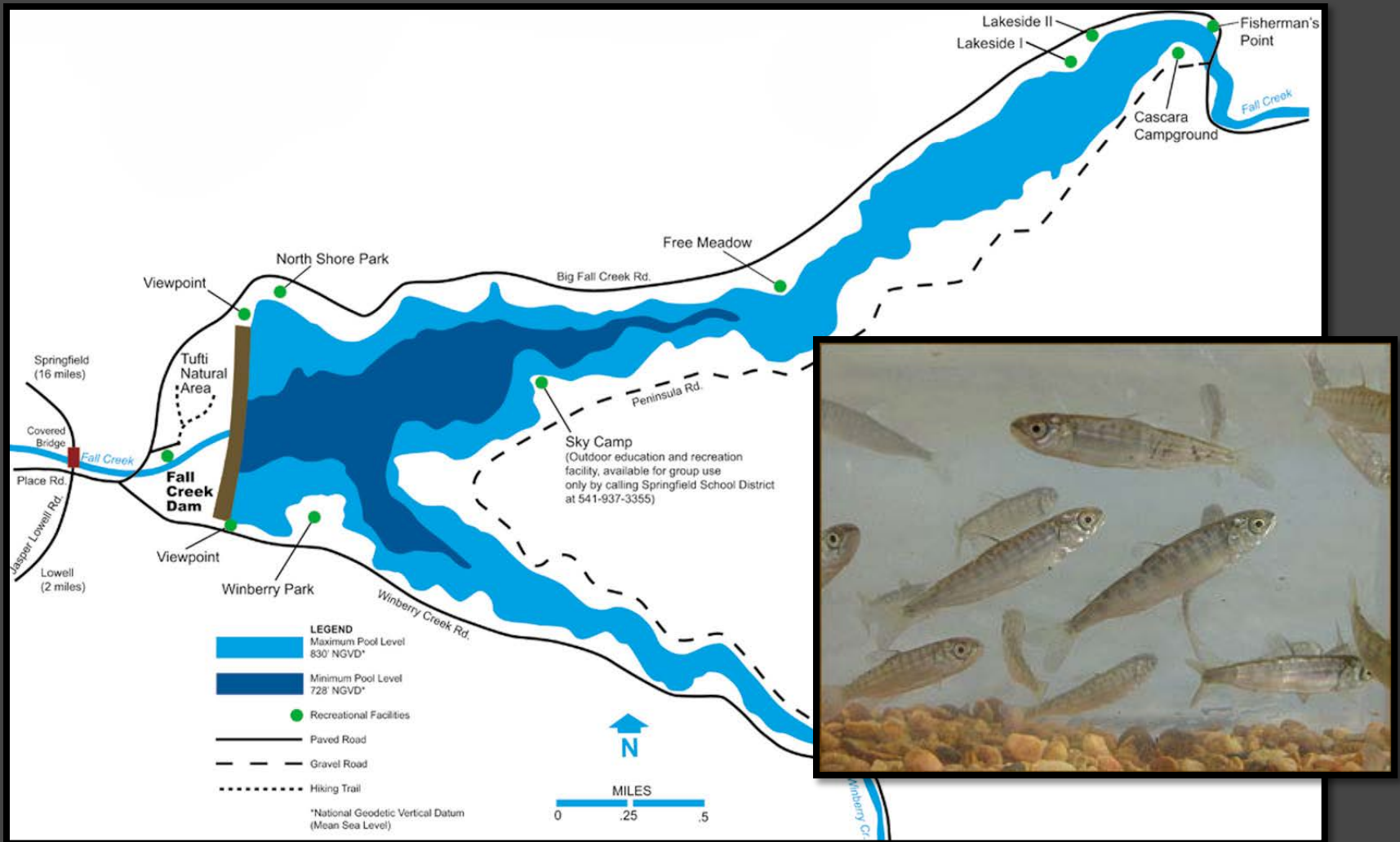


# Preliminary Assessment of Geomorphic Responses to Reservoir Drawdowns at Fall Creek Lake, Oregon

**Willamette Fisheries Science Review 2017**

**Mackenzie Keith, Rose Wallick, Greg Taylor, James  
White, Joseph Mangano, Gabe Gordon, Liam  
Schenk, Heather Bragg**

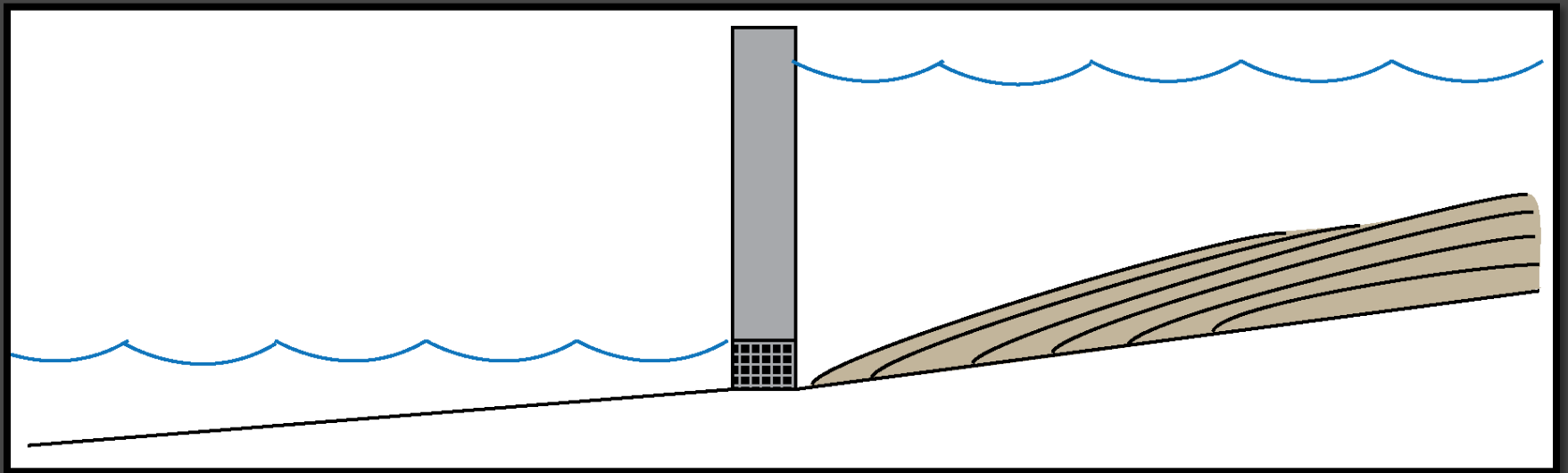
# Drawdown Operations



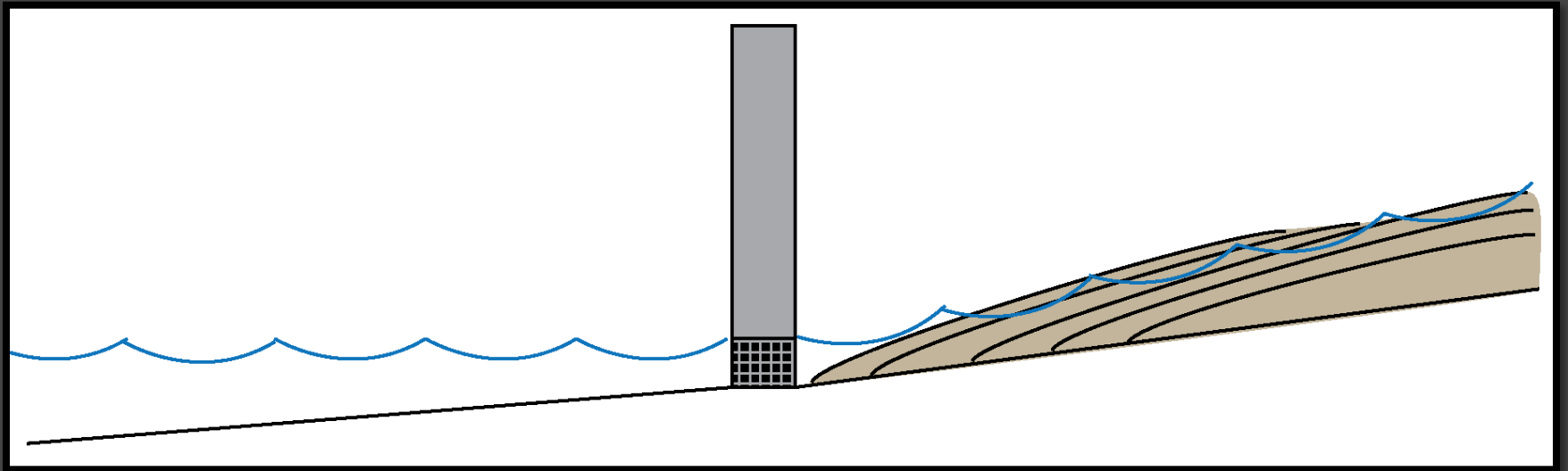
Map credit: USACE Fall Creek Lake map, <http://www.nwp.usace.army.mil/Locations/WillametteValley/FallCreek.aspx>

