

A scenic view of a forest with tall pine trees and snow-covered ground under a blue sky. The foreground shows snow patches and green shrubs. The background features a dense forest of tall pine trees and distant mountains under a clear blue sky.

Water Erosion Prediction Project (WEPP) and Forest Treatments on Steep Slopes within the Tahoe Basin

Forest Health and Wildfire Committee July 2021

Agenda

- History and Background: Lake Tahoe West
 - Kat McIntyre, Ph.D.
- Introduction to WEPP Model and Preliminary Results and Implications for Lake Tahoe basin
 - Jonathan Long, Ph.D.
 - Mariana Dobre, Ph.D.
- Next Steps
 - Kat McIntyre, Ph.D.
- Questions

Lake Tahoe West: Background

- Collaboration amongst 3 lead agencies focusing on cross-jurisdictional, holistic restoration of the west shore.
- Stakeholder and science engagement
- Landscape Resilience Assessment
 - Completed 2017
- Landscape Restoration Strategy
 - Completed 2019



Current: Focused, but fragmented, restoration



Vision: Coordinated, contiguous restoration

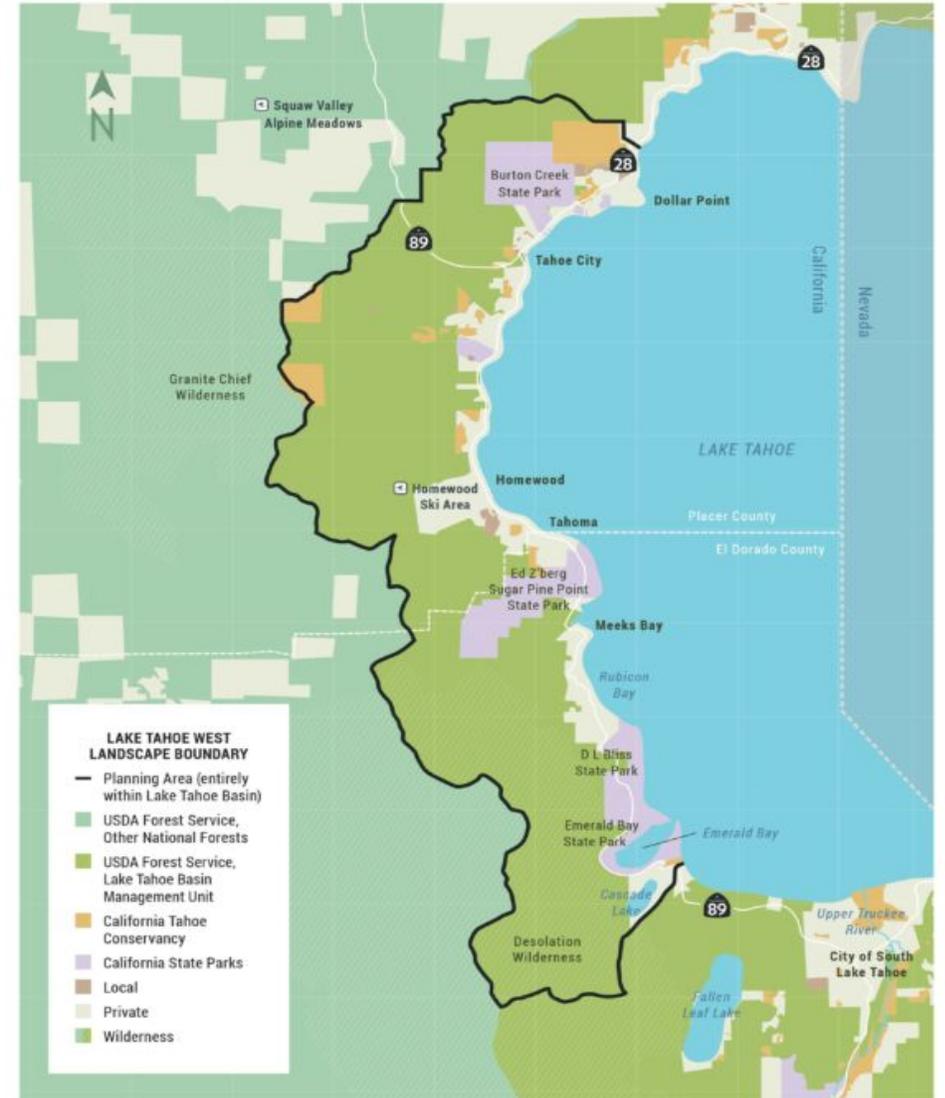
Healthy forests and watersheds
with coordinated agency effort



