Producers Board. Integrated Citrus Fertilizer Management Strategies for Calcareous Soils in South Texas. J. Jifon (PD), M. Setamou, J.C. Melgar, J. daGraca, and S.D. Nelson.

$ 7,200 Texas A&M University-Kingsville. Quality Enhancement Plan (QEP) grants. Graduate Students as Mentors of High School Students. J.C. Melgar (PD), E. Louzada, M. Setamou, G. Schuster, and S.D. Nelson.

$ 3,000 Texas A&M University-Kingsville. 2012-13 TAMUK Council for Undergraduate Research (TCUR) grants. Potential Plant Bioaccumulation of Caffeine in Sandy Soils. S.D. Nelson, M. Dupnik, and C. Hagen. 2012-2013.

Section 4: Surge Irrigation as a Water-Saving Option for Surface Irrigation in the Lower Rio Grande Valley

Juan Enciso, Associate Professor, Texas A&M AgriLife Research Center
Hugo Perea, Postdoctoral Research Associate, Texas A&M AgriLife Research Center

Continuous irrigation using surface water from the Rio Grande has long been a common practice in the Lower Rio Grande Valley. However, the practice is often characterized by runoff and deep percolation of water due to unequal infiltration opportunity times for water across the field and spatial variability in soil water transport properties. The result is inefficiency in water application.

Because of recurrent drought and new demands on surface water supplies from the river, traditional furrow irrigation does not appear to be a sustainable management practice.

Pressured irrigation systems (e.g., center pivots with modified sprinklers that apply water at different rates) are obvious options to replace continuous irrigation. These types of systems – including low elevation spray application (LESA) and low energy precision application (LEPA) pivots – use much less water, apply water with high uniformity and have lower labor costs than continuous irrigation. However, their initial costs for equipment are high and ongoing energy demands substantial.

Surge irrigation, on the other hand, appears to be a more efficient form of furrow irrigation that yields considerable benefits without the expenses that accompany pressurized systems. A growing body of research has found that surge irrigation's intermittent application of water can advance water more quickly and improve uniform distribution while at the same time reducing both the total volume of water applied and water losses from runoff and decreasing emissions of nutrients and agrochemicals from fields.

Nevertheless, studies also clearly show that the surge effect is very dependent on soil conditions. In particular, surge appears to have less favorable results with fine-textured, cracking soils, precisely the type most often found in the drainage areas of the Valley. Because field evaluation of surge irrigation in the region has been limited, researchers with the Texas Project for Ag Water Efficiency undertook a study to compare the performance of surge and continuous flow irrigation on Valley soil texture types.

Starting 2011, we began evaluating performances of surge and continuous irrigation on a commercial sugarcane field in the Lower Rio Grande Valley. A key task was to characterize the relationship between advance distance and applied volume for both types of systems using entire irrigation sets. Furrow irrigation is a complex phenomenon due to infiltration variability and surge irrigation is more complicated by the multiple advances and the effect of alternate wetting and dewatering on the soil infiltration characteristics.

The primary goal of the study has been to characterize the field behavior of infiltration under surge irrigation and compare it with continuous irrigation, taking into account the particular soil type, crop, and field conditions.

The specific tasks include:

- Establishing a volume balance for the entire irrigation set and determining the average depth of infiltrated water by measuring the total volume of applied and runoff water.
- Examining the performance of surge irrigation compared to conventional continuous irrigation practices under local conditions.
- Monitoring the position of advance water front for both continuous and surge irrigations for the entire set of furrows using a GPS.
- Determining seasonal differences in efficiency and uniformity of surge versus continuous irrigation.
- Calibrating a surface irrigation model and then proposing different surge irrigation strategies for the LRGV.

FIELD EXPERIMENTS & RESULTS

Our research was conducted on a single 29.8-acre sugarcane field serviced by the Harlingen Irrigation District (HID). The field has a clayed soil texture and intake rate of 0.003 in/hr. We analyzed the first four irrigations of the 2012 growing season, comparing the hydraulic performance of surged and conventional contiguous irrigation based on typical irrigation management practices in the area.

