

Camp Sacramento Erosion Control Project – Five Years Later



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Outline

History of Project and Problem Statement

Construction Actions

Volunteer Activities

Sediment Control

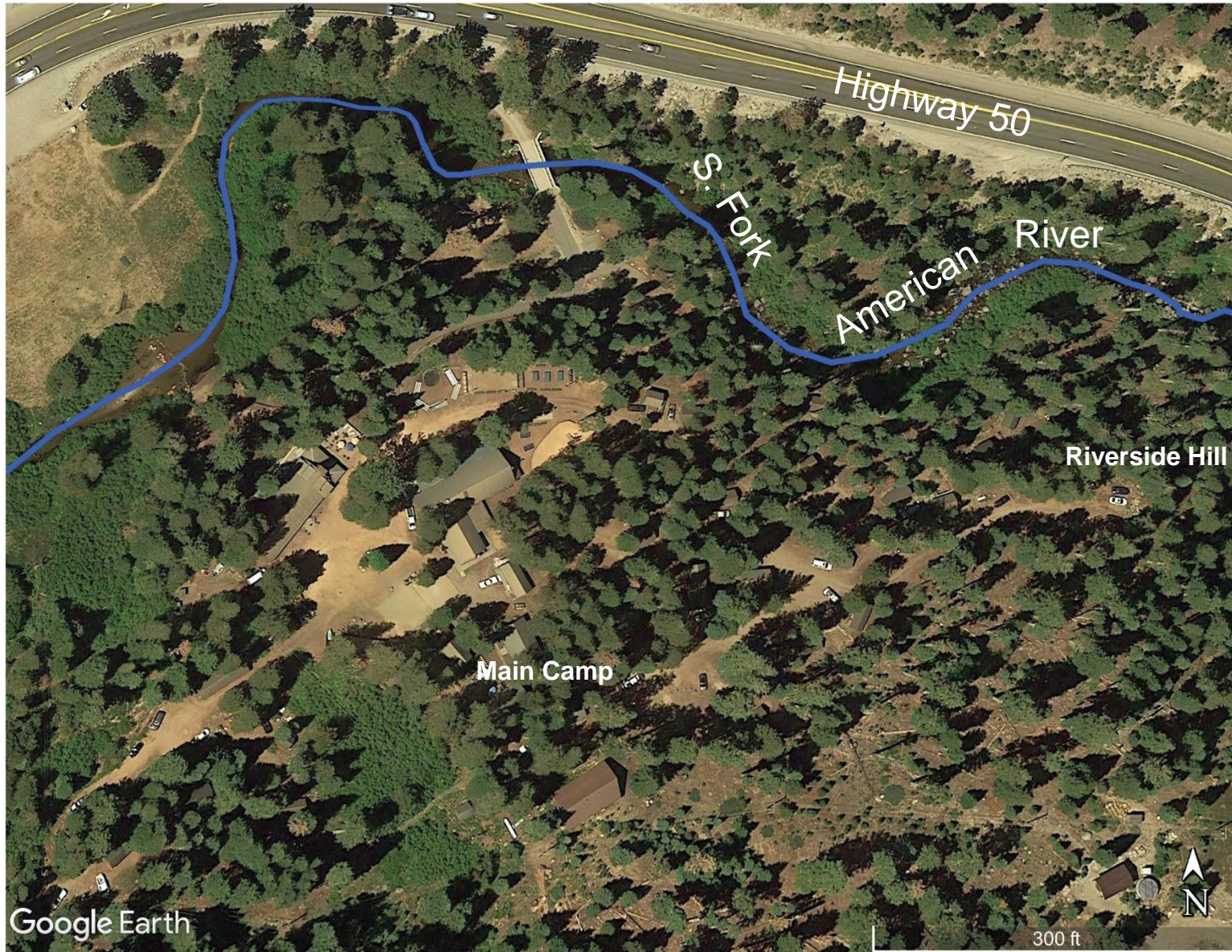
Photo Monitoring

Observations

Conclusions



Camp Layout



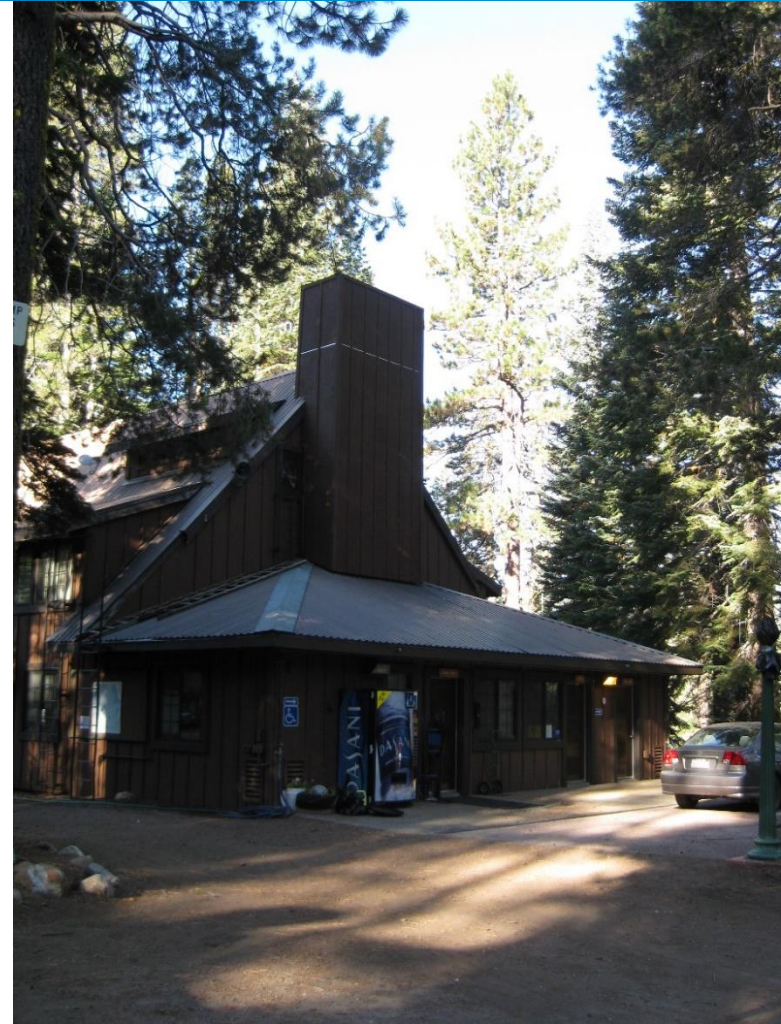
History and Problem Statement

What is Camp Sacramento?

- Family Camp at 6500' elevation
- Open June through September
- Snow present from November to May

Problem Statement

- Granite rocks were “growing”
- Visual evidence of soil loss and soil accumulation
- Sediment ended up in South Fork American River (SOFAR)
- Common problem throughout the Sierras
- Solutions to problem must be compatible with recreation use



History and Problem Statement

Problem Areas

- Riverside Hill
- Roads
- Parking areas
- Volunteer trails



Construction Actions

Erosion Control Master Plan

- Completed in 2011
- Grant-funded by SNC

Phase I Project (near SOFAR)

- Constructed basins
 - Lover's Leap detention basin
 - Archery detention Basin



Basin Details

- Archery Basin outflows to floodplain
- 1.0' and 2.5' of dead storage in Lover's Leap and Archery basins

Construction Actions

Durable Surface Roadway

- Paved steep road section
- Previous site of erosion and sediment movement
- Culvert under road connects two basins



Note:

- Remaining roads in Camp are unpaved
- Trail system is unpaved

Volunteer Activities

Volunteer Activities

- Build rock slope protection
- Build rock-lined channel to connect camp with constructed facilities



Volunteer Activities

Volunteer Activities

- Basins and control berms created in fall to capture winter runoff
- Taken down in spring
- Hydroseed test section in 2013



Erosion Control Design Approach

Design Approach

- Follow Lake Tahoe Approach:
 - Source Control
 - Hydrologic Design
 - Treatment



