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Geomorphic Impacts to Fall Creek and the Middle Fork Willamette River from Annual Drawdowns at Fall Creek Dam

Willamette Fisheries Science Review 2018

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

U.S Department of Defense
U.S. Army Corps of Engineers

Study 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

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Photo credit: M. Keith, USGS, ORWSC

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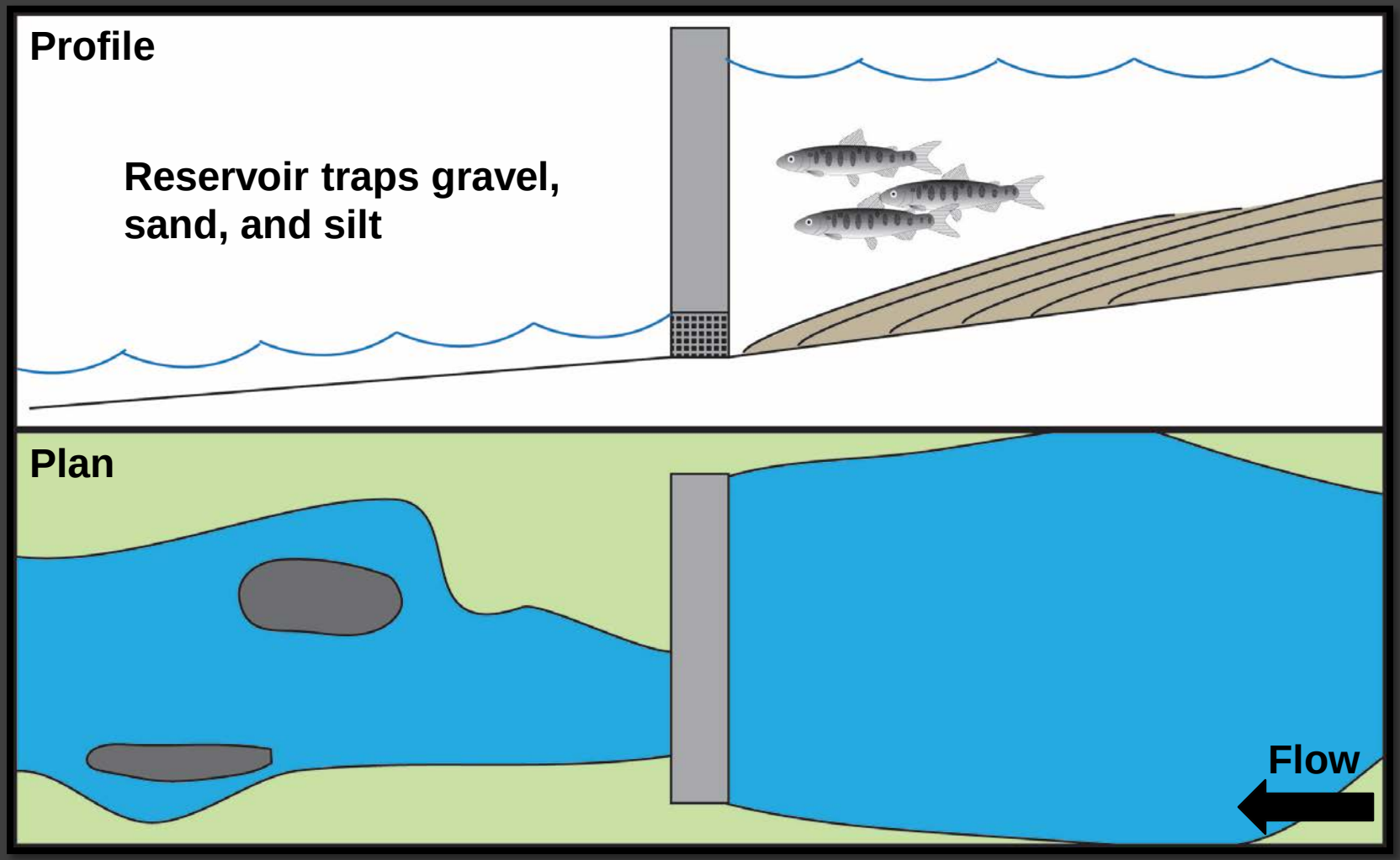
Photo credit: M. Keith, USGS, ORWSC

Summary of Coupled Upstream-Downstream Responses: Phase 1



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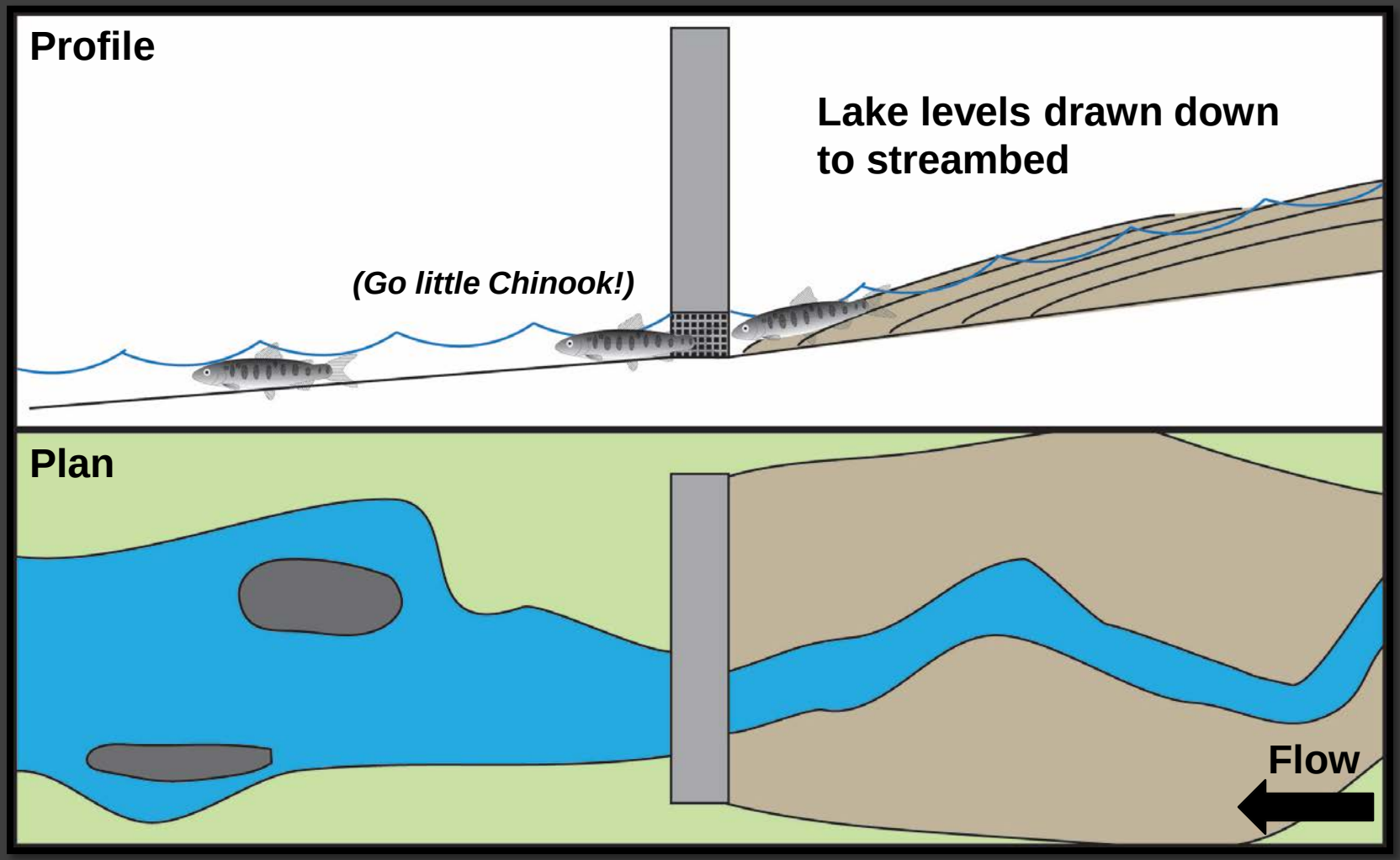
Summary of Coupled Upstream-Downstream Responses: Phase 2



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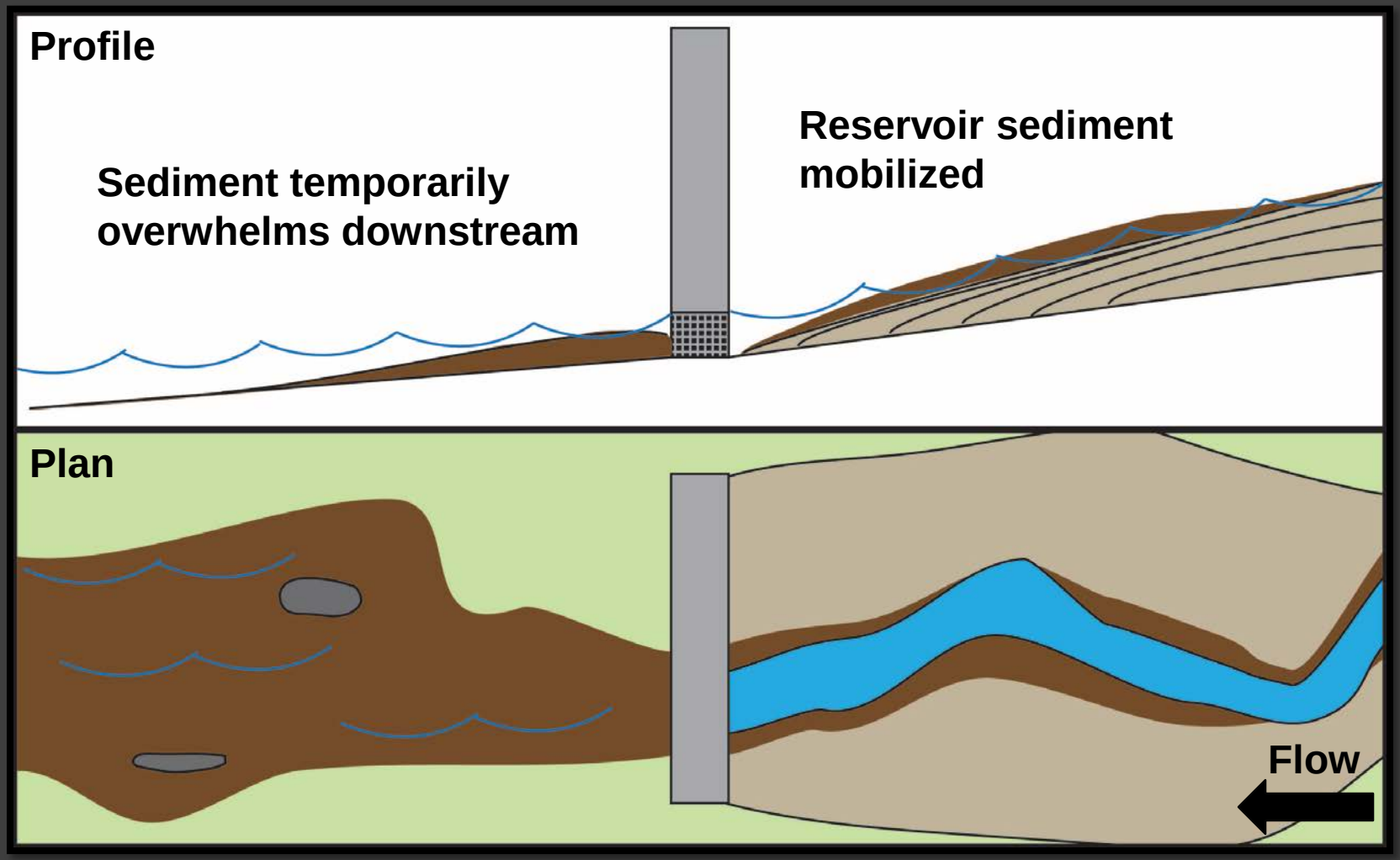
Summary of Coupled Upstream-Downstream Responses: Phase 3a



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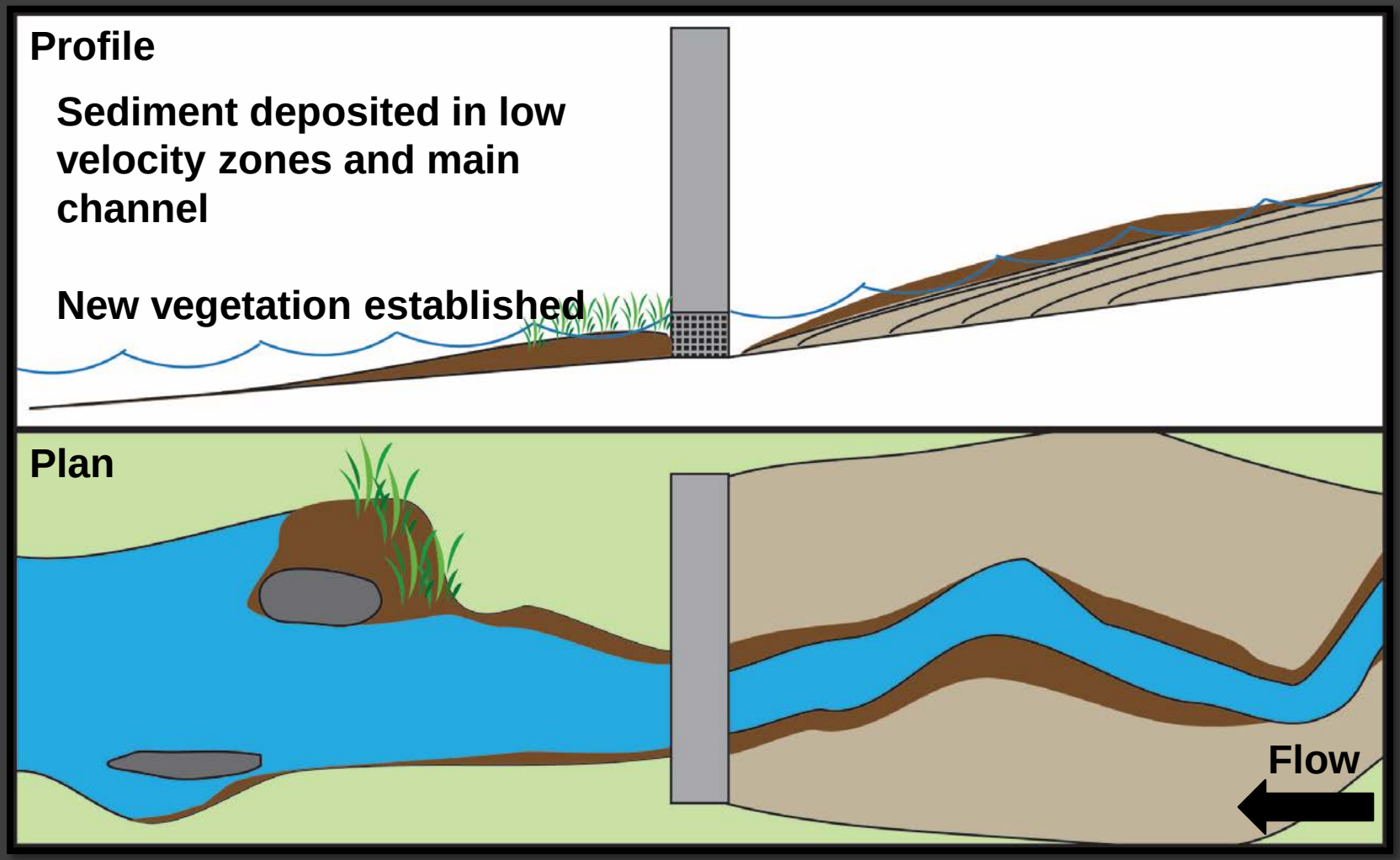
Summary of Coupled Upstream-Downstream Responses: Phase 3b