Exhibit 4.1. Surge Valve in Demonstration Field

Both types of irrigation were applied in the same field so that we could compare them under the same conditions. Using two different fields could have created a scenario of having two different soil types and two different water requirements. Quantifying the potential benefits of surge will be difficult if changes in infiltration conditions throughout the irrigation season are greater than changes induced by the surge effect.

We installed a flexible plastic pipe (poly-pipe) with orifices punched at a constant distance the upstream end of the field to convey and deliver water during the continuous irrigation experiment. A surge valve device was installed at the middle of a field to irrigate 210 furrows (see Exhibit 4.1). The surge valve included a controller and internal program that allowed for variable surge “on-times” during the irrigation. A cycle ratio of 0.5 was used, resulting in equal on- and off-times for both sides of the valve.

Continuous irrigation was used on April 12 and June 14, 2012; surge irrigation was used on May 1 and May 30, 2012. The application depth for both varied from one irrigation to another:

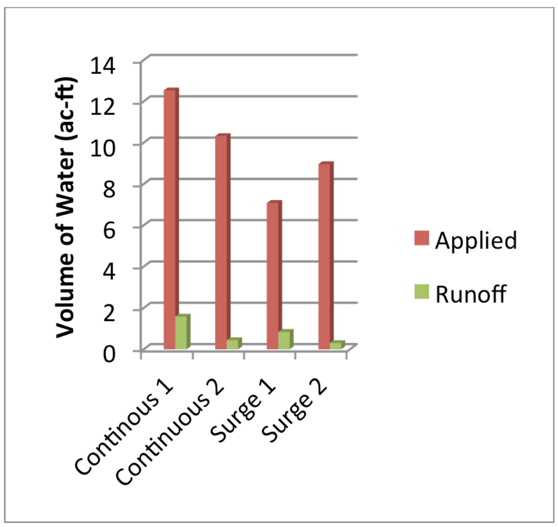
- For continuous irrigation, a depth of 4.4 inches was applied during the first event and 4.0 during the second irrigation event.
- For surge irrigation, a depth of 2.5 inches was applied during the first event and 3.5 during the second.

As delineated in Exhibits 4.2 and 4.3, the field was watered faster, irrigation time was shorter, and, consequently, less water was applied during the surge irrigations. Surge reduced the irrigation amounts applied on the field and the volumes of runoff generated and may have created more uniform distribution of water across the field.

Exhibit 4.2. Continuous vs. Surge Irrigation in Four Plots

Event	Application Rate		Input Volume		Runoff		Infiltrated Volume	Application Depth (inches)	Application Efficiency (%)
	GPM	Ac-in per hr	Hours	Ac-ft	Hours	Ac-ft	Ac-ft		
Cont. 1	1580	3.5	84	12.53	47	1.58	10.95	4.4	87.4
Cont. 2	1361	3.0	43	10.32	38	0.44	9.88	4.0	95.7
Surge 1	1454	3.2	27	7.08	25	0.84	6.24	2.5	88.1
Surge 2	1331	2.9	21	8.96	33	0.30	8.66	3.5	96.6

Exhibit 4.3. Water Application and Runoff



The infiltrated volume of water during an irrigation event is an important measure of the relative performances of surge and continuous. One of the main problems in surface irrigation is achieving small irrigation depths with high irrigation uniformity. In this study, less water infiltrated with surge irrigation: the maximum amount infiltrated totaled 3.5 inches with surge and 4.4 inches with continuous.

Monitoring and managing are keys to irrigation efficiency. Once the targeted application depth is applied, irrigation needs to be shut off to reduce runoff and deep percolation. In this study, all irrigation events were closely monitored and managed, yielding high application efficiencies with very little runoff. The maximum runoff produced was 12.6 percent (from continuous irrigation). Surge irrigation produced slightly less runoff.

CONCLUSIONS & NEXT STEPS

Surge irrigation appears to be a promising technique for reducing runoff while continuing to use existing surface irrigation systems in the Lower Rio Grande Valley, especially for early-season irrigations where high infiltration rates can result in low application efficiencies with continuous flow. Improving poor efficiencies associated with surface-irrigated, shallow-rooted crops also appears to be possible using surge irrigation. More information is needed to establish best management practices, including the optimum combination of inflow rates, cycle times, and number of surges.