Runoff Treatment

Treatment Methodology

- Passive treatment (uncontrolled basins)
- Soil berms across roads break up sheet flow and control the runoff direction
- Upslope basins (in camp) lead to Constructed (Phase 1) basins
- Any outflow from Archery Basin goes to SOFAR floodplain
- Terrain barriers in floodplain prevent direct connection with river until high flood stage
- Entire system of berms and basins forms a treatment train



Treatment Train System

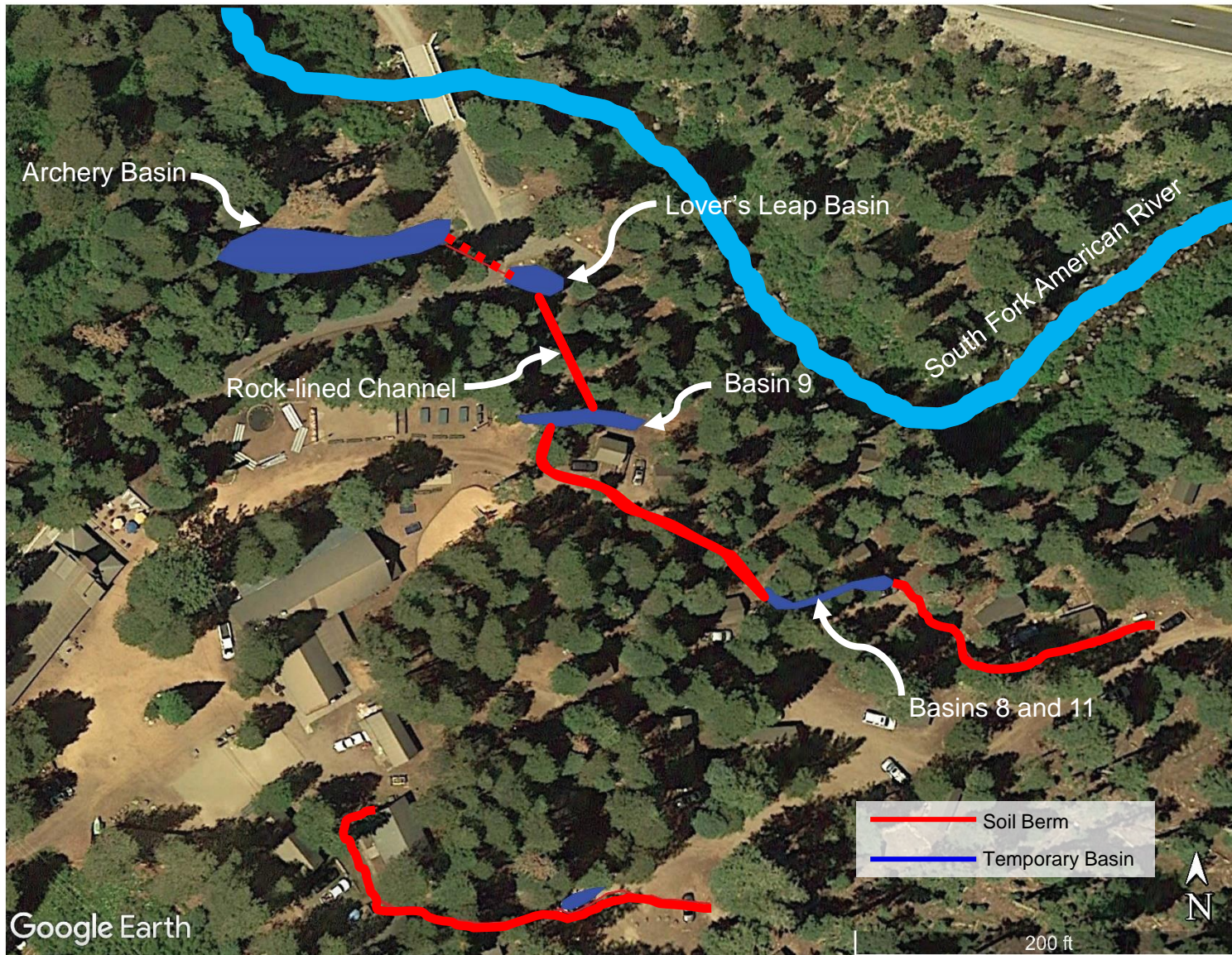


Photo Monitoring

Typical Year

- First flush
- Spring snowmelt
- Major storm

Wet Year

- Long duration high intensity storm
- Back-to-back storms



Photo Monitoring

- Typically fall, spring
- Rainstorm of 10/30/16
- Spring snowmelt 2017

Measurements

- Taken Spring 2017

Hydrology

Fall 2016

- Multiple storms starting in October
- Back-to-back 2-yr to 5-yr storms
- Basins filled with water and sediment
- Wash off of detached summertime road sediment

Winter 2017

- Heavy snow starting in November 2016
- Some rain-on snow events but mostly snowfall

Spring 2017

- Snow fell through May
- Several rainfall events in May/June

