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From Mountaintop to River's Mouth: An Overview of U.S. Geological Survey Activities in the North Santiam Basin since 2001

Glen Hess, North Santiam Basin Strategic Emergency Planning Summit # 3, April 2013

U.S. Department of the Interior
U.S. Geological Survey

USGS North Santiam River basin project overviews and cooperators since 2001.

- Brief Project Description
- Cooperators or funding

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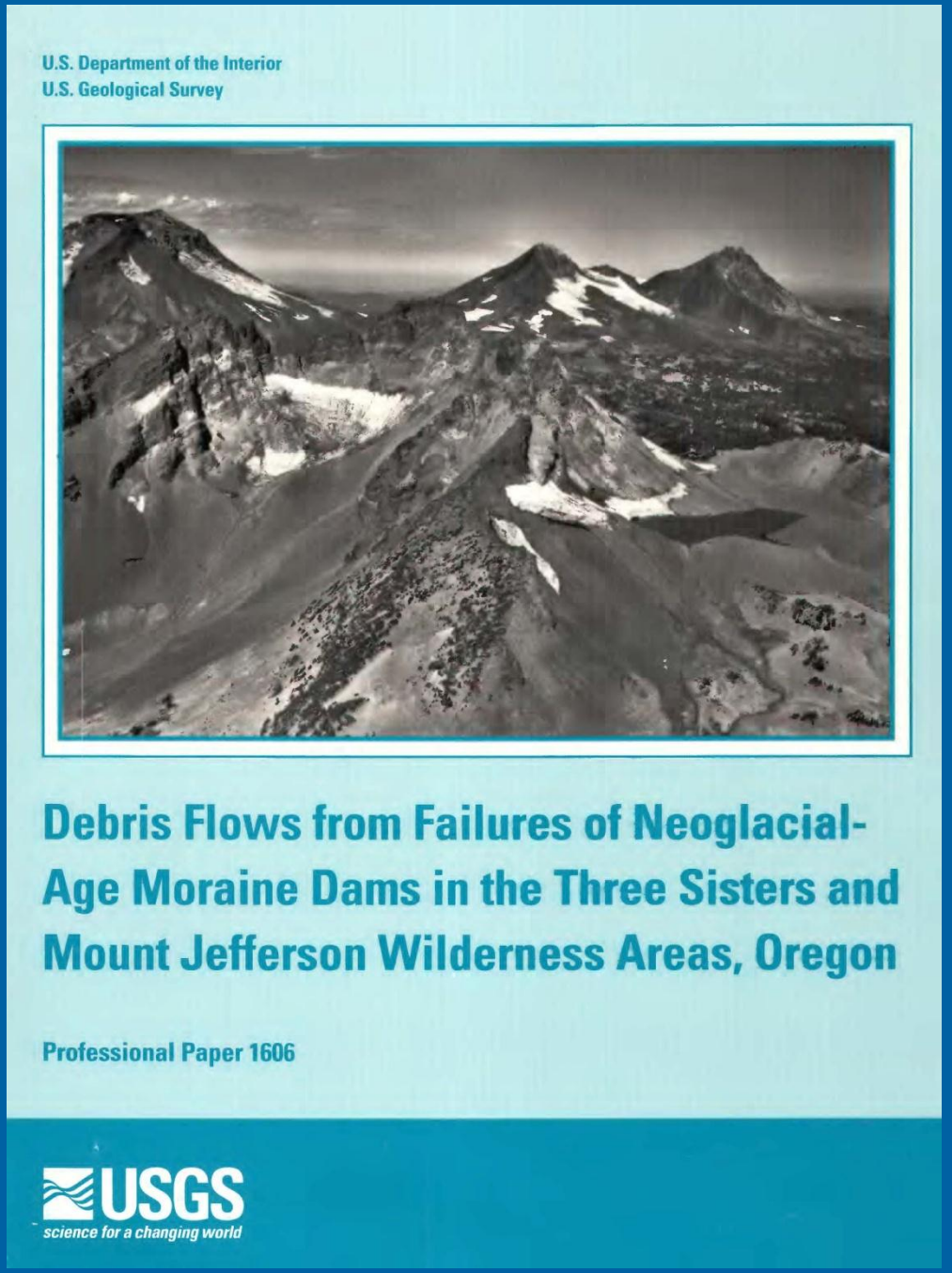
Geologic Moraine Dams

- Debris dam failures on Mt Jefferson/ Three Sisters area
- USGS Geologic Division (2001)



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2006 Pamelia Creek Debris flow

- Turbidity sources in basin
- City of Salem

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Prepared in cooperation with the City of Salem, Oregon

Analysis of Geomorphic and Hydrologic Characteristics of Mount Jefferson Debris Flow, Oregon, November 6, 2006

Scientific Investigations Report 2008–5204

U.S. Department of the Interior
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North Santiam near Niagara

USGS Gage Network (many years)
Corps of Engineers, Salem, etc.

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North Santiam River Turbidity, Sediment, and Water Quality Network

- 1999–2010 Monitored and determined turbidity sources in basin
- City of Salem

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Total Dissolved Gas at Niagara gage

- New to North Santiam Basin after 10+ years in Columbia Basin
- Corps of Engineers

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North Santiam River Streamflow and Water Temperature Modeling

- Rounds and Sullivan
- 2001–2010, Detroit Reservoir and below
- Upstream of Detroit Reservoir project later
- Time of travel tool

