PROGRESS IN DEVELOPING A WEB-BASED MANAGEMENT SYSTEM FOR IRRIGATION DISTRICTS

USCID Water Management Conference

Irrigated Agriculture Responds to Water Use Challenges —
Strategies for Success

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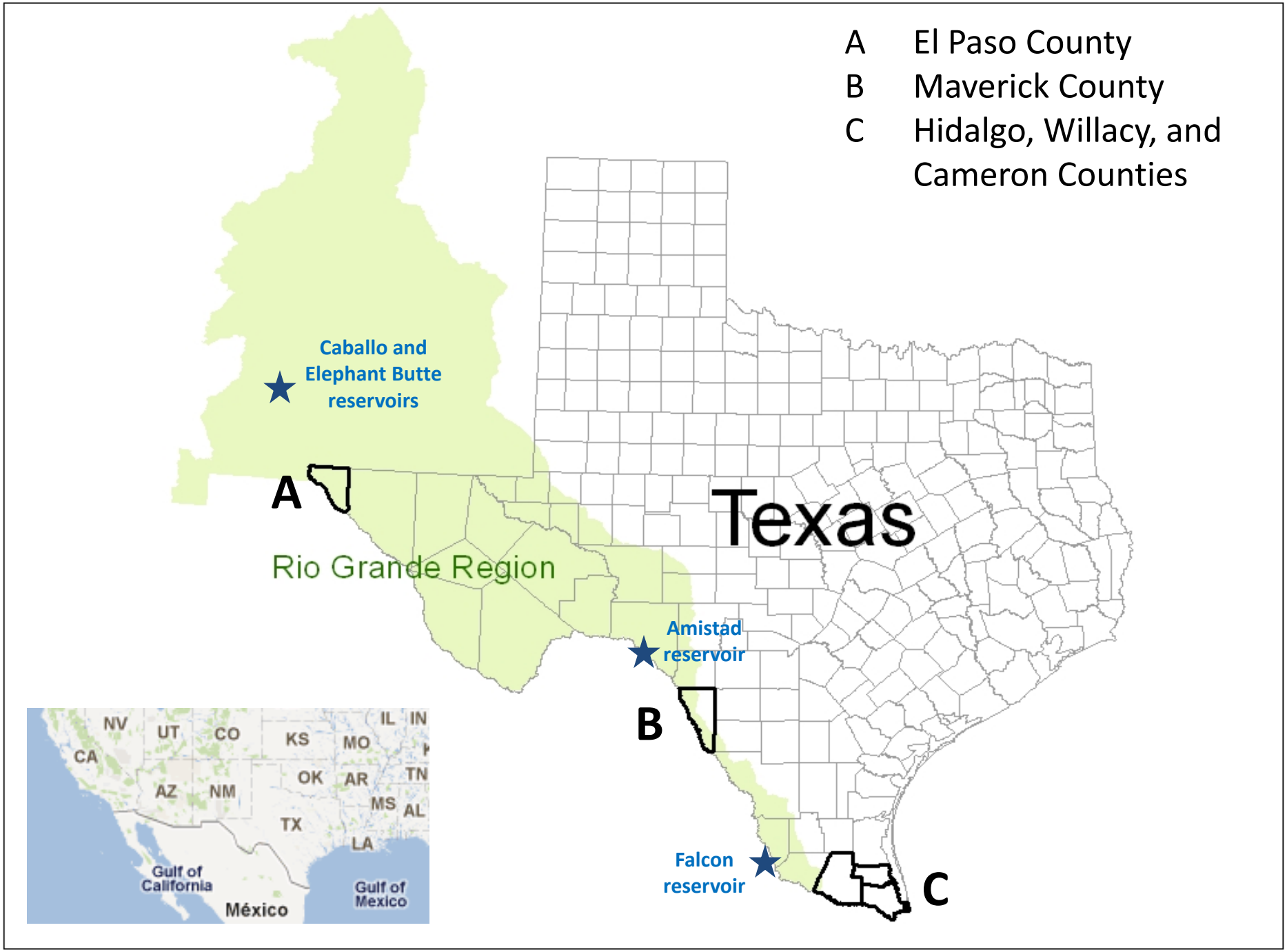
A El Paso County
B Maverick County
C Hidalgo, Willacy, and Cameron Counties
Caballo and Elephant Butte reservoirs
A
Texas
Rio Grande Region
Amistad reservoir
B
Falcon reservoir
C
NV
UT
CO
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CA
OK
AR
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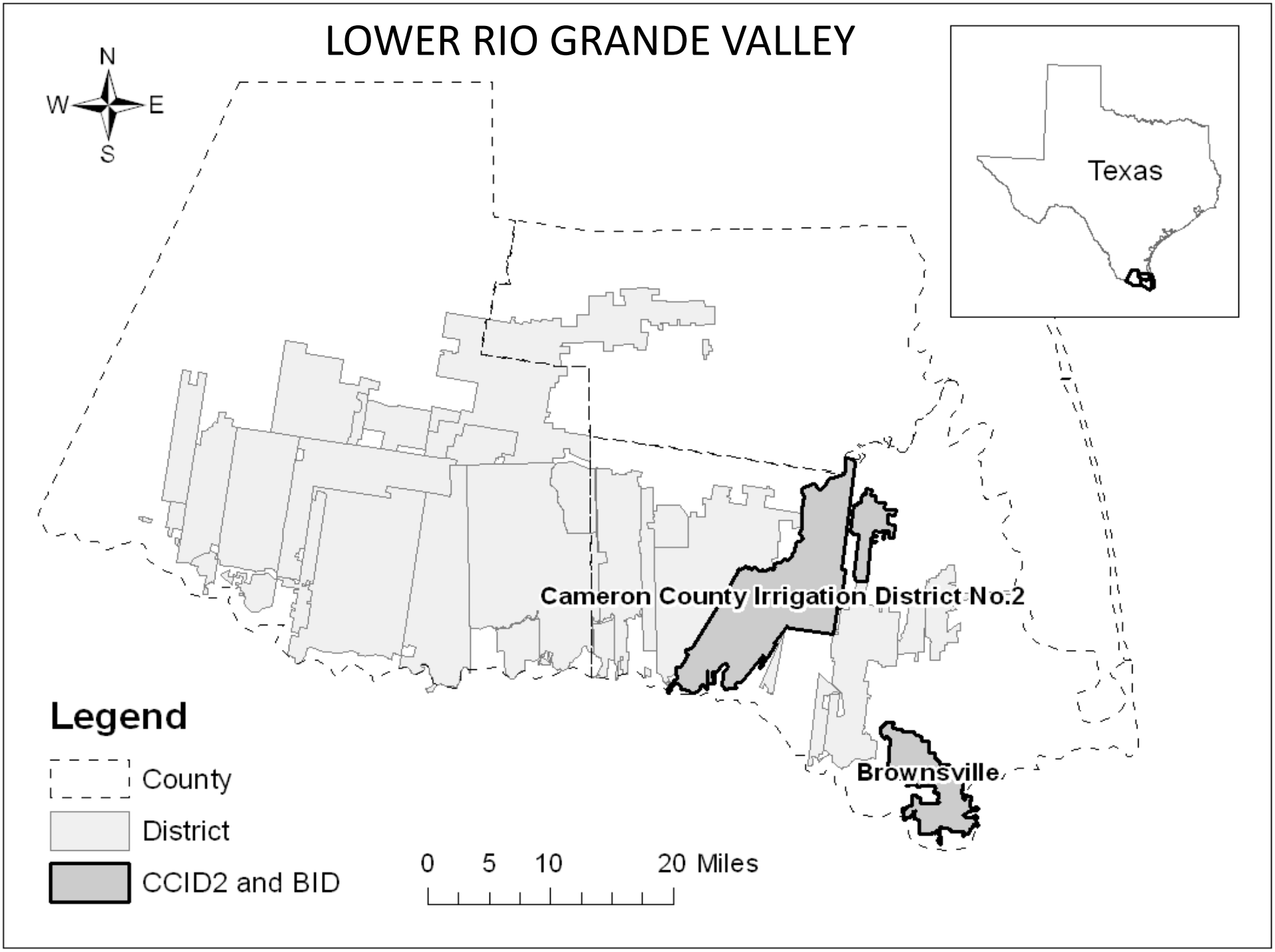
LA
Gulf of California
Gulf of Mexico
México