LAKE TAHOE

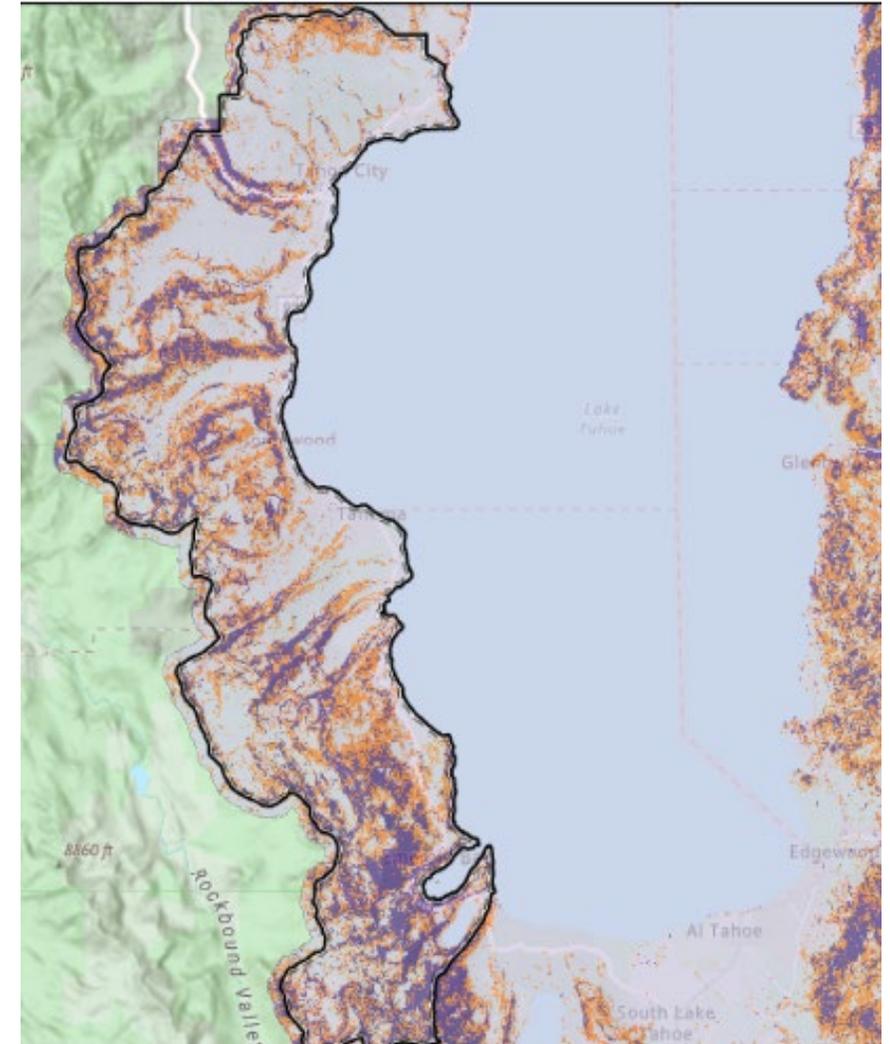
Lake Tahoe West: Background

- Approximately 60,000 acres
- Cross-jurisdictional
- Forest thinning, Rx burning, watershed and stream restoration activities, biomass utilization



Environmental Goals: Lake Tahoe West

- Historically, forest treatments have focused on treating the WUI.
- LTW expands upon these treatments and focuses on cross-jurisdictional restoration in the general forest.
- Areas of 30-50% slope within LTW and the Basin would benefit from treatments.
 - Efficiencies: financial and ecological



The Emergency California-Nevada Tahoe Basin Fire Commission Report

Recommendation 17 *Simplifying Regulations*

The Governors should direct regulatory and implementing agencies in the Lake Tahoe Basin to simplify the existing system for permitting fuel reduction projects. Steps that should be taken to reduce or eliminate complexity, confusion, and redundancy shall include:

- J. The Commission recommends the TRPA, the LRWQCB, USDA Forest Service, and other affected agencies amend their plan and ordinances to allow equipment use on slopes greater than 30% based on *current* and *future* technology, and current forest practices to ensure resource protection.

2016: Emerald Fire Treatment Effectiveness



2007: Angora Fire Treatment Effectiveness



(A) Treated



(B) Untreated

“Our results show that fuel treatments generally performed as designed and substantially changed fire behavior and subsequent fire effects to forest vegetation. Exceptions include two treatment units where slope steepness led to lower levels of fuels removal due to local standards for erosion prevention. Hand-piled fuels in one of these two units had also not yet been burned.” Safford et al., 2009

Engaging Scientists on Analysis

- Keeping in mind the restoration goals under LTW, it is important to explore the environmental aspects of treatments on steep slopes (slopes 30-50%).
- Engaged science partners to assess erosion effects of a variety of restoration treatments on hillslopes and soil types within the LTW landscape and across the Lake Tahoe basin.



Analyzing erosion risks on 30-50% slopes in the Lake Tahoe Basin

Joint research by the University of Idaho and Pacific Southwest Research Station



Mariana Dobre¹, Jonathan Long²

¹ University of Idaho, Department of Soil and Water Systems

² USDA Forest Service

Main Question

Should we expect water quality impacts from allowing ground-based mechanical treatments on 30-50% slopes in the Lake Tahoe Basin?



