Suttle Lake Dam Fish Passage Project

Existing condition pre-project

A tale of two dams and a lost sockeye population

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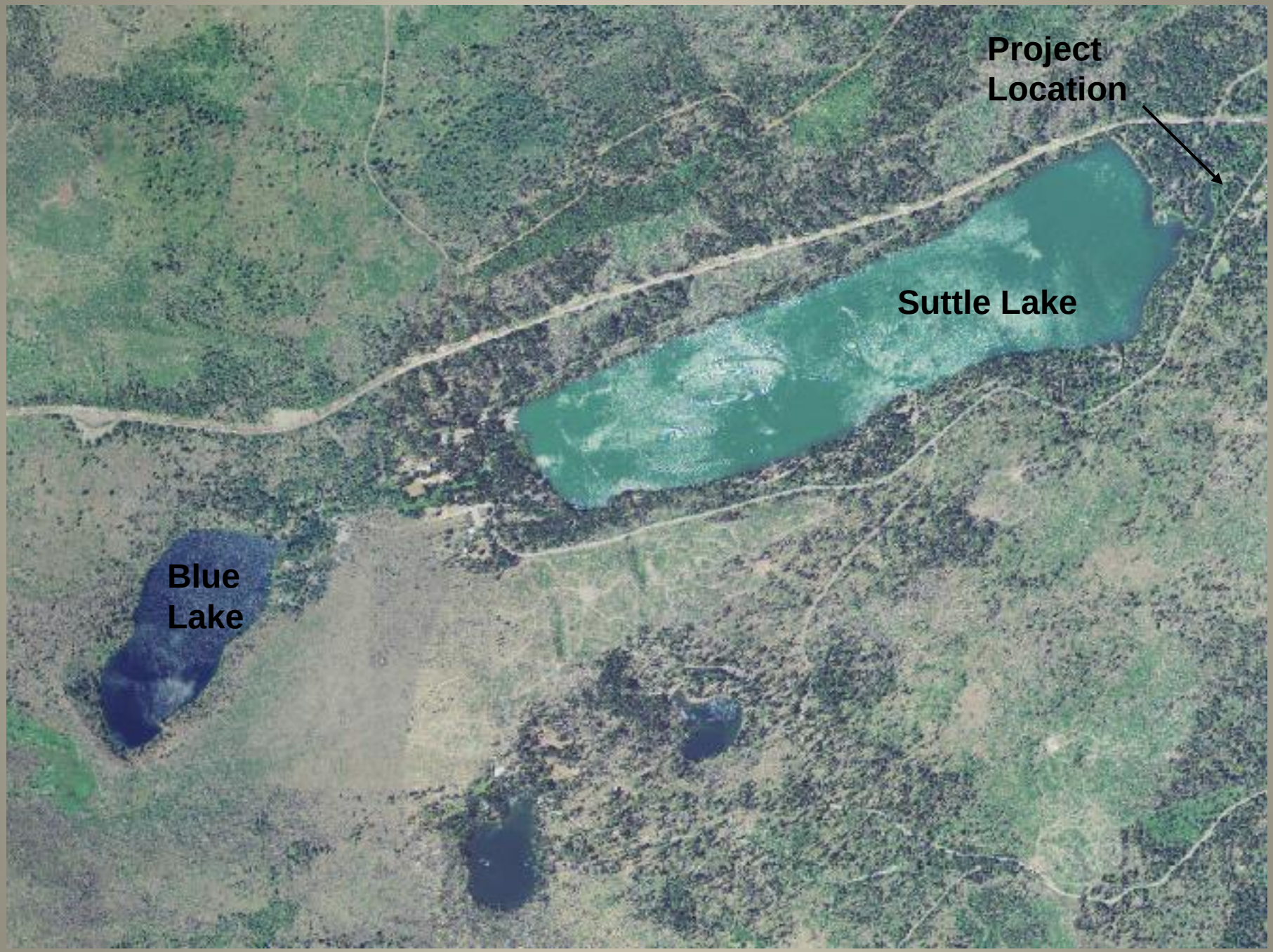

Project
Location
Suttle Lake
Blue
Lake

Powerhouse and fish ladder below dam at Suttle Lake outlet, 22 June 1942. Source: Pacific Northwest Stream Survey Photographic Collection, Oregon State University Archives, Corvallis, Oregon.

A Lost Sockeye Population

- Suttle Lake was one of two lakes in Oregon that historically had sockeye and kokanee.
- USGS (1914) stated that a run of blueback (sockeye) ascends to Suttle Lake each year.
- Frey (1942) reported that “a run of blueback salmon used to ascend to Suttle Lake, but none have been observed for a number of years.
- Kokanee were stocked into Suttle Lake from 1954 to 1973.
- Due to several small dams on Lake Creek the sockeye run was likely extinct before the completion of the Pelton Round Butte dams in 1964.

Rotating screens and spillway in power dam at the Suttle Lake outlet, 22 June 1942.
Source: Pacific Northwest Stream Survey Photographic Collection, Oregon State University Archives, Corvallis, Oregon.

Upper dam on Lake Creek at Lake Creek Lodge, 22 June 1942.
Source: Pacific Northwest Stream Survey Photographic Collection , Oregon State University Archives, Corvallis, Oregon.

Start of excavation for the 1961 dam.

Then

- Second dam constructed to maintain lake level for recreation.
- The 1961 dam cost $ 18,507 to construct and took eight months to complete.
- Excavation was accomplished with a TD-9 Drott 4 in 1 and a ½ yard backhoe.
- Heavy rains in November and February delayed construction.

Now

- The 2013 fish passage project cost around $85,000 for construction and took six weeks to complete.
- Both projects were constructed by Forest Service crews and equipment operators.

Pouring core wall for the 1961 dam.

Filling in bypass channel for 1961 dam.

Completed 1961 dam with fish ladder.


Photo Courtesy of ODFW

Todays Fishery

- Downstream fish passage restored at Pelton Round Butte Dams in 2009.
- Downstream passage of sockeye/kokanee smolts begins in 2010 with 45K smolts passed.
- Nineteen sockeye adults return and are passed upstream in 2011.
- Eighty six adult sockeye return and are observed in the Metolius River during 2012.
- Twenty five sockeye adults return and are passed upstream in 2013.
- No known adult sockeye have returned to Suttle Lake yet.
- Bull trout once inhabited Suttle Lake but today brown trout are likely the primary predator.