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

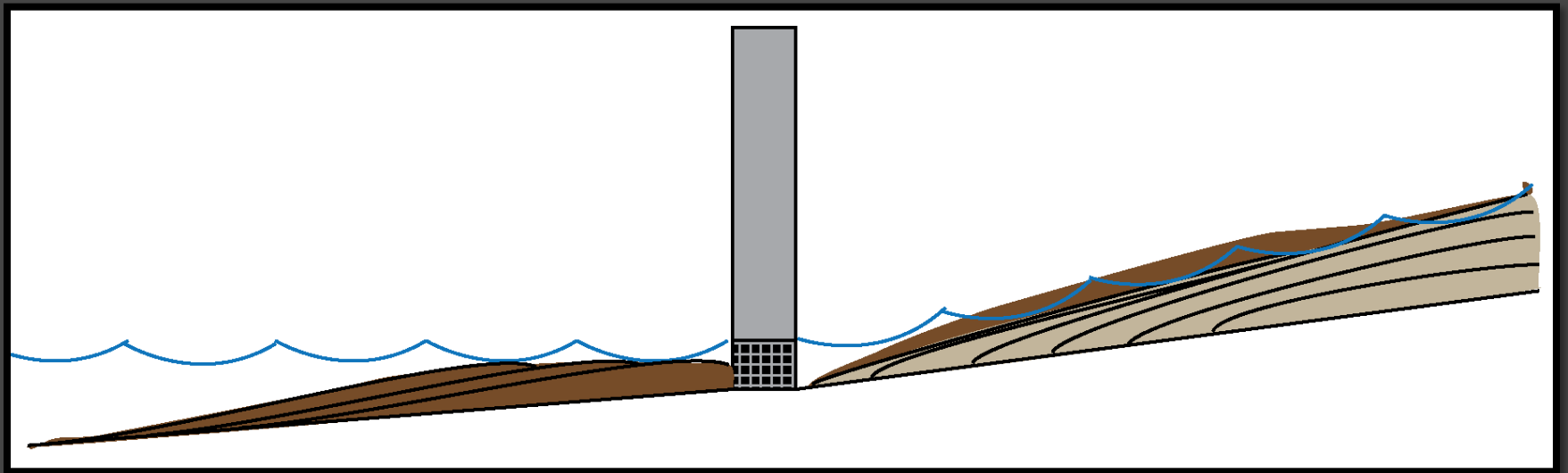
# Drawdown Operations



# Drawdown Operations



# Drawdown Operations



# Drawdown Operations

- Proxy dam removals, landslides, volcanism ....but the dam is still there
  - Altered flow
  - Reservoir erosion is temporary
  - Upstream sediment trapping
- These rivers are fundamentally different than pre-dam



Marmot Dam removal  
Photo credit: USGS  
Cascades Volcano Observatory

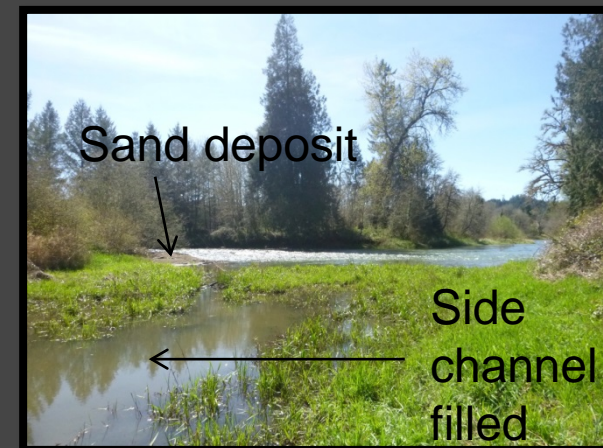
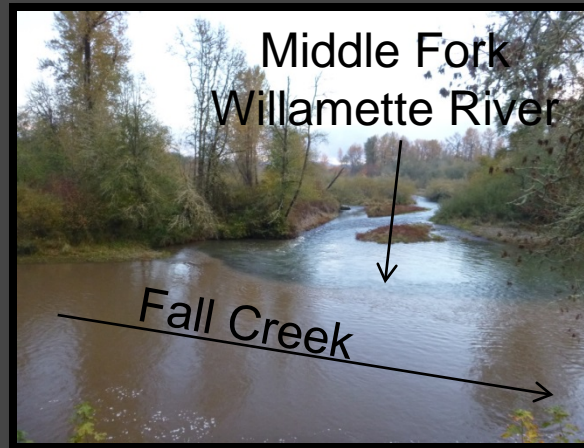
# Key Objectives

- Document reach-scale geomorphic responses
- Evaluate linkages between
  - reservoir operations and erosion
  - downstream sediment transport
  - re-deposition of sediment
- Place responses within the broader context of geomorphic stability and historical changes



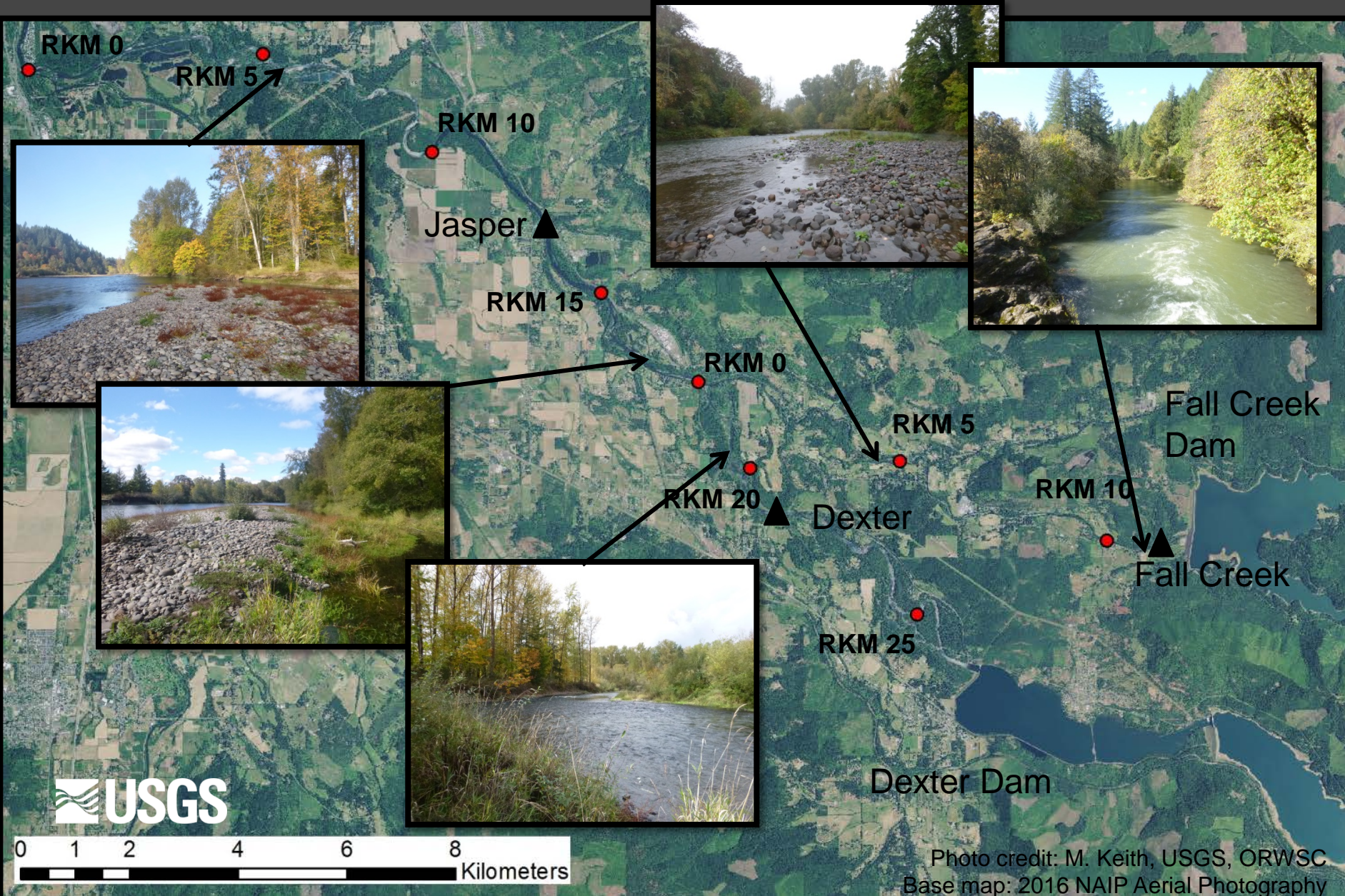
# Study Highlights

- Upstream reservoir change
- Downstream sediment transport
- Downstream site scale change
- Downstream reach scale change





