January 20, 2021

Madera County GSA IrriWatch Set Up and Use Training

10:00 a.m. to 12:00 p.m., January 20, 2021
Zoom, Madera County
Madera, CA
Introductions

• Dr. Bryan Thoreson
  *Davids Engineering (USA)*
  https://davidsengineering.com/

• Dr. Wim Bastiaanssen
  *IrriWatch (The Netherlands)*
  https://www.irriwatch.com/
Presentation Outline

- IrriWatch as the GSA measurement system
- IrriWatch as a farmer’s irrigation management tool
- Steps to Enroll
- How to log in, define parcels, assemble farm units.
- How to read and interpret available data
- How IrriWatch determines field irrigation status
- Describe how to view ET_{aw} versus allocation

Q&A/Discussion Following Each Topic
Questions Welcome Any Time
Groundwater Condition Without Projects (2040-2090)
Groundwater Condition Without Projects (2040-2090)

Average Annual Volume, 2040-2090 (Acre-Feet)

Groundwater Extraction

Groundwater Recharge

545,200

379,300
Madera County Recharge Program: Divert all available flood waters (when available) to increase recharge.
Groundwater Condition With Projects (2040-2090)-Step 2: Demand Management

Crop Water Use Reduction Program: Madera County GSA 90,000 acre-feet (AF). Remaining crop water use reduction due to permanent recharge basins replacing irrigated area.
Groundwater Condition With Projects (2040-2090)
GSP Requires Increased Recharge and Consumptive Use Reduction

- Increased recharge in the Madera County GSAs
  - Recharge (basins, flood-MAR, in-lieu)
  - Other supplies and transfers

- Consumptive use reduction (Demand management) program
  - Allocation–IrriWatch
  - Allocation + Water Market
  - Land Resting/Retirement and Easements
  - Fee structures
IrriWatch Tracks ET for GSA

• SGMA requires groundwater basin to be sustainable (water inflows = water outflows over 50 years of average hydrology)

• Currently water outflows are greater than water inflows

• Solution
  • Increase inflows—Recharge program
  • Decrease outflows (ET), *IrriWatch tracks ET*
    • Sustainable Ag Land Conservation (SALC) program
    • Demand Management
IrriWatch ET Calculations

- Surface Energy Balance Algorithm for Land (SEBAL)
- Daily calculation based on data
  - Remotely sensed
  - Ground-based
- Calculated for each approximately 33-foot by 33-foot square area of the field
GSA ET Tracking Program (Under Development)

- Water year or calendar year tracking
- GSA staff review IrriWatch reports on
  - ET
  - ET of applied water
- Late July/early August GSA alerts growers that are on pace to exceed allocation.
- GSA sends ETaw report to all growers after end of year
- What basis do you prefer for tracking water year or calendar year?
IrriWatch Tracks ET and Provides Irrigation Scheduling Support for Farmers

- Uniform ET equals good production
- Information on ET supports irrigation scheduling
- Additional parameters in IrriWatch support on-farm management, e.g. Leaf Nitrogen and daily Actual Crop Production
- Allows farmer to assemble farm units
IrriWatch Training Schedule

• November 6, 2020 – SEBAL and root zone water budget
• December 16, 2020 – Enrollment workshop with MAWA
• January 20, 2021 – IrriWatch set up and use
  • Explain the data portal, including how to register, log in, define parcels, assemble farm units
  • Explain how to read and interpret available data
  • Describe how IrriWatch determines the irrigation status of a field
  • Describe how to view ET_{aw} versus allocation
• Mid/late summer 2021 – IrriWatch feedback and comparison to field measurements
  • Listen to feedback
  • Respond to questions
  • Discuss comparisons with field measurements.
  • Discuss relationships between AW, ET and ET_{aw} for selected fields
Meet the Davids Engineering team