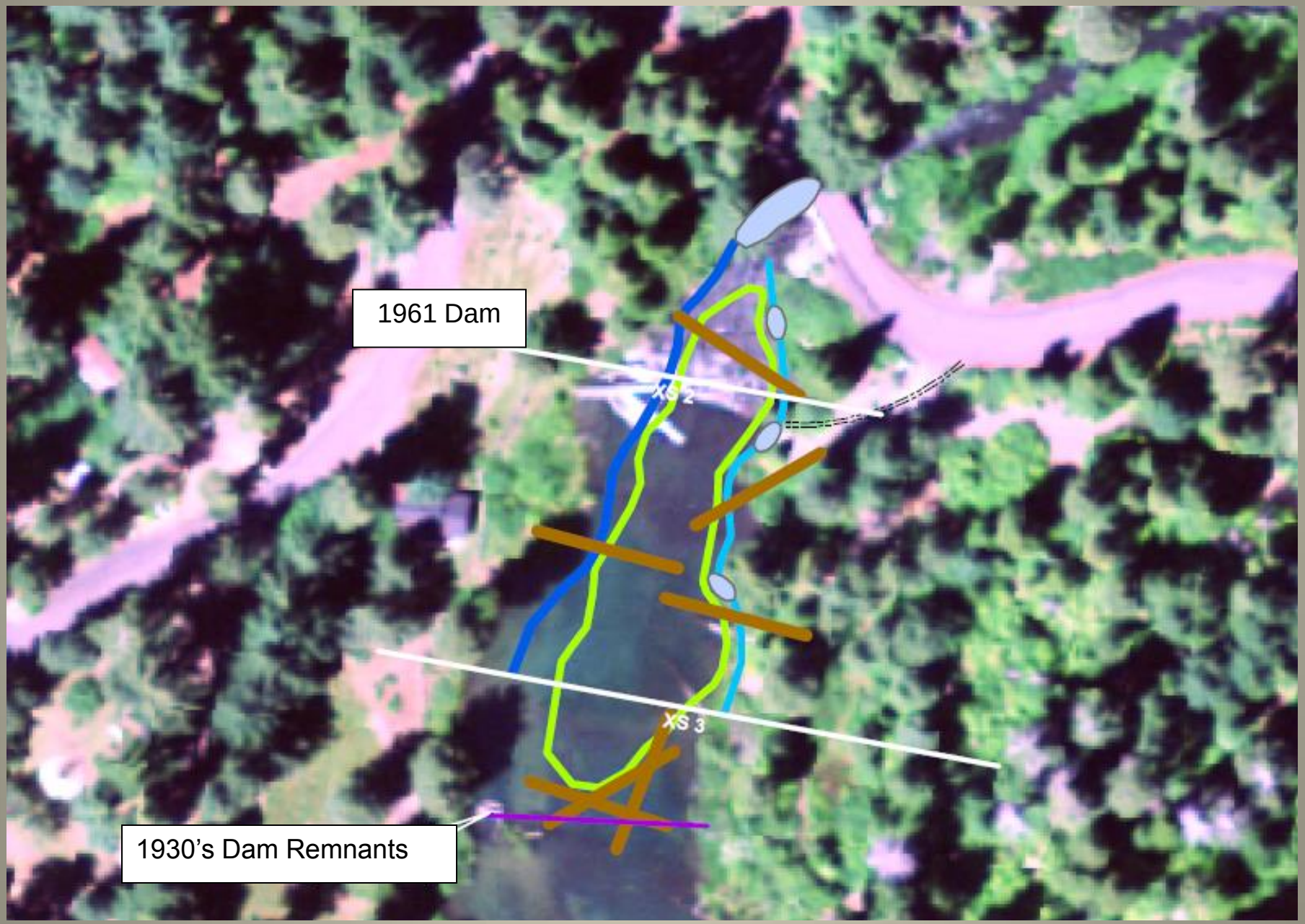
Population abundance estimates for outmigrant *O. nerka* and associated 95% confidence limits, from Suttle Lake, Lake Creek rotary screw trap, 2009 - 2012.
Data courtesy the Confederated Tribes of the Warm Springs Reservation of Oregon.

