DELIVERY OF FLOW AND SOIL WATER CONTENT MEASUREMENTS TO FARMERS FOR IMPROVED IRRIGATION WATER MANAGEMENT

FINAL REPORT

January 22, 2013

El Paso County Water Improvement District No. 1

1. Executive Summary and Background

On August 16, 2010 the Texas Water Development Board (TWDB) signed Contract No.1003581095 with El Paso Water Improvement District No. 1 (EPCWID) for an Agricultural Water Conservation Project titled "Irrigation Water Use Metering–Delivery of Flow and Soil Water Content Measurements to Farmers for Improved Irrigation Water Management" (the Project). The contract was amended October 4, 2011 extending the Project completion date to November 30, 2012. According to the Project proposal the project consists of installation and monitoring of measurement systems for five farmers within EPCWID. The main components of the measurement systems are as follows:

- Task 1: Turnout Flow Meters
- Task 2: Soil Moisture Measurement
- Task 3 Telemetry and Internet Programming
- Task 4 Training and Field Days

A Subcontract Agreement between EPCWID1 and AW Blair Engineering was approved by TWDB on October 12, 2011.

EPCWID primary water supply is from upper Rio Grande and is stored in the Elephant Butte reservoir in New Mexico. The water levels in Elephant Butte have been at record low levels since 2010 and it appears that 2013 may be the lowest levels in over 50 years.

EPCWID has been operating under an extreme drought and reduced allocations since 2010. The drought has caused much of the irrigated land to be fallowed for lack of irrigation water. Furthermore, because of the shortage of water, EPCWID only has water in their canals during limited time periods. Selection of flow meter sites for the demonstration project was complicated by these two drought-related impacts. Full use of the installed flow meter is not anticipated until after the drought is over.

2. Estimate of Amount of Water Conserved

Flow meters are management tools that allow a more accurate estimate of the amount of water delivered to an irrigated field. It is difficult or in many case impossible to analytically determine water saving by comparing the amount of water used prior to the meter installation with water used after installation. This is because the crop, field, climate, water supply, economics and other conditions are changes from one year to the next making direct comparison unapproriate. Because of the drought, most if not all farmers in EPCWID are deficit irrigating their crops. Comparison of post meter installation water use with water use in prior years would show a significant decrease, but due to drought not metering. Any estimates of water conservation impact will need to be made after one or two years of normal water allocations.

3. Work Tasks

3.1. Task 1: Turnout Flow Meters

3.1.1. Measurement Site Design

After performing a preliminary survey at the proposed turnout location at the Guadalupe 1.81L site, it was determined that the site has insufficient the depth of cover at the transducer position. Consequently, other proposed sites (See Progress Report for October, 2010-April 2011, Figure 1) were evaluated and the site at Franklin Canal 26.98R was found to be suitable for the initial installation. Engineering drawings for the turnout design and placement on site are included in Appendix A of this report.

A custom-designed meter vault was also installed at the site. See Figure 1 below.

Figure 1. Custom meter vault.

3.1.2. Measurement Site Construction

Hawk Construction completed the fabrication of the five headwalls for the 24" turnout sites. An 18" section of 24" PIP was cast into each headwall. Five additional 20' joints of PIP were purchased for installation at the sites. Figure 2 shows the construction of the headwalls.

Figure 2. Construction of 24" Headwalls

The first headwall with 24" sluice gate was installed on September 8, 2011 at Bills Farm at the Franklin 26.98R location shown in Figure 3.

Figure 3. Installation of 24" Headwall at 26.98R Franklin Canal

3.1.3. Installation of Flow Rate Transducers

Figure 4 below shows the typical installation of the Siemen's ultrasonic flow meter transducers.

Figure 4. Installation of ultrasonic transducer at Bills Farm

3.1.4. Five Meter Sites

Meters, soil moisture sensors, and low cost telemetry units were installed at the following five metering sites:

Ysla Lateral (Surratt)

Guadalupe Lateral (Schuster)

Franklin Canal (Bills)

Franklin Canal (Rogers)

Salitral Lateral (Skov)

3.2. Task 2 – Soil Moisture Sensors

Soil moisture sensors were purchased for all five sites and installed at the three sites with orchard crops (pecans). The remaining two sites have row crops and the sensor cannot be installed until after the land is prepared for irrigation in 2013. Aquaspy sensors were installed in the three orchard crops, and Echo sensors were purchased for the row crops.