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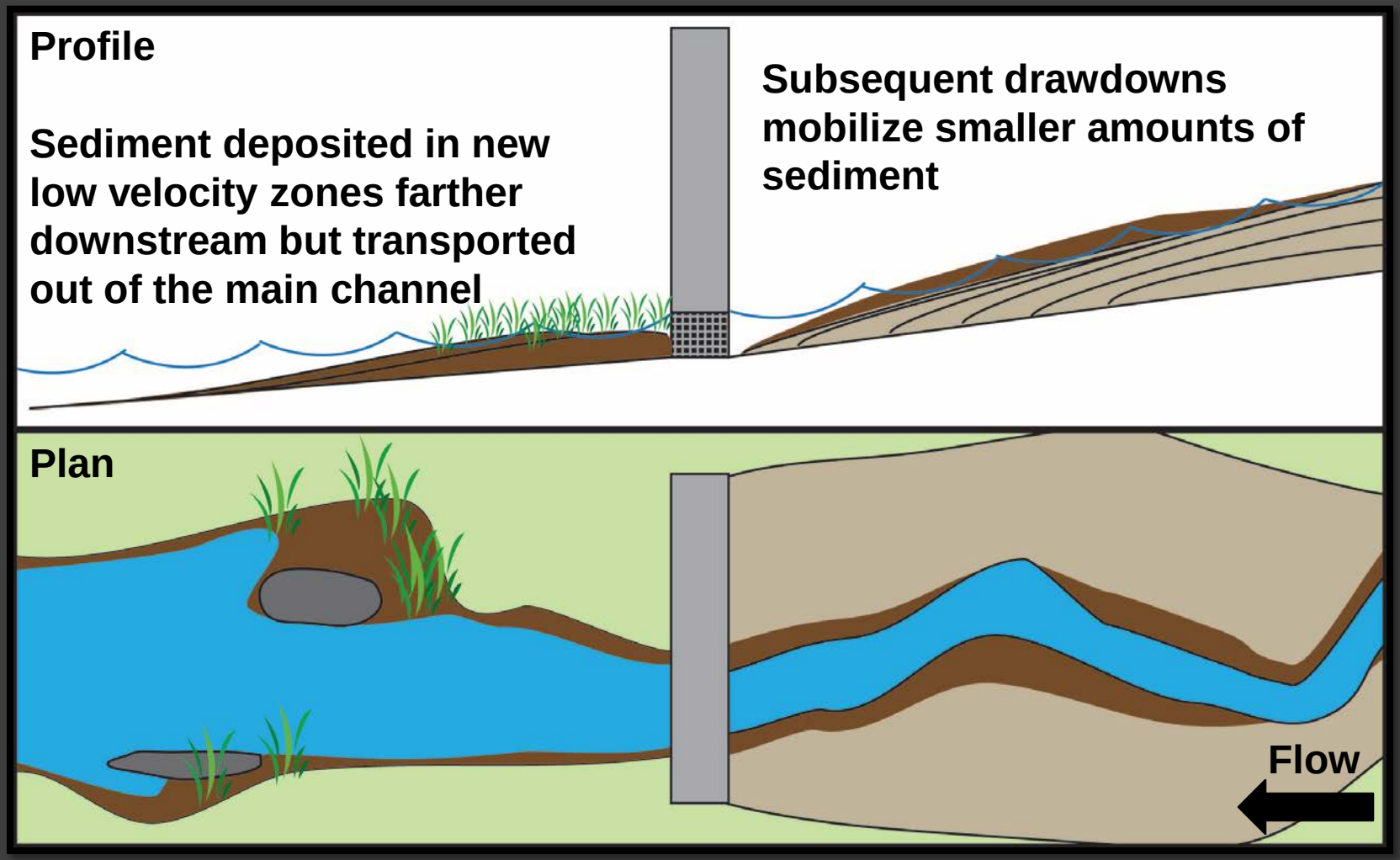
Summary of Coupled Upstream-Downstream Responses: Phase 4



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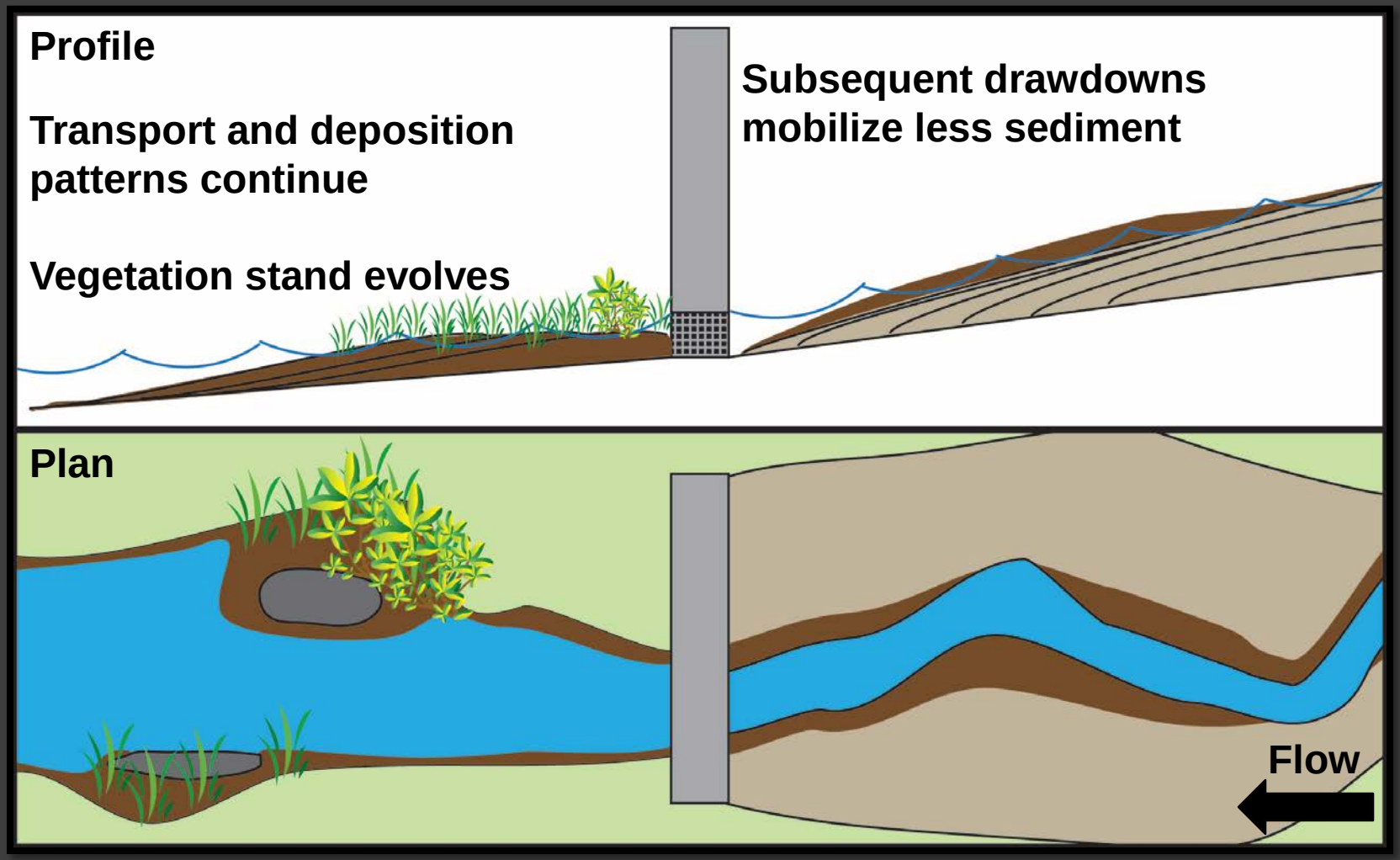
Summary of Coupled Upstream-Downstream Responses: Phase 5



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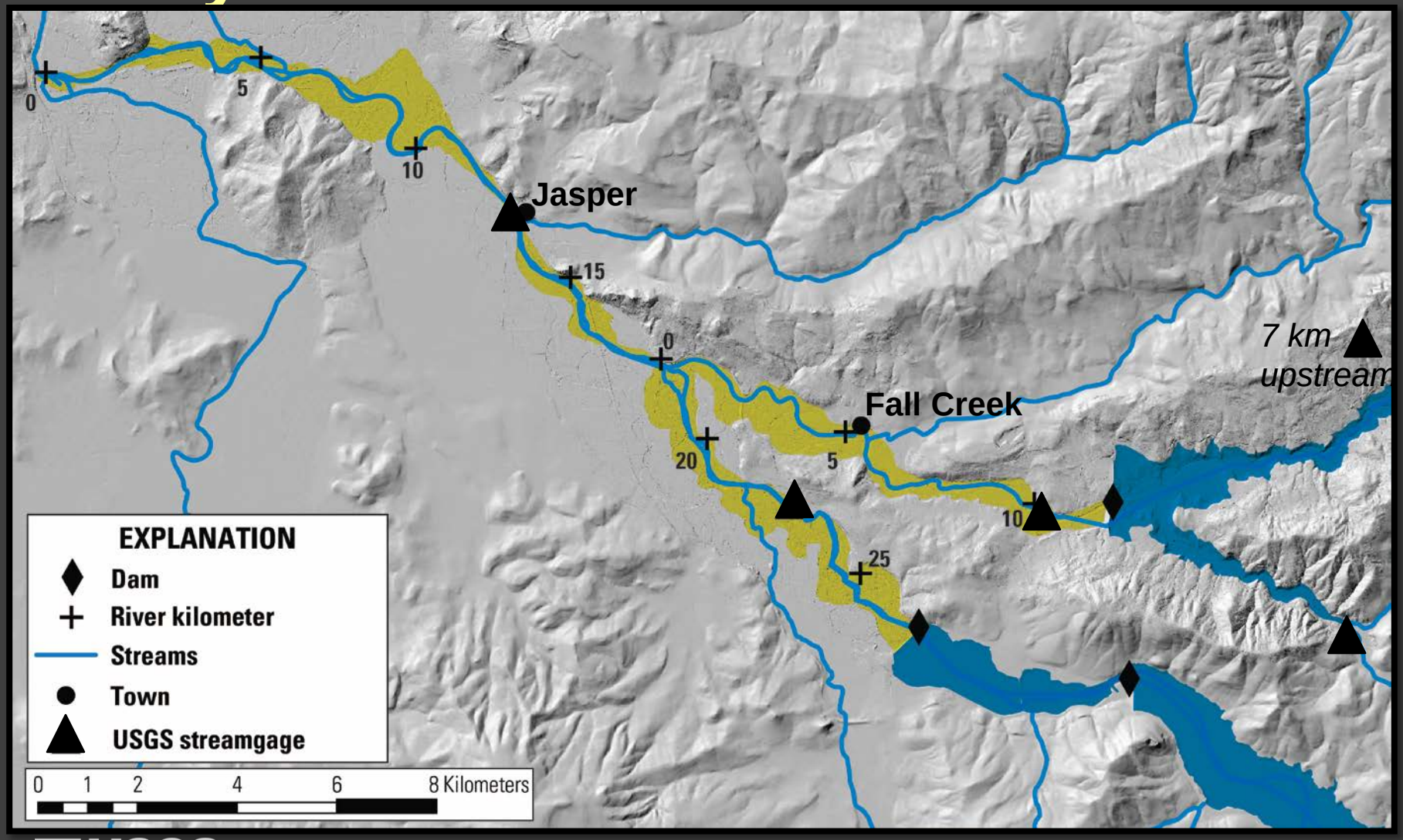
Study Area