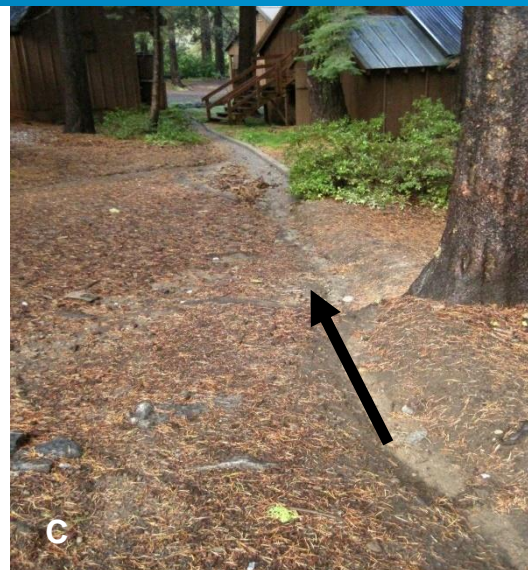
Basin Response

- Archery and Lover's Leap basins with water on 10/30/16 and empty on 11/2/16
- Archery Basin filled with water on 6/9/17 and near empty next day

Riverside Treatment Train



Main Treatment Train



Treatment Train-Lover's Leap Basin



Treatment Train – Archery Basin



Treatment Train – Archery Basin Outflow

Outflow Conditions

- Outflow to outer edge of floodplain
- Dense tree cover with extensive forest litter
- Flow paths are shown by disturbed litter
- No direct connection with SOFAR



Treatment Train – Archery Basin



Observations

Overflow from Archery Basin

- Multiple fill/spill of constructed basins with limited outflow
- Outflow carried very little sediment that dropped out before the river
- Archery Basin was a detention/retention basin. Water primarily left via infiltration. (2.5' dead storage)
- Outflow now going to river via subsurface rather than overland

Lodge Overflow

- Flow from Main Treatment Train caused by blocked culvert
- Flowed downhill below lodge to outer edge of floodplain
- Overflow ceased after culvert cleared

