Blackwood Creek Stream and Floodplain Restoration;
a Novel Approach in a Dynamic and Changing Environment

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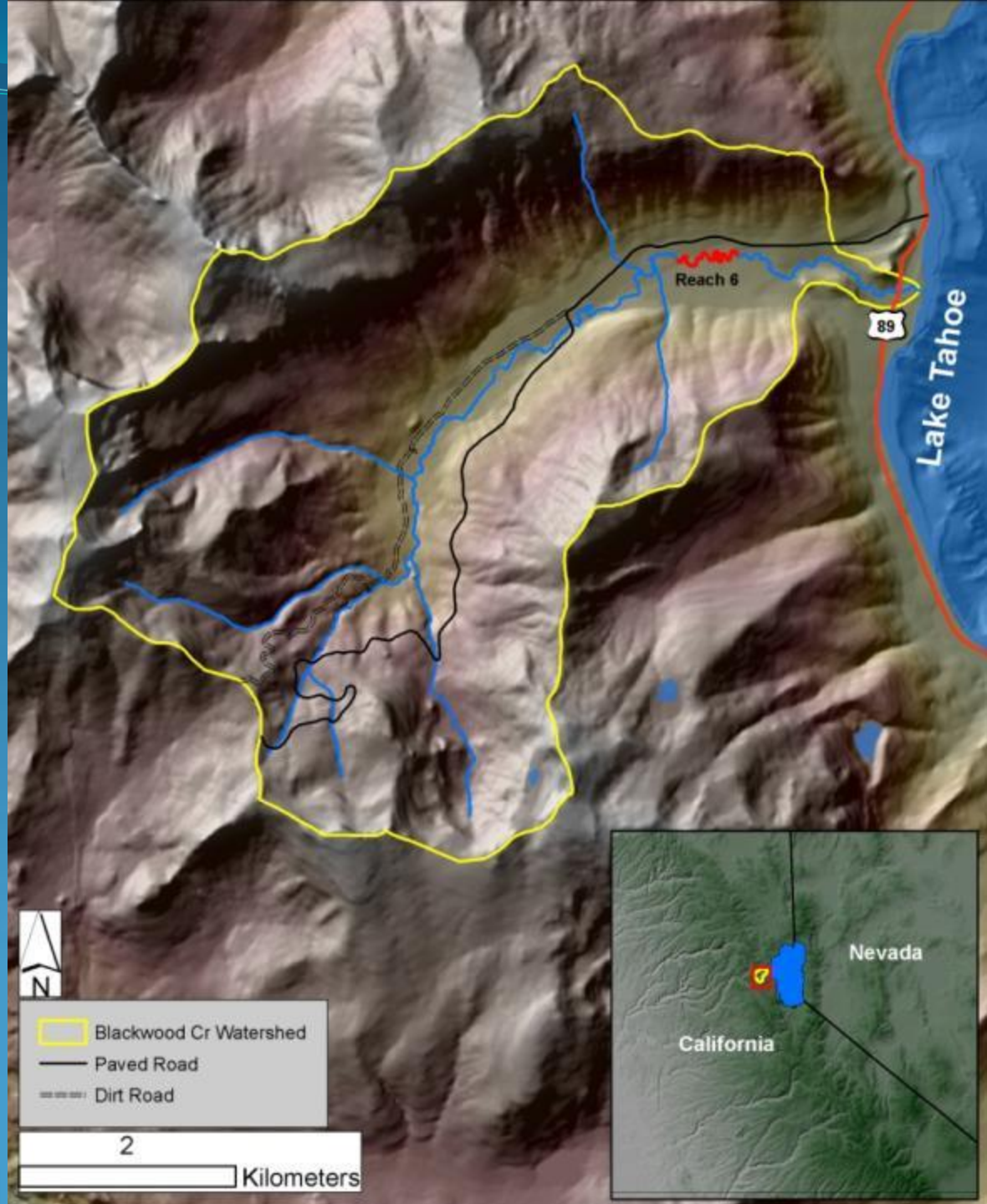
Blackwood Creek Watershed

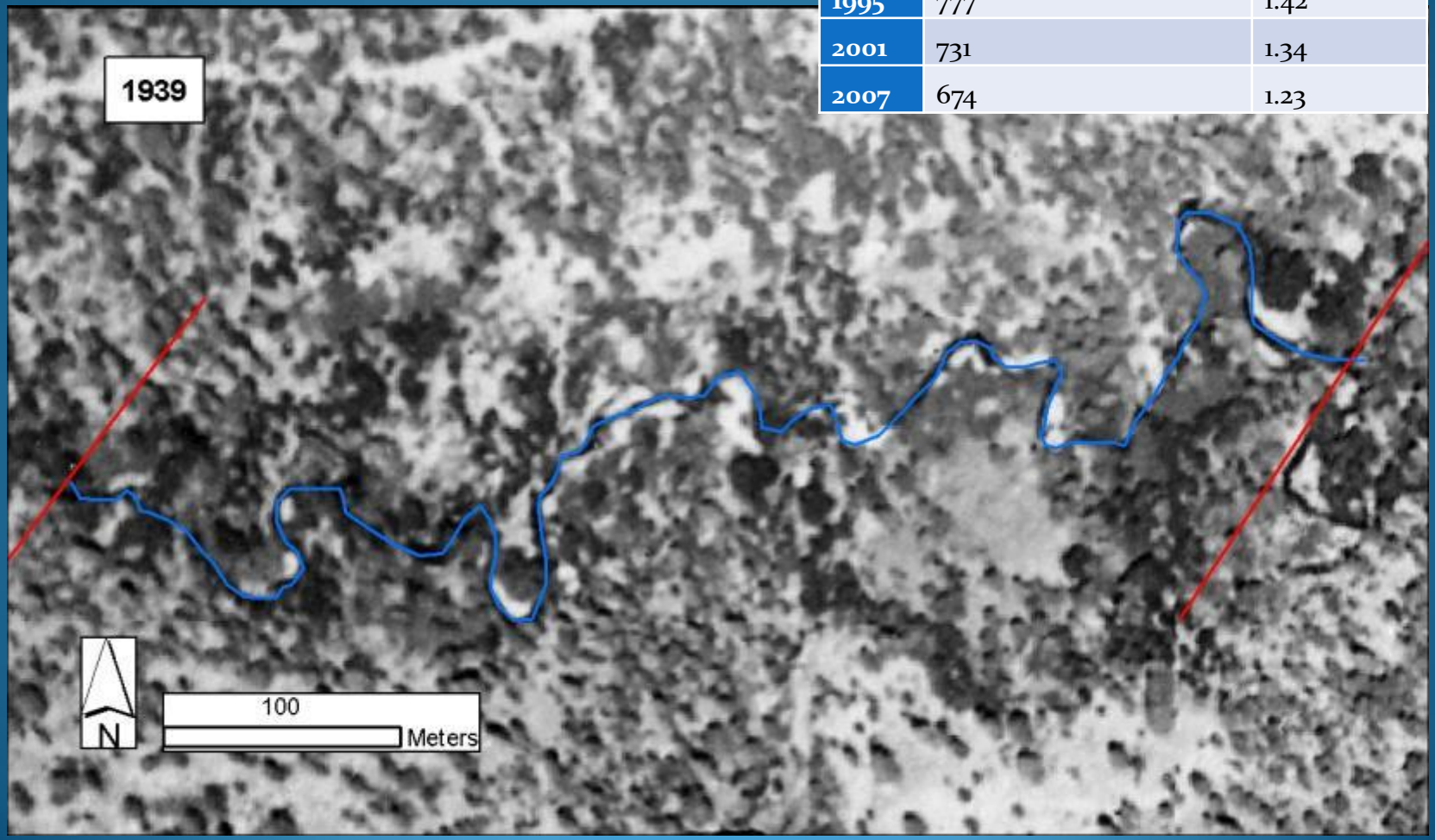
- 29 km²
- Elevation range
  - 2,706 m
  - 1,897 m at Lake Tahoe
- Blackwood Creek 11.5 km long
- Drains east into Lake Tahoe
- Volcanic geology
- Glaciated