LOWER RIO GRANDE VALLEY
N
W
E
S
Texas
Cameron County Irrigation District No.2
Brownsville
Legend
County
District
CCID2 and BID
0
5
10
20 Miles

INTRODUCTION

- Irrigation districts in Texas are aware that more is to be done in terms of efficiency and data management, and that GIS can be a useful tool
- SCADA systems and online information are more being used and linked to GIS
- The integration of these tools, though, is hardly achieved
- Security is an issue when sensitive data are to be displayed online

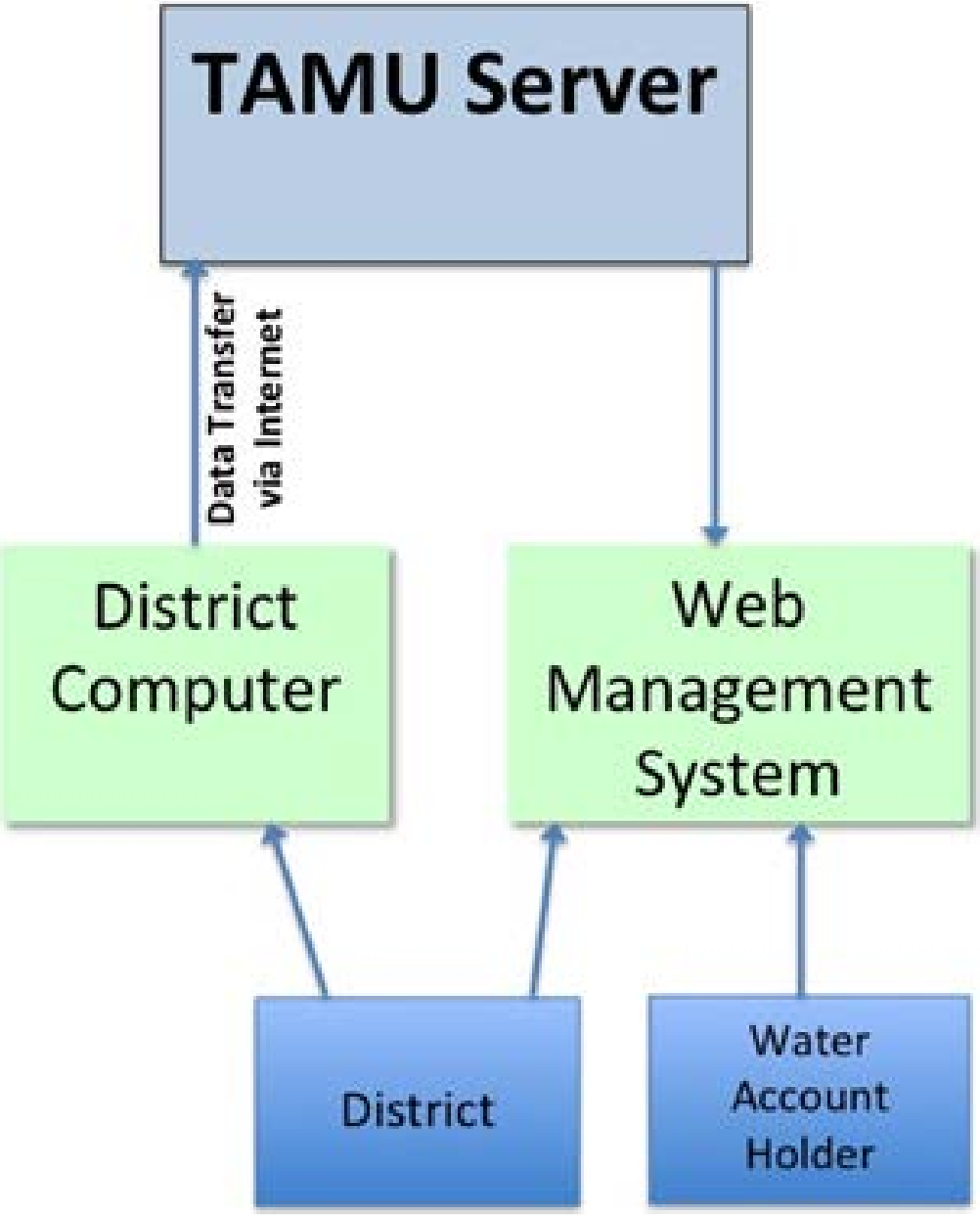
INTRODUCTION

- We selected irrigation districts with detailed information on water accounts and flows in the canals, with the general objective to improve the efficiency of daily water management
- Two districts that begun in 2009 and 2010. GIS was linked to daily water accounting information and to real time water flow monitoring, and posted in the district website
- Objective of identifying problems and recommendations, proposing changes, and evaluating the effects of adopted changes

FEATURES

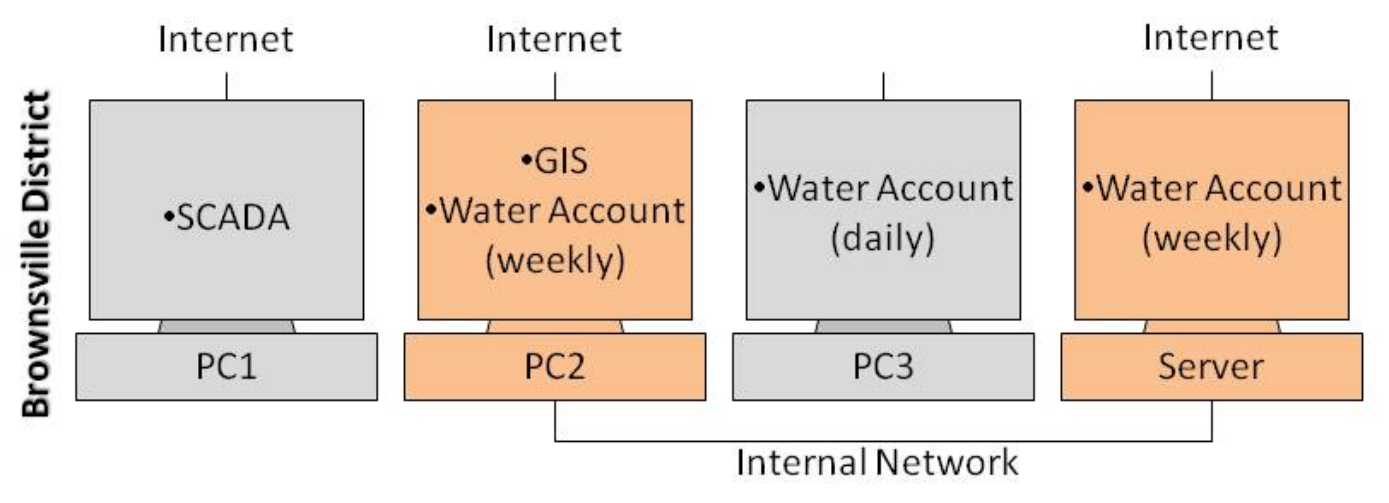
Improved and simplified management of databases

