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Precision Hydromet Instrumentation

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Presenters

- Michael Watt, Host

- Kerry Hubbard, YSI
  - Outdoor Water Monitoring Specialist
  - Decade of HydroMet monitoring experience
  - Passion for urban hydrology

Transmission Order

- Submersible Pressure Transducers
- Shaft Encoders
- Amazon Bubbler
- Nile Radar
- Storm 3
- HydroSphere

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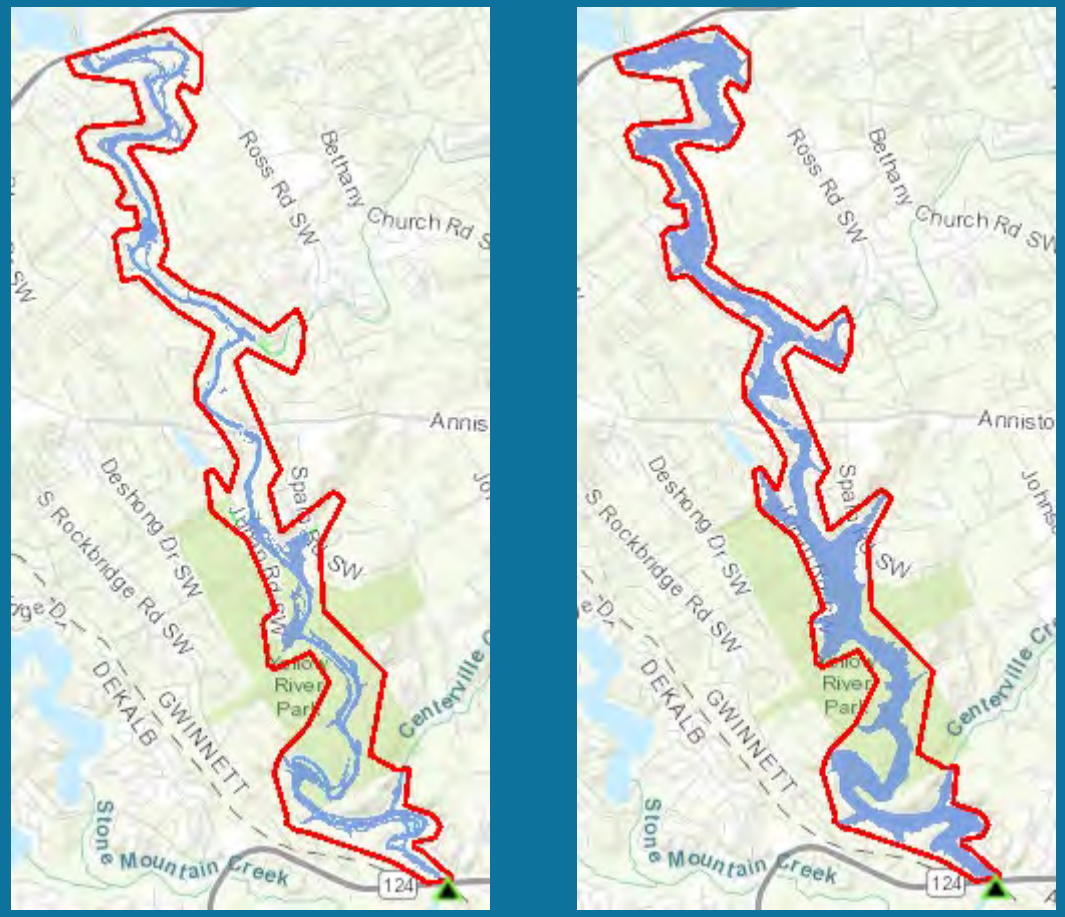
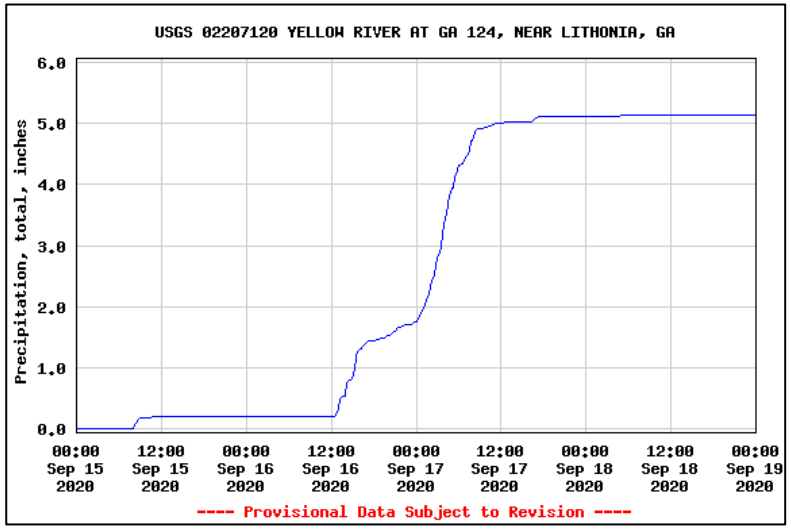
What is HydroMeteorology?



USGS

- Combines meteorology and hydrology
- Studies transfer of water between land and atmosphere
- Example:
  - Meteorologist forecasts 5” of rain
  - Hydrologists model impacts on rivers



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Submersible Pressure Transducers

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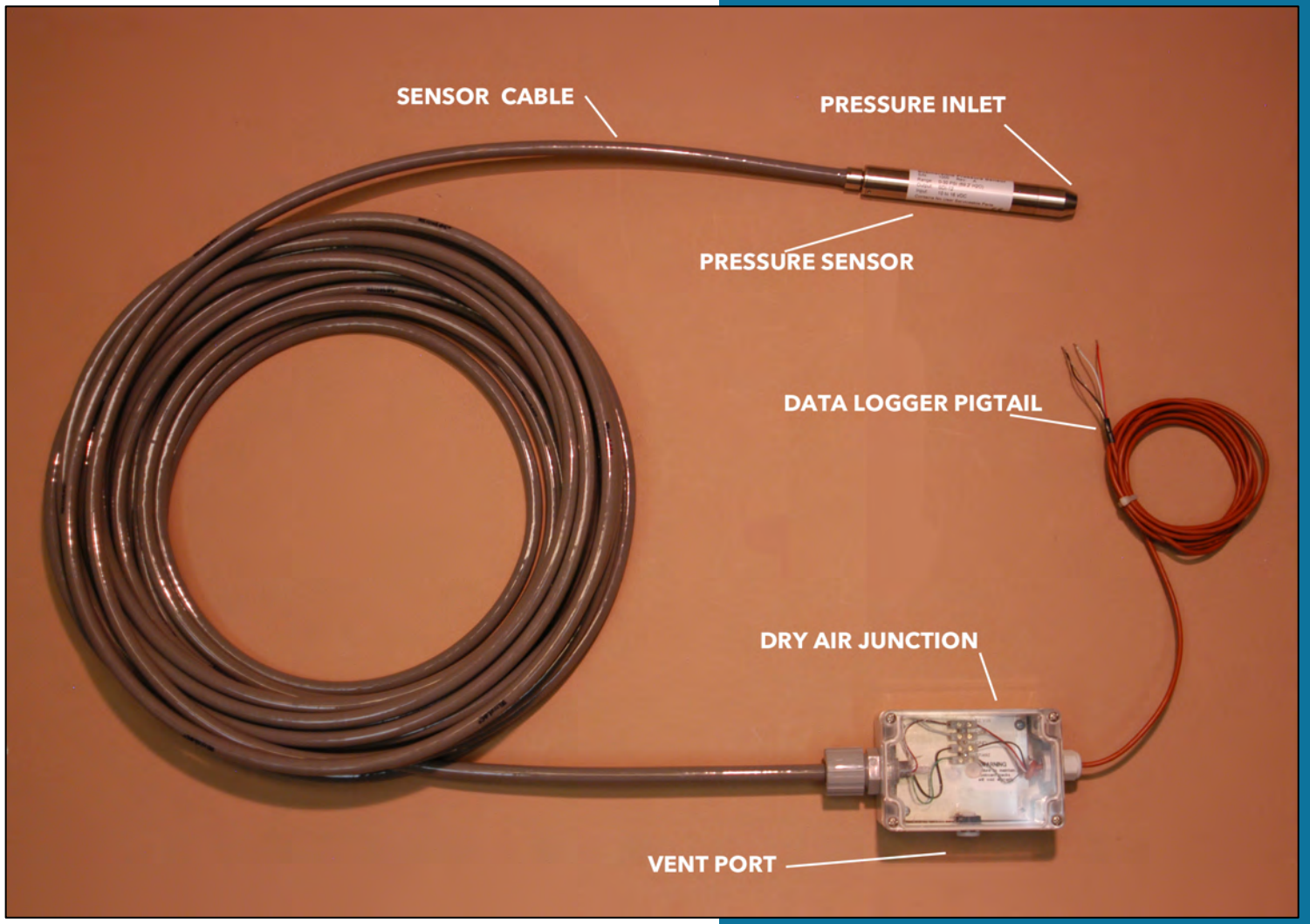
Pressure Transducer Anatomy