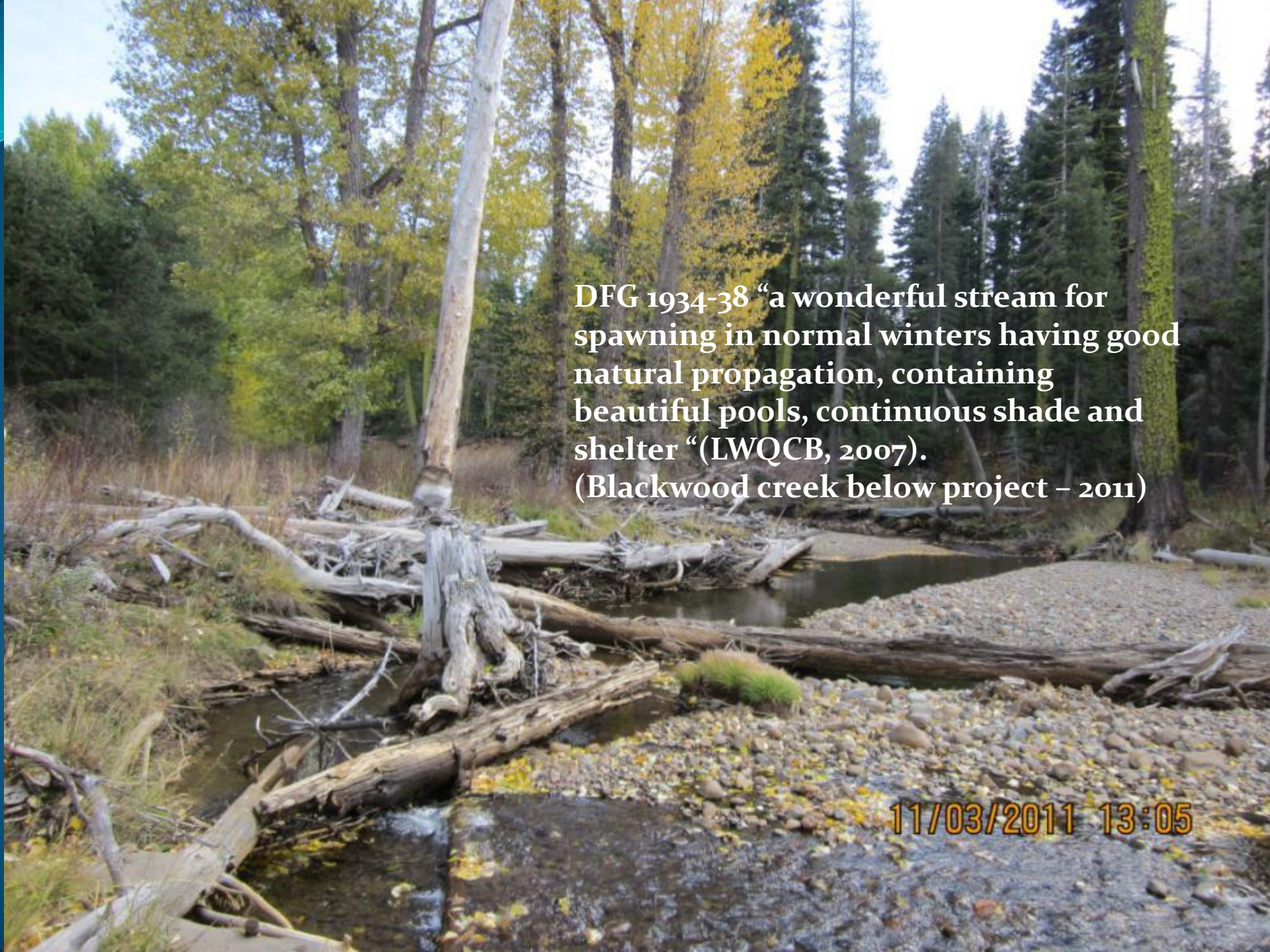


1939 Reach 6 Aerial Photo

The key -- Riparian Resiliency in the face of Climate change

Year	Channel Length (m)	Sinuosity
1939	985	1.80
1969	894	1.63
1986	835	1.53
1995	777	1.42
2001	731	1.34
2007	674	1.23




DFG 1934-38 “a wonderful stream for spawning in normal winters having good natural propagation, containing beautiful pools, continuous shade and shelter “(LWQCB, 2007).
(Blackwood creek below project – 2011)
11/03/2011 13:05

