Harmful Algal Blooms—a Proactive Monitoring Approach

Lacey Goeres-Priest
Water Field Supervisor, AIC
City of Salem Public Works Department

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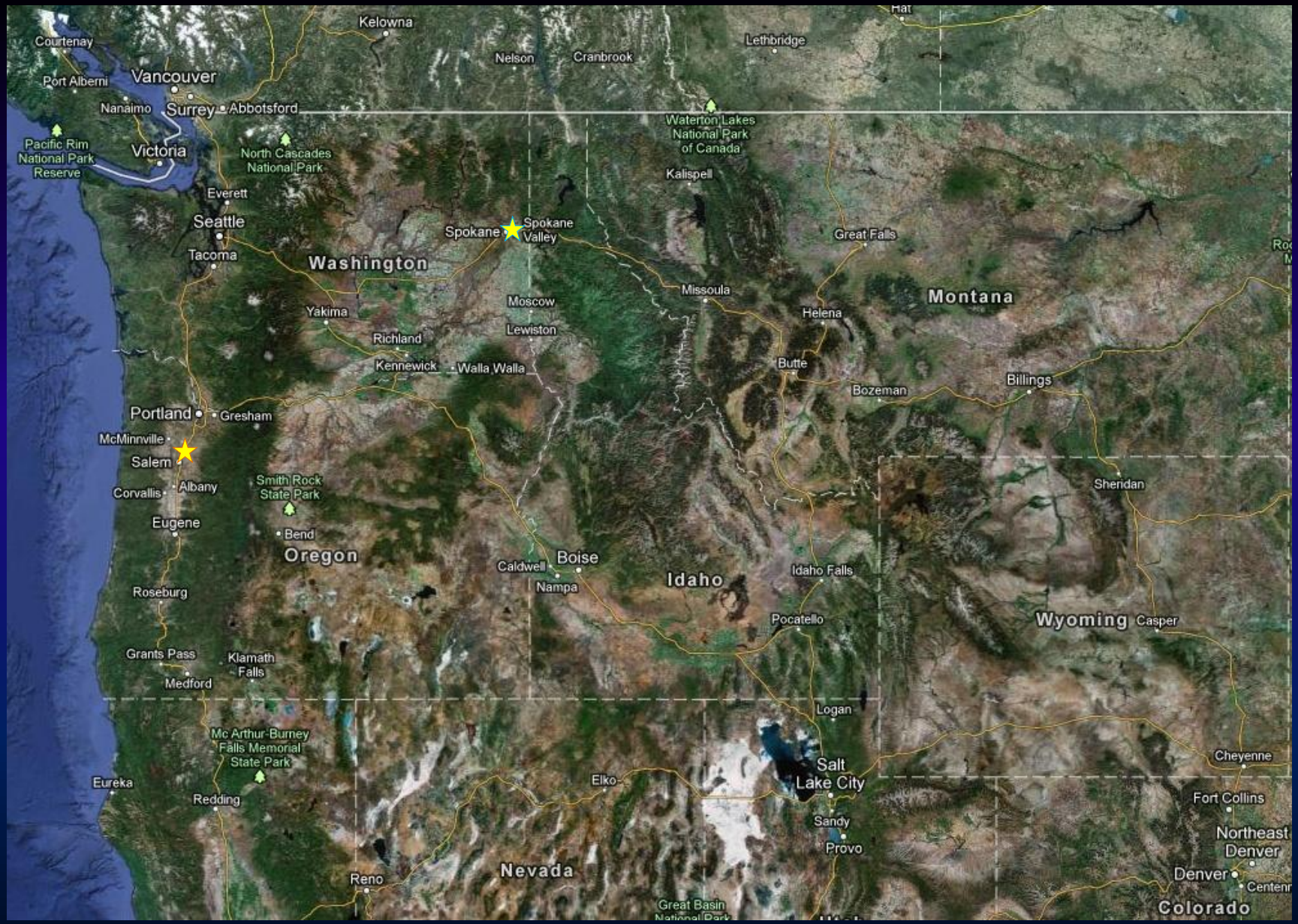

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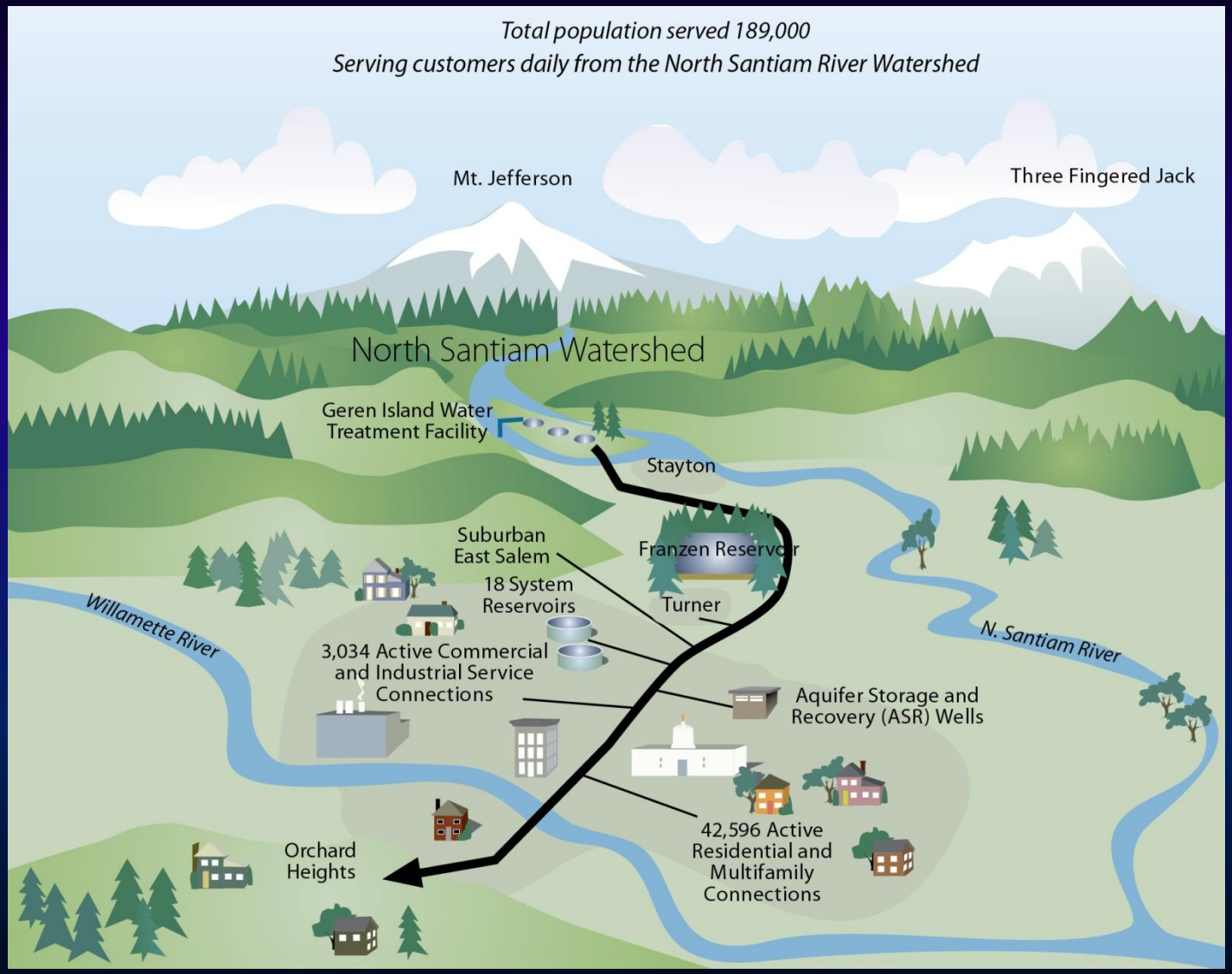
Salem's Water System



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Salem's Water System

Geren Island Drinking Water Treatment Facility

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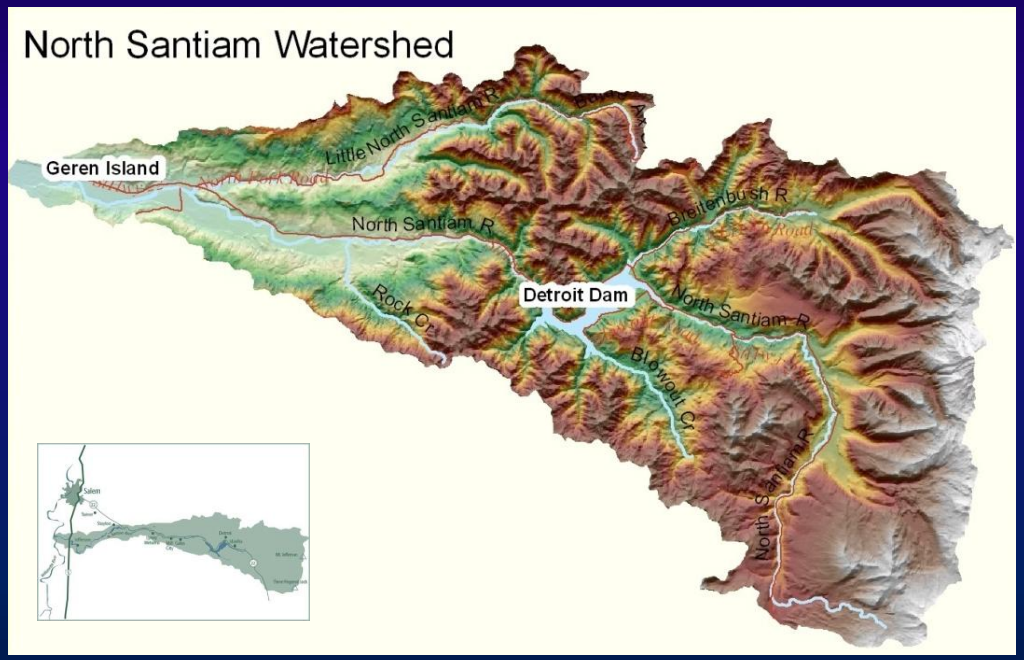
North Santiam Watershed

- Large, mostly-forested watershed (500,000 + acres)
- High quality source water
- No City land ownership
- Two-thirds publicly owned
- Dams/reservoirs
- Other small municipalities



Harmful Algal Blooms

- Rapid increase or accumulation of algae, usually near the surface– can happen year-round
- Appear as foam or scum– typically green or blue-green (but can vary)
- Not all blooms are toxic, but some have the potential
- Algae toxins listed on Drinking Water Contaminant Candidate List.

Early stage “banding” in Detroit Reservoir caused by *Anabaena*.

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Harmful Algal Blooms

Early stage “banding” in Detroit Reservoir caused by *Anabaena*.

Using a Secchi disc to quantify a rough estimate of algae colonies

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Harmful Algal Blooms

- City's filter beds should remove microcystin toxins that could be present, but breakthrough is a concern
- Other toxins could also be present depending on genera– anatoxin and cylindrospermopsin
- Can cause filter-clogging and taste-and-odor issues
- Increases operational expenses
- Dam releases impact severity

A non-toxic green algae bloom slows infiltration rates

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9/25/05 Breitenbush Arm

Photos: U.S. Forest Service

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Algae Monitoring

- Intended to identify, predict, and respond to changing conditions
- Requires tracking conditions at watershed scale
- Multiple data sources--processing is timely
- Lab turnaround is slow
- Communication with other management agencies is critical for response

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Algae Monitoring

What types of data do we collect?

Water Quality

- Nutrients
- pH
- Temperature
- Conductivity
- Turbidity
- Dissolved Oxygen
- Total Organic Carbon

- Algae enumeration and speciation
  - Chlorophyll-a
  - Phycocyanin
  - Silica
  - Cyanotoxins
  - Water clarity (Secchi depth)
  - Visible blooms or scum

Dam Operations

- Discharge-- spill vs. power generation
- Reservoir Elevation

Climate and Streamflow Conditions

- Annual Precipitation and Snowpack
- Snow-Water Equivalent
- Realtime Flow & Discharge Forecast
- Wind direction & speed
- Solar radiation
- Air temperature

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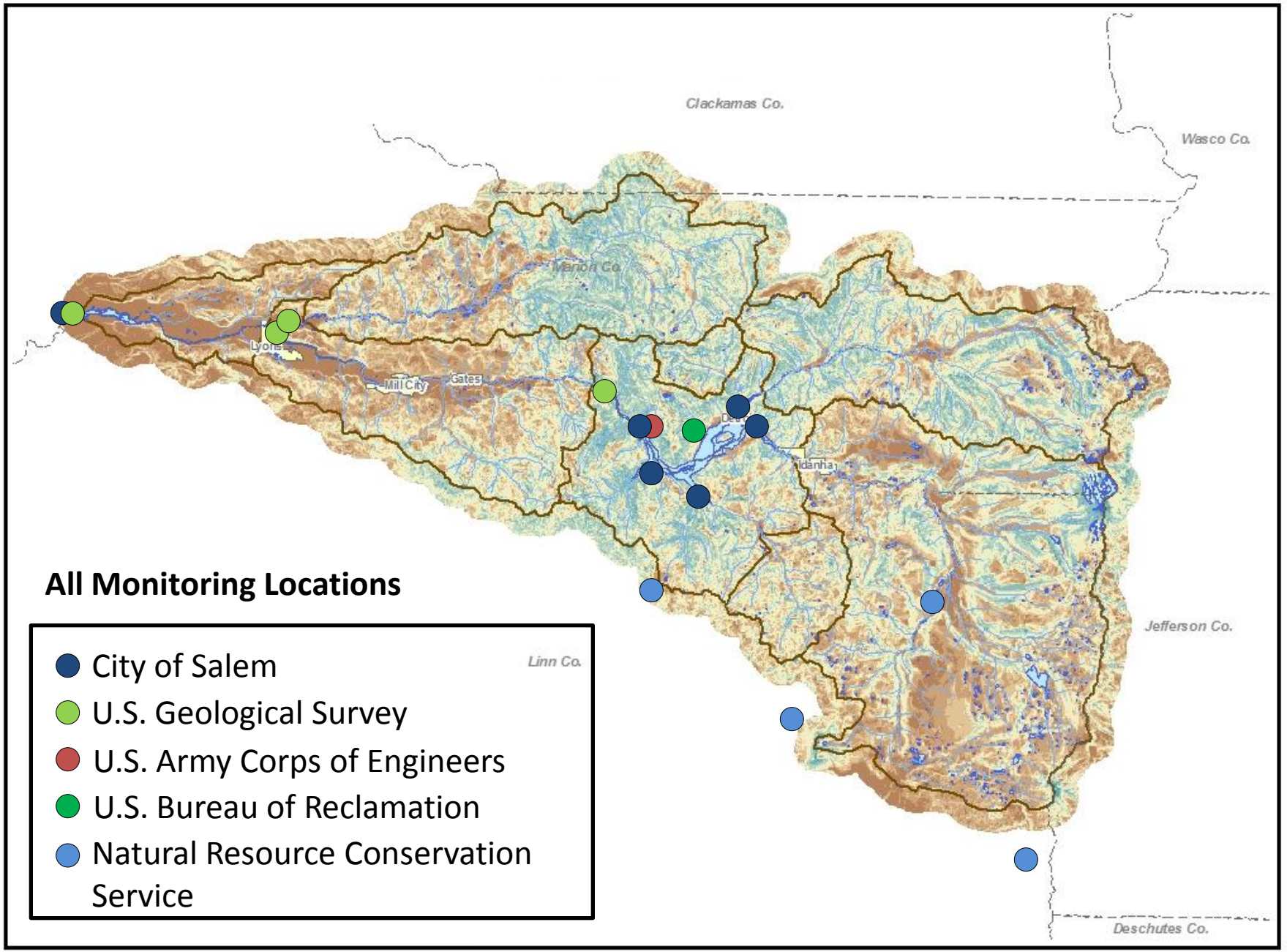
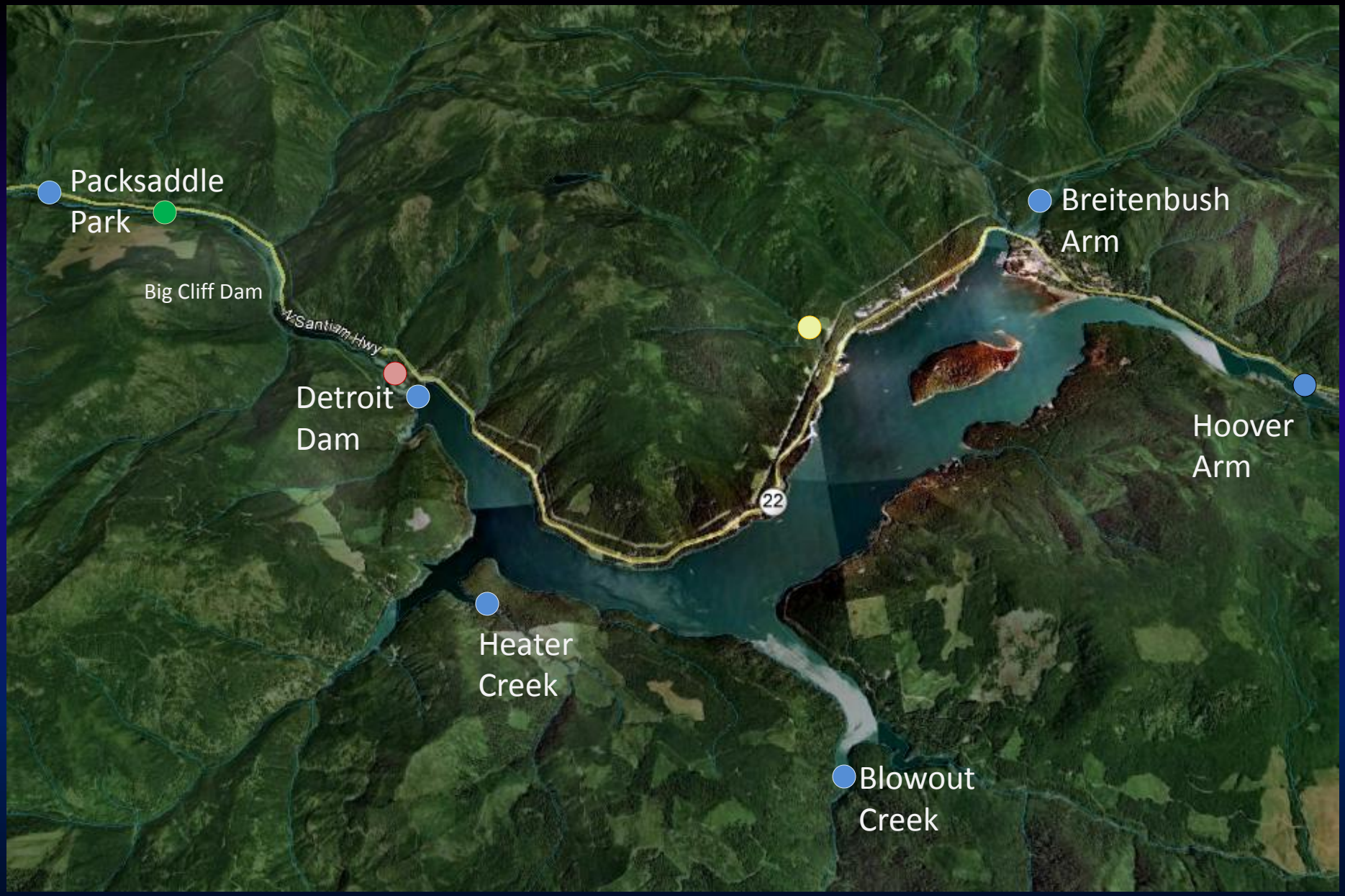

Clackamas Co.
Wasco Co.
Marion Co.
Lyons
Mill City
Gates
Idanha
Linn Co.
Jefferson Co.
Deschutes Co.
All Monitoring Locations
City of Salem
U.S. Geological Survey
U.S. Army Corps of Engineers
U.S. Bureau of Reclamation
Natural Resource Conservation Service



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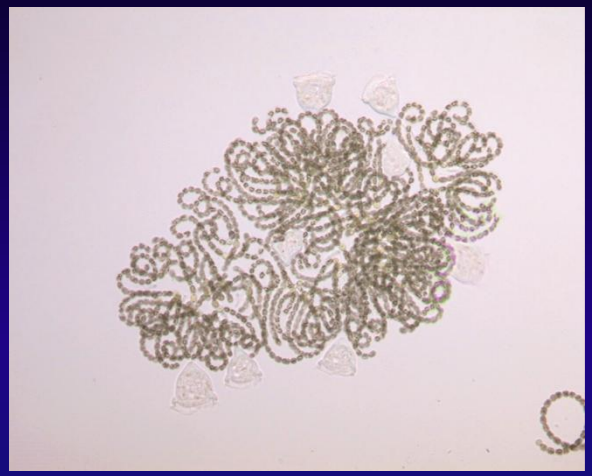
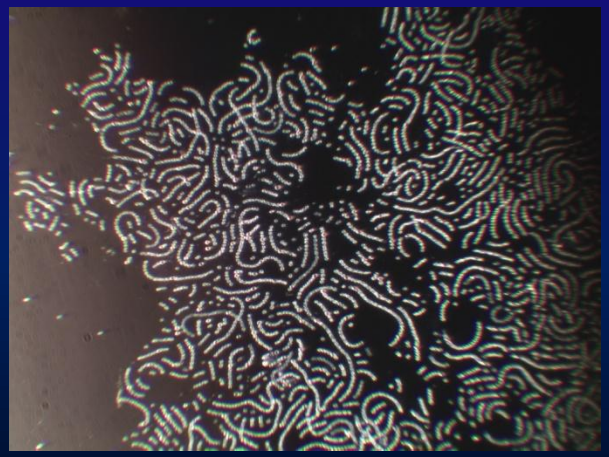
Algae Monitoring

- Visual observation is quickest and easiest
- Using a field and bench top microscope allow quick identification of algae genera
- Maintain a list of “problem species” to quickly know potential management problems
- External lab analysis confirms identification and provides more accurate counts





Anabaena colonies viewed under microscope

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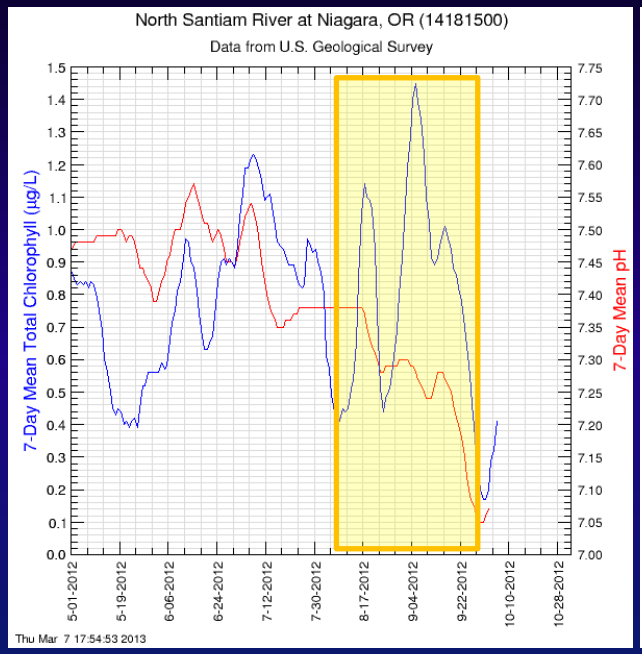
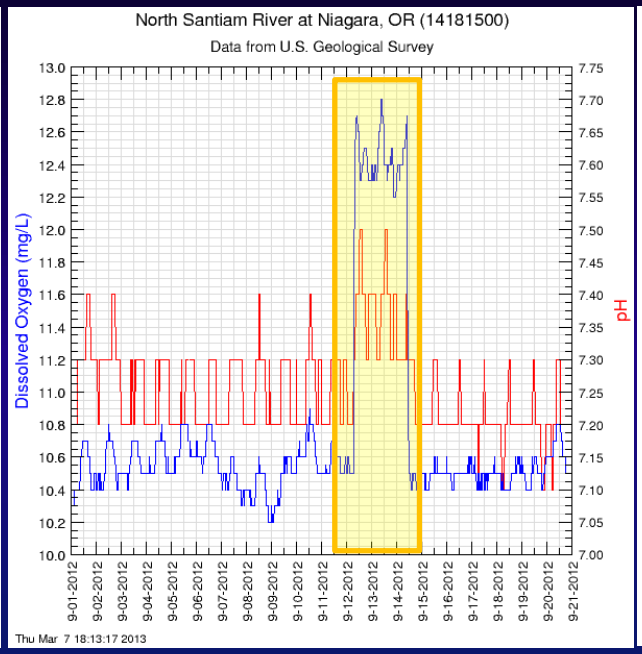
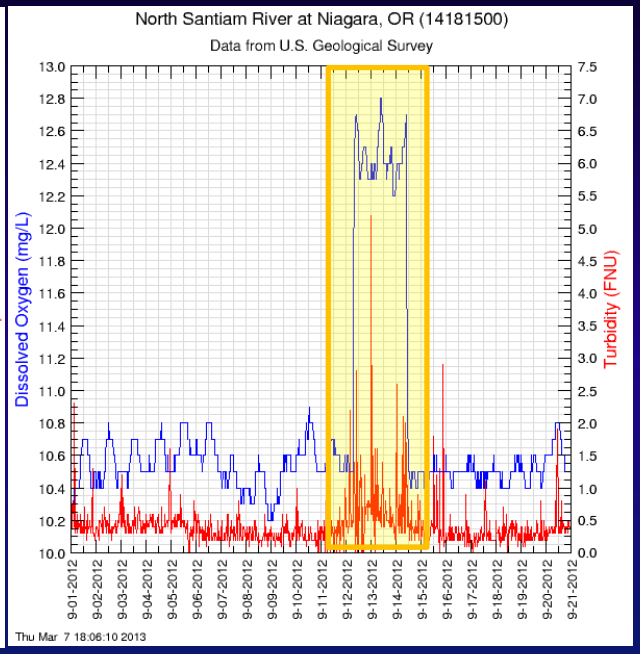
Algae Monitoring







September 2012: Increasing algae density in Detroit Reservoir in unison with top-spilling from Detroit and Big Cliff dams releases blue-green algae (*Anabaena)* into the North Santiam River. The above graphs show indicator values (chlorophyll, pH, dissolved oxygen) at the USGS Niagara gage. High blue-green algae counts were recorded at Geren Island during this time period.

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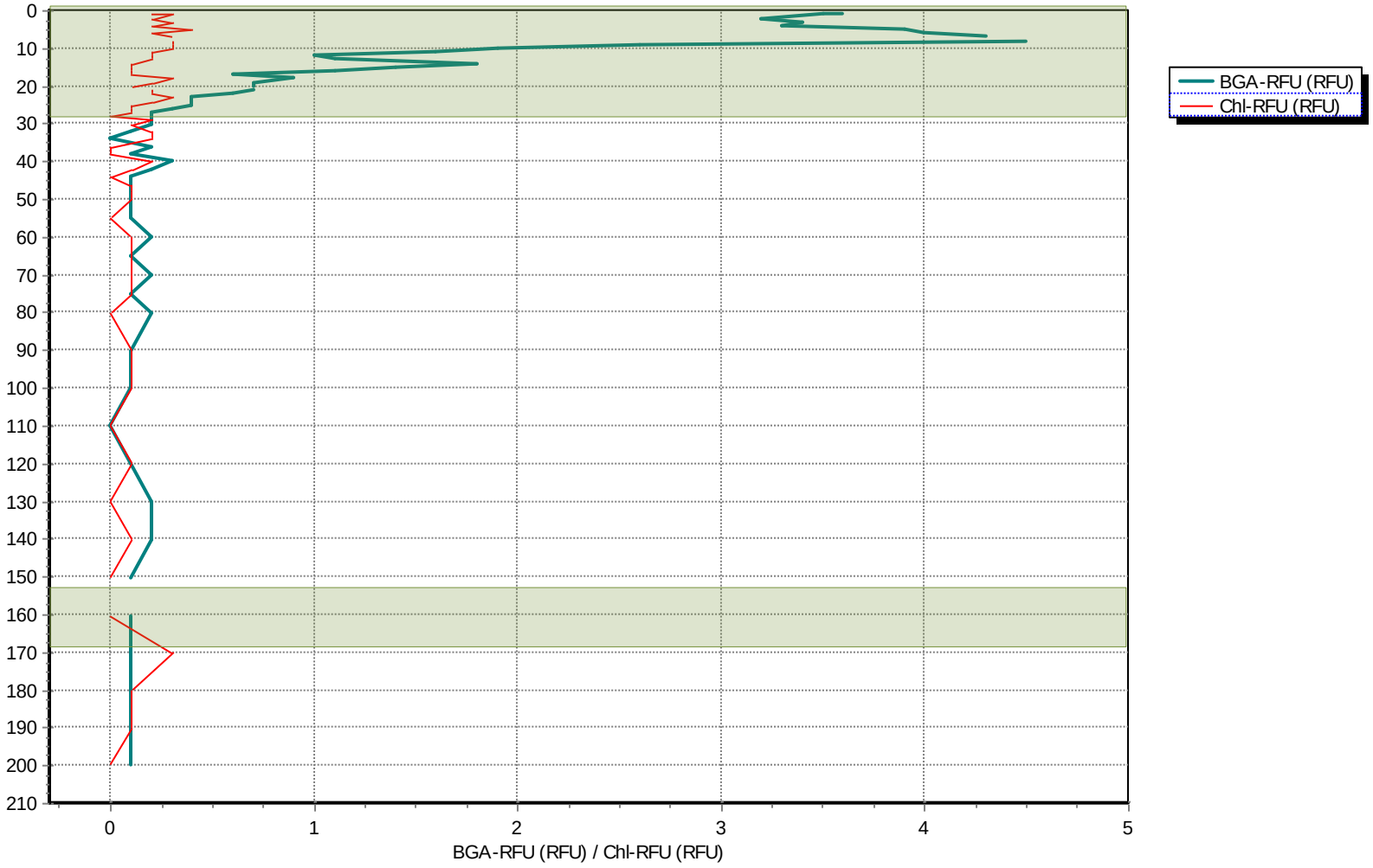
Algae Monitoring



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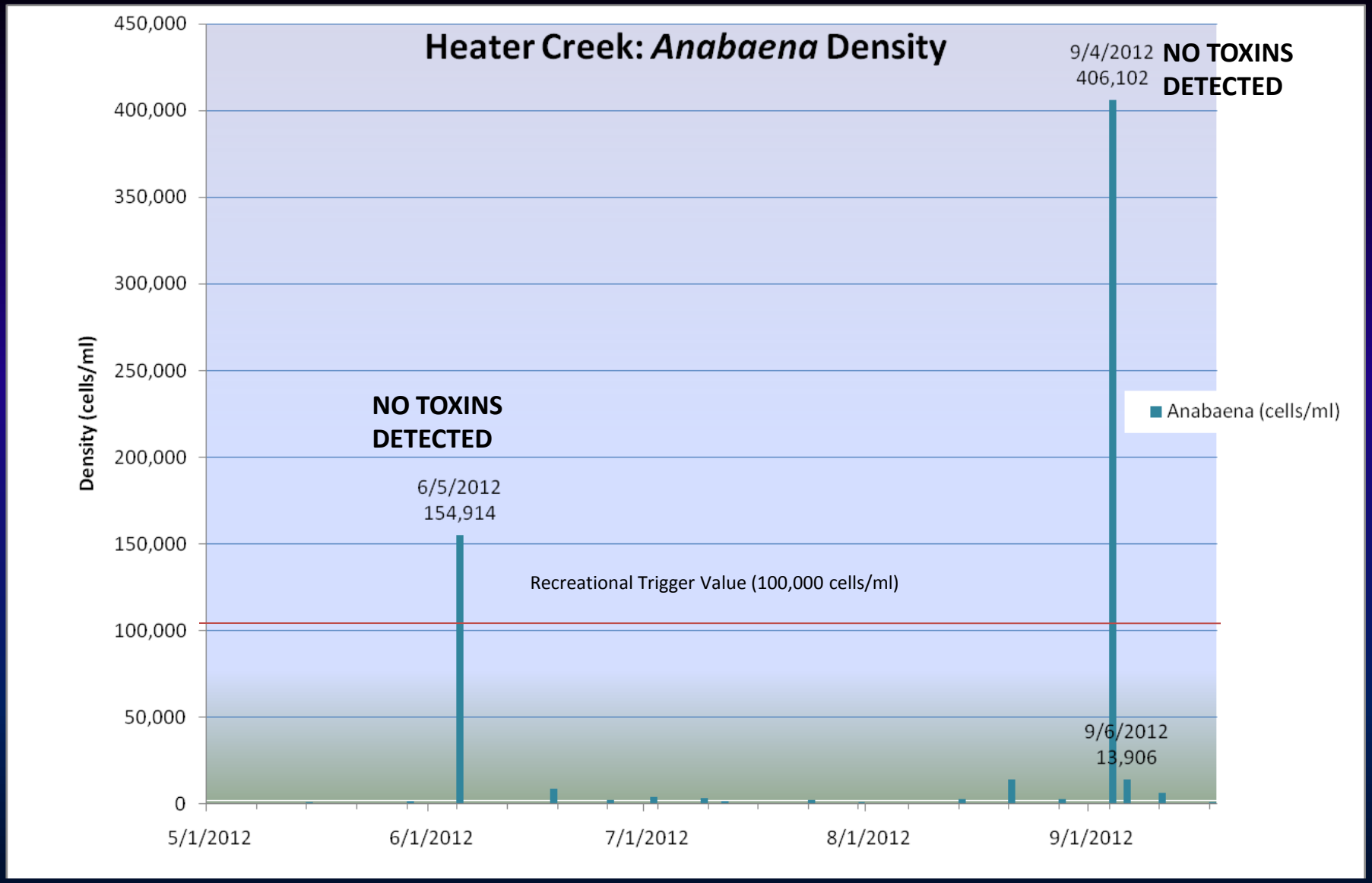

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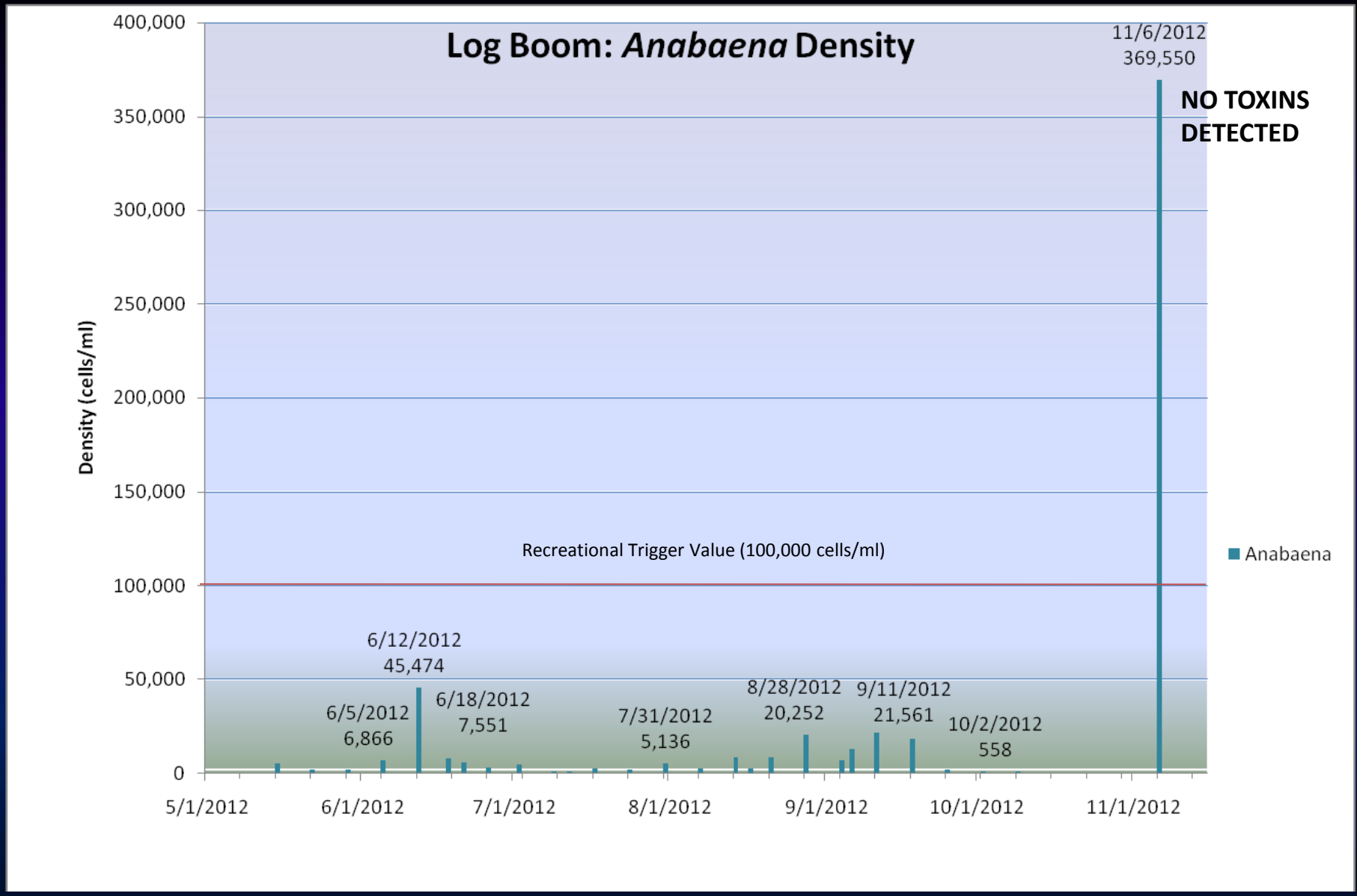

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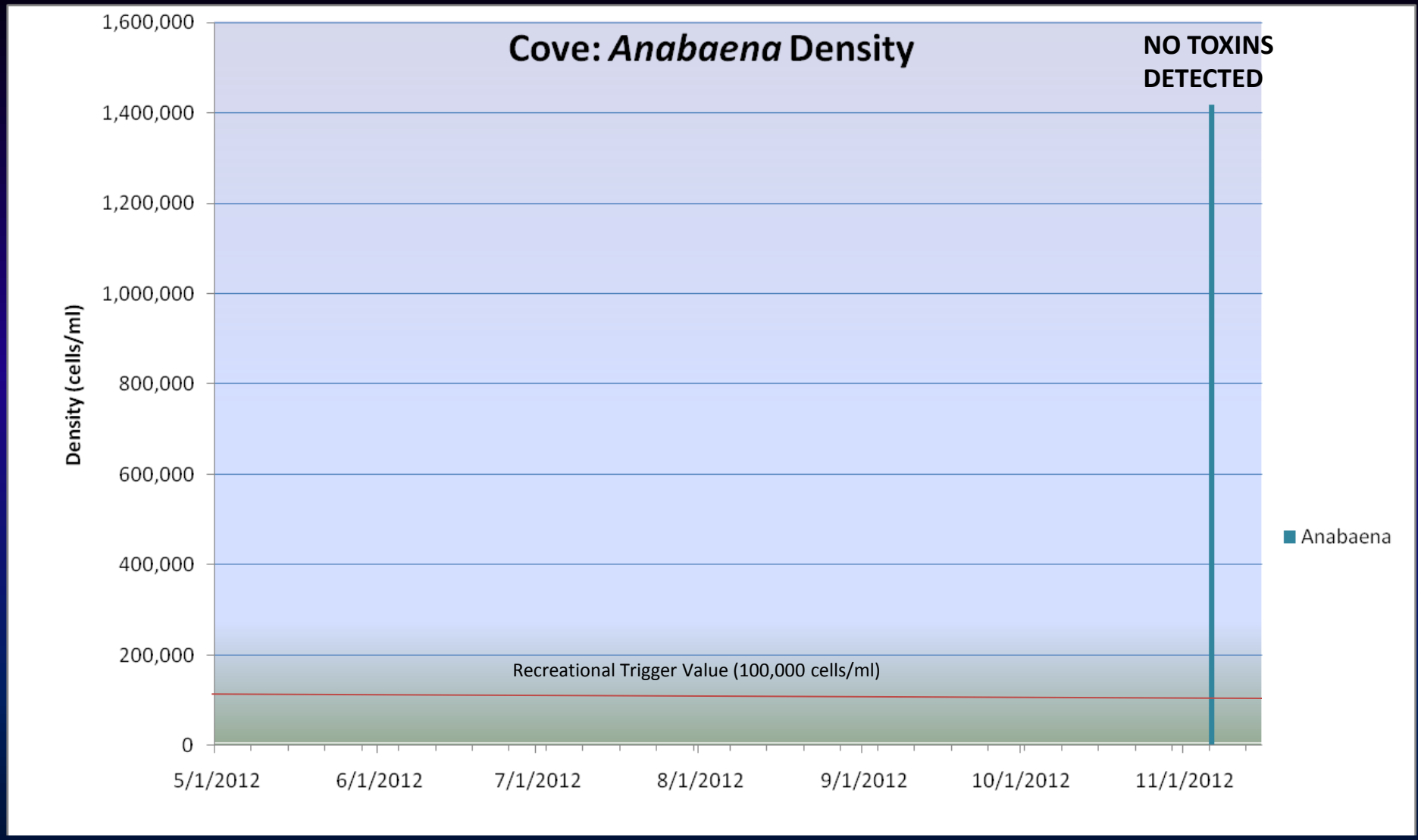

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November 6, 2012: Blue-green algae surface accumulation at Detroit Reservoir log boom

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November 6, 2012: Phycocyanin pigment from blue-green algae bloom (*Anabaena*) stains north shore across from Kinney Creek

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November 6, 2012 blue-green algae bloom (*Anabaena*)– north shore near Detroit Dam

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The Future

- Development of DataSight Software
- Utilizing ArcGIS Online
- Continued coordination with Army Corp and US Forest Service
- Long-term trending of data

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Questions

Lacey Goeres-Priest
City of Salem Public Works Department
lgoeres@cityofsalem.net

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