# Study Area and Geomorphic Context

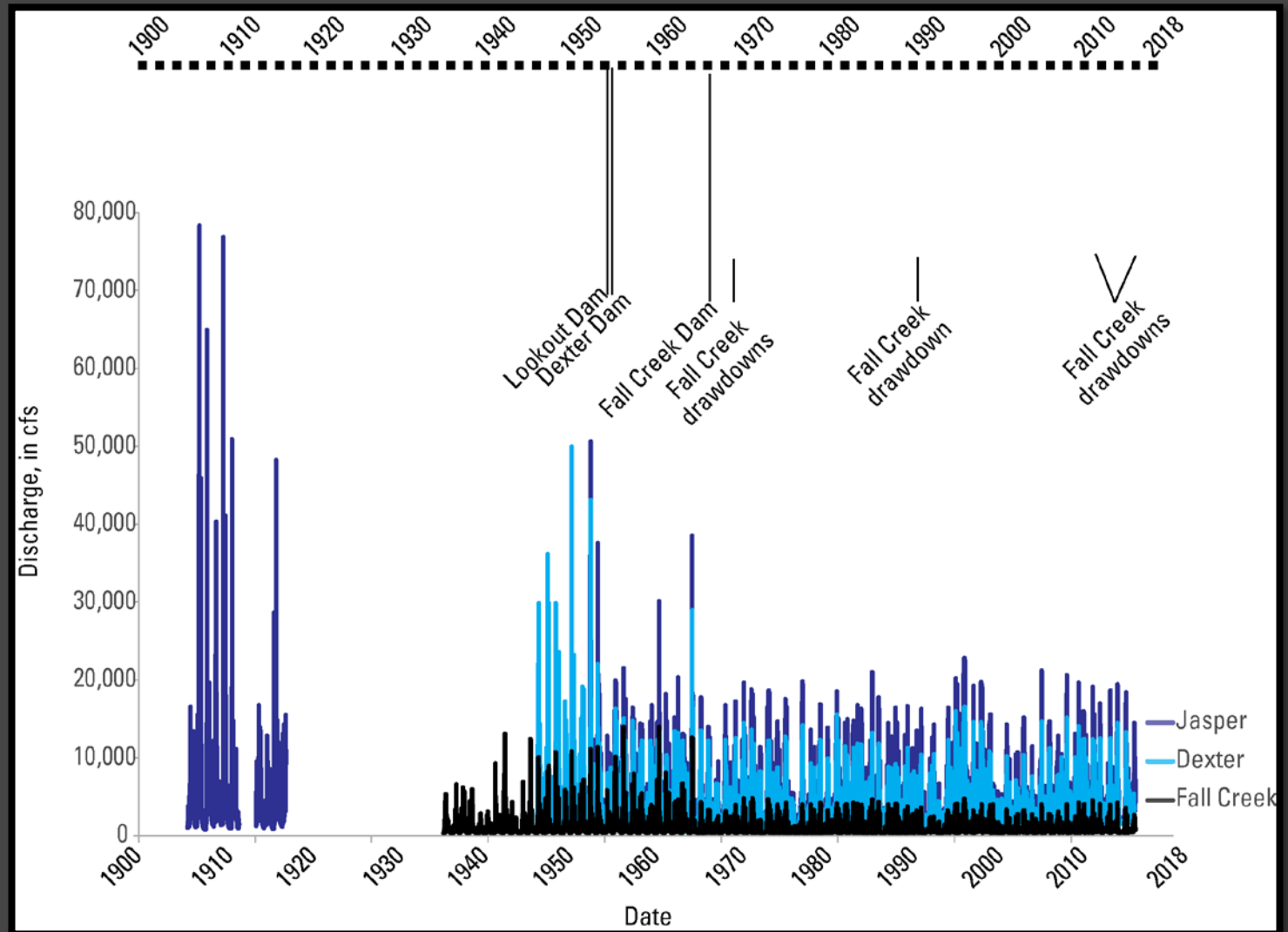


USGS

0 1 2 4 6 8 Kilometers

Photo credit: M. Keith, USGS, ORWSC  
Base map: 2016 NAIP Aerial Photography

# Study Area and Geomorphic Context

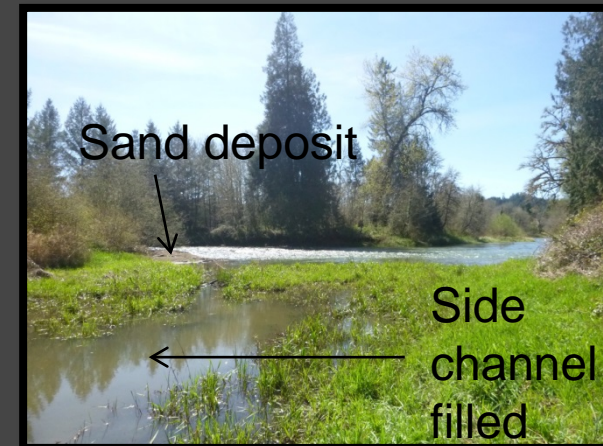
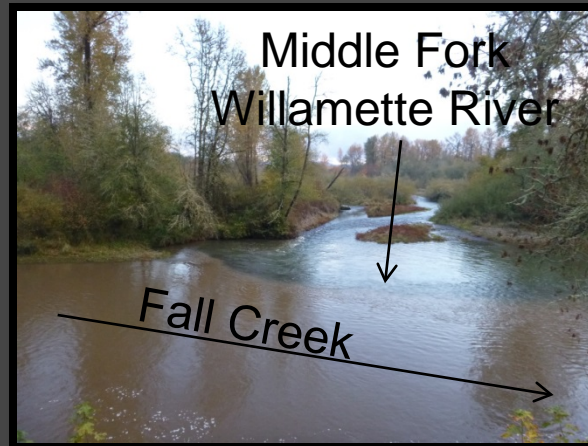


# Study Highlights

- Upstream reservoir change
- Downstream sediment transport
- Downstream site scale change
- Downstream reach scale change