Problems	Recommended changes
Data are in standalone machines	Connect machines to the network
Water account	
Format is encrypted Infrequent update Irrigated fields ID are missing Crop information is missing	Use standard format Update daily Add irrigated fields ID Add crop information
SCADA	
Data are hidden	Use standard format
GIS	
Is not properly drawn Is not up to date Irrigated fields are missing	Correct data Update at least yearly Add irrigated fields

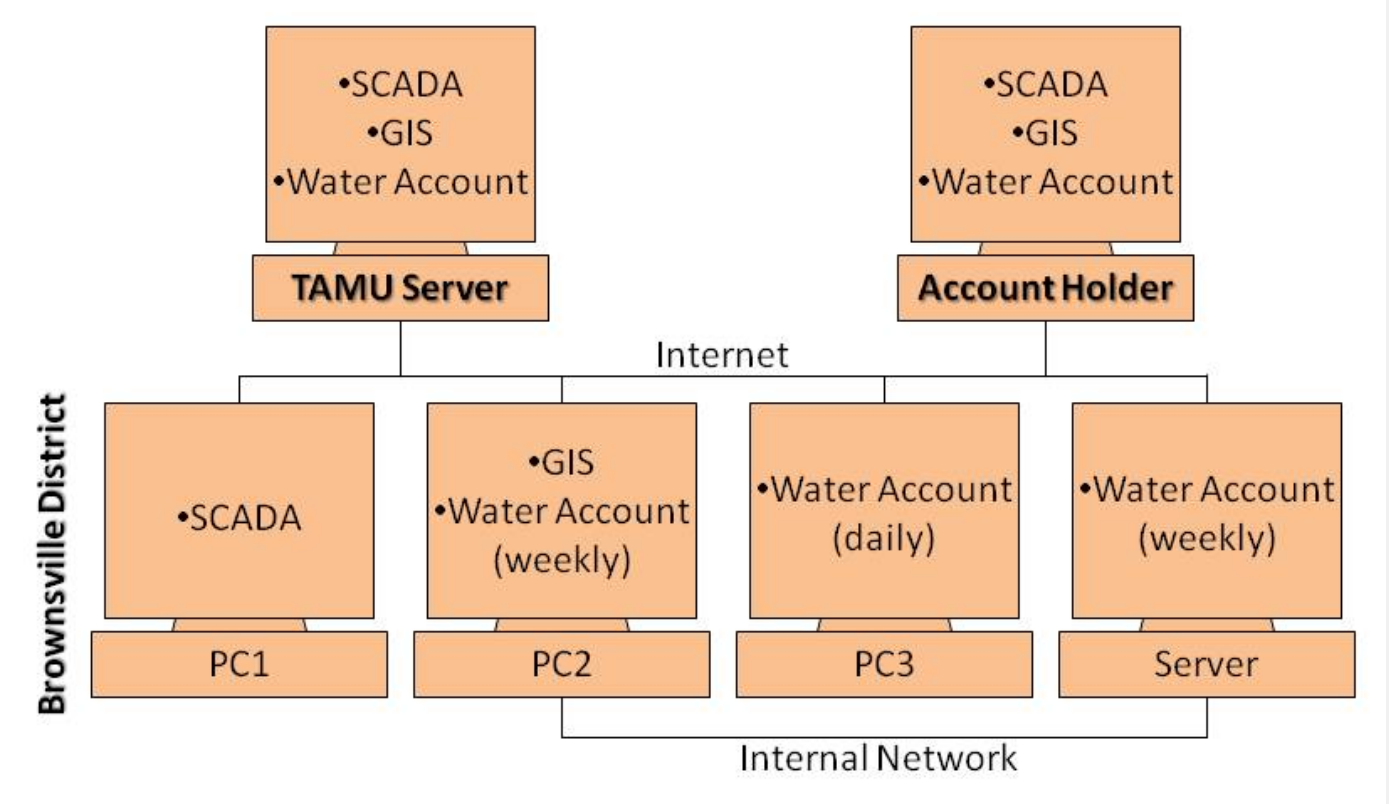

TAMU Server
Data Transfer via Internet
District Computer
Web Management System
District
Water Account Holder

BID Example

BEFORE:



AFTER:



Establishing Data Transfer to TAMU server

1. Automatic extraction of data from existing District database
   - SCADA (polled every 15 minutes)
   - Water accounts (polled once a day)
2. Transfer of data to TAMU server via the Internet
3. Partition of data into a SQL Server database

Example of data to be included:

- SCADA
  - Pumps status
  - Water levels
  - Gate position
  - Current and cumulative flow
  - Alarms based on water levels
- Water account
  - Water sales
- GIS
  - Water accounts shape

Web-based tools for use of data through the Internet

Example 1

- **Query and download real time and historical SCADA data as spreadsheet and charts**

Cameron County Irrigation District No.2

CCID2

1301 F.M. 510 SAN BENITO, TEXAS 78586 956/ 399-2484

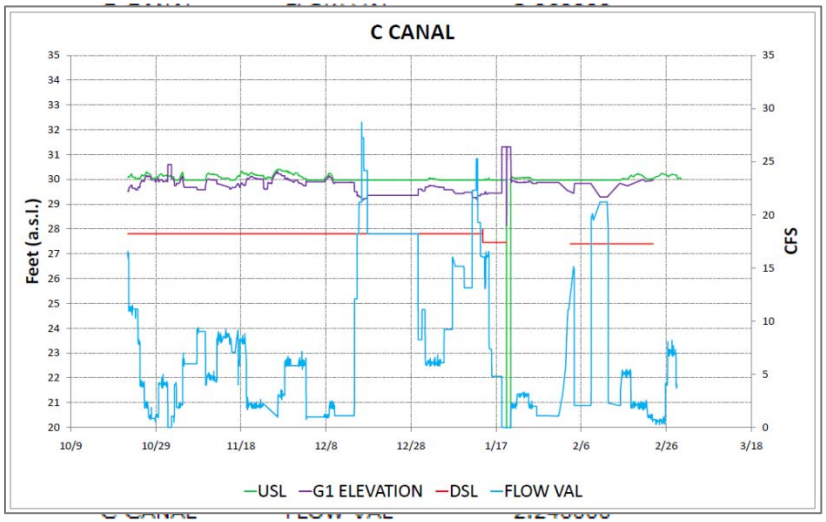
March 15, 2011

Office Hours
Mon-Thur: 7:00-5:30
Fri: 8:00-5:00

Previous Day Summary
2 (# of days)
Specify Dates (enter data below)
Start Date (mm/dd/yyyy)
Stop Date (mm/dd/yyyy)