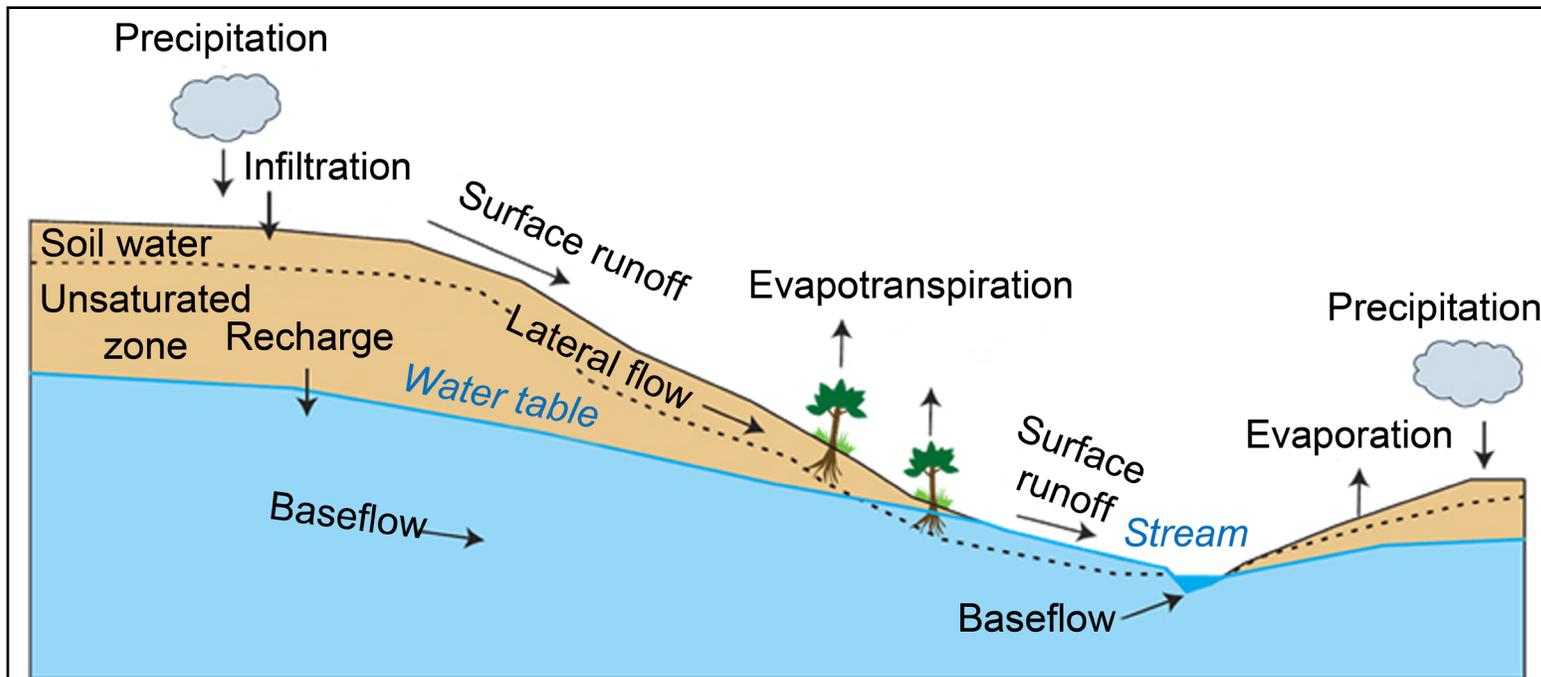
Applied a basin-scale hydrologic model (WEPP)
and supplemental statistical analyses



Water Erosion Prediction Project (WEPP) model

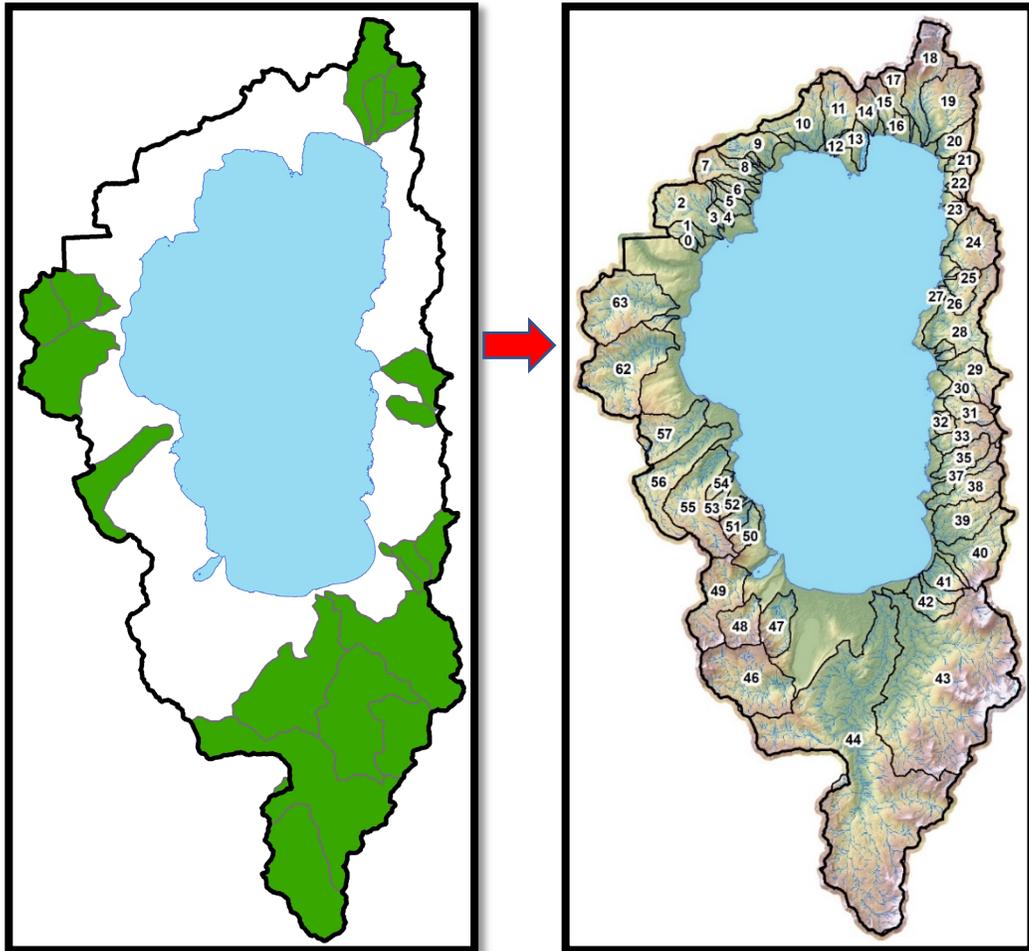
- Hydrologic model developed in the 1980s to assess the effects of management on soil erosion
- Simulates harvest, wildfire, thinning, Rx burning, mulching
- Multiple research over the past 14 years to calibrate, validate, and customize the model for use in the Lake Tahoe Basin