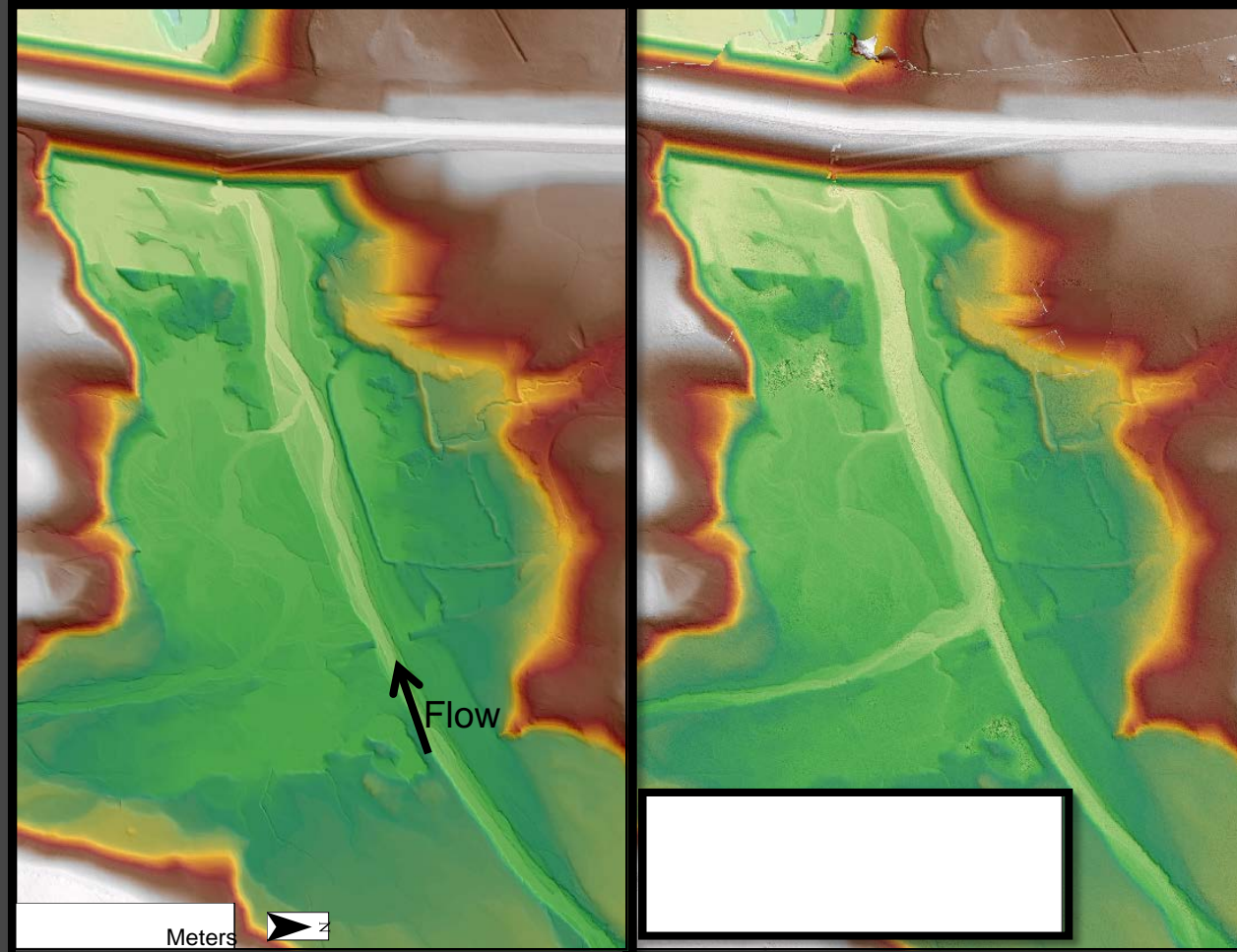
USGS



# Reservoir Evolution

January 2012

November 2016

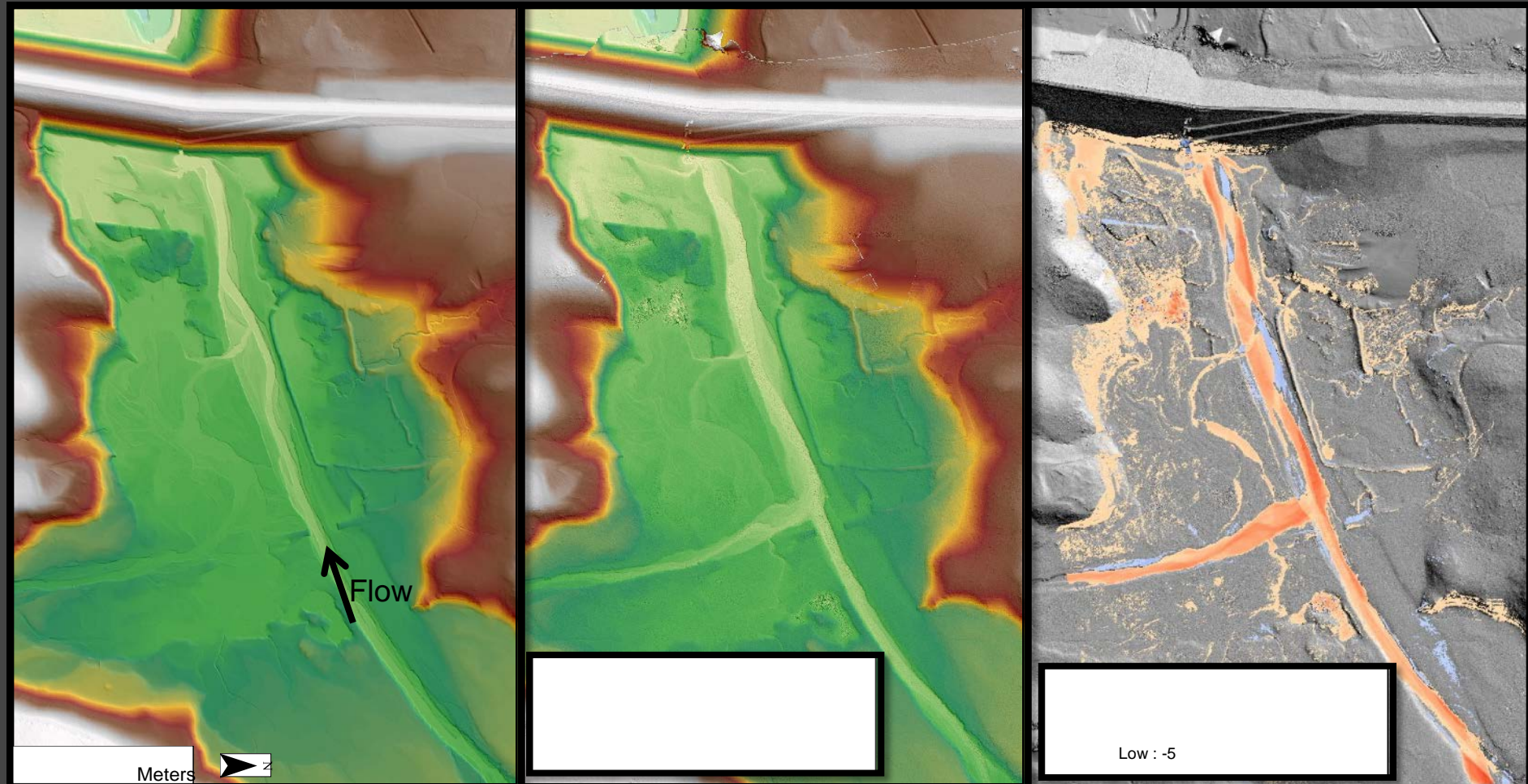


# Reservoir Evolution

January 2012

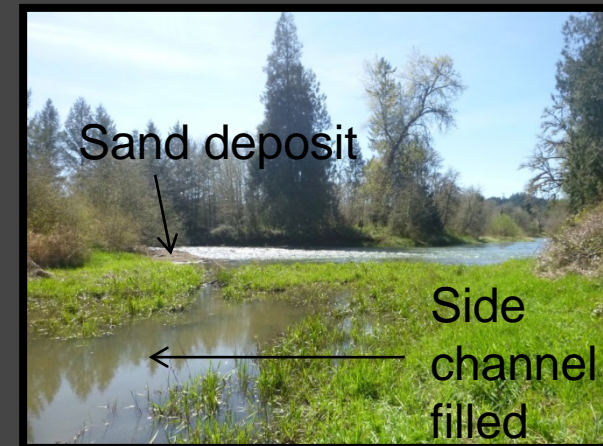
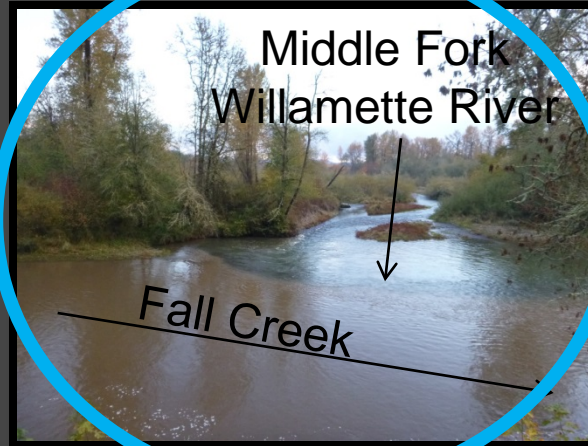
November 2016

Difference



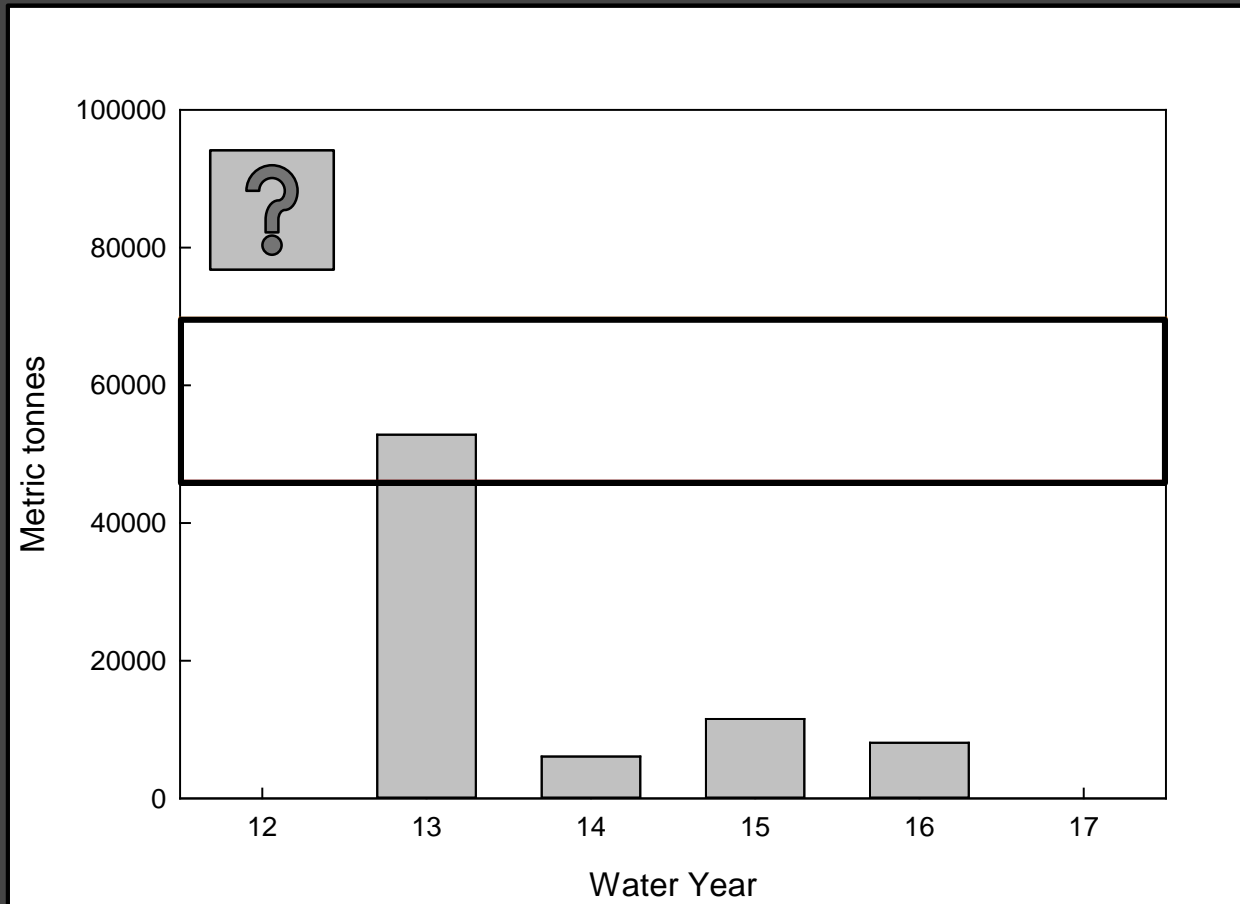
# Study Highlights

- Upstream reservoir change
- **Downstream sediment transport**
- Downstream site scale change
- Downstream reach scale change



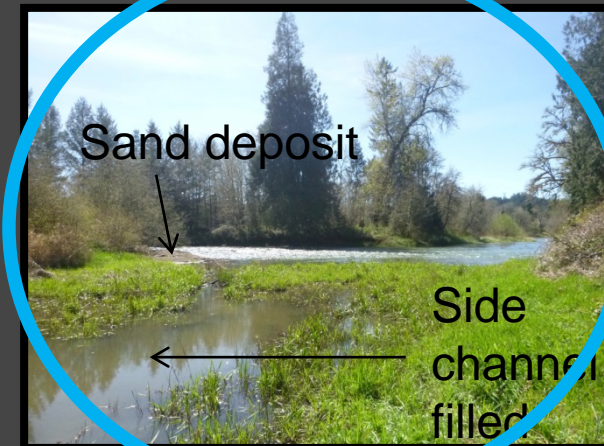
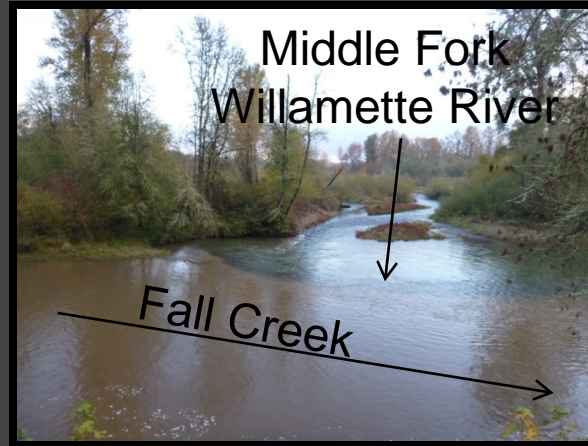
# Sediment Transport