Query Data

Date	Canal	Data Type	Value
03/15/2011 10:03:49 AM	C CANAL	FLOW VAL	2.861000
03/15/2011 9:52:49 AM	C CANAL	FLOW VAL	3.085000
03/15/2011 9:19:08 AM	C CANAL	FLOW VAL	2.846000
03/14/2011 9:23:41 PM	C CANAL	FLOW VAL	3.088000
03/14/2011 8:26:35 PM	C CANAL	FLOW VAL	3.090000
03/14/2011 6:55:50 PM	C CANAL	FLOW VAL	2.885000
03/14/2011 6:35:55 PM	C CANAL	FLOW VAL	3.303000
03/14/2011 5:43:06 PM			
03/14/2011 5:28:34 PM			
03/14/2011 4:58:33 PM			
03/14/2011 2:52:51 PM			
03/14/2011 12:49:00 PM			
03/14/2011 10:46:17 AM			
03/14/2011 9:52:57 AM			
03/14/2011 9:34:22 AM			
03/14/2011 9:13:04 AM			
03/14/2011 8:50:53 AM			
03/14/2011 8:31:28 AM			
03/14/2011 6:30:26 AM			
03/14/2011 6:18:48 AM			
03/14/2011 12:52:22 AM			
03/13/2011 11:50:17 PM			
03/13/2011 11:32:57 PM			
03/13/2011 6:24:28 PM			
03/13/2011 6:05:24 PM			
03/13/2011 4:15:16 PM			
03/13/2011 3:43:35 PM			
03/13/2011 3:20:14 PM			
03/13/2011 2:38:43 PM	C CANAL	FLOW VAL	2.023000
03/13/2011 2:22:53 PM	C CANAL	FLOW VAL	2.896000



Example 2

- **Current flows are shown, critical water levels are highlighted in yellow and red**

District Web Page

River Pump chart | Rubicon gate chart | Historic data | Scheduling Tool

Owner | Account | PID | Pending Orders | Gates | Pump | Command Area | Canal | Pipe | Print

1:10,000

Results

Canal C

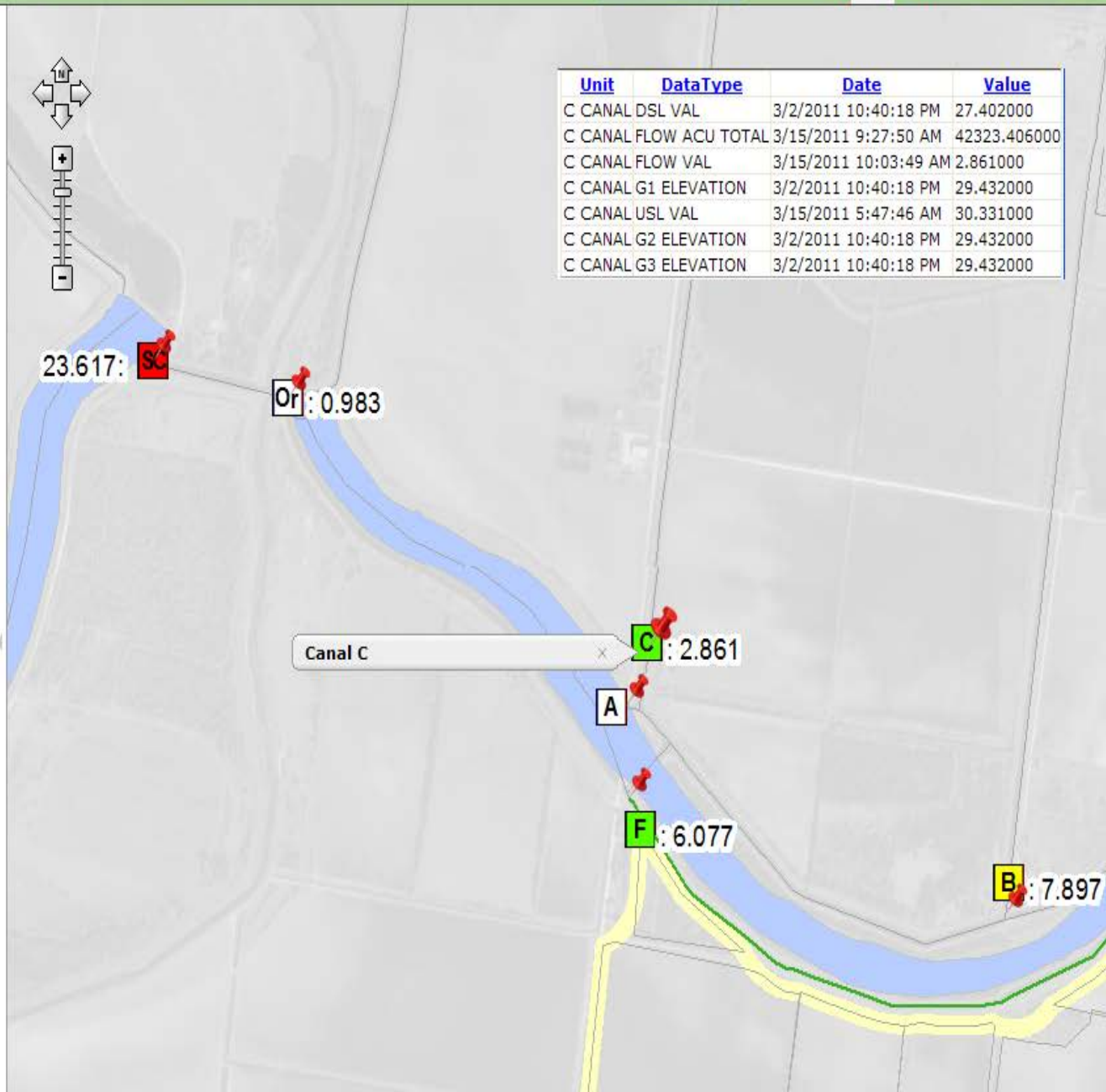
http://watergis.tamu.edu/other linked documents/C_Canal_chart.pdf

OBJECTID	4
Id	0
Location	Canal C
Max_CFS	0
NumofGates	3
ID_Join	2
Gates.ID_join_dbo	C CANAL
Unit_short	C
Hyp_doc	
Hyp_pic	

Map Contents

- Flow and Account
  - Flow
    - Rubicon gates
      - Gates IN (label)
      - Gates IN
        - No Flow
        - LOW
        - OK
        - HIGH

Unit	DataType	Date	Value
C CANAL	DSL VAL	3/2/2011 10:40:18 PM	27.402000
C CANAL	FLOW ACU TOTAL	3/15/2011 9:27:50 AM	42323.406000
C CANAL	FLOW VAL	3/15/2011 10:03:49 AM	2.861000
C CANAL	G1 ELEVATION	3/2/2011 10:40:18 PM	29.432000
C CANAL	USL VAL	3/15/2011 5:47:46 AM	30.331000
C CANAL	G2 ELEVATION	3/2/2011 10:40:18 PM	29.432000
C CANAL	G3 ELEVATION	3/2/2011 10:40:18 PM	29.432000



Example 3

- **Display water account information such as field ID, owner, grower, pending orders**

District Web Page

River Pump chart | Rubicon gate chart | Historic data | Scheduling Tool

Owner | Account | PID | Pending Orders | Gates | Pump | Command Area | Canal | Pipe | Print

1:10,000

Results

- Account (16)
  - Accounts (16)
    - 1045-13
    - 1045-6
    - 1045-3
    - 1045-1
    - 1045-5
    - 1045-2
    - 1045-9
    - 1045-16
    - 1045-8
    - 1045-7
    - 1045-11
    - 1045-10
    - 1045-14
    - 1045-15
    - 1045-12
    - 1045