- Corps of Engineers

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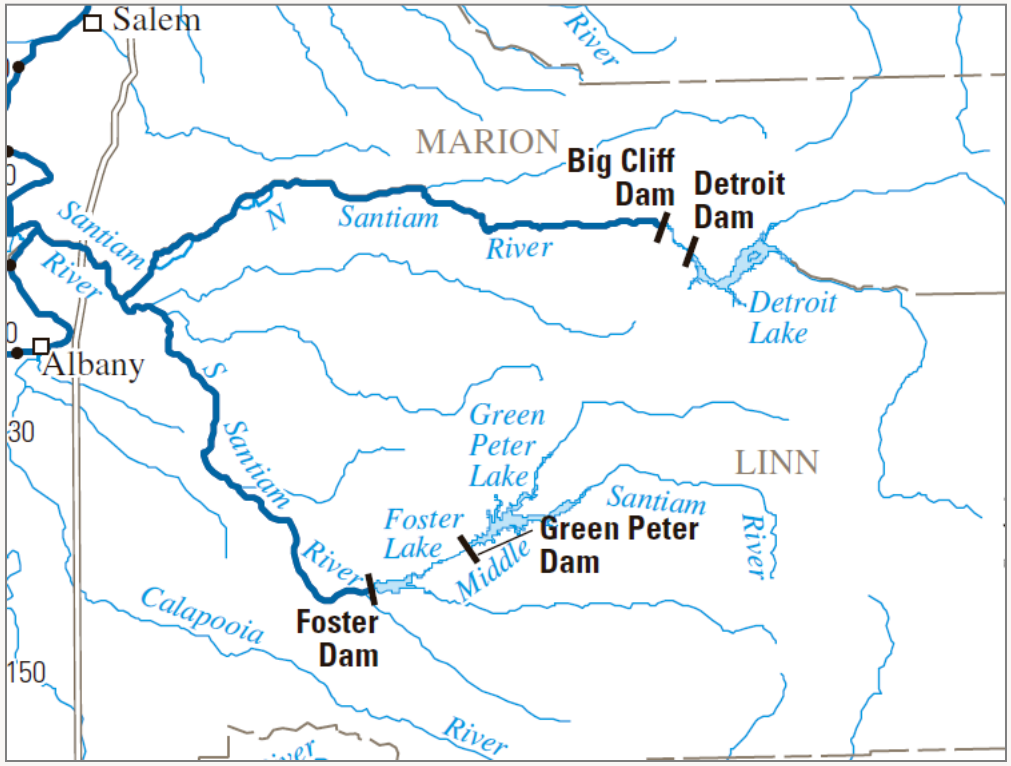
Santiam Basin USGS CE-QUAL-W2 Models

- Detroit Lake
- Big Cliff Lake
- North Santiam and Santiam River
- Green Peter Lake
- Foster Lake
- (South Santiam River model developed by ODEQ-PSU)



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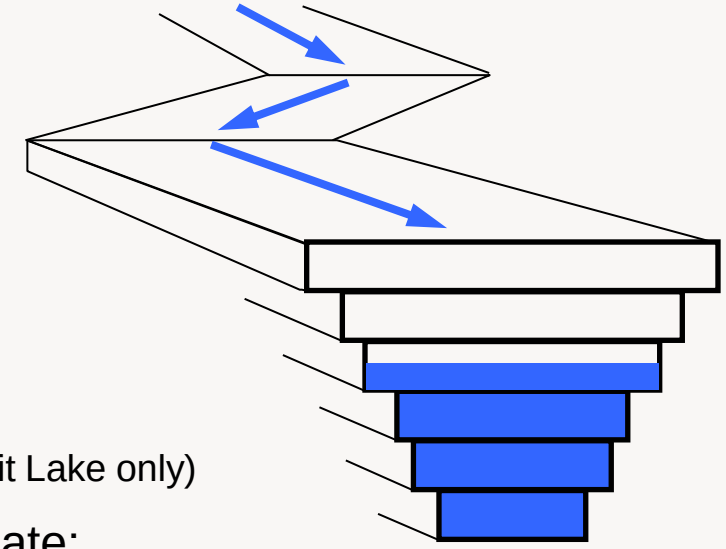
CE-QUAL-W2 Models



- Dynamic: output typically hourly
- 2-D: longitudinal and vertical
- Models currently simulate:
  - flow, stage, velocity (all models)
  - water temperature (all models)
  - total dissolved solids, suspended sediment (Detroit Lake only)
- If data available, models could also simulate:

dissolved oxygen	ice cover
ammonia	aquatic plants
nitrate	algae
orthophosphorus	dissolved organic matter
total N, C, P	alkalinity
pH	particulate N, C, P

North Santiam River at RM 29.5
USGS photo by Ian Wigger

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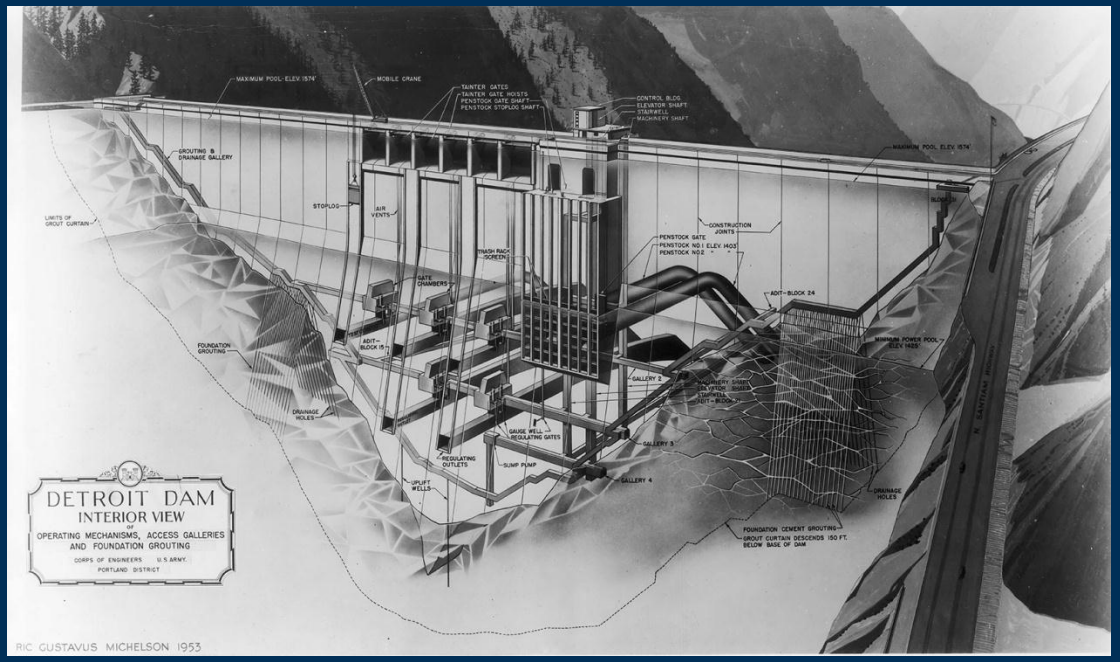
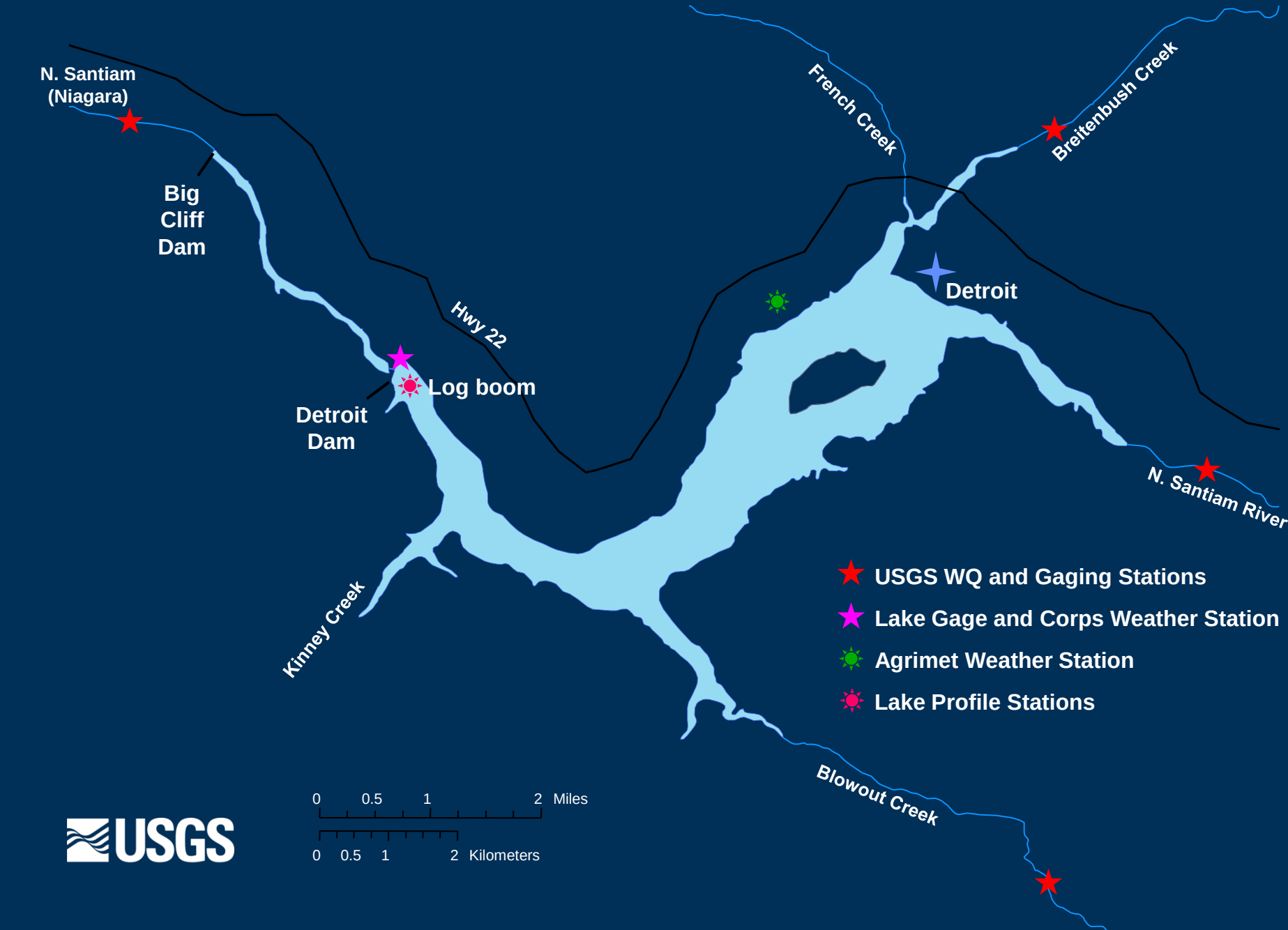


Modeling Downstream Temperature of Operational and Structural Changes to Detroit Dam, Oregon

Norman Buccola, Stewart Rounds, Annett Sullivan

U.S. Department of the Interior
U.S. Geological Survey

Detroit Lake Data Network



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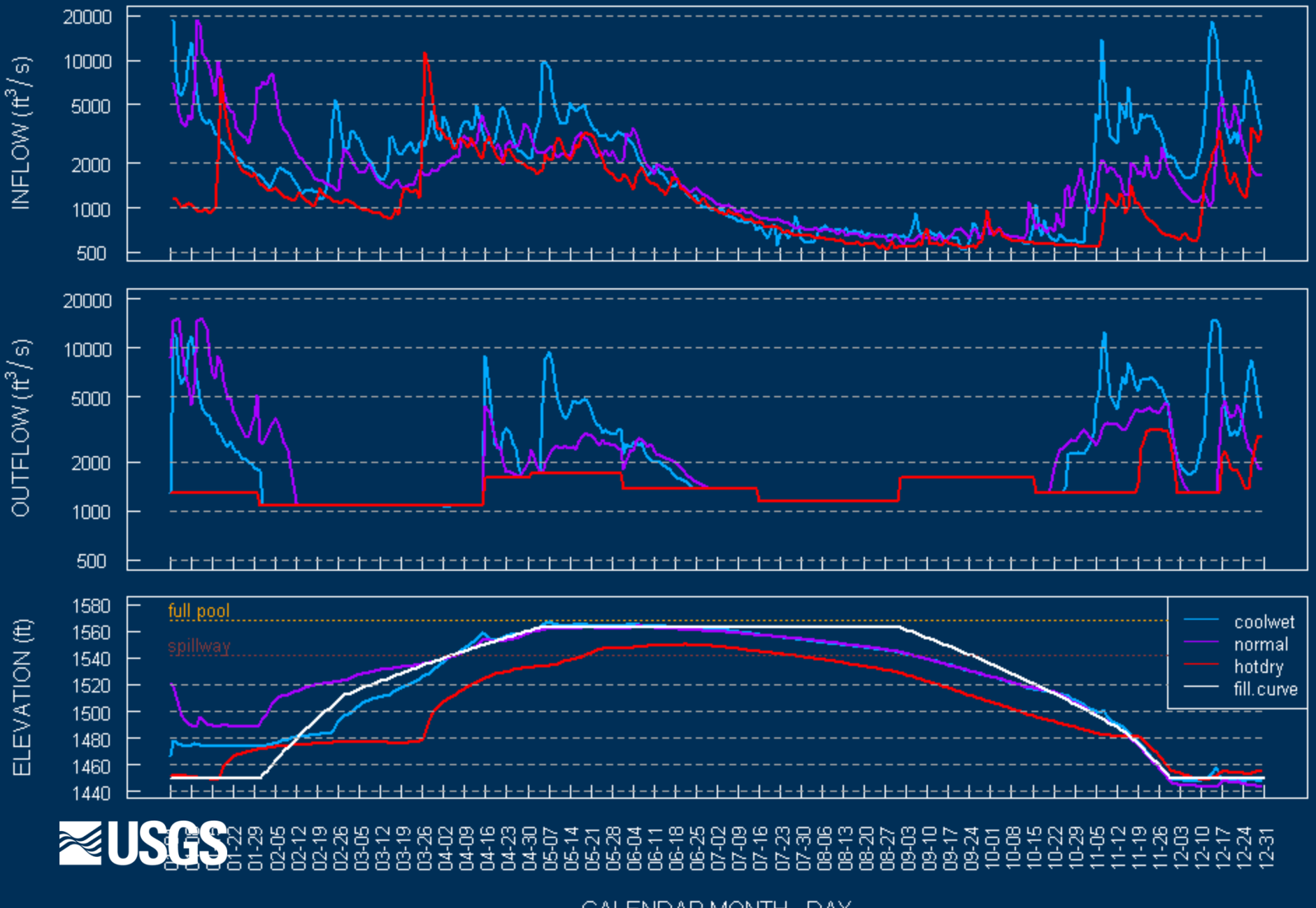
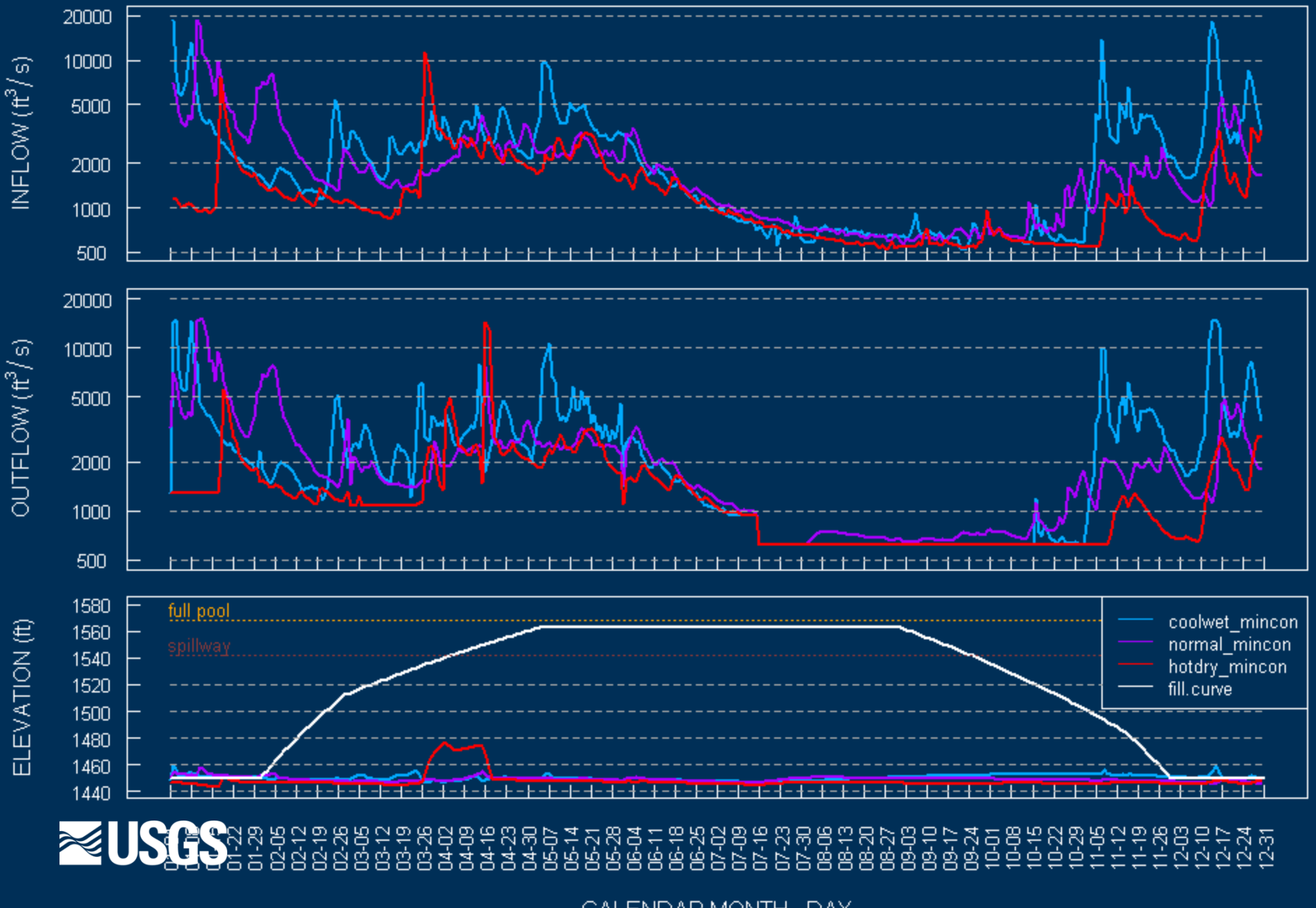
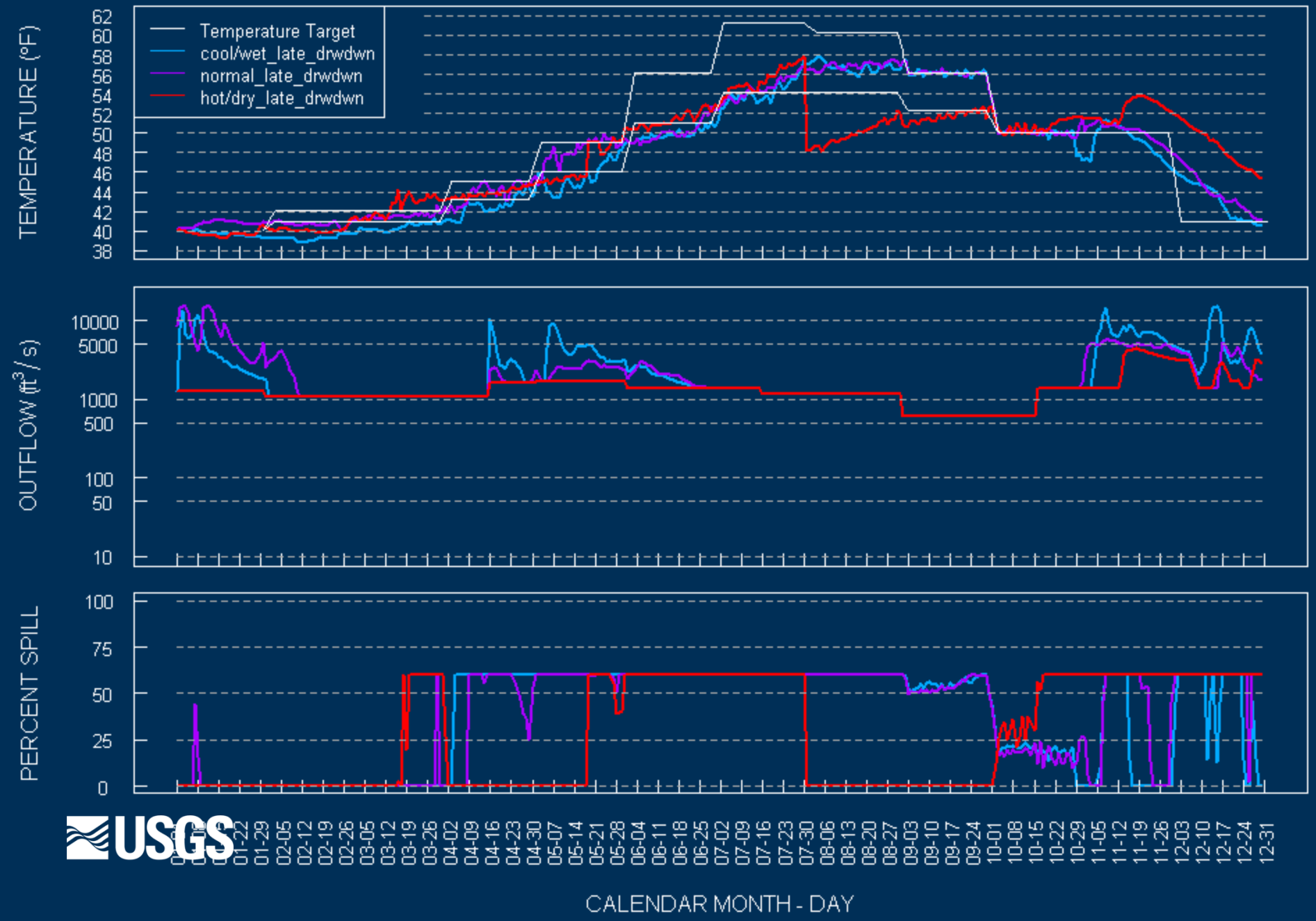
Inflows/Outflows: Current Conditions



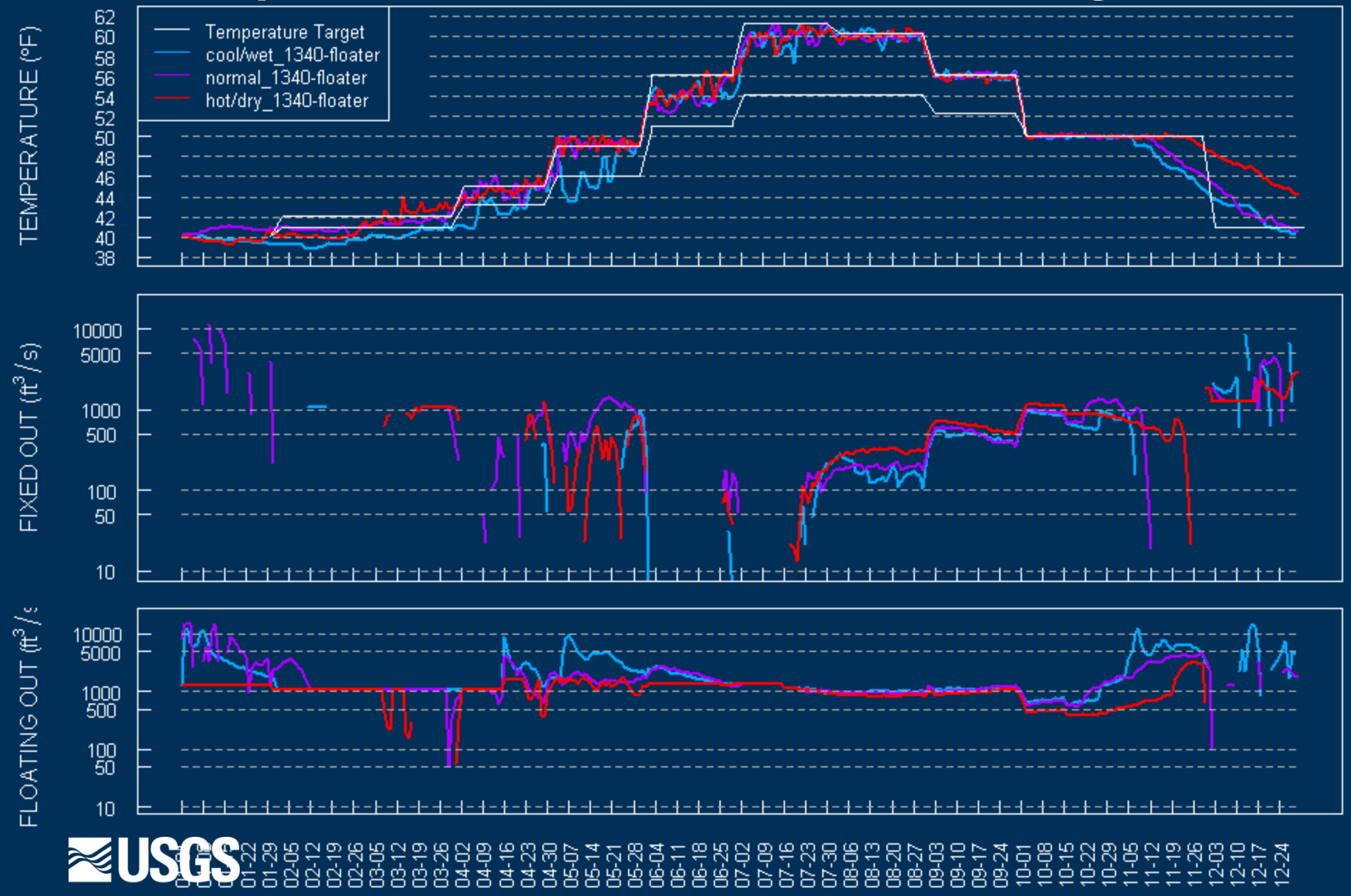
Inflows/Outflows: “Run-of-River”



Temperature Results: “Late Drawdown”



Temperature Results: Fixed + Floating Outlet



Environmental Flows

- Leslie Bach will highlight next
- Corps of Engineers and The Nature Conservancy

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An Environmental Streamflow Assessment for the Santiam River Basin, Oregon

By John C. Risley, J. Rose Wallick, Joseph F. Mangano, and Krista L. Jones

Prepared in cooperation with the U.S. Army Corps of Engineers

Open-File Report 2012–1133

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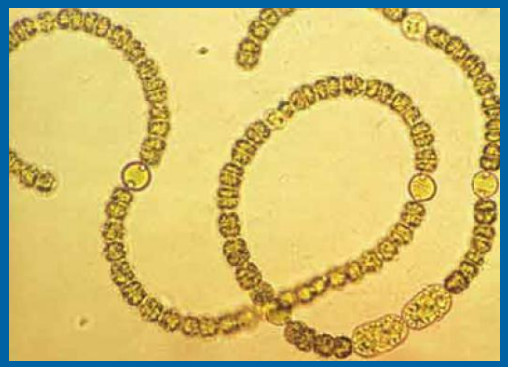
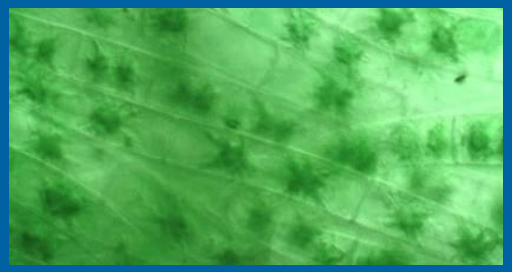
Effects of Algae on Operations at Geren Island Slow-Sand DWTP

- 2010–11 monitoring data included algal species, biomass, and associated water-quality indicators (oxygen, pH, nutrients)





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Preliminary Findings

- Export of algae from Detroit Lake has been associated with clogged sand filters at the Geren Island DWTP, particularly during the 2009 heat wave
- Attached algae (periphyton) from the North Santiam River also contribute to filter clogging and other operational issues at times
- Dam operations and use of surface and groundwater at the Geren Island DWTP also has the potential to influence algal abundance and filter performance
- Algal blooms have been less severe in recent years owing to poor weather and shorter growing seasons
- Spilling of more surface water at Detroit Lake for temperature targets for salmon appears to have reduced blue-green algae blooms in the lake

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Flows - North Santiam River at Geren Island

- 2005-2010
- Flow rates at 9 sites above and below Geren Island
- City of Salem

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Flows at Mouths of Willamette River Tributaries

- Gains or losses between USGS gage and mouth at six Willamette River basin tributaries (2011–2014)
- Virtual gage on USGS Data Grapher
- COE

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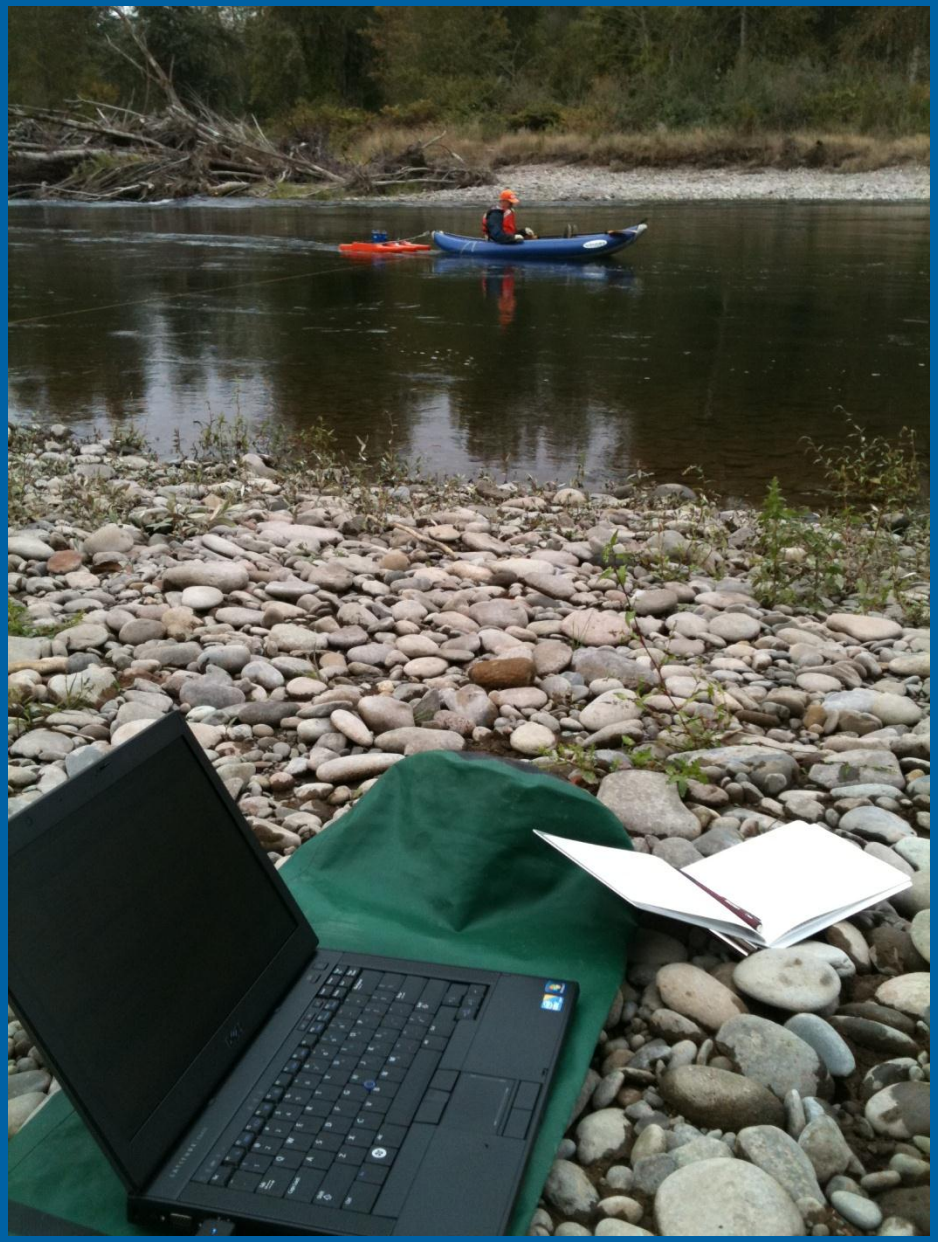
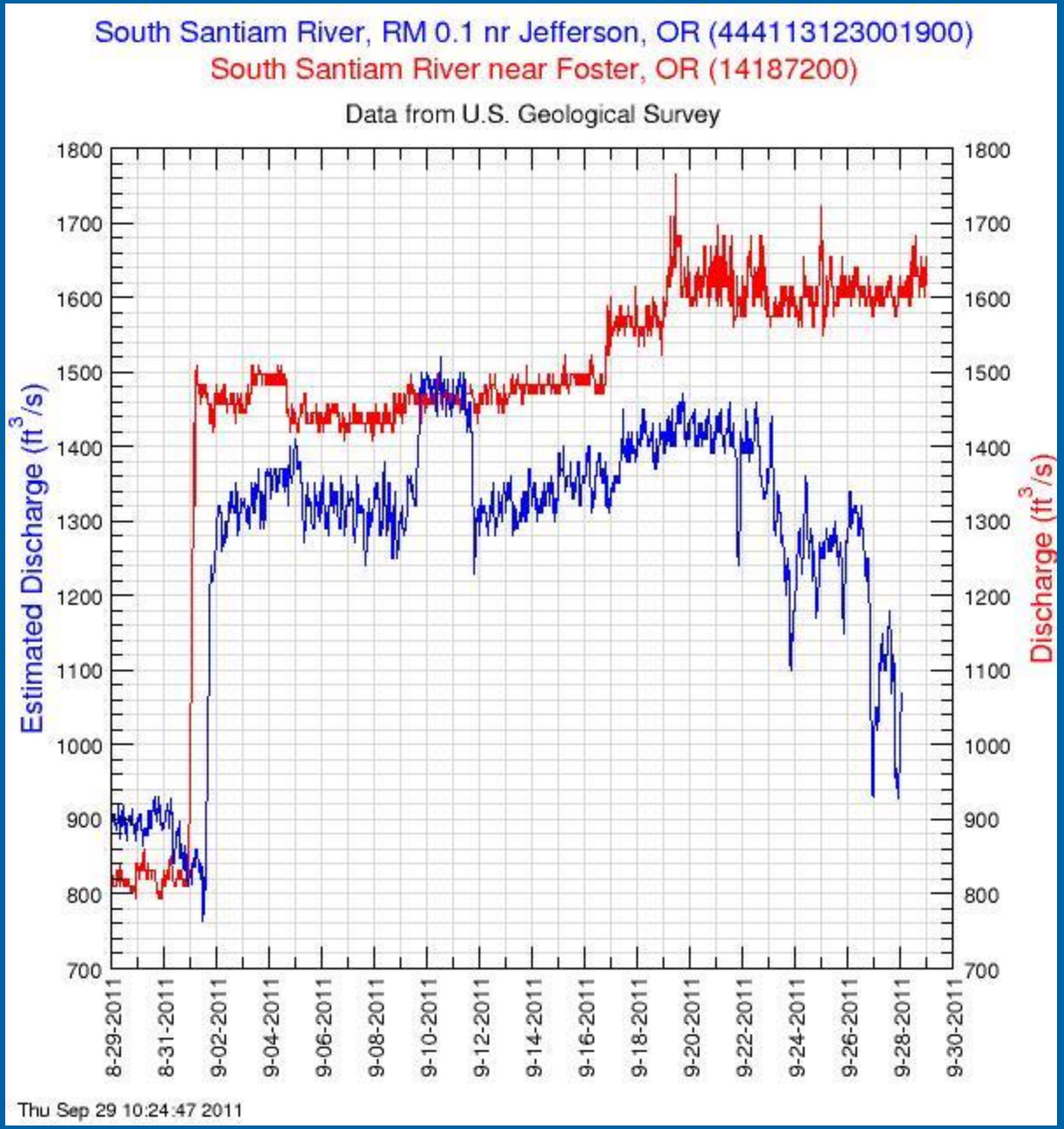


USGS Data Grapher

- Easy to compare Oregon real time data
- http://or.water.usgs.gov/grapher/
- USGS funded



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Ongoing Project : Hydraulics and 1-D Water temperature HECRAS model

- From Big Cliff Dam downstream to mouth of Santiam River
- More efficient and faster than CE-QUAL W2
- Calibrate with past model runs 2002-2011 water years
- New river cross sections data base.
- COE

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Possible Project: North Santiam River Basin Flood Inundation Mapping (FIM)

- National USGS / NWS / FEMA / COE efforts
- Locally funded

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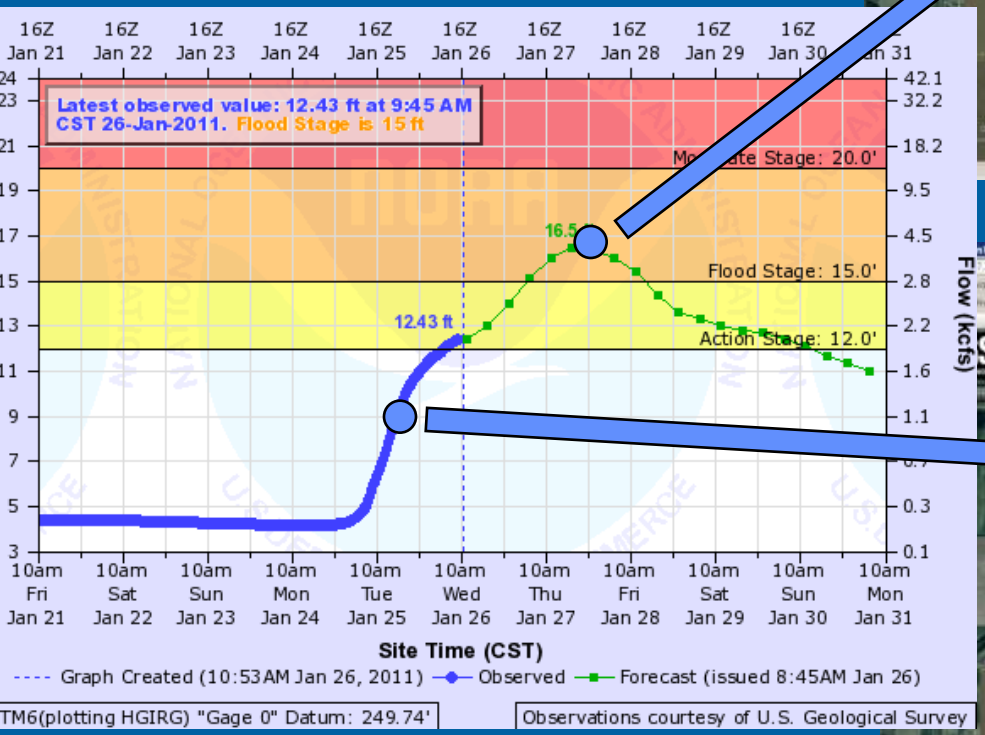
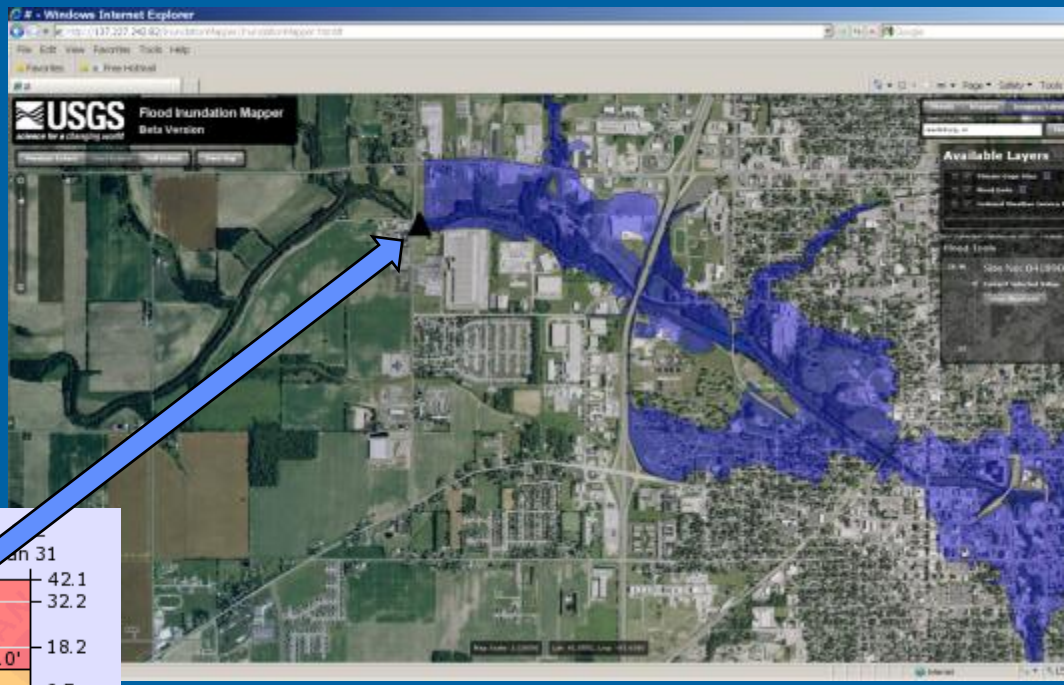
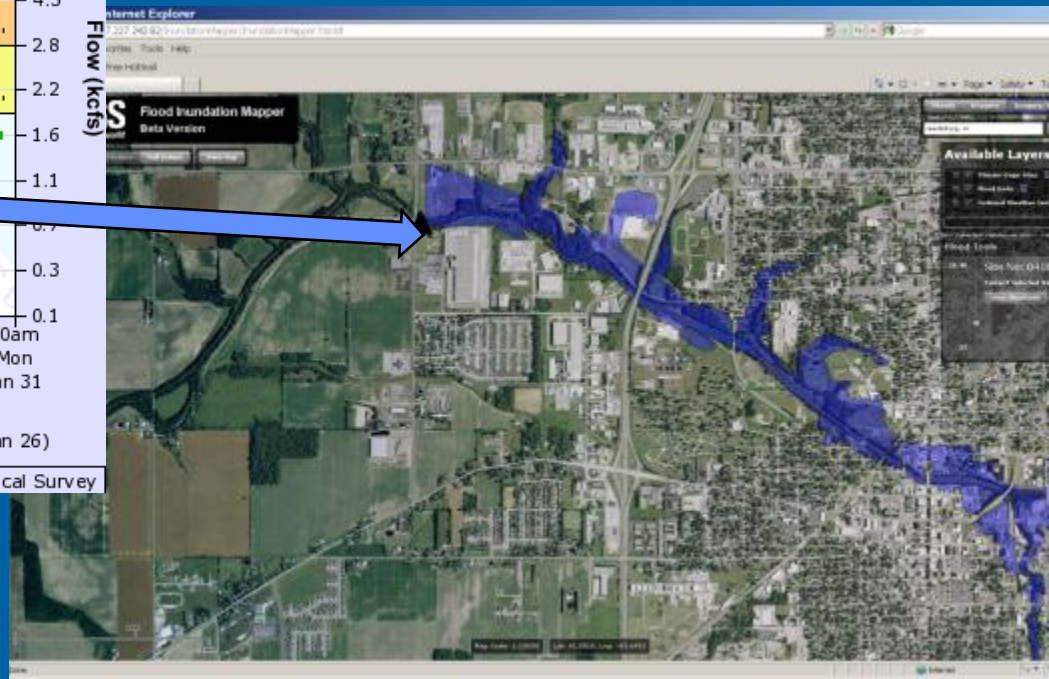
Flood Inundation Maps translate a hydrograph into operational maps that communicate risk and consequences







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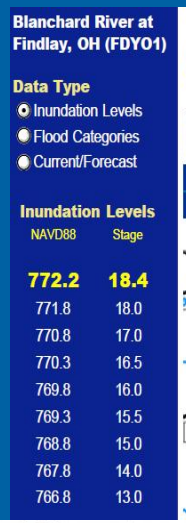
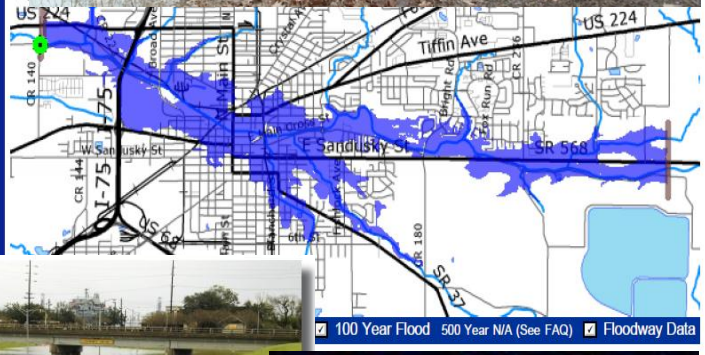
FIM becomes a tool for flood….

- Preparedness
  - “What-if?” scenarios
- Response
  - Tied to gage and forecast data
- Recovery
  - Damage assessment
- Mitigation and planning
  - Flood risk analyses
- Environmental and ecological assessments





Flooded underpass, Beaumont, TX (photo courtesy of L. Roll/FEMA)

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Possible Project : North Santiam River Spill and Time of Travel Tool

- Very simple, quick tool to decide how far downstream a parcel of water travels
- Calibrated from 1960s Harris and 2004 North Santiam modeling project
- Uses real time USGS gage data
- Excel tabular format now. Mapped possibility?
- Local funding ?

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USGS North Santiam Projects

- Got questions ?