Past Land Use

Sheep Grazing – 1880s-1960

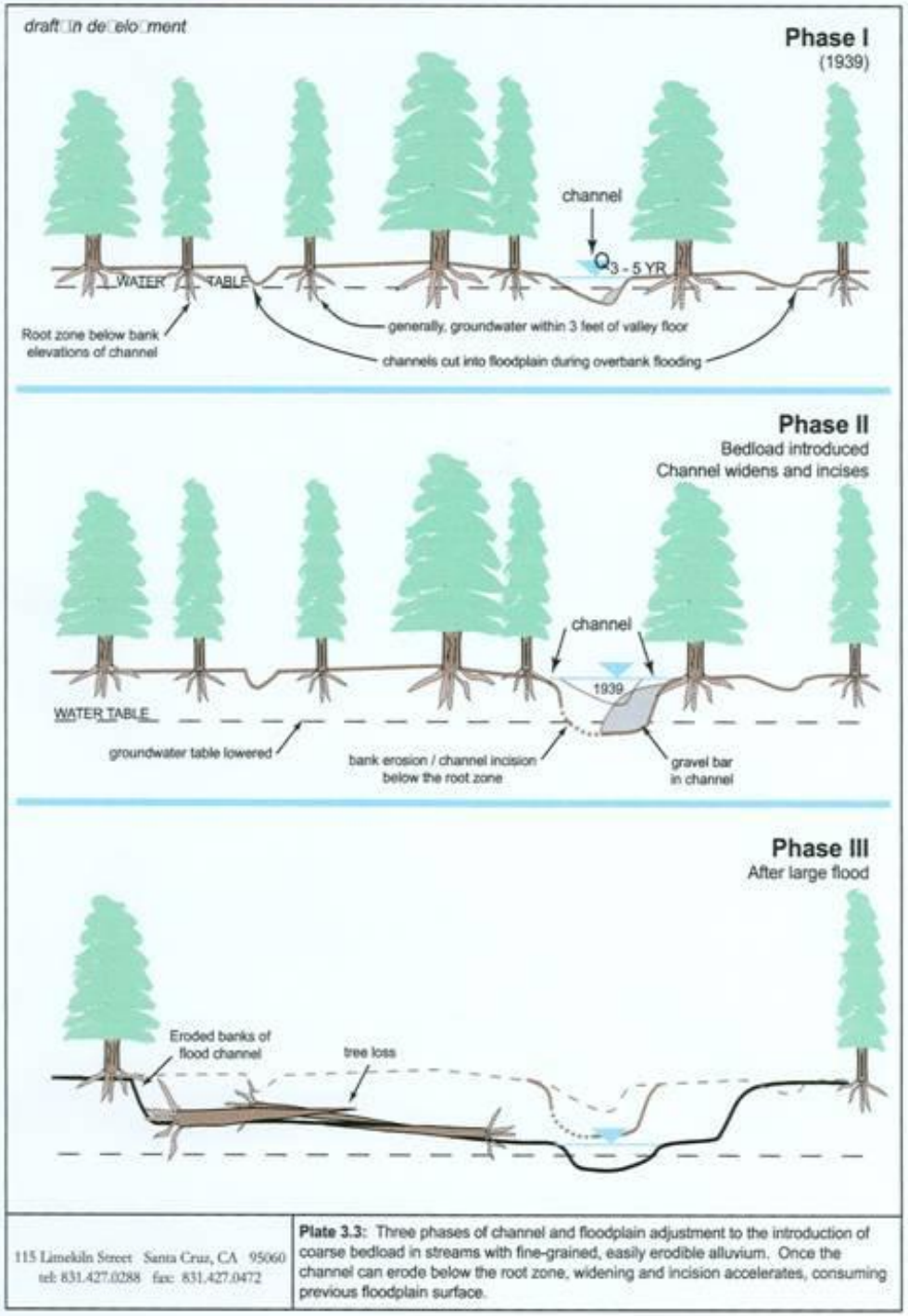
Comstock Logging – 1800s

Gravel Mining – 1960-1968

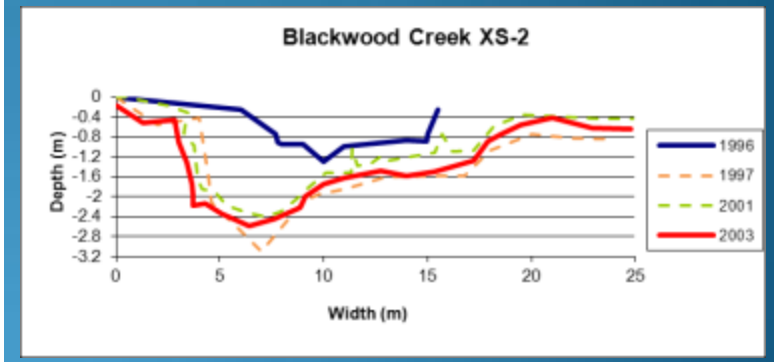
Mechanized Logging – 1950s & 1960s

Watershed Effects
Complex Sequence of Events:

- Increase in supply of bedload to reach below gravel mine
- Aggradation in channel, decreasing channel capacity
- Cutoff channels form across meanders
- Channel straightens and becomes steeper
- Steeper channel Incises
- Incision increases bedload for downstream reaches
- Destabilization then propagates downstream