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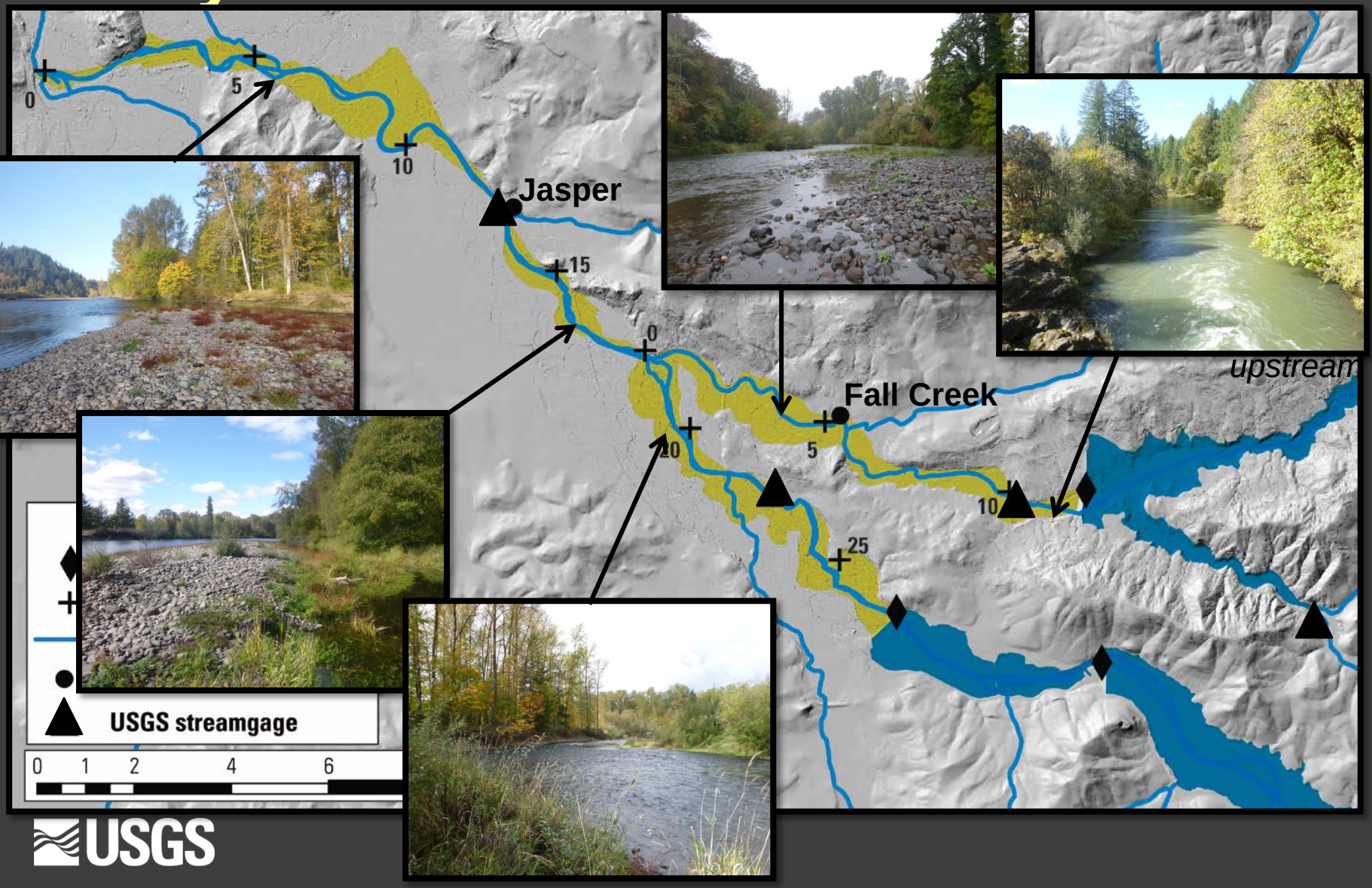
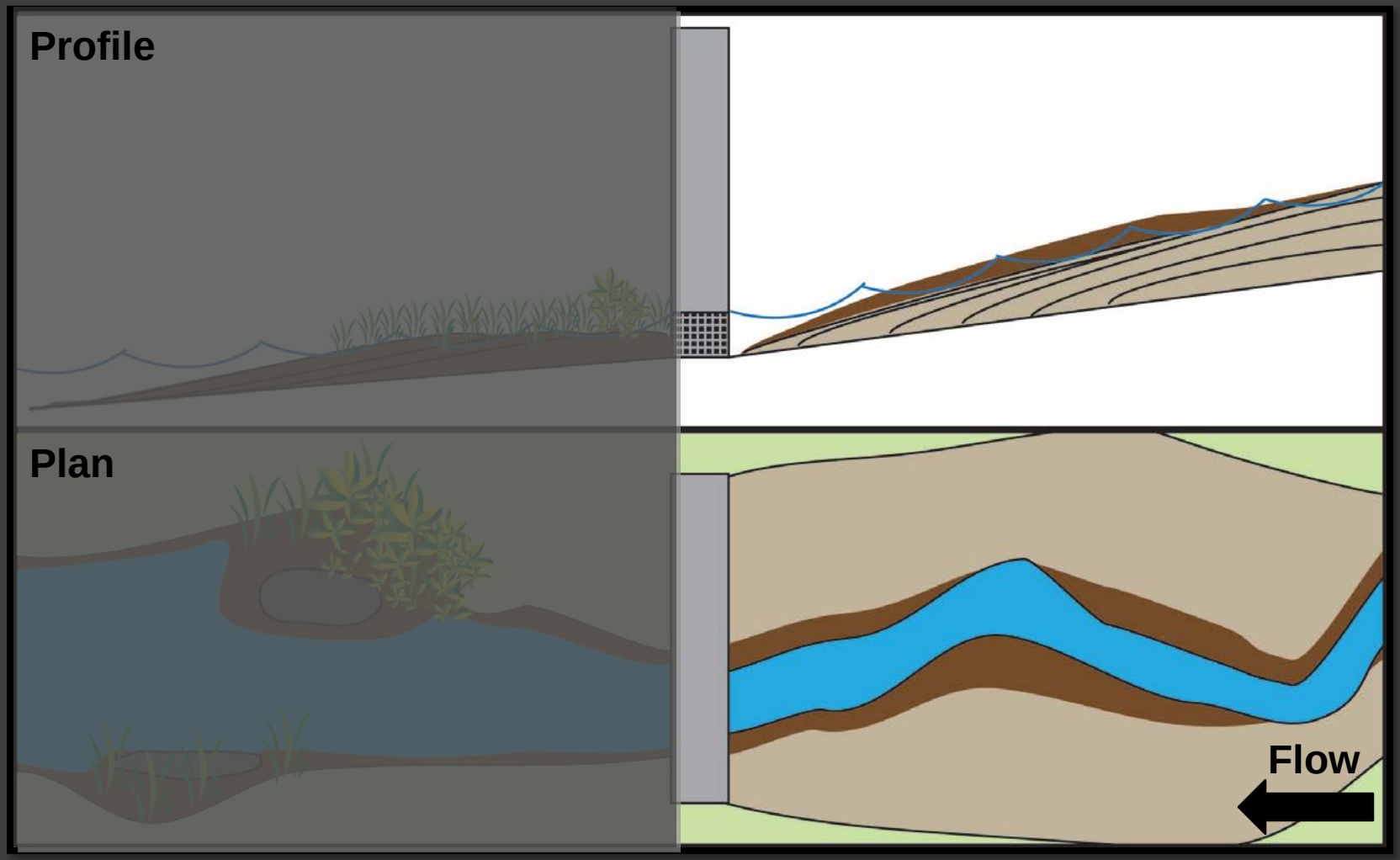
Study Area


0
5
10
Jasper
15
0
20
Fall Creek
5
10
25
upstream
USGS streamgage
0 1 2 4 6
USGS

Reservoir Erosion



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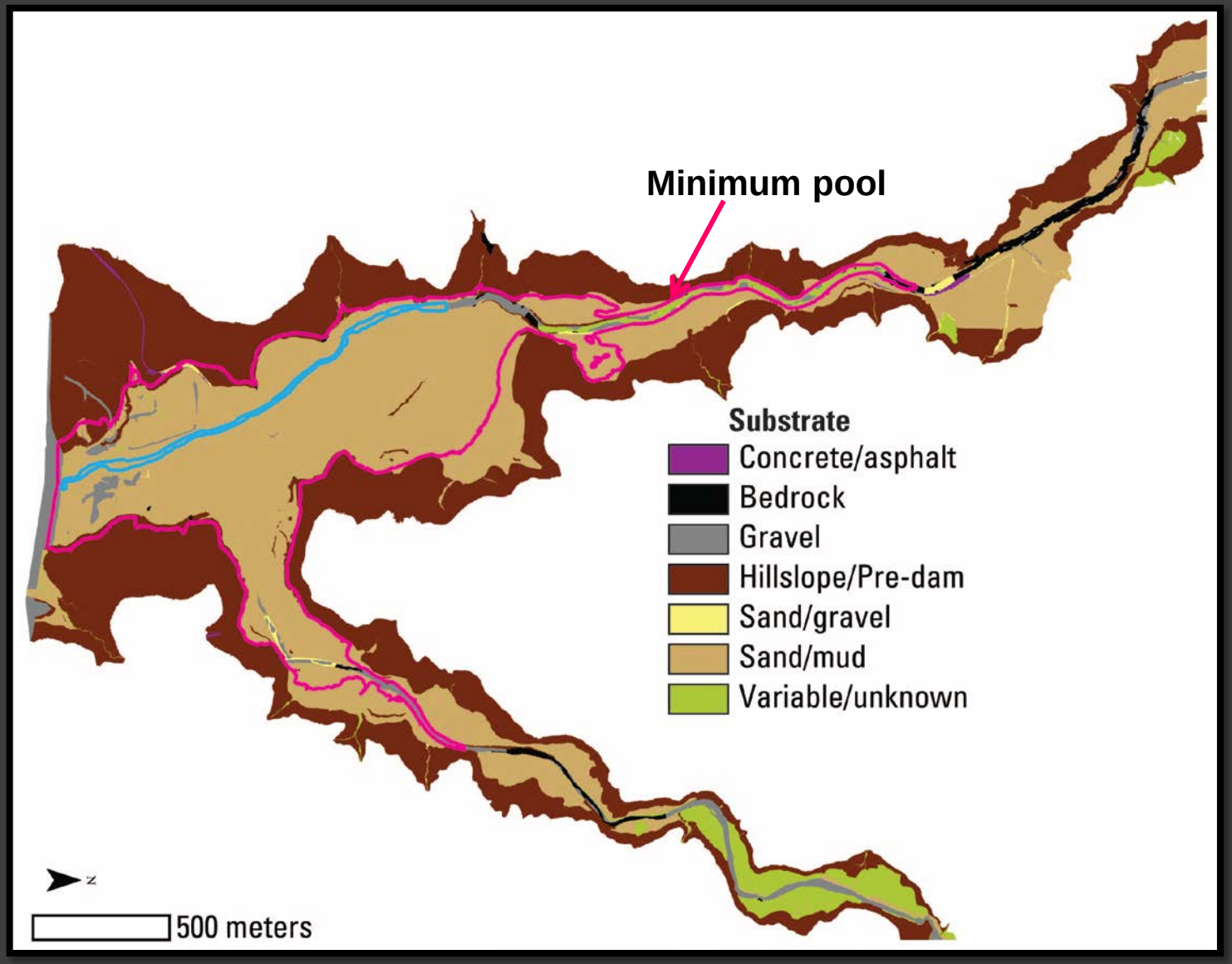
Reservoir Erosion: Substrate



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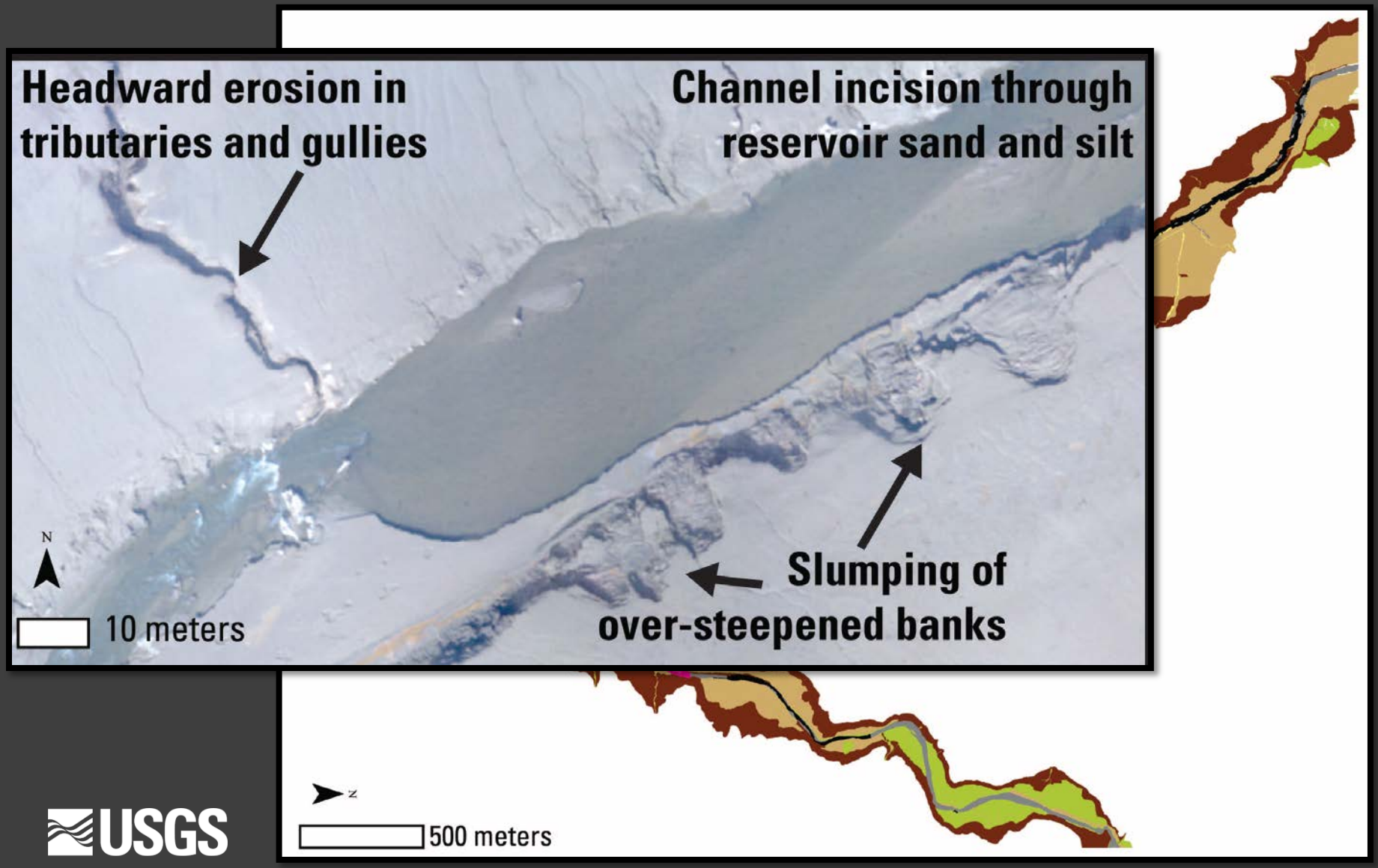
Reservoir Erosion: Mechanisms



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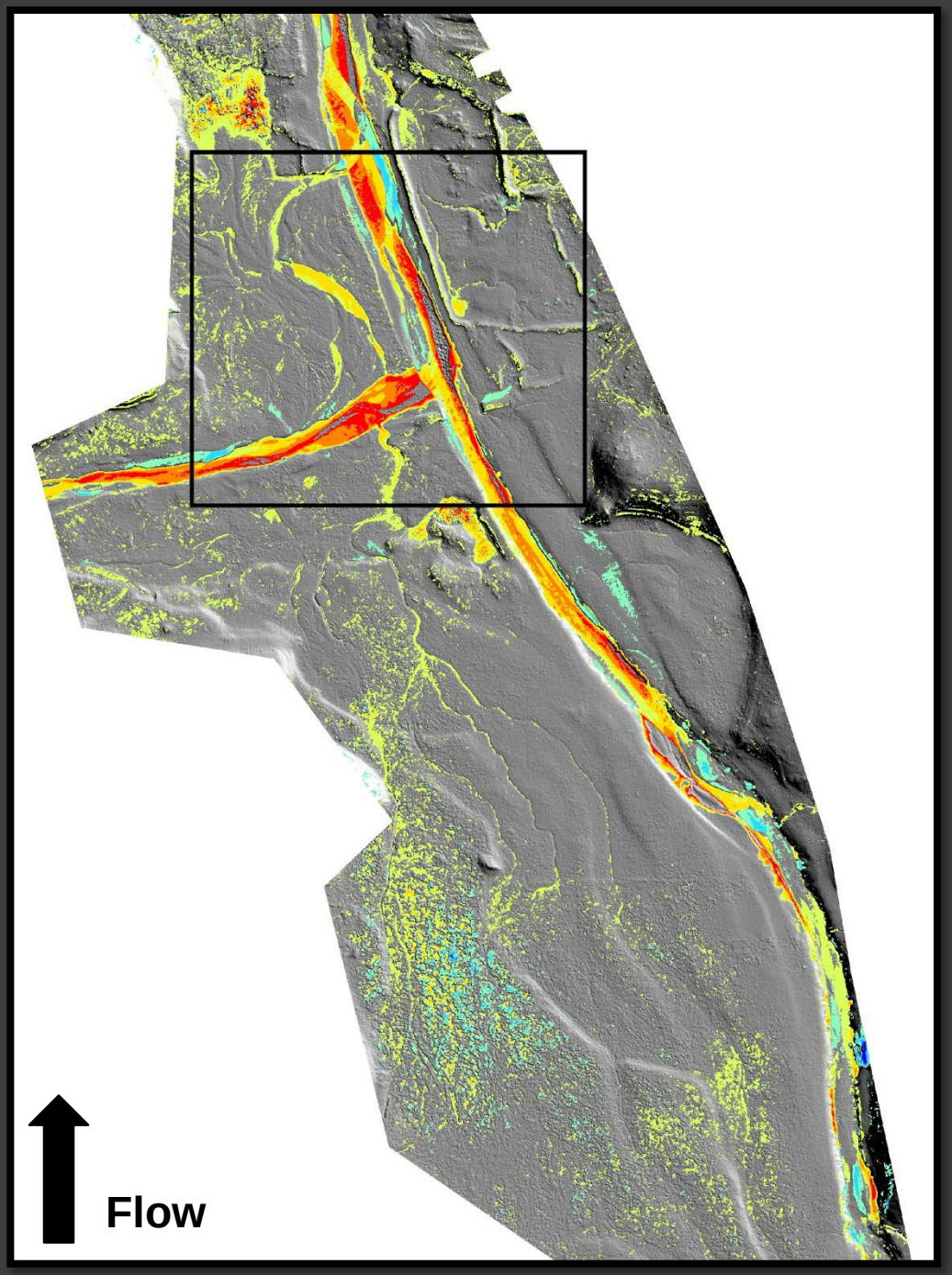
Reservoir Erosion: Spatial Patterns



