



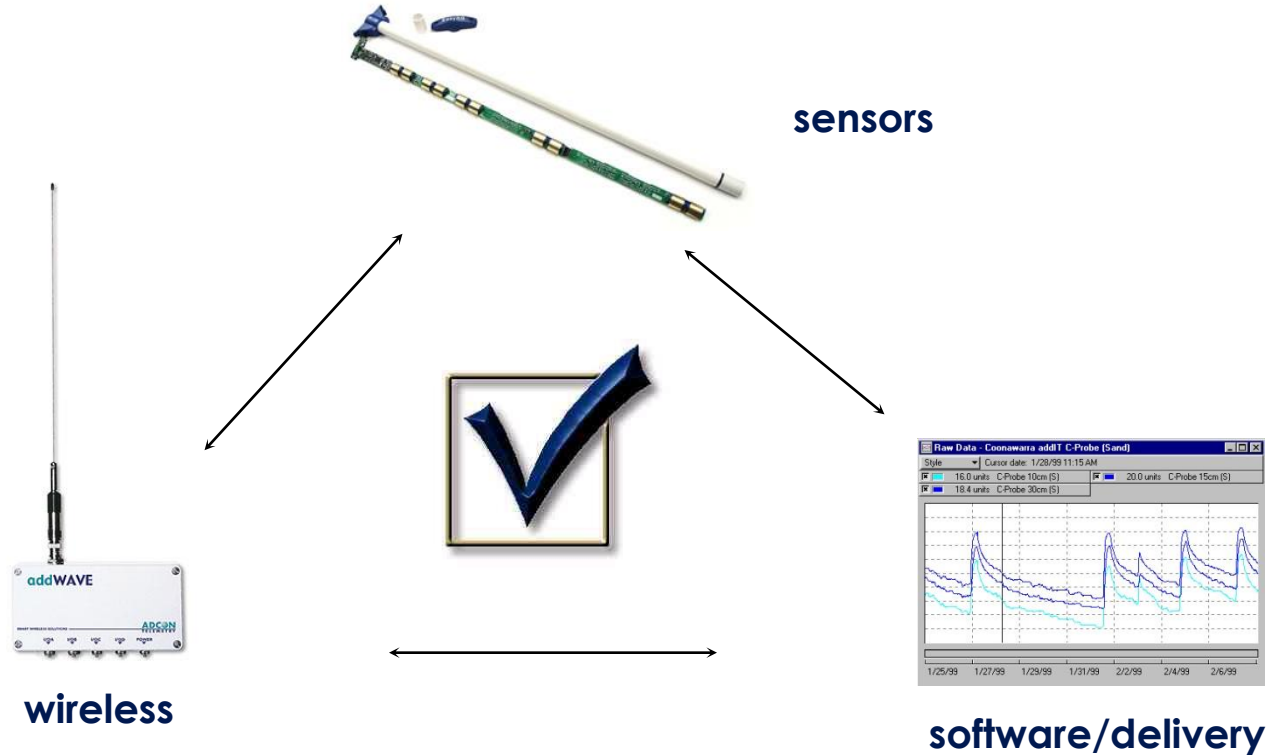
# CONNECT Wireless Monitoring Soil Moisture & Irrigation Systems

© 2015 by McCrometer Inc. & Crop Production Services

» System – Sensor to Desktop



*Integration is done for you ....*

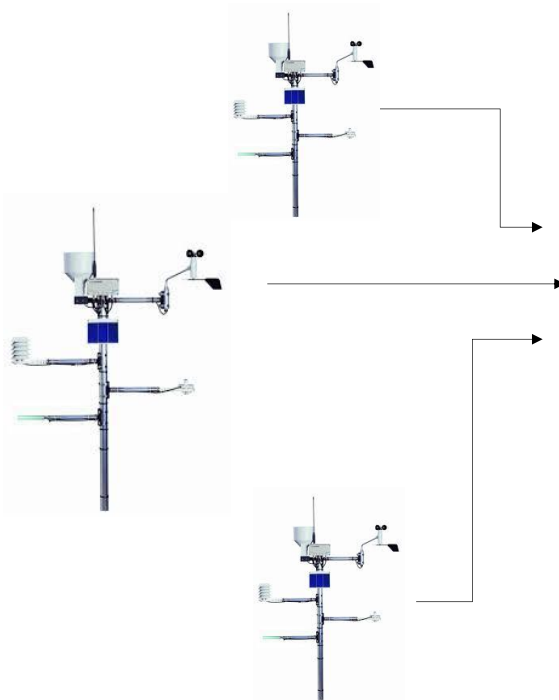


*...it is a **system** not just the individual components...*

# » Complete CONNECT System



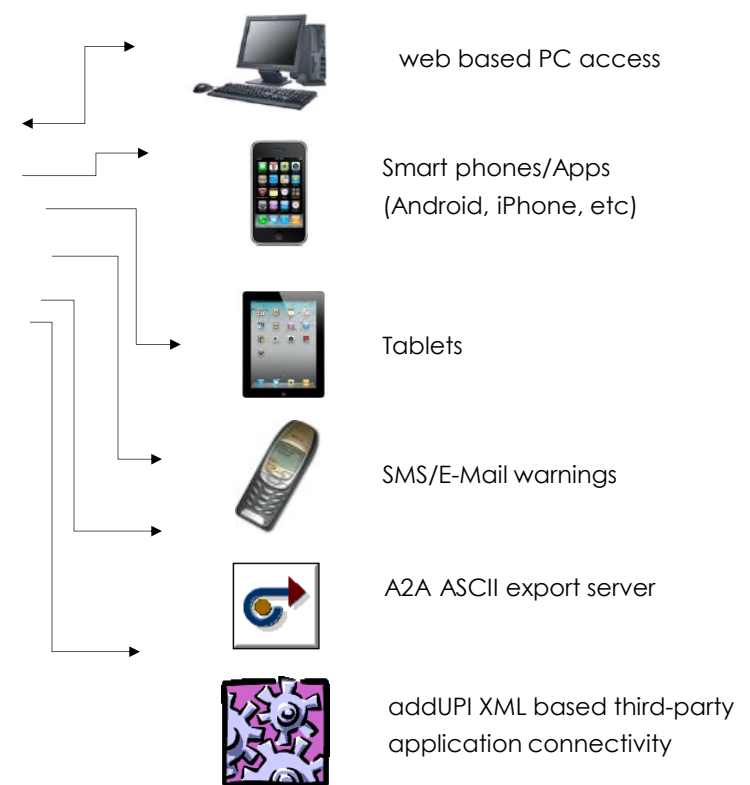
## Field Stations



## Central Server



## End user



## » Field Station Tool Box

- » Communication options
- » Full Integration - Ease of Use



## » Field Stations – Common Features

» **Complete integration:** each station integrates 5 components:

- Logger
- Radio
- Battery Pack
- Waterproof connectors & case
- Designed for solar panel operation

**Advantages:**

- Ease of installation
- Ease of maintenance
- Simple pole sufficient for mounting
- Very low risk of vandalism or theft



## » Common Wireless Communication Options



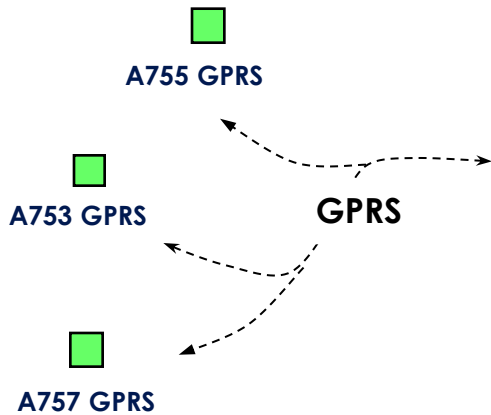
- **Satellite**
  - can be sited anywhere with view of horizon
  - \$\$\$ cost of transmission
- **Cellular**
  - Requires cellular service provider
  - easy to site under coverage
  - \$\$ transmissison costs
- **Radio**
  - point-to-multi point
  - short & long range
  - \$ lowest transmissison costs
  - create/maintain wireless infrastructure



## » Flexible Wireless Options

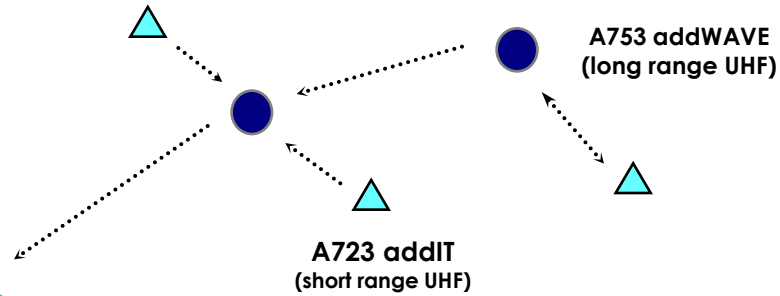


### Stand Alone GPRS Stations

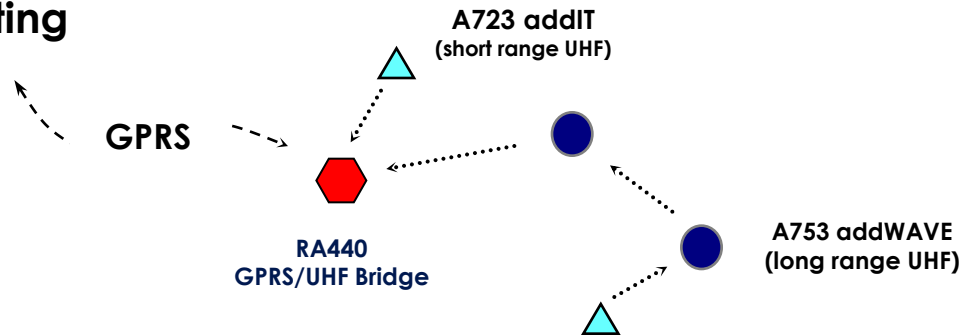


**CropConnect™**  
CPS/Crop CONNECT  
Hosting

### Local UHF Network



### Remote Radio Networks



## » Wide Choice of Plug-N-Play Sensors



- High Quality & Professional Grade Lines
- Reputable Manufacturers

*McCrometer*

*Adcon*

*Streat Instruments*

*Irrrometer*

*EnviroPro*

*Acclima*

*Keller Druck*

*Nason*

*Pronamic*

*C-Probe*

*Kipp & Zonen*

*Hukseflux*

*Water Specialties*

*Decagon*

*ESI*

*Campbell Scientific*

*Stevens Water*

*INW USA*

*OTT*

*Sentek*

*Vaisala*

*and more ...*





## » Single Platform - Multiple Applications

- » Weather / Evapotranspiration (ET)
- » Disease Risk / IPM
- » Frost Monitoring
- » Soil Moisture Monitoring
- » Irrigation System Monitoring



## » Weather Applications



- Site specific weather
- ETo (evapotranspiration)
- Disease Risk Monitoring
- Degree days / IPM



## » Reference Evapotranspiration



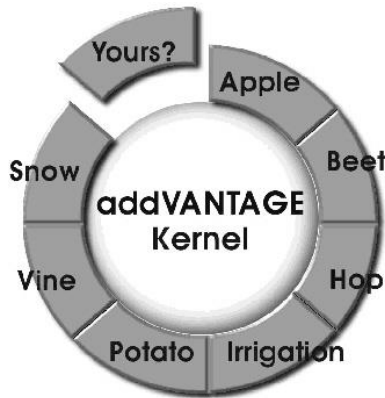
- Irrigation scheduling based upon calculating crop water use
- Penman-Monteith FAO Equation
- Crop coefficients are used to adjust crop water use for crop type and growth stage
- Growers use a “replacement” strategy and irrigate with the quantity of water used by the plant