- Mostly fine sediment .....Sand and Silt
- USGS measurements



# Study highlights

- Upstream reservoir change
- Downstream sediment transport
- **Downstream site scale change**
- Downstream reach scale change





# Downstream Deposition: Site Scale



Annual pebble counts

Event-based sediment depths



Field mapping





Flow

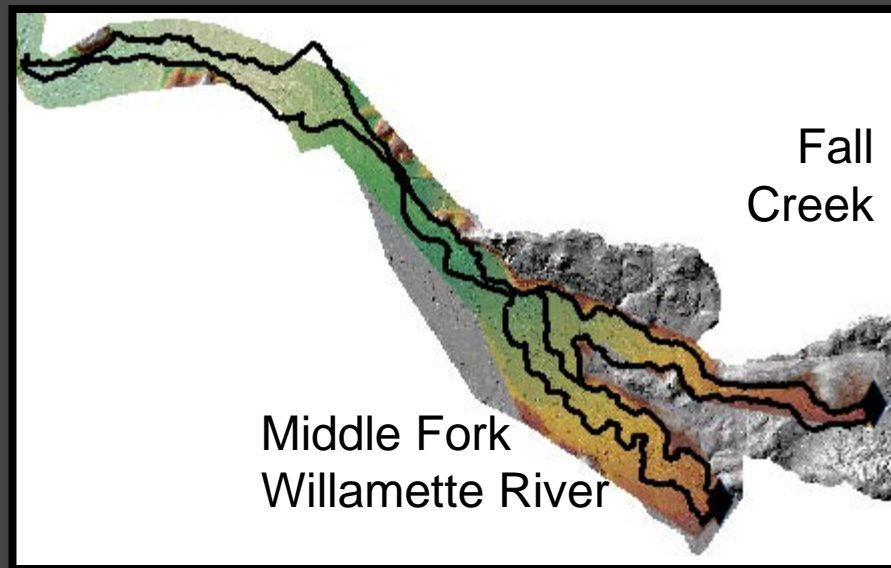
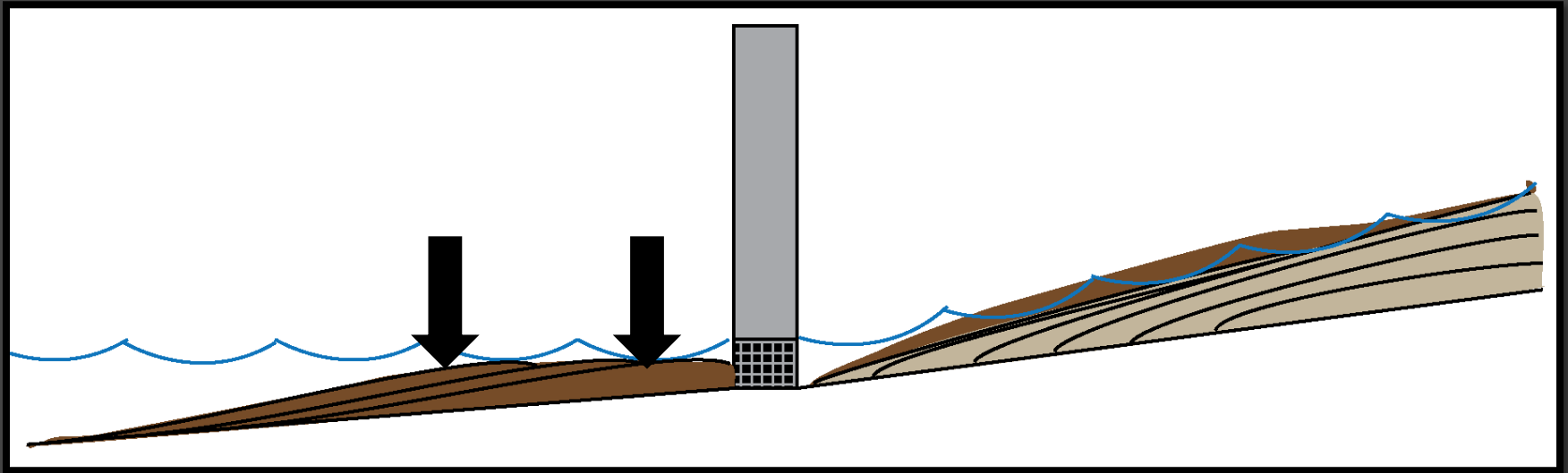


Photo credit: M. Keith, USGS, ORWSC

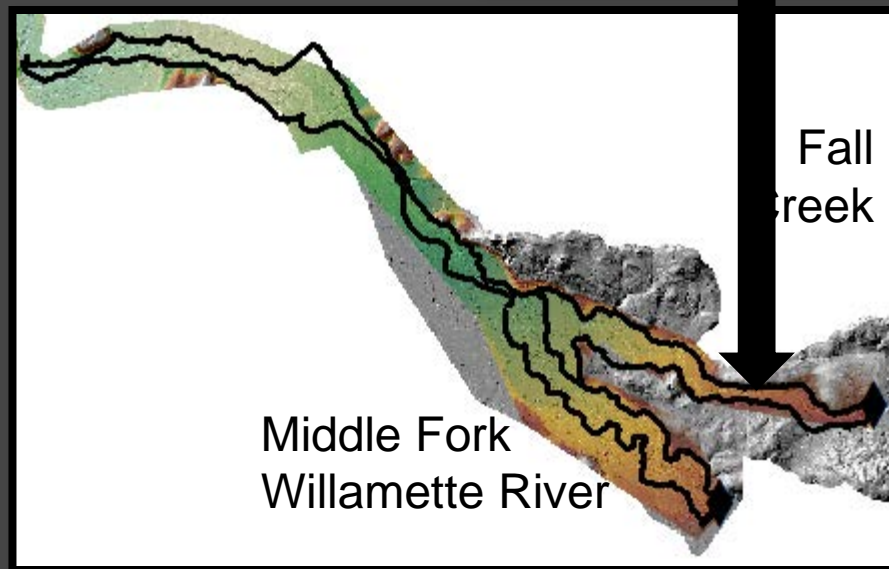
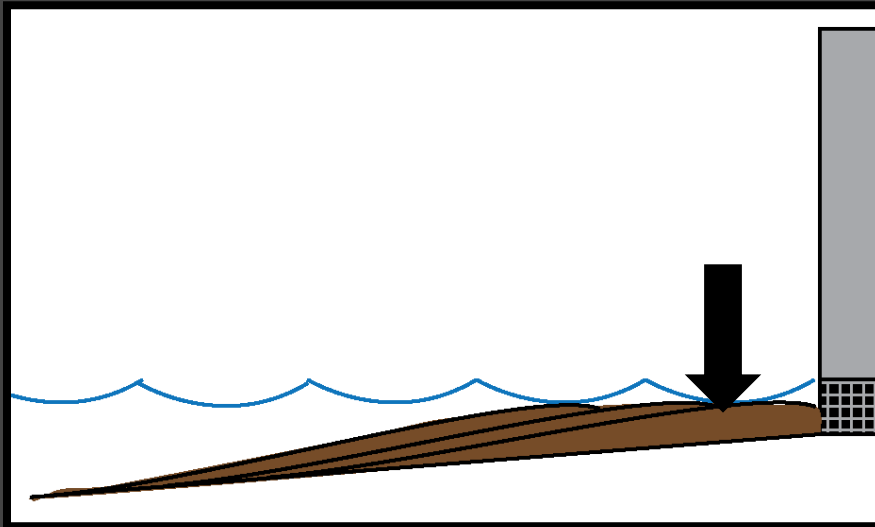