The information obtained from these tests will be input into the WinSRFR surface irrigation developed by the USDA Agricultural Research Service. This computer model will be used to train farmers and develop guidelines on how they can manage their irrigation systems more efficiently and conserve water. The systems graphically illustrate the infiltration and runoff processes when different flow rates and irrigation times are used during the simulation.

The surface irrigation model inputs are furrow length, infiltration characteristics, furrow slope, furrow spacing, roughness coefficient, furrow parameters, required depth of irrigation, inflow rate, and irrigation time.

Outputs are water distribution along the furrow and irrigation performance parameters, which include application efficiency, storage efficiency, and distribution uniformity coefficient.

The surface irrigation model is generally used to determine the optimum irrigation time and flow rate for achieving desired performance criteria when soil infiltration is known. The field tests helped obtain the necessary information on infiltration.

Section 5: Economic Evaluation of Demonstrated Irrigation Practices & Technologies

Mac Young, Texas A&M AgriLife Extension Service FARM Assistance Program

Throughout 2012, the Financial and Risk Management Assistance (FARM Assistance) program of Texas A&M AgriLife Extension Service continued its support to the Texas Project for Ag Water Efficiency. The two primary realms of FARM Assistance activities have encompassed:

- Collaborating with project management team and coordinating FARM Assistance efforts into the project by participating in management team meetings, planning sessions, and producer meetings, and contributing to project promotional materials. Extension faculty also support the overall project effort of recruiting project demonstrators.
- Conducting economic evaluations of demonstration sites maintained by cooperating producers to calculate the financial benefit and/or viability of water conservation practices on farming operations. Individual cooperators also are offered FARM Assistance planning services for their entire operations to demonstrate the value of long-range financial planning. As one AWE cooperator remarked, "the FARM Assistance program has been an excellent tool in helping me evaluate the direction I need to proceed with my farm operation."

2012 ECONOMIC ANALYSES

In FY 2012, FARM Assistance specialists completed analyses for four AWE cooperators involving three whole-farm and 14 demonstration sites.

All but two of the demonstration sites involved citrus production using a variety of irrigation technologies: traditional large pan flood, narrow border flood, two-line drip, and microjet spray.

The other two sites were planted in onions (furrow irrigation) and sugarcane (surge irrigation). The sugarcane site was the only field crop demonstration active in 2012. As of February 15, 2013, the site had not been harvested to obtain official yields.

Summaries of financial projections for all demonstration sites are provided in Exhibit 5.1, following. The demonstration site evaluations completed in FY 2012 continue to support the major findings of economic analyses conducted of 2005-2011 field crop demonstrations and presented in previous annual reports.

In summary, while field demonstrations of alternatives to using furrow in field crops do show potential for water saving, under current "per event" pricing structures, savings in water do not necessarily translate into savings in cost for producers. With no significant differences in yields, the additional fixed or variable costs related to a surge valve or a drip system, for example, reduces the net returns per acre compared to furrow flood. An exception is onions where drip technology has shown water savings as well as economic incentives.

Nevertheless, even though FARM Assistance analyses indicate limited existing economic incentives for adoption of conservation practices in field crops, these demonstrations have illustrated the value of water saving methods under conditions of limited water availability, water restrictions, and/or volume pricing. As reported in 2011, results indicate that incentives to invest in and adopt surge irrigation would begin with just less than doubling of 2010 water prices. Based on Net Cash Farm Income (NCFI), the advantage of surge over furrow improves significantly as the price for irrigation water increases.

Cost savings and water savings already converge, however, in citrus production, where economic analyses of the 2005-2012 demonstrations show economic incentives to adopt alternatives to traditional large pan flood irrigation. As emphasized in the 2011 Annual Report, our evaluation of differences in fruit quality and yields show clear economic incentives to adopting microjet spray, drip, and, in particular, narrow border flood technologies. And given the ease with which producers can adopt narrow border flood management practices, this practice may offer the best economical option for water savings, assuming 2010 water pricing.

As noted in earlier reports, NBF has the economic advantage over microjet and drip systems due to their costs and over traditional flood because of NBF produces higher yields and pack-out quality, which is reflected in price.