300
Meters

Provisional data.
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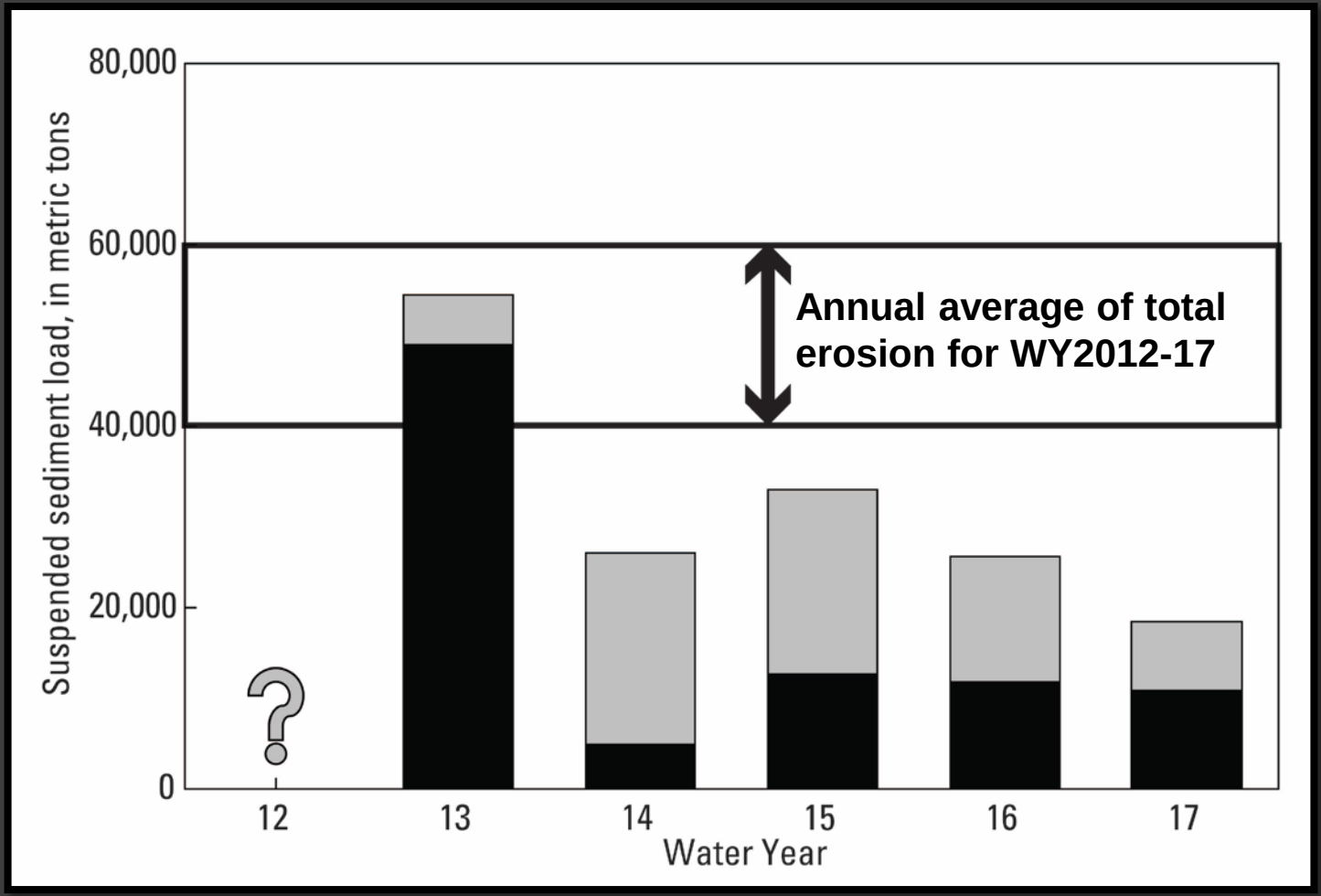
Reservoir Erosion: Comparison to Calculated Sediment Transport



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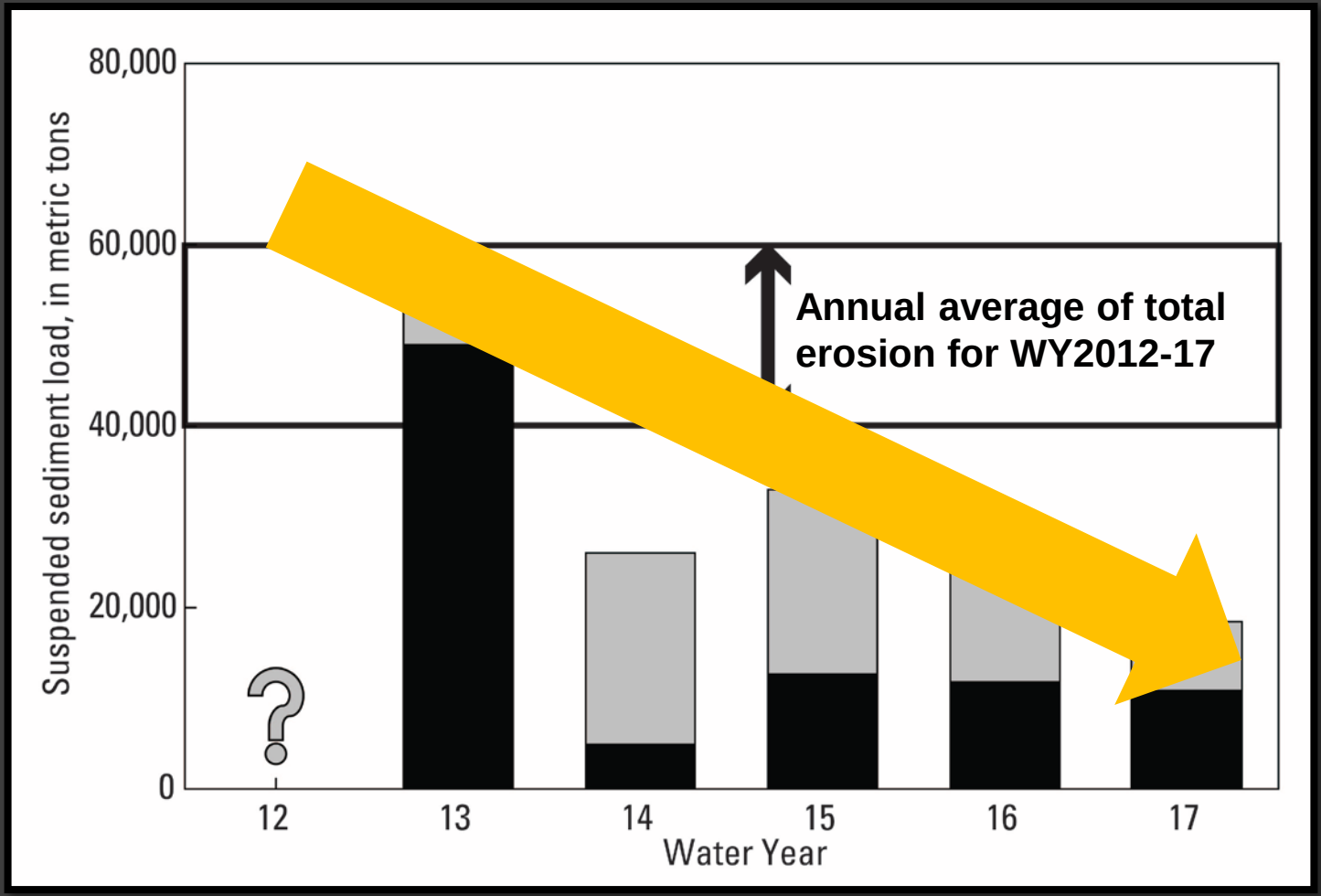

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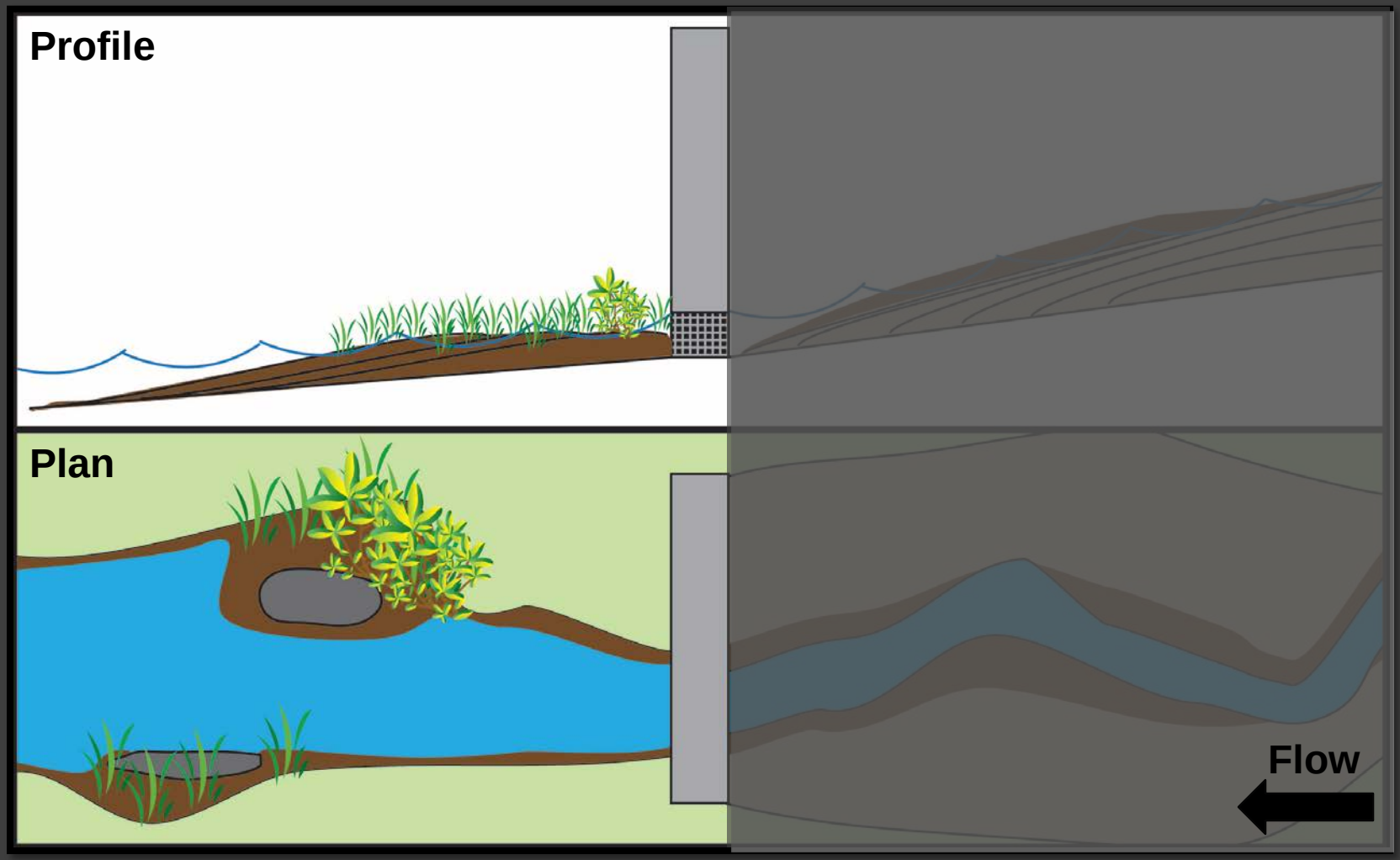
Downstream Impacts



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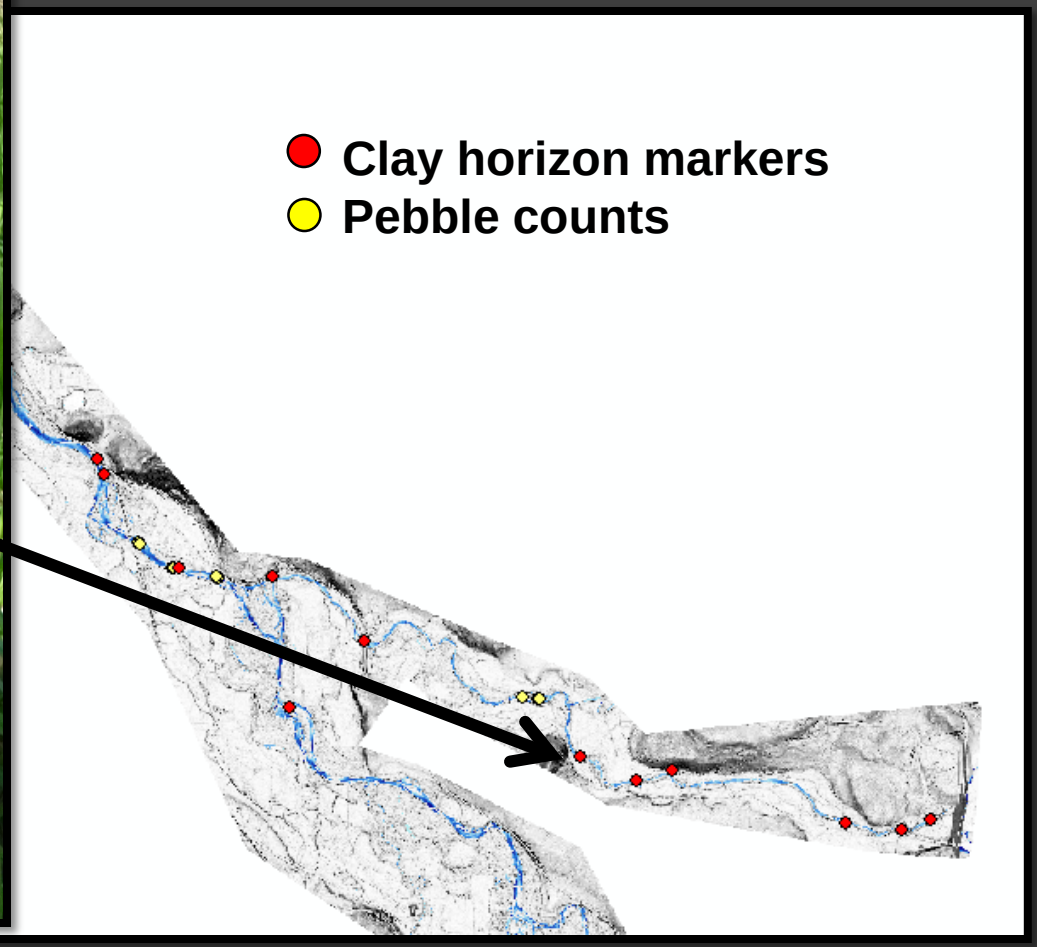
Provisional data. Subject to revision.