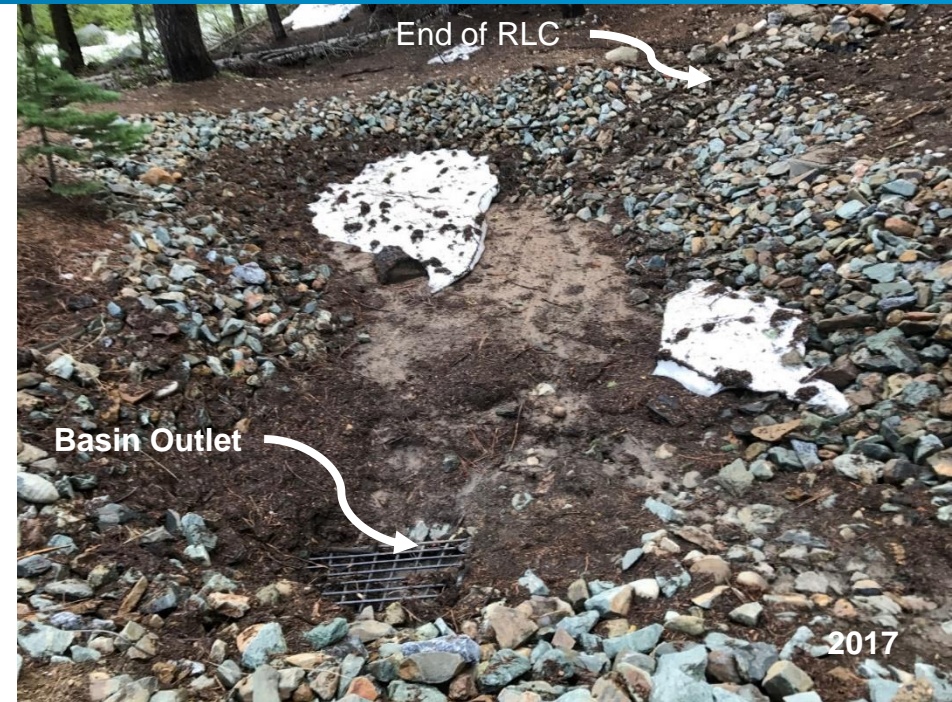
Temporary Basin Storage

- Temporary basins filled with sediment after first flush
- Disturbed ground yielded majority of sediment
- Soil type indicated source

Collected Sediment-Lover's Leap Basin

Storage Conditions

- Limited stored sediment for first 4 years
- Organic matter collected on the road found in basin
- Sediment filled the dead storage extending above the outlet invert



Note: Photos taken from opposite ends of basin

Collected Sediment-Archery Basin

Storage Conditions

- No stored sediment for first 4 years
- Organic matter from Lover's Leap Basin
- Evidence of overflow at outlet weir for several rainfall events