- Based on free national data of topography, soils, land cover
- Uses Tahoe-specific management files developed in past previous studies
- Estimates **runoff**, **erosion (including very fine particles)** and **phosphorus** within hillslopes



WEPP model calibration

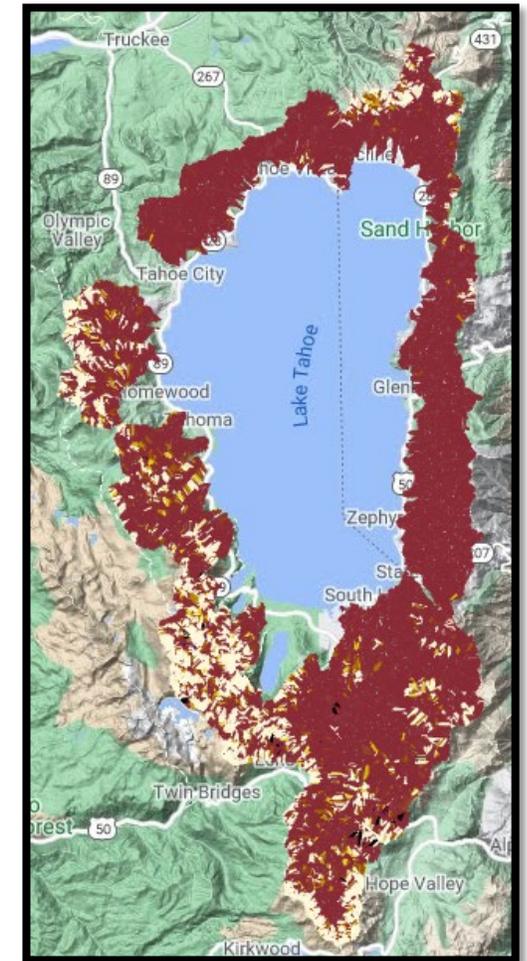
Calibrated model at 18 watersheds and applied calibrating parameters to the rest of the Lake Tahoe Basin



