

ONLINE IRRIGATION SCHEDULING CONSULTANT FOR THE BELLE FOURCHE IRRIGATION DISTRICT



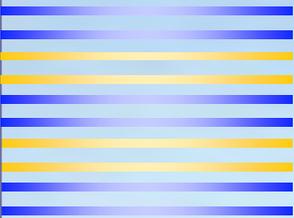
Jared Oswald, RESPEC, Rapid City, SD

2009 Conservation Innovation Grants Showcase

July 13-14, 2009

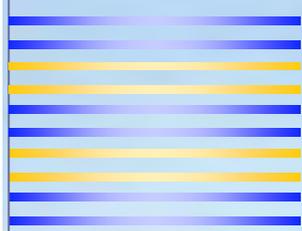
Dearborn, Michigan





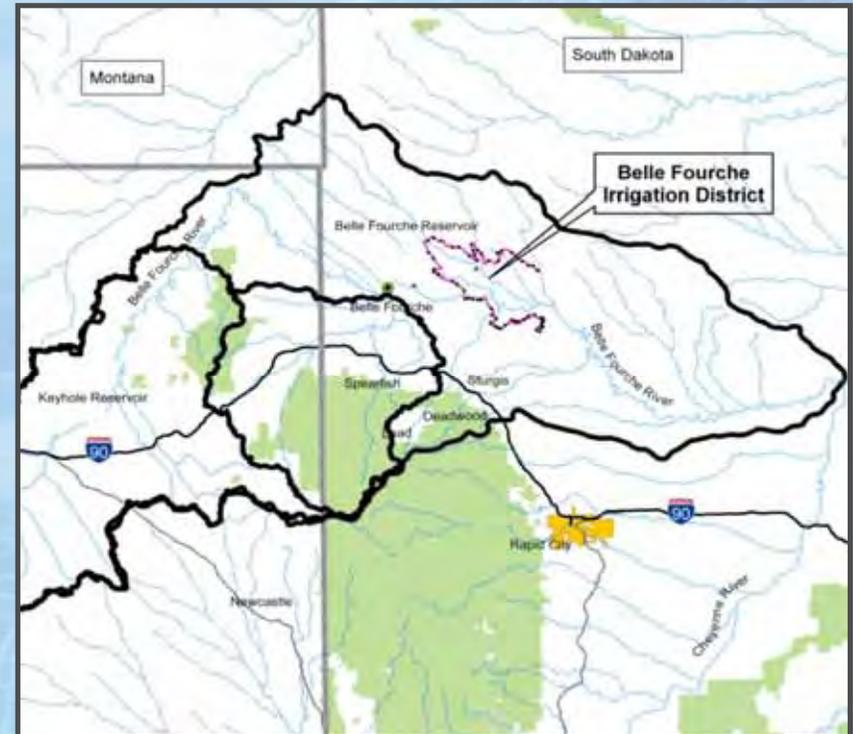
Presentation Outline

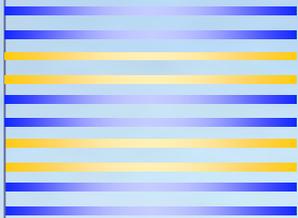
- ❖ **Project Background**
- ❖ **Methods Used**
- ❖ **Online Scheduler**
- ❖ **Results From First Year of Implementation**
- ❖ **Future Challenges**



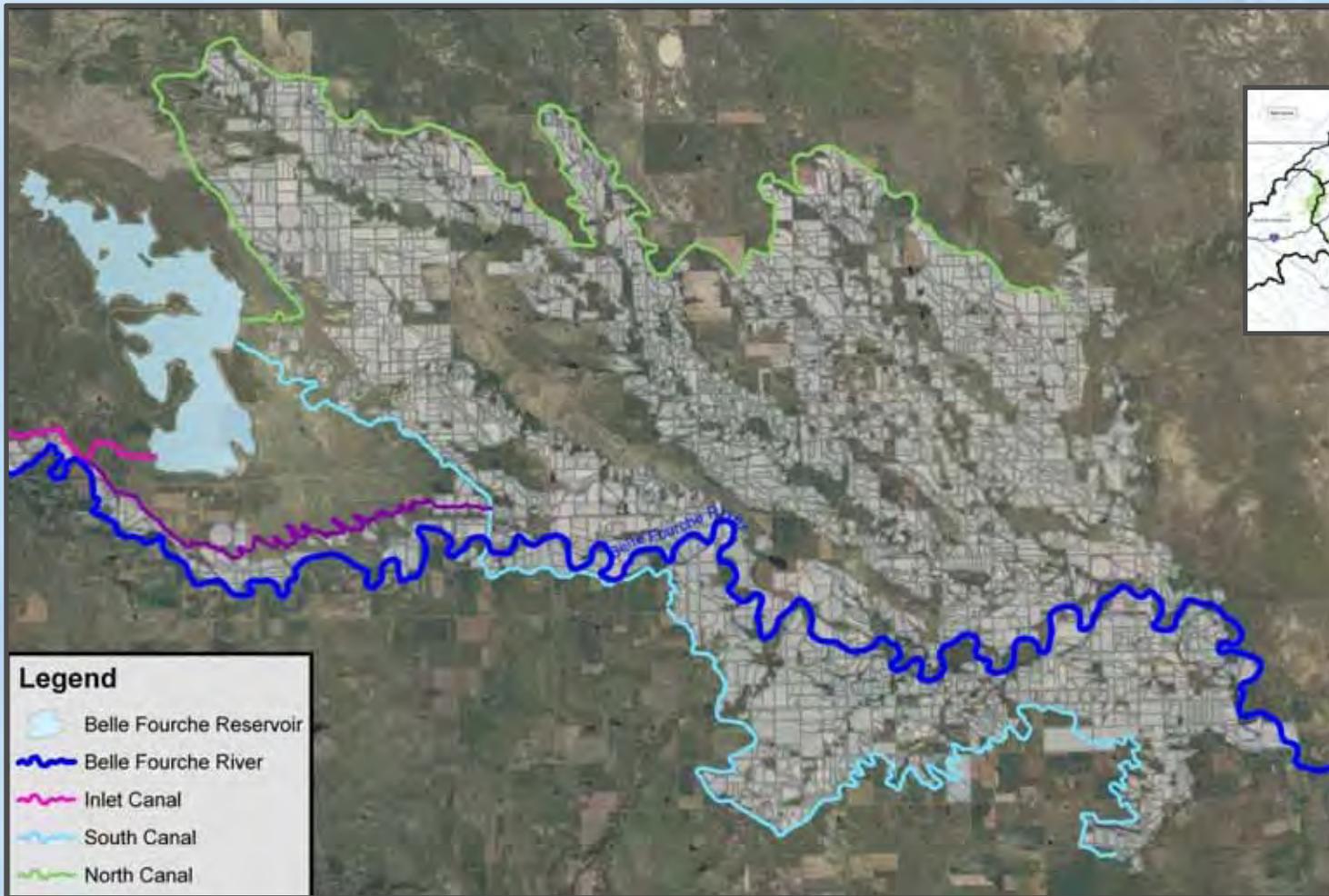
Belle Fourche Irrigation District (BFID)

- ❖ **57,183 Acres**
- ❖ **Crops:**
 - *Alfalfa, corn, wheat, and barley*
- ❖ **Surface Irrigation Dominated**
- ❖ **Annual Water Availability**
 - *~13" Precipitation*
 - *~20" Allotted water*