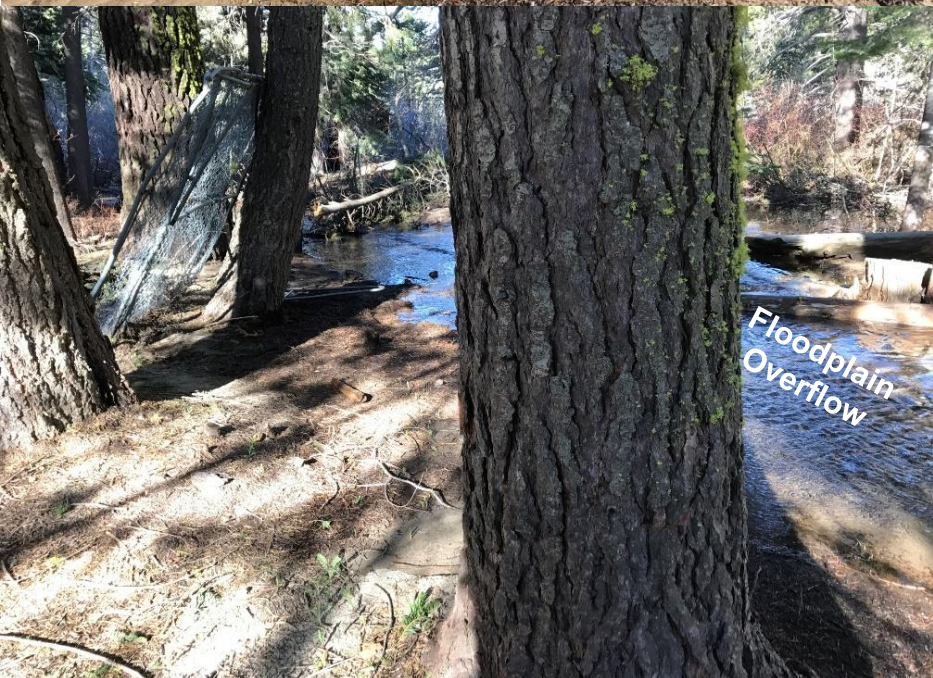
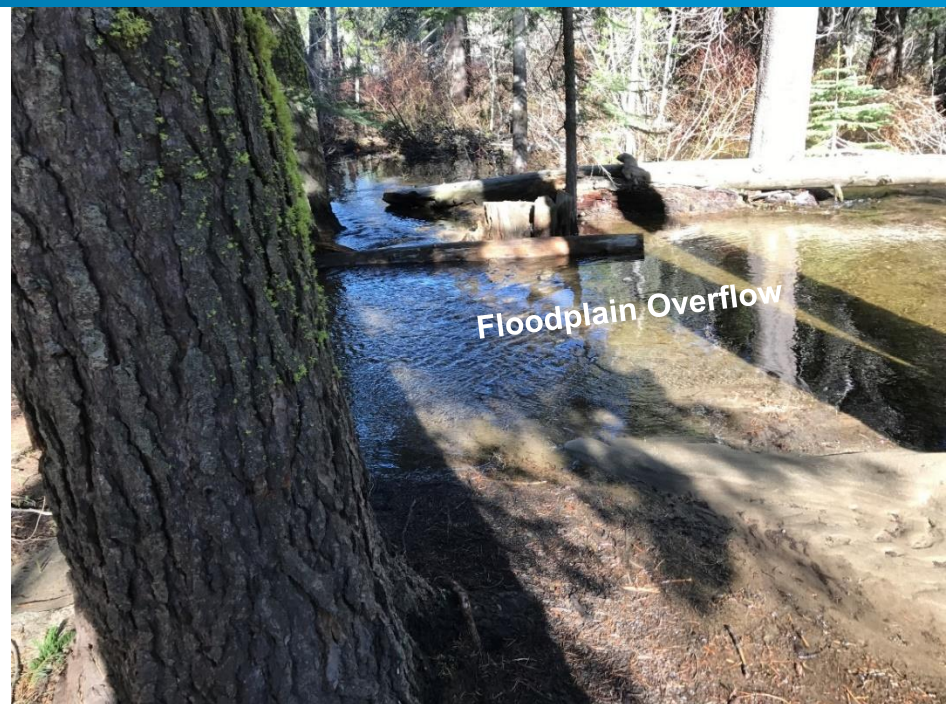
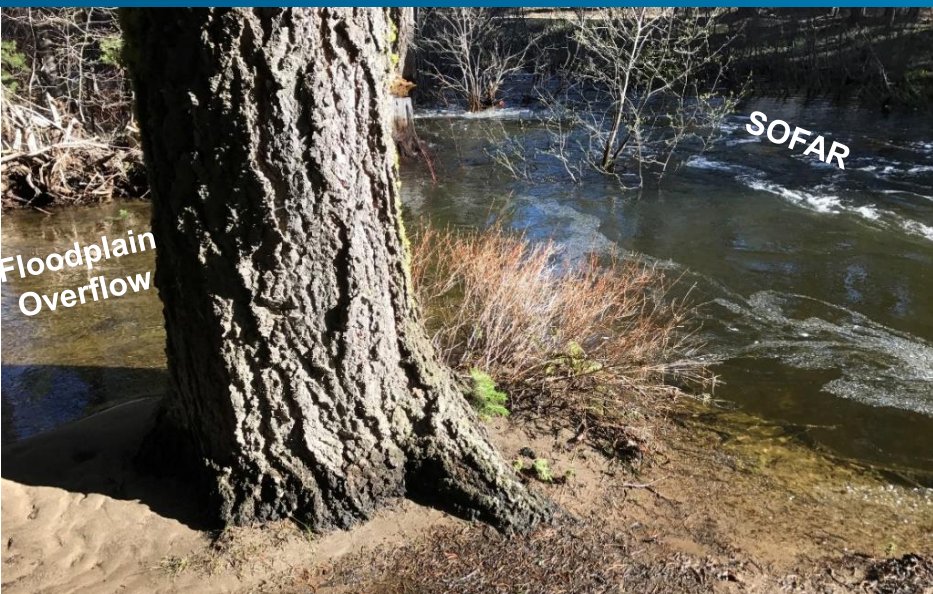
New Sediment – June 9 Storm