PID

PID

24042
0
1000-1
10005-1
10010-1
10010-2
10010-3
10020-1
10020-2
10020-3
10020-4
10060-3
10080-1
1010-1
10144-1
10180-1
10193-1
10193-2
10193-3
10193-4
10193-5
10215-1
10215-10
10215-2
10215-3
10215-4
10215-5
10215-6
10215-7

Map Contents

- Flow and Account
  - Flow
  - Accounts
    - Pending Orders
      - Orders IN

Alfalfa
Citrus
Corn
Cotton
Garden
Grain
Hay
Land
Onions
Other
Pasture
Pond
S/Beans
S/Cane
S/F
Trees
Veg
grass
guayaba

1045-13

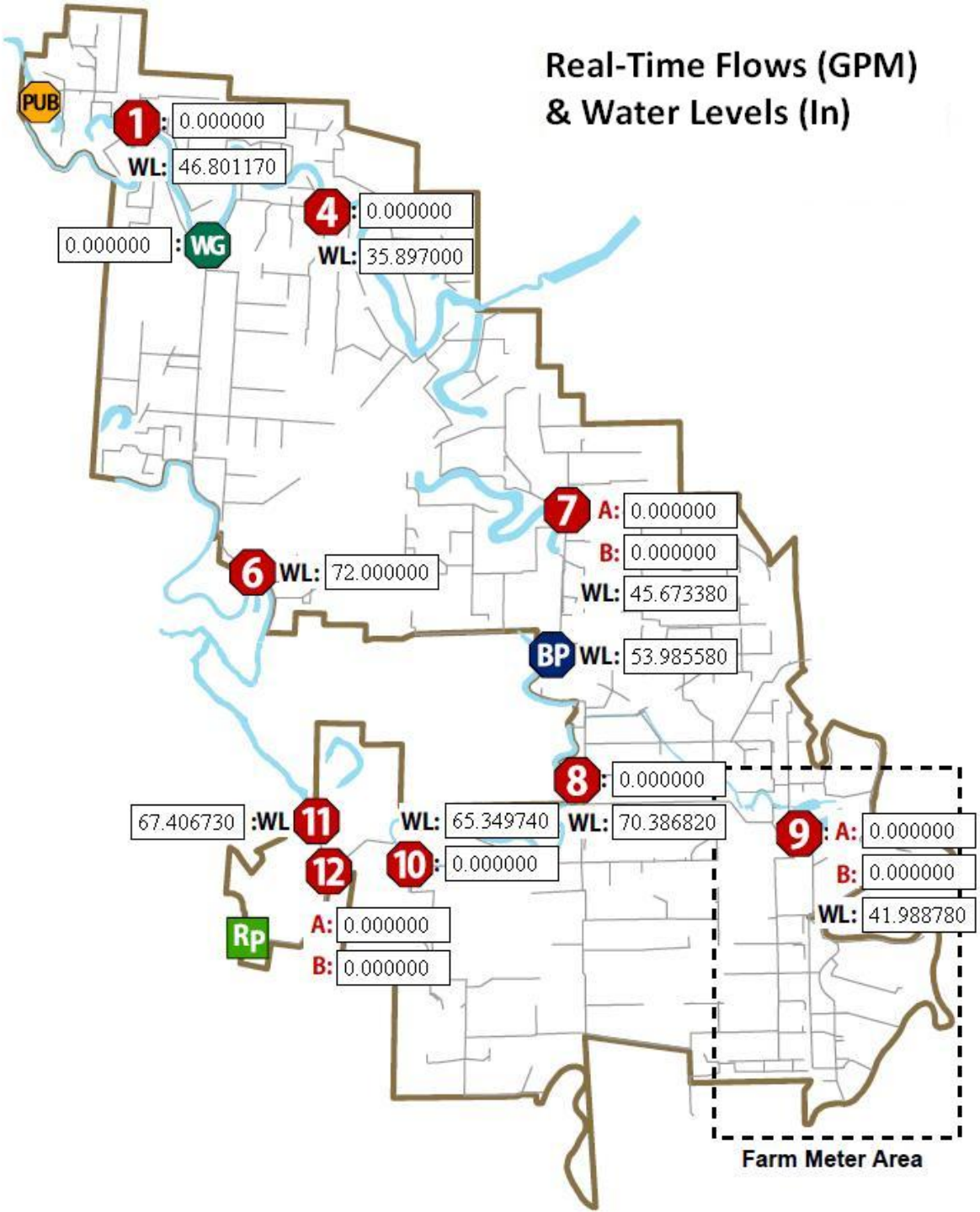
PID3	1045-13
TICKETNO	20447
TKTDATE	03/25/2010 00:00:00
DATEWANTED	03/25/2010 00:00:00
TAKENBY	LUCIA
OWNER	BALLENGER, JOE

0 168 336 672 1008 1344 Feet

Maps for display and use of data - Examples

Example 1

- **Status map set up to show the most relevant information in real time, such as water flow, water levels, alarms**


Real-Time Flows (GPM)
& Water Levels (In)
PUB
1 : 0.000000
WL: 46.801170
4 : 0.000000
WL: 35.897000
0.000000 : WG
7 A: 0.000000
B: 0.000000
WL: 45.673380
6 WL: 72.000000
BP WL: 53.985580
8 : 0.000000
WL: 70.386820
67.406730 :WL 11
WL: 65.349740
12
10 : 0.000000
9 : A: 0.000000
B: 0.000000
WL: 41.988780
Rp
A: 0.000000
B: 0.000000
Farm Meter Area

Example 2

- District personnel can access data by means of a password protected interactive map, on which real time and historical data can be queried and displayed

District Web Page

Unit 1 | 2 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | Historical Data