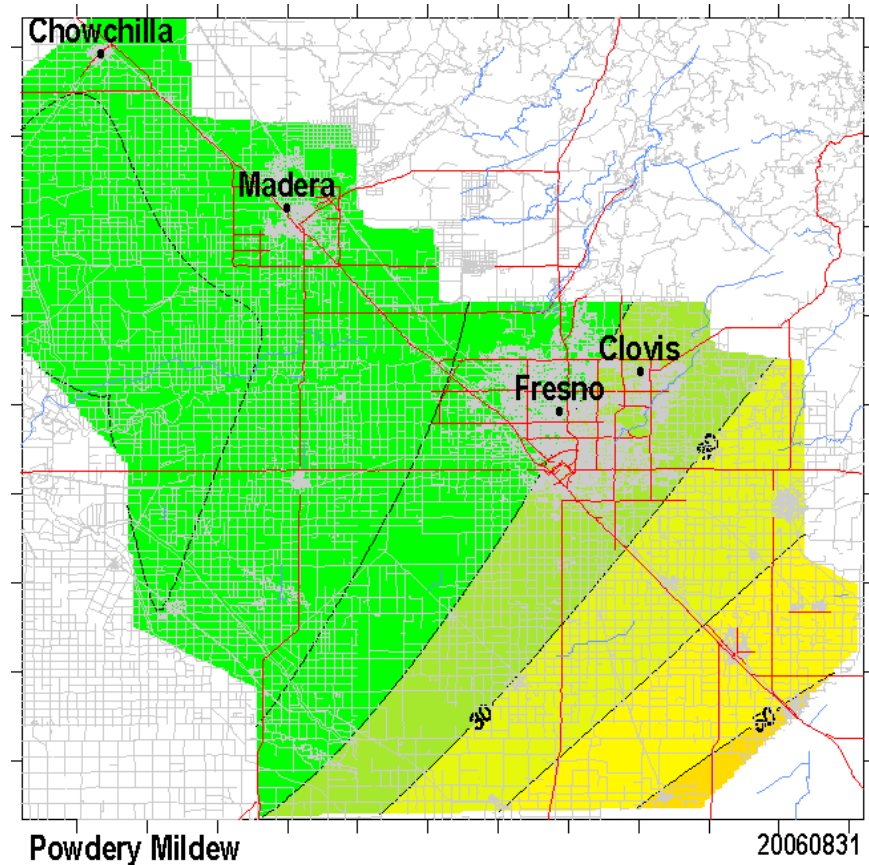
## » Site Specific Weather



- Site specific weather
- Robust risk models
- Optimized control efforts



Maps courtesy of Crop Production Services Madera, CA

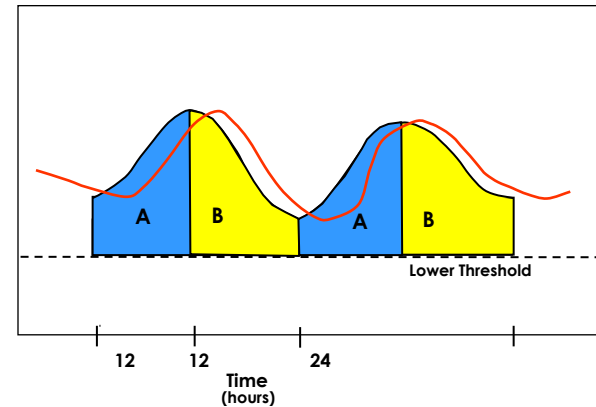


## » Degree Day & Chilling Hours



- 5 Degree day calculation methods
- Calculates daily and accumulated values

Events - 3000 - Standard Station		
Date	Duration	Comments
8/1/96		Heatunit - Wine Grapes - cumulative value 2337.6
8/1/96		Heatunit - Wine Grapes - daily value 16.5
8/2/96		Heatunit - Wine Grapes - cumulative value 2352.5
8/2/96		Heatunit - Wine Grapes - daily value 14.8
8/3/96		Heatunit - Wine Grapes - cumulative value 2370.0
8/3/96		Heatunit - Wine Grapes - daily value 17.6
8/4/96		Heatunit - Wine Grapes - cumulative value 2389.8
8/4/96		Heatunit - Wine Grapes - daily value 19.7
8/5/96		Heatunit - Wine Grapes - cumulative value 2406.7
8/5/96		Heatunit - Wine Grapes - daily value 16.9
8/6/96		Heatunit - Wine Grapes - cumulative value 2425.1
8/6/96		Heatunit - Wine Grapes - daily value 18.3
8/7/96		Heatunit - Wine Grapes - cumulative value 2443.0
8/7/96		Heatunit - Wine Grapes - daily value 18.0

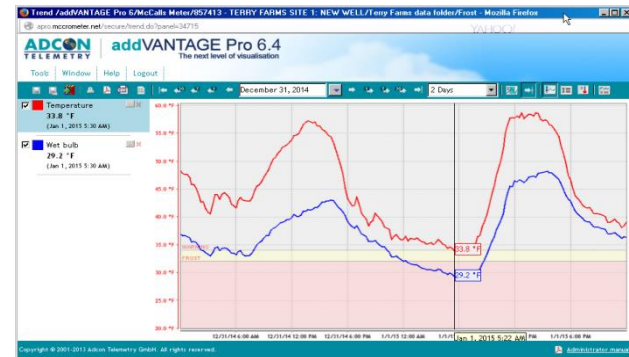


- Ready to work with most IPM DD pest models
- User set warnings & thresholds

## » Frost Monitoring



- Three measurement types  
Wet bulb, dry bulb &  
dew point
- User defined warning thresholds
- Warning Options  
SMS/text  
SIP (text to voice call)



## » Soil Moisture Sensors

- » Brands & Models
- » Types of Sensors
- » Soil Moisture Display
- » Additional Irrigation Sensors



## » Soil Moisture Sensors



- Wide range of soil moisture sensors on the market
- McCrometer telemetry compatible with 25+ brands/models

*Sentek*

*EasyAg, EnviroSMART probes, Drill & Drop  
(various lengths)*

*Adcon*

*SM-1 probe (various lengths)*

*Streat Instruments*

*Aquaflex*

*Decagon*

*5TM, 5TE, HS10, MPS1 & 2, Echo 5/10/20*

*Irrrometer*

*Watermark & tensiometers*

*ESI*

*GroPoint, GroPoint Lite*

*EnviroPro*

*Standard, Lite*

*Campbell Scientific*

*655 TDR*

*C-Probe*

*various lengths*

*AquaSpy*

*various lengths*

*AquaCheck*

*various lengths*

*Stevens Water*

*Hydraprobe*

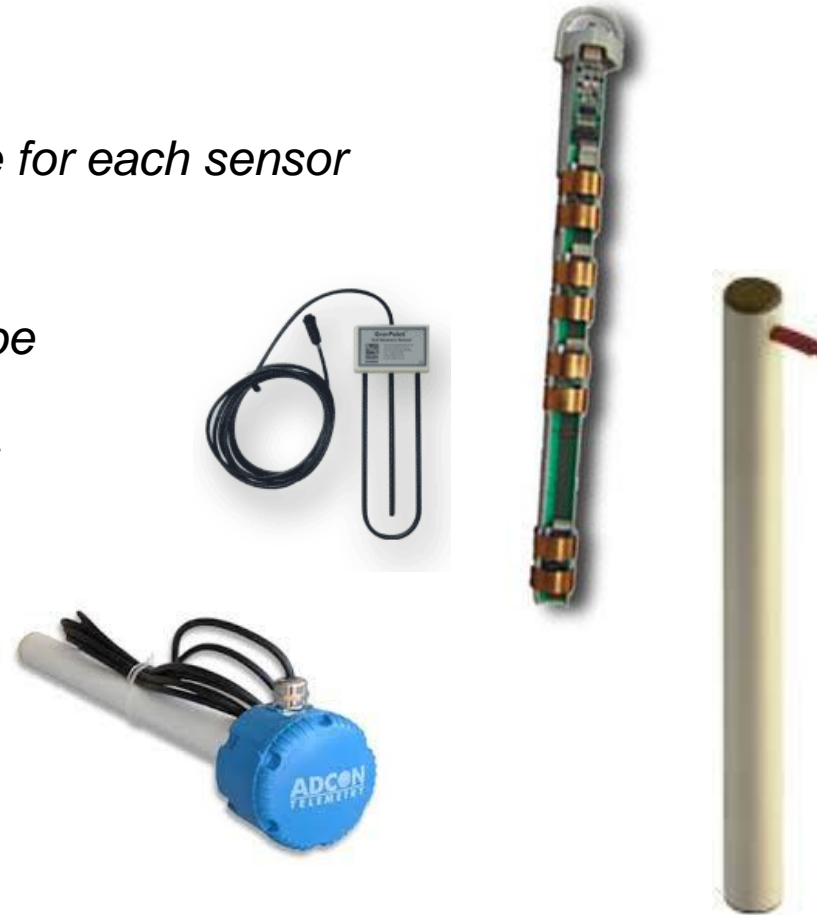




## » Types of Sensors



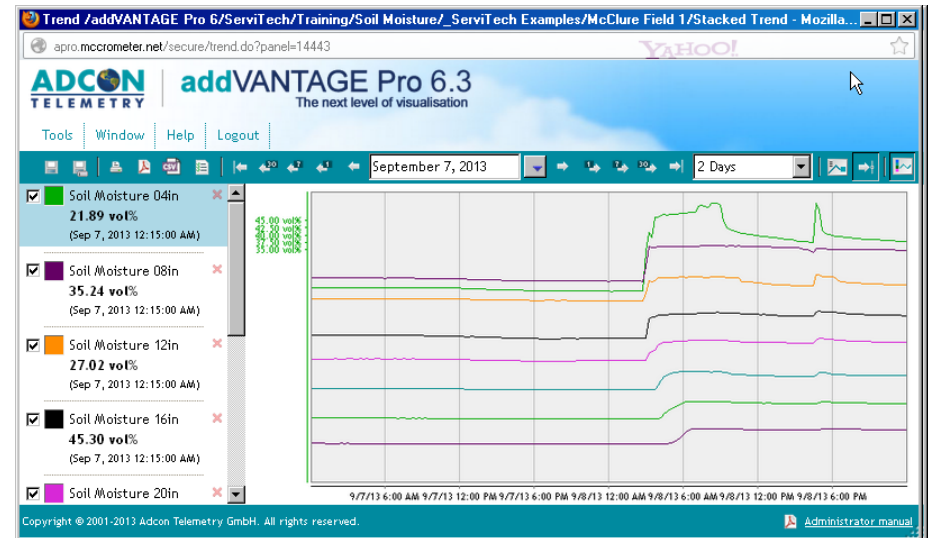
- Single sensor/probe  
*single sensor for one depth*  
*usually requires a separate hole for each sensor*
- Multi-depth probe  
*Multiple sensors in a single probe*  
*access tube based*  
*sealed and non-sealed versions*
- Multi-parameter probe  
*moisture*  
*temperature*  
*salinity or conductivity*



## » Data Display – Separate Layer Graph



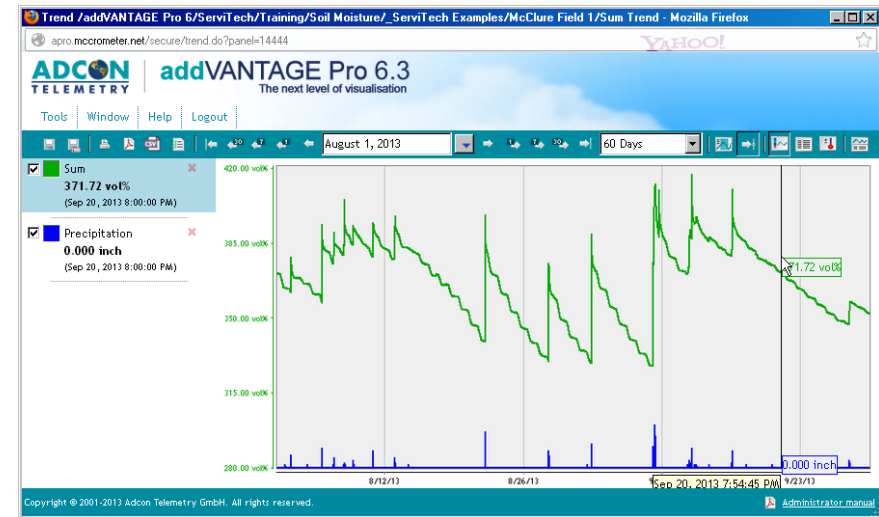
- Raw data
- Sort the lines  
*no overlap*  
*Sorted by depth*
- Zoom in to see detail
- Display like a soil profile



## » Data Display – Summed or Average Graph



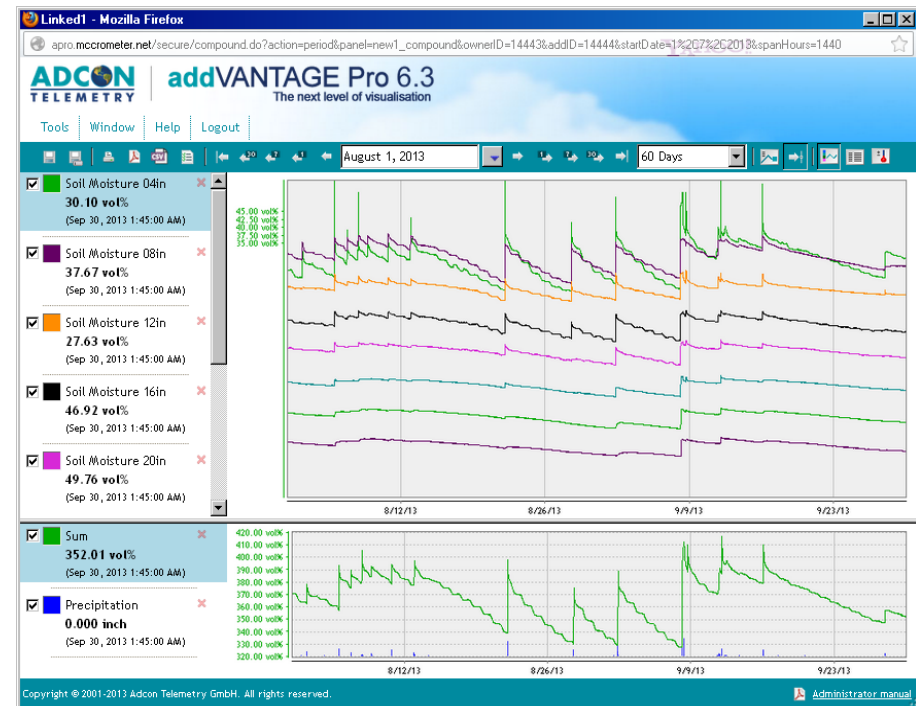
- Single Curve
- Represents whole root zone
- Shape of summed and average curve is the same



## » Data Display – Dual Panel Separate/Summed Trend



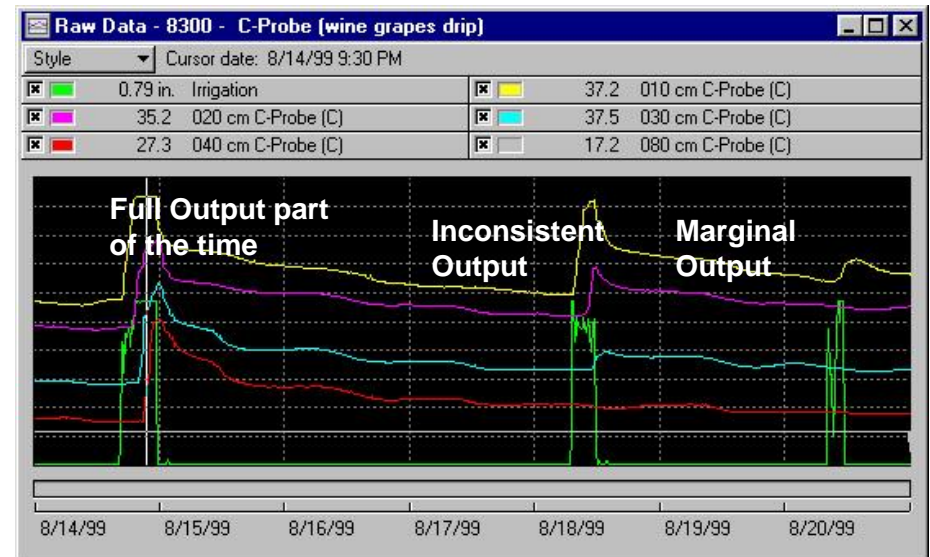
- Viewing curves together is very useful
- Patterns in this example:
  - reaction to irrigation /rain event
  - depth of irrigation
  - infiltration rate
  - crop water use
  - implied “available” water
- *Patterns/Trends are useful irrespective of engineering unit*



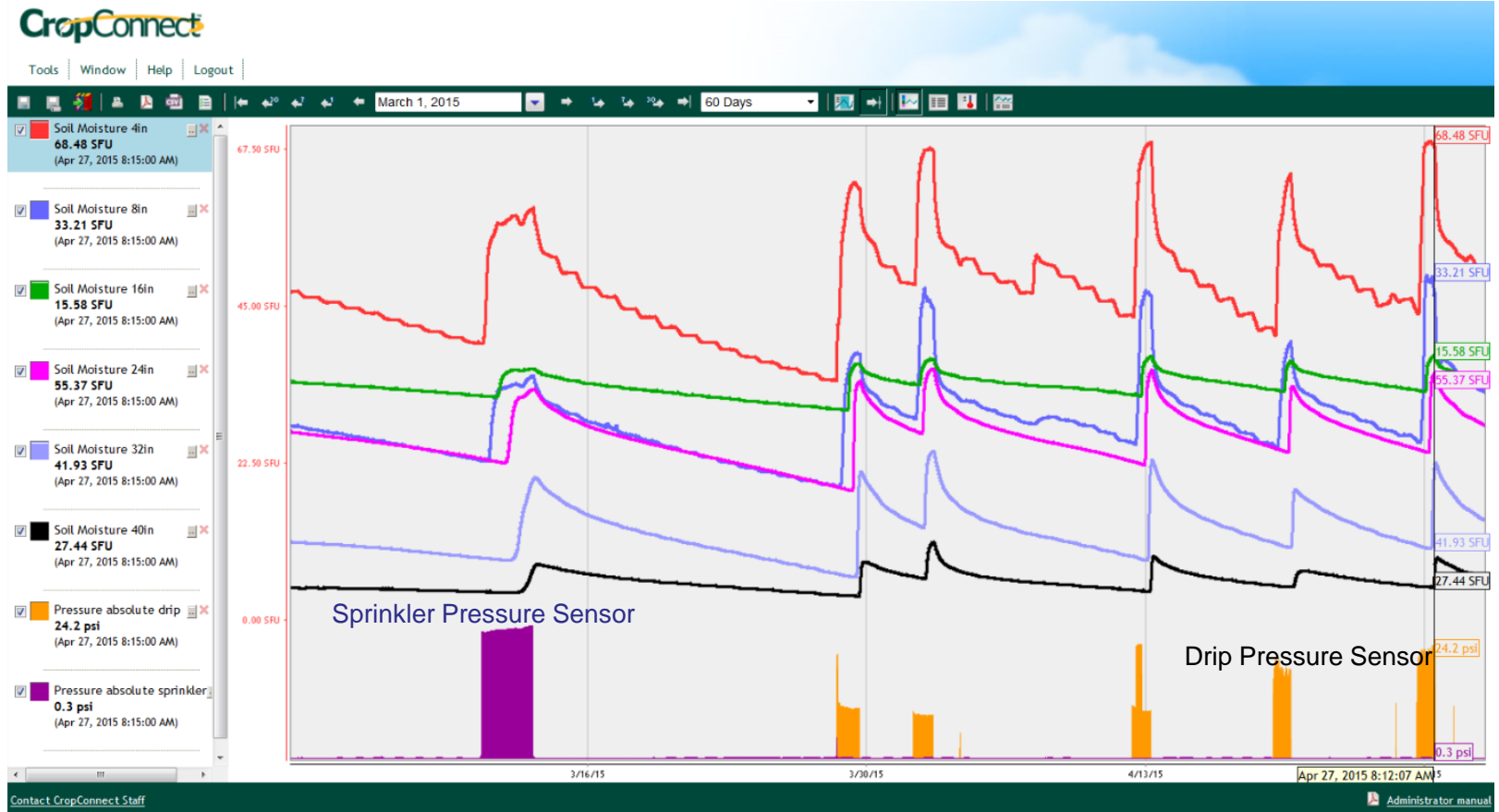
## » Complementary Irrigation Measurement



- Highly recommend to quantify irrigation delivery
- Irrigation quantity or runtime
- Distinguish between rain and irrigation
- Gives consultants an edge when you do not have the grower's irrigation schedule.



## » Multi-Depth Probe With Dual Pressure Sensors



## » Irrigation System Monitoring

- » Pump/Flow Monitoring
- » Pressure
- » Well Water Level
- » Fertigation



## » Types of Flow Meters



- Mechanical propeller meters
- „Insertion“ meters
- Digital propeller meters
- Battery operated mag meters
- Full bore mag meters

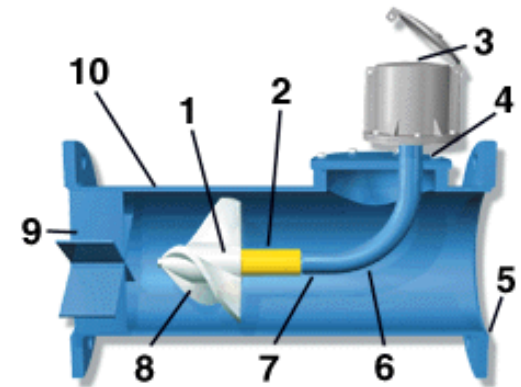




## » Pulse outputs



- Wide range of flow meters provide pulse outputs for loggers/recorders
- Typically provide a pulse per unit volume  
*example: 1 pulse = 100 gallons*
- Pulses are accumulated for every time slot then the sum is reported
- Mechanical meters requires a transmitter to create the incremental pulse out



## » Other Meter Outputs



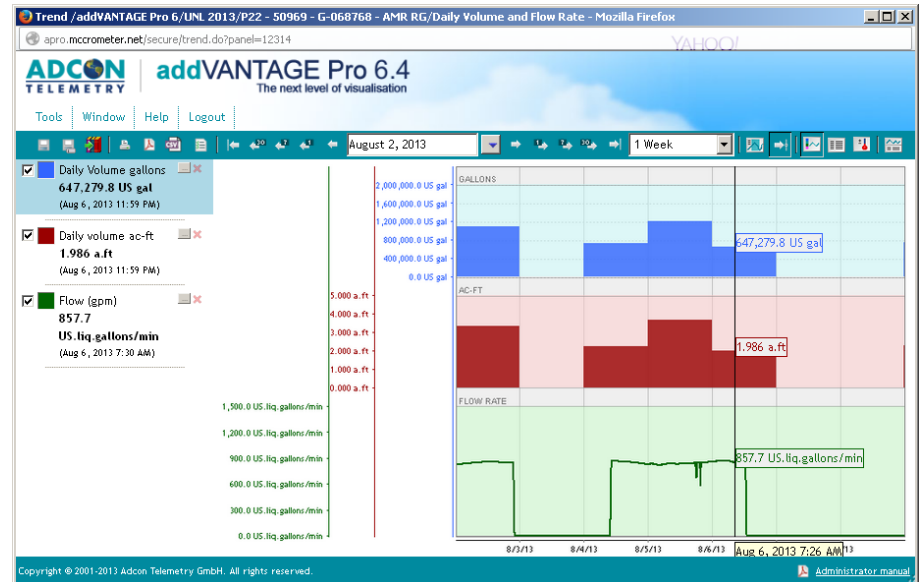
- Some meters can provide digital pulse outputs
  - *Example is McCrometer FlowCom register*
  - *Pulse rates and widths need to match field station capability*
- Flow Converters/Computers on mag meters etc often of 4-20mA outputs
  - *4-20mA outputs typically used to read instantaneous flow rate.*



## » Volume vs. Flow



- In most cases only volume is monitored
- Flow rate is for database purposes is typically calculated
- Lower sampling rate
- Higher water use accuracy
- Typical sampling period in agriculture is 15 minutes



## » Other AMR/Pump Monitoring Sensors



- Pressure Sensor
  - 1/2" NPT fitting*
  - 0-145 PSI range*
  - 1.0% accuracy FS*
- Pressure Switch
  - 1/2" NPT fitting*
  - various threshold (% PSI and up)*
  - indicates on/off status*
- Excellent complementary sensor to flow meter
  - can indicate flow if meter is broken*



## » Maintenance



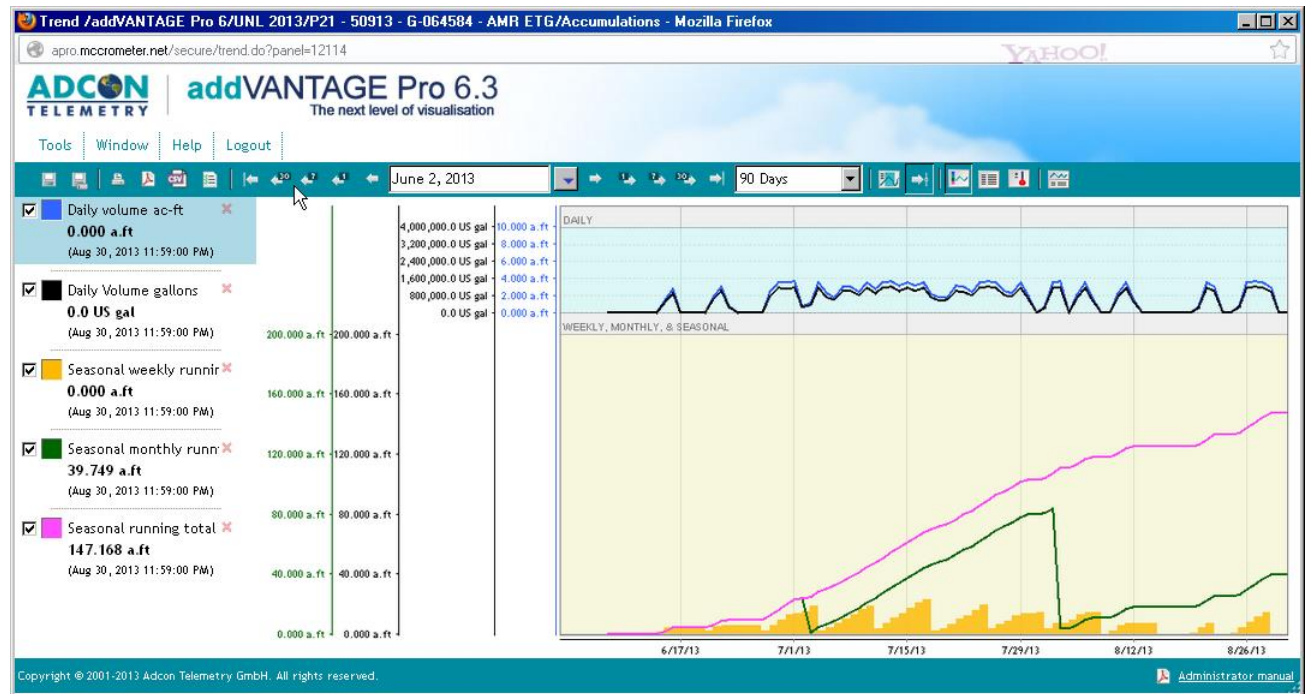
- Minimal maintenance on AMR / BPM stations
  - *clean solar panel & field station*
  - *check cables*
  - *normal flow meter maintenance*



## » AMR – Automatic Meter Reading



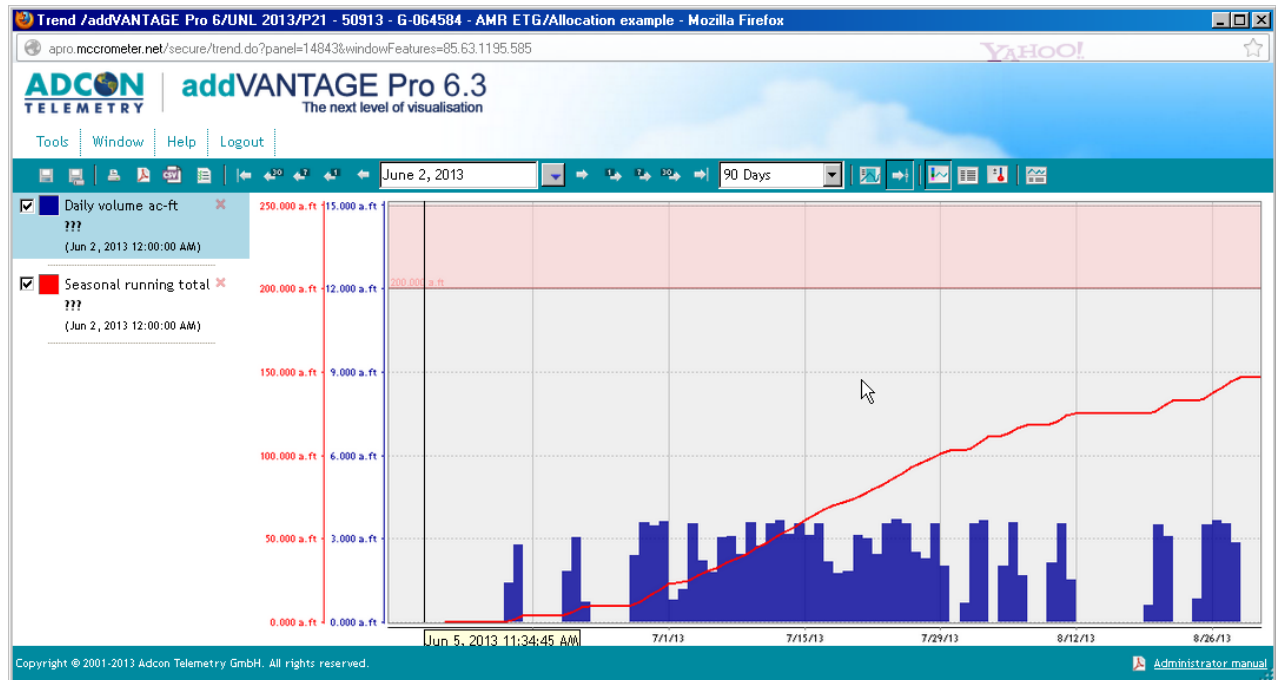
- Typically “record keeping in nature”
- Daily, monthly, seasonal usage etc.



## » Allocations



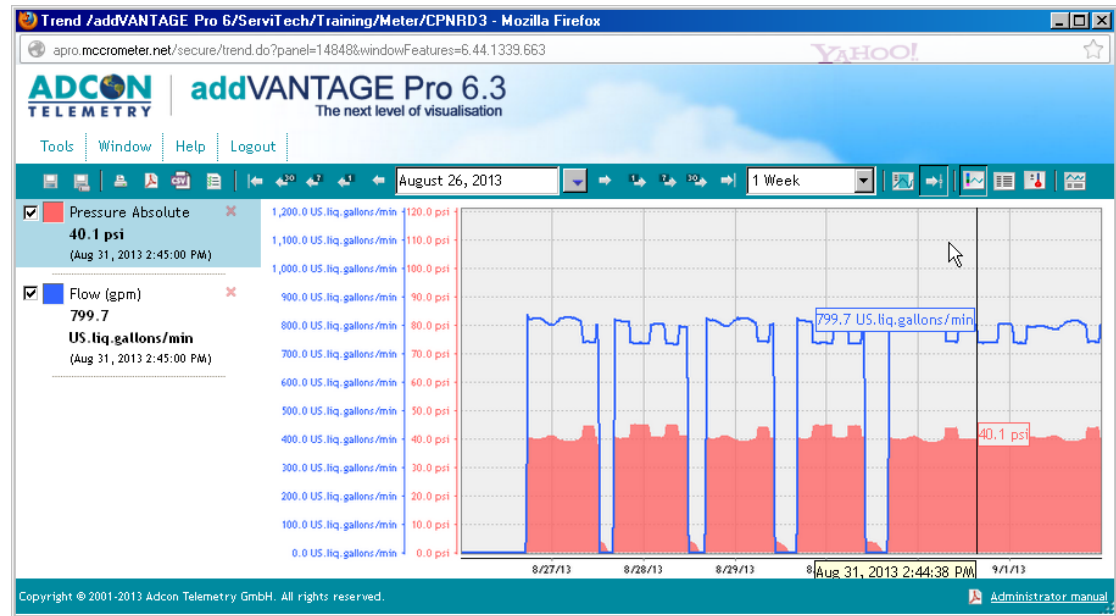
- Running totals / seasonal water use easy to set up
- Easy to track relative to seasonal allocation



## » Basic Pump Monitoring



- AMR with addition of pressure sensor
- Can now compare flow rates and operational pressure
- Identify problems before they become serious

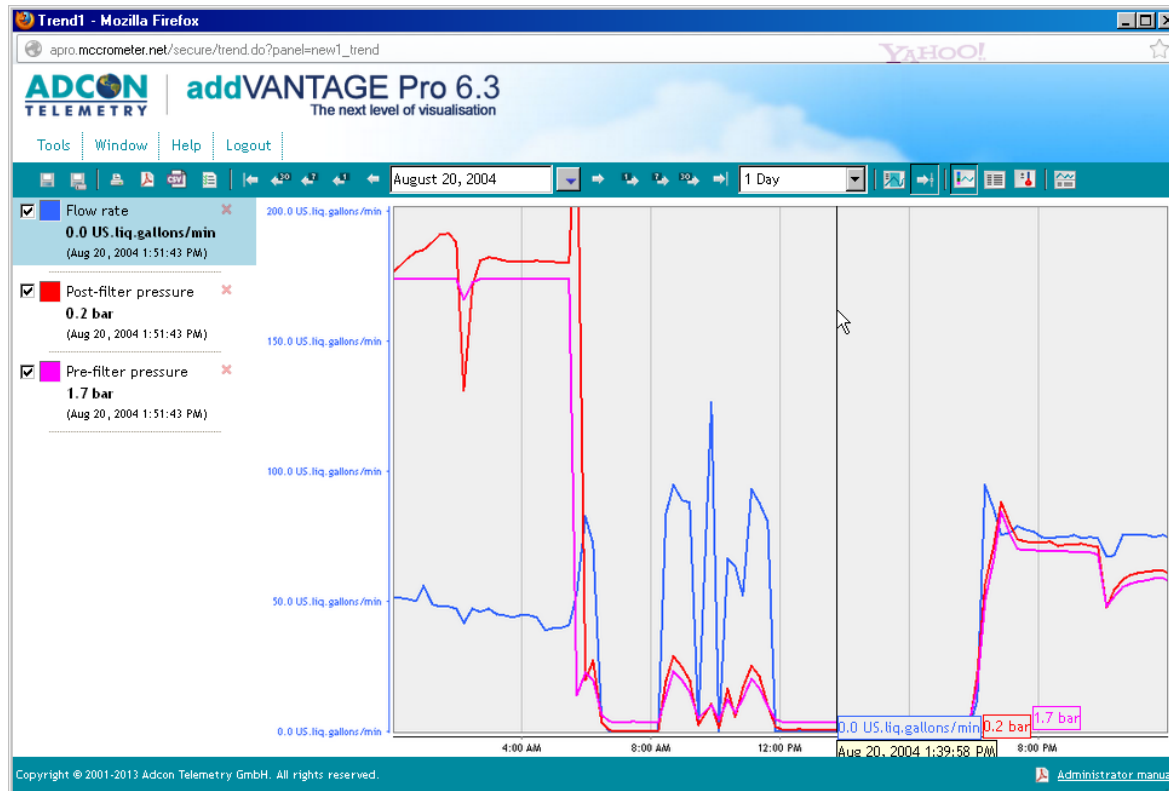




» Basic Pump Monitoring



# Problem & Correction



## » Pump and Well Management



- **Water level**

*Canals*

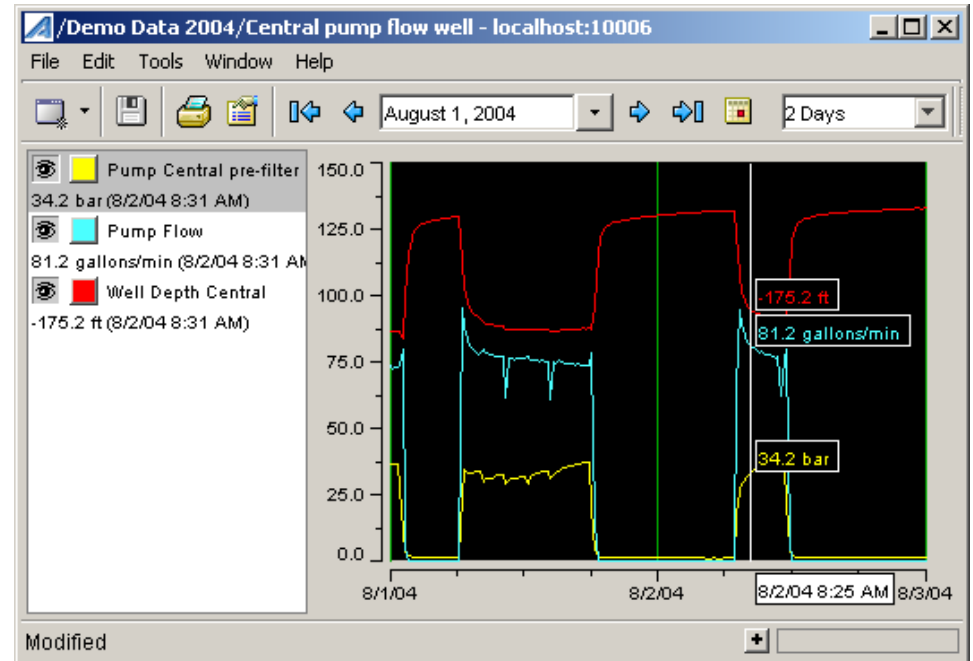
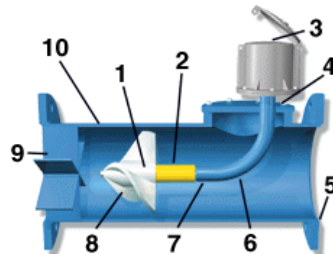
*Reservoirs / ponds*

*Wells*

*Deep well*



- **Water Meters**



## » Fertigation and Small Line Size Meters



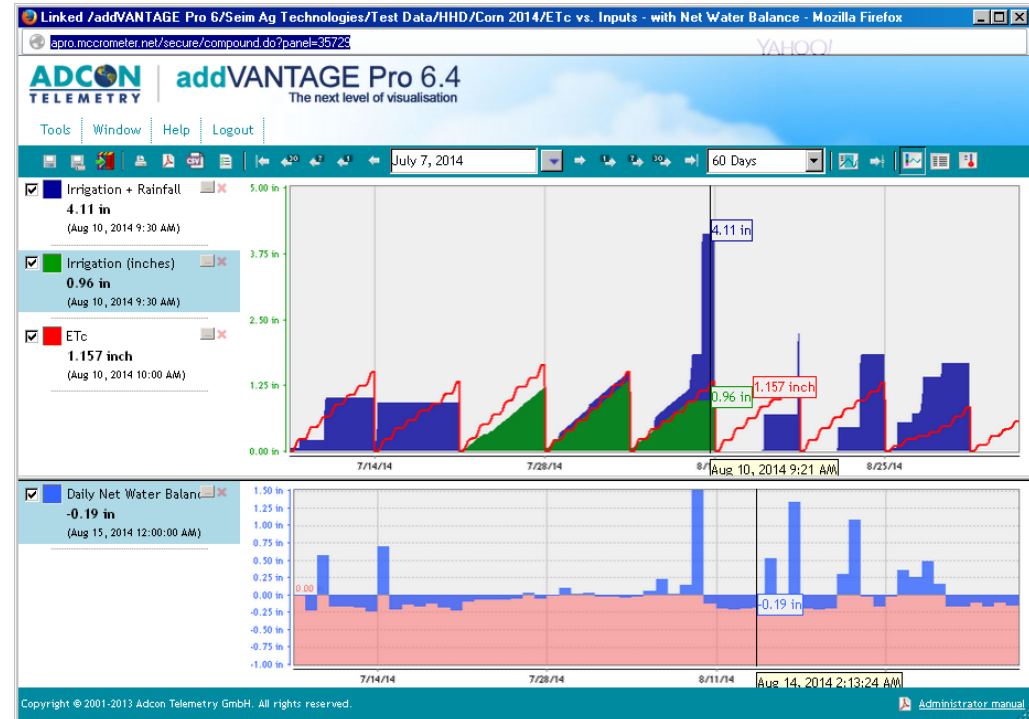
- *Flow meters for smaller lines*  
*Monitoring individual irrigation blocks*  
*Typically 3/4" to 3"*
- *Ultra small line size*
  - *fertigation systems*
  - *1/8" to 1/4" lines*
  - *combine with pump data to monitoring injections rates and quantities*



## » Water Use & Reference ET



- Water use data from flow meter compared against ETo/ETc
- Irrigation by block
- Inches actually applied can now be compared with ET
- Can be done daily, weekly etc.





Thanks!!!