# Longitudinal Shifts

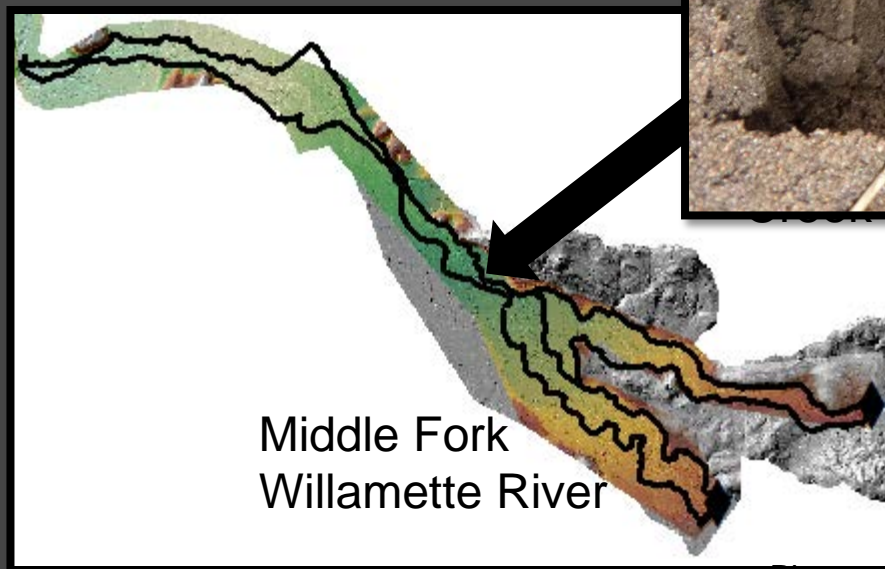
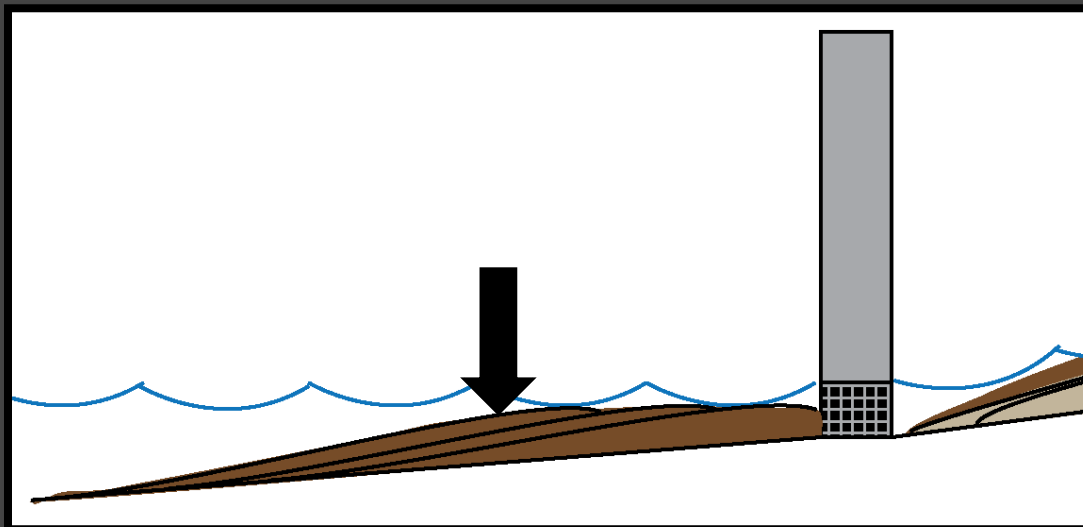


# Longitudinal Shifts



WY  
2016

# Longitudinal Shifts

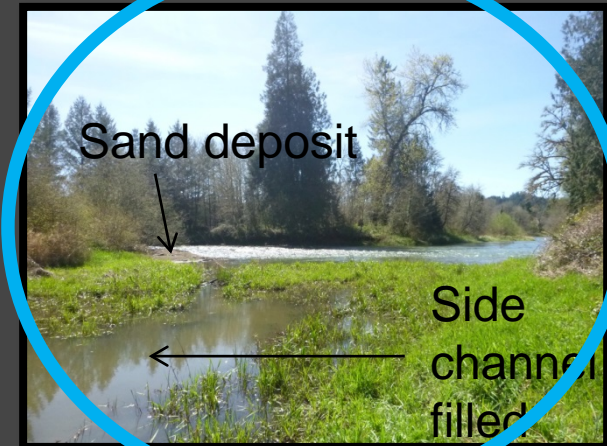
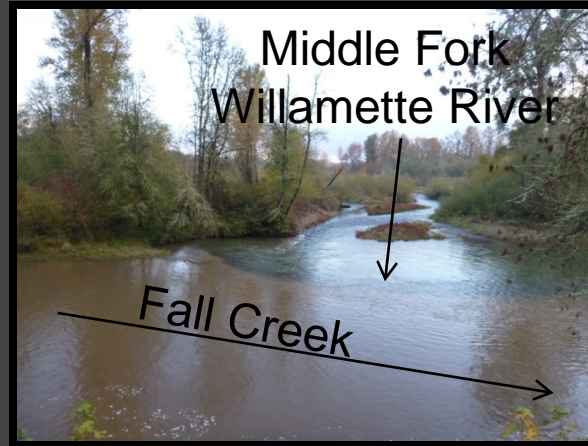


WY  
2016

Photo credit: J. Mangano, USGS, ORWSC  
Provisional data, subject to revision

# Study Highlights

- Upstream reservoir change
- Downstream sediment transport
- Downstream site scale change
- Downstream reach scale change