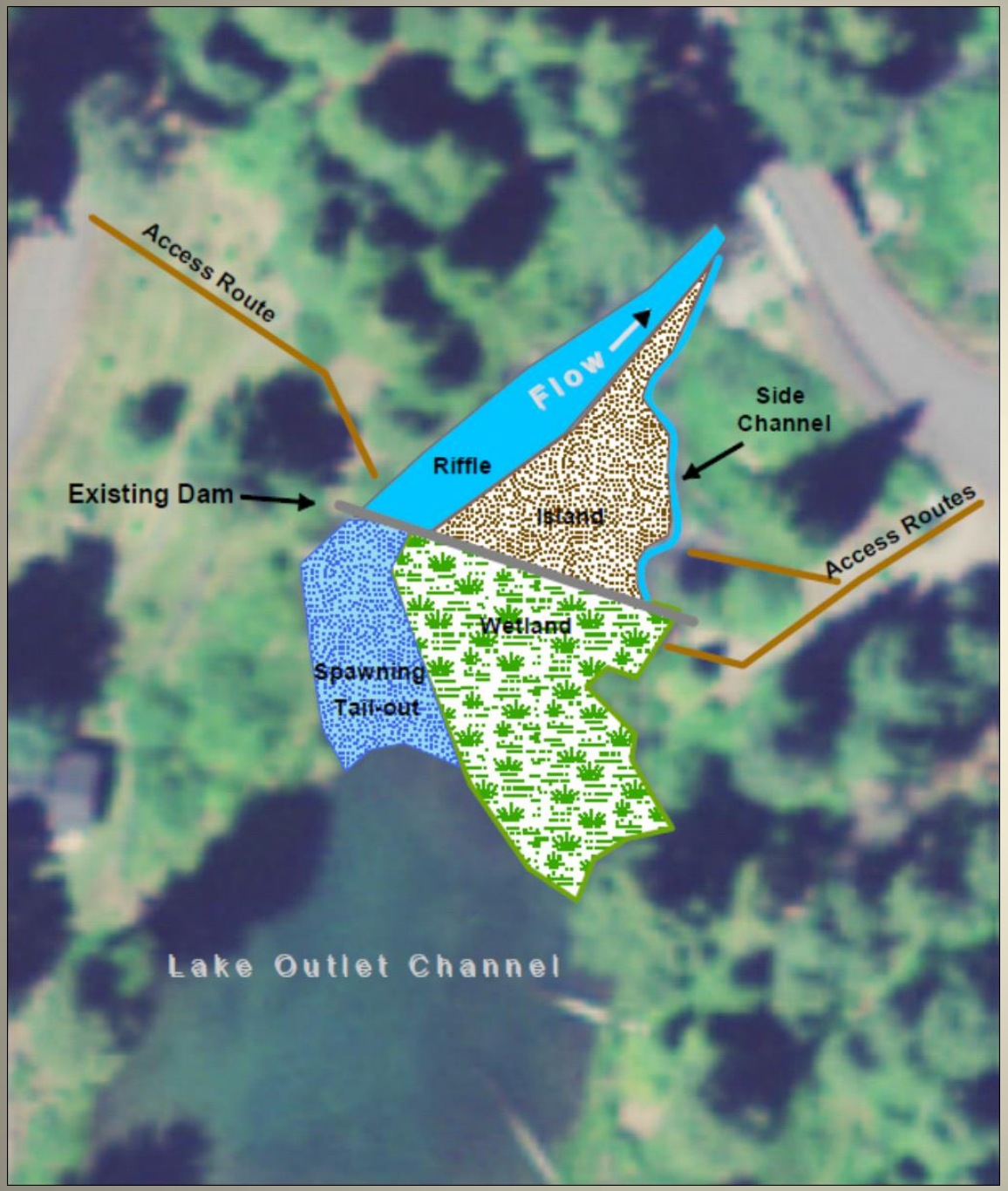
Year	Estimated smolt outmigrants (N*)	95% C.I. (N* ± CI)	Relative Error (%)	Expanded migrants (± 95% C.I.)	Trap Efficiency (%)
2009	45,368	27,582	47.1	17,786 – 72,950	6
2010	3,555	1,143	35.9	2,412 – 4,699	13
2011	22,258	6,012	24.1	16,246 – 28,270	6
2012	2,743	1,405	57.8	1,338 – 4,149	7


Suttle Lake kokanee/sockeye smolt


Lake Creek screw trap

Original Design – Dam Removal





Dam Modification Design

Project Objectives

1) Restore fish passage for all life stages, especially at low flow.

2) Improve spawning and rearing habitat at the lake outlet.

3) Maintain current lake level, dam stability and functional recreation infrastructure around Suttle Lake.

Dam Modification Design

To Achieve Project Objective #3 – Engineering Assistance Utilized

- **Engineering Design Procedure:**
  - **Dam Hazard Analysis**
  - **Weir Analysis to Estimate Size of Notch to Maintain Target Flows**
  - **Flood Routing Analysis**
  - **Earthwork Calculations and Grading Plan**
  - **Hydraulic Analysis**

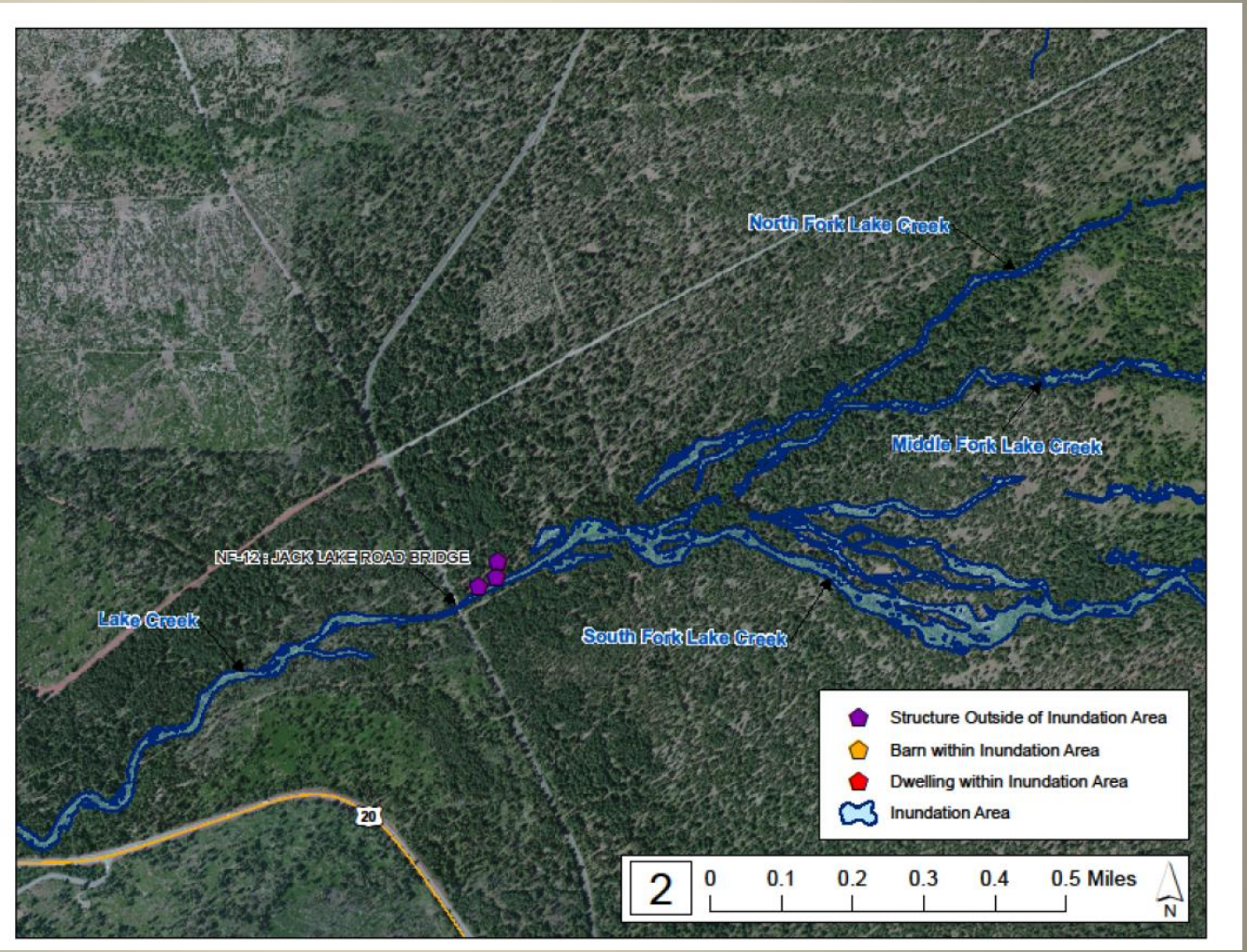
- Dam Hazard Analysis

West Engineering Consultants Retained to Complete the Analysis

-HEC-RAS hydraulic modeling was used for 100 year inundation study.