Sediment Capture

- Runoff-generating rainstorm
- Snow removal operations disturbed soil in camp
- Runoff was clear during snowmelt but turbid during rainstorm



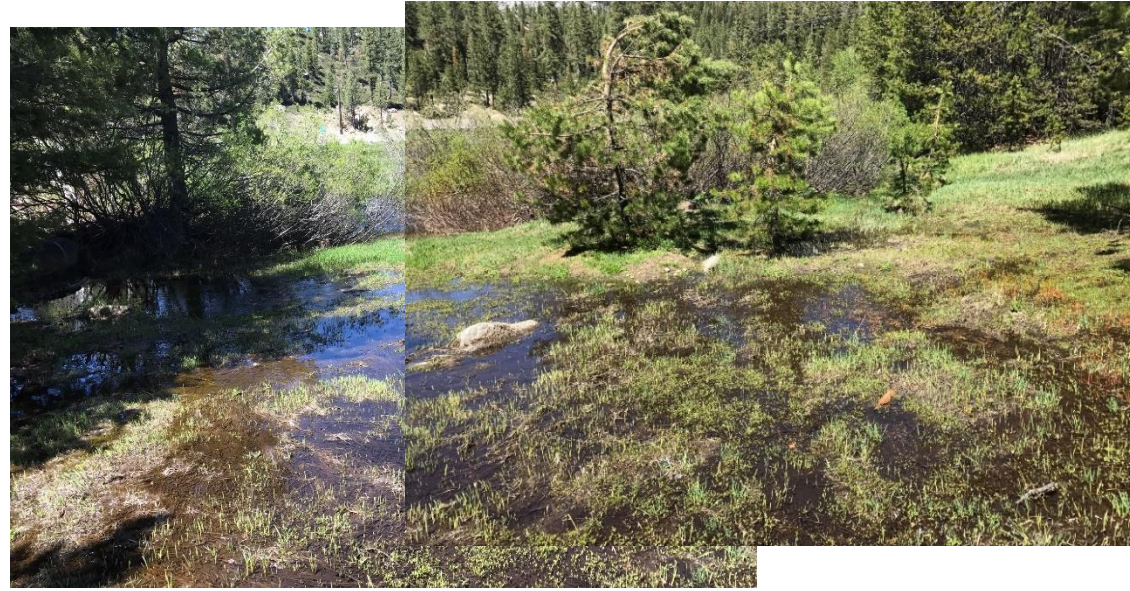
Floodplain



Floodplain



Floodplain – Meadow Flooding



Floodplain



Conclusions

Source Control

- Essential for controlling sediment – revegetation
- Spring snowmelt is clear, sediment free
- First flush rainfall storm produces most sediment
- Sediment loss doesn't end with first flush

Hydrologic Control

- Divert runoff with a controlled berm to a basin
- Break up flow whenever possible

Treatment

- Basins serve several purposes:
 - Trap sediment
 - Partial offset of hydromodification (storage and flow path)
 - Infiltrate runoff in both temporary basins and Constructed Basins

Conclusions

Problems Corrected

- Riverside Hill no longer receiving upslope runoff
- Reduced direct runoff of water and sediment to river

Measurements

- Taken spring 2017
- Estimated basin sediment loads
 - Archery: 156 ft³
 - Lover's Leap: 191 ft³
 - Basin 9: 80 ft³
 - Basin 8: 60 ft³
 - Basin 11: 105 ft³
- Net effect: 7/16 inches of soil loss on camp roads/parking (east side)
- Soil loss is occurring even without noticeable signs
- Develop a monitoring program

Recommendations

Recommendations

- Finish the ECMP
- Need full control of runoff including main camp area
- Replace pre-ECMP undersized culverts
- Replace roads with durable surface
- Designate and improve trails, remove volunteer trails
- Add dripline trenches at cabins wherever possible
- Add monitoring for:
 - Rainfall
 - Water storage in Constructed Basins