Exhibit 5.1. Demonstration Site Economic Summaries of Financial Projections (2012-2021)

Notes:

- For all citrus sites, orchards were presumed to have mature trees.
- For all sites, prices were held constant for the 10-year period. This constant affects "10-Year Average NCFI."
- "10-Year Average Probability of Negative NCFI" is based on risk associated with prices and yields.
- All 2012 producer costs & overhead charges are producer-estimated.

Acronyms:

- NCFI = Net Cash Farm Income
- IC = irrigation costs
- VIC = variable irrigation costs
- ANFC = assuming no financing costs

Crop	Site Data	Price per Ton	Irrigation Techniques	10-Year Average Cash Receipts per Acre	10-Year Average Cash Costs per Acre	10-Year Average NCFI per Acre	Possible Range of NCFI per Acre	10-Year Average Probability of Negative NCFI	10-Year Average Probability of Carry-Over Debt
Rio Red grapefruit	1A 48.5 ac	$165	**narrow border flood** with remote sensing (expensed at $9.90/ac per year)	$3,630	$1,890 ($220/ac IC in 2012)	$1,740	-$227 to $3,876	7.1%	1% or less
	1C 15 ac	$165	**narrow border flood** with remote sensing (expensed at $11.67/ac per year)	$3,640	$1,890 ($220/ac IC in 2012)	$1,740	-$200 to $3,800	6.6%	1% or less
	4A 16.5 ac	$150	**2-line drip** costing $2,081/ac (expensed at $208/ac per year, ANFC)	$3,000	$2,680 ($292.90/acre IC in 2012)	$810	-$339 to $2,440	12.2%	1% or less
	4B 6 ac	$150	**micro-jet spray** costing $2,500/ac (expensed at $250/ac per year, ANFC)	$3,000	$2,280 ($299.77/ac IC in 2012)	$720	-$313 to $2,493	19.5%	1.6%
	4C 14 ac	$150	**large-pan flood**	$3,000	$1,830 ($156/ac IC in 2012)	$1,170	$59 to $2,924	2.6%	1% or less
	28B2 3 ac	$120	**2-line drip** costing $1,000/ac (expensed at $100/ac per year, ANFC) with remote sensing (expensed at $17.25/ac per year)	$2,640	$1,943 ($266/ac IC in 2012)	$697	-$900 to $3,533	32.5%	7.1%
	28C 8 ac	$120	**micro-jet spray** costing $1,000/ac (expensed at $100/ac per year, ANFC)	$2,641	$1,926 ($266/ac IC in 2012)	$715	-$888 to $3,263	32.5%	7.1%

Crop	Site Data	Price per Ton	Irrigation Techniques	10-Year Average Cash Receipts per Acre	10-Year Average Cash Costs per Acre	10-Year Average NCFI per Acre	Possible Range of NCFI per Acre	10-Year Average Probability of Negative NCFI	10-Year Average Probability of Carry-Over Debt
Valencia oranges	1B 15 ac	$140	**narrow border flood**	$2,100	$1,890 ($220/ac IC in 2012)	$210	-$733 to $1,200	25.2%	4.8%
	28A 8 ac	$175	**micro-jet spray** costing $2,000/ac (expensed at $100/ac per year, ANFC) with remote sensing (expensed at $17.25/ac per year)	$2,588	$1,820 ($263/ac IC in 2012)	$768	-$425 to $2,750	33%	9.2%
Marrs oranges	28B1 5 ac	$140	**2-line drip system** costing $1,000/ac (expensed at $100/ac per year, ANFC)	$2,036	$2,376 ($263/ac IC in 2012)	$650	-$680 to $2,720	41.6%	13.4%
	28D2 3.5 ac	$140	**2-line drip system** costing $1,000/ac (expensed at $100/ac per year, ANFC)	$2,377/ac	$1,726 ($263/ac IC in 2012)	$651	-$686 to $2,714	41.6%	13.4%
Navel oranges	28D1 3.5 ac	$120	**2-line drip system** costing $1,000/ac (expensed at $100/ac per year, ANFC)	$1,800	$1,777 ($263/ac IC in 2012)	$23	-$1,343 to $2,343	47.9%	24.3%
Onions	1F 30 ac		**furrow irrigation**	$2,000	$1,480 ($213/ac IC in 2012)	$520	-$67 to $1,000	1% or less	1% or less
Sugarcane (first-year production)	44A 30.36 ac	$25	**Surge with poly-pipe** $2,000 cost of surge valve (expensed evenly at $200/year, ANFC)	$1,020	$740 ($106.47/ac IC in 2012)	$590	-$418 to $107	1% or less	1% or less