-Flood wave of 1,180 cfs will reach Camp Sherman Store in 2 hrs and 10 minutes.

-2 homes will be impacted in 100 year event. Dam rated at significant hazard.

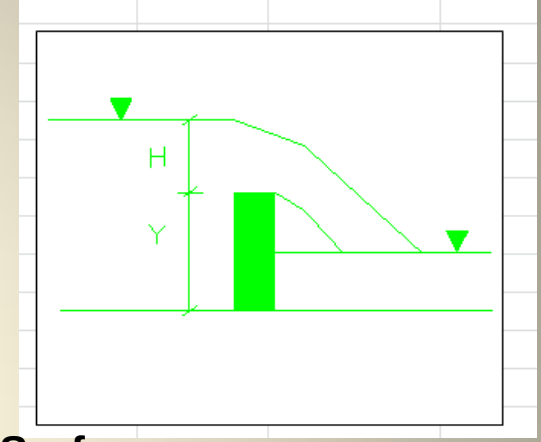


- **Weir Analysis**

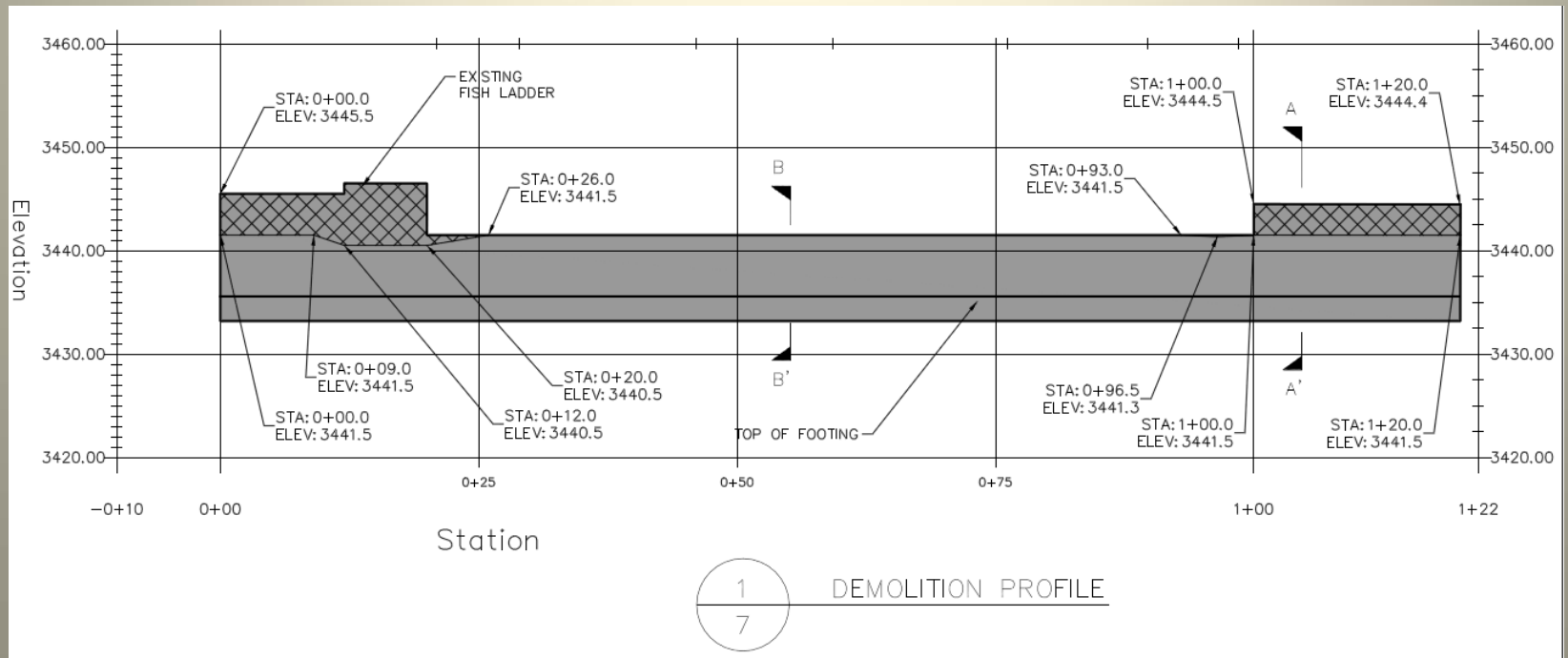
At Current State at Low Summer Flows (30 cfs) – 3-inches of Water Sheet Flows Over 80 feet of weir.