Soil Moisture Sensors – Echo (upper device) and Aquaspy (lower device)

3.3. Task 3: Low-Cost RF Telemetry and Internet Programming

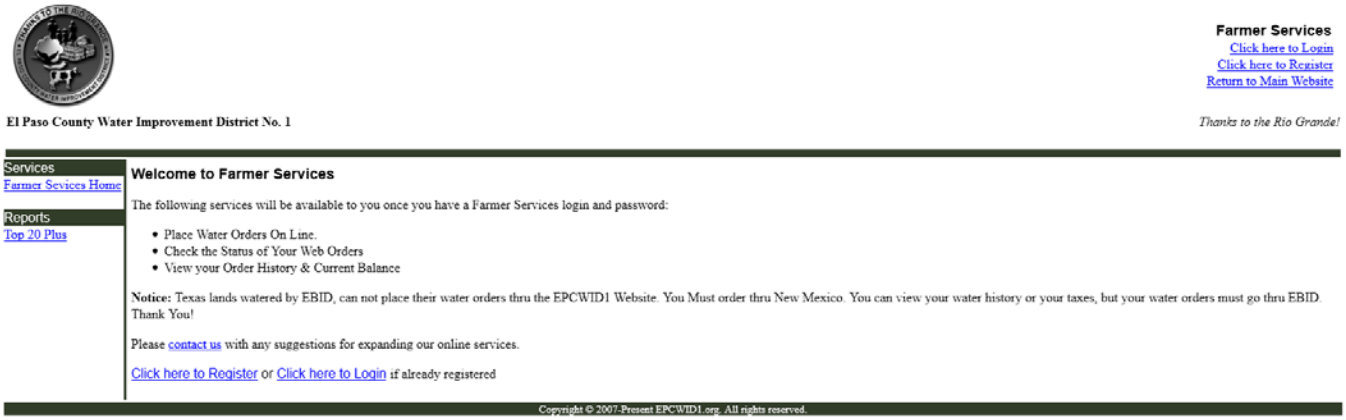
3.3.1. Telemetry Units

Telemetry units (radio, RTU, solar regulator, and battery) and Siemen Ultrasonic Flow Meter heads were installed in all five sites and field tested.

Telemetry Unit (left) and Flow Meter (right) Inside Vandal Box

3.3.2. Internet Programming

EPCWID developed an IIS server system for displaying real-time data for use by farmers (www.fs.epcwid1.org). This sever is linked to the district telemetry server for display of real time flow and soil moisture data. Because of the drought and delays in getting the flow meter installed, the 2012 irrigation system had come to an end prior to the system being fully operational. No data was logged on the telemetry system during 2012. Testing was performed using software developed by Harlingen Irrigation District which was incorporated into the EPCWID system.



EPCWID's Farm Services Internet Page

3.4. Task 4: Training and Field Days

Field days for local farmers were conducted on August 9 and September 13, 2012. Between 10 to 15 people attend each field day. The Field Day included training session for District Staff as to the operation and maintenance of the On-Farm meters. A copy of the power point presentation prepared for the field days is included in Appendix B.

Class Room Portion of Field Day August 9, 2012

On-Site Portion of Field Day September 13, 2012

APPENDIX A

Engineering Drawings

Appendix removed.

Contact publicinfo@twdb.texas.gov to request these items

APPENDIX B

Field Day Presentation

On Farm Flow Measurement

Accurate Flow Measurement

Streamlined Installation

Minimize Erosion

Low Maintenance

Canal Water Level

Soil Moisture

Real Time Access

Allocation Charges

Components

Pre-cast Turnout

24” x 20’ Section of PIP

Custom PIP Adapter

24” Turnout Valve

Flow Meter - Siemen Ultrasonic Travel Time

Low Cost Radio and Remote Telemetry Unit (Computer)

Soil Moisture Sensor (Digital)