Appendix A: Professional Papers & Presentations Pertaining to Texas Project for Ag Water Efficiency

Part 1. Submitted By Dr. Shad Nelson

A. 2012-13 REFEREED PUBLICATIONS

Journal Publications (Peer Reviewed)

Nelson, S.D., M. Young, R. Hanagriff, and S. Klose. Mar. 2012. An evaluation of flood irrigation and compost use in South Texas Rio Red grapefruit production: Are there economic values? *The Journal of American Academy of Business, Cambridge*. 17(2):23-29.

B. MANUSCRIPTS IN PROGRESS

Nelson, S.D., J.M. Enciso, H. Perea, M. Setamou, M. Young, and C. Williams. Alternative flood irrigation strategies that improve water conservation in citrus production. (In Review by Coauthors).

Enciso, J., H. Perea, J. Jifon, S. Nelson, and C. Fernandez. Performance of tensiometer and WaterMark sensors on light, medium, and heavy irrigated fields. (In Revision).

C. 2012 PUBLISHED NEWSLETTERS

Texas A&M University Kingsville Citrus Center Newsletter, http://kcc-weslaco.tamu.edu

Nov 2012 — Water Savings in Citrus Production for 2011 On-Farm Water Conservation Demonstration Sites. S.D. Nelson. Fall 2012. Vol. 30. No.2. Pgs 1-2. http://kcc-weslaco.tamu.edu/files/newsletter/2012/Fall_2012_Vol_30_No_2.pdf

D. 2012-13 PRESENTATIONS BY S.D. NELSON

Feb 2013	73nd Annual Meeting of the Southern Region American Society for Horticultural Science, Orlando, FL. S.D. Nelson, J. Enciso, H. Perea, L. Beniken, M. Setamou, M. Young, and C.F. Williams. Alternative flood irrigation strategies that improve water conservation in citrus production. Feb. 2-5, 2013.
Jan 2013	On-Farm Irrigation Advances for Producers. Tools, Techniques & Technology for Producers 2013 Workshop Series. S.D. Nelson. Soil water sensors and irrigation scheduling. Harlingen, TX. Jan. 24, 2013. (Invited)
Apr 2012	Horticulture Dept. Graduate Seminar, College Station, TX. (Invited). S.D. Nelson. Irrigation and Nutrient Management Strategies for Preserving Citrus in the LRGV.
Jan 2012	Soil & Crop Dept. Graduate Seminar, College Station, TX. (Invited). S.D. Nelson. Soil and Water Management Strategies in Citrus Production.
Jan 2012	2012 W-2082 Annual Meeting, Weslaco, TX. S.D. Nelson. Irrigation Management Impacts on Agricultural Chemical Movements in Soil.

E. 2012-13 PROFESSIONAL MEETING PRESENTATIONS (PUBLISHED ABSTRACTS)

73nd Annual Meeting of the Southern Region American Society for Horticultural Science, Orlando, FL. Feb. 2-5, 2013. S.D. Nelson, J. Enciso, H. Perea, L. Beniken, M. Setamou, M. Young, and C.F. Williams. Alternative flood irrigation strategies that improve water conservation in citrus production.

Southern Agricultural Economics Association annual meeting. Feb 4-7, 2012. Birmingham, AL. M. Young, S.D. Nelson, S. Klose and J. Enciso. Assessing Irrigation Methods Based on Grapefruit Pack-Out in the Lower Rio Grande Valley.

Part 2. Submitted By Mac Young, FARM Assistance

In 2012, FARM Assistance presented, authored, or co-authored a peer-reviewed journal article, a presented paper, a newsletter, and a poster on results of Texas AWE demonstration analyses.