Pressure Transducer Advantages

- Vented cable provides on-site barometric compensation
- Very high accuracy
- Stainless steel design
- Dry air box to keep vent tube dry

- Must be deployed in a no-flow environment
  - “Stilling Well”
  - Groundwater wells
  - Stand pipes

How It Works

- Set up in stilling well/sand point/well
- Sensor measures water pressure
- Compensates using air pressure
- All calculations performed internally

Applications: Irrigation

- Image from deployment in Europe
- Transducer mounted in stilling well
- Very accurately measuring baseflow and flooding conditions
- Also able to monitor amount of water used by agriculture

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Sensors – Shaft Encoders

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Shaft Encoder Anatomy

Pulley Wheel

LCD Display

Electronics Housing

Adjust Knob

Read Button

Output Connections

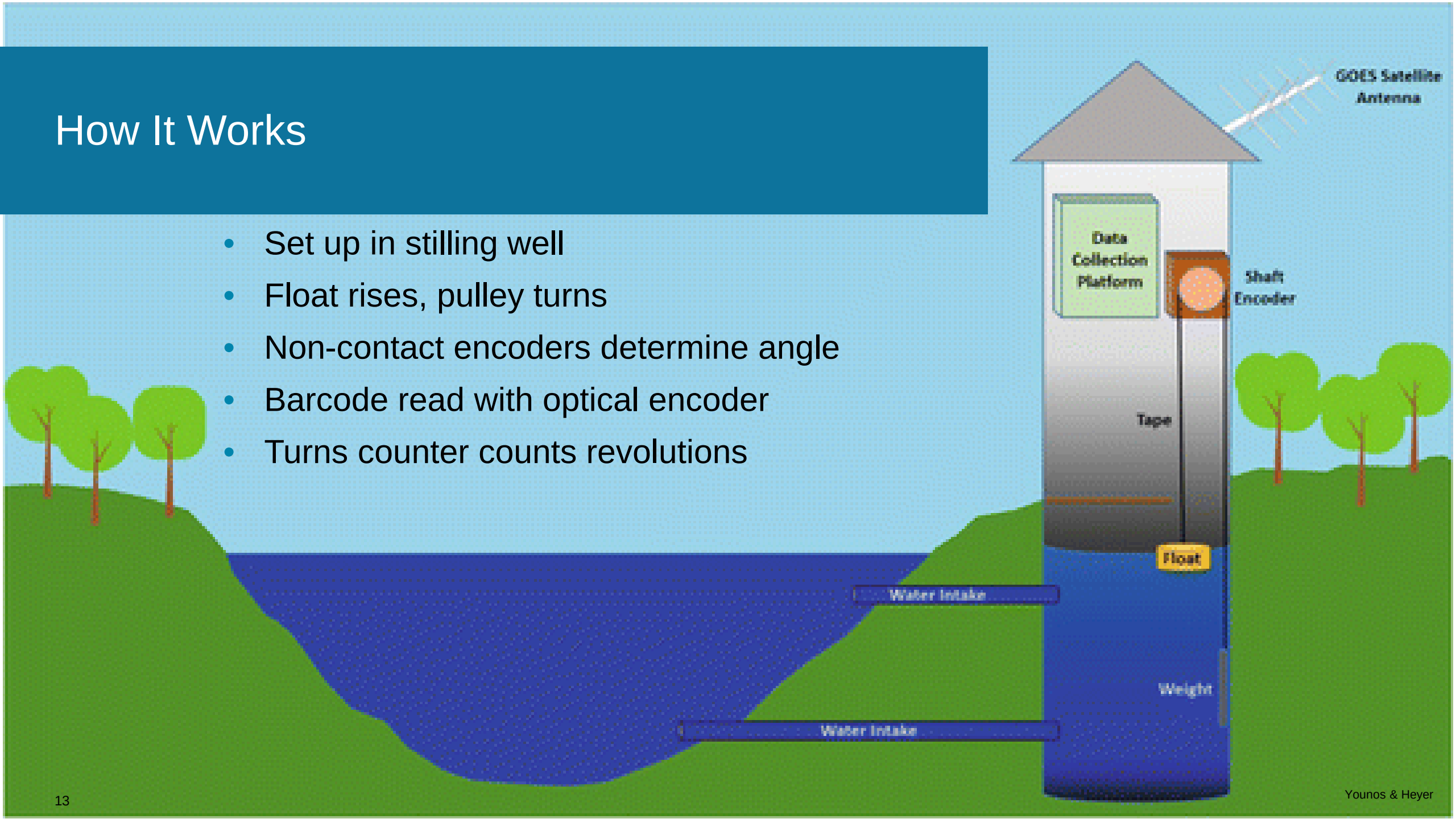
Shaft Encoder Advantages

- Non-Contact Optical Encoder
- Position Not Lost
- Threaded Shaft Compatible with Other Pulleys

- Ideal deployment in stilling wells
  - Not ideal for turbulent environments

How It Works

- Set up in stilling well
- Float rises, pulley turns
- Non-contact encoders determine angle
- Barcode read with optical encoder
- Turns counter counts revolutions



Applications: Irrigation Districts

- Del Rio, Texas – Water Rights
- Water level correlated to rating
- Farmers cannot use more than their share
- More accurate than just measuring opening of a gate

Water Monitoring Solutions

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Applications: Early Warning

- Alameda County, California
- Water rights, habitat sustainability, inflow/outflow of surface water, flood control management
- Old equipment made gage house cluttered! Hard to maintain equipment.
- New equipment = easier to maintain → BETTER DATA

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Sensors – Amazon Bubbler

Also known as a non-submersible pressure transducer!

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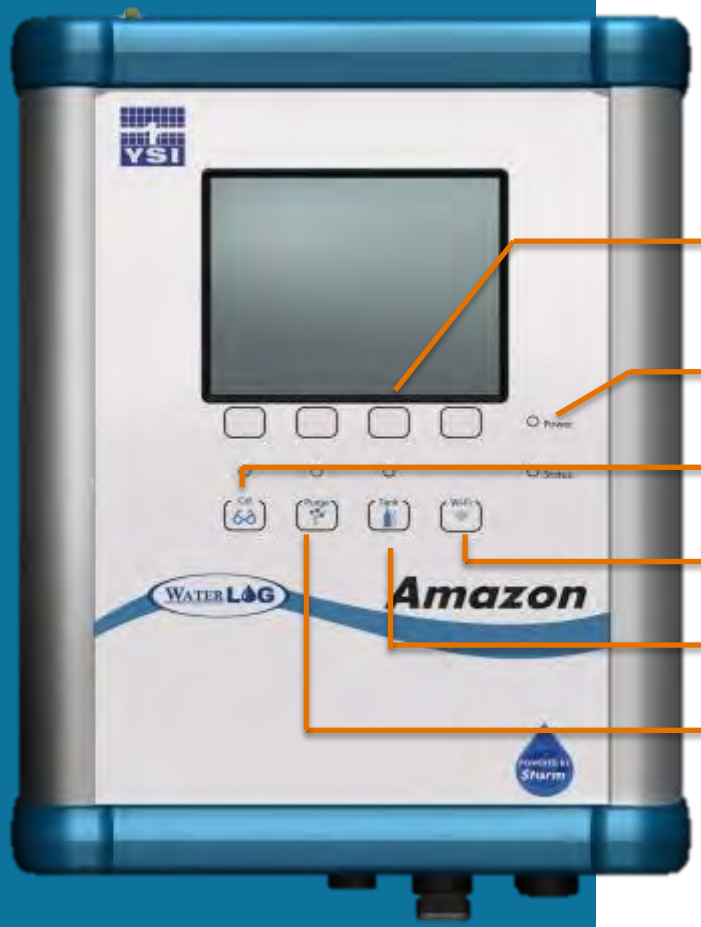
Amazon Bubbler Anatomy



Top Panel Connections

- Display and Control Buttons
- Diagnostic Lights
- Cal Button
- Wi-Fi Button
- Tank Button
- Purge Button

Amazon Bubbler Anatomy

I/O Panel Connections

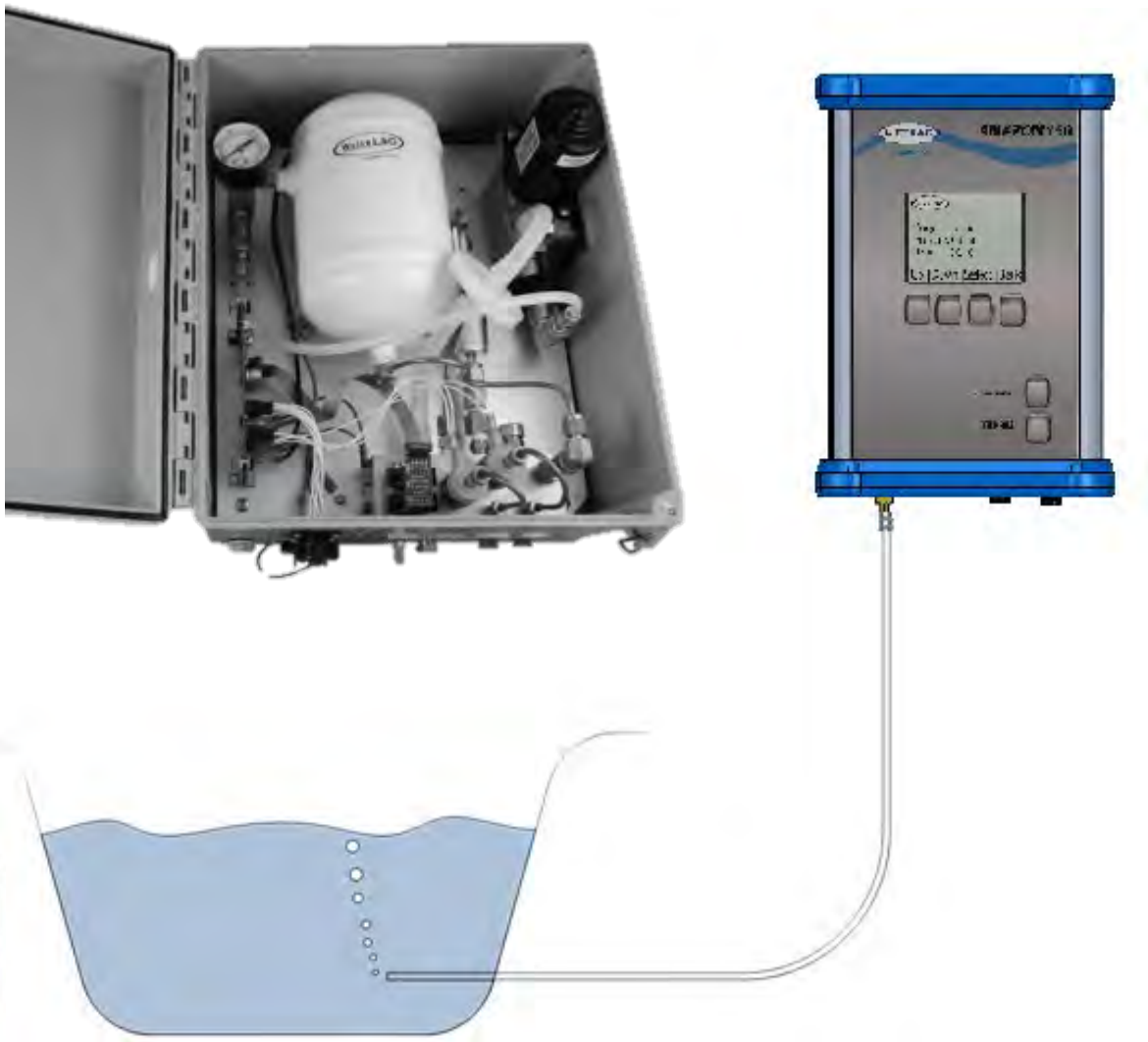
Amazon Bubbler Advantages

- Easy to use browser interface
- Communicates with *any* datalogger
- Internal data logging
- High accuracy
- Continuous bubble and automated purge
- No external pressure sensor required

- Great for use in streams, rivers, lakes
- Orifice line mounted along streambank or down culvert wall

How It Works

- Compressor and holding tank provide a continuous flow of gas bubbles
- Pressure required to maintain flow of bubbles determines depth:
  - Height = Pressure/Specific Gravity
- Don’t forget the desiccant!!



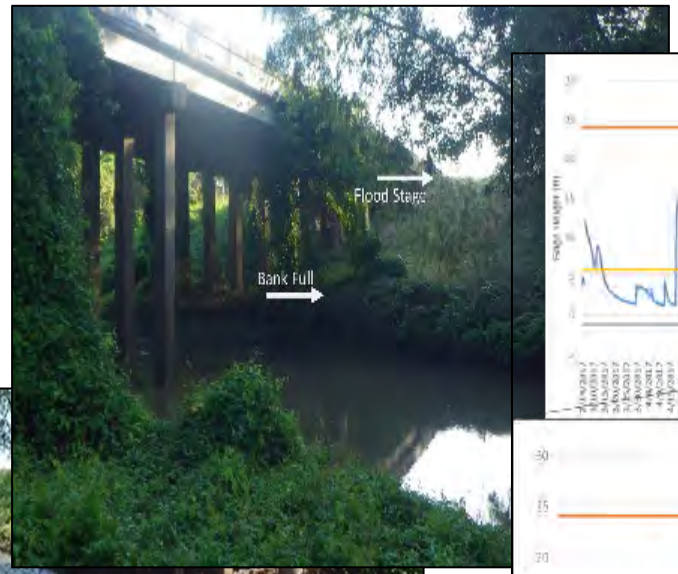
Basic Setup - Web Interface

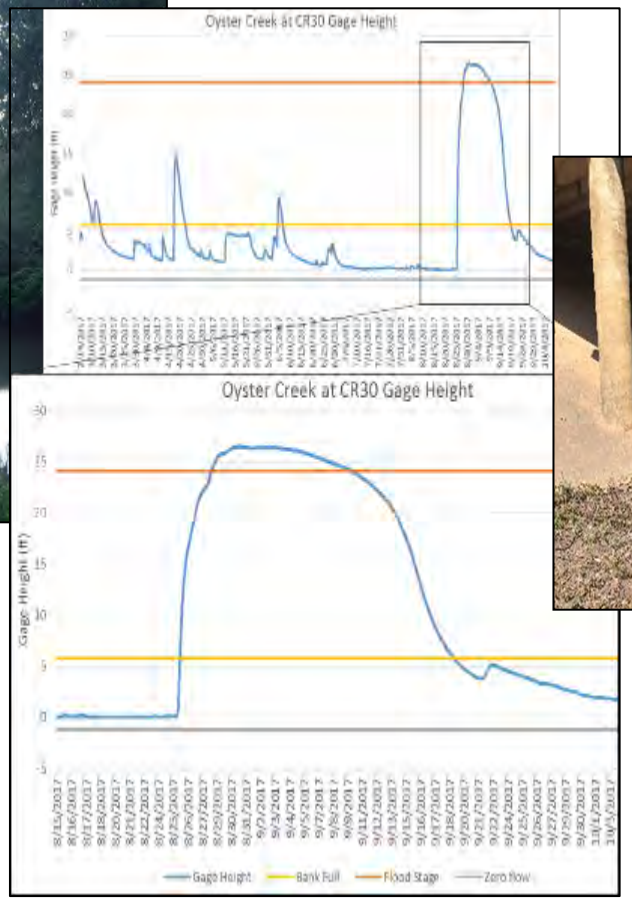
Amazon Menu Options →

Applications: Flood Monitoring

- Contra Costa County in California
- Flood monitoring
- Upgraded from old WaterLOG bubblers due to new features
- Creeks are normally fairly dry
- Rain can quickly lead to floods

Applications: Hurricanes and Stream Changes





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Sensors – Nile Radar

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Nile Anatomy

Nile Advantages

- Easy to install, use, maintain
- Heavy duty housing for outdoor installs
- Communicates with *any* datalogger
- High accuracy up to 70m

- Great for use in streams, rivers, lakes and turbulent environments
- Mount on overhead structures like bridges

Non-corrosive Construction

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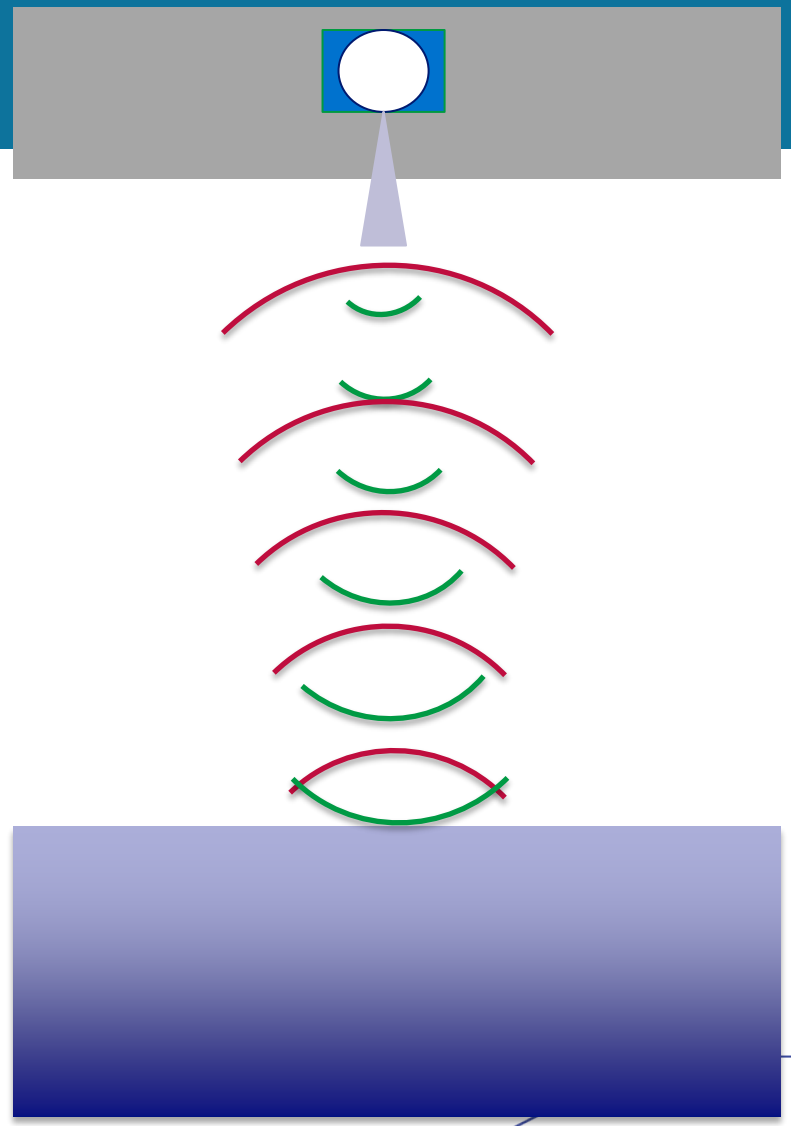
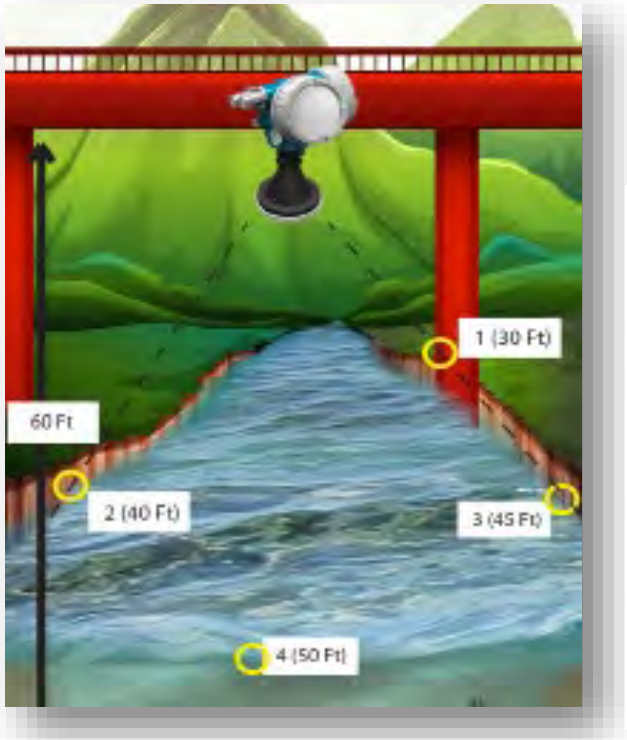
How it Works

- Integrated microwave transmitter and sensor
- Distance to water is proportional to time of pulse
  - D = c * t/2
  - D = distance
  - C = speed of light
    - ~3 million m/s
  - T = time

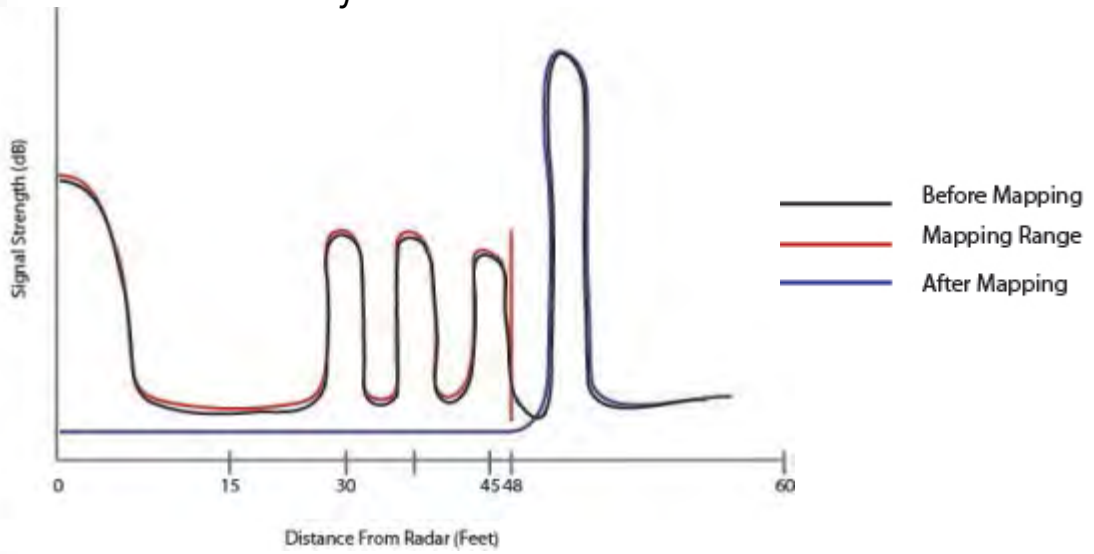


Echo Mapping

The signal from the Nile reflects off everything within its footprint



When adding a map to the instrument, you are creating a threshold that will tell the unit to ignore all false signals before this threshold. In the example below anything under 48' is mathematically eliminated



The Nile sensors provide ***Mapping*** and **Multi-Echo Tracking** to suppress false echoes

Applications: Water Level Measurements

Metropolitan Water Reclamation District of Chicago site along the Chicago River
Wanted to add a continuous level monitoring station to an existing DO gauge.

- Non contact
- Easy communication set-up (SDI-12)
- Minimal maintenance
- Real time data

Applications: Air Gap Measurements

In areas of commercial boat traffic the “Air Gap”, the distance from a bridge to the water’s surface, is a critical piece of information that captains need to safely navigate. The Nile is the perfect instrument to provide both (Air Gap) and water level data.

The radar is always measuring distance to water. The first two parameters from a standard SDI-12 measure command returns first Water Level and second Distance to Water (Air Gap).

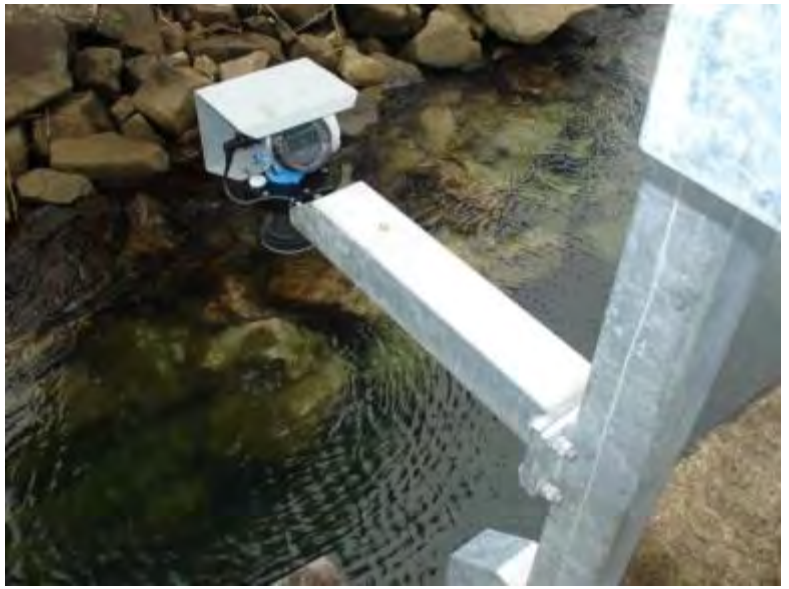
In applications like the one pictured here the radar returns Water Level and Air Gap from one measurement. Combined with a data logger the radar becomes a non contact automated measuring solution.

Applications: Tide Measurement

One of The National Oceanography Centre Liverpool’s tide gauging sites in St Lucia

In this application the Nile radar is always on using one of the NOAA mode measure commands that computes a standard deviation, removes outliers and returns an average.

"(*context e.g. installation in St Lucia by)* the National Oceanography Centre, UK, and delivered as part of the Commonwealth Marine Economies Programme".



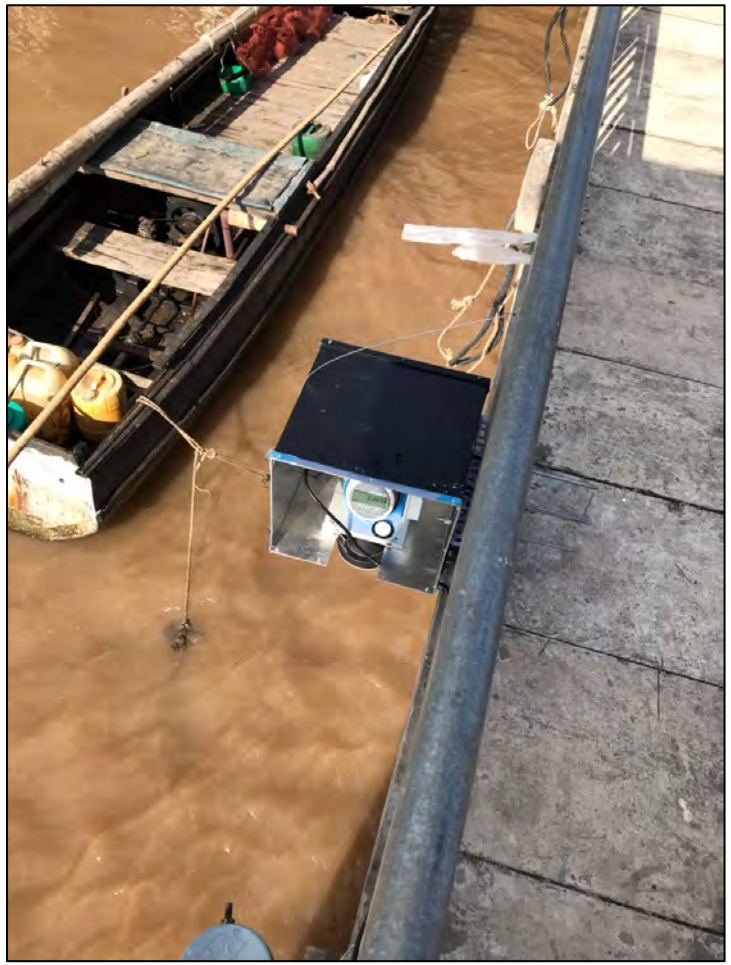
What is NOAA Mode?

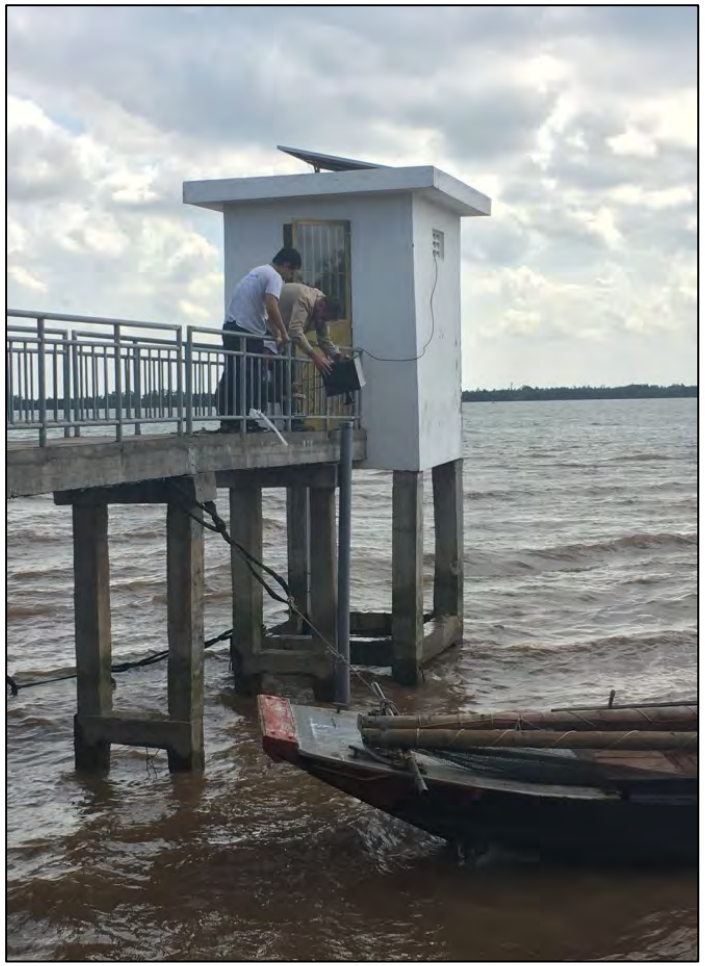
- 1. Makes 181 measurements at precise 1.0 second intervals
- 2. Computes the standard deviation for the data set as follows:
- a. Compute the mean for the data set
- b. Compute the deviation by subtracting the mean from each value
- c. Square each individual deviation
- d. Divide by one less than the sample size
- e. Take the square root
- 3. Multiplies the standard deviation by 3 to obtain a High and Low outlier threshold.
- 4. Sifts through the data set and discards data points above and below the outlier threshold.
- 5. Computes the mean and standard deviation again for the data set with the outliers removed.

EACH SAMPLE OUTPUTS:

1) **Mean Stage**
2) **Number of Outliers**
3) **Number of Good Values**
4) **Standard Deviation**

Applications: Surface Height Measurement





Applications: Storm Surge Monitoring

One of NOAA's Mobile Bay Storm Surge Monitoring Network sites:

- NOAA's Center for Operational Oceanographic Products and Services in partnership with Mobile County Commission established 8 water level observatories for storm surge monitoring in Mobile Bay
- Data From the water level observatories combined Meteorological and Tidal data from existing sites provides critical information for coastal resource management and emergency management before, during, and after severe storm events.
- The radars can be mounted above category five storm surge heights without affecting measurements. Storm surge high flows also have no affect on the radar's measurements
- Telemetry at these sites provides near real time data

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Storm 3 Data Logger

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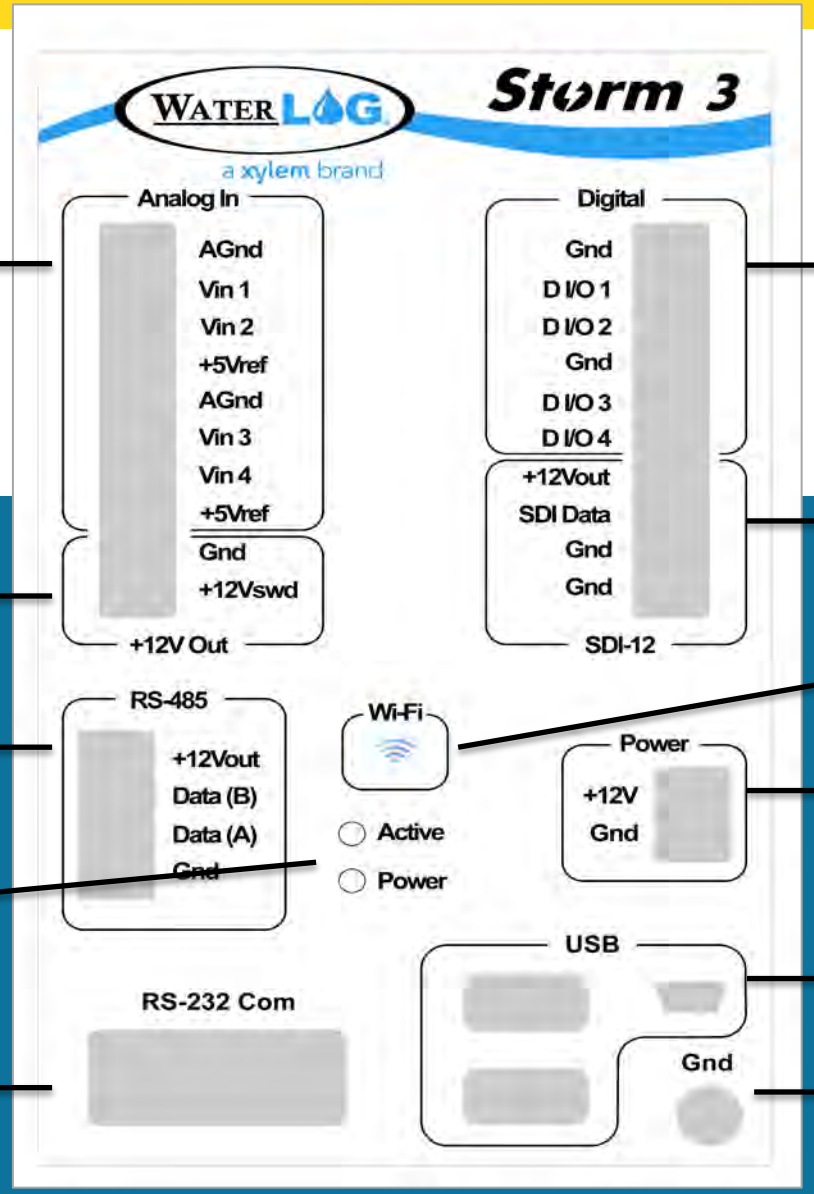
Storm 3 – The Basics

- Mid-range Data Logger
- Supports External Cellular Modems
- Supports GOES Satellite Radios
- Built-in Sensor Library
- Built-in Help Menus
- Graphical User Interface
- USB Wifi or Device Cable Connection

Storm 3 Anatomy



Analog

+12 Volt

RS-485

Active and Power LEDs

RS-232

Digital I/O

SDI-12

Wi-Fi

Power Connection

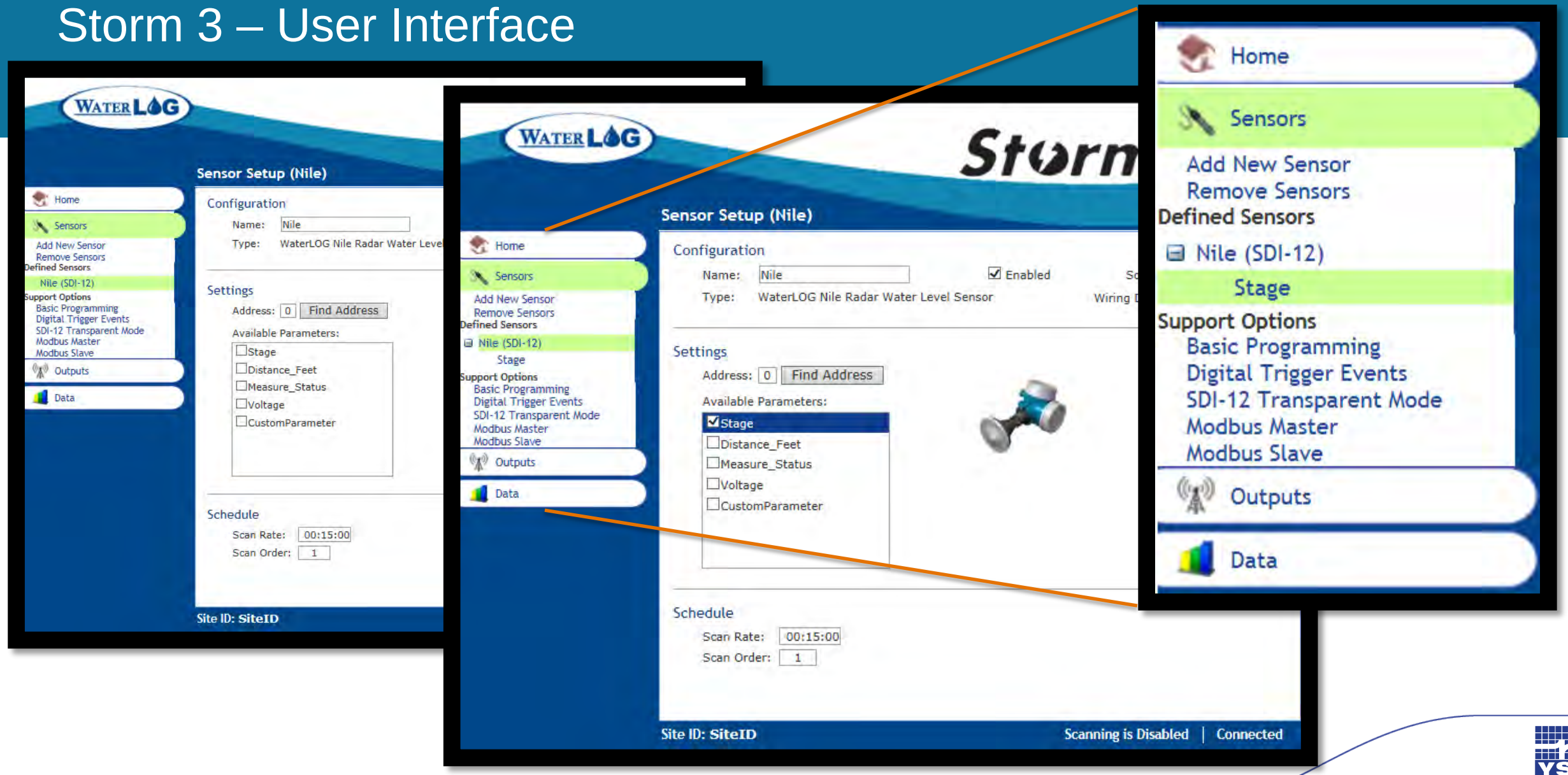
USB

Ground Lug

Storm 3 User Interface

- Connect and open internet browser
- Navigate to 172.20.20.20

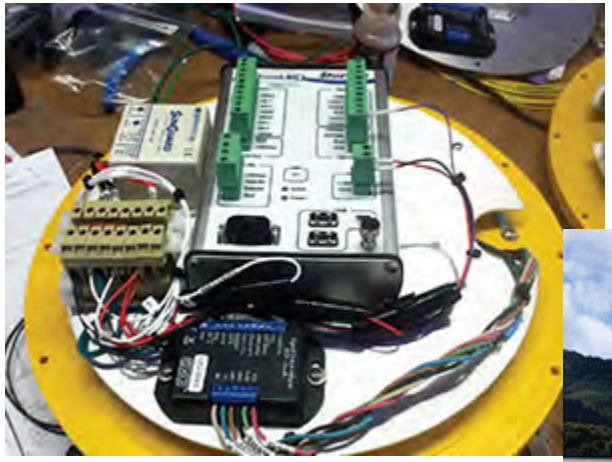
Storm 3 – User Interface



Adding a new Sensor to the Datalogger

Applications: Environmental Protection

- San Francisco Public Utilities Commission
- Reservoir serves over 1 million residents
- Fish and Game Refuge for wildlife
- Storm 3 transmits water quality data
- pH is biggest concern
- Data goes to HydroSphere



Applications: Improving Efficiency

- Zone 7 Water Agency in Alameda County
- Arroyo Del Valle Water Rights
- Habitat sustainability
- Modeling for flood control
- Better technology, less site visits
- Alarms for low/high flow
- Quicker quality control

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Software – HydroSphere

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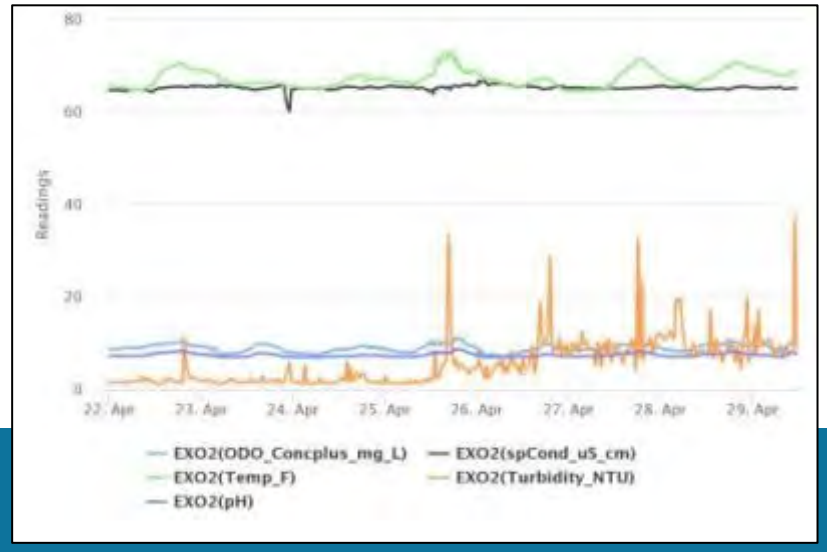
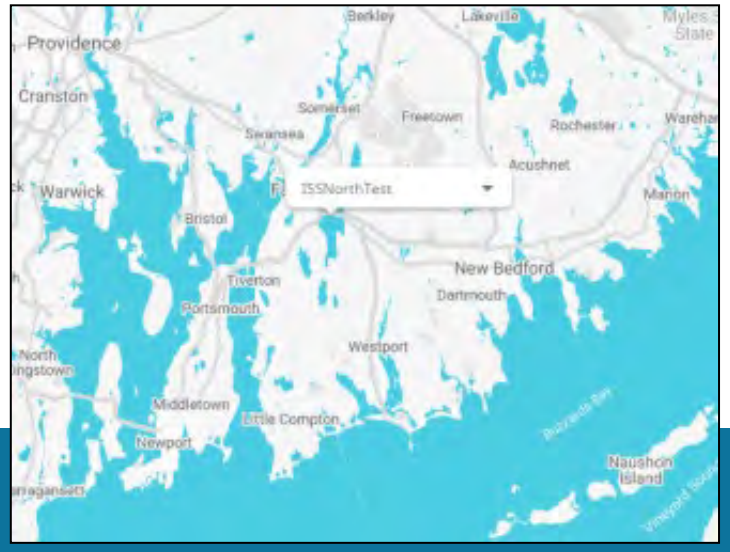
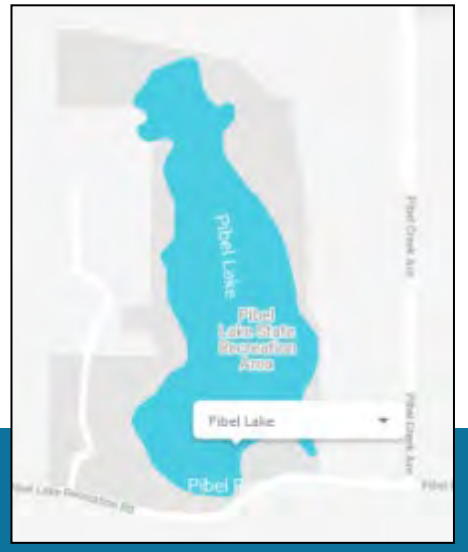
Real-Time Monitoring Software: HydroSphere



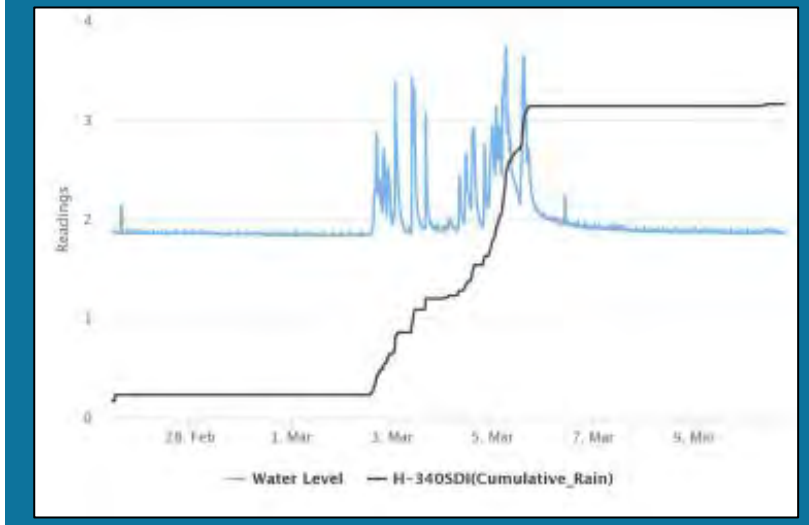




- Data available *anywhere* and *anytime*, 24/7
- Easy connection to telemetry system
- Real-time data assistance:
  - Alarms warn if a threshold is met
  - Alerts let you know if a site stops transmitting

University of Georgia

- Tanyard Branch
  - YSI/UGA partnership began in 2019
  - 2.02 sq km watershed
  - 74% impervious surfaces
  - 50% of the stream runs through pipes
  - Storm 3 Data Logger
  - Amazon Bubbler
  - H-3401 Rain Gage



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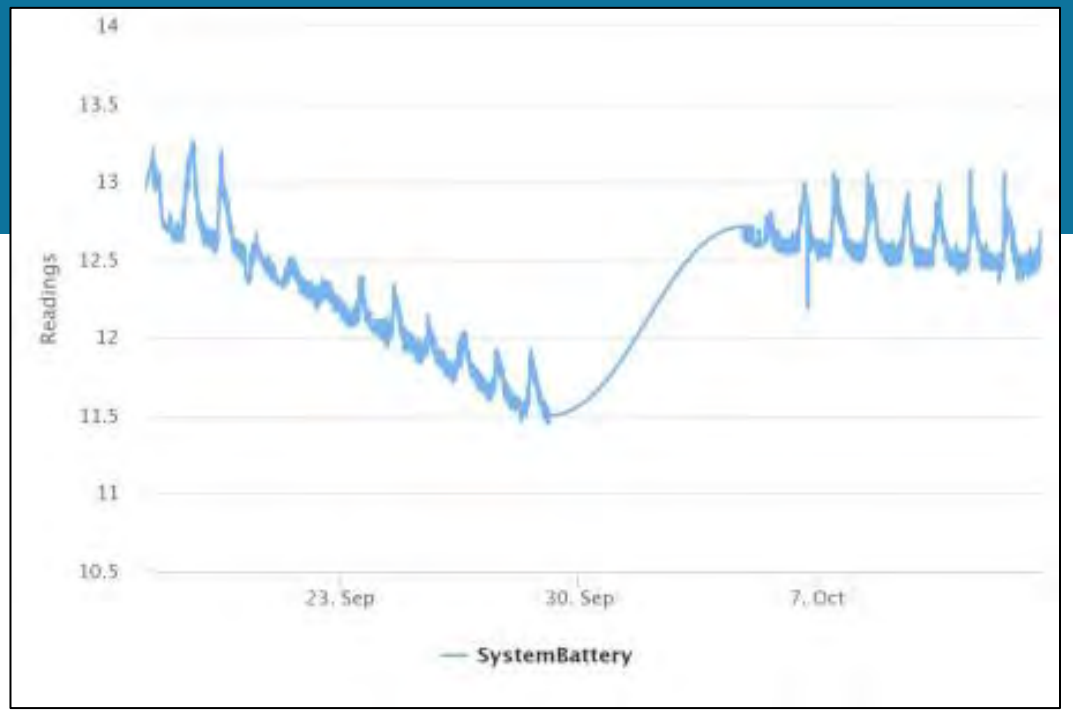
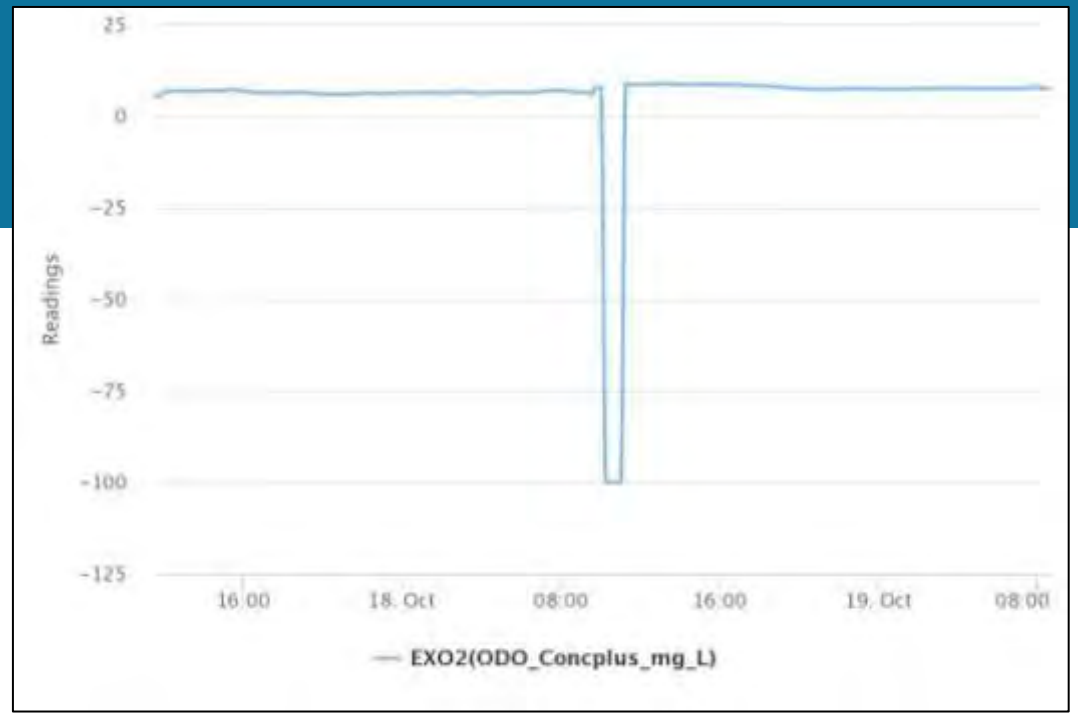
Alarm: Low Battery Voltage

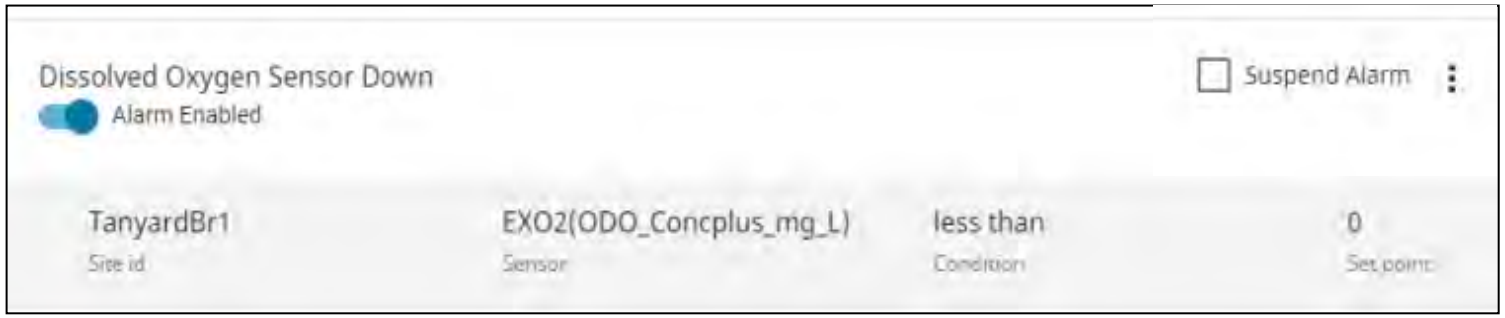


- Battery voltage can drop over time and with clouds blocking sun for extended time
- Transmissions will stop if battery gets too low
  - Stops transmitting at 11.5V at UGA
- Set an alarm for:
  - Battery Voltage less than 11.7V

Alarm: Sensor Not Working

- Dissolved oxygen is monitored because stream is characterized as recreational.
- Need to monitor DO to ensure that there are no spills that will harm wildlife.
- Set an alarm for:
  - Dissolved oxygen less than 0

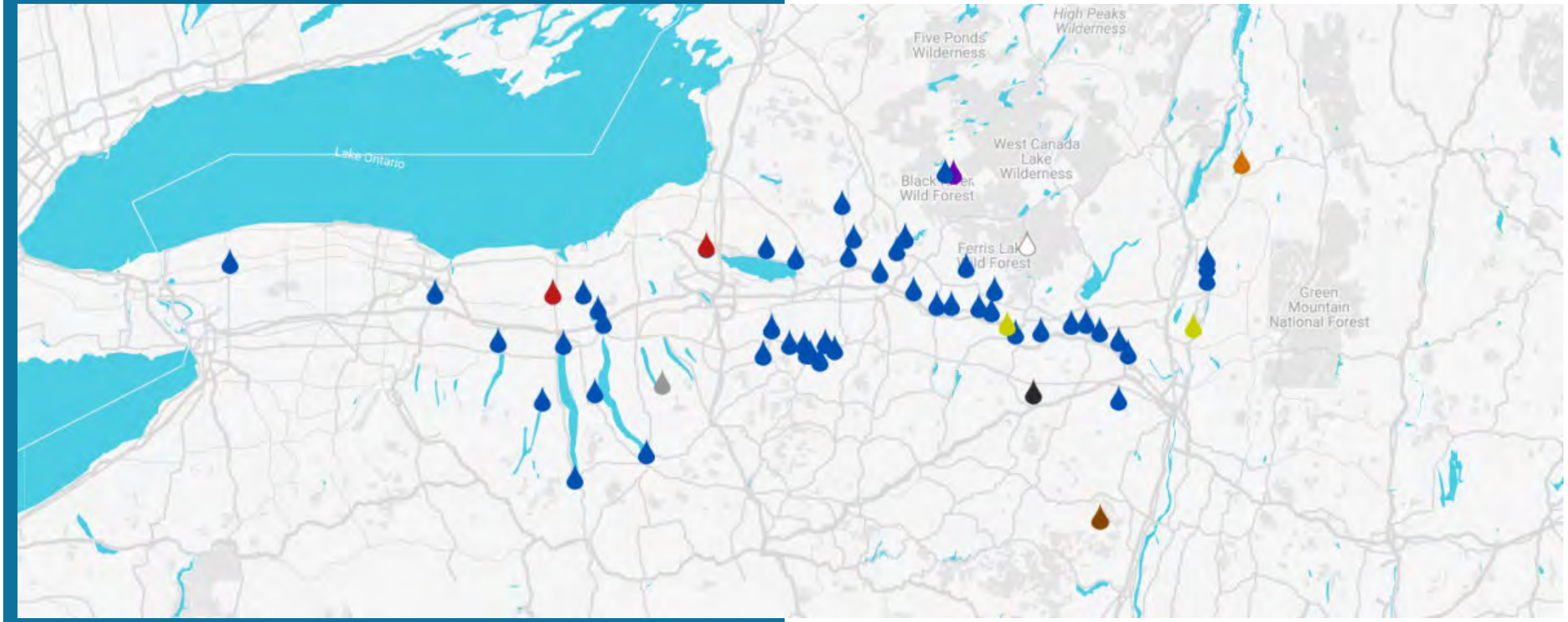




Alerts: Missing Communication

- Need to keep sites as close to 100% uptime as possible
- Missing communication alerts allow a user to know in real-time if a site has stopped transmitting
- Allows for quick deployment of technicians to service equipment

Alarms for Large Networks



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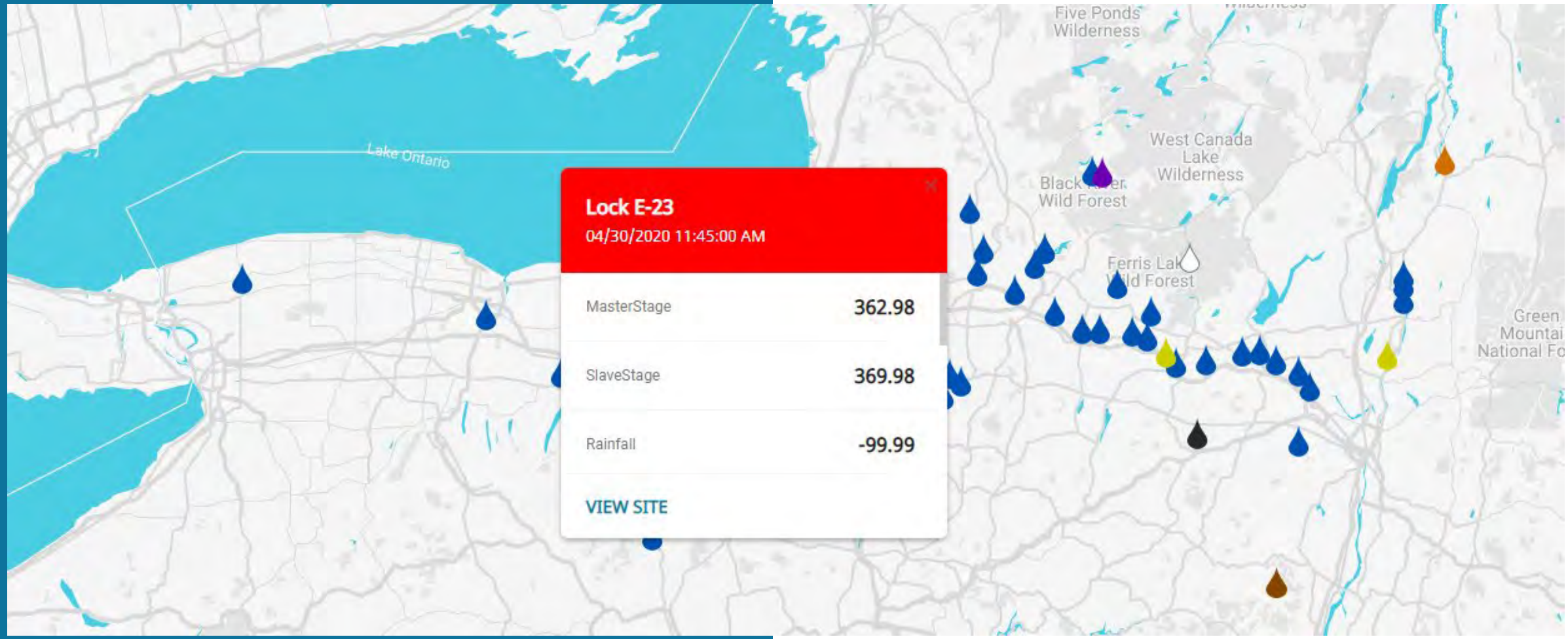
Alarms for Large Networks



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QUESTIONS?

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