Grant Davids  
Sr. Principal Engineer

Bryan Thoreson  
Supervising Engineer/Scientist

Ryan Fulton  
Associate Engineer/Scientist I
Meet the team

Prof. Wim Bastiaanssen  
Founder & CEO

Ir. Tim Hessels  
Geo-Irrigation Specialist & Ph.D. student

Ir. Harald Tijink  
IT Developer

Ing. Sam Bastiaanssen  
GIS Expert & Operational Manager

Madera County GSA IrriWatch Set Up and Use Training  
January 20, 2021
IrriWatch data is taken up in California
Steps to Enroll

- Email to Etmeasurement@maderacounty.com
  - Your Email address
  - Your APNs
  - Optionally provide
    - Crops
    - Irrigation method

- OR

- Submit form on maderacountywater.com
Steps After Enrolling

• IrriWatch will send you an email with the request to create a password
• One email address for each company account for getting started
• Except for Madera County, nobody else has access to your fields
• You have to validate fields, crops, soils and irrigation methods
• Comments can be sent to support@irriwatch.com, preferably with a sketch or a map
• IrriWatch data is live since 1st of January 2021
Dear Madera GSA grower,

Thank you for registering for the IrriWatch irrigation advisory service that is offered free of charge through the Madera County GSA. Please login to portal.irriwatch.com with your email as your username and create a password. Review your field boundaries, crop types, irrigation types and soil types. If corrections are needed, please send written or visual corrections to support@irriwatch.com. If one or more of your fields is not found, it might be located outside the Madera County GSA, in another nearby GSA.

If requested, IrriWatch will adjust your field boundaries before the January 1, 2021 IrriWatch start date. IrriWatch cannot adjust field boundaries during the growing season, but will adjust field boundaries between November 1 and December 15th each year for the upcoming year. If one crop is harvested and you plant a second crop, please inform IrriWatch of the plant date of the next crop and the crop type will be updated. You can view the graphs and download spreadsheets with the data, but you cannot edit the field boundaries, crop, soil or irrigation type information. Your fields will also be visible on the IrriWatch App that is freely downloadable from the PlayStore or AppStore. Also, you can add more members with their email addresses to your company account.

Thank you,

IrriWatch
## Registrations as per 18 January 2021

<table>
<thead>
<tr>
<th>Subbasin</th>
<th>Irrigated area (2015, Source: GSP)</th>
<th>Total number of companies/growers signed up</th>
<th>Total irrigated area signed up</th>
<th>% of total irrigated area signed up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chowchilla</td>
<td>37,100 acre</td>
<td>16 n.a. acre</td>
<td>14,850 acre</td>
<td>40%</td>
</tr>
<tr>
<td>Delta Mendota</td>
<td>2,700 acre</td>
<td>0 n.a. acre</td>
<td>0 acre</td>
<td>0%</td>
</tr>
<tr>
<td>Madera</td>
<td>84,900 acre</td>
<td>41 n.a. acre</td>
<td>34,468 acre</td>
<td>41%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>124,700 acre</td>
<td>49 n.a. acre</td>
<td>49,318 acre</td>
<td>40%</td>
</tr>
</tbody>
</table>
Number of portal visits

- 20 growers have visited the portal
- 181 total portal visits since Jan. 1, 2021
- 8.6 average visits per grower
- One grower has visited 20 times
How to Log In

[Image: A screenshot of the IrriWatch login page with the email and password fields filled in.]
You can add colleagues

<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
<th>Profile</th>
<th>Status</th>
<th>Mails</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Expert</td>
<td>Enabled</td>
<td>Pwd lost mail, New usr mail</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Expert</td>
<td>Enabled</td>
<td>Pwd lost mail, New usr mail</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Expert</td>
<td>Enabled</td>
<td>Pwd lost mail, New usr mail</td>
</tr>
<tr>
<td>Local manager</td>
<td></td>
<td>Enabled</td>
<td>Not banned</td>
<td>Pwd lost mail, New usr mail</td>
</tr>
</tbody>
</table>
You can change your own settings

User details

- Email
- Name
- Preferred language: English
- Profile: Expert

Change your password

- Current password
- New password
- Repeat password

The password must be 8-20 characters

To confirm, type the new password again.