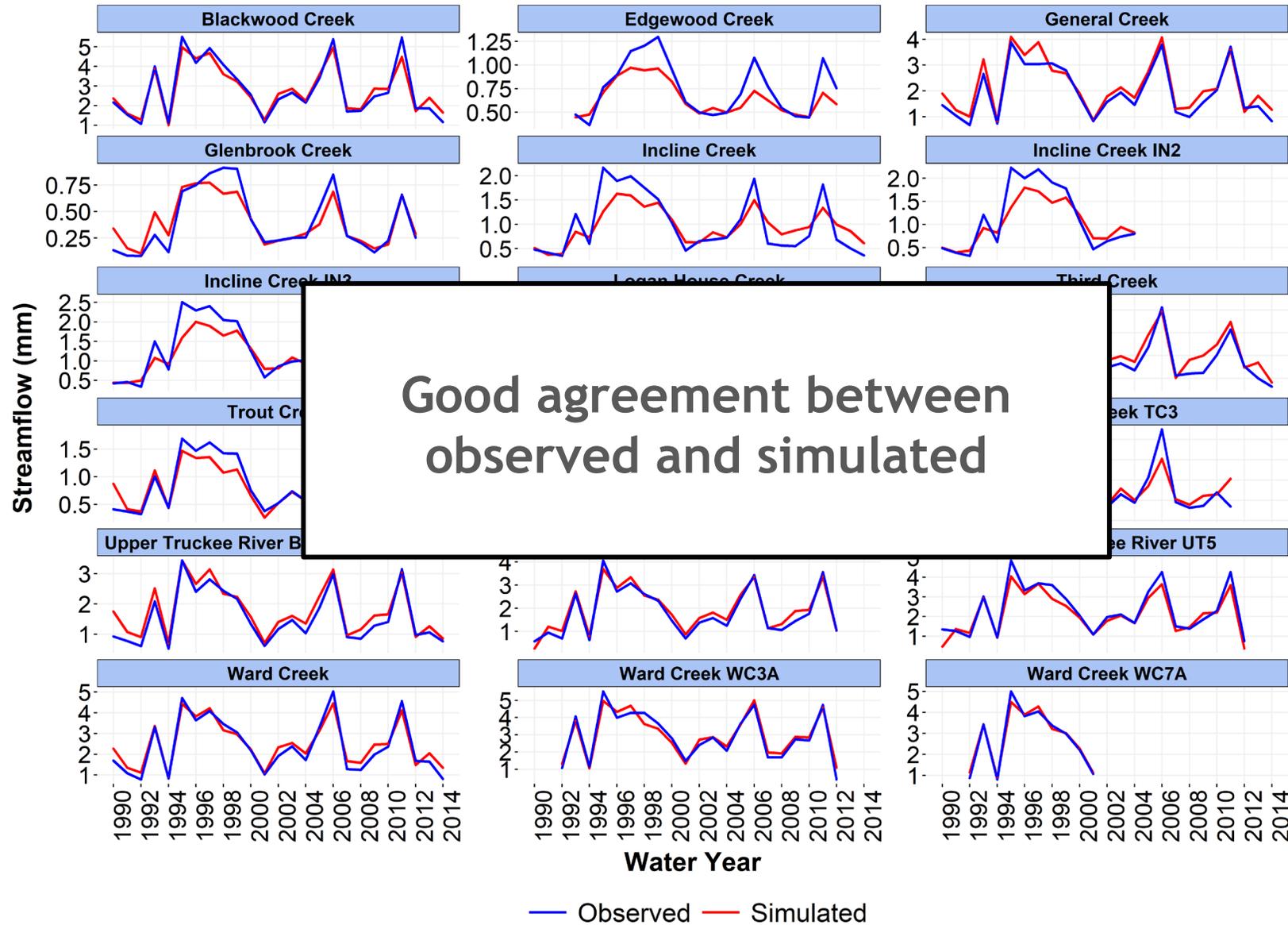
WEPPcloud interface

Runoff

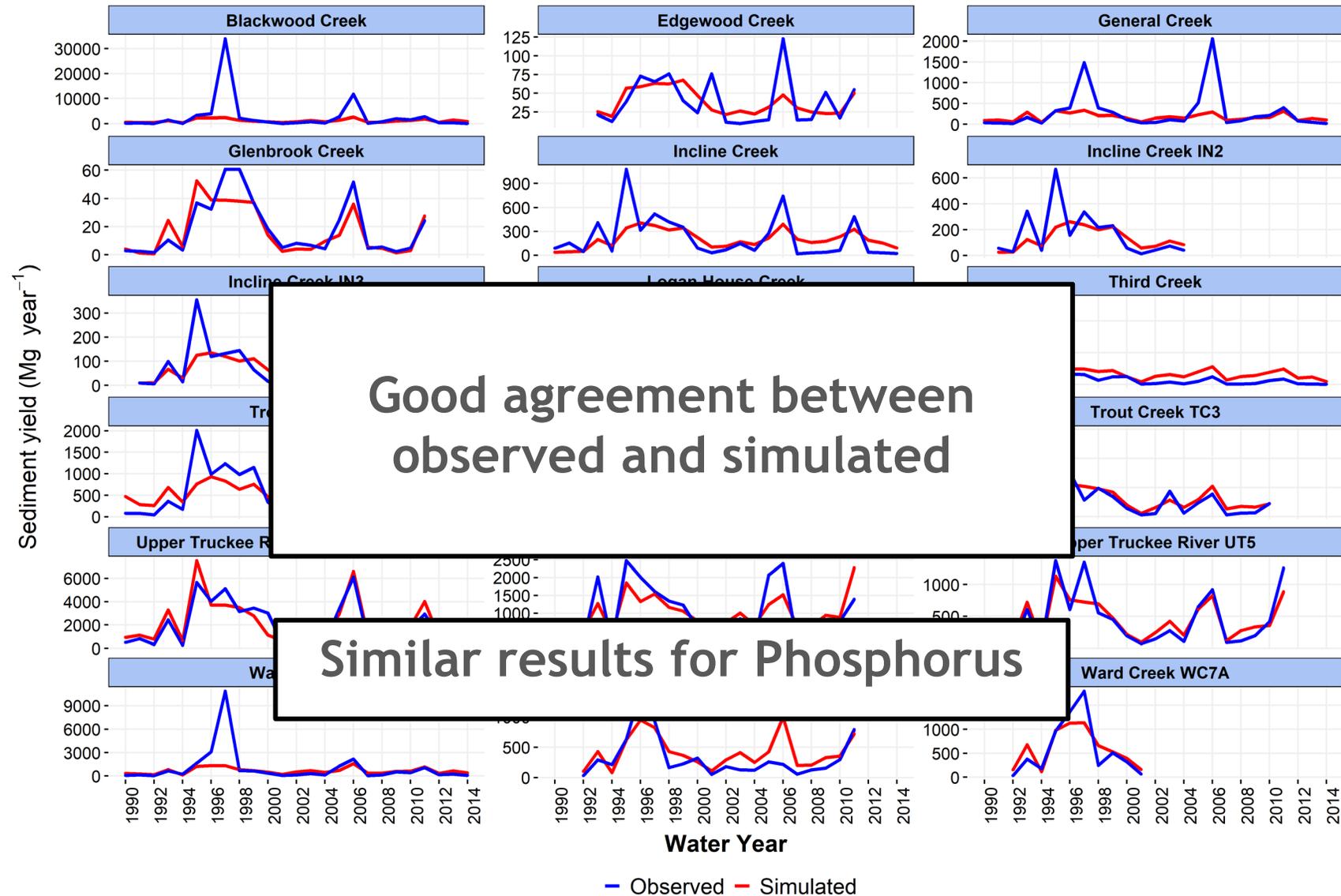
Erosion



Undisturbed model results (streamflow)