Water Level Sensor

Vandal Protection

Solar Panel and Regulator

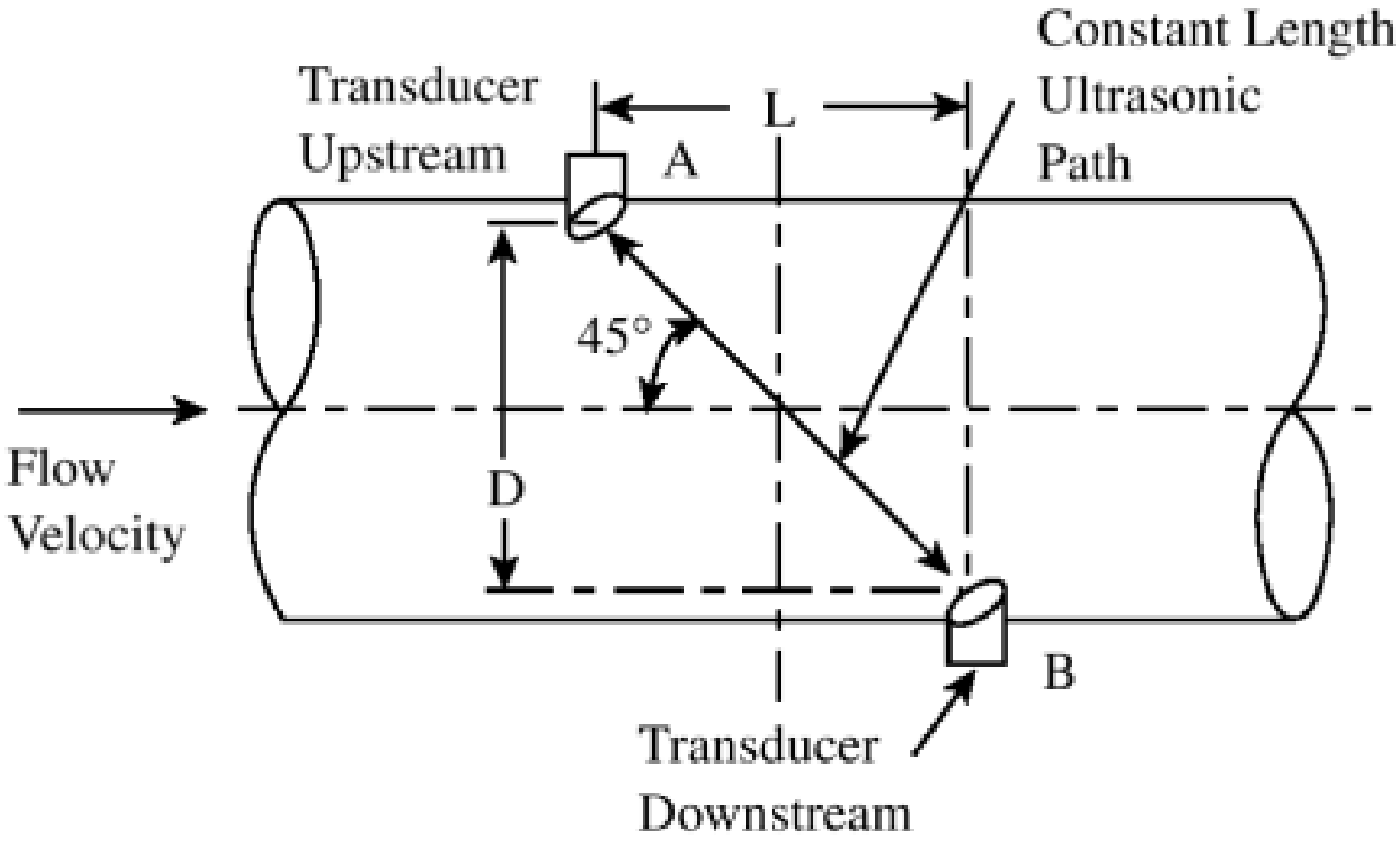
Battery

High Gain Antenna and Antenna Mast

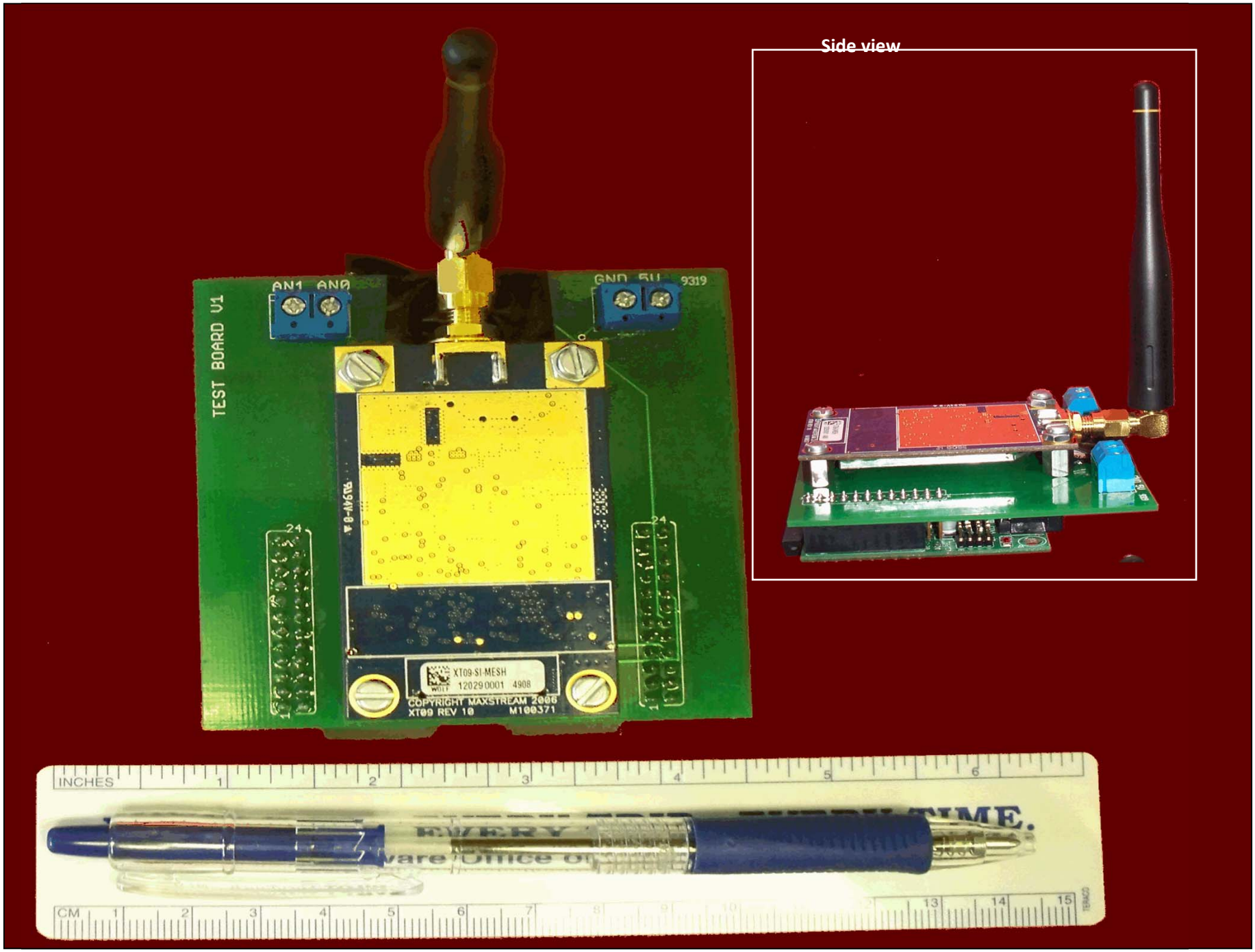

DEERE
2011/09/08


PC·11
Marine Grade
WATERPROOF
HIGH STRENGTH
WHITE
EPOXY
PASTE
SIMPLE 1:1 MIX
PC·11B
Permanent Repairs
BOND-SEAL-FILL
Metals · Fiberglass · PVC · Tile · Pools
Boats · Porcelain · Masonry, and more
NO SAG · NO DRIP · NO SHRINK
A+B = 1/2lb. (227g)
11/4"X3/4" BUSHING
CHINA
STAEDTLER-MARS
987 18-34
ENGINEER
GERMANY
04/01/2011


2011/09/08


Constant Length
Ultrasonic
Path
Transducer
Upstream
L
A
45°
D
Flow
Velocity
B
Transducer
Downstream