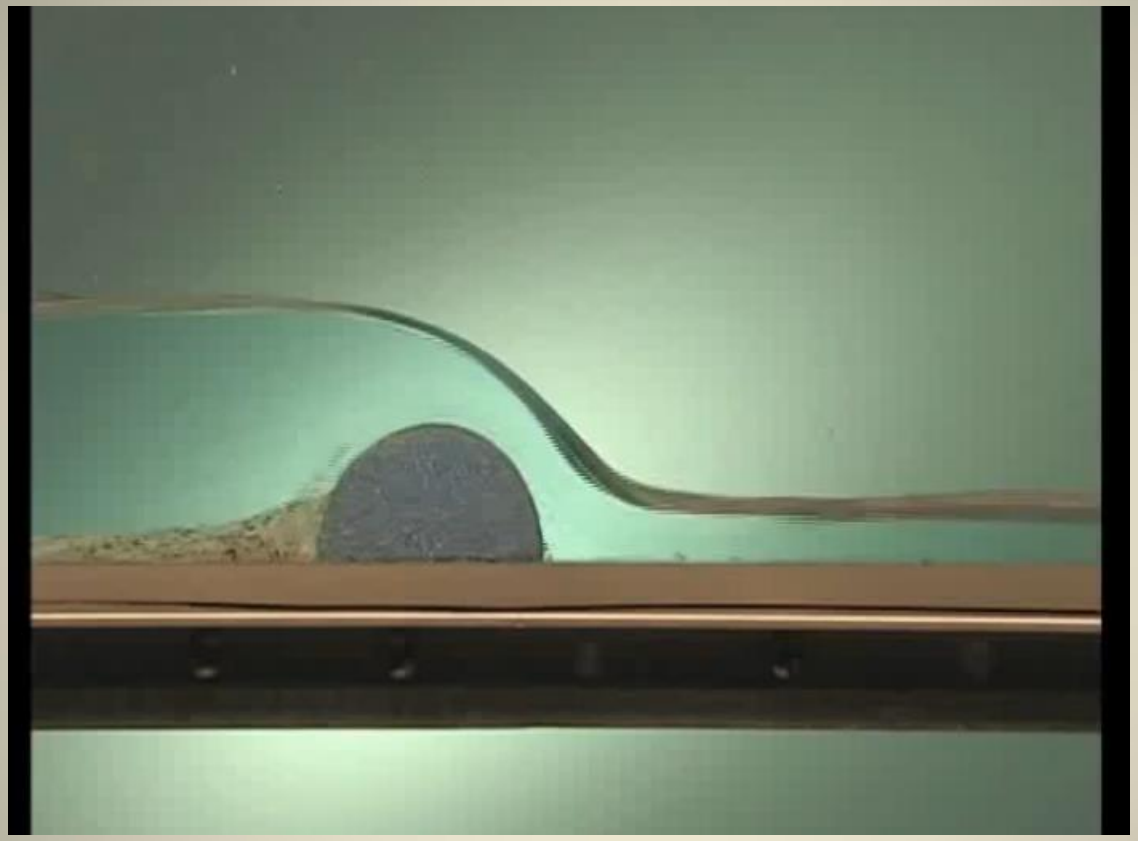
Analysis Used to Estimate Notch Depth and Width. Two Methods Utilized in Analysis To Accommodate Low Flow – 30 cfs.:

- **Bernouli Equation**
- **Kindsvater-Carter Method**



To Low Flow Channels Analyzed With Goal to Keep H (Steady Low Flow Head) No Less than Top of Water Surface





- **Flood Routing Analysis**

Evaluate Effect of Design on Dam Attenuation:

-By Reducing Afttenuation Effect – Flashier Events Downstream

-By Increasing Attentuation Effect – Store More Water Lake Causing Elevations to Rise

-Goal is close to net zero change.

100 Year Unit Hydrograph Enters Suttle Lake

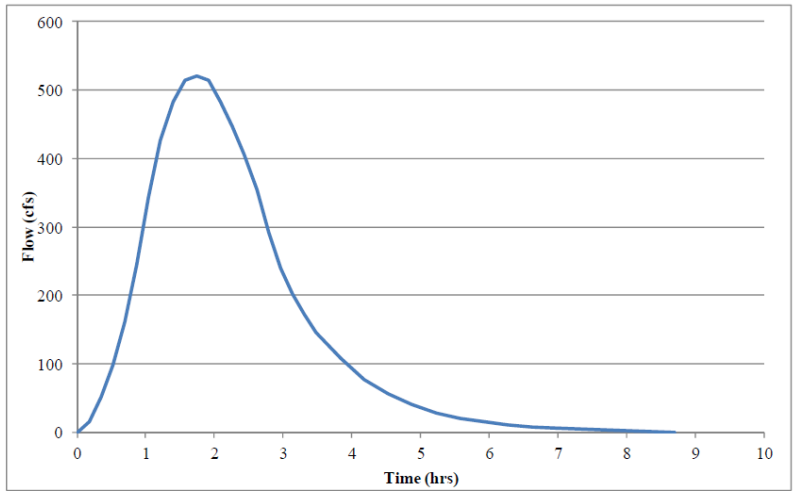
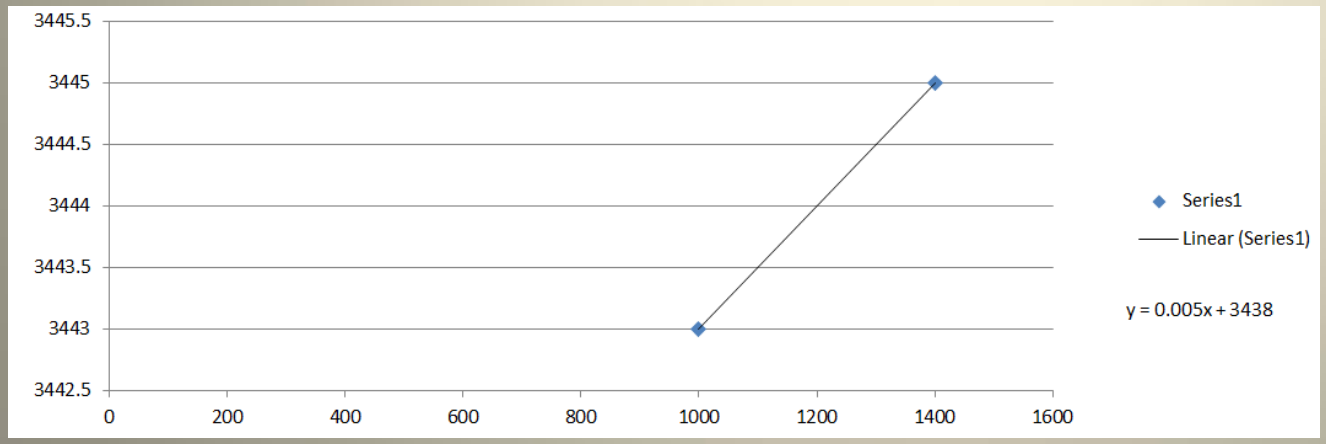