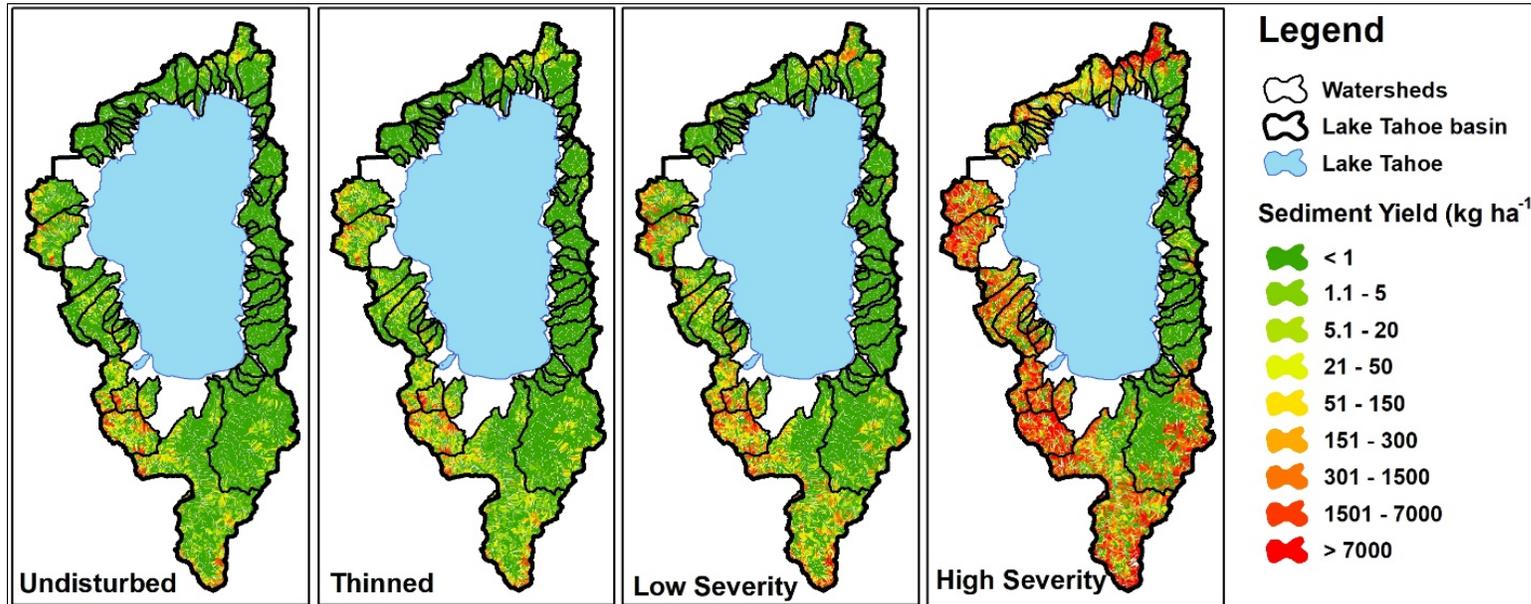
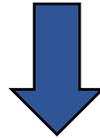
Undisturbed model results (sediment)



Changed key soil and management parameters to simulate several conditions

Ground Cover (%)			
Undisturbed	Thinning	Low severity	High severity
100	85, 93, 96	80	30

+1 moderate severity fire (50%) and three additional wildfire conditions



*Example of post-treatment forest floor residual ground cover (after a prescribed burn) in mixed conifer forest fuels similar to those found in the Lake Tahoe Basin.
Harrison et al., 2016*

Post-modeling data analyses

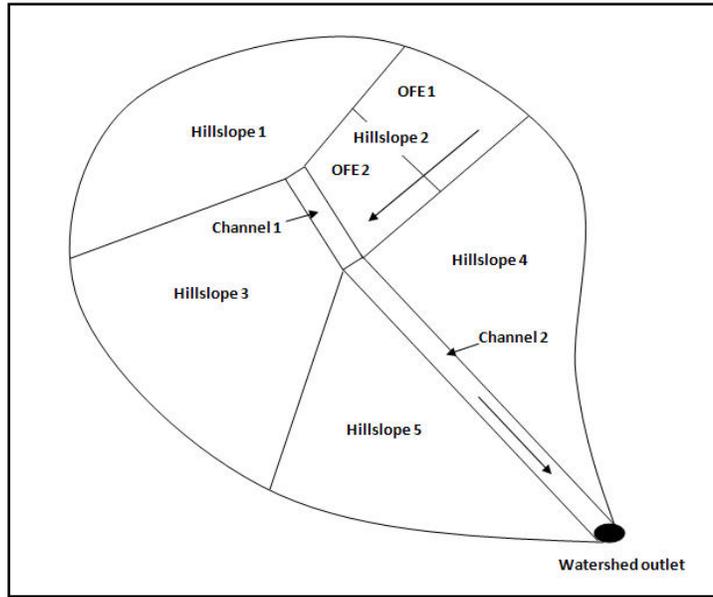
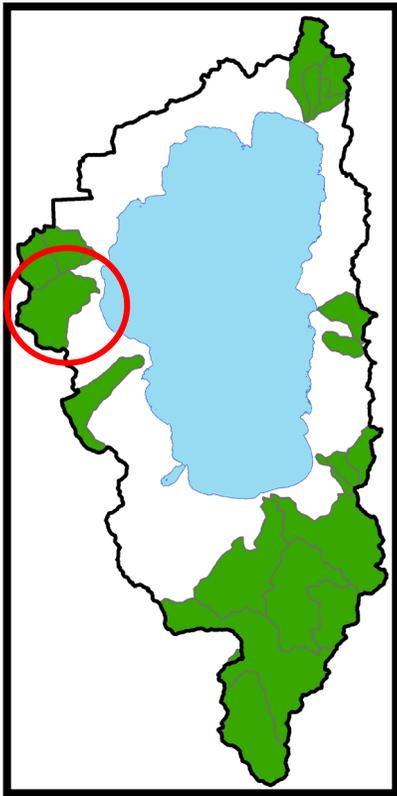
Watershed

vs.