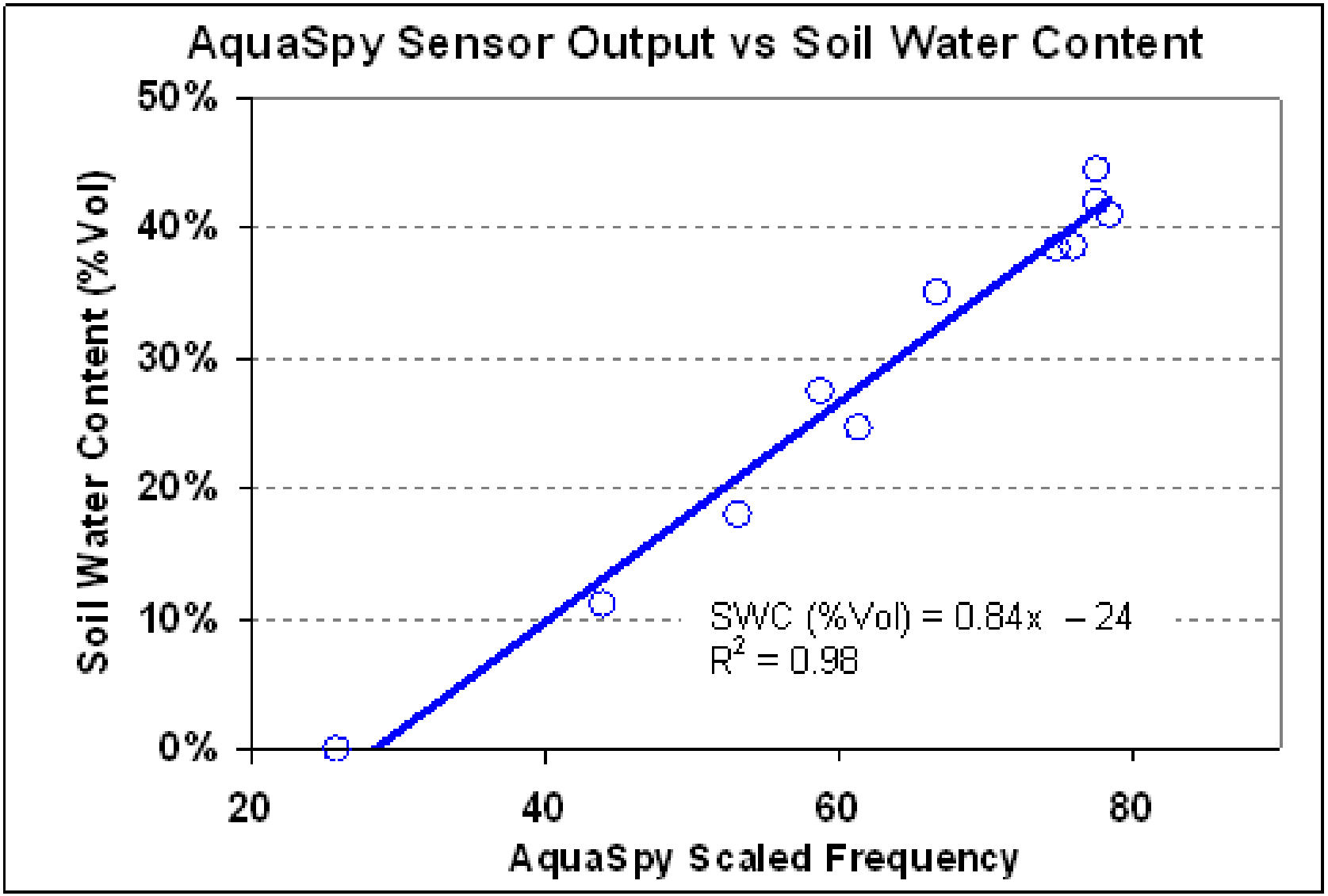

SIEMENS
AcFt
CFS
SIEMENS
SITRANS FLOW ULTRASONIC
Siemens Flow 08SL2401 03-06-05
Induktion uH
25.41
04/01/201