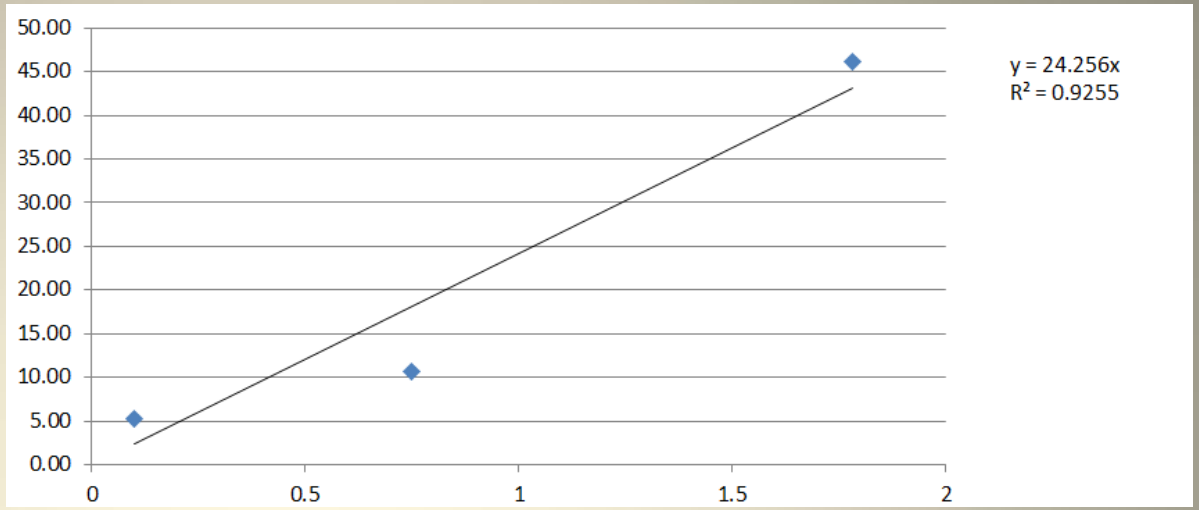
Figure 2-2. SCS Unit Hydrograph for Suttle Lake Dam Flood Inflow.

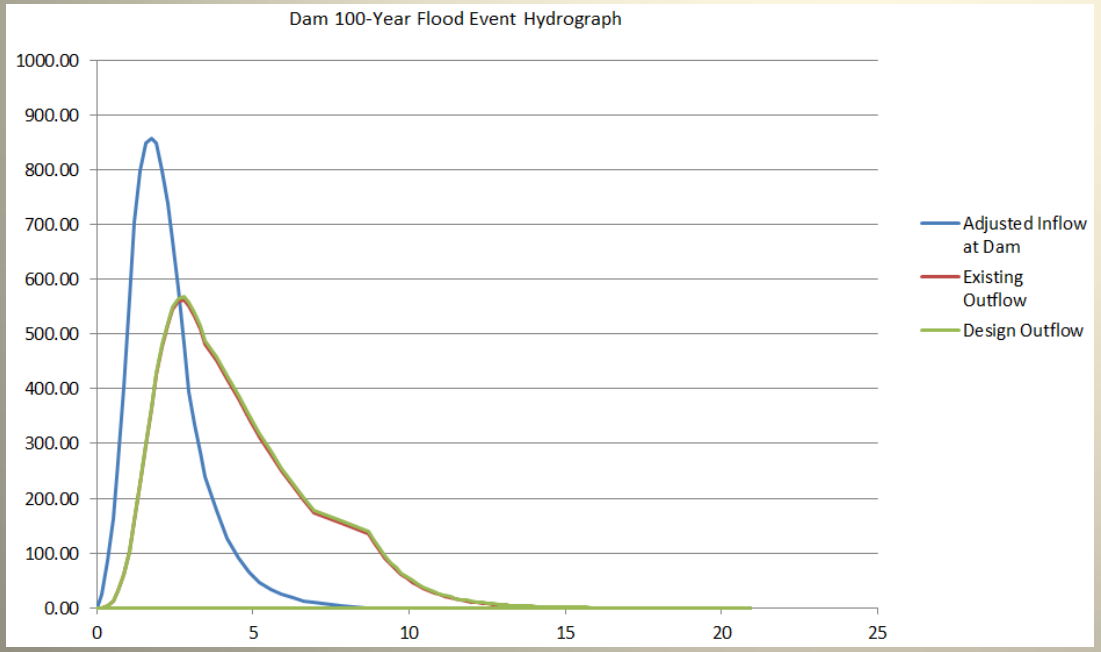


Reservoir Fills Up At Known Relationship

- **Flood Routing Analysis**

Water Exits Dam At Calculated Rate





Time Step Analysis Completed at 10 minute Intervals.

Conclusion – Based on Reduced Dam Surface Area but Increase Earthwork & Logss Attenuation Effect of Dam on Watershed Is Not Expected to Change From Existing

- **Earthwork and Grading Plan**

Grading Plan and Estimated Quantities Developed For Road Crew Construction:

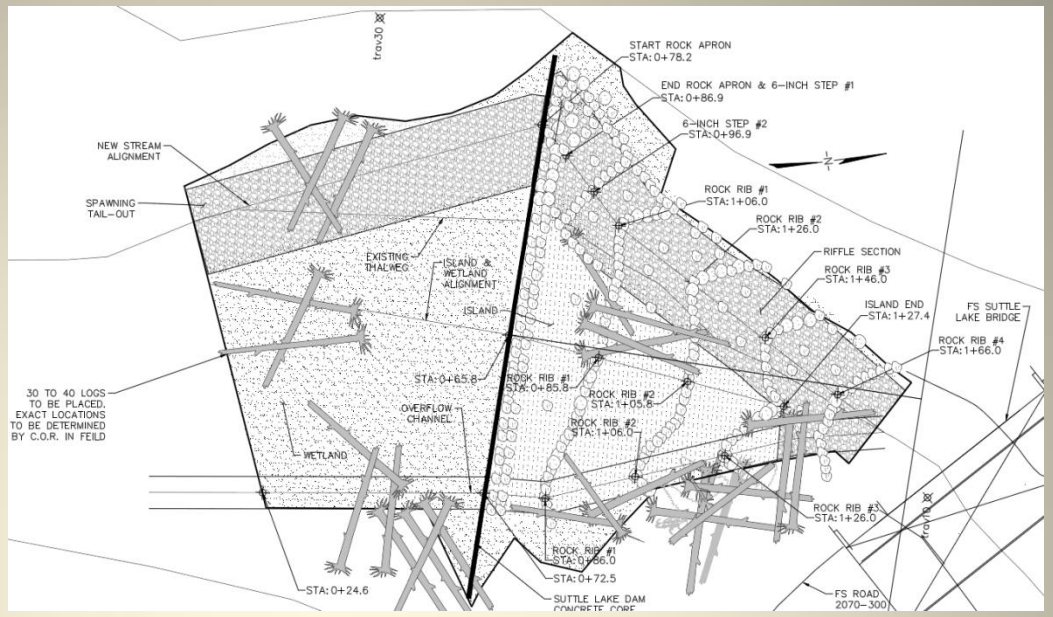
Construct Low Flow Channel On Either Side of Downstream Channel.