# Downstream Deposition: Reach Scale

2005

2011

2012

2014

2016

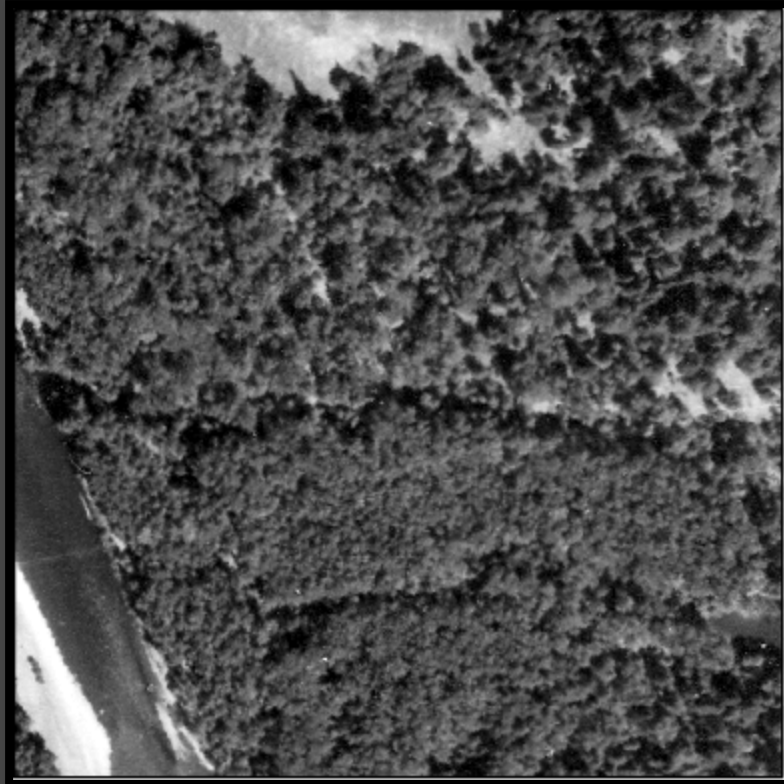


0 100 200  
Meters

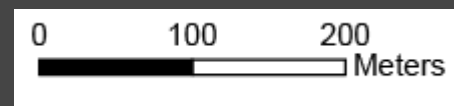


# Drawdown Effects: Historical Context

1936

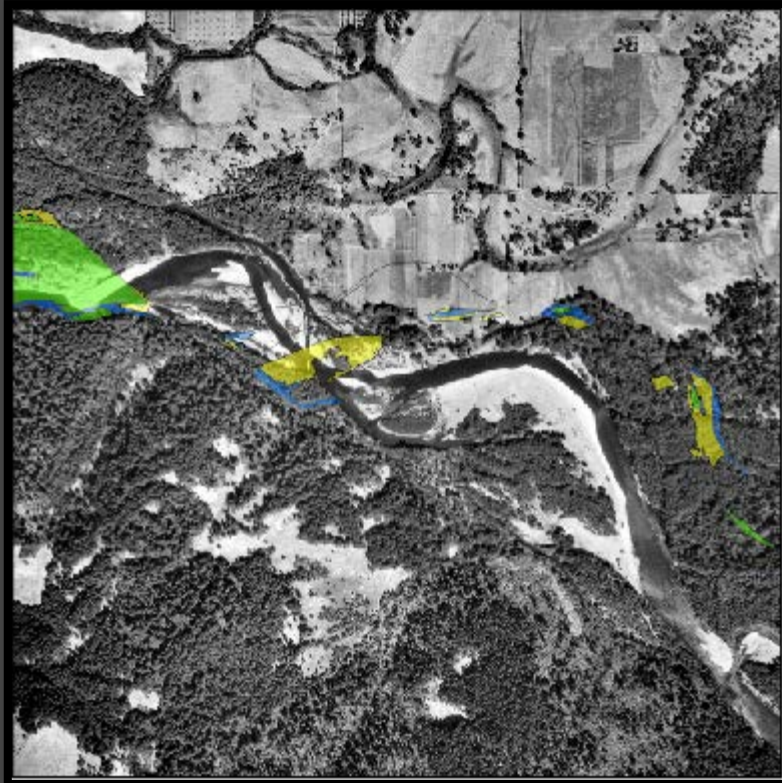


2016



# Drawdown Effects: Historical Context

1936



2016

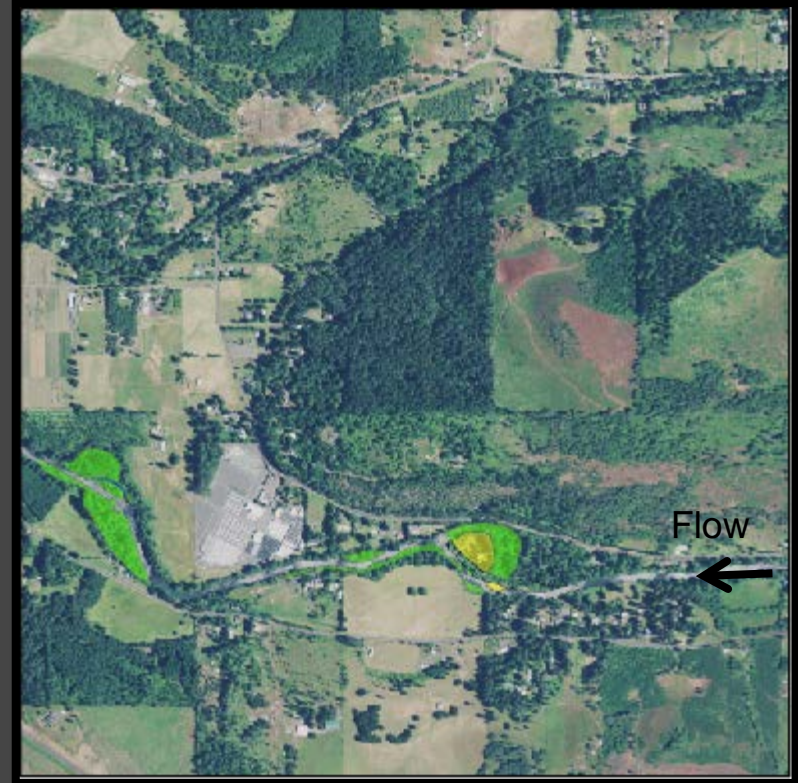


# Drawdown Effects: Historical Context

1936



2016



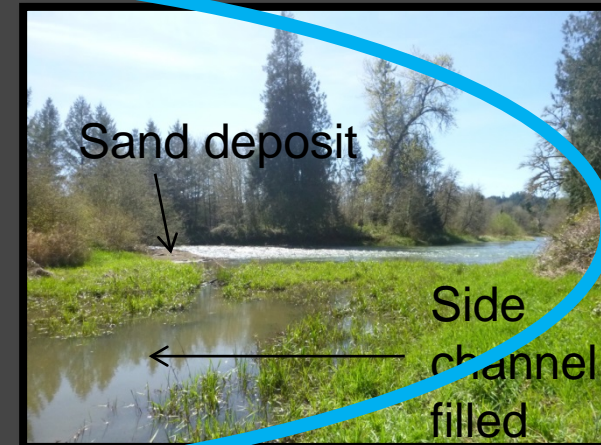
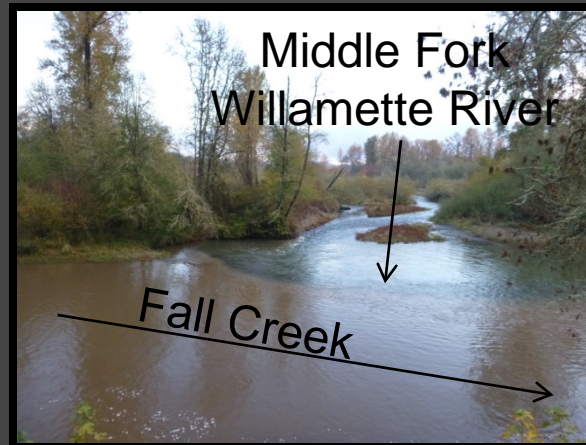
0 400 800 Meters



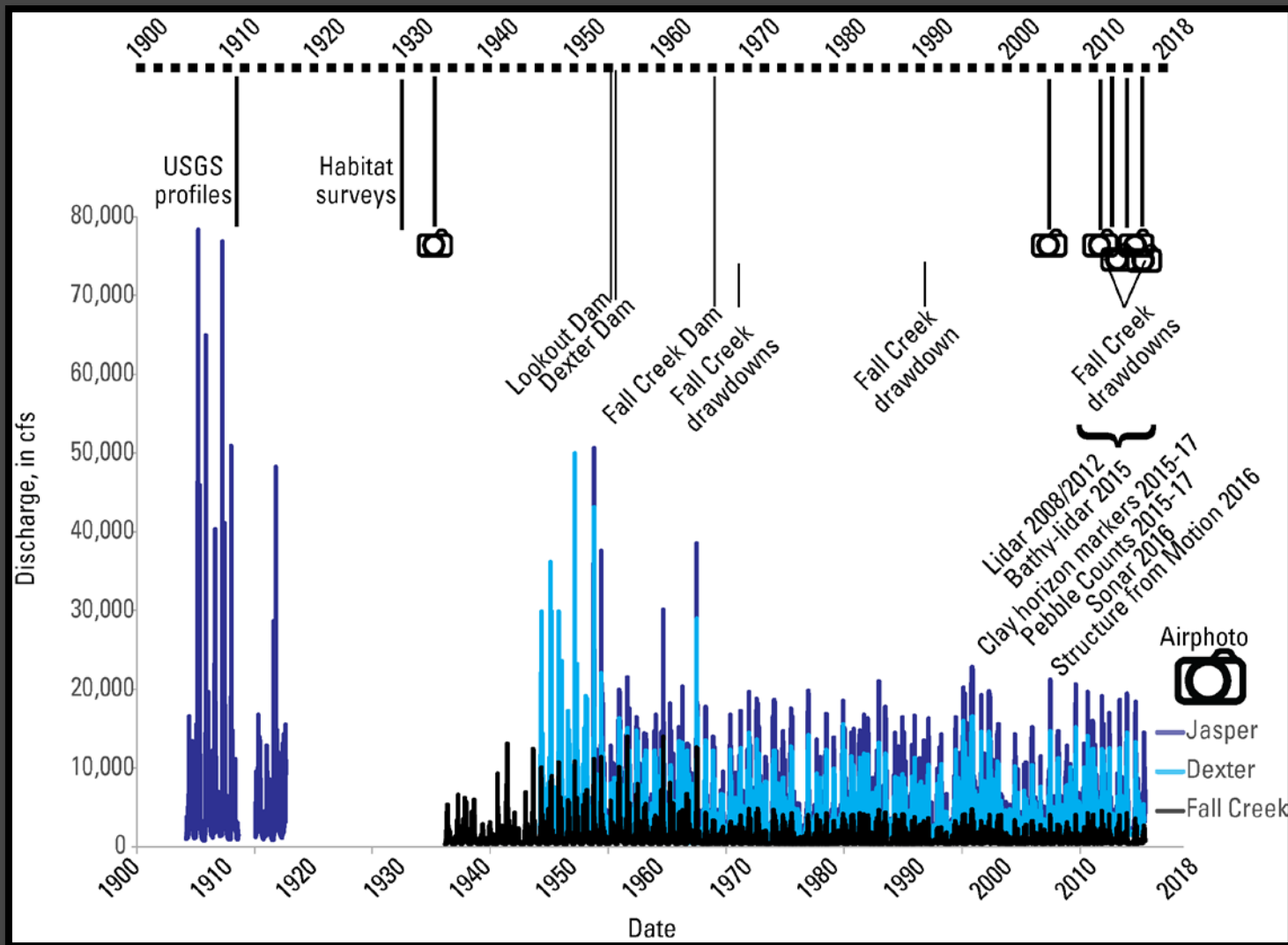
Provisional data, subject to revision

# Study Highlights

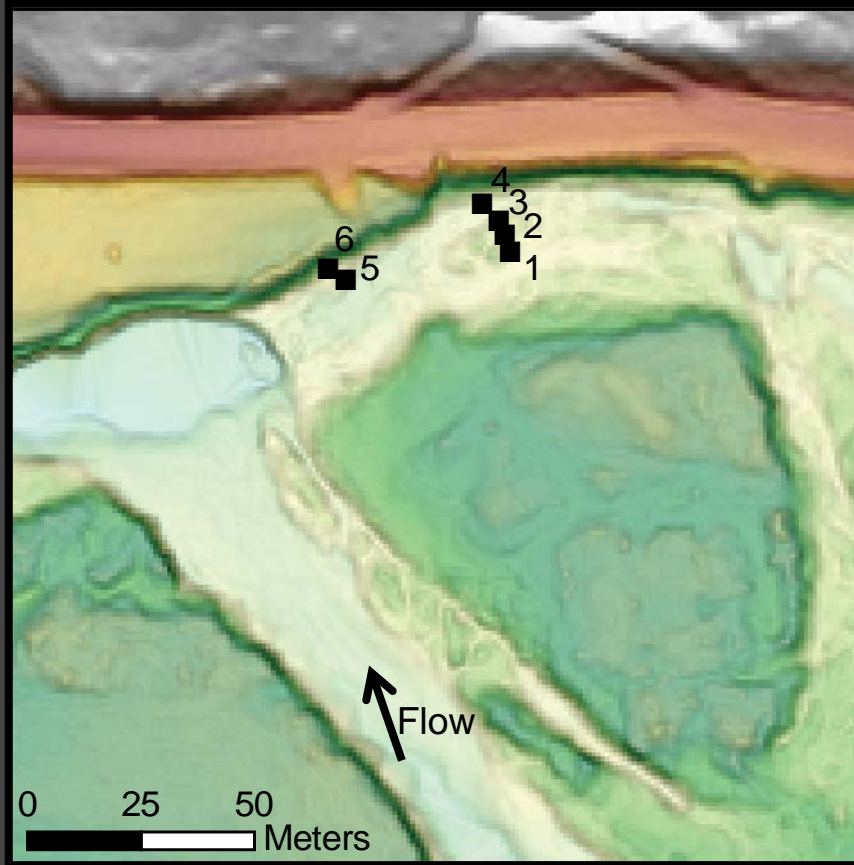
- Upstream reservoir change
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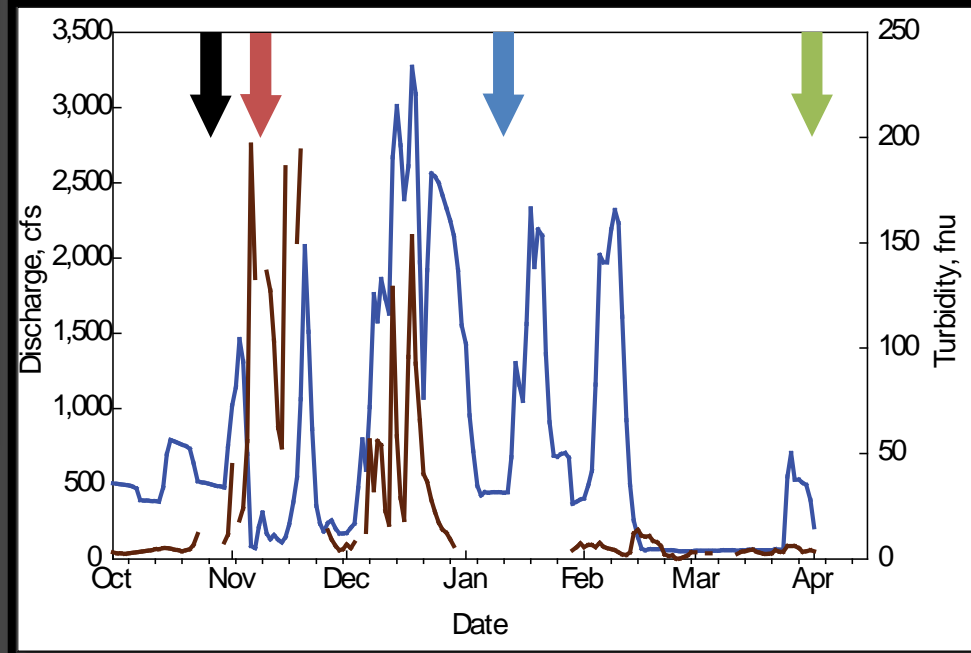
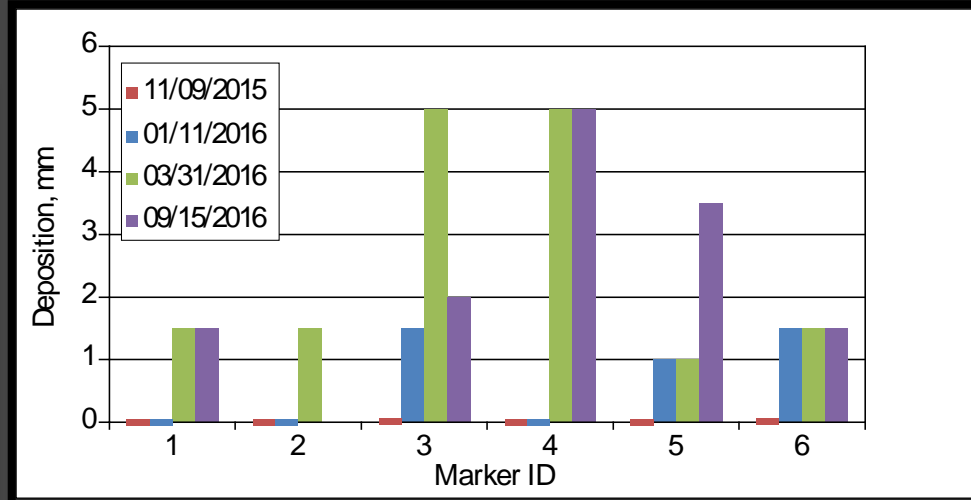
# Linking Sediment Dynamics to Dam Operations



# Linking Sediment Dynamics to Dam Operations



Base map modified from 2015 bathymetric lidar.



Provisional data, subject to revision

# Linking Sediment Dynamics to Dam Operations

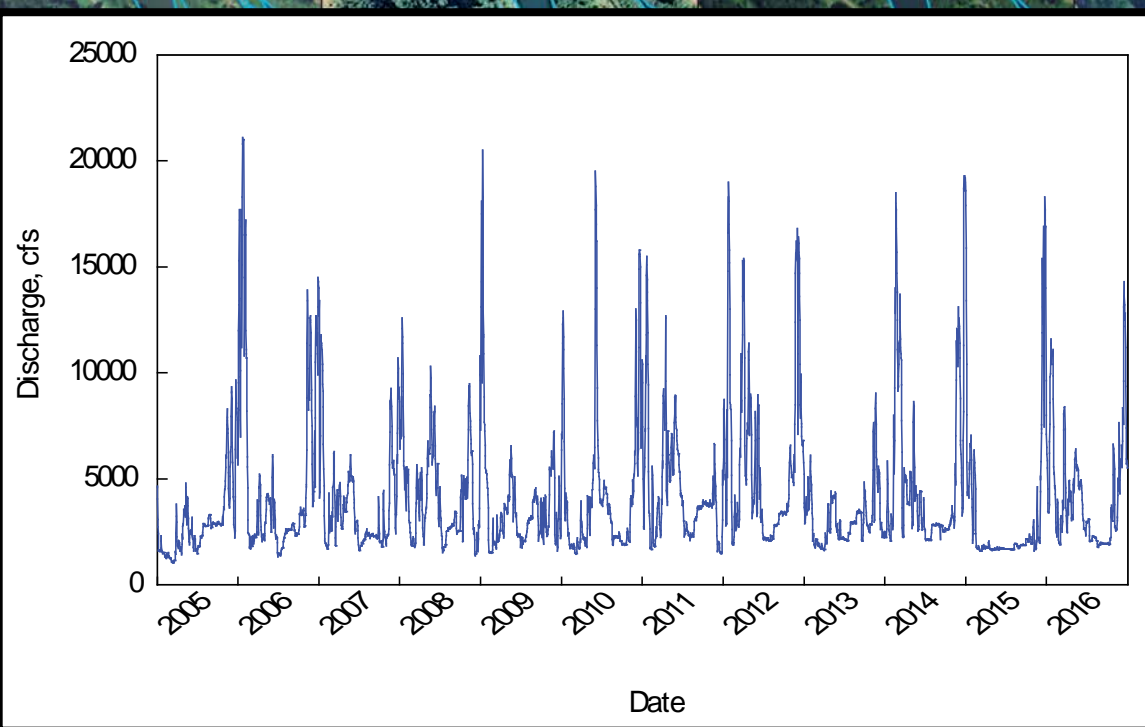
2005

2011

2012

2014

2016



Provisional data,  
subject to revision

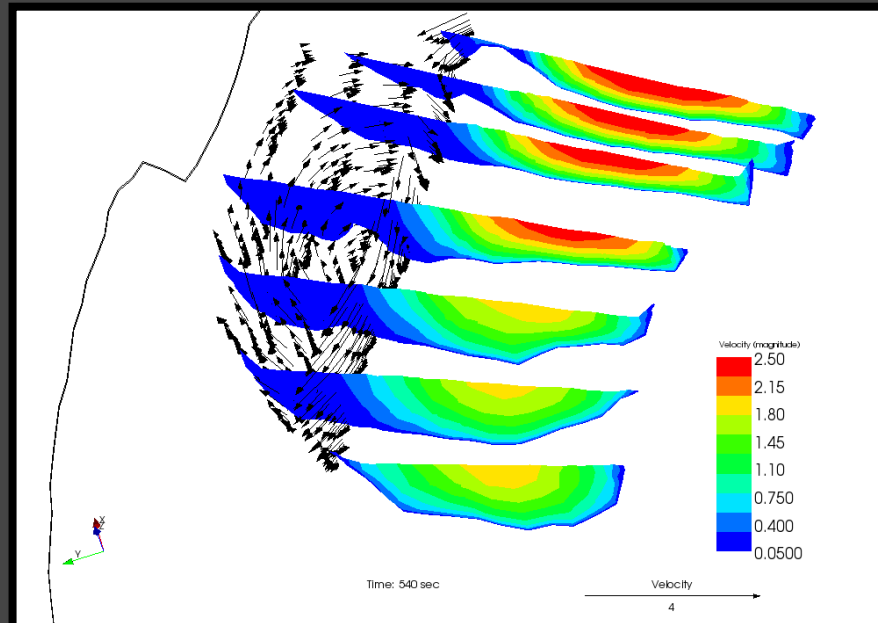


Base maps modified from  
2005, 2011, 2012, 2014,  
and 2016 NAIP aerial  
photography.



# Linking Sediment Dynamics to Dam Operations: Modeling

- What flows does it take to pass the sediment out of Fall Creek?
- Where are the “sensitive” zones?
- What type of flows would it take to “clean out” a filled side channel/alcove, if any?



# Sediment Impacts on Geomorphology and Habitat

- **>200,000 m<sup>3</sup> eroded from lower reservoir but substantial sediment remains**
- **Aggradation downstream**
  - **Thickest deposits on Fall Creek during early drawdowns and on Middle Fork during later drawdowns**
  - **Finer sediment accumulating in Fall Creek now**
- **Reach scale impacts are small in comparison to pre-dam era**

# Acknowledgments

- **USGS: Jon Major, Scott Anderson, Tess Harden, Laurel Stratton, Erin Poor, Alex Costello, Heather Bervid, Brandon Overstreet, Norman Buccola, Lisa Faust, Jeff Sloan, Todd Burton**
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- **ODFW: Brian Bangs**
- **Frontier Precision: Chase Fly**
- **Brown-Western Aviation: Gary and Mary Brown**
- **Middle Fork Watershed Council: Audrey Squires**
- **Mikel Calle Navarro, El Museo Nacional de Ciencias Naturales**
- **Land owners: Pat and Kerney Simpson, John and Pam Bauman, Carol Brewer, Jeff and Joan Devore**
- **The Nature Conservancy: Melissa Olson and Jason Nuckols**

# Questions?



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