- Nelson, Shad, et al. Water Savings in Citrus Production for 2011 On-Farm Water Conservation Demonstration Sites. TAMUK Citrus Center Newsletter. Fall 2012, Vol.30, No.2, Pg. 1-2. http://kcc-weslaco.tamu.edu/files/newsletter/2012/Fall_2012_Vol_30_No_2.pdf
- Nelson, Shad, Esparza, M., Garza, D.E., Setamou, Mamoudou, and Young, Mac. *Supplemental Calcium Additions for Sustaining Citrus Production and Quality.* Selected Paper presented at American Society of Horticultural Science Annual Conference, Miami, FL, July 31-August 3, 2012.
- Nelson, Shad, Young, Mac, Hanagriff, Roger, and Klose, Steven. *An Evaluation of Flood Irrigation and Compost Use in South Texas Rio Red Grapefruit Production: Are There Economic Values?* The Journal of American Academy of Business, Cambridge, 17(2):23-29. March 2012.
- Young, Mac, Nelson, Shad, Klose, Steven, and Enciso, Juan. *Assessing Irrigation Methods Based on Grapefruit Pack-Out in the Lower Rio Grande Valley*. Poster presented at the Southern Agricultural Economics Association 2012 Annual Meeting, Birmingham, AL, Feb 5-8, 2012.

FARM Assistance staff participated in the videos on Texas AWE filmed and produced in 2012 and presented on “Economics and Water Management” at the Texas AWE workshop on “On-Farm Irrigation Advances for Producers” held January 24, 2013, at the Rio Grande Center for Ag Water Efficiency.

Appendix B: RGRWA WaterSMART Grant Application Executive Summary

RECLAMATION

Managing Water in the West

WaterSMART: Water and Energy Efficiency Grants for FY 2013

Funding Group 1

Rio Grande Regional Water Authority

Surge Valve Collaborative for On-Farm Water Conservation in the Lower Rio Grande Valley

Project Manager:

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January 17, 2013

RGRWA
RIO GRANDE REGIONAL WATER AUTHORITY

A. Executive Summary

This WaterSMART grant application is submitted 17 January 2013 by the Rio Grande Regional Water Authority (RGRWA), with offices at 301 W. Railroad, Weslaco, TX 78596, Hidalgo County, Texas. The RGRWA is a regional entity established under state law to supplement the services, regulatory powers, and authority of irrigation districts, water supply corporations, counties, municipalities, and other political subdivisions within its borders. Its permissible functions range from agricultural water conservation to desalination, and from municipal water supply to wastewater treatment.

The RGRWA proposes to use WaterSMART grant funds for a "Surge Valve Collaborative" aimed at promoting in its jurisdiction the use of highly efficient surge valves in irrigated agriculture by (1) training willing producers in proper use of the devices and (2) heavily subsidizing the cost. The project will leverage WaterSMART and RGRWA financial resources with cost-shares from cooperating producers and in-kind technical assistance from the Texas Project for Ag Water Efficiency. The principal goals of the Collaborative are to conserve and use water more efficiently and thereby prevent water-related crisis and/or conflict. A number of secondary benefits also will be achieved, including increasing the use of renewable energy, improving energy efficiency, providing additional instream flows to protect endangered and threatened species, and support regional water marketing. Collaborative activities will be initiated upon notice of award and completed by 31 December 2014.

Water savings will NOT be used to increase total irrigated acreage or to otherwise increase consumptive use of water in agricultural operations.

Here are details in summary:

The award-winning Texas Project for Ag Water Efficiency – an ongoing 10-year agricultural water conservation demonstration initiative in the Lower Rio Grande Valley funded by the Texas Water Development Board – has found that using surge valves in furrow irrigation (a common irrigation method in the region) realizes **proven water savings of 22 percent to 58 percent across a variety of crops: seed corn, cotton, and sugarcane.**

These impressive results were chronicled by four Texas AWE demonstrations involving three different cooperators:

Table Error! No text of specified style in document.-1. Texas Project for Ag Water Efficiency: On-Farm Demonstration Results for Surge vs. Furrow Irrigation