BFID



Conservation Innovation Grant (CIG) Project Overview

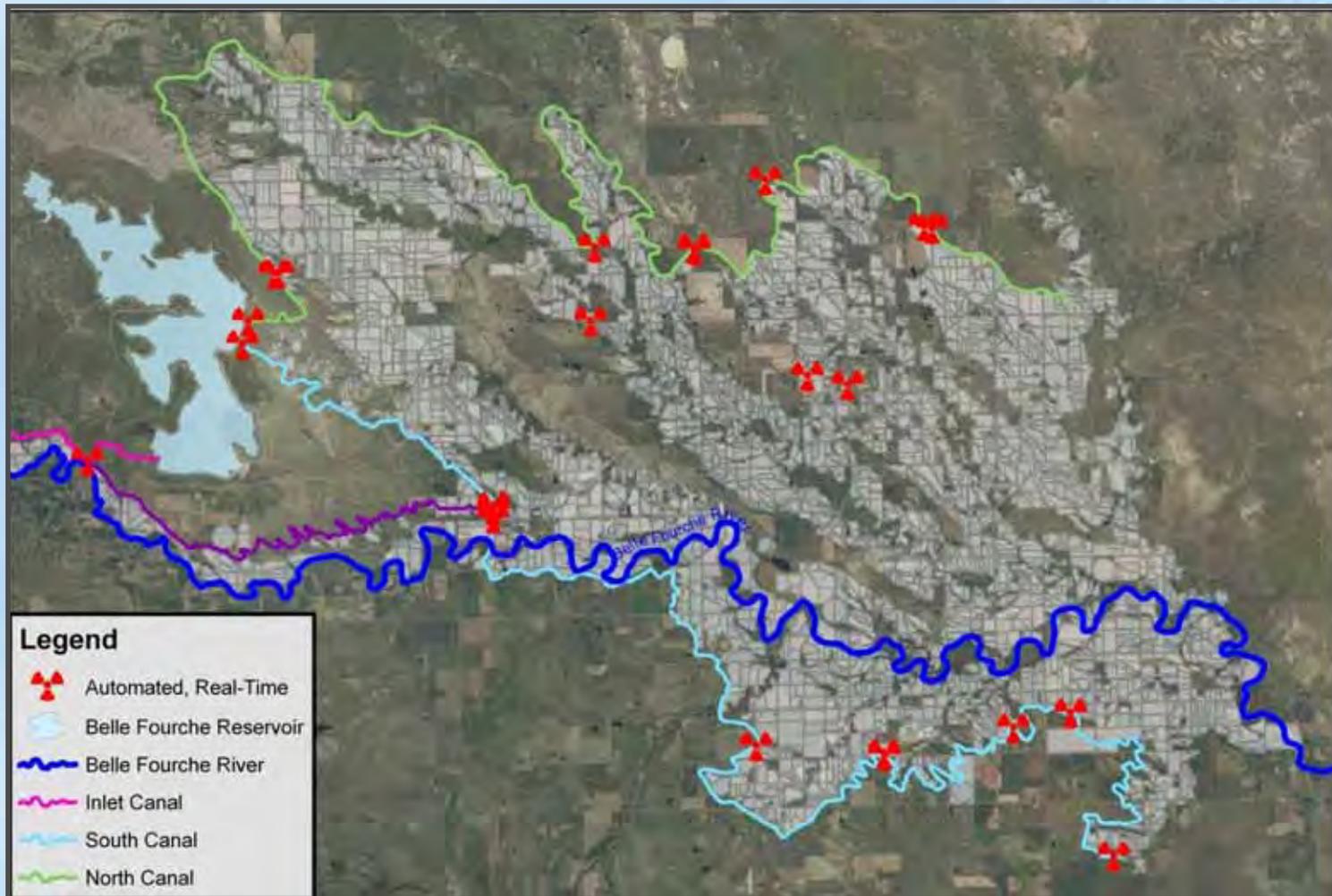
❖ 3-Year Project

❖ Components

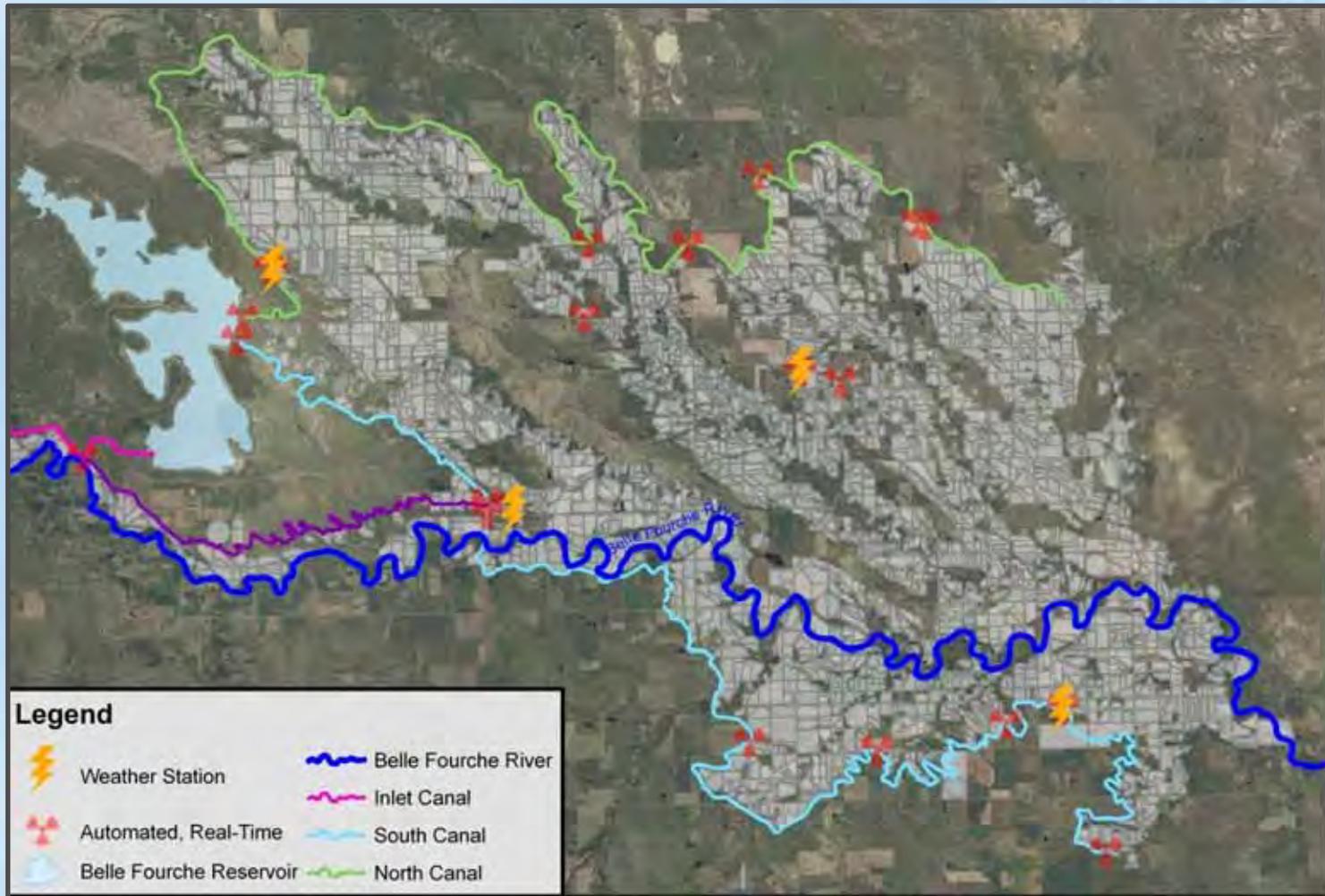
- ***Extensive weather network***
 - ☞ Four weather stations
 - ☞ Nine rain gage sites
- ***Soil moisture stations***
- ***Web-based irrigation scheduling consultant for producers (20 total producers)***
 - ☞ Easy to set up
 - ☞ Accurate, reliable, and adaptable