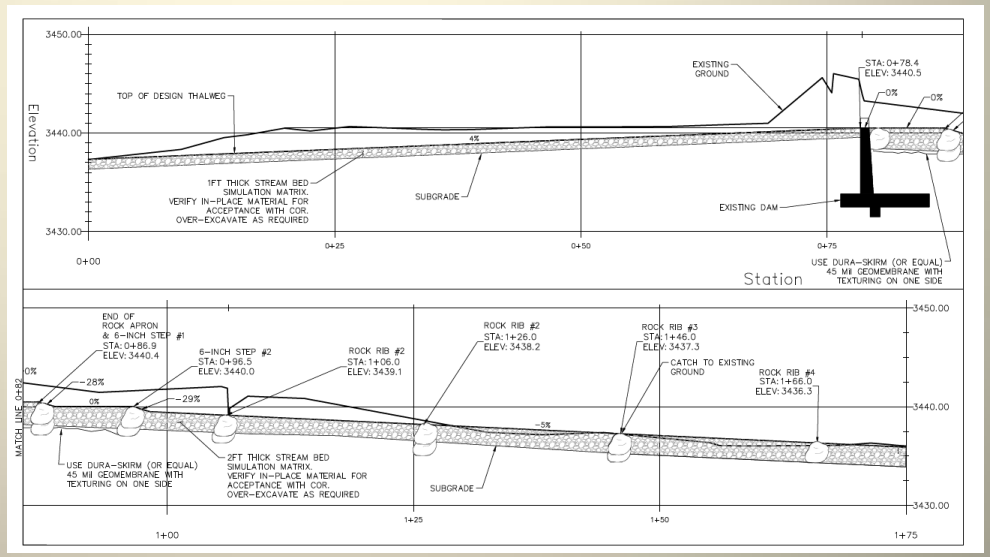
Downstream Riffle Section at 5 percent max grade to tie to existing.

-300 cy of Stream Matrix Material (18-inch minus)