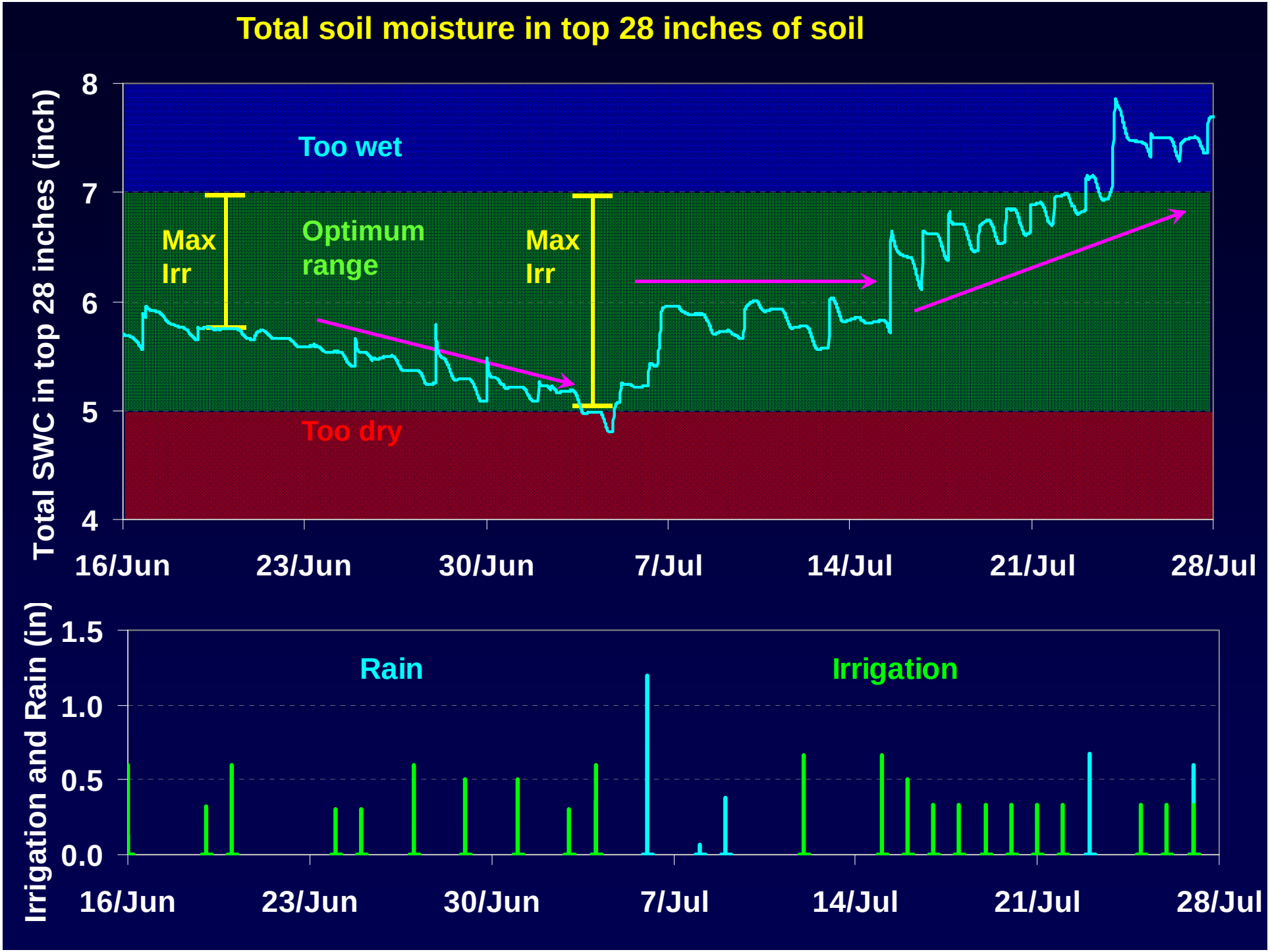

TEST BOARD V1
AN1 AN0
GND 5V
9319
XT09-SI-MESH
120290001 4908
COPYRIGHT MAXSTREAM 2006
XT09 REV 10 M100371
Side view
INCHES
CM


POWERSONIC


SIEMENS
SIEMENS
SITRANS FLOW ULTRASONIC
24in PVC (Solid) BOP/P


10HS


AquaSpy Sensor Output vs Soil Water Content
Soil Water Content (%Vol)
50%
40%
30%
20%
10%
0%
20
40
60
80
AquaSpy Scaled Frequency
SWC (%Vol) = 0.84x – 24
R2 = 0.98


Total soil moisture in top 28 inches of soil
Total SWC in top 28 inches (inch)
8
7
6
5
4
Too wet
Max Irr
Optimum range
Max Irr
Too dry
16/Jun
23/Jun
30/Jun
7/Jul
14/Jul
21/Jul
28/Jul
Irrigation and Rain (in)
1.5
1.0
0.5
0.0
Rain
Irrigation
16/Jun
23/Jun
30/Jun
7/Jul
14/Jul
21/Jul
28/Jul

COST

Turnout and Gate	$3,500
PIP	$800
Flow Meter	$2,500
Radio/RTU/Solar/Battery	$1,200
Soil Moisture Sensor	$200
Water Level Sensor	$100
Misc.	$200
	$8,500

Installation, Programming, Support ?

Demonstration Program

- Franklin 26.98 R– Bills
- Guadalupe 1.81 – Schuster
- Ysla 6.40 – Surratt / Strachan
- Salitral 2.08 – Bonito Farms
- Franklin 23.49 - Rogers