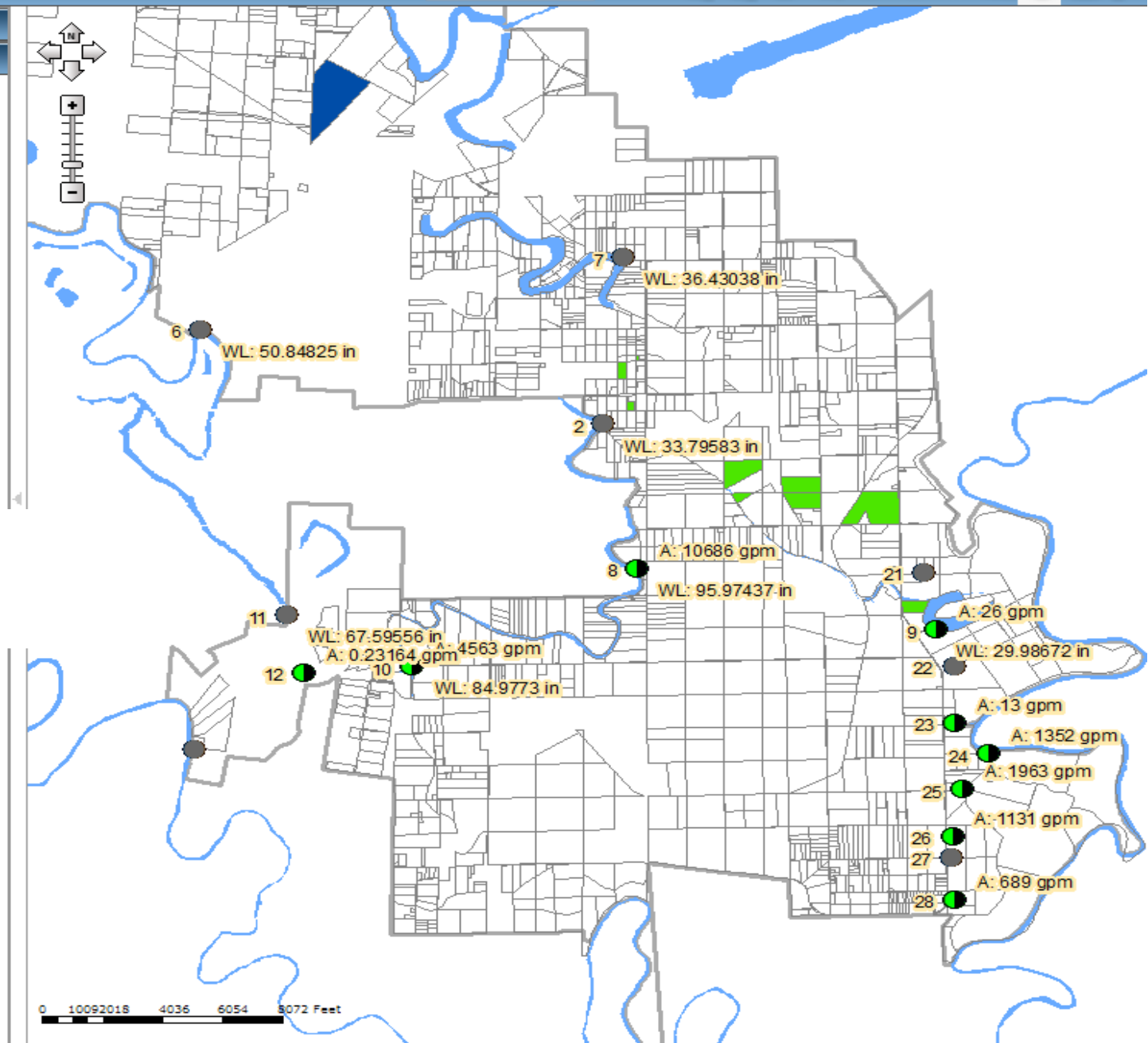
Account | Owner | Grower | Unit | Print

1:60,000

Results

Map Contents

- Pumps
  - Flow meter A (ON)
  - Flow meter B (ON)
  - Water Level
  - Units
  - Meters
- Accounts
  - Pending Orders
  - All accounts
  - Urbanization
- Background
  - Network
  - Water Bodies
  - Boundaries
  - aerial 2001

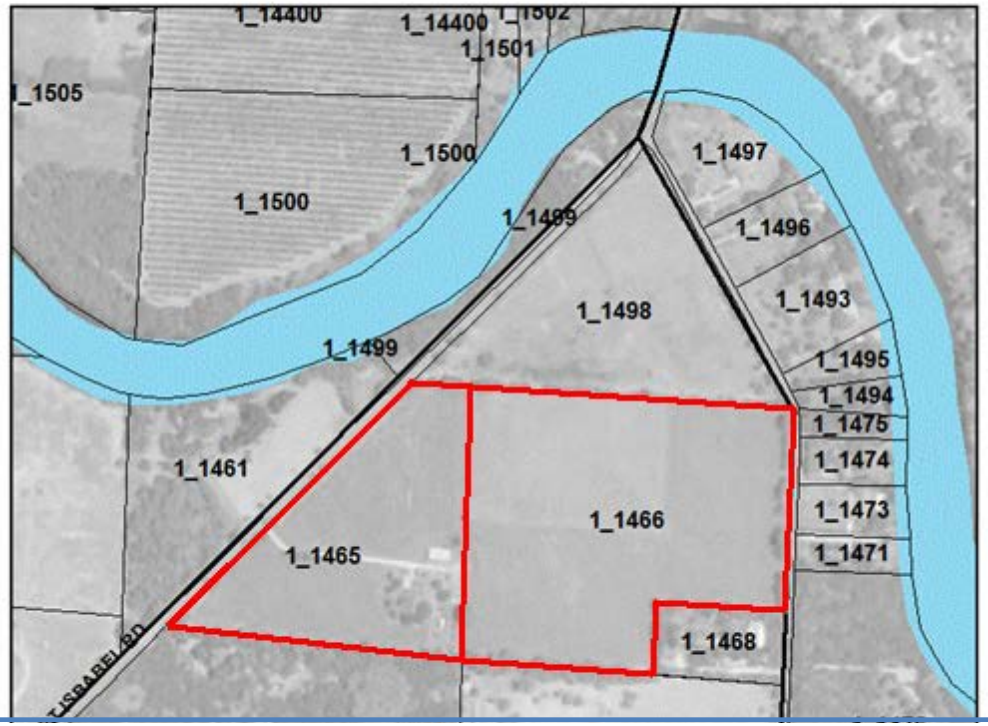


Enabling access to specific data for water account holders

Example 1

- **The grower/landowner can locate their fields, and find and print information**

Map



Owner Maps

ACCOUNTS	BLOCK	LOT	SUBDIVISION	GROWER	OWNER	NET_ACRES	NET_ACRES
1-1465	161	1	Texas Acres	Joe Jones	John SMITH	10	4
1-1466	162	1	Texas Acres	Sue Smith	John SMITH	16	5