Update
3 types of user profiles

Field Irrigator
Local Manager
Expert

More detailed information
This is what you see as opening
YouTube instruction movie
How the viewer works
(3 min)

https://www.youtube.com/watch?v=qki07xrBQys
Summary

• Set Imperial (Inches/feet) units
• Set language
• Select your date for viewing results
• Field level data provides the average value of a given field
• Pixel level data provides the data for every individual pixel (33 feet x 33 feet)
Pixel level data layers

• Soil moisture root zone
• Soil water potential
• ET
• Crop production
• Leaf Nitrogen
• more
Time series of soil moisture

Graphs - C230_Almonds_field

Field Capacity Line

Soil Moisture Line

Stress Line (dynamic)
No irrigation today
What kind of irrigation scheduling information do I get?

- Yes / No
- Min Advised Water for today
- Max Advised Water for today
- Number of days until next irrigation
Daily Decision Model

$\Psi = \text{Soil Water Potential}$

- **Do I need to irrigate?**
  - $\text{abs} \ | \ \Psi > \psi_{\text{crit}} \ | \ \text{per pixel}$
    - **YES**
  - $\text{abs} \ | \ \Psi < \psi_{\text{crit}} \ | \ \text{per pixel}$
    - **NO**

**Should I irrigate the whole field?**

- $\geq 20\% \text{ pixels requiring irrigation}$
  - **YES**
- $< 20\% \text{ pixels requiring irrigation}$
  - **NO**

**Min. and Max. Applied Water advise**

**Time until next irrigation**
Principles of Advised Irrigation

• Minimally recover expected ET on the basis of weather forecasts
• Bring back moisture to the critical moisture level at which crop water stress emerges
• Never surpass soil moisture at field capacity
• Consider the type of irrigation system in place; micro-irrigation systems have certain capacity limits that needs to be considered
Min Advised Irrigation
Time until next irrigation
ET Terms

• Reference ET - ET of grass (CIMIS used in IrriWatch), calculated from weather station measurements of:
  • Temperature
  • Net radiation
  • Wind
  • Relative humidity

• Actual ET - calculated by SEBAL

• ET of precipitation ($ET_p$) is ET from water supplied by precipitation

• ET of applied water ($ET_{aw}$) is ET from water supplied by irrigation

• Actual ET equals $ET_p + ET_{aw}$
Daily Root Zone Water Balance for Every 33-foot by 33-foot Area

Example for Typical Summer Day (Between Irrigations)

- $\text{ET} = 0.18$ inches
- $\text{Irrigation (applied water)} = 0$
- $\text{Rain} = 0$
- $\text{Runoff} = 0$
- $\text{Deep Percolation} = 0$
- $\Delta S_p = -0.02$
- $\Delta S_{aw} = -0.16$
ALLOCATION = 32 inches

EXAMPLE ONLY

\[ \text{ET}_{aw} = \text{ET} - \text{ET}_{pr} \]
**ALLOCATION = 32 inches**

**EXAMPLE ONLY**

\[
ET_{aw} = ET - ET_{pr}
\]
EXAMPLE ONLY

ALLOCATION = 32 inches

\[ \text{ET}_{aw} = \text{ET} - \text{ET}_{pr} \]
Example from IrriWatch

**ALLOCATION = 32 inches**

**EXAMPLE**
Feedback on format of $ET_{aw}$ Allocation Graph

• What suggestions do you have on the format for the $ET_{aw}$ graph?