Downstream Impacts: Increased Sand and Silt Deposition



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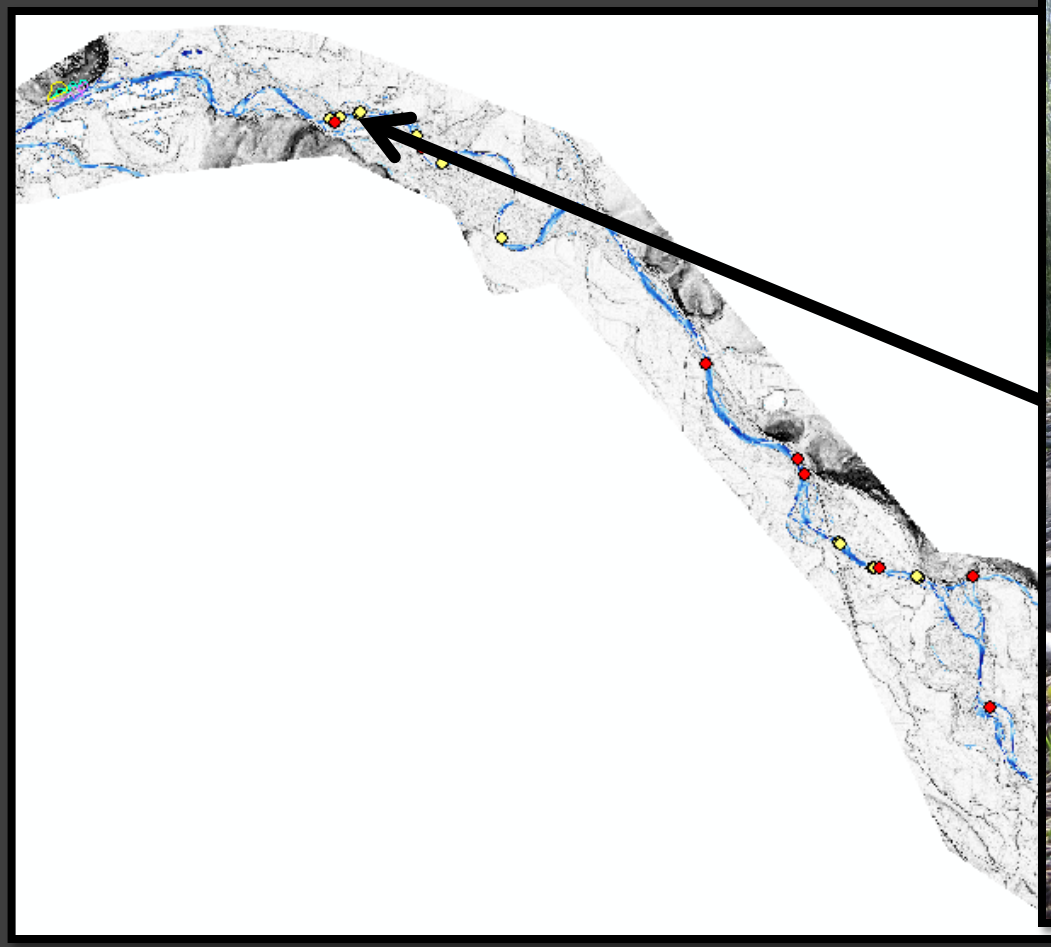

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Downstream Impacts: Local Change

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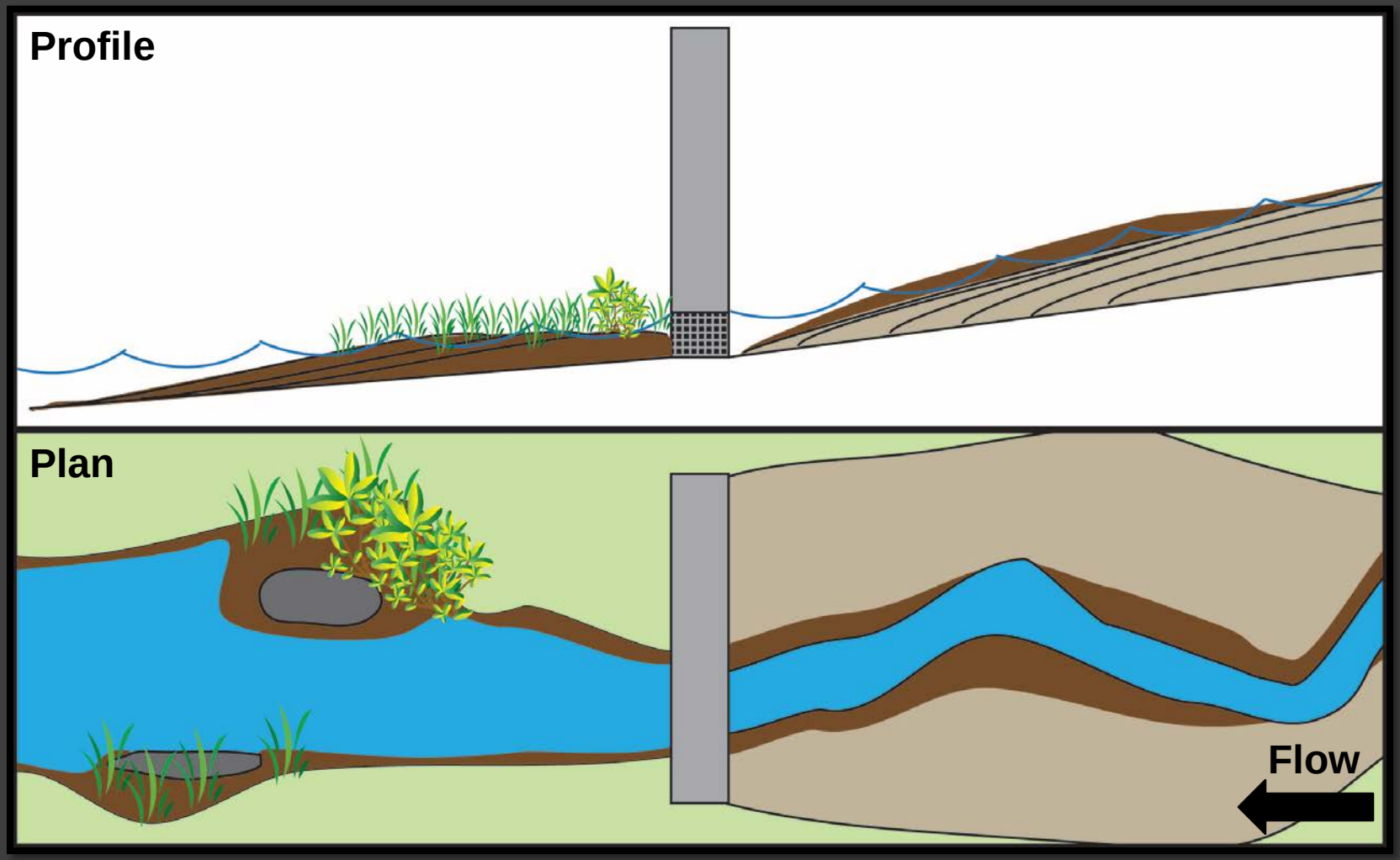
Linking Upstream and Downstream



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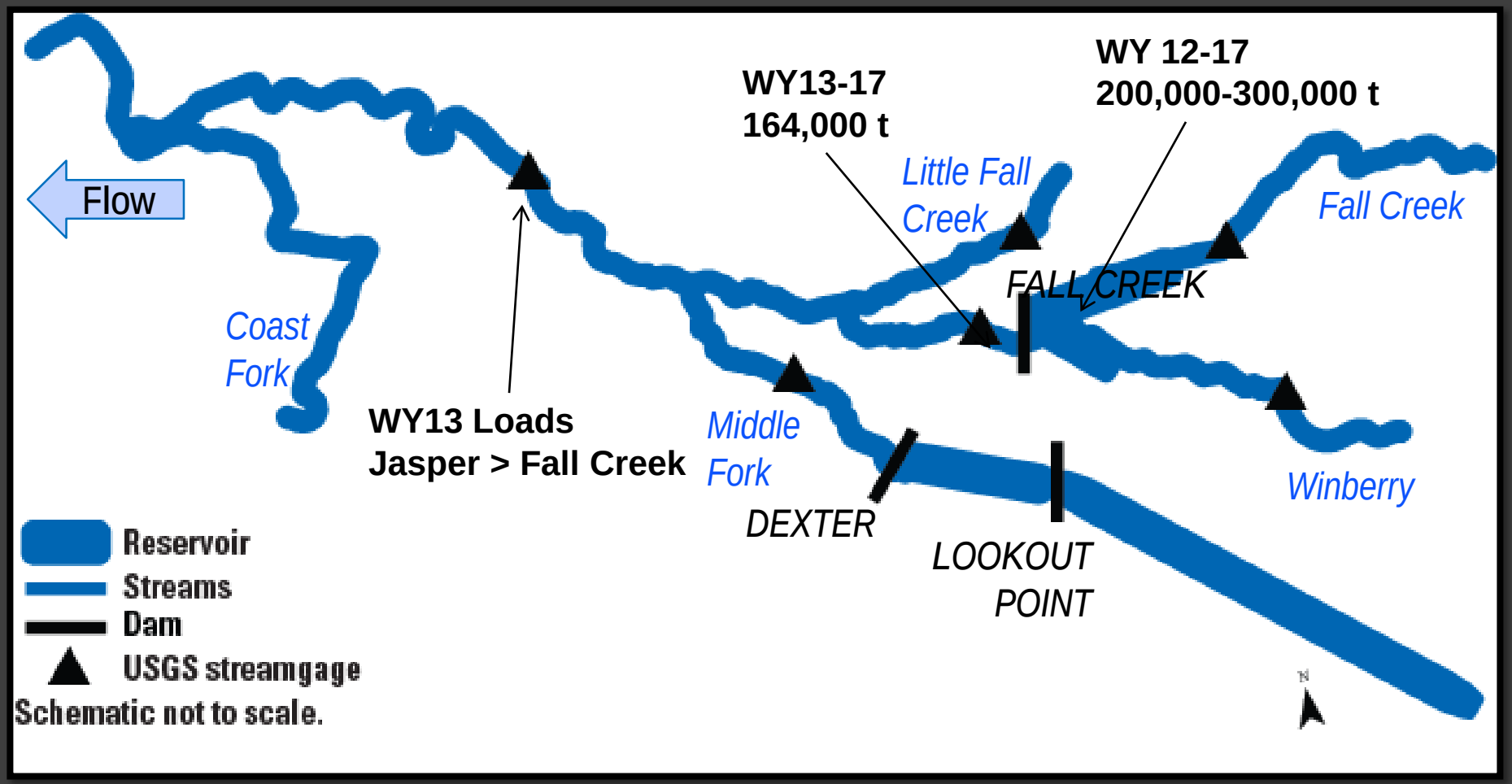
Linking Geomorphic Change to a Sediment Budget



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Provisional data. Subject to revision.

Conclusions

- **Reservoir Erosion**
  - **~176,000 m^3 eroded from lower reservoir**
  - **Reservoir morphology constrains future erosion**
- **Downstream Impacts**
  - **More deposition near the dam on Fall Creek during early drawdowns**
  - **Off-channel deposits developed with vegetation feedback and continued regulation**
  - **Reach-scale impacts are small in comparison to historical changes**
  - **Impacts tightly linked to upstream erosion**

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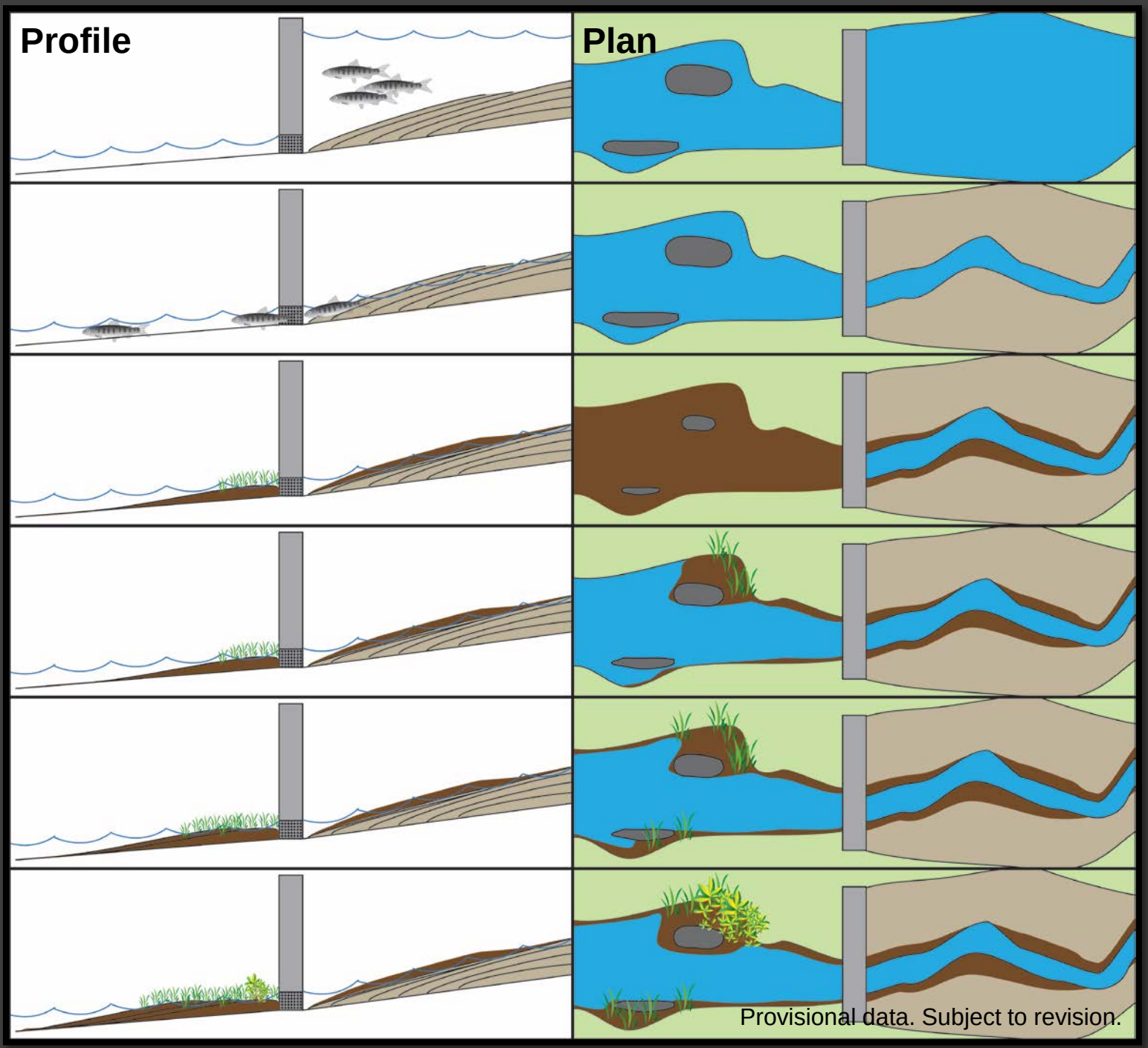
Profile
Plan
Time
Distance
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Insights for Management at Fall Creek and Other Locations

- Upstream-downstream coupling
- Multiple, independent approaches to assess change at different locations and scales
- Multiple influences that affect magnitude and type of downstream impacts
  - Drawdown operations
  - Historical operations
  - Basin geology
  - Reservoir morphology
  - Channel morphology

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Photo credit: USACE, Detroit Dam , http://www.nwp.usace.army.mil/Locations/Willamette-Valley/Detroit/

Acknowledgments

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- **Brown-Western Aviation: Gary and Mary Brown**
- **Middle Fork Watershed Council: Audrey Squires and Sarah Dyrdahl**
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- **Land owners: Pat and Kerney Simpson, John and Pam Bauman, Carol Brewer, Jeff and Joan Devore**
- **The Nature Conservancy: Melissa Olson and Jason Nuckols**

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Questions?