Owner Maps

Meters

District meter

Farmer meter

Boundaries < 22500

Water Bodies

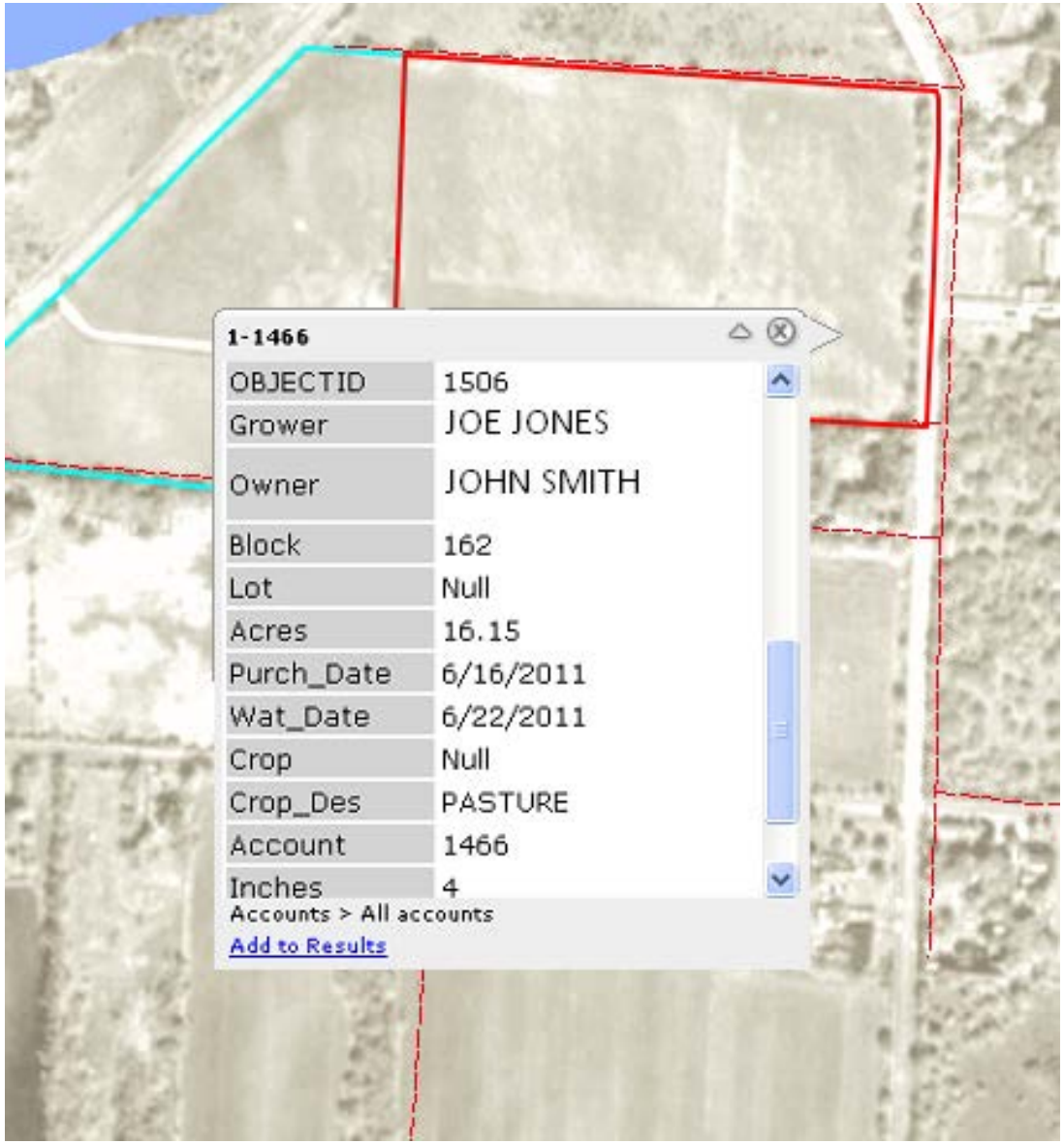
Owner Map (2)

Owner Maps

ACCOUNTS	BLOCK	LOT	SUBDIVISION	GROWER	OWNER	NET_ACRES	NET_ACRES
1-1465	161	1	Texas Acres	Joe Jones	John SMITH	10	4
1-1466	162	1	Texas Acres	Sue Smith	John SMITH	16	5

Example 2

- **Detailed information can be viewed for each field**


1-1466
OBJECTID 1506
Grower JOE JONES
Owner JOHN SMITH
Block 162
Lot Null
Acres 16.15
Purch_Date 6/16/2011
Wat_Date 6/22/2011
Crop Null
Crop_Des PASTURE
Account 1466
Inches 4
Accounts > All accounts
Add to Results