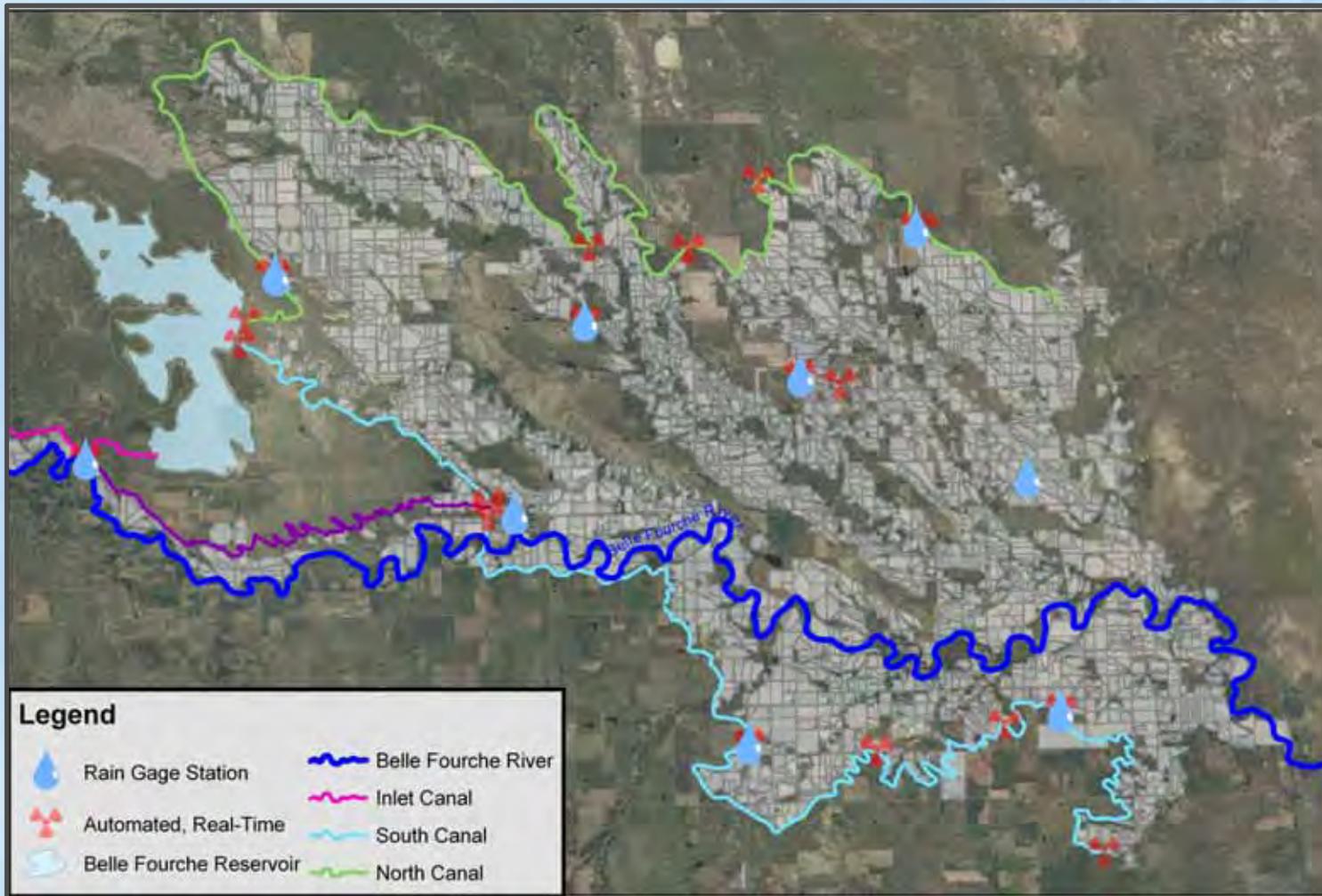
Existing Radio Network

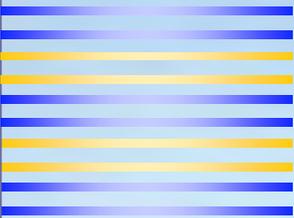


Weather Stations



Rain Gage Sites





Water Balance

❖ Calculate Available Water

Available H₂O = Previous Day Available H₂O – ET + Rainfall + Irrigation

❖ Evapotranspiration (ET) Estimates

→ *Calculated using data from installed weather instruments (ASCE standardized alfalfa)*

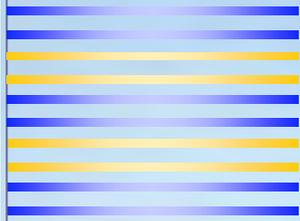
$$ET_c = ET_{sz} \times K_c \times K_a$$

❖ Rainfall

→ *Collected from installed rain gages*

❖ Irrigation

→ *Entered by the producer*



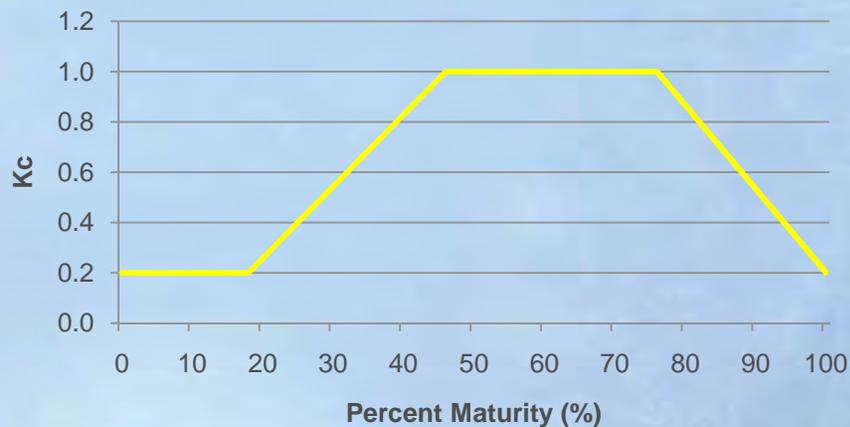
$$ET_c = ET_{sz} \times K_c \times K_a$$

❖ **K_c – Crop Coefficient**

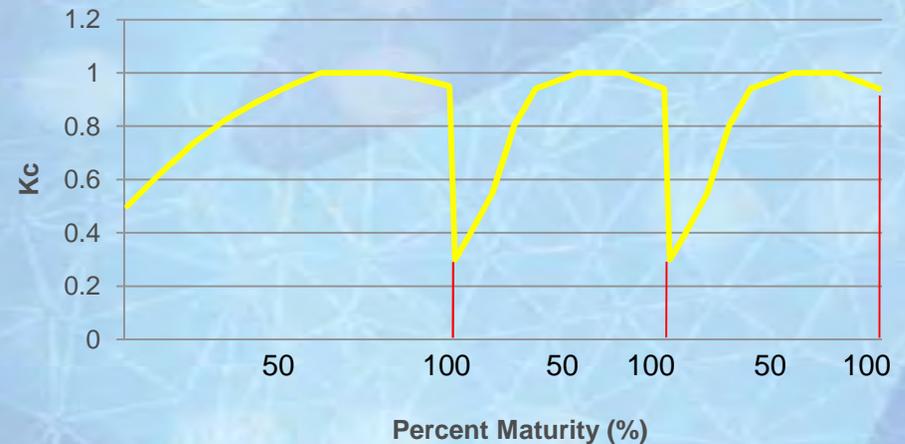
→ *Methods in FAO 56*

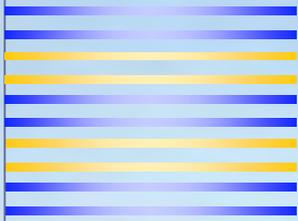
→ *Based on percent maturity of the crop*

Corn K_c



Alfalfa K_c



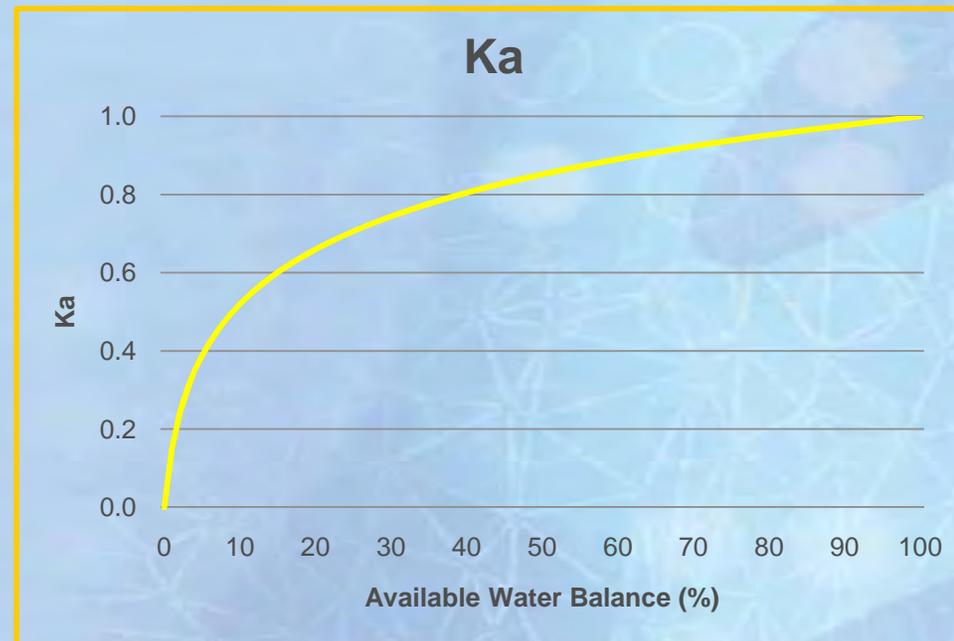


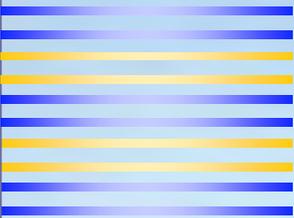
$$ET_c = ET_{sz} \times K_c \times K_a$$