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Extra Slides

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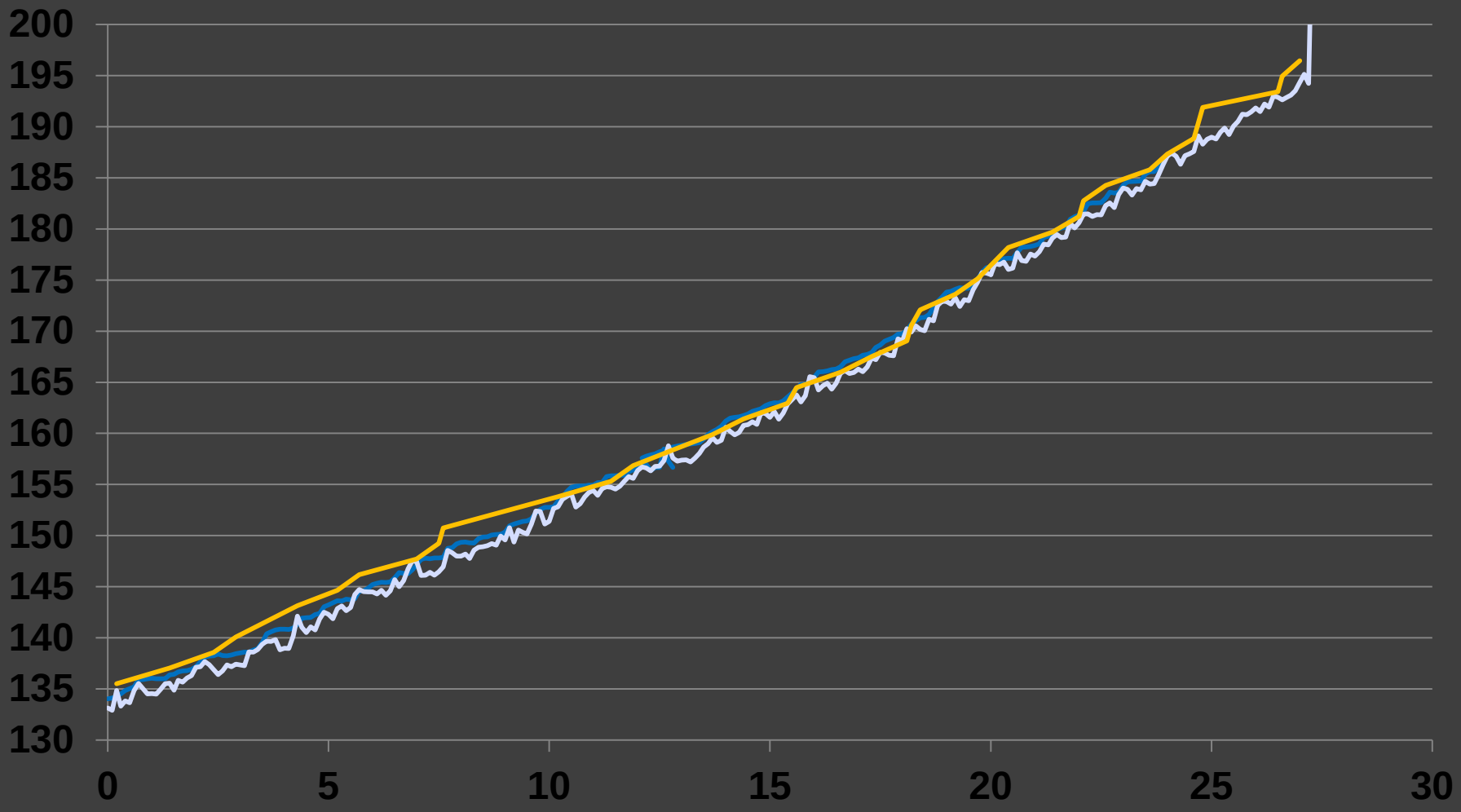
Historical Context



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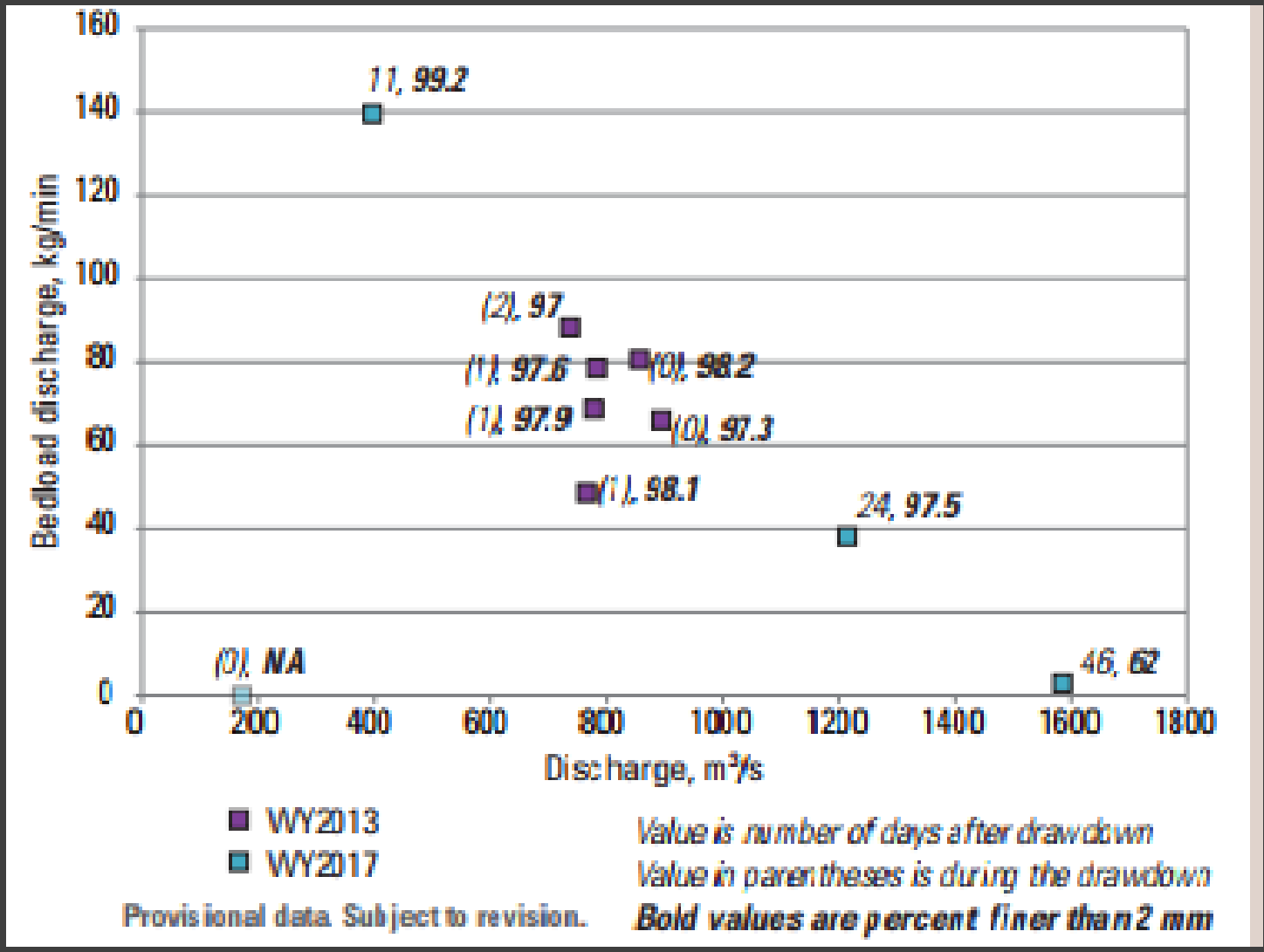
Link to Sediment Transport



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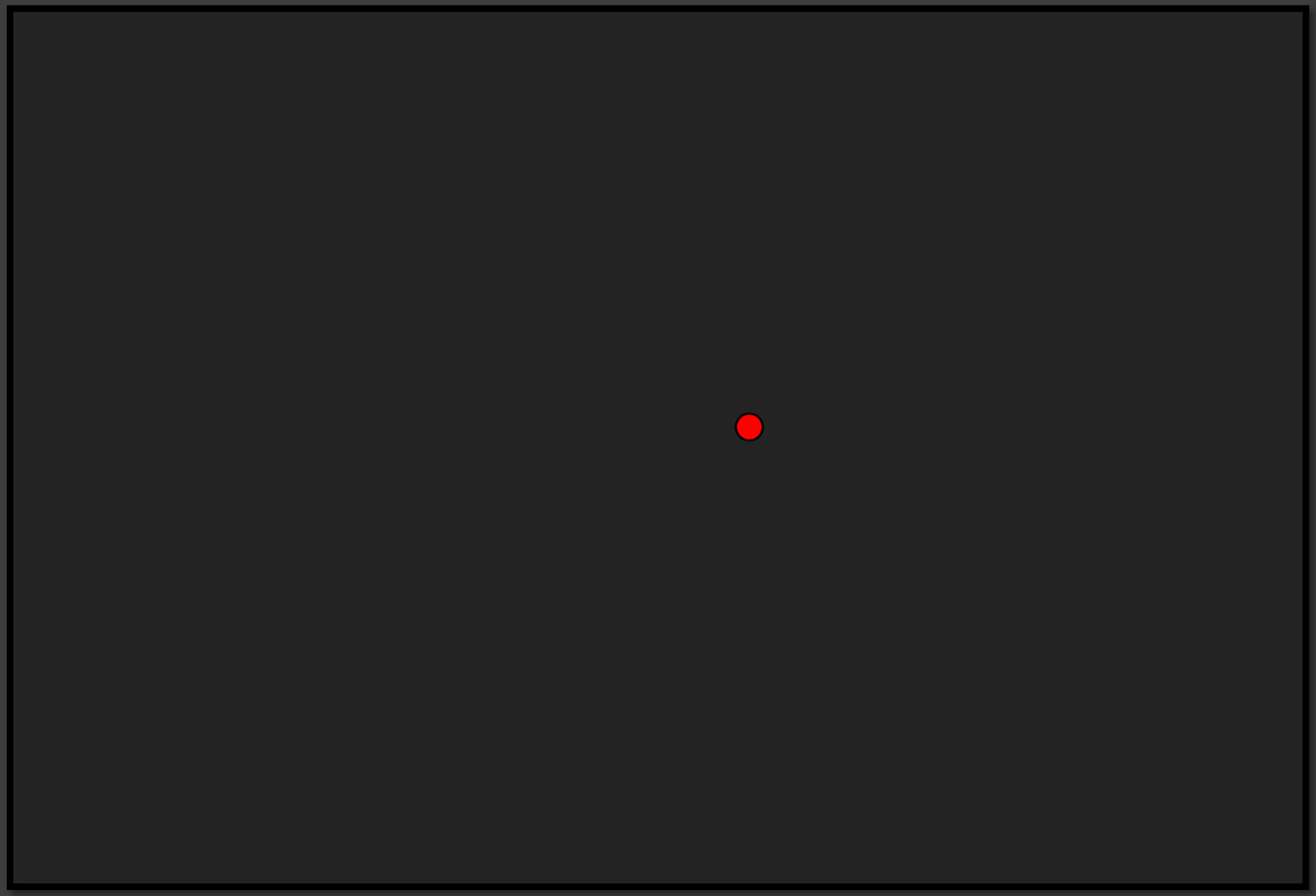
Downstream: Local Changes



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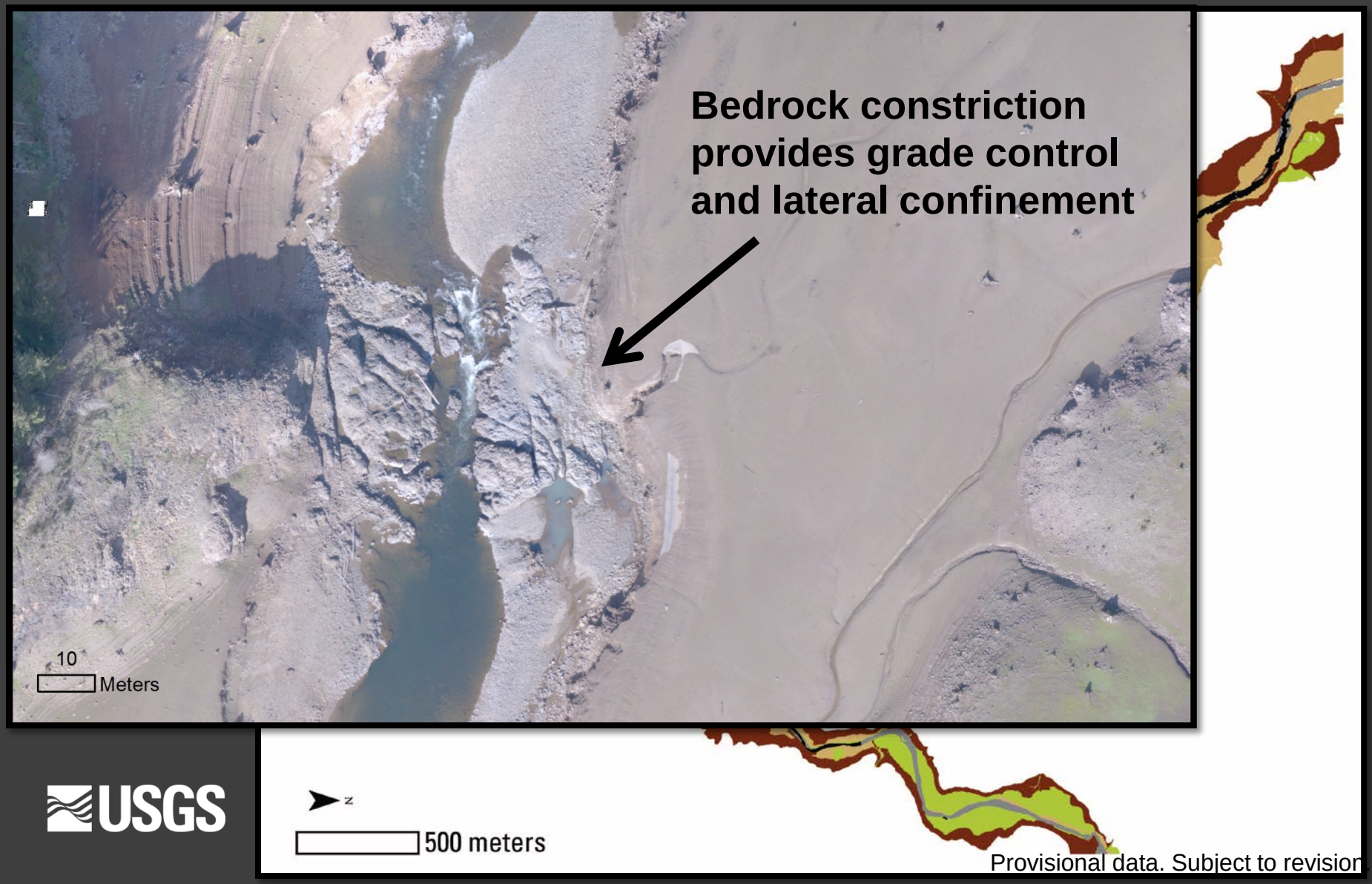
Reservoir: Processes and Controls