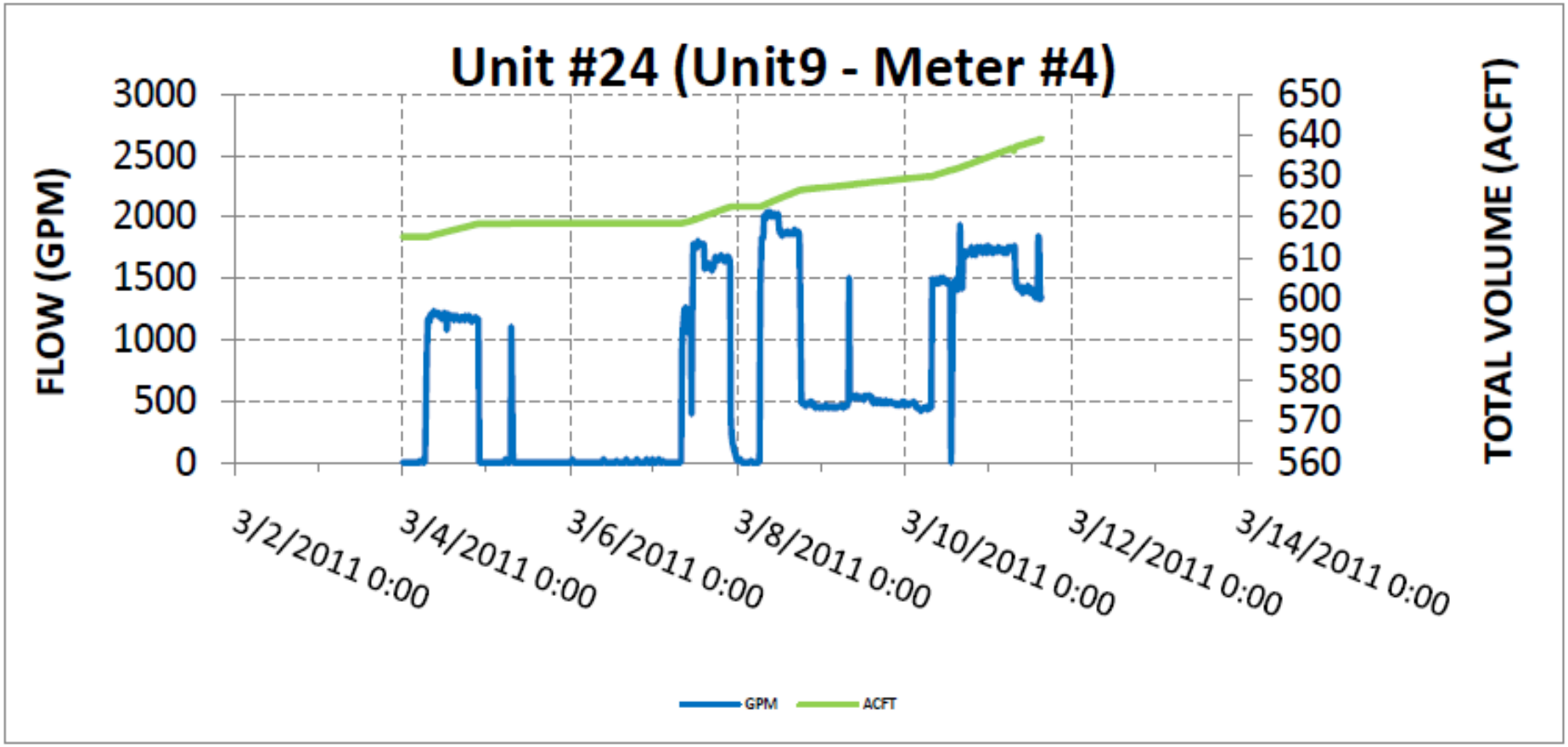
Example 3

- **Farmer can access his own meter readings**

Water Account Holder Map

Unit 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

Account | Print



Tuesday 3/15/2011 8:46	GPM	ACFT
	1352	639.127

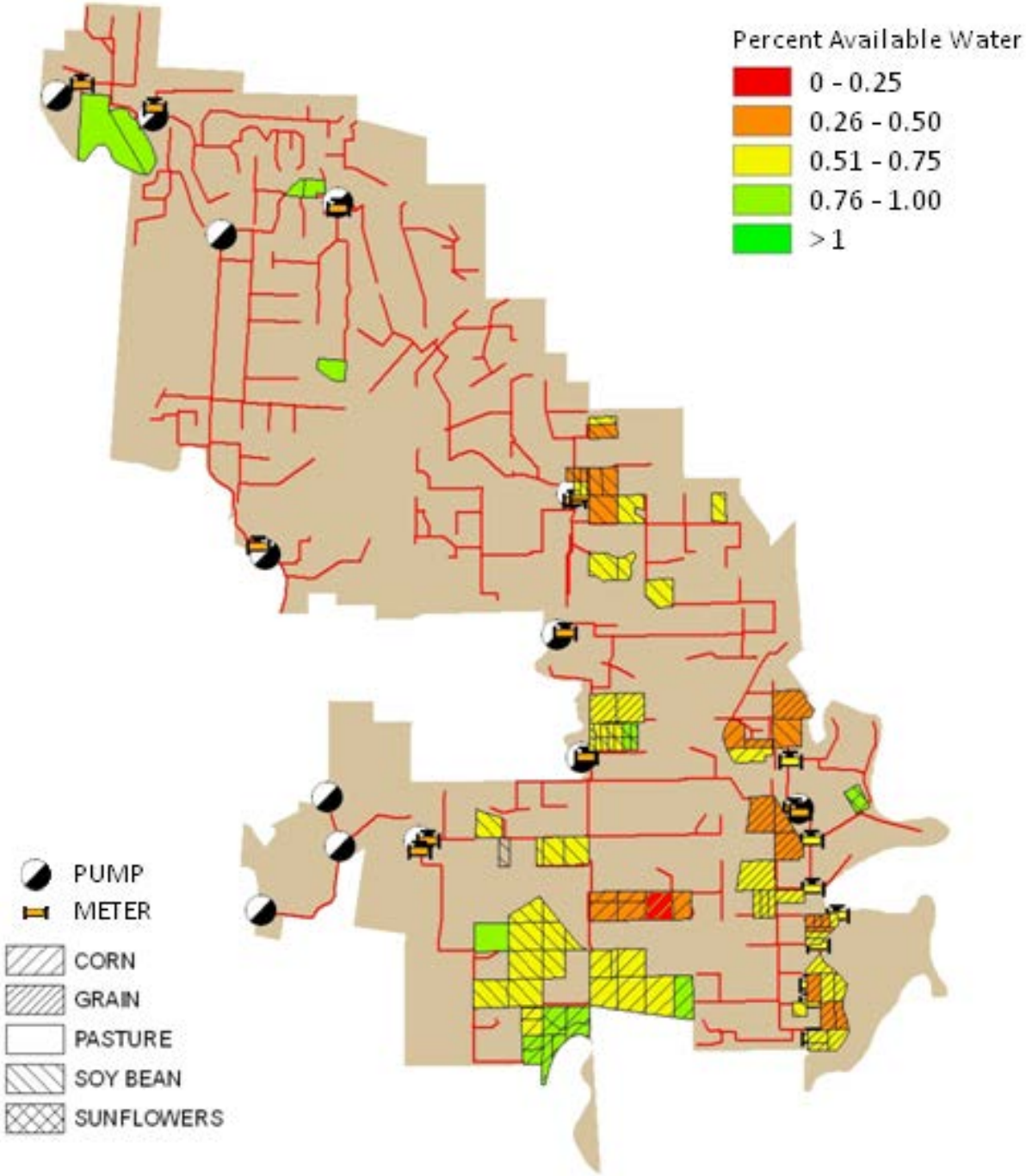
Date	GPM	ACFT
3/4/2011 0:00	0	615.1078
3/4/2011 0:15	0	615.1078
3/4/2011 0:30	0	615.1078
3/4/2011 0:45	0	615.1078

Management tools to improve conveyance efficiency and water deliveries

Example

- **Use of soil-water balance models to create maps showing water status of crops**

- **Red and orange fields need irrigation**


Percent Available Water
0 - 0.25
0.26 - 0.50
0.51 - 0.75
0.76 - 1.00
>1
PUMP
METER
CORN
GRAIN
PASTURE
SOY BEAN
SUNFLOWERS

PROBLEMS AND SOLUTIONS

Data management

- SCADA and water account databases proprietary format → contractor set-up of a routine creating text output data
- Automatic transfer of data to our server → Specific code to bypass the firewall protecting the TAMU server
- Data storage and management → SQL server database
- Connection to spatial data: geodatabases and “join” operation within the ArcGIS software

PROBLEMS AND SOLUTIONS

Collaboration with contractors and consultants

- Only contractors could manipulate the data and knew what data were available
- Contractors sometime saw us as competitors
- District encouraged us to be involved with the contractors
- Overall there was a beneficial interaction in terms of knowledge and future collaboration, but also in terms of minimizing any impediment to the current organization of the system

PROBLEMS AND SOLUTIONS

Identification of district needs and best solutions

- Proposed technology was relatively new, so we had to design the project based on our knowledge of the district, rather than on a specific request
- GIS classes and demonstration workshops resulted to be useful activities

Security

- We had to set some passwords to protect sensitive data; this is possible to be done also within ArcGIS Server

Data validation

- District typically used SCADA data only as real time source of information
- We decided to take care of errors in historical data with simple automatic strategies (e.g. minimum or maximum threshold)

BID Information Management System project - USER EVALUATION FORM

Name: Yvette Date: 3/31/11

1. Did you use one of the new web pages at least once:
   - ☐ No
   - ☑ Yes
     - ☑ Pump and Meters — ○ Daily ☑ Weekly ○ Monthly
     - ☑ Water orders — ☑ Daily ○ Weekly ○ Monthly
     - ☑ Interactive map: — ☑ Daily ○ Weekly ○ Monthly
       - ☑ Pump Flow
         - ☑ Default displayed data (on/off, flow volume, resaca level)
         - ☑ Unit Chart links
         - ☑ Other information related to units
       - ☑ Water account
         - ☑ Default displayed data (current purchased ticket)
         - ☑ Account/Owner/Grower/Ticket 2010 queries
         - ☑ Print
     - ☑ Historical data: — ☑ Daily ○ Weekly ○ Monthly

2. General comments:
   - ☑ Useful
   - ☐ Sped my work
   - ☑ I will you use again
   - ☐ Too difficult to use
   - ☐ Too slow
   - ☐ There are no useful information
   - ☐ Other: .....

3. Water management improvements (also if based only on perception):

☑ Time saving	☑ Major	○ Minor	○ None
☑ Money saving	☑ Major	○ Minor	○ None
☑ Water saving	☑ Major	○ Minor	○ None
☑ Energy saving	☑ Major	○ Minor	○ None
☑ Interaction with account holders	○ Major	☑ Minor	○ None

   - ☐ Other: .....

4. What other information would you like us to add to the web site?
   Have already added all we need at this time.

5. What changes/improvements would you like us to make?
   password protected

6. Any other comment?
   .....

CONCLUSIONS

- We identified some clear specific interest
  - Make best use of the large amount of available data
  - Adopt web applications
  - Enable customers to access their data through the internet.

- Changes require a long time to be fully implemented
  - Identifying district needs and accurately designing the project
  - Integrating the non optimal existing data
  - Securing sensitive data
  - Involving contractors and consultants to extract data that were in a proprietary format
  - Collaboration with contractors resulted nevertheless beneficial for the sound implementation of the project

- Involved districts believe this is the way to go
  - Adopted most of the new proposed strategies
  - Promptly complied with many recommendations

- District personnel feels that adopted changes will save time and water
  - Through use of water balances and reliable historical data
  - A measure of this saving can be obtained listing the improved services provided to growers, such as:
    - with internet access do their data, farmers will check their own meters without call
    - with timely internet access to flow data, farmers will be more efficient on-farm