Cumulative land use effects result in loss of channel -floodplain resiliency…



Stream eats itself and it floodplain

1969 Reach 6 Aerial Photo

Floodplain logging and influx of bed load

Year	Channel Length (m)	Sinuosity
1939	985	1.80
1969	894	1.63
1986	835	1.53
1995	777	1.42
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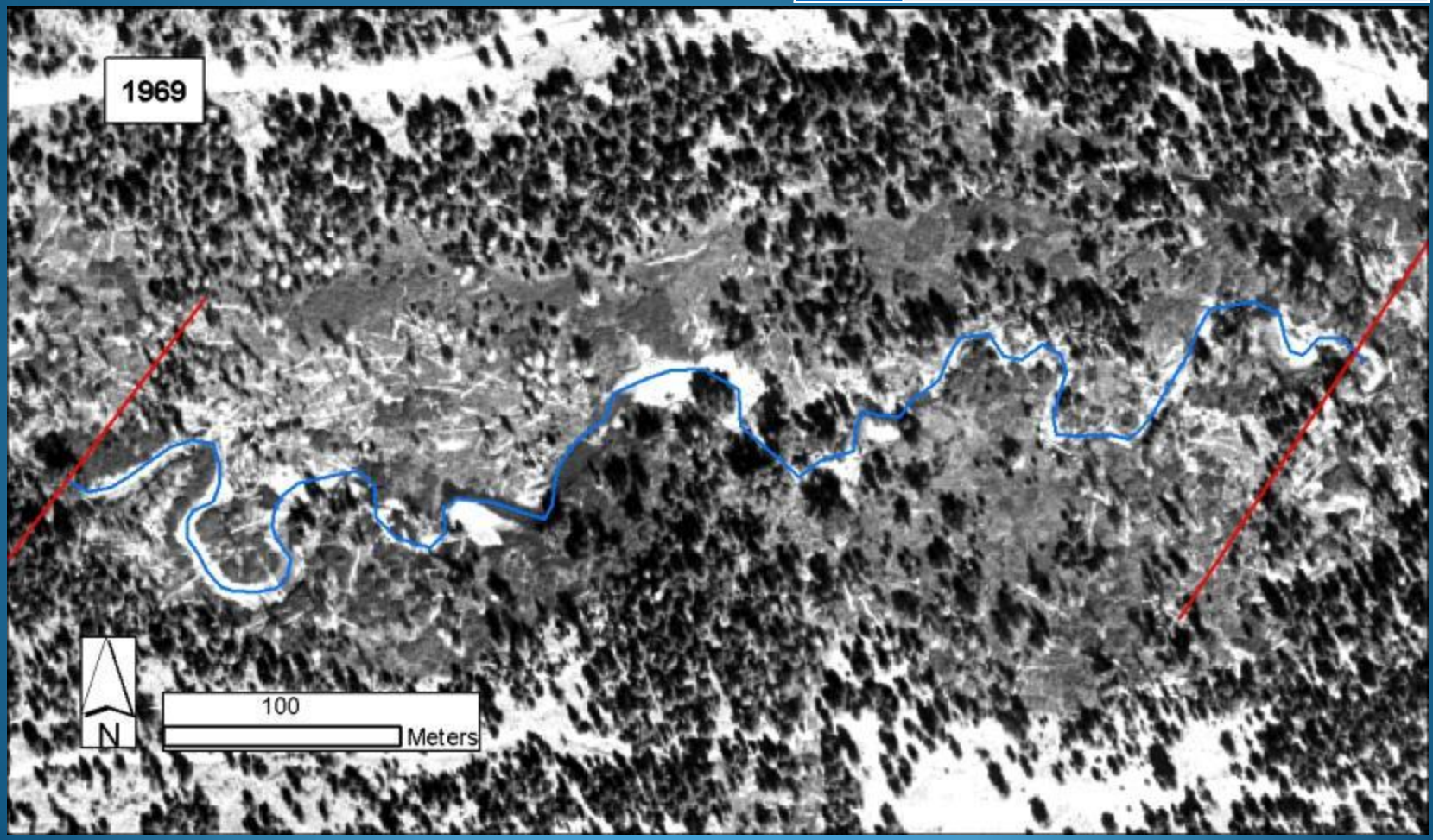

2001 Reach 6 Aerial Photo

Year	Channel Length (m)	Sinuosity
1939	985	1.80
1969	894	1.63
1986	835	1.53
1995	777	1.42
2001	731	1.34
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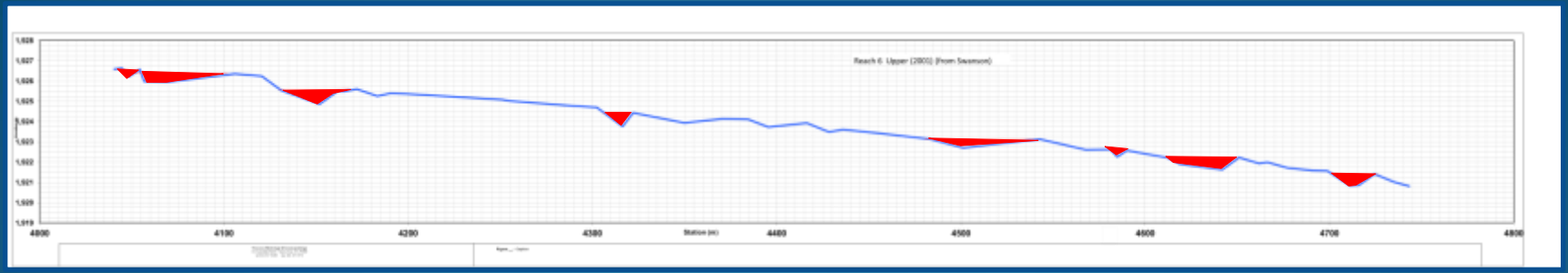
Blackwood Creek Reach 6 Aquatic Habitat Conditions 2001:

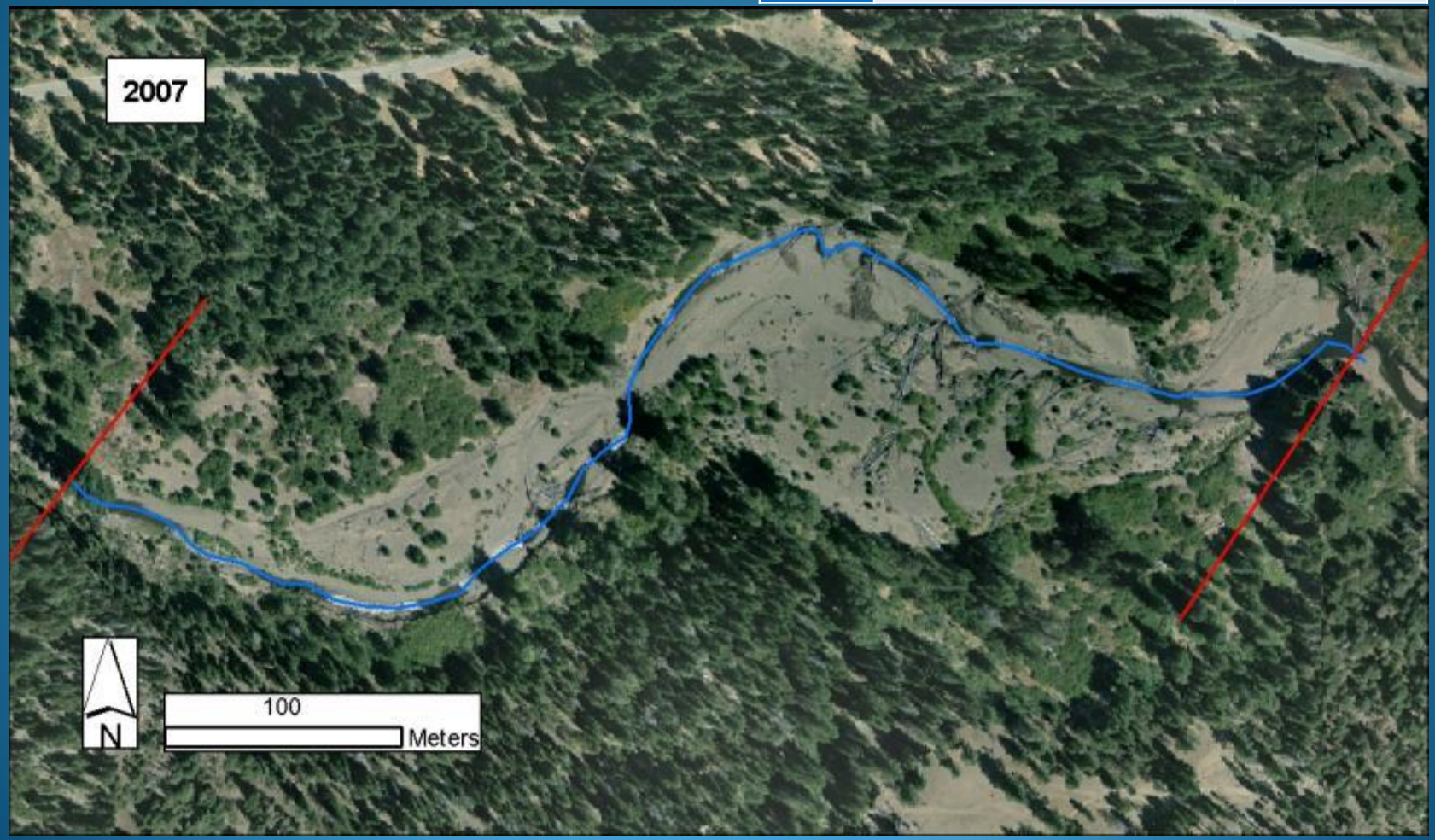


- 30 % stable banks (70 unstable) (2001)
- Pool / Riffle ratio = 0.54:1
- # of pools =8
- Median residual pool depth = 0.5m
- % riffle fines = 15% (2003)
- Stream Shade = 9%

2007 Reach 6 Aerial Photo

Year	Channel Length (m)	Sinuosity
1939	985	1.80
1969	894	1.63
1986	835	1.53
1995	777	1.42
2001	731	1.34
2007	674	1.23

Destabilization continues…



“ highly unstable with little evidence of the floodplain recovering from previous erosion “ – Swanson 2003

Post 12/31/05 flood. Photo taken 7/2006

Blackwood Creek Reach 6 Restoration Project Design Goals:

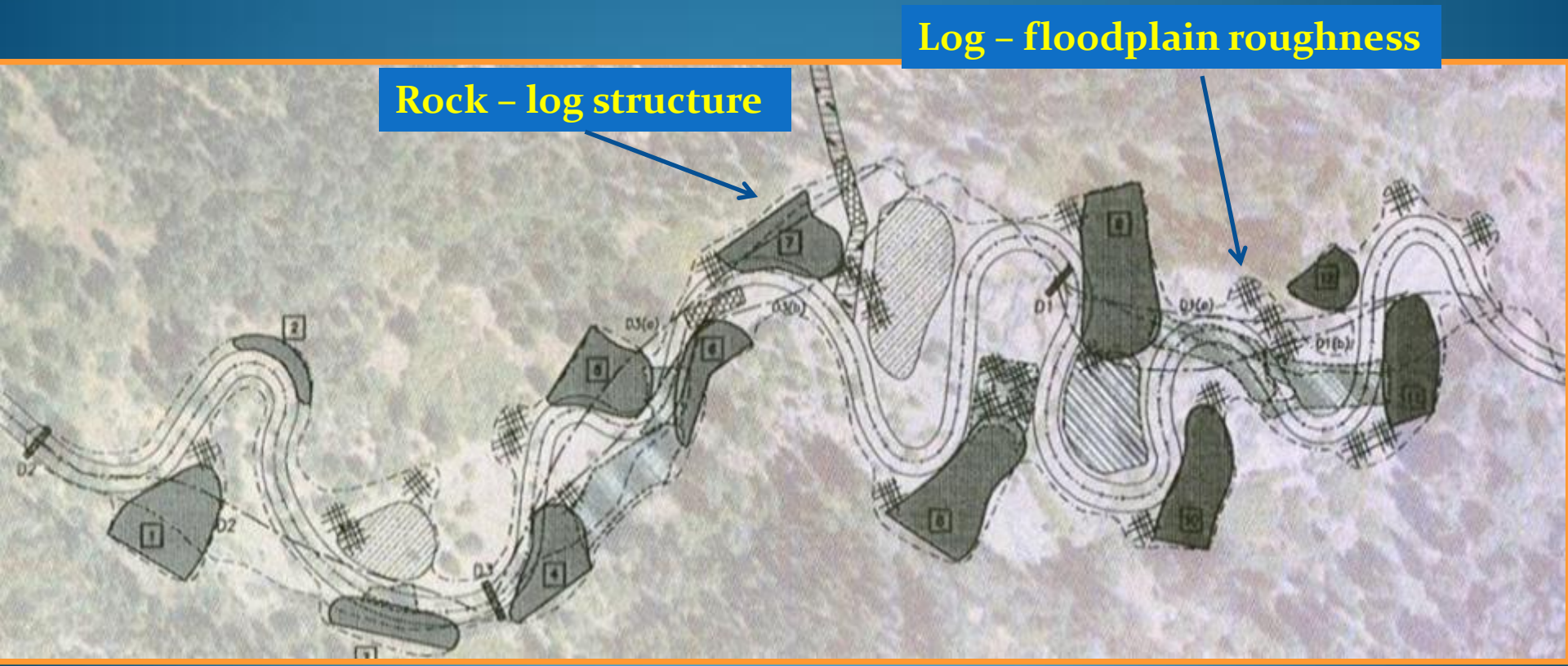
RESTORE RESILIENCY BY:

- Increase extent of flooding
- Decrease erosion by reducing shear stress of channel and floodplain
- Absorb surplus bedload and sediment moving through system, especially fines
- Allow the stream to rebuild its floodplain

Restoration Work in Reach 6

- Project constructed in 2008 and 2009
- Channel lengthened from 674 m to 1,090 m
- Design
  - New channel construction through Reach 6
  - Flow deflection structures of rock and logs
  - Incorporated floodplain depressions