Hillslope

Blackwood

623 hillslopes



- Performed summaries of the data based on the hillslope results and also map calculations and statistical analyses to:
 - better understand the effects of potential treatments on soil erosion
 - identify variables that are driving soil erosion
 - analyze data by slope steepness

Results

<https://wepp.cloud/weppcloud/It>

<https://wepp.cloud/weppcloud/It/SteepSlopes/>

Slopes between 30-50% do not appear to be a major driver of erosion risk

Slope Steepness (%)	Sediment yield (tn/yr)	
	Undisturbed	Thinned
<30	0.005	0.01
30-50	0.05	0.14
>50	0.07	0.2

Overall low erosion rates from thinning



Slopes 30-50%

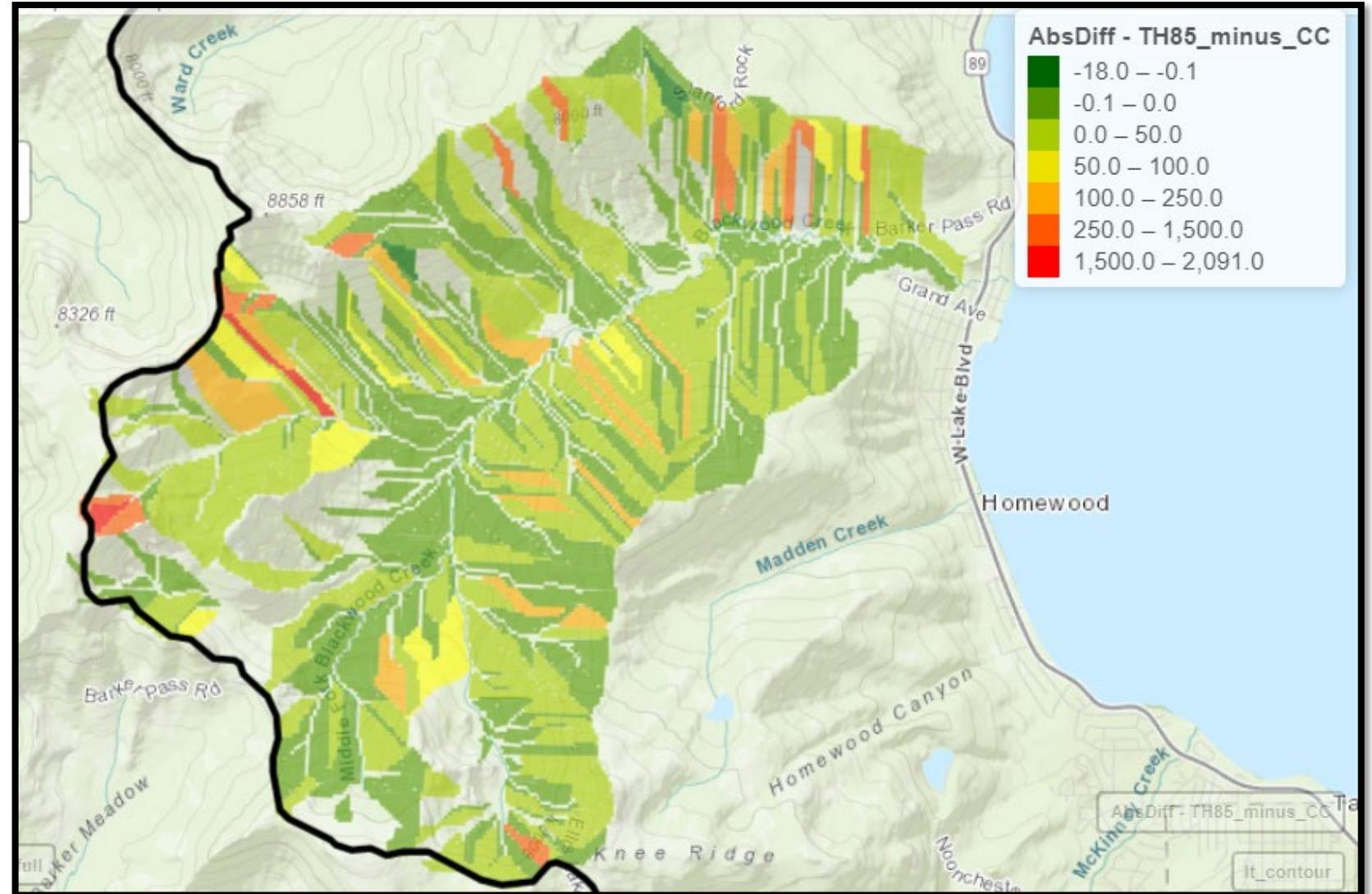
Slope Length (m)	Sediment yield (tn/yr)	
	Undisturbed	Thinned
<300	0.004	0.01
300-800	0.145	0.45
>800	0.674	2.08

Longer slopes generate more erosion

- Slope *length* is a more important predictor of erosion than 30-50% slope
- Actual treatments are unlikely to treat the entire length of a slope at one time
- Mitigation could include untreated buffer areas within a slope

Results: Projected change in sediment yield with thinning (kg/ha/yr) in Blackwood watershed

- Orange-red areas → predicted to yield more sediment with thinning disturbance.
- Dark green (negative) to light green (minimal) erosion



Allowing mechanical thinning of forest areas with 30-50% slopes is expected to reduce erosion impacts from wildfires