• How can we make the graph more understandable and useful?
Field level data layers

- Irrigation advice
- Fullness Root Zone Water Tank
- Applied Water
- more
Fullness Root Zone
Irrigation distribution uniformity

Field: Field Uniformity Soil Moisture average last 10 days (std/mean)

- Very uniform
- Non-uniform

H-02
Crop: Cotton
Soil: Sandy Loam
Irrigation type: Furrow
Accumulated Applied Water

There is a verification program
Opportunity to Validate Applied Water Estimates

Describe the opportunity

- Use IrriWatch to estimate and validate irrigation efficiency

What are we asking participating growers to do?

- Enroll as a user of IrriWatch
- Help us identify well locations and field boundaries corresponding to areas served by each well
- Provide applied water estimates collected using a flow meter installed and maintained according to manufacturer specifications
- Meet with staff from Davids Engineering to collect field information (i.e., sprinkler/emitter application rates, number of sprinklers/emitters, etc.)

If interested in learning more about using IrriWatch to estimate irrigation efficiency, contact

- Ryan Fulton, Davids Engineering, Inc.
- Email: ryan@davidsengineering.com
Leaf Nitrogen
Various graphs (experts)
Various graphs (local manager)
Various graphs (field irrigator)
Other graphs with time series
YouTube instruction movie
How the App works (3 min)

https://www.youtube.com/watch?v=msB4e7u5oC0
### Field Details

<table>
<thead>
<tr>
<th>Variable</th>
<th>Today</th>
<th>Tomorrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Time Satellite Overpass</td>
<td>13:17</td>
<td>-</td>
</tr>
<tr>
<td>Vegetation Cover</td>
<td>92.3%</td>
<td>-</td>
</tr>
<tr>
<td>Threshold Area Requiring Irrigation</td>
<td>35%</td>
<td>-</td>
</tr>
<tr>
<td>Area Requiring Irrigation</td>
<td>-</td>
<td>7.0%</td>
</tr>
<tr>
<td>Irrigation Need</td>
<td>-</td>
<td>NO</td>
</tr>
<tr>
<td>Area Over-Irrigated</td>
<td>0.0%</td>
<td>-</td>
</tr>
<tr>
<td>Min Applied Water</td>
<td>-</td>
<td>0.0 inch/d</td>
</tr>
<tr>
<td>Max Applied Water</td>
<td>-</td>
<td>0.0 inch/d</td>
</tr>
<tr>
<td>Time Until Next Irrigation</td>
<td>-</td>
<td>1 days</td>
</tr>
</tbody>
</table>

### Irrigation Map

- **Urgent Irrigation**
- **Irrigation**
- **No Irrigation**
- **Over-Irrigation**
- **No Vegetation**

### Informe Diario

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hoy</th>
<th>Mañana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hora Local de Pase Del Satélite</td>
<td>13:17</td>
<td>-</td>
</tr>
<tr>
<td>Cobertura Vegetal</td>
<td>92.3%</td>
<td>-</td>
</tr>
<tr>
<td>Umbral de área Requiere Riego</td>
<td>35%</td>
<td>-</td>
</tr>
<tr>
<td>Área Requiere Riego</td>
<td>-</td>
<td>7.0%</td>
</tr>
<tr>
<td>Necesidad de Riego</td>
<td>-</td>
<td>NO</td>
</tr>
<tr>
<td>Área Con Riego Excesivo</td>
<td>0.0%</td>
<td>-</td>
</tr>
<tr>
<td>Mínima Agua a Aplicar</td>
<td>-</td>
<td>0.0 inch/d</td>
</tr>
<tr>
<td>Máxima Agua a Aplicar</td>
<td>-</td>
<td>0.0 inch/d</td>
</tr>
<tr>
<td>Tiempo Hasta el Próximo Riego</td>
<td>-</td>
<td>1 días</td>
</tr>
</tbody>
</table>

### Mapa De Riego

- **Riego Urgente**
- **Necesita Riego**
- **Sin Riego**
- **Sobre Riego**
- **Sin Vegetación**
Familiarize the portal prior to the irrigation season

Remarks and suggestions to support@irriwatch.com