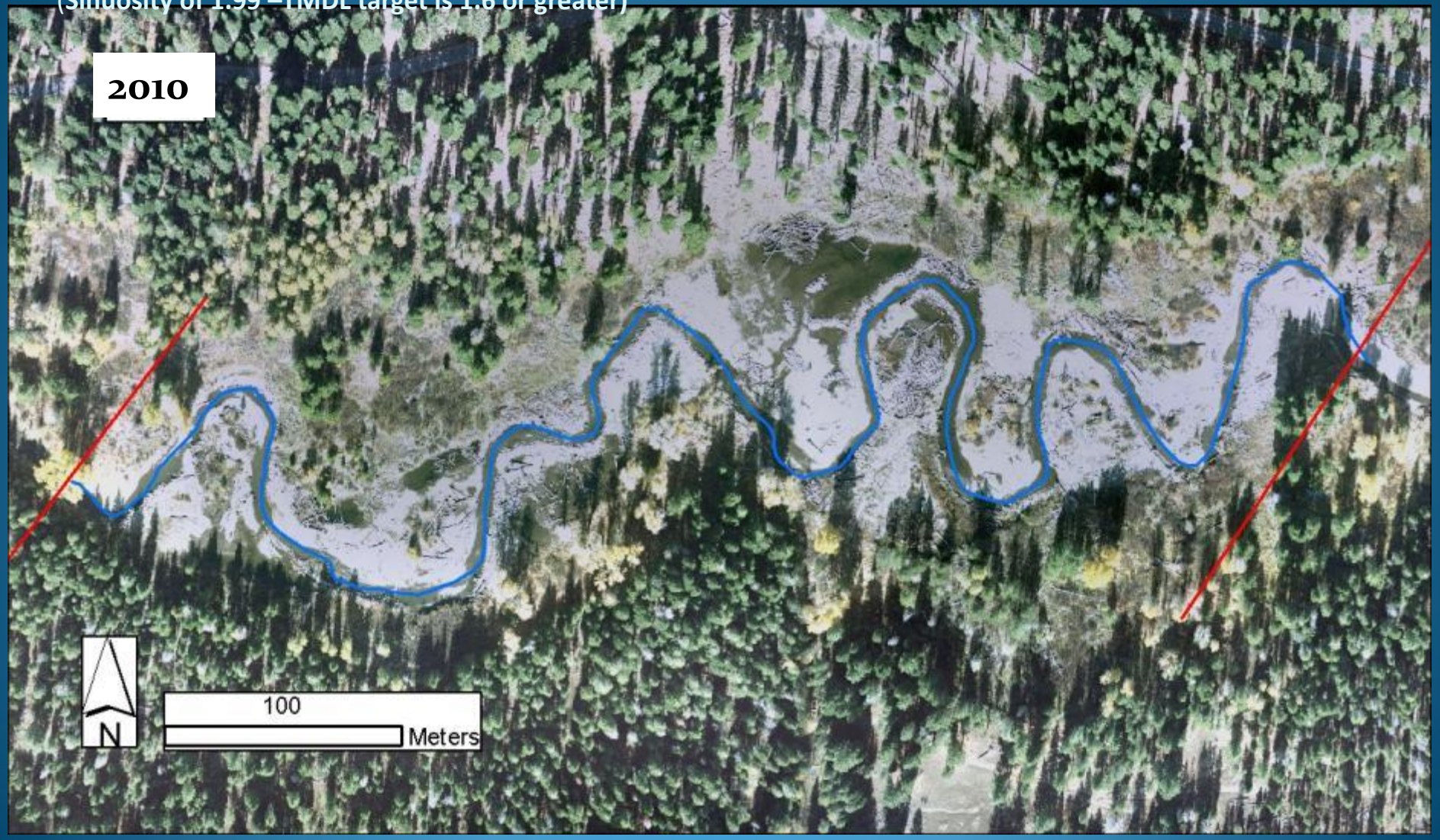
Blackwood Creek
Reach 6- Design Layout



Reach 6 – Implementation

Reach 6 Restoration Post-Project

(Sinuosity of 1.99 –TMDL target is 1.6 or greater)