❖ **Ka – Plant Available Water Coefficient**

→ *Crop independent*

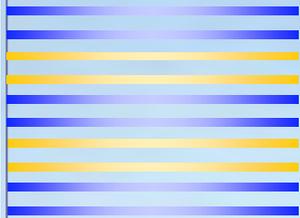
→ *Based on available water*



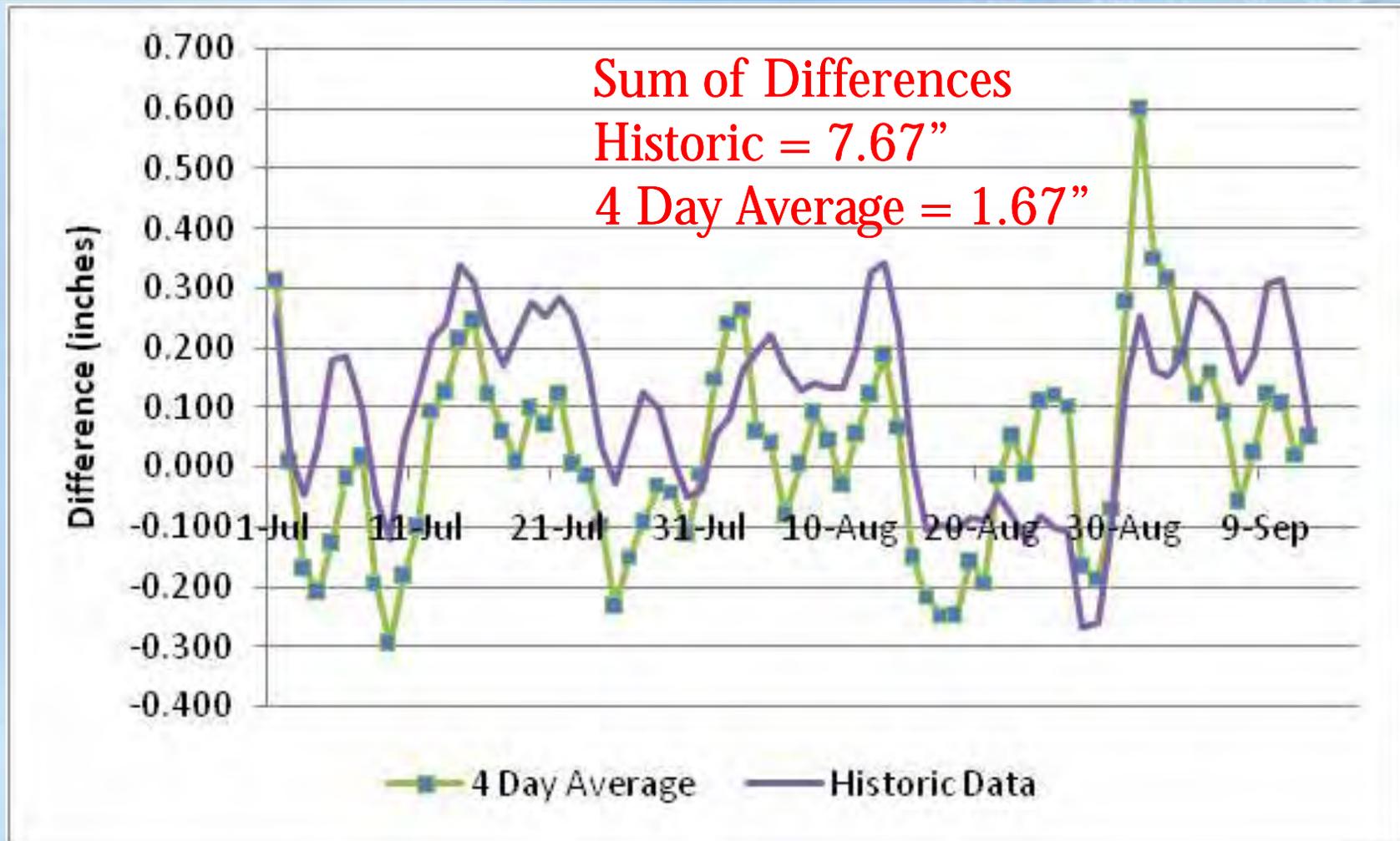


ET Forecasting

- ❖ **Used to Determine Timing and Depth of Irrigation**
- ❖ **Typical to Use Historic ET Estimates**
- ❖ **Use Average of Previous 4 Days to Predict the Next 3 Days**



ET Forecasting



User Interface

Web Mapping Application - Windows Internet Explorer

https://gis.podassoc.com/cig/cig_060509/Default.aspx

File Edit View Favorites Tools Help

ESRI | ESRI Support Center | Help

Web Mapping Application

Locate a City | Locate By Township & Range | Log In

Results

Map Contents

- Selection
- CIG
 - Producer Fields
 - Cities
 - RainGageStations
 - weatherStations
 - Roads
 - NRCS Soils
 - Townships
 - ESRI_Limagery_World_2D

Weather Data

Station ID	<input type="text" value="Newell"/>
Temperature	<input type="text" value="82"/> °F
Humidity	<input type="text" value="32"/> %
Wind Speed	<input type="text" value="8"/> mph

Belle Fourche River

Setup ~ Field Selection

The screenshot displays a web browser window titled "Web Mapping Application - Windows Internet Explorer". The address bar shows the URL "https://gis.podassoc.com/cig/cig_060509/Default.aspx". The browser's menu bar includes "File", "Edit", "View", "Favorites", "Tools", and "Help". The page title is "Web Mapping Application".

The application interface features a "Locate a City" section with a "Locate By" dropdown set to "Township & Range" and a "Log In" button. On the left, a "Map Contents" panel lists several layers: "Selection", "CIG", "Producer Fields", "Cities", "RainGageStations", "weatherStations", "Roads", "NRCS Soils", "Townships", and "ESRI Imagery_World_2D". The "CIG" layer is expanded, showing "Producer Fields" checked.

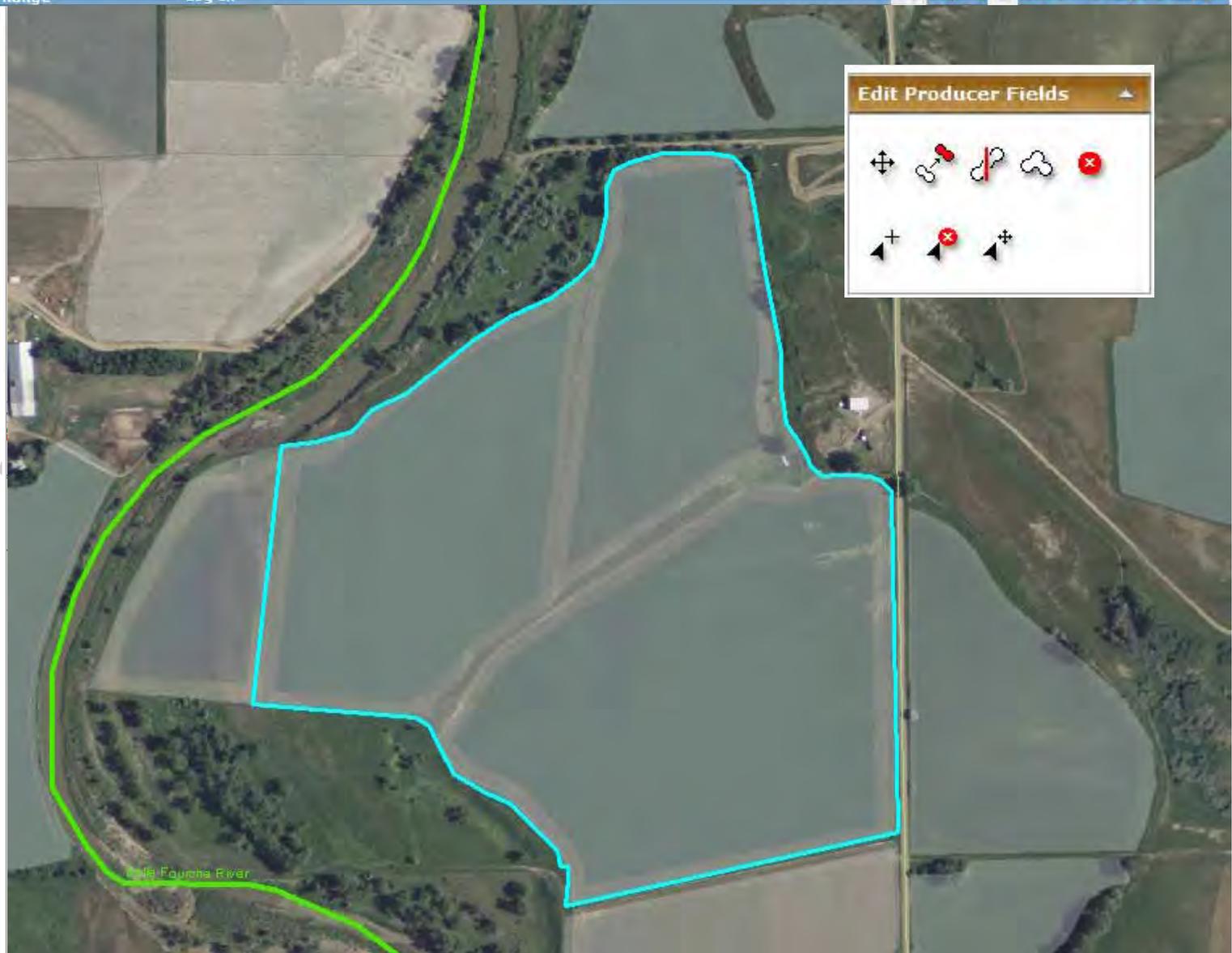
The main map area shows a geographic area with a grid, a blue river labeled "The Folsom River", and several orange markers. A "Log In" dialog box is overlaid on the map, containing the following fields:

- Producer Information**
- Name:** Jared Oswald
- Phone #:** 605 394 6400
- Password:** (masked with dots)
- Confirm:** (masked with dots)
- Buttons:** Cancel, Submit

Results

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Edit Producer Fields

- Move tool (crosshair)
- Line tool (red pin)
- Line tool (red line)
- Line tool (cloud)
- Delete tool (red X)
- Zoom in tool (+)
- Zoom out tool (-)
- Zoom reset tool (0)

Web Mapping Application

Locate a City | Locate By Township & Range | Log In

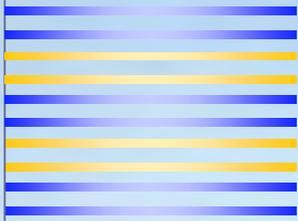


Results

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Soils

❖ Area Weighted Water Holding Capacity (WHC)

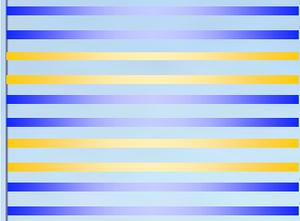
<u>Soil Type</u>	<u>Percent of Area</u>
<i>HeA</i>	10%
<i>LnA</i>	70%
<i>LnB</i>	5%
<i>MaA</i>	15%



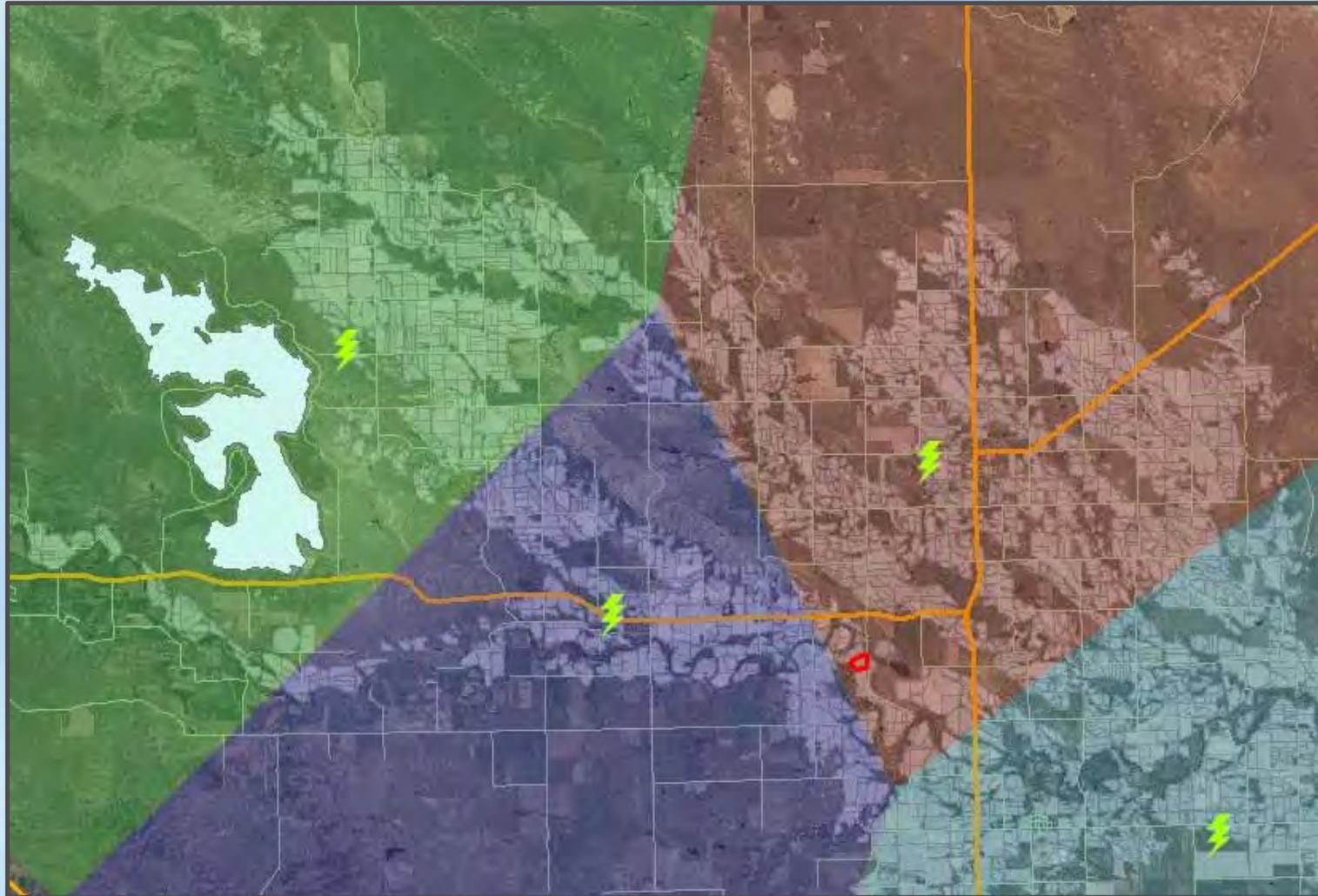
← Water Holding Capacities →

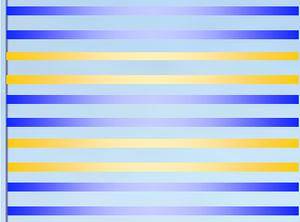
MUSYM	MUKEY	Inch_0_12	Inch_13_24	Inch_25_36	Inch_37_48
HeA	353179	1.92049	1.92049	1.92049	1.92049
LnA	353195	1.92049	1.80046	1.80046	1.80046
LnB	353196	1.92049	1.80046	1.80046	1.80046
MaA	353199	1.68043	1.5604	1.5604	1.32034

$$WHC_{13-24} = (1.92046 * 0.10) + (1.80046 * 0.70) + (1.5604 * 0.15) + (1.80046 * 0.05)$$

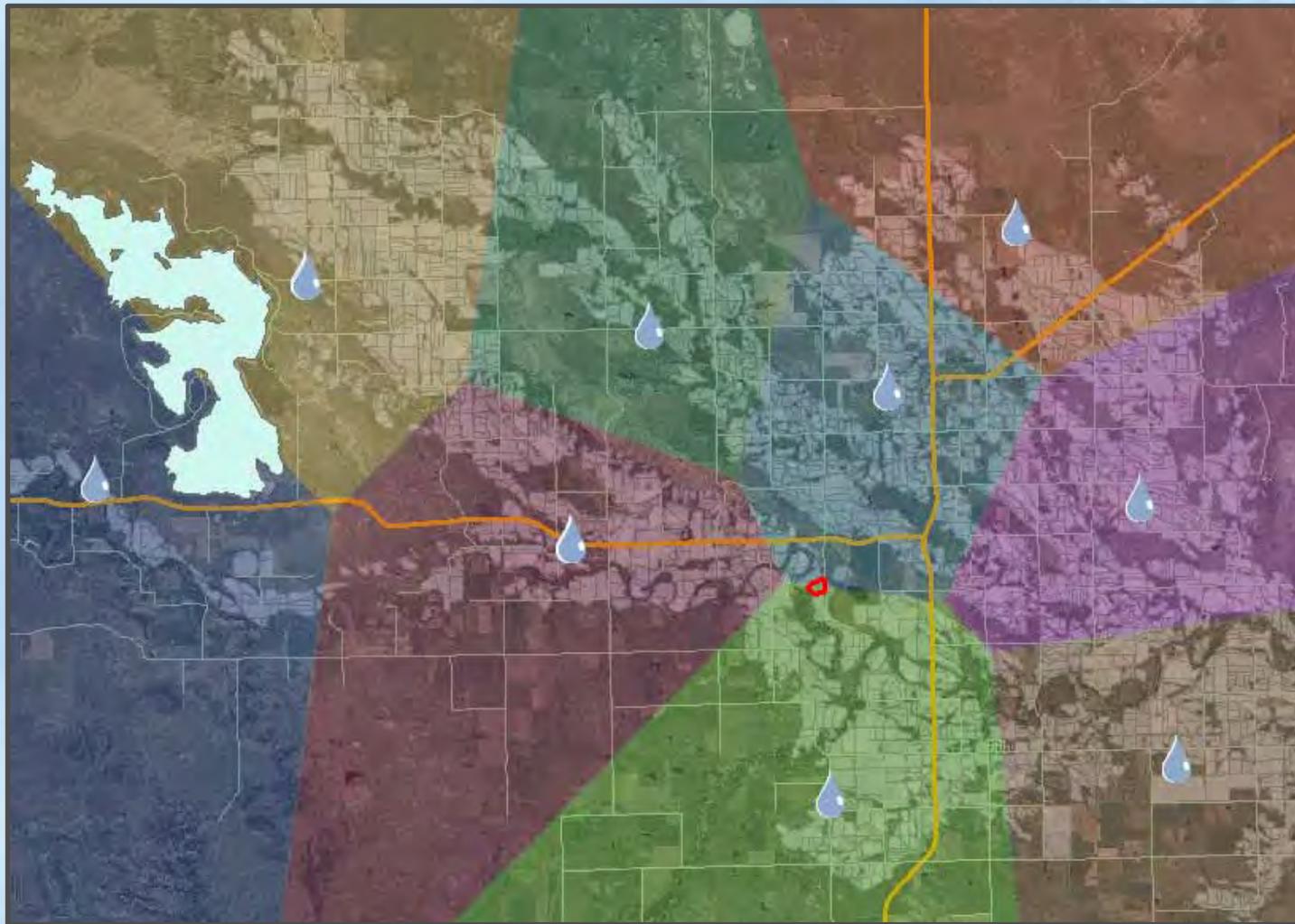


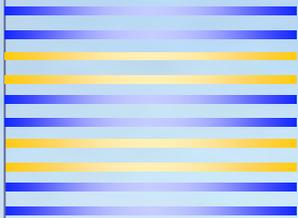
ET Zones



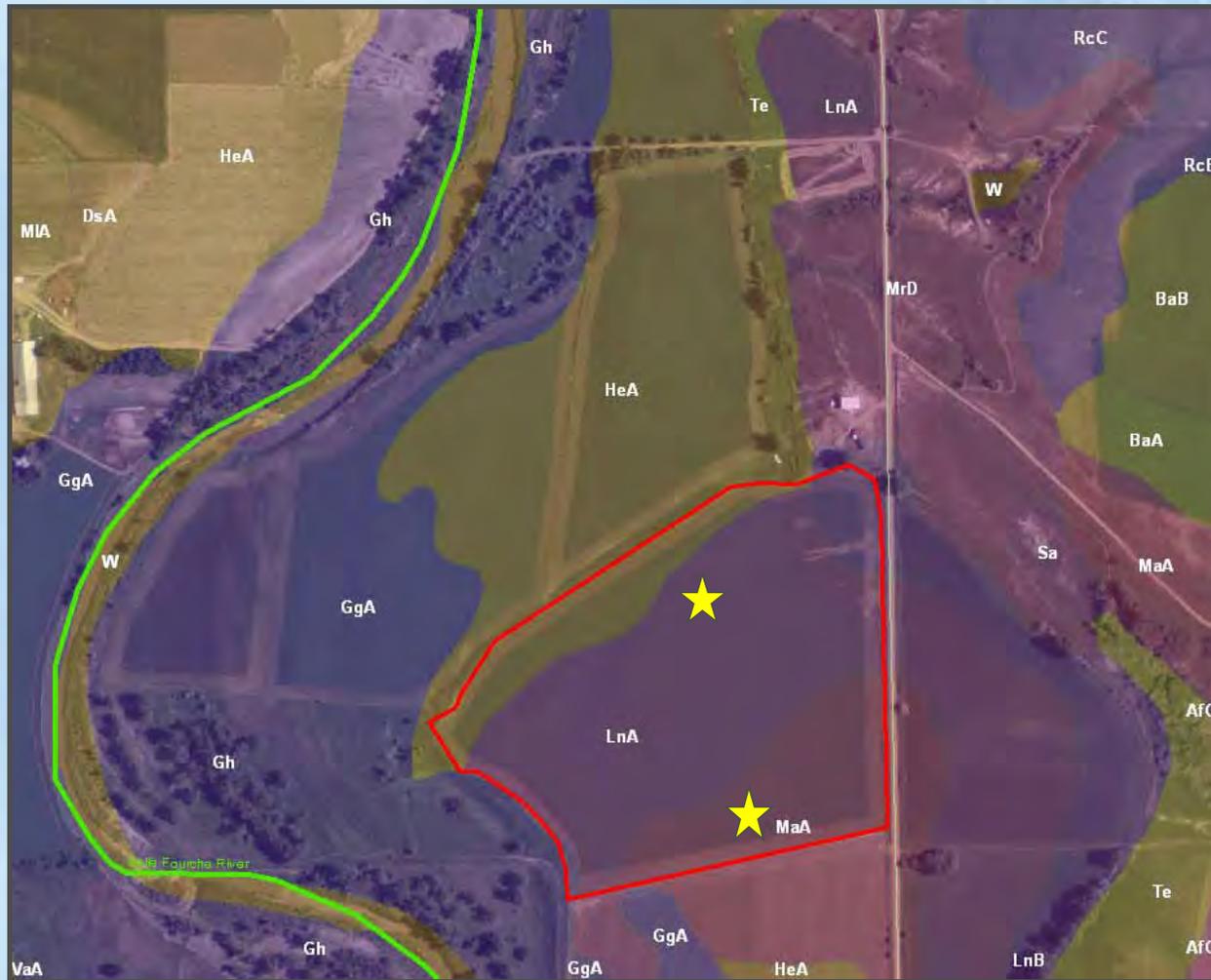


Precipitation Zones





Soil Moisture Sensors





Results

SoilMoisture

Producer Information

Field Setup

Calc SM

Description

Delivery rate to field (cfs)

Irrigation Delivery Method

Initial soil moisture %

Crop Type Alfalfa

Thaw Date

Cutting Dates

First

Second

Third

End of Season

Auto Calc

Planting Date

Assumed Maturity

Submit

Field Locate

Map Contents

Selection

CIG





Results

SoilMoisture

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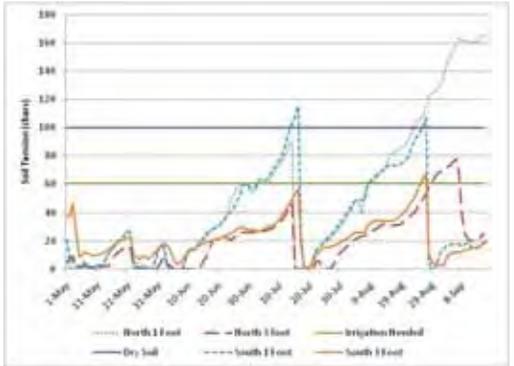
CIG





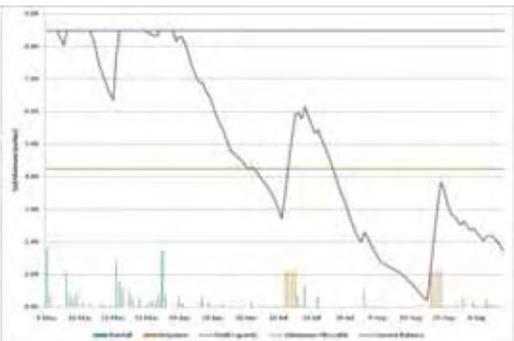
Results

SoilMoisture



Current Readings:

- Site 1 Shallow = 20 cbar
- Site 1 Deep = 22 cbar
- Site 2 Shallow = 175 cbar
- Site 2 Deep = 22 cbar



Current Calculated Soil Moisture = 25%

[Edit Soil Moisture](#)





Results

SoilMoisture

Producer Information

Field Setup

My Fields

2864

Add selected Field to my MyFields list

Rainfall

Date
5/3/2008 Inches

Irrigation

Date Range

From To
5/10/2008

Delivery Time

3 Hours

Field Locate

Map Contents

- Selection
- CIG

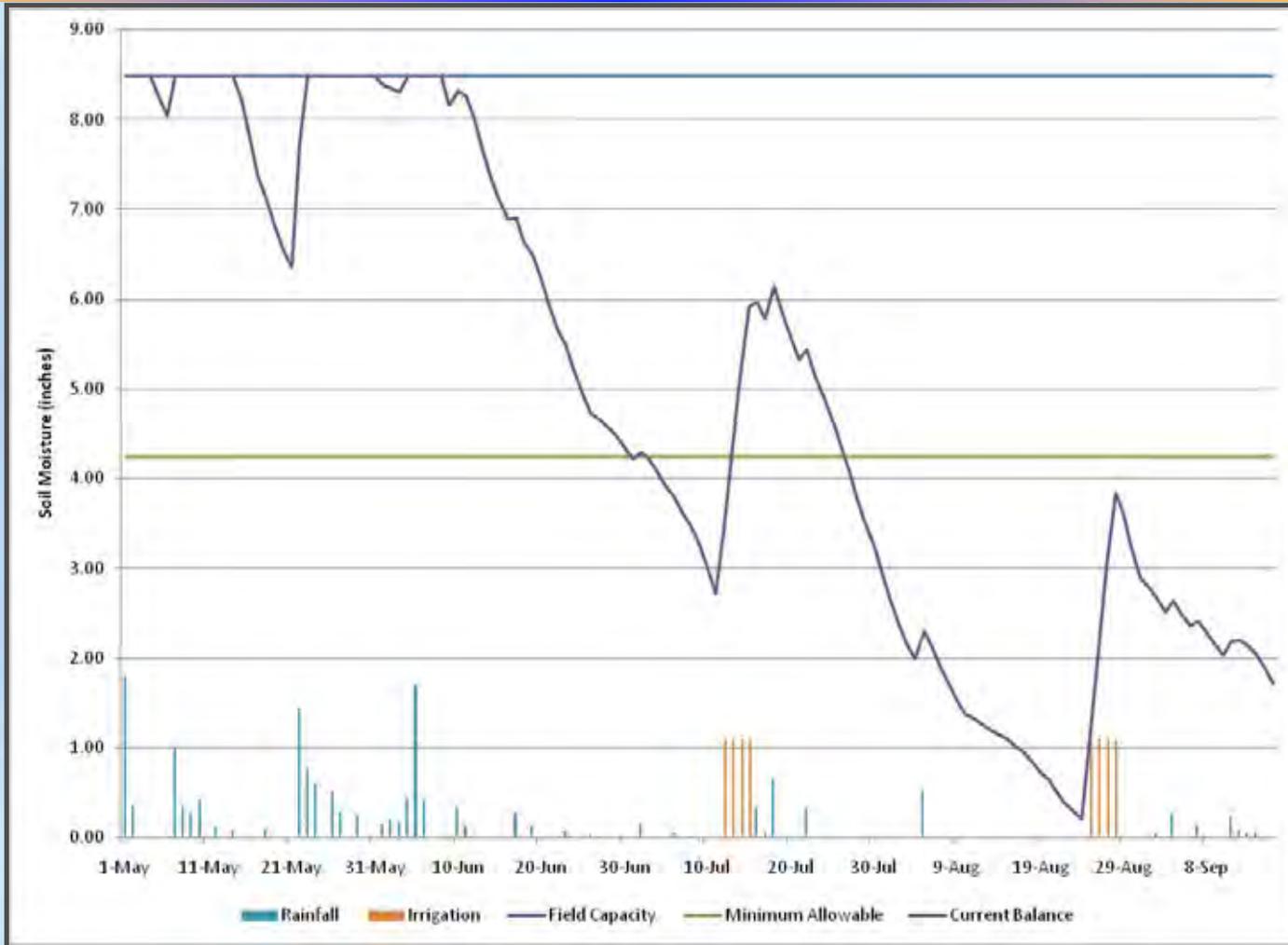


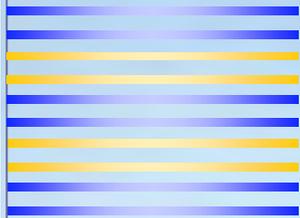
2008 Example

- 23 acres
- Savo Silt Clay Loam
- Water Holding = 2.12"/ft
- Gated Pipe
- Goal: Maximize First Two Cuttings

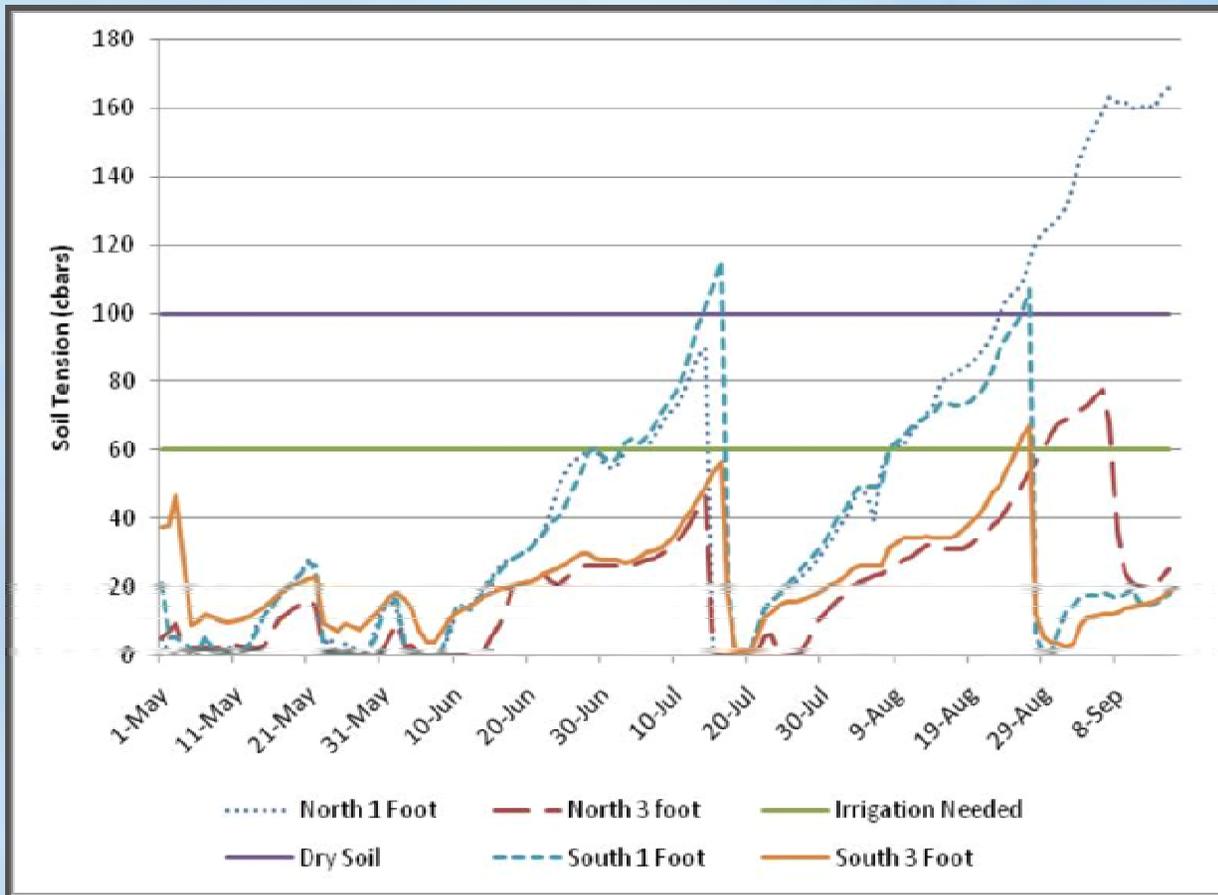


2008 Calculated Balance





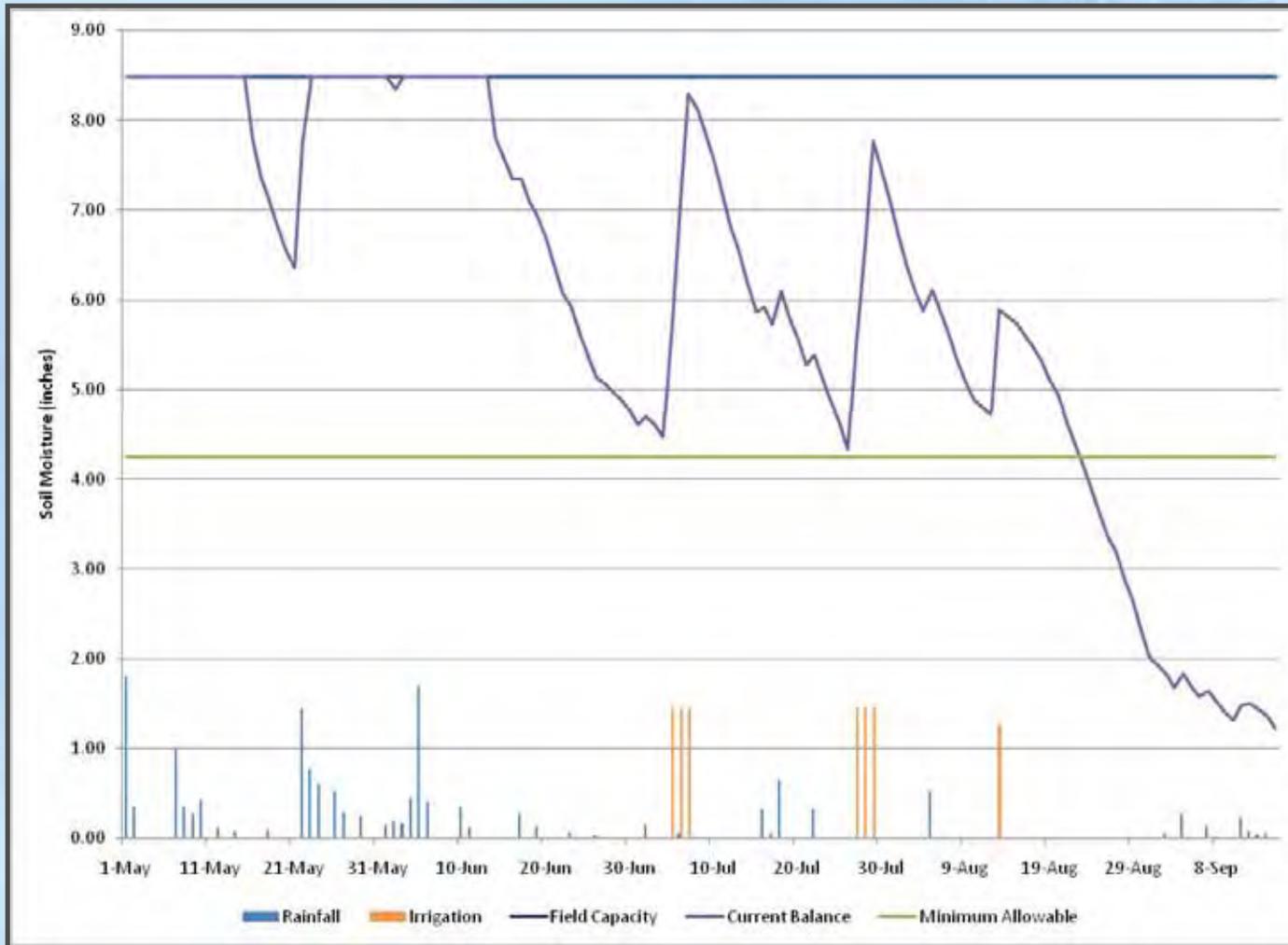
2008 Example

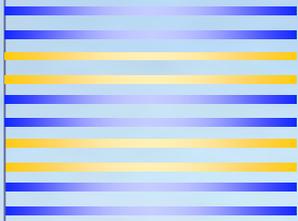


2008 Calculated Balance



2008 Model Results





CIG Cooperators

❖ **17 Total Cooperators**

❖ **850 Acres**

❖ **Crops**

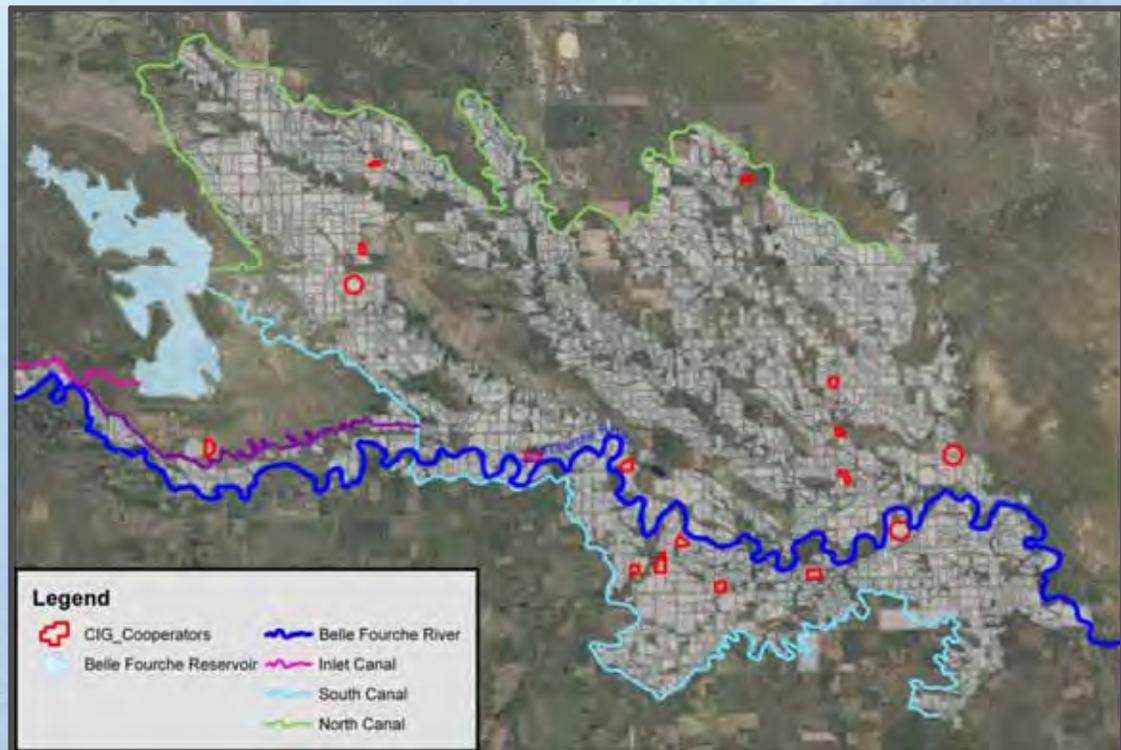
→ *Alfalfa*

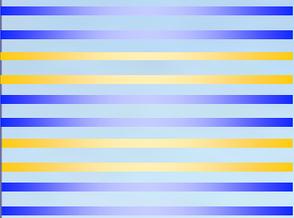
→ *Corn*

→ *Barley*

→ *Soybeans*

→ *Wheat*





Future Challenges

- ❖ **Understand Irrigation Efficiency Better**
- ❖ **Better Correlation Between Soil Moisture Readings and ET Estimates**
- ❖ **Further Develop User Interface**

Questions?

