Hetch Hetchy Regional Water System

Operated by the San Francisco Public Utilities Commission

Rim Fire

BASCWA Annual Technology Transfer Workshop

November 13, 2013

Adam Mazurkiewicz

Water Operations Analyst/Hydrologist

Hetch Hetchy Water and Power

Water Enterprise

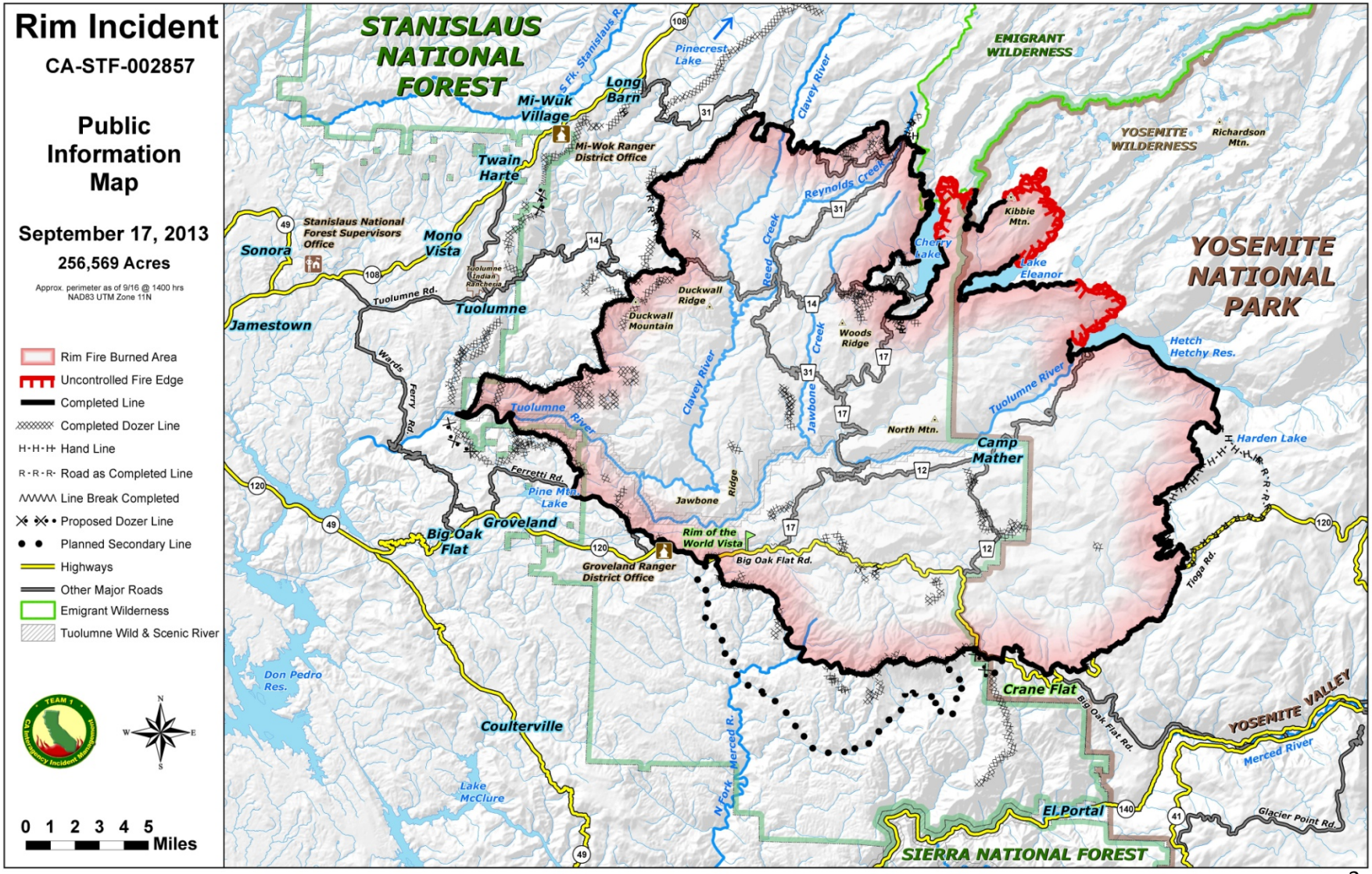
Hetch Hetchy Regional Water System

Outline

- Rim Fire Status and Stats
- Burn Area Emergency Response (BAER)
- Fire within Upcountry Watersheds
- SFPUC and Rim Fire
  - Fire history in the Hetch Hetchy watershed
  - Rim Fire within the Hetch Hetchy watershed
  - Field assessments
  - Erosion/Sediment modeling
  - Outlook of the Rim Fire impacts

Hetch Hetchy Regional Water System

Rim Fire



Rim Fire

- Total of 257,314 acres
  - 3rd largest fire in CA history
- 100% contained as of 10/24/13
- Firefighting Costs: $127.350 million

SFPUC Affected Assets

- **No damage to water delivery system**
- Distribution lines damaged
  - Cherry Ridge Line, Mather Line, Intake Camp, OSH
- Holm Powerhouse – roof fire
- Loss of communications
- Lost multiple non-critical structures
  - Cottage @ Intake, storage sheds, Miguel Meadows Cabin, LCA Gate House facility
- Damage to road system

Recovery from the Fire – Preparation for Winter

- Forest closure
- Hazard tree clearing
- Road rehabilitation

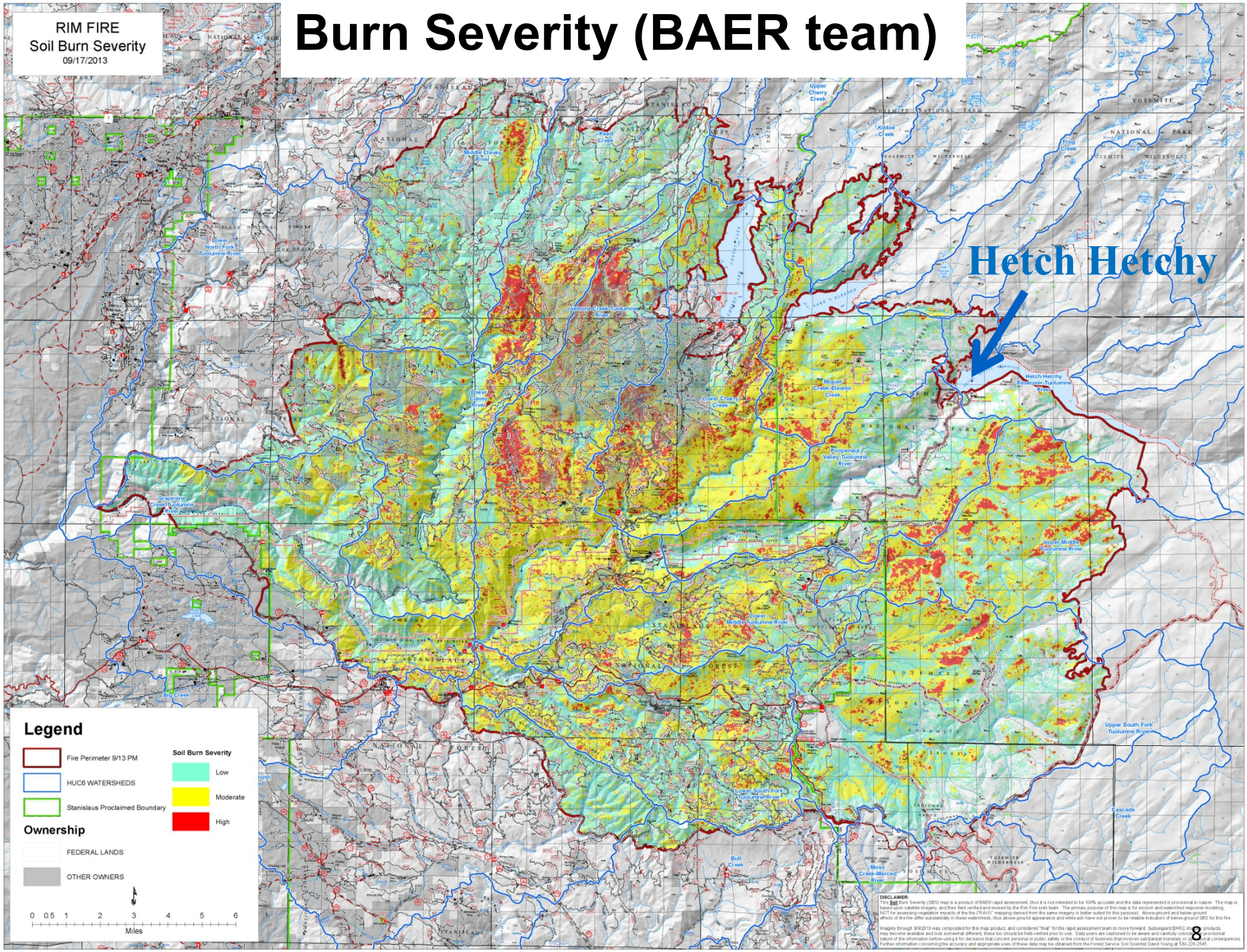
- Recreation closures
- USFS closing of roads
- Slope stabilization

USFS/NPS tasks are prioritized through BAER.

Assessing Burn Conditions (BAER)

- Burn Emergency Response Team (BAER)
  - An interagency team of field experts
  - Assess conditions and develops plans to address emergency stabilization for threats to human life and property
  - Specialists in: hydro, soils, geology, botany, road engineers, hazmat, archaeology
- Field orientated group that use models and spatial info to inform their decisions
- Tools
  - Burn severity mapping
  - Hydrologic modeling
  - Debris flow modeling

Burn Severity (BAER team)



Low: *surface material is not completely burned, structural stability of soil is unchanged*

Moderate: *ground cover is consumed, ash may be blackened with patches of gray*

High: *all of the ground cover is consumed, bare soil and ash, loss of soil structure*

BAER Team Reports

- Identify values at risk, evaluate the risk potential and make treatment recommendations
- Examples of Treatments:
  - Cleanup and containment of HAZMAT sites
  - Hazard tree removal
  - Closing of hiking trails, roads, or recreation sites
  - Road work such as: culvert replacement, rolling dips, re-grading, ditch pulling.
  - Slope stabilization and erosion control measures: i.e. hydromulching, mastication, rock scaling, waddles
- Over $9 million in funding granted

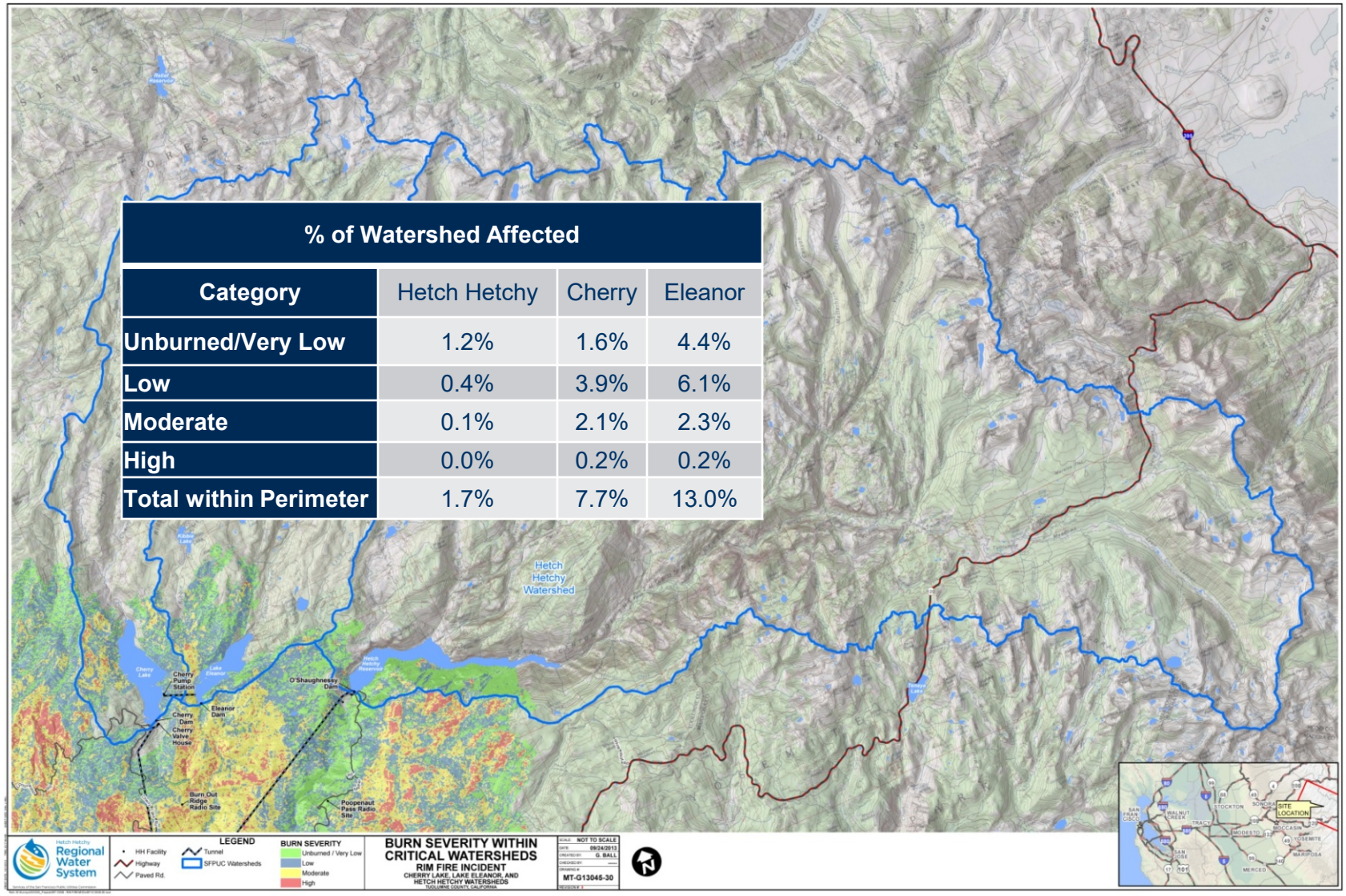
BAER Recommendations relating to SFPUC

- BAER makes recommendations for USFS & NPS facilities and lands
  - However, there is overlap to SFPUC
- Mastication and helimulching in Granite Creek basin
- Culvert clearing along the SFPUC Right of Way (ROW)
- Sandbagging stream channel adjacent to facilities in the HH compound to contain high flows
- Hazard tree removal, slope stabilization

SFPUC Post-Fire Actions

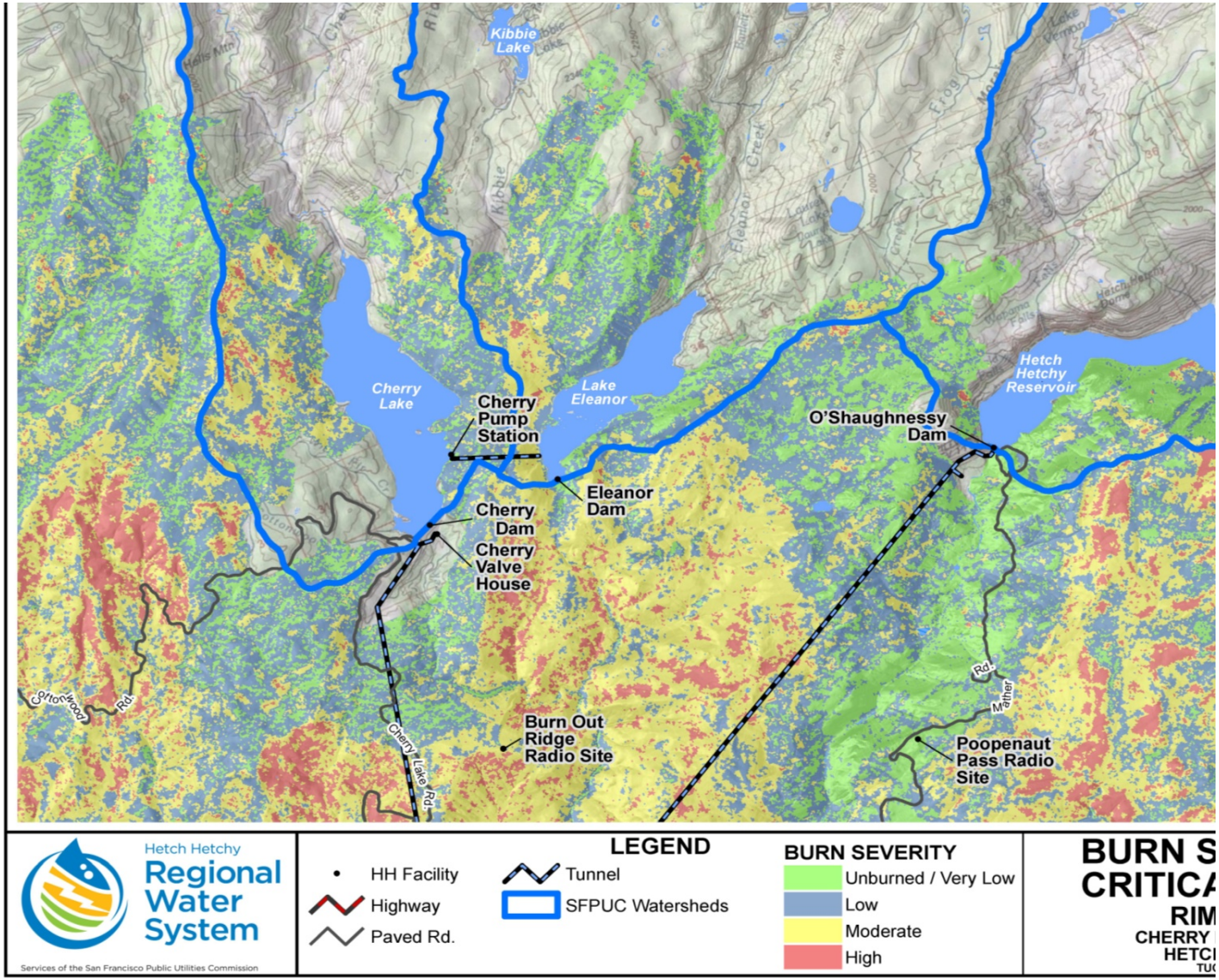
- Initial Response
  - Cleared hazard trees along roads and power lines
- Roads
  - Replaced culverts, pulled ditches, removed floatables, cleared culverts, hydromulching
- Logging operations
  - Along the ROW to remove trees
- Powerlines
  - Re-established power to Camp Mather – working on lines to Hetch Hetchy and Cherry

Fire within Watersheds

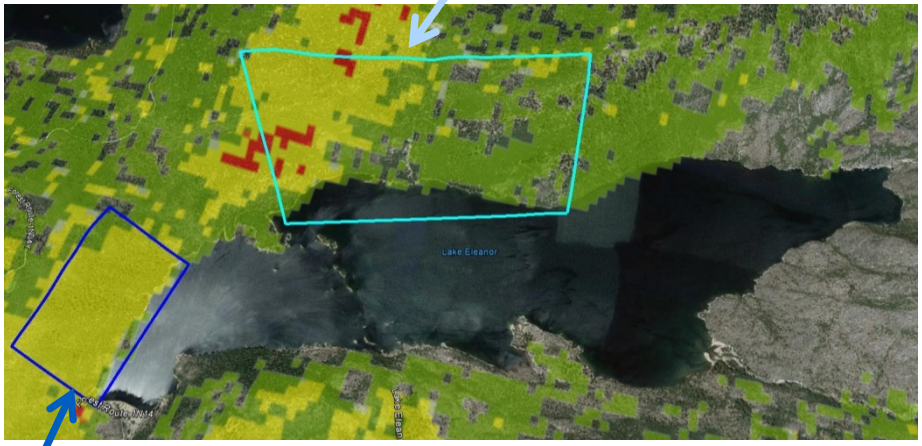


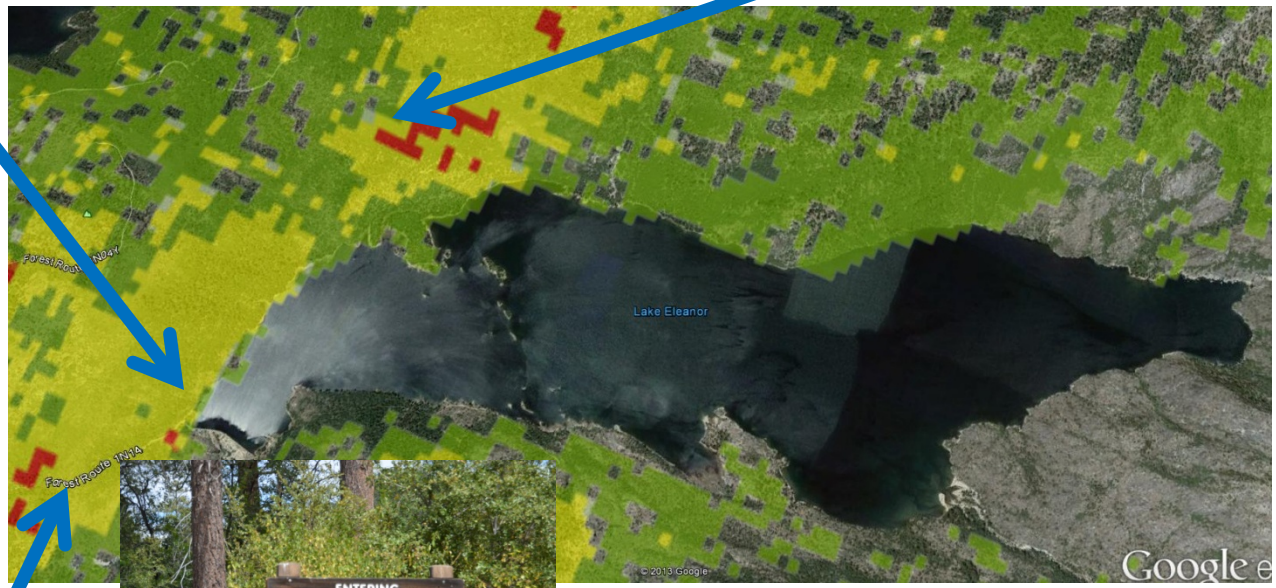
% of Watershed Affected			
Category	Hetch Hetchy	Cherry	Eleanor
Unburned/Very Low	1.2%	1.6%	4.4%
Low	0.4%	3.9%	6.1%
Moderate	0.1%	2.1%	2.3%
High	0.0%	0.2%	0.2%
Total within Perimeter	1.7%	7.7%	13.0%

Fire within Cherry Lake and Lake Eleanor Watersheds



Lake Eleanor




Lake Eleanor
Google

ENTERING
YOSEMITE NATIONAL PARK
Wilderness Permits Required
All Pets and Firearms Prohibited
Authorized Vehicles Only

Cherry Reservoir

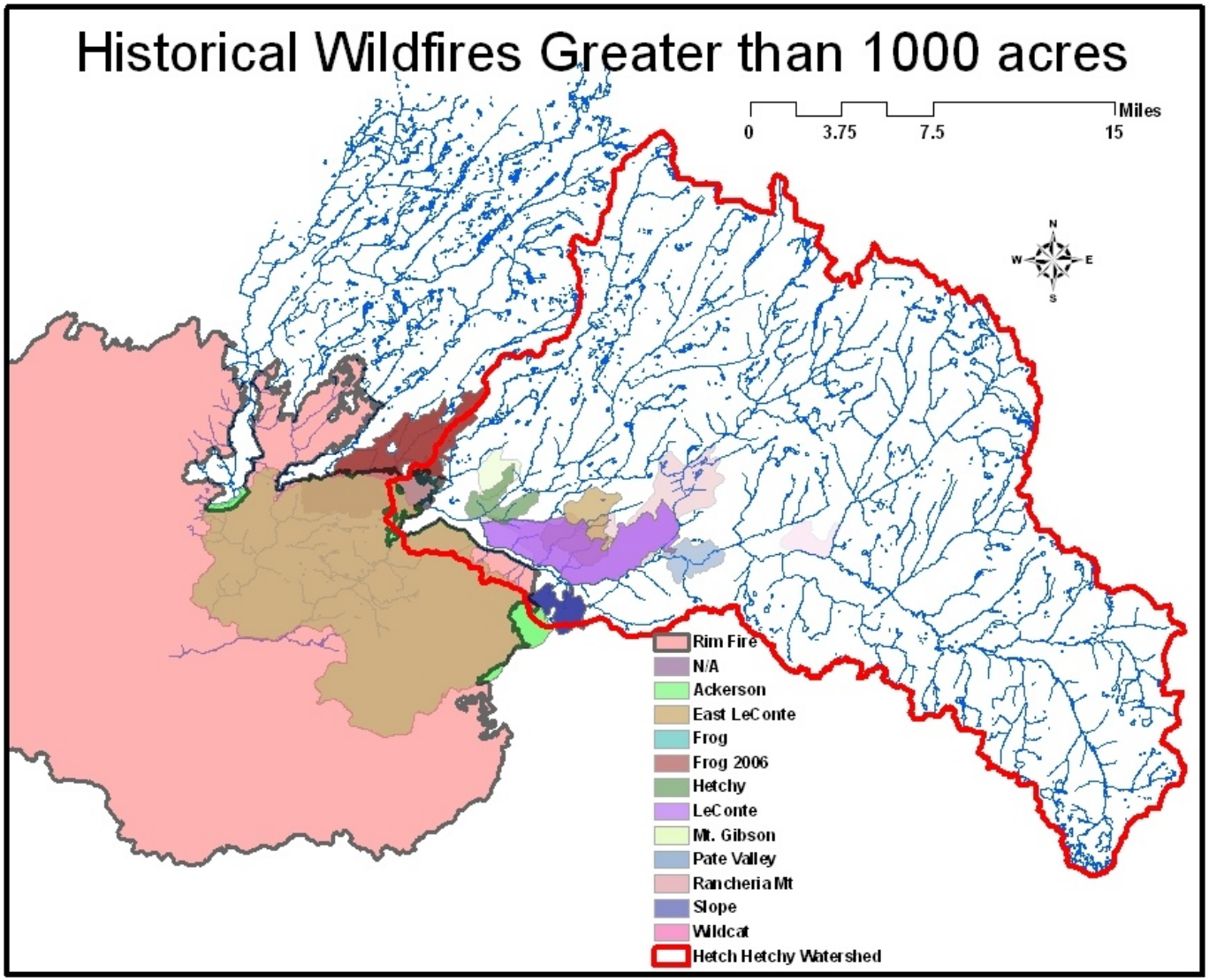
Potential Impacts of Fires in a Watershed

- *Runoff*
  - Increased runoff due to loss of evapotranspiration
  - Increased peak flow due to higher surface runoff (lower infiltration rates) and lack of canopy attenuation of precipitation
- *Erosion*
  - Increase in potential erosion due to loss of ground cover, lowered infiltration rates and increased hydrophobicity
  - Increased debris flow due to loss of vegetative stabilization
- *Increased Sediment and Debris Delivery*
  - Ash and burned debris transport
  - Surface erosion, dry raveling, hillslope contribution
- *Water Chemistry*
  - Increased Nutrients: N, C, P
  - Increase in heavy metals
  - Nutrient loading due to fire retardant

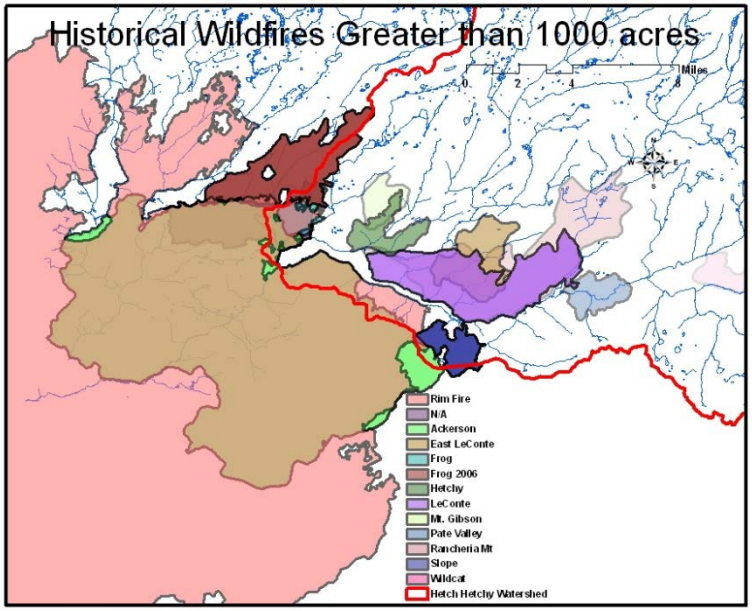
SFPUC Evaluation of Rim Fire Effects on Hetch Hetchy Watershed

- Review historic fire conditions
- Review historic water quality
- Perform field assessments
  - Monitor fire conditions
  - Investigate burn conditions and evaluate severity mapping
  - Measure hydrologic impacts
  - Limnology and chemistry sampling
- Evaluate potential changes to erosion/sediment contributions

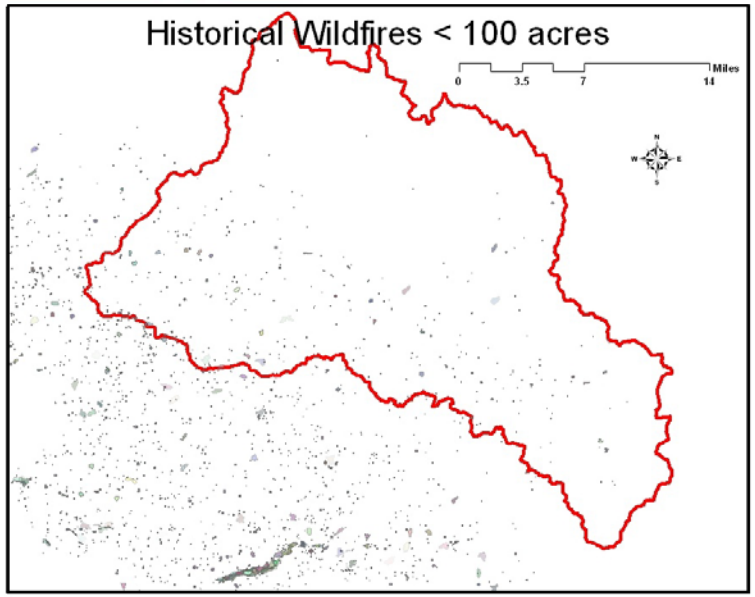
Fire History

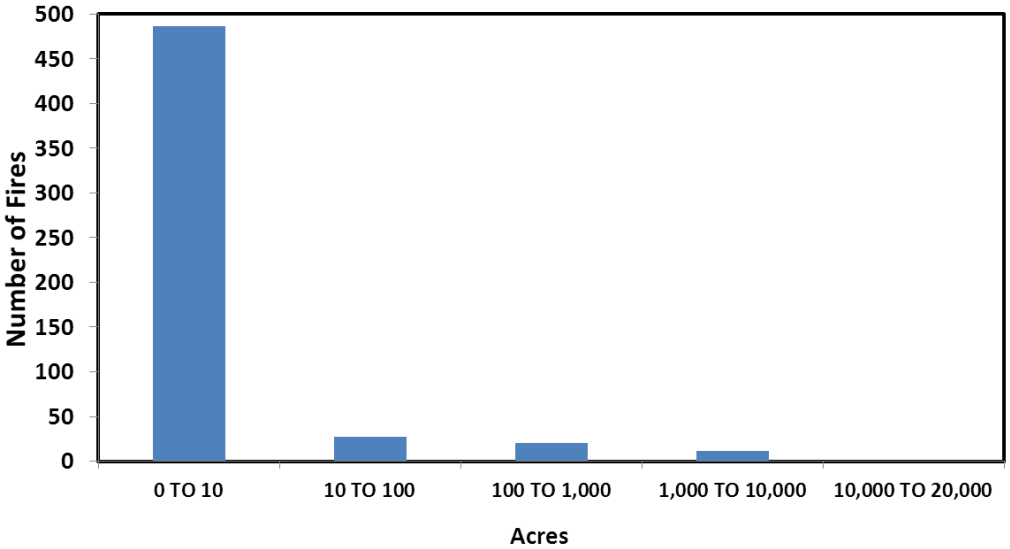


Recorded Fire History, since 1931



Year	Name	Acres
1948	Rancheria Mt	12116
1999	LeConte	8861
2013	**Rim Fire**	**5087**
1988	East LeConte	3755
1996	Ackerson	3634
2004	Hetchy	1937
1985	Pate Valley	1762
1991	Frog	1582
1978	N/A	1553
2010	Slope	1530
1960	Mt. Gibson	1472
2009	Wildcat	1293
2006	Frog	1098



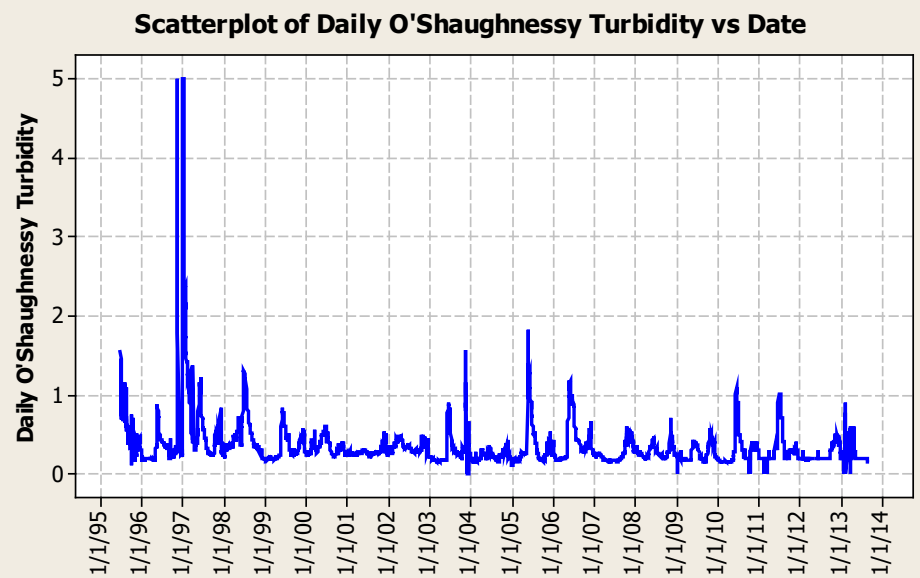


Hetch Hetchy Watershed

- Granite dominated basin
- Few sediment sources
- Generally low forest densities
- Discontinuous forest stands
- Nutrient limited
- Limited fuels near reservoir
- Active fire history

Historical Water Quality

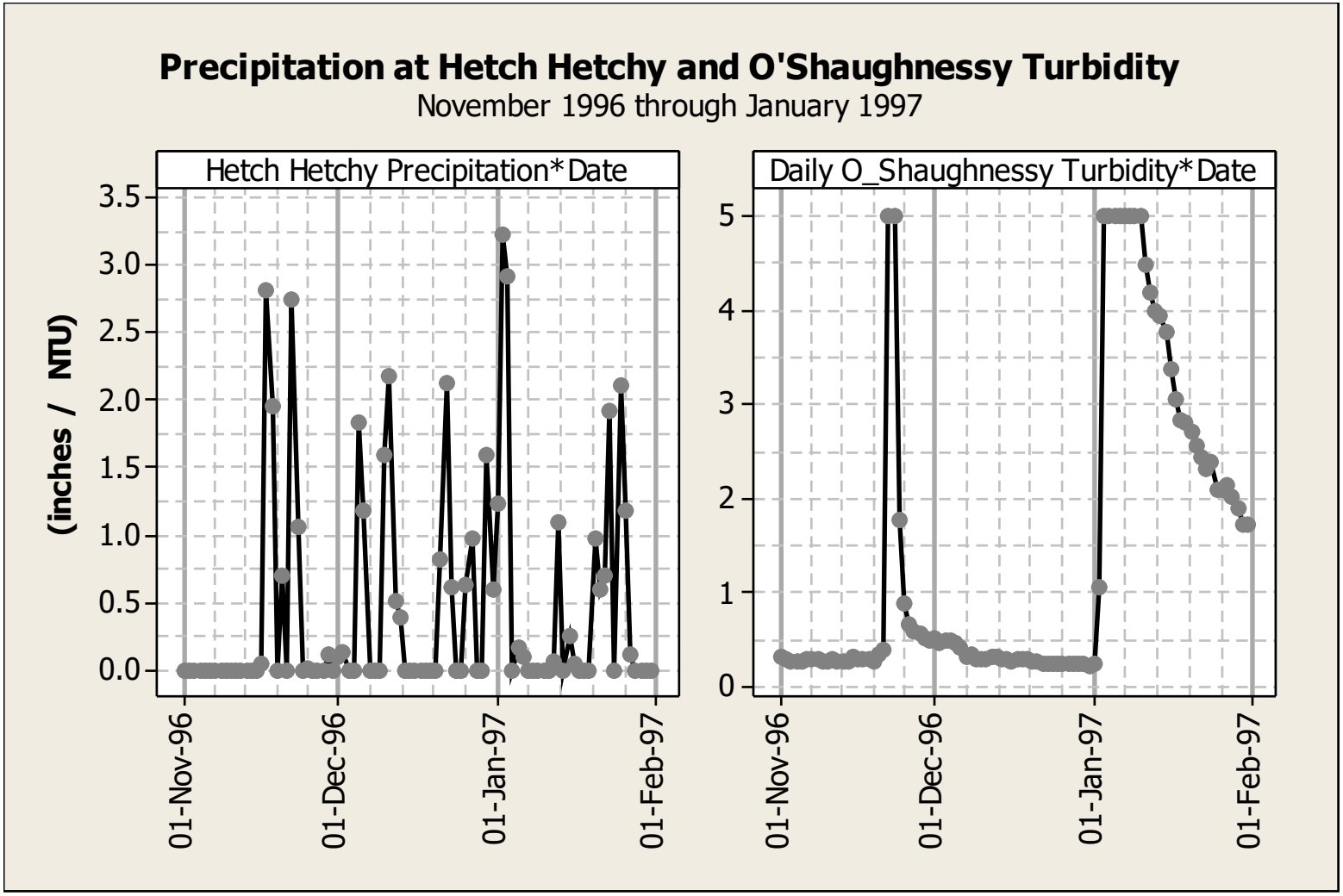
Time	Comment	Peak Turbidity
Summer 1995	snowmelt	1.57 NTU on 7/1/95
Nov 1996	Fall Storm	> 5 NTU on 11/22-11/23/96 > 1 NTU on 11/22-11/24/96
Jan 1997	100-year event	> 5 NTU on 1/3-1/10/97 > 2 NTU on 1/2-1/28/97
Spring 1998	snowmelt	1.31 NTU on 6/30/98
Nov 2003	Winter storm	1.57 NTU on 11/24/03
Spring 2005	snowmelt	1.40 NTU on 6/1/05
Spring 2006	snowmelt	1.01 NTU on 6/26/06
Spring 2010	snowmelt	1.10 NTU on 6/23/10
Spring 2011	snowmelt	1.00 NTU on 6/26-7/16/11



Composite dataset from monthly CDPH turbidity reports, Form 11, and Kirkwood Powhouse raw water.

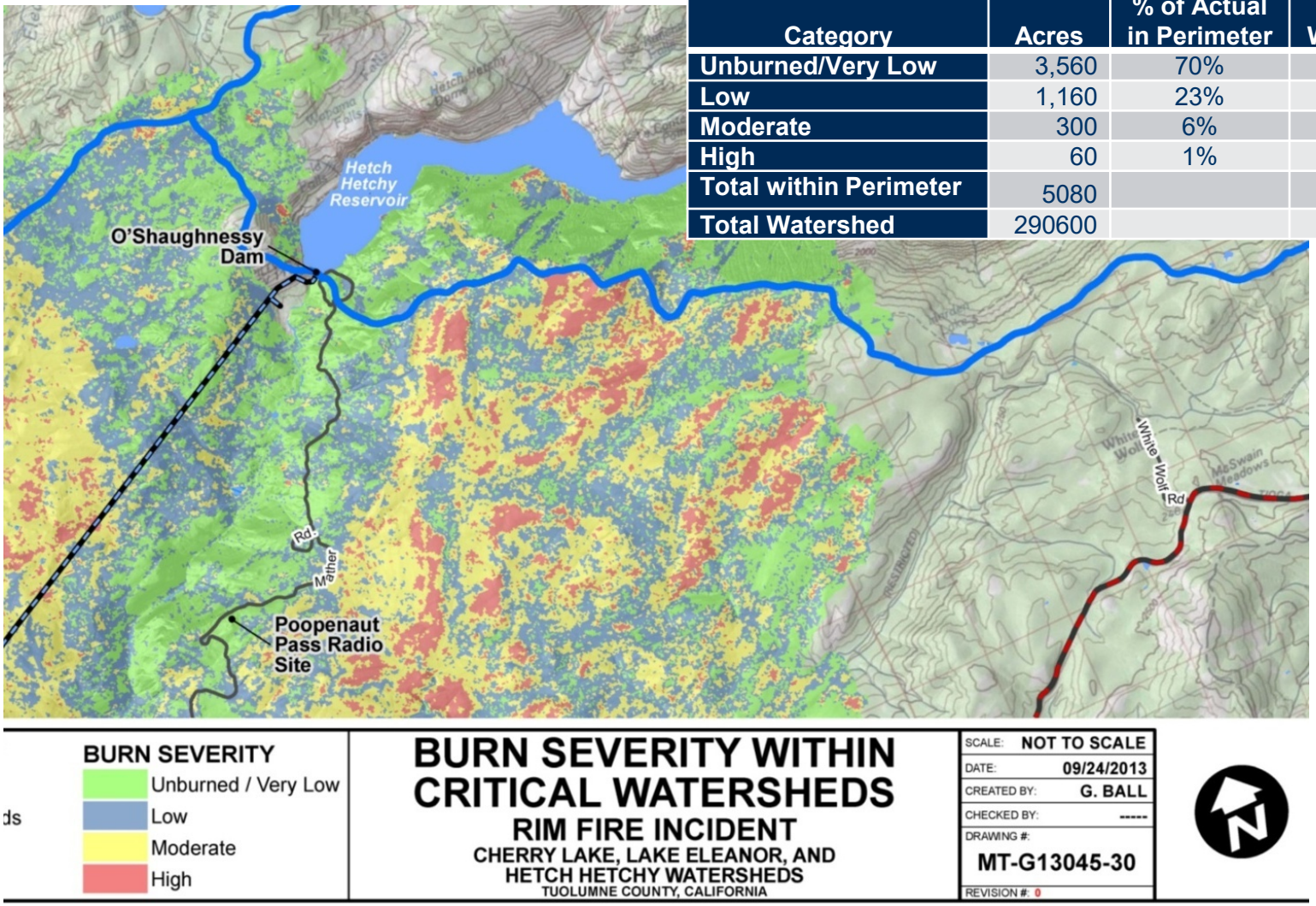
- Turbidity is typically 0.15 to 0.5 NTU
- Elevated turbidity occurs during periods of high inflows
  - i.e. snowmelt runoff & major storms
- Two historical events impaired Hetch Hetchy water quality
- Prior post-fire data show no detectable change in nutrient levels (N, TOC, P) following a fire
- Historical data shows that turbidity is driven by runoff magnitude with no direct correlation to burned area

Historical events



Rim Fire: Field Assessments

Category	Acres	% of Actual in Perimeter	% of Watershed
Unburned/Very Low	3,560	70%	
Low	1,160	23%	
Moderate	300	6%	
High	60	1%	
Total within Perimeter	5080		2%
Total Watershed	290600		



Rim Fire: Field Assessments

- During and post-fire on the ground observations
- Limnology and chemistry sampling in Hetch Hetchy
- Field Hydrology tests: infiltration & hydrophobicity

Isolated Spot fires – 8/30, 9/5, 9/11

More Widespread Understory Burn – 9/17

Mainly Understory Burn on South Shore – 9/17

Isolated Canopy Mortality – 9/26

Rill Erosion Observations – 9/25 & 9/26

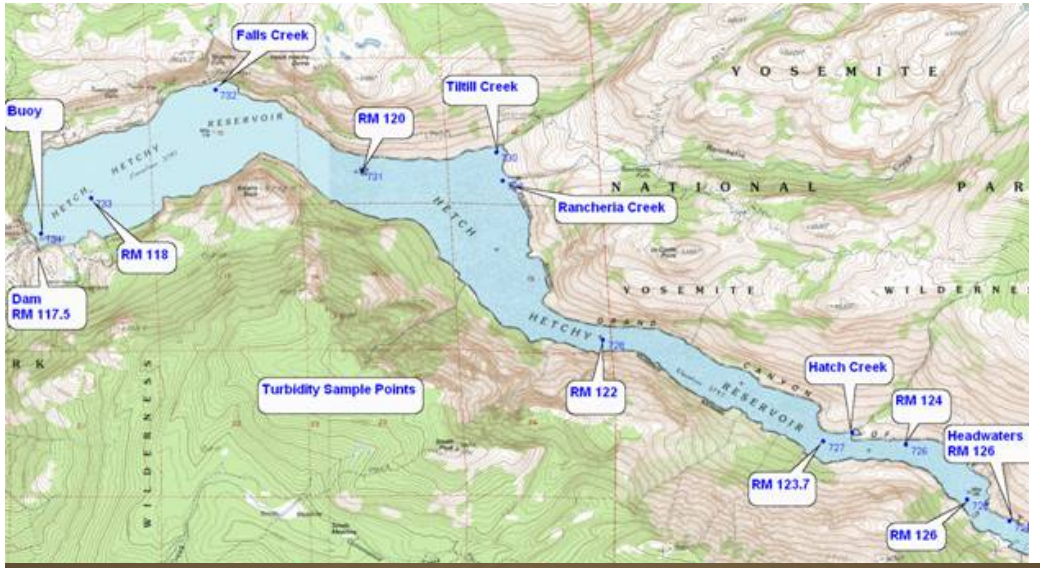
Hydrophobicity and Infiltration Tests

- Tests show that infiltration rates are typical for soil texture
  - 3-8 inches per hour
  - Some decrease from measured rates at unburned areas
  - Well below precipitation rates
- Tests show soil rates extremely hydrophobic
  - Water drops sit on soil surface >2 minutes
  - Surface of mineral soil, rather than overlaying organic layer
  - Soils are naturally hydrophobic due to soil /vegetation properties
  - Infiltration tests show hydrophobicity effects lessen under wetted soils

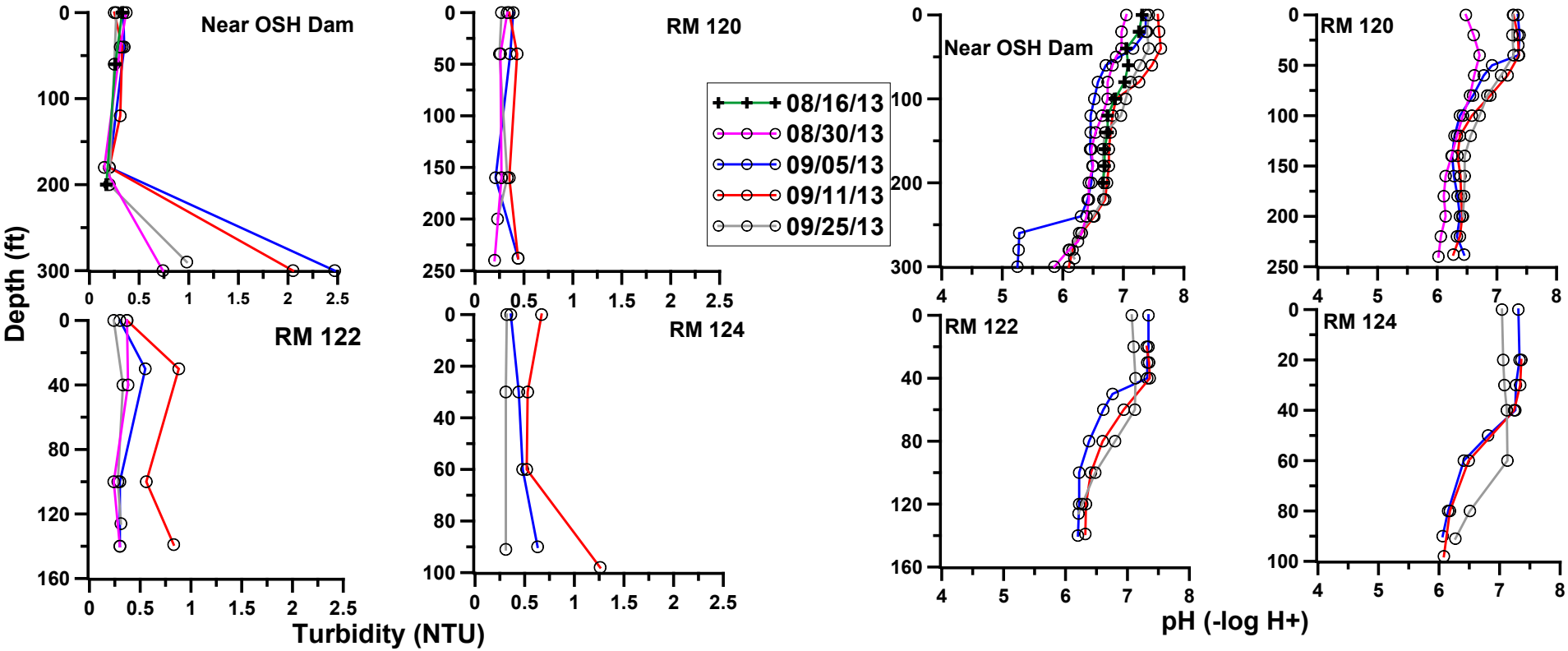
Location	Burn Intensity	Infiltration Rate	Hydrophobicity
Hetch Hetchy South Shore	Light	7.6 in/hr	Extreme
Hetch Hetchy North Shore (1)	High	7.7 in/hr	Extreme
Hetch Hetchy North Shore (2)	High	3.0 in/hr	Extreme
Hetch Hetchy No Burn (1)	None	19.3 in/hr	High/Extreme
Hetch Hetchy No Burn (2)	None	12.1 in/hr	High/Extreme

Water Sampling and Monitoring

- Aug 16
  - Routine Limnology
- August 28
  - Mountain Tunnel @ Priest comprehensive chemistry
- August 30
  - Limnology and comprehensive chemistry
- September 5 and 11
  - Mountain Tunnel at Priest comprehensive chemistry
  - Limnology and comprehensive chemistry
  - Irvington Portal flavor profile
- September 25
  - Limnology



Limnology Results



Comprehensive Chemistry

General chemistry (pH, alkalinity, conductivity, turbidity, TSS, TDS, hardness, color)

- Typical, no significant change over sampling period

Nutrients (ammonia, nitrate, nitrite, total nitrogen, sulfate, orthophosphate)

- Typical, no significant change over sampling period

Organics (TOC, DOC)

- Typical, no significant change over sampling period

Polyaromatic hydrocarbons (PAH)

- No detections, with one exception – naphthalene at 0.25 ug/L at RM 120 on 9/11; likely due to sampling or laboratory sources

Metals (Ca, Si, Cd, Hg, Ni, Pb, Se, Al, As, Cu, Fe, K, Mn, Zn)

- Typical, no significant change over sampling period

Radionuclides (Gross alpha)

- All measurements non-detect (< 3 pCi/L)

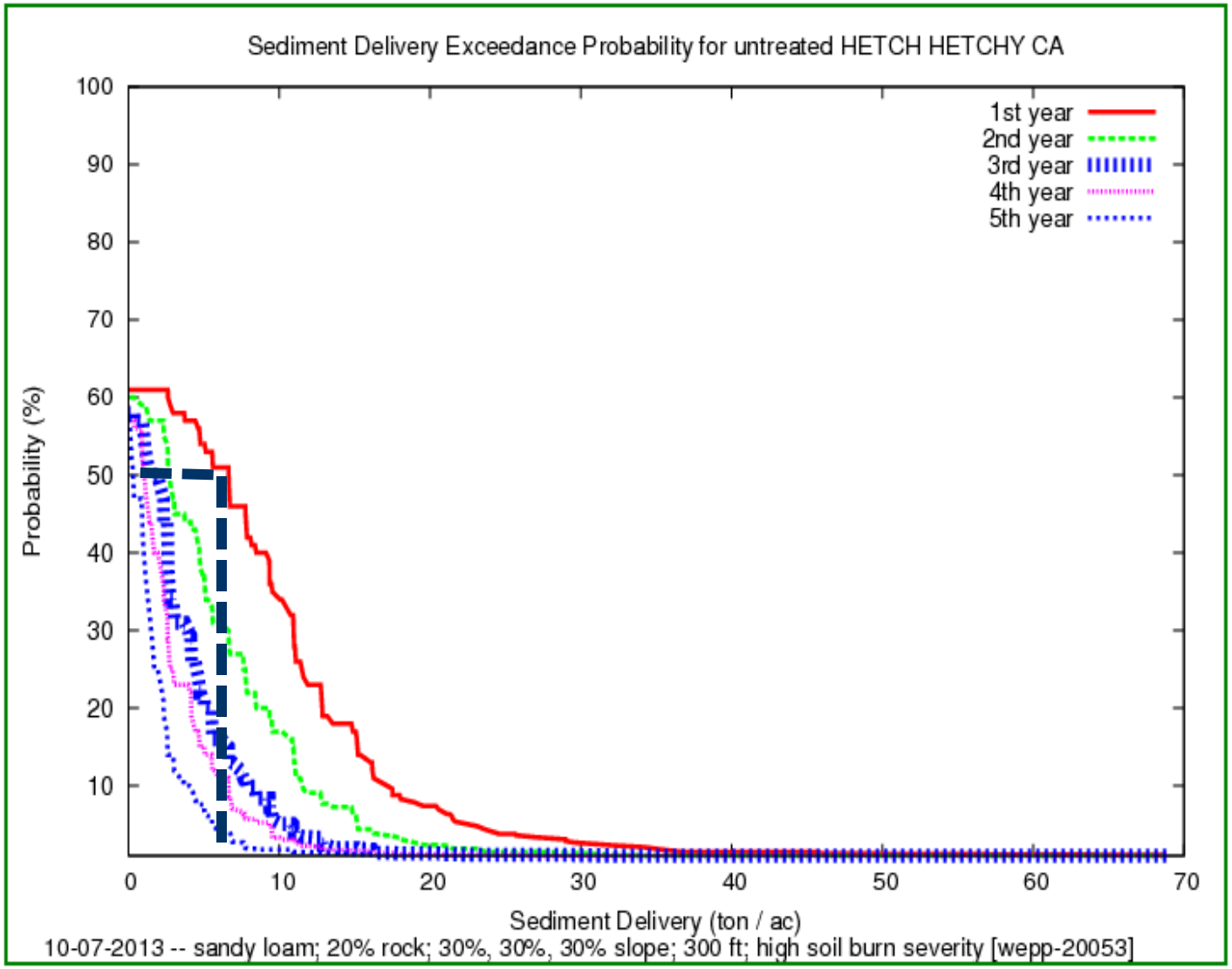
Flavor profile analysis (FPA)

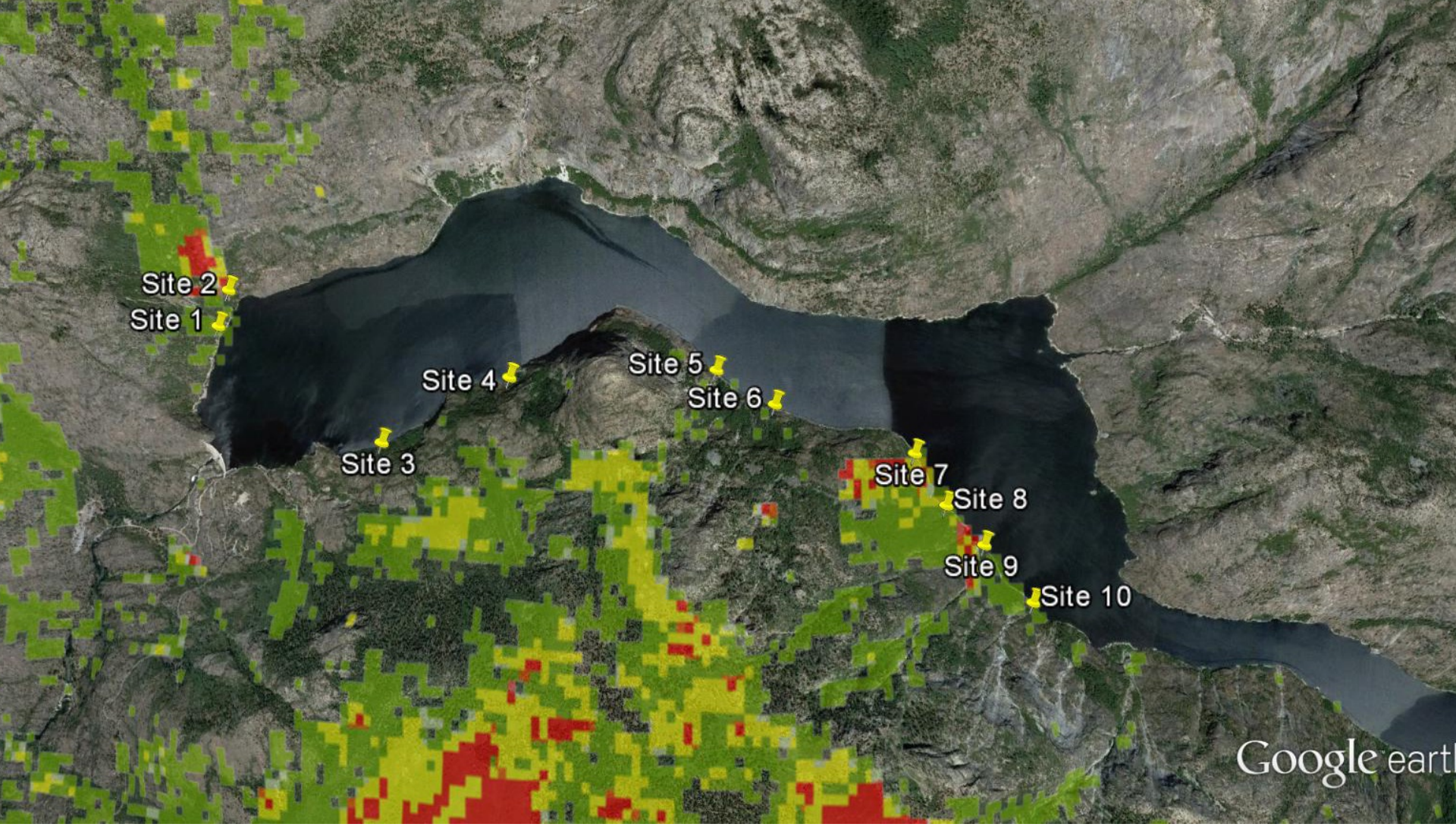
- Medium intensity fishy odor at 285' depth (anoxic zone) at O'Shaughnessy Dam on 8/30
- No odors of any intensity have been detected at Alameda East (8/30) or Irvington Portal (9/5 to 10/3)

Sediment Transport Modeling

- ERMiT – Erosion Risk Management Tool
- ERMiT allows users to predict the probability of a given amount of sediment delivery from the base of a hillslope following variable burns on forest, rangeland, and chaparral conditions in each of five years following wildfire
- Inputs include: Climate data, Soil Texture, Rock Outcrops, Vegetation type, Hillslope length and gradient, Soil burn severity class
- Used by Forest Service and BAER team
- General patterns of increased sediment delivery

ERMiT: Sediment Exceedance Probability





Potential Sediment Increase @ affected locations
2-3 times for low burn severity sites
3-4 times for moderate severity sites

Sediment/Erosion Modeling Summary

- A small area of the watershed is within the fire perimeter – 1.8%
- The results only represent "total erosion" and do not predict delivery to a watercourse
- The modeling results show only ~1% increase in total potential erosion over the entire watershed
  - NPS BAER conclusion: "*Given the highly dispersed nature of the burn within the watershed and very small amounts of moderate and high soil burn severity, risk to Hetch Hetchy Reservoir from increased post-fire watershed response and erosion is negligible to low.*"
- *Recovery of vegetation and ground cover over time decreases potential erosion*
- *Needle and litter cast from living vegetation will expedite recovery around Hetch Hetchy*

Hetch Hetchy Regional Water System

Conclusions

- There are few historic large scale fires in the HH watershed
  - Rim Fire fits within historