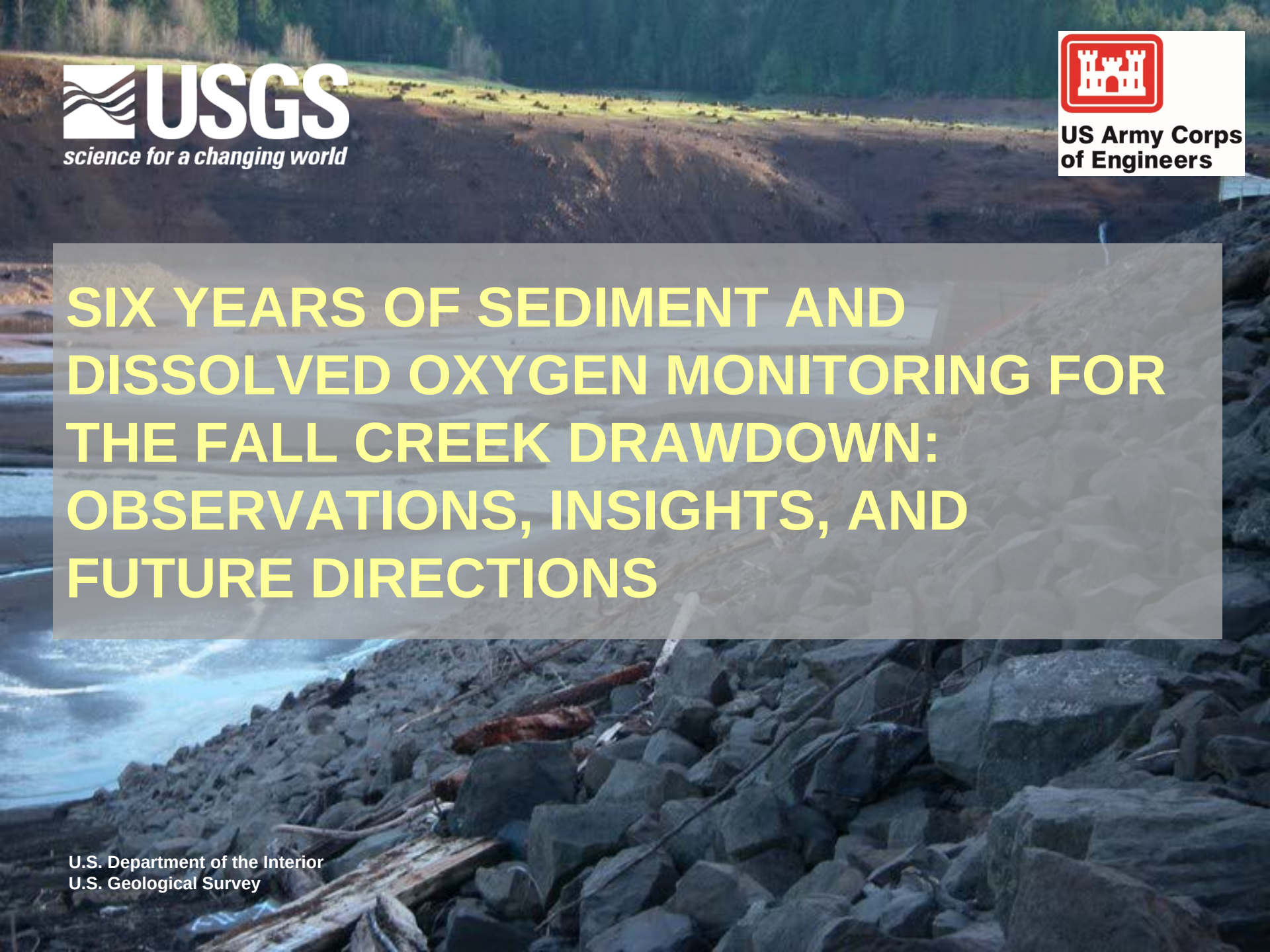

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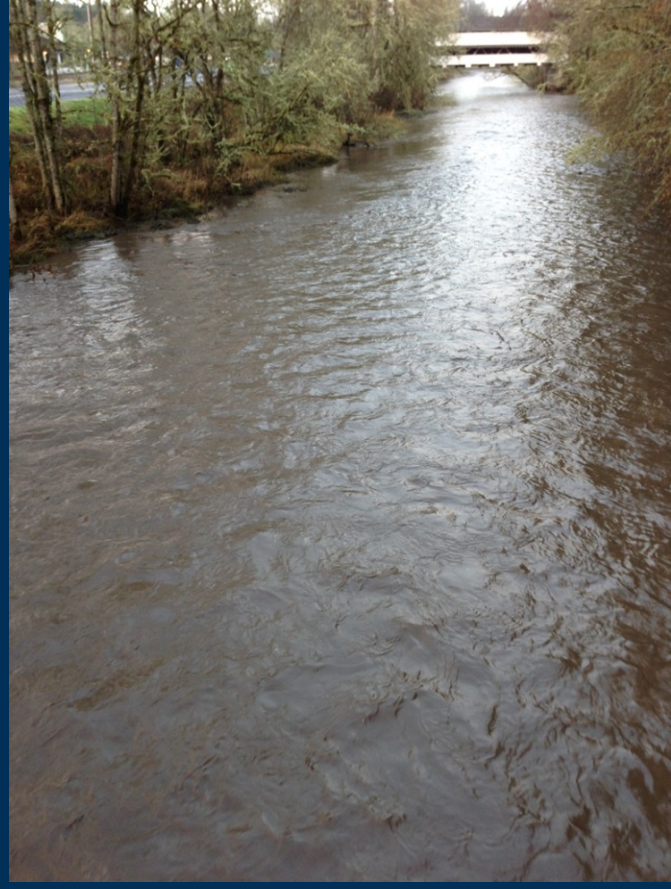
SIX YEARS OF SEDIMENT AND DISSOLVED OXYGEN MONITORING FOR THE FALL CREEK DRAWDOWN: OBSERVATIONS, INSIGHTS, AND FUTURE DIRECTIONS

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

Presentation Outline

- Project Background
- Fall Creek Study Results
  - Surrogate Models
  - Suspended Sediment Loads
  - Dissolved Oxygen
- Data Gaps
- Future Directions



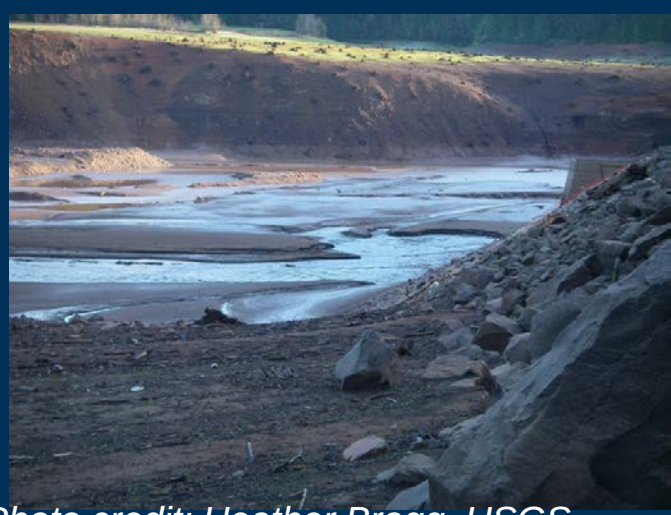
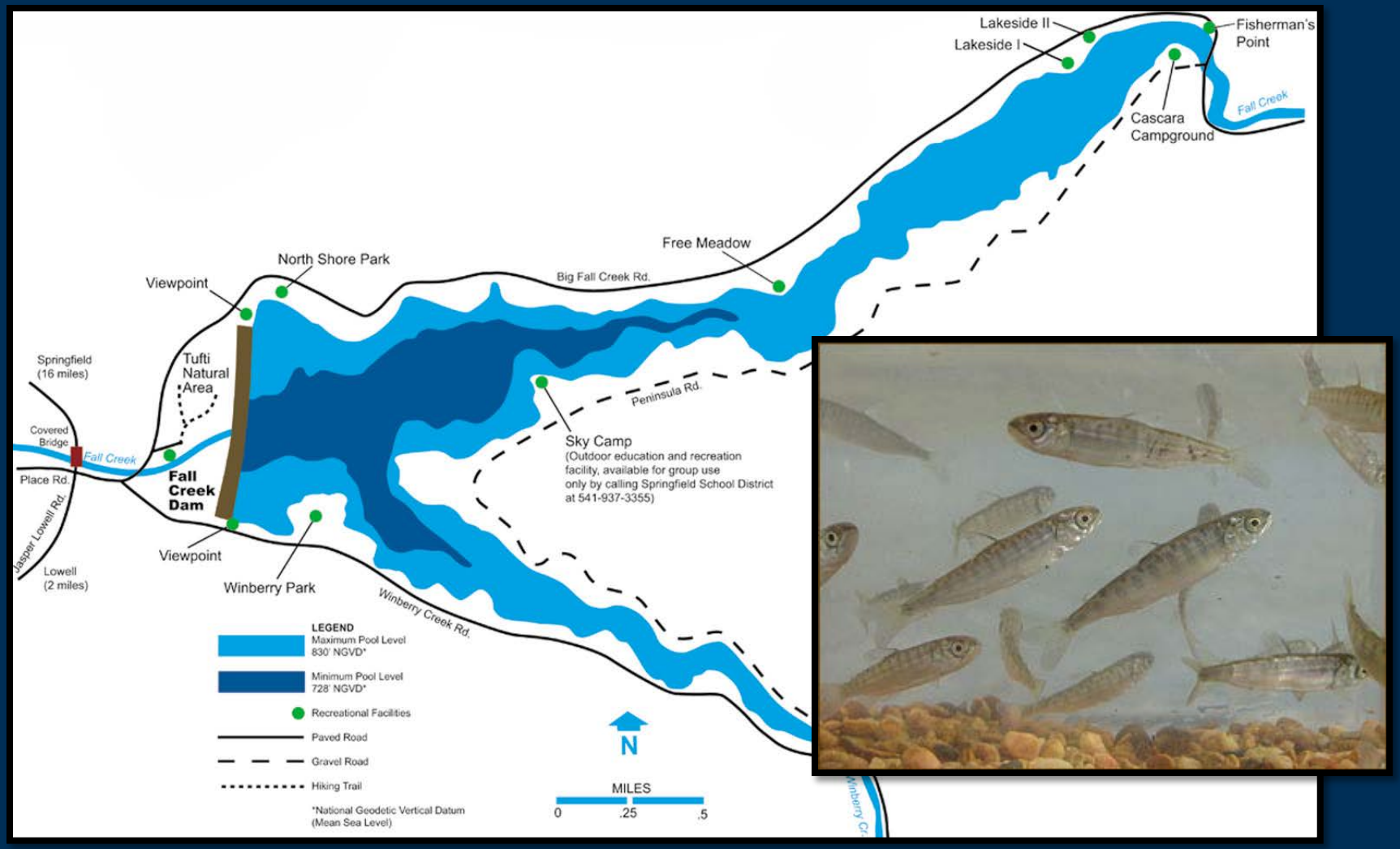


Photo credit: Heather Bragg, USGS

Drawdown Operations



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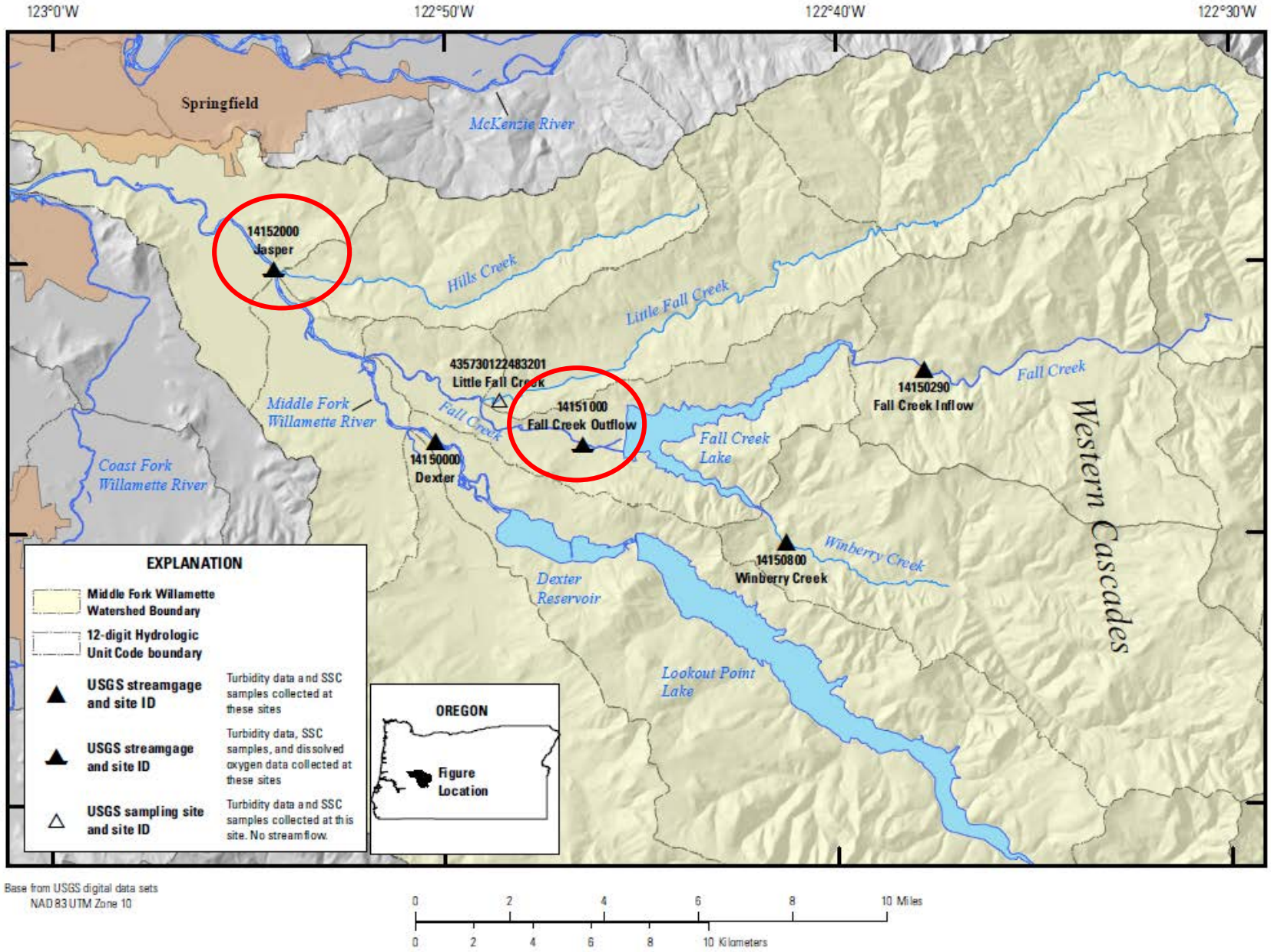
Map credit: USACE Fall Creek Lake map, http://www.nwp.usace.army.mil/Locations/WillametteValley/FallCreek.aspx

Photo credit: USGS Western Fisheries Research Center, Columbia River Research Laboratory

Project Sites: WY 2013-2018



Suspended Sediment/ Dissolved Oxygen Monitoring

- WY 2013
  - 6 sites – overall sediment budget
    - Published Report – OFR 2014-1114
- WY 2014-2018
  - 2 sites: Below Fall Creek Dam, Middle Fork at Jasper

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Methods

- Continuous turbidity and discrete Suspended Sediment Concentration (SSC) at six sites
  - Real-time, subhourly turbidity and DO sensors
  - Standard USGS sampling protocols for SSC
    - Depth-width integrated, & pump samples
- Turbidity-SSC surrogate regressions
  - Computes nearly continuous SSC and sediment loads
- Bedload sampling at site below Fall Creek Dam

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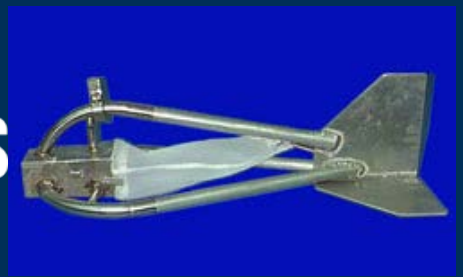
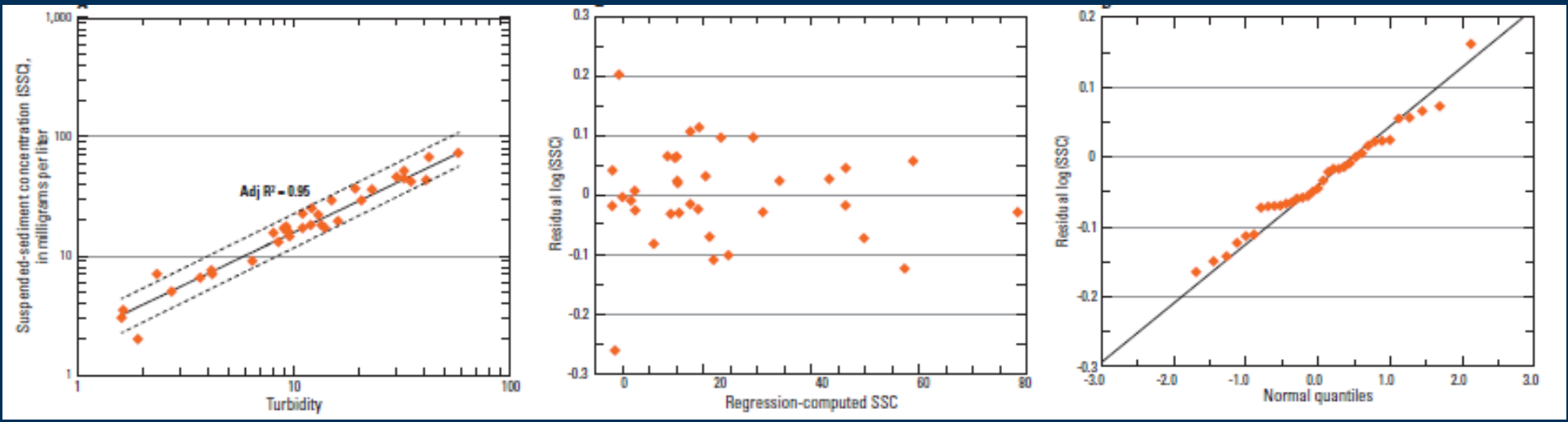


Regression Model Development Methods

- Turbidity/streamflow as explanatory variables
- Log-transformation vs non-transformed models
  - Probability plot correlation coefficient (PPCC)
  - Duan BCF used for transformed data
- Simple Linear vs Multiple Linear Regressions
  - Multi-collinearity



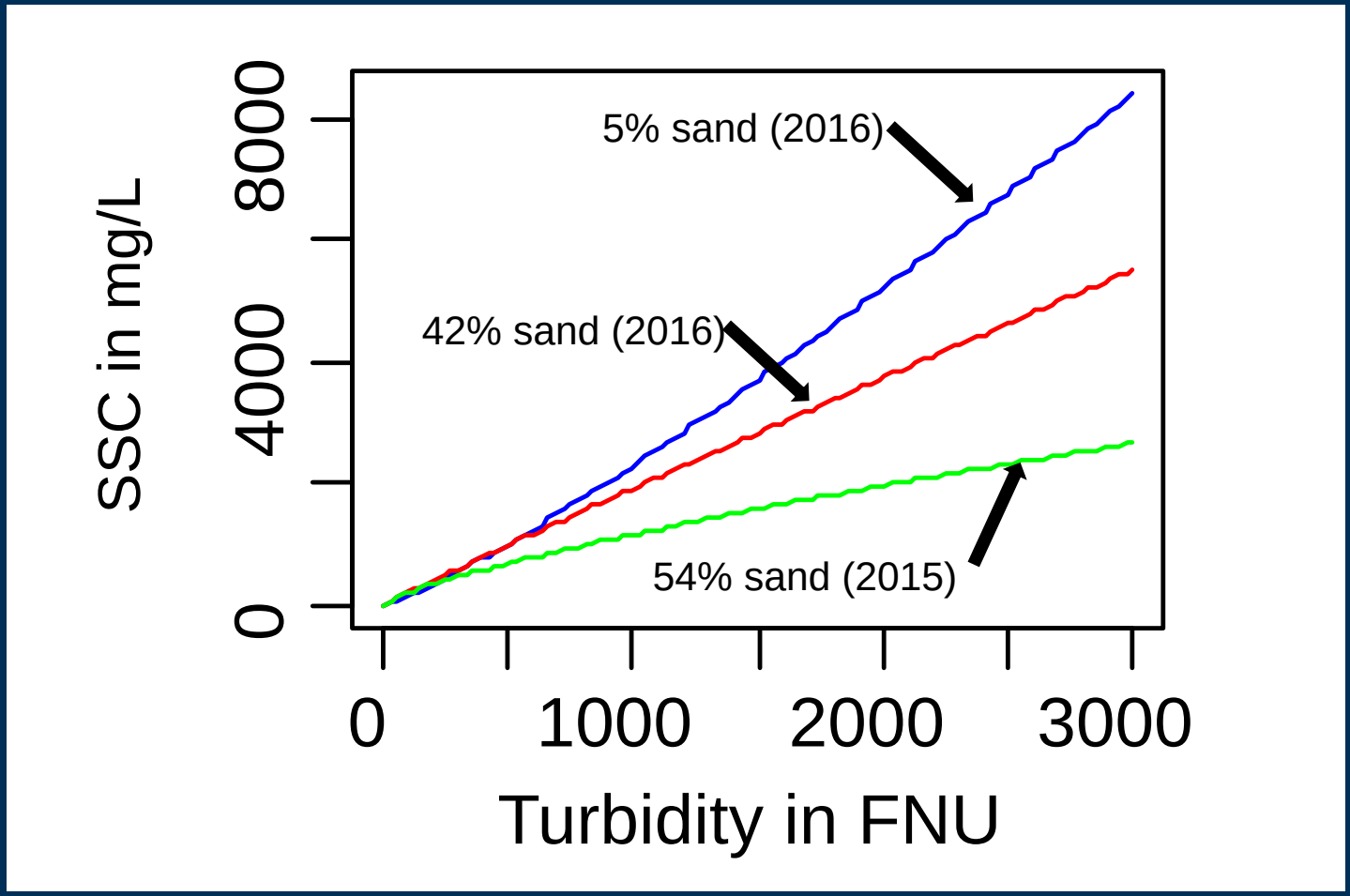
Schenk and others, 2016

Surrogate Model Results 2013-2017
Fall Creek below Winberry Creek
USGS Site ID 14151000

Water Year	Period	Equation	Transformed Equation	n	Bias Correction Factor
2013	Pre-drawdown	SSC = 4.91 + 0.764Turb - 0.00312Q	NA	5	NA
2013	Drawdown/Post drawdown	logSSC = -1.07 + 0.966logTurb + 0.612logQ	SSC = 0.867*Turb^0.966*Q^0.612	10	1.02
2014	Pre-drawdown	logSSC = -0.00509 + 0.723logTurb	SSC = 1.03*Turb^0.723	13	1.04
2014	Drawdown	SSC = 423 + 2.01Turb - 0.500Q	NA	30	NA
2014	Post-Drawdown	logSSC = -0.385 + 7.831logTurb + 0.375logQ	SSC = 0.450*Turb^7.831*Q^0.375	10	1.09
2015	Pre-drawdown	SSC = 0.494 + 0.504Turb	NA	9	NA
2015	Drawdowns	logSSC = 1.25 + 0.969logTurb - 0.313logQ	SSC = 18.13*Turb^0.969*Q^-0.313	20	1.02
2015	Inter/Post	logSSC = 0.800 + 0.752logTUrb	SSC = 6.50*Turb^0.752	5	1.03
2016	Pre+Drawdown	logSSC = -0.198 + 1.18logTurb	SSC = 0.666*Turb^1.18	16	1.05
2016	Inter/Post Drawdown	logSSC = 0.375 + 0.958logTurb	SSC = 2.58*Turb^0.958	11	1.09
2017	All	logSSC = -0.189 + 1.25logTurb	SSC = 0.789*Turb^1.25	19	1.22

Grain size effect on turbidity signal

- **Sands/Fines affect Turbidity response from the same sensor**



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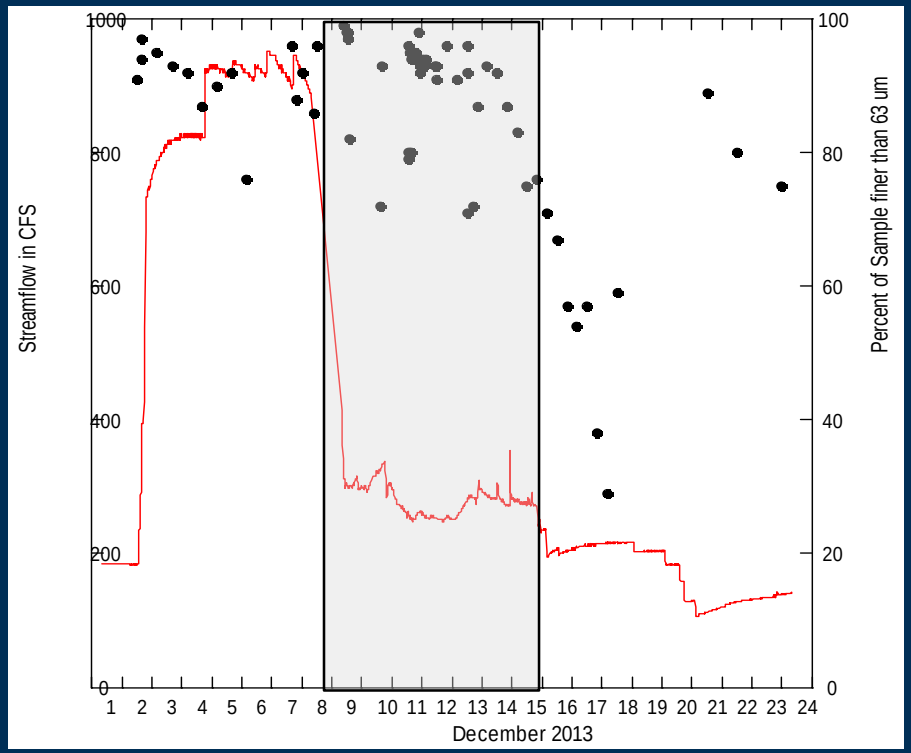
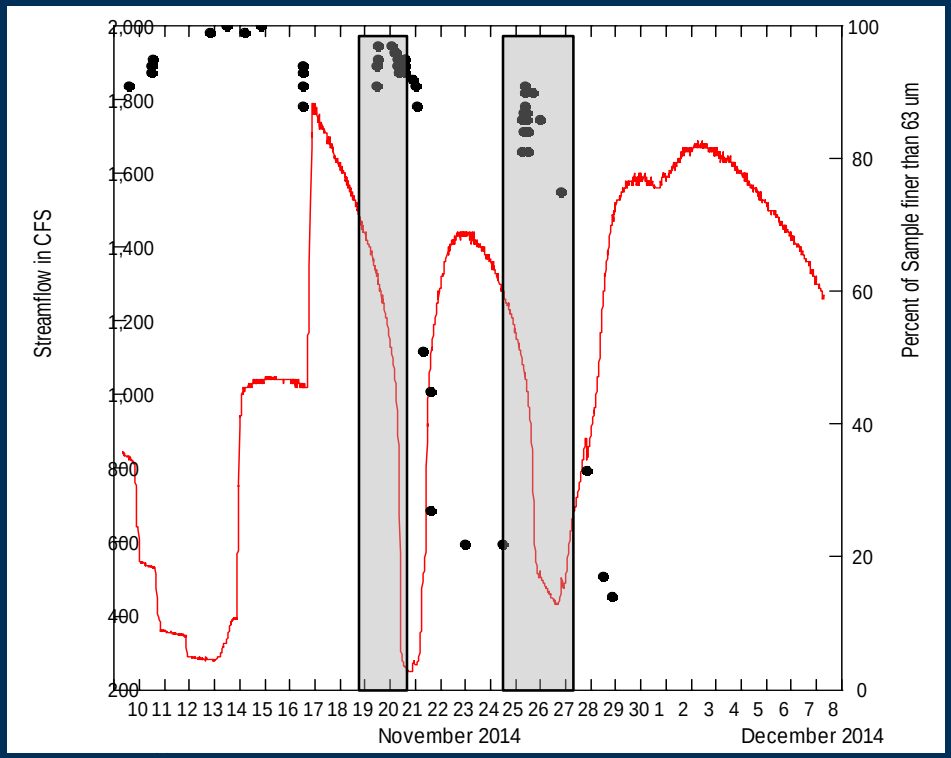
Grain Size changes during drawdowns

- **In most years, percent fines decrease toward the end of the drawdown**



December 2013

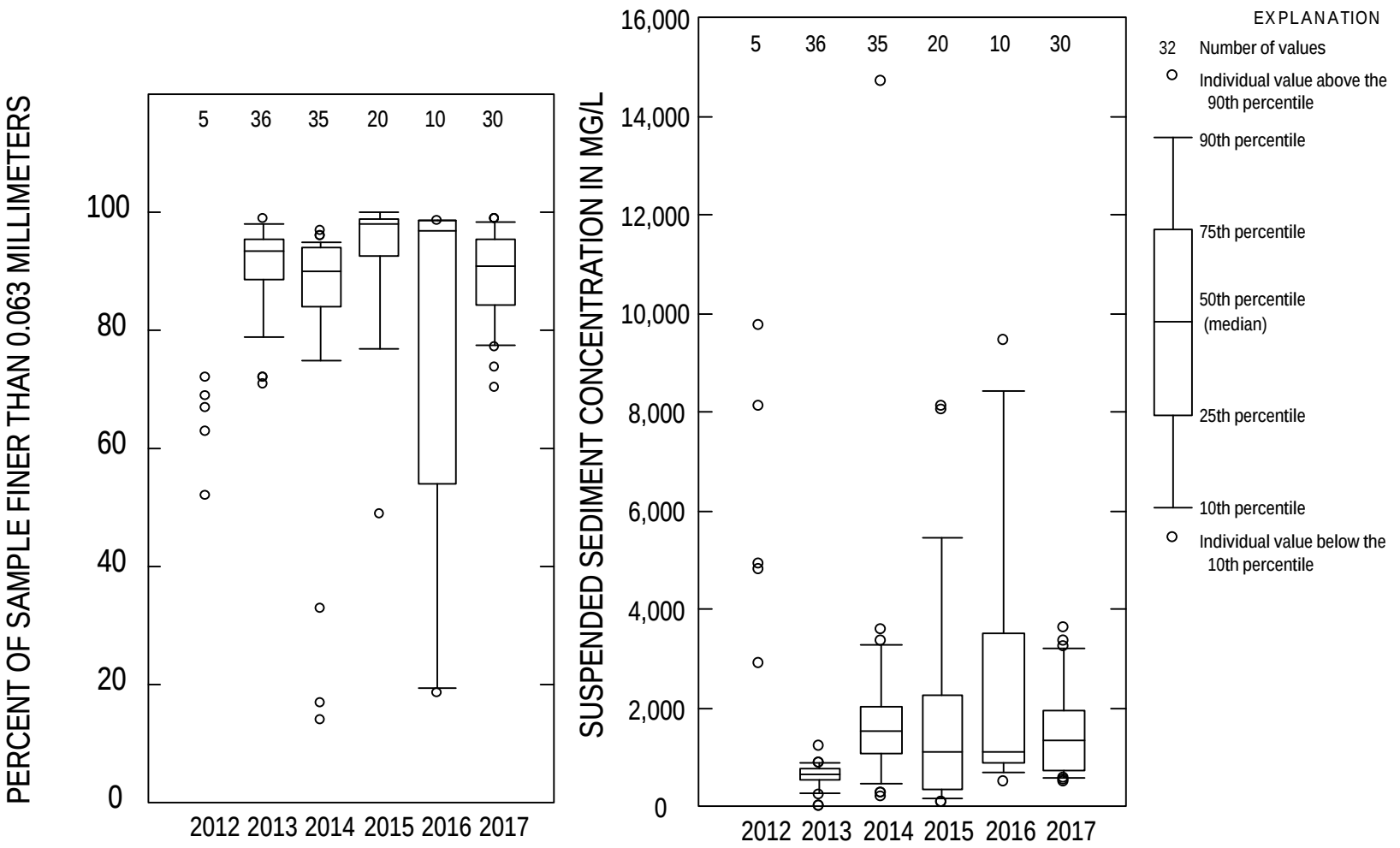


Dec/Nov 2014

USGS

U.S. Geological Survey, 2013-2015

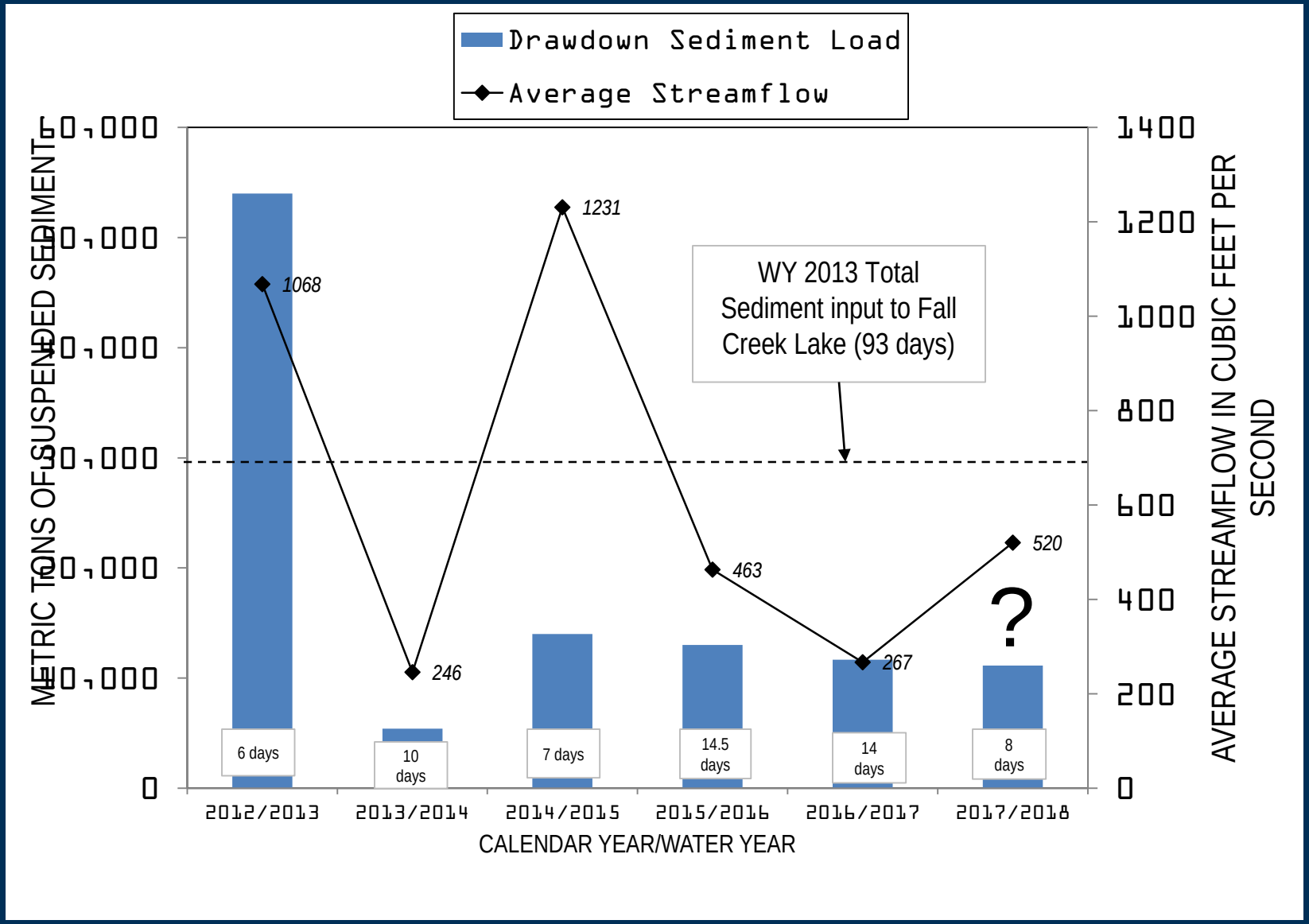
Percent Fines and Suspended Sediment Concentration Drawdown Samples



2016-2017 data provisional and subject to revision

USGS

Sediment Loads During and after Periods of Drawdown



Water Year 2016/2017 Data are provisional and subject to revision

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2013/14 Drawdown Conditions

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Photo credit: Heather Bragg

Bedload Monitoring

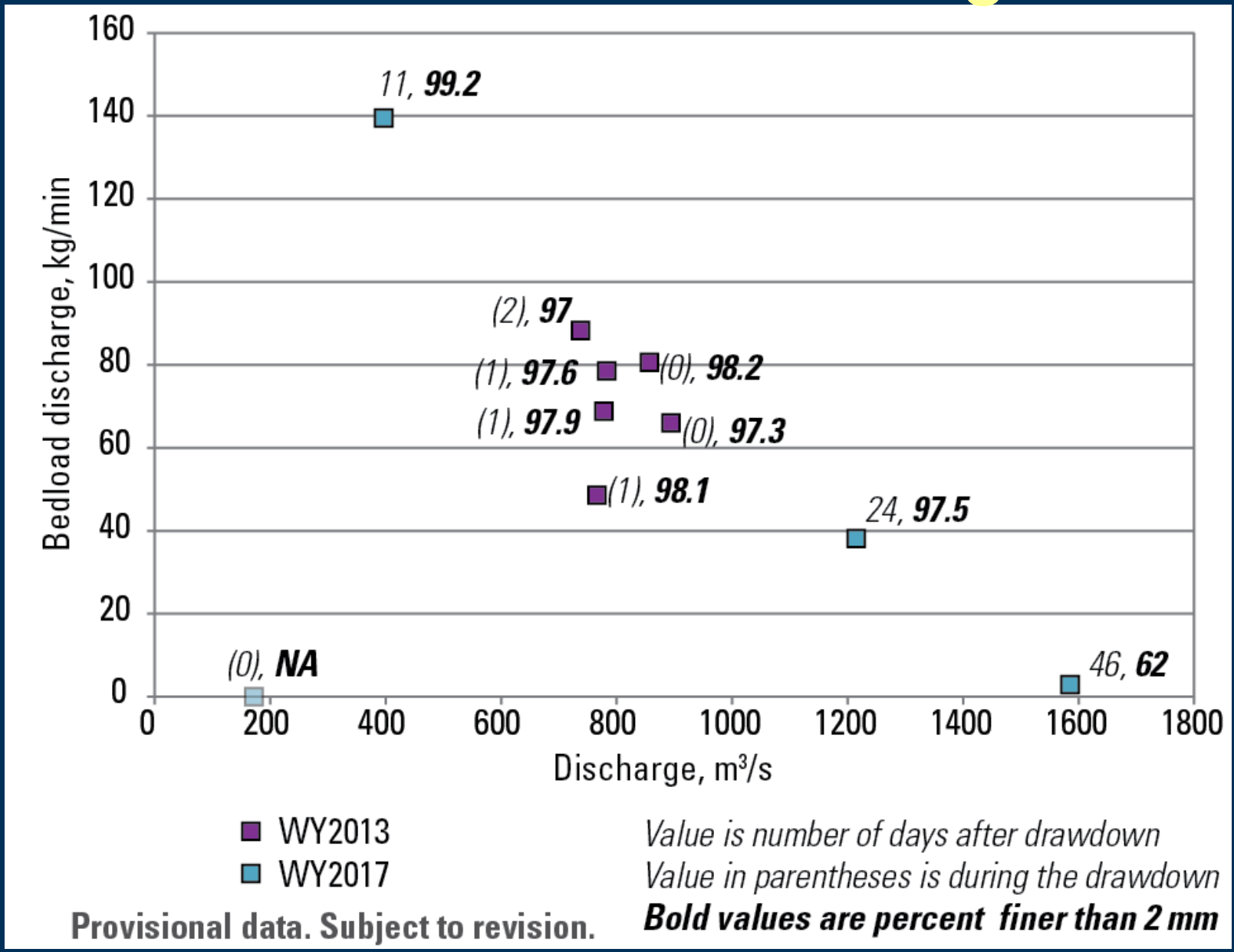
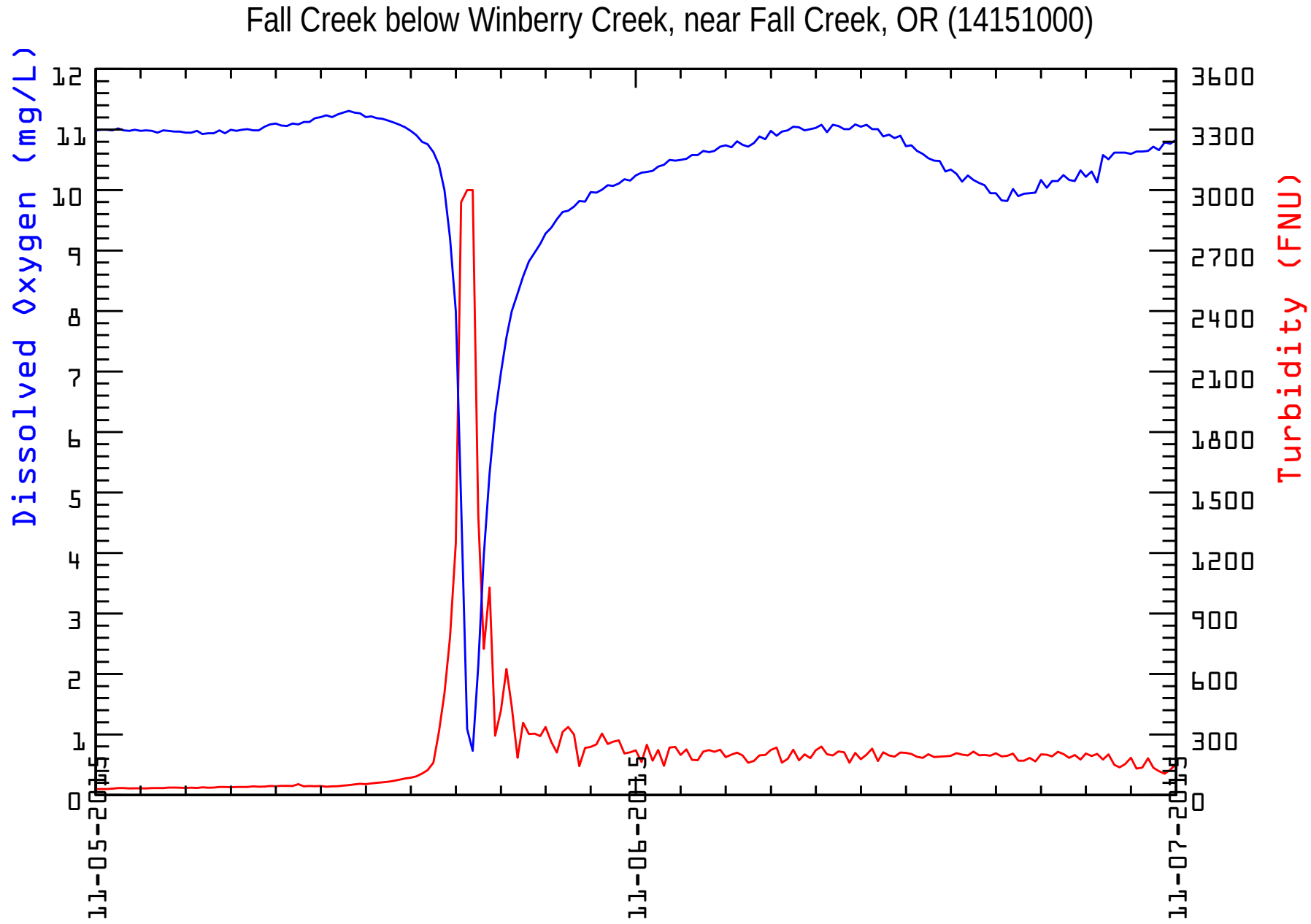
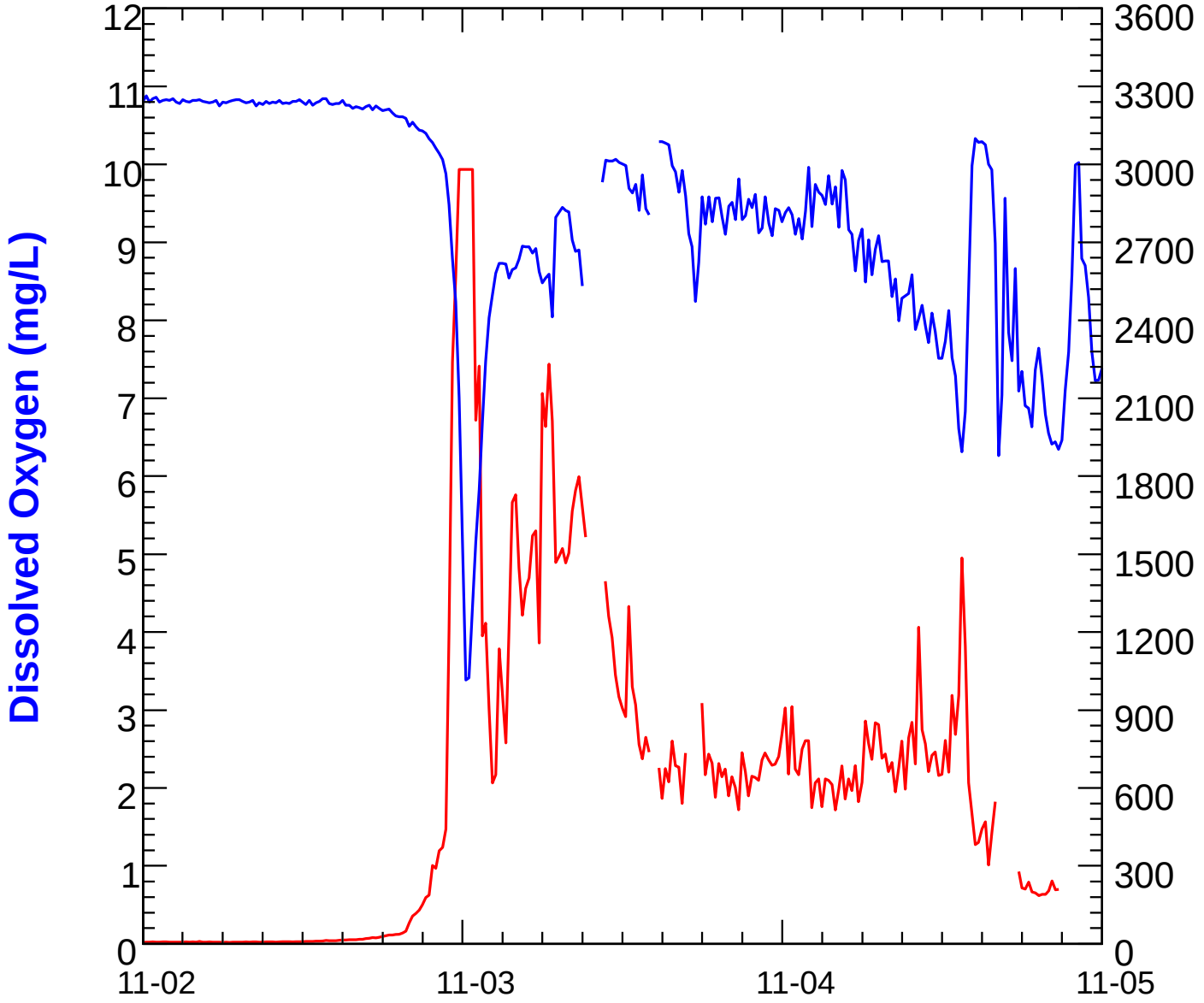


Figure credit: Mackenzie Keith, USGS

Dissolved Oxygen Response to Drawdown

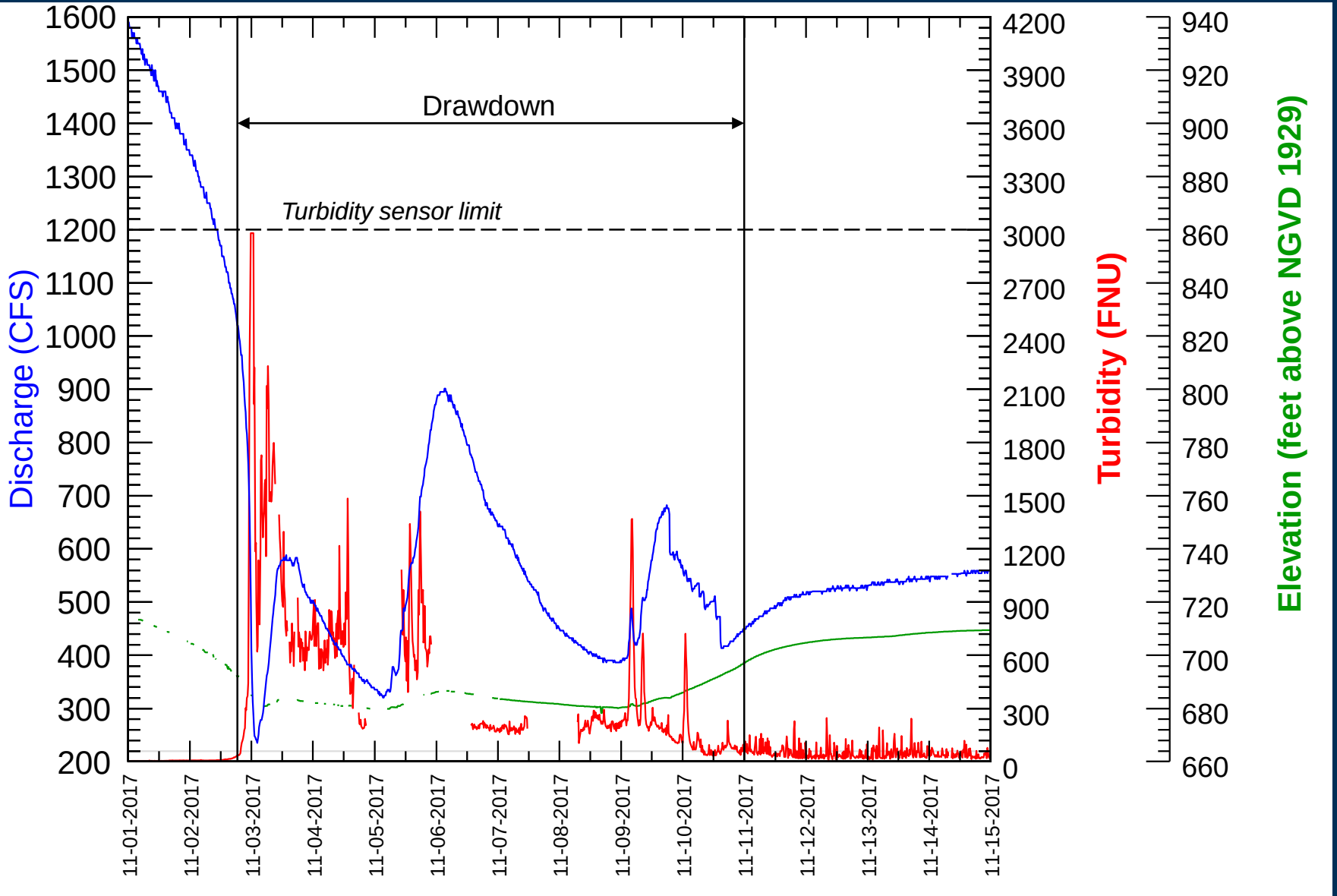


November 2017 Drawdown



Data are provisional and subject to revision

November 2017 Drawdown



Data are provisional and subject to revision

Insights from Monitoring Efforts

- Suspended-sediment loads highest in WY 2013, variable but lower for WY 2014-2017.
  - Affected by hydrologic, meteorological conditions, and sediment supply
  - Drawdown loads for WY 14-18 less than inflow SSL calculated in 2014
  - Loads decreasing in the last 4 years regardless of streamflow during drawdowns
- Sand transport may be limited by timing drawdowns with low inflows, and avoiding drastic increases in streamflow that transport sand-sized material
- Periods of hypoxia are evident 1 mile below the dam. Duration appears proportional to sediment pulse time

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Data Gaps / Future Directions

- Annual Sediment input to Fall Creek Lake, putting drawdown into context of annual mass balance
  - Reservoir Erosion and how it affects reservoir storage (trapping efficiency)
- Can water quality impacts be mitigated as we learn more about the response to drawdowns?
- What would sediment transport look like under different drawdown operations or watershed alterations
- Site specific pre-drawdown investigations in-reservoir

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Applicability to Drawdowns at other Corps Projects

- Streamgaging networks can be used to assess suspended-sediment mass balance with continuous turbidity/streamflow data
  - Longer drawdown periods would require year-round monitoring
- Not going to streambed limits “coarse” (>63µm) sediment transport
  - Likely see fine sediment transport increase
- Periodic bedload sampling can confirm coarse sand or gravel transport

USGS

Acknowledgments

- Heather Bragg - USGS
- Casie Smith, Dave Piatt -USGS
- Rose Wallick, Mackenzie Keith, Brandon Overstreet, James White – USGS Geomorphology Team
- USACE - Greg Taylor, Kathryn Tackley, Ari Powers, Kathryn Warner, Rich Piaskowski, Mary-Karen, Yamen

USGS

Questions ?

References

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