Crop (Date)	Volume of Water Used/Acre (in acre-inches)		Savings with Surge	Demonstration Report (all reports available at www.TexasAWE.org)
	Furrow	Surge		
Sugarcane (2005)	30.68	14.64	58%	Impact of Volumetric Water Pricing for Sugarcane Comparing Furrow vs. Surge Irrigation in the Lower Rio Grande Valley, FARM Assistance Focus 2006-4, Dec. 2006
Cotton (2005)	19.53	13.48	31%	Impact of Volumetric Water Pricing for Cotton Comparing Furrow vs. Surge Irrigation in the Lower Rio Grande Valley, FARM Assistance Focus 2006-3, Dec. 2006
Seed Corn (2007)	23.95	17.31	28%	Impact of Volumetric Water Pricing for Seed Corn Comparing Surge vs. Furrow Irrigation in the Lower Rio Grande Valley, FARM Assistance Focus 2007-7, Oct. 2007
Cotton (2010)	18	14	22%	Furrow vs. Surge Irrigation in Cotton Assuming Restricted Water Availability in the Lower Rio Grande Valley, FARM Assistance Focus 2011-2, March 2011

As part of the process that produced the 2011 Regional Water Plan, Texas Water Development Board economists calculated the acreage and water use of irrigated crops in the planning area. Some 27 percent of the total amount of water used for all irrigation is consumed by cotton and sugarcane, two crops where surge valves have produced demonstrated water savings. According to TWDB, 59,000 acres in the region are planted in cotton and 42,000 acres in sugarcane.

- In sugarcane, the Texas AWE studies referred to above found that surge valves produced 58 percent savings in water consumption. If all 42,000 acres of sugarcane fields in the region were irrigated using this method, water savings would amount to 82,360 AF/yr.
- In cotton, savings of 22 percent were realized in one study and 31 percent in the other. Using surge valves for all 59,000 irrigated acres of cotton would produce water savings in the range of 24,420 – 34,410 AF/yr.

For these two crops alone, then, surge valve technology could save about 107,000 to 117,000 AF/yr in the region, an amount equal to about 40 percent of current municipal demand.

However, a price tag of $1,800 to $2,000 per surge valve renders this equipment economically unfeasible for most producers, given the current low cost of water. As noted in the March 2011 FARM Assistance Focus 2011-2 report:

> *"Although surge offers the opportunity to conserve irrigation water in cotton and other field crops, the incentive for producers to switch to the new technology is minimal under current water delivery methods and water pricing levels. Demonstration results indicate that incentives to invest and adopt surge irrigation would begin with volumetric pricing and almost a doubling in water price . . . In drought or other high water demand situations where the availability of water is restricted or limited, economic forces will ration supplies through higher prices and water will likely be metered. Water use efficiency will then become more crucial in controlling water cost."*

The RGRWA Surge Valve Collaborative aims to jump-start the economic incentive to use surge technology by providing surge valves to up to 32 willing cooperating producers and training them in how to use the equipment for maximum irrigation efficiency.

We plan a series of three training sessions to ensure customized attention and ample opportunity for hands-on experience with the equipment prior to use. We also will take in-field measurements of water usage using available meters from area irrigation districts; perform detailed analyses of a 20 percent sample of cooperators; and collect follow-up data on field experience and common issues and problems.

Each participating producer will be eligible for two valves. This should allow irrigation of up to 100 acres at a time (depending on the infrastructure of irrigation district serving the producer). Each producer will pay an initial out-of-pocket fee of $350 per surge valve, with $50 per valve refunded for participation in a follow-up meeting. Two participants from each training group (a 20 percent sample) also will be selected for in-field follow-up evaluation by Texas A&M specialists.

All training and follow-up will be provided as an in-kind match by the Harlingen Irrigation District (which manages Texas AWE) and its partners in the project from Texas A&M and Agricultural Extension offices.

Public outreach on the Collaborative and support for the final report on the project will be tasked to WaterPR, another Texas AWE partner, as an additional in-kind match for the grant.

State of Texas funding for the Texas Project for Ag Water Efficiency ends December 31, 2014. All activities for the proposed Collaborative will be completed by that date. Because of the shortened timeframe, we request that certain planning activities required for the Collaborative be allowed in advance of the October 2013 funding date. The activities include planning for outreach and developing outreach materials development as well as soliciting firm cost proposals for the equipment. These advance efforts will permit the Collaborative to begin recruiting participants immediately upon funding.