Phase IIIA - Flood Response
Blackwood Creek takes over

2009 peak flow = 590

2010 peak flow = 440

2011 peak = 650-700

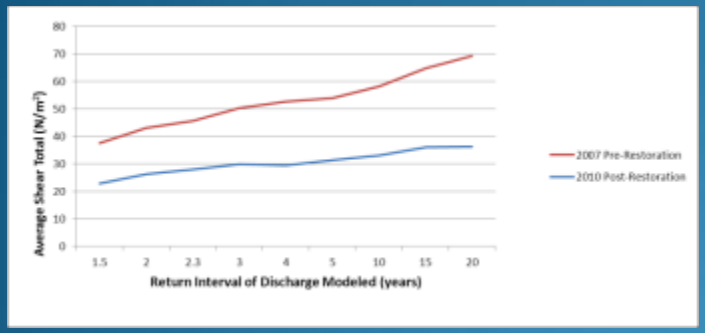
2012 peak =500

05-04-09

Results: Hydraulic Improvements

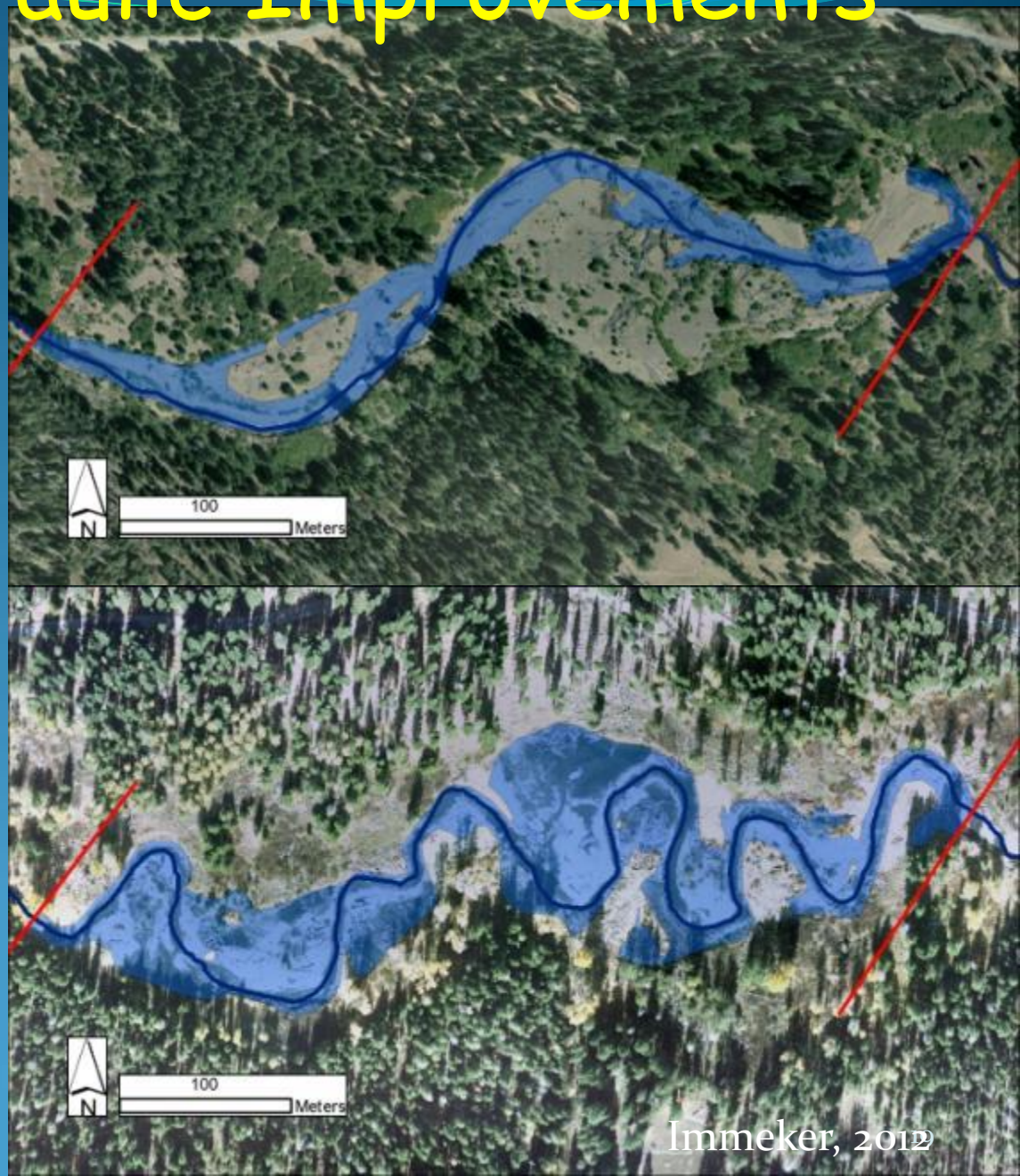
2 year return flow
of 10.7 m^3/s

Pre-Restoration
16,063 m^2



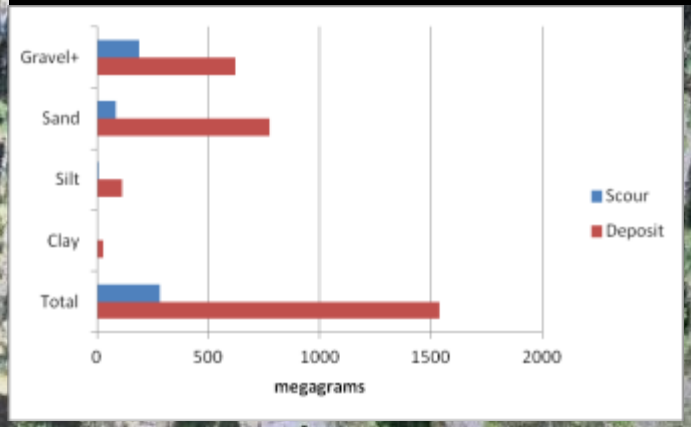
Post-Restoration
32,327 m^2

101% increase in flooded area extent
40-60% less total average shear stress

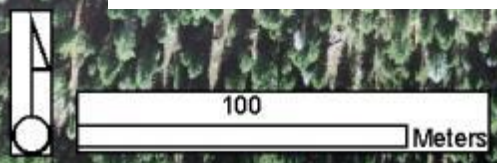


Immeker, 2012

Results: Sediment Mapping/Sampling



Pre project = - 61 tons fine sediment per eroded per year
Post project = + 142 tons of fine sediment retained



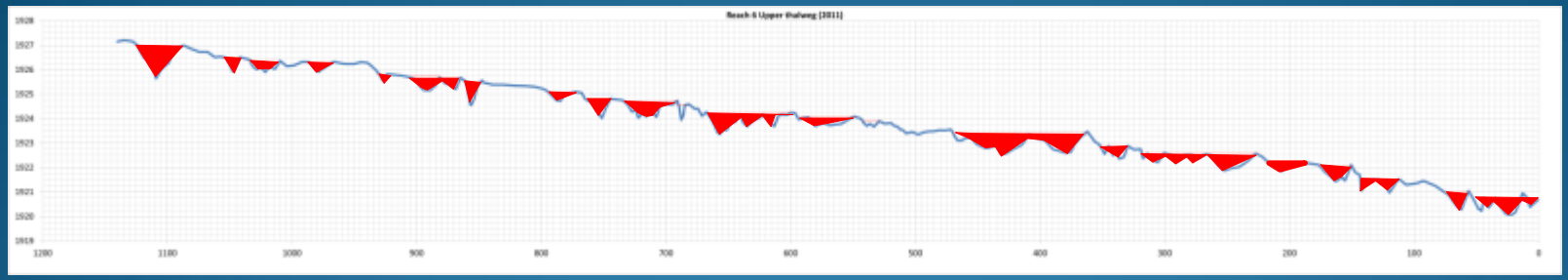
Immeker, 2012

Blackwood Creek Reach 6 Are We Achieving Restoration Project Design Goals?

- Increase extent of flooding - YES
- Decrease erosion by reducing shear stress of channel and floodplain - YES
- Absorb surplus bedload and sediment moving through system, especially fines - YES
- Allow the stream to rebuild its floodplain – YES