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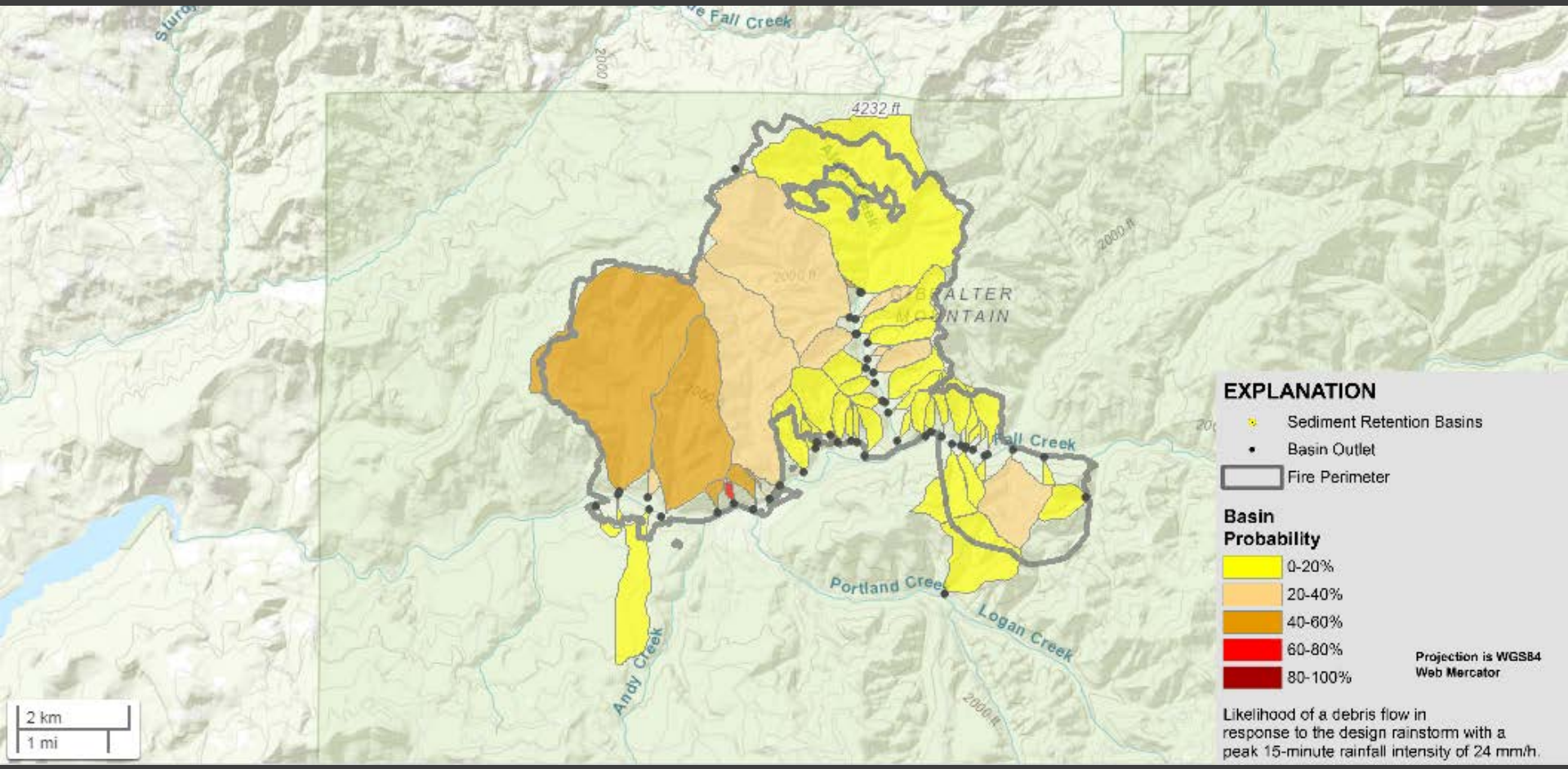

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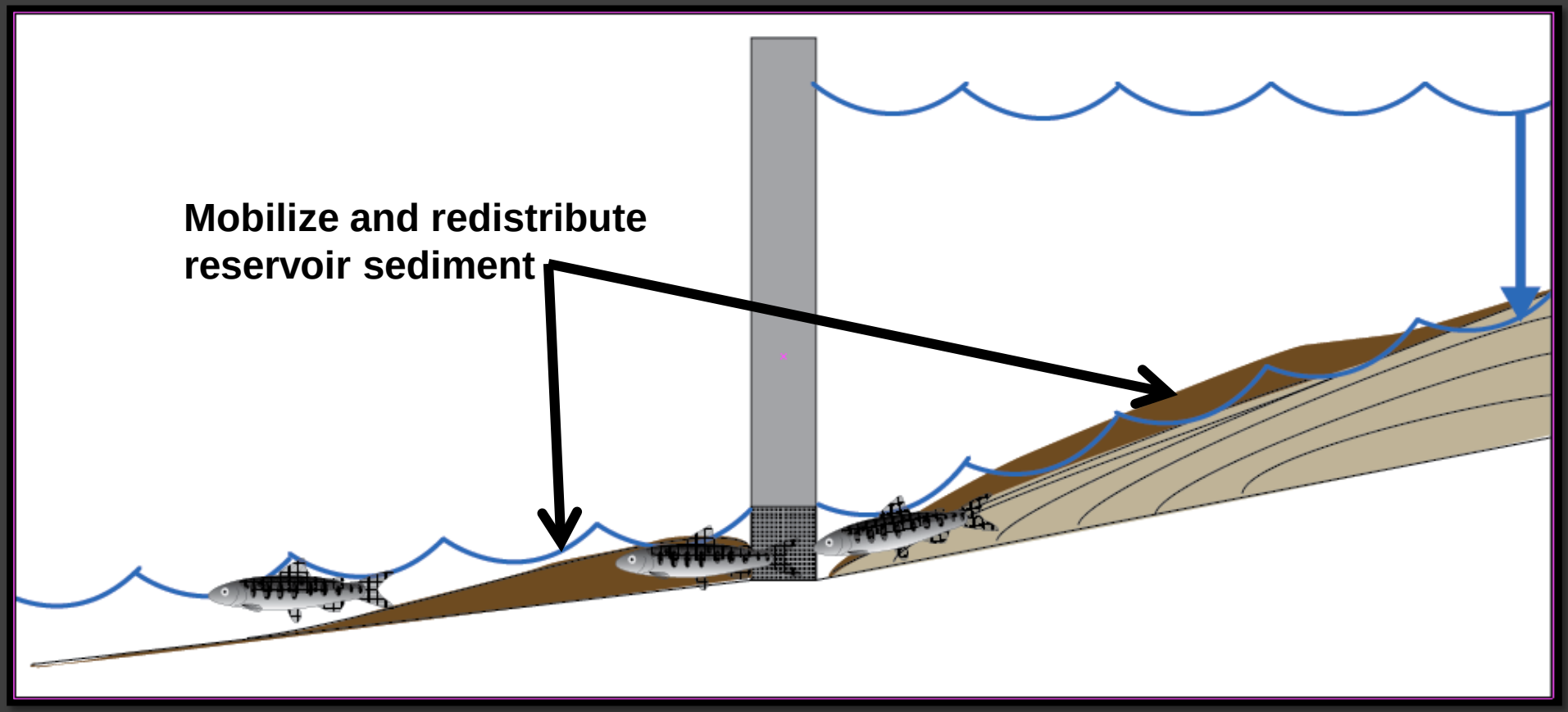
Drawdown Operations



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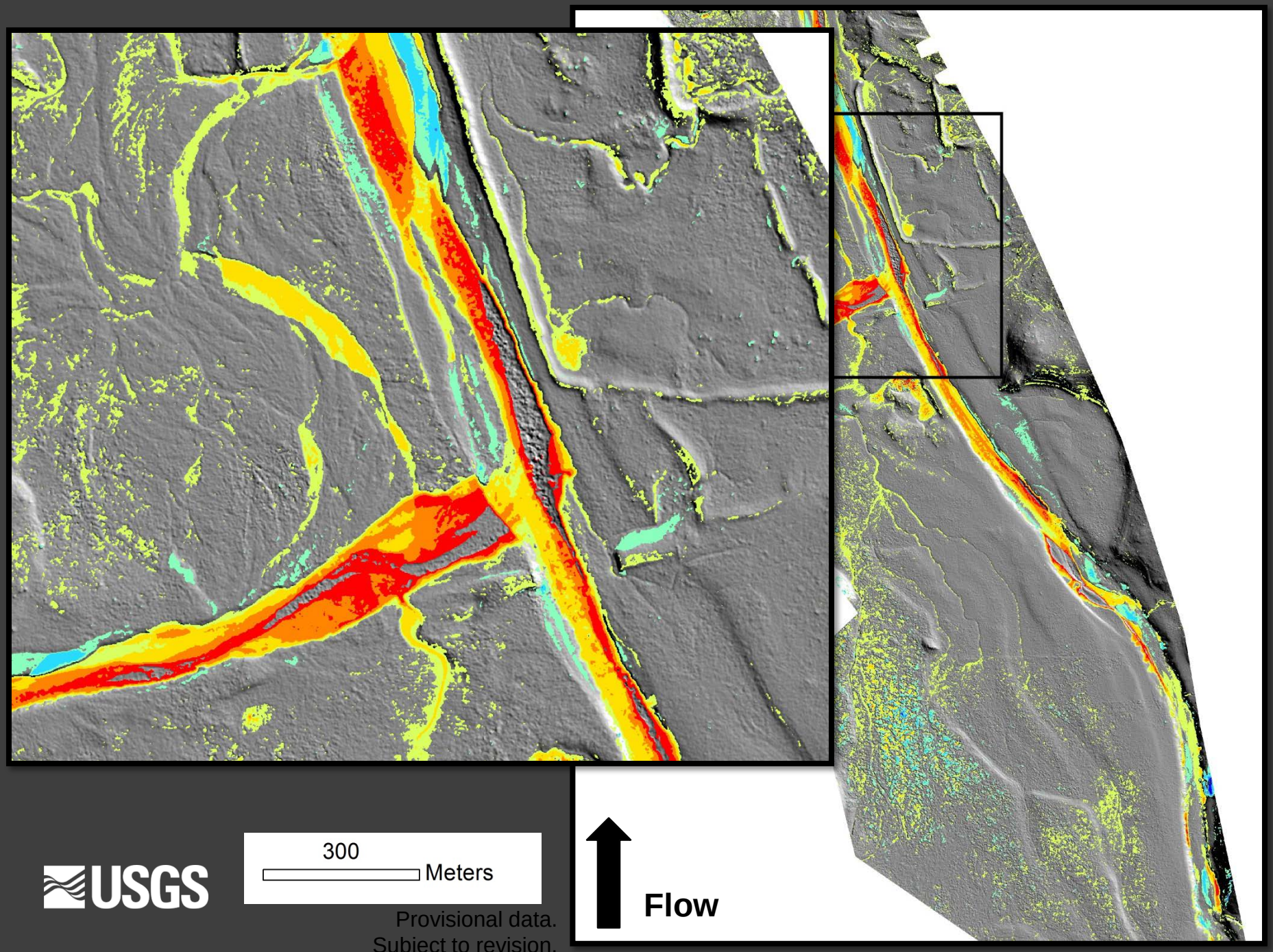

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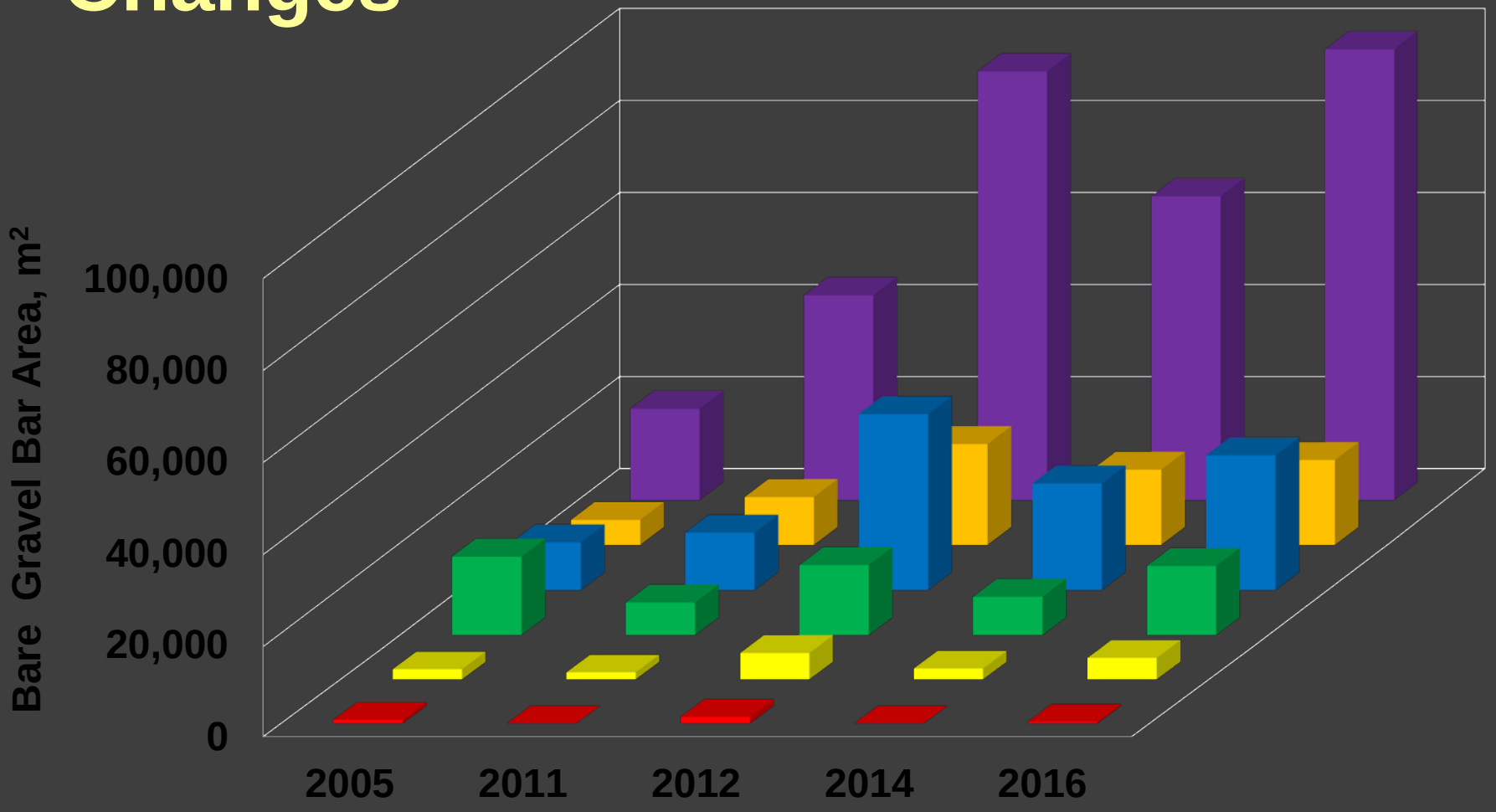
Downstream: Coarse Sediment Changes



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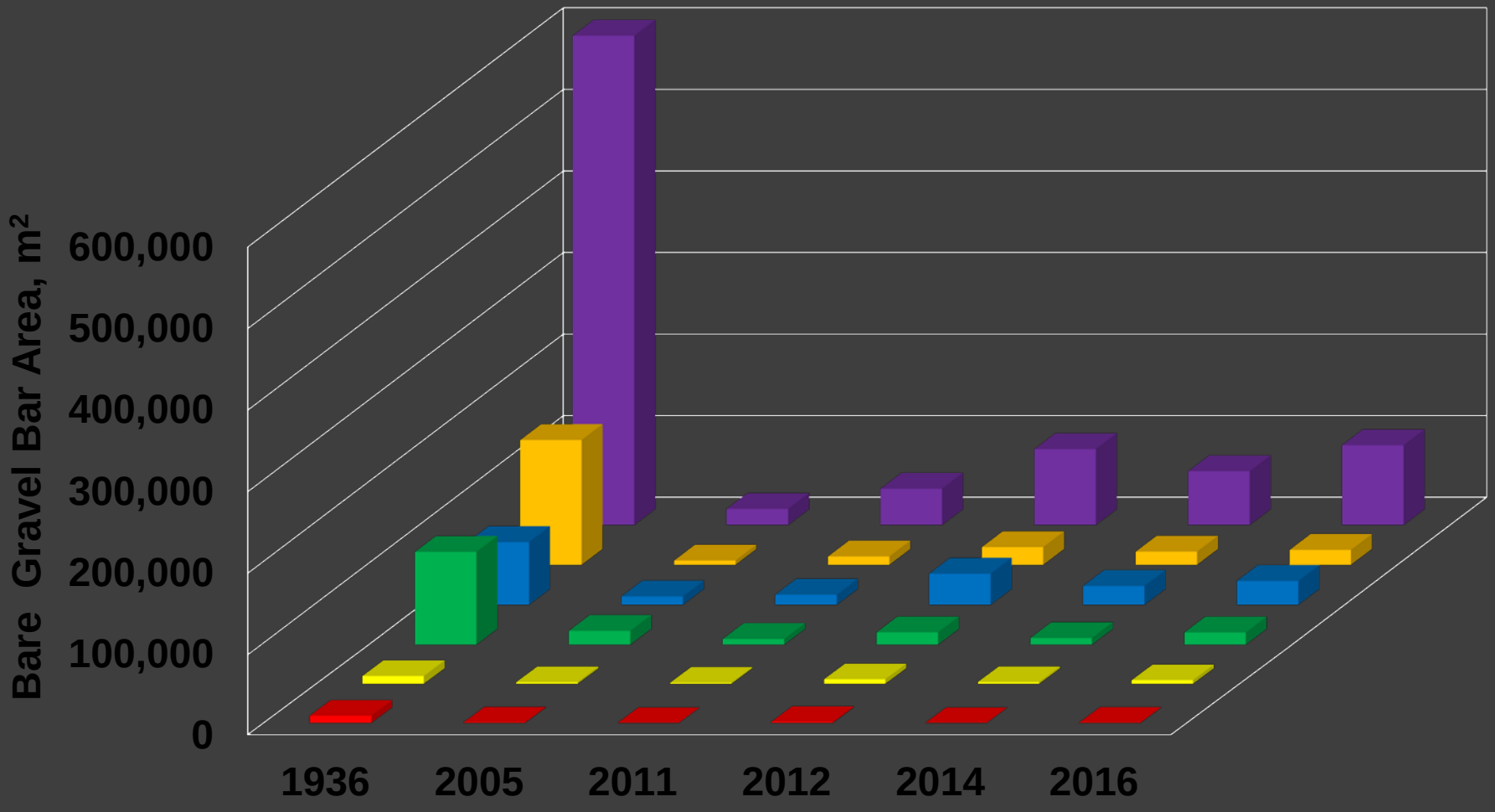
Downstream Impacts: Historical Context



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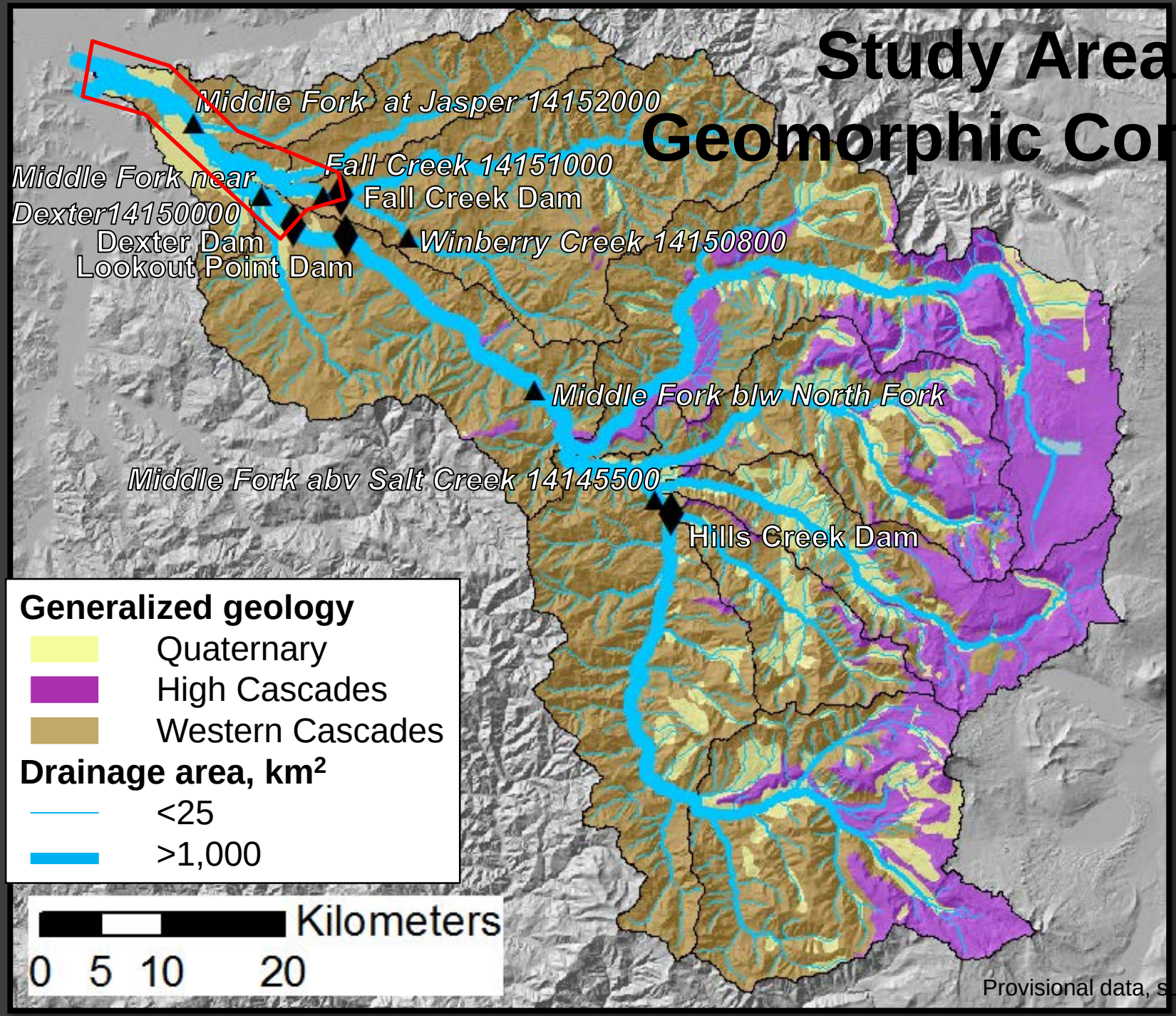
Study Area and Geomorphic Context



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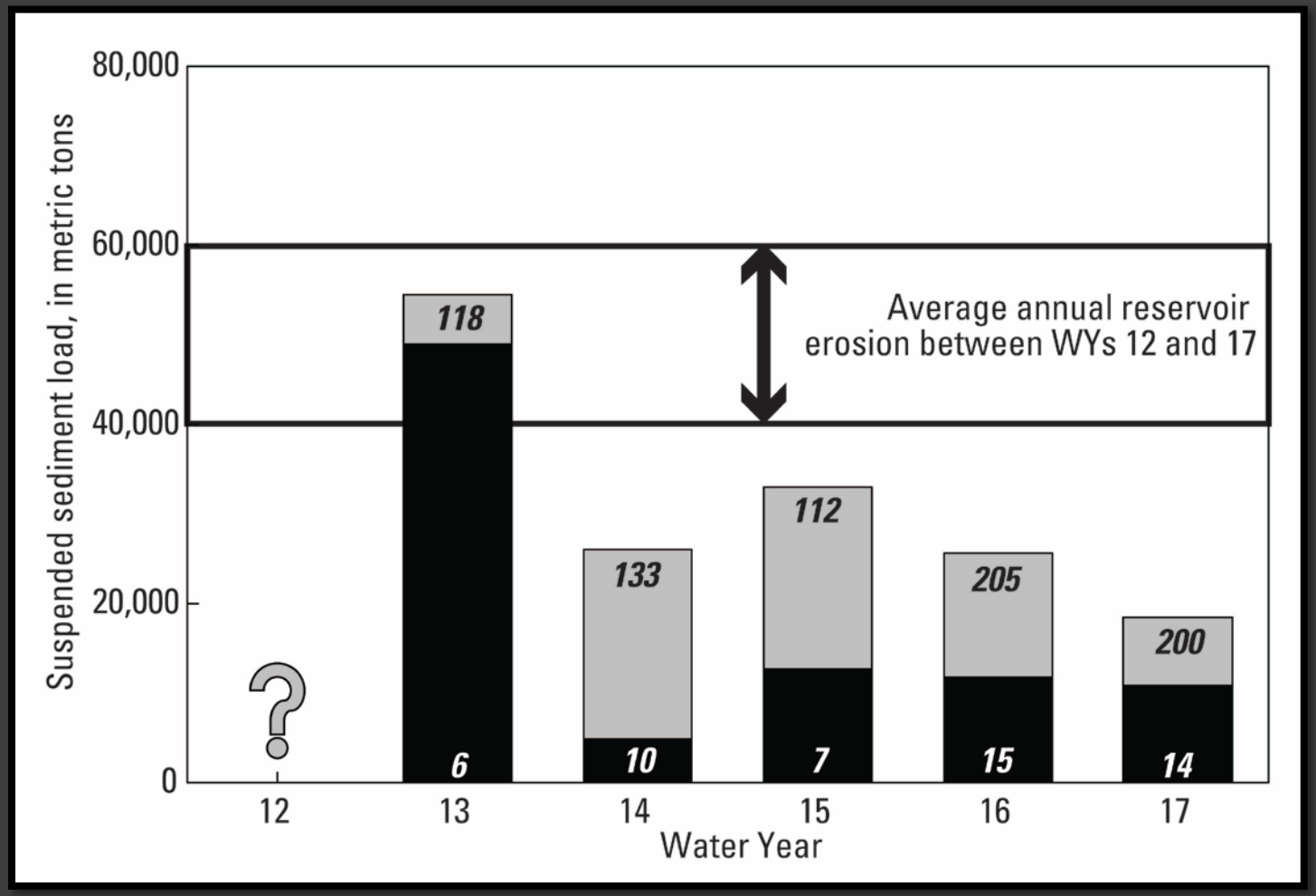
Reservoir Erosion: Comparison to Calculated Sediment Transport



Total days measured

Days during full drawdown

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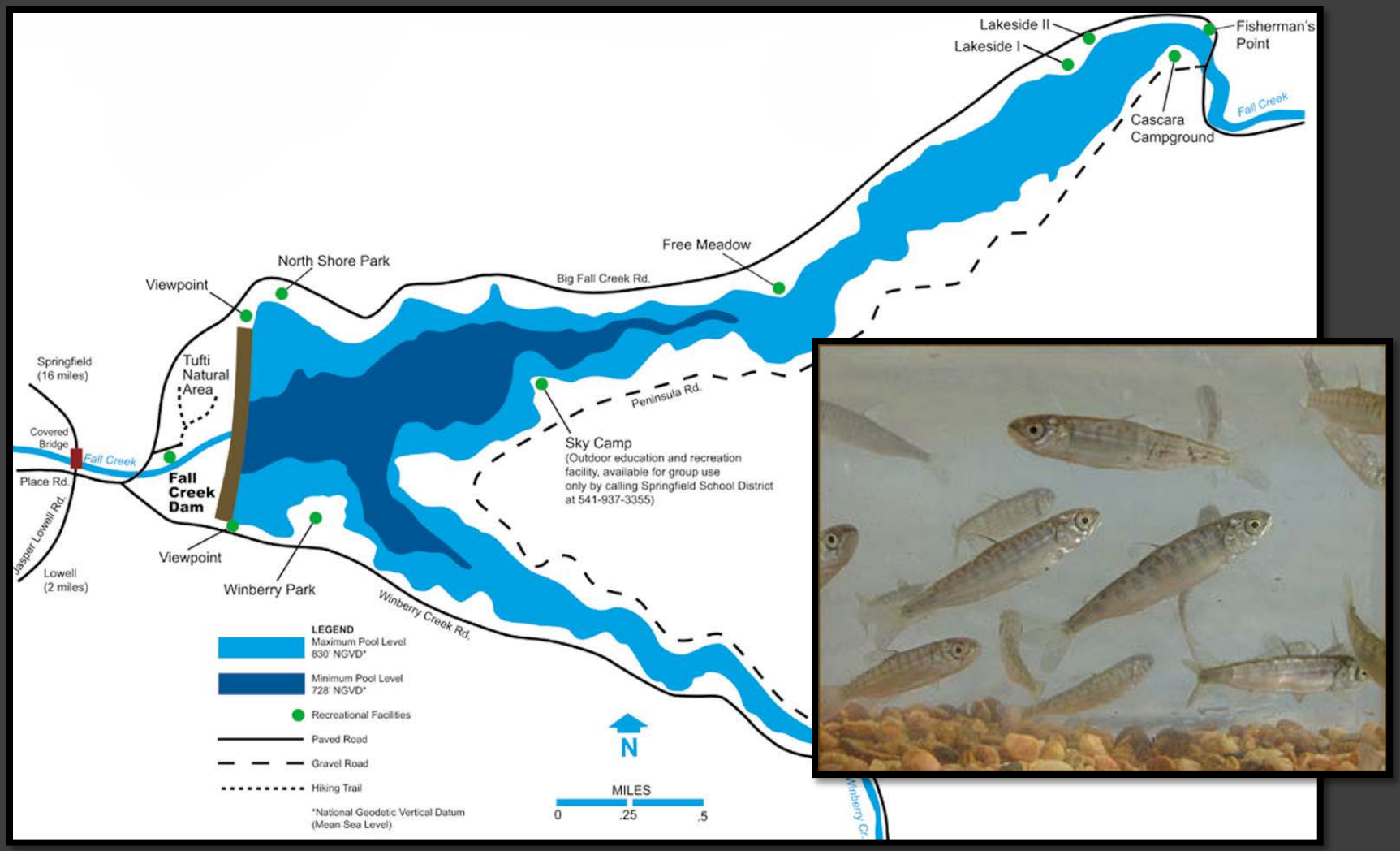
Provisional data. Subject to revision.

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