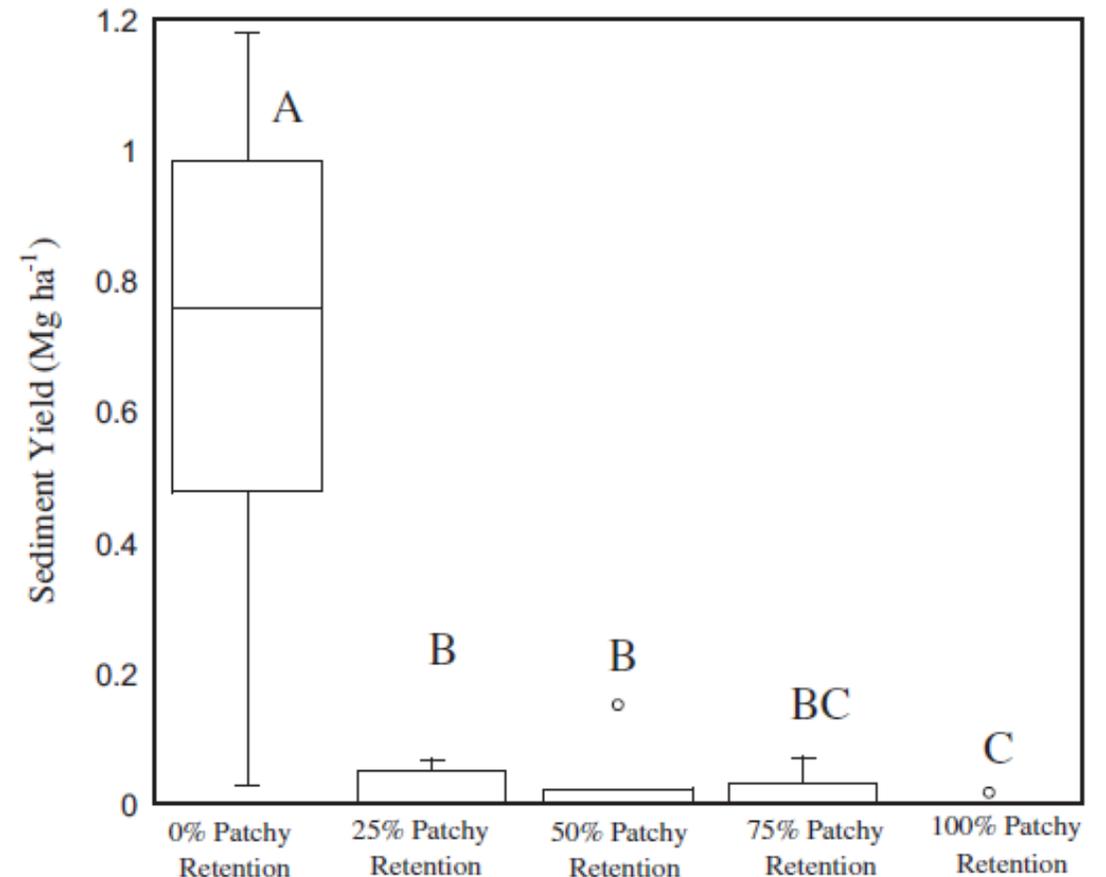
- Risks of treatment are generally low in forest-covered areas compared to other vegetation types.
- Shrub-dominated areas are higher risk, but they are likely to be treated with prescribed burning rather than mechanical equipment.

Ground cover is a key driver of sediment yield

- We assumed relatively small reductions in ground cover (e.g., from 100% to 85%)
- Representatives from private industry report that they would expect residual ground cover in this range
- They may use slash mats to increase ground cover where soil erosion is a concern, while avoiding increasing surface fuels
- Rutting is another potential cause of erosion, but we assume that existing requirements and practices address that risk

Recent field research in Tahoe basin found that much lower levels of ground cover, especially if patchy, avoid erosion while lowering fuels

- Harrison, Nicolas M.; Stubblefield, Andrew P.; Varner, J. Morgan; Knapp, Eric E. 2016. Finding balance between fire hazard reduction and erosion control in the Lake Tahoe Basin, California–Nevada. *Forest Ecology and Management*. 360: 40-51.
- In their study, slope (range = 12–33%) was not a significant predictor of sediment yield



(b) Sediment Yield for Patchy Retention Treatments

Newer equipment options reduce soil impacts for steeper slopes

- Equipment with flexible tracks or frames
- Tethering is another option that can help to reduce area disturbed
- Examples in recent field study from Oregon:

Green, P.Q.; Chung, W.; Leshchinsky, B.; Belart, F.; Sessions, J.; Fitzgerald, S.A.; Wimer, J.A.; Cushing, T.; Garland, J.J. 2019. Insight into the Productivity, Cost and Soil Impacts of Cable-assisted Harvester-forwarder Thinning in Western Oregon. *Forest Science*. 66(1): 82-96.





Harvester

Tracked wheels

Slash Mat

Tether

Tethered harvesting includes a piece of machinery, a cable or “tether” and either another piece of machinery or other stationary object holding the tether under tension.

>60% slope

Summary of Key Points

- Modeling, field research, and discussions with soil scientists studying practices on steep slopes indicate that mechanical harvesting can be conducted in ways that minimize reductions in ground cover and avoid risk of increased erosion in detectable amounts
- These approaches rely on advanced technologies and applications of Best Management Practices to avoid impacts
- Modeling results indicate that treatments in many of these forested areas could generate a net water quality benefit by reducing soil burn severity from wildfires

Next Steps

- This foundational analysis will support the environmental analysis and documentation needed to propose a basin-wide code amendment regarding mechanical ground-based equipment on slopes 30-50%.

Committee Comments/Questions

Public Comment

Committee Comments/Questions