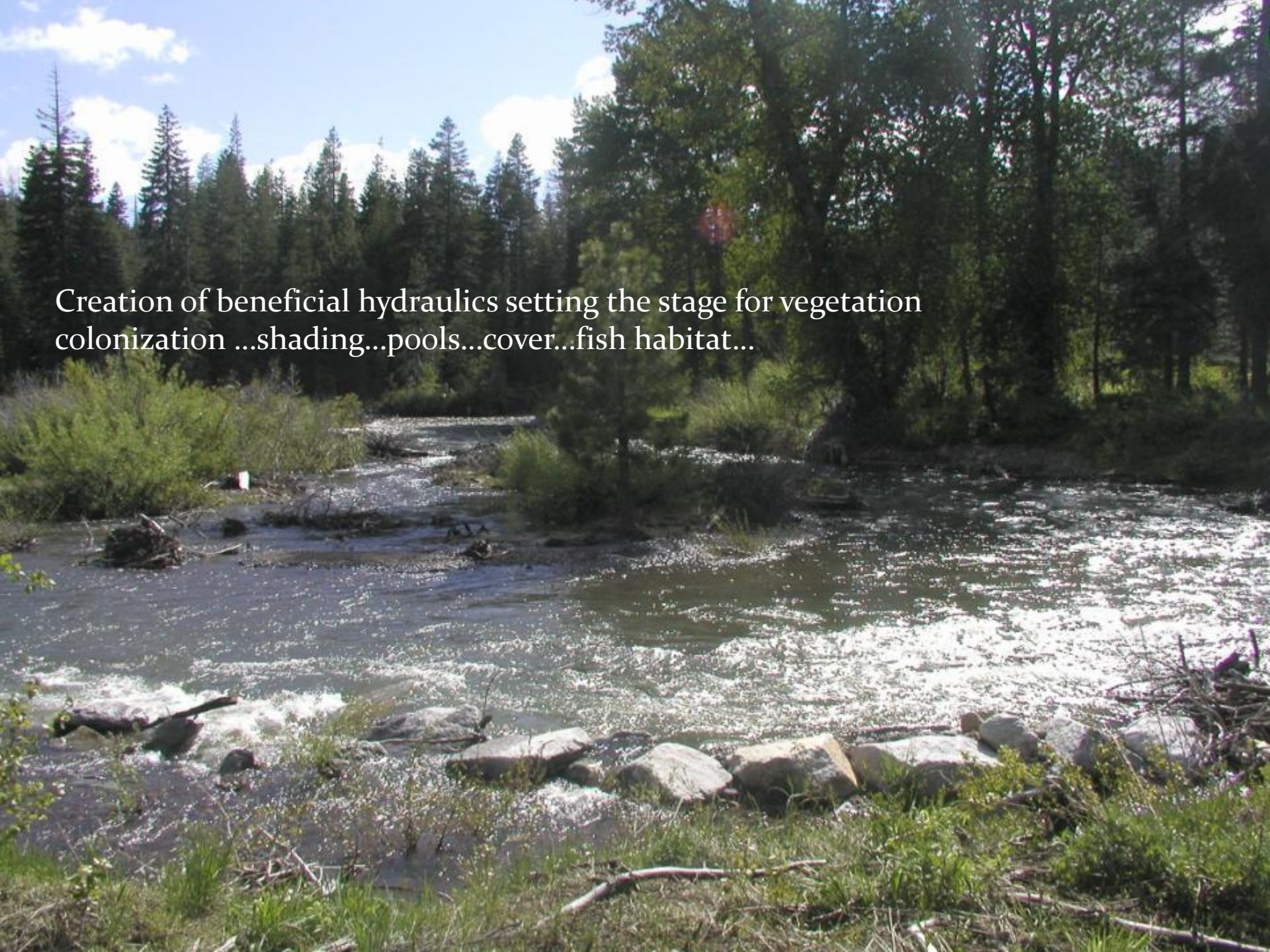
Its early but we are encouraged…

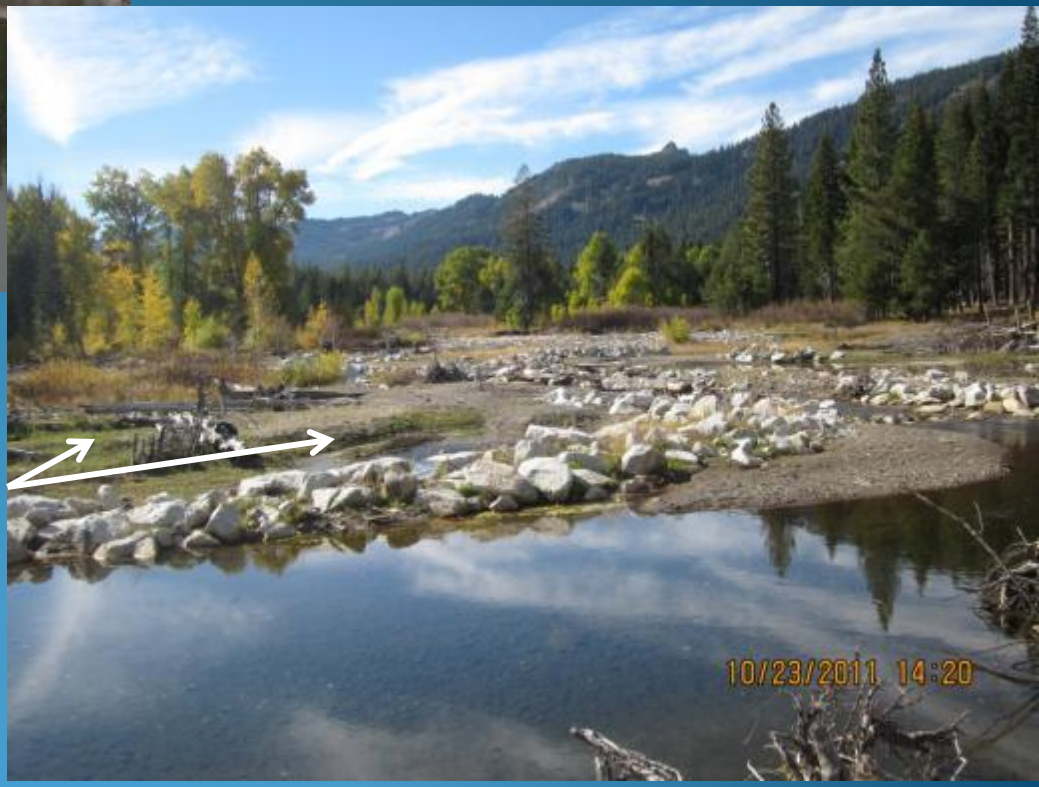
Blackwood Creek Reach 6 Aquatic Habitat Conditions 2001:



30” Rainbow trout near structure 7
Photo by Jeff Marsolais LTBMU 2012

- 95% stable banks
- Pool riffle ratio = 1.9:1
- # pools = 25
- Median pool depth = 0.6m
- 7% riffle fines
- % Shade = 5


Creation of beneficial hydraulics setting the stage for vegetation colonization …shading…pools…cover…fish habitat…



Riparian grasses colonizing
Fresh flood sediments
2011..the start

Questions ?