-30 to 40 Logs

-Approximately (300) 3ft Dia. Channel Rocks for Long-term Stability





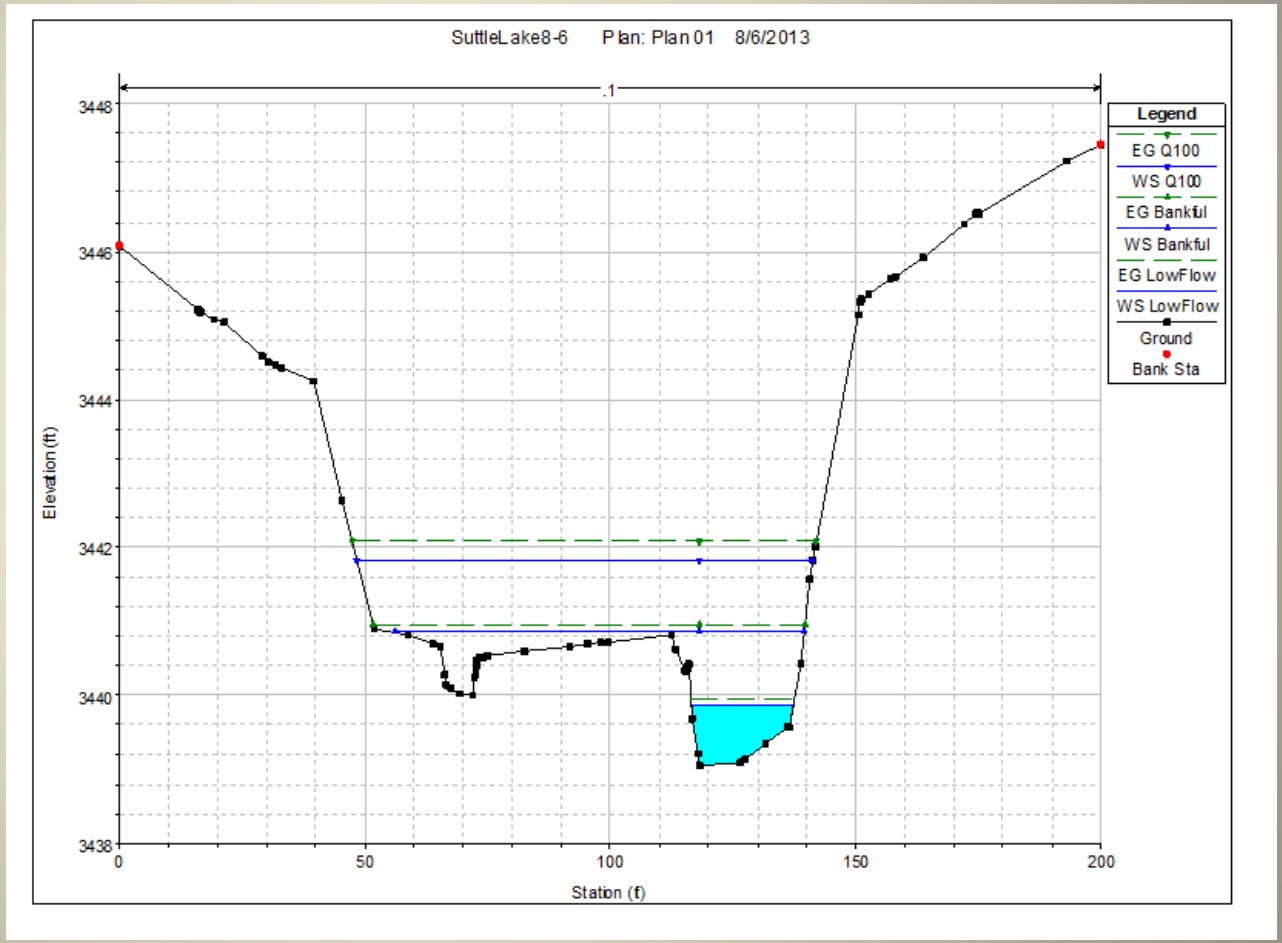
- **Hydraulic Analysis**

Hec-Ras utilized
to evaluate hydraulics
Of stream Downstream

-Check 100 year flood elevations

-Evaluate to see if any hydraulic jumps occur – global scour concerns

-Check bed mobility
Of particles that will not move in a 100 year flood event

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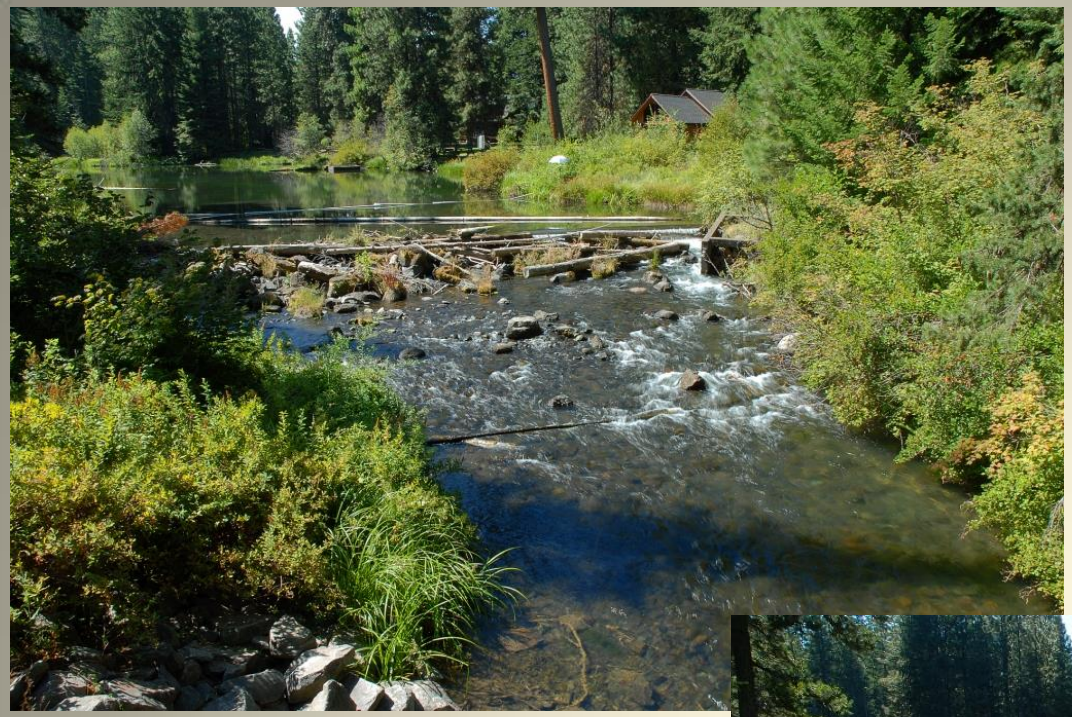


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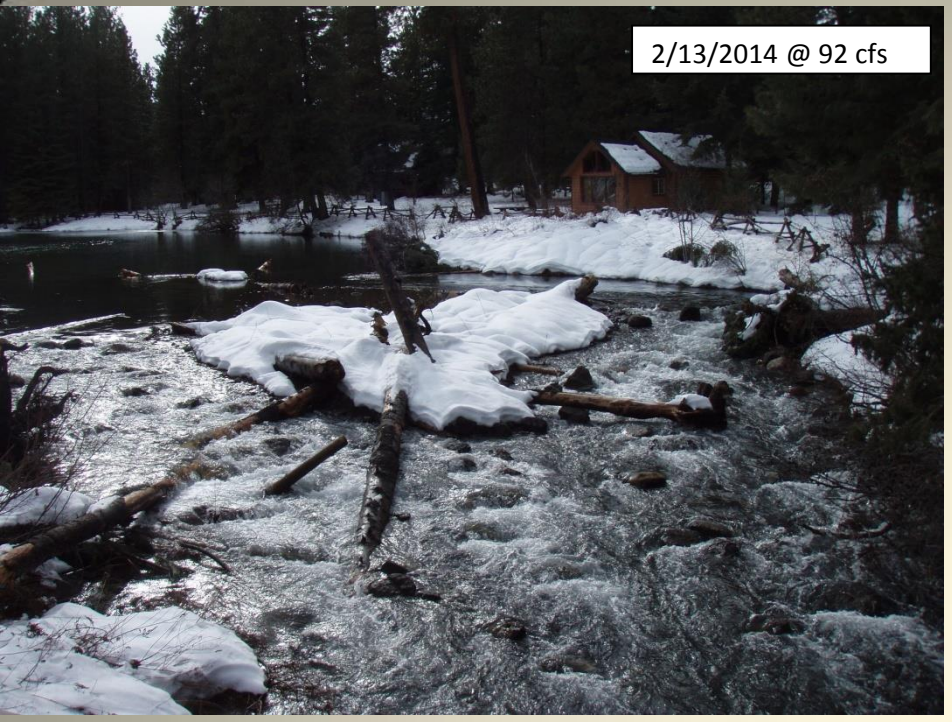
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Lessons Learned

- Dam removal or modification projects take more planning than you think.
- Make sure all persons that need to know about the project are informed early in the planning process.
- Be ready to modify design plans if needed.
- Depending on the stream gradient use appropriate sized substrate and enough roughness to ensure the project will provide fish passage for years to come.
- Have the ability to make changes to the project after initial high flows have tested it.

Acknowledgements

- Paul Powers – Fisheries Biologist – Crescent Ranger District
- Cari Press – Hydrologist – Sisters Ranger District
- Alan Buehrig – Engineer – Deschutes National Forest
- Mathias Perle – Project Manager – Upper Deschutes Watershed Council
- Darek Staab – Upper Deschutes Project Manager – Trout Unlimited
- Ron Bussard – Equipment Foremen – Deschutes National Forest
- Kelsey DeJean – Equipment Manager – Deschutes National Forest
- The Rest of the Road Crew Equipment Operators – Deschutes and Ochoco National Forests
- The Confederated Tribes of the Warm Springs Reservation of Oregon
- Suttle Lake United Methodist Camp
- The Lodge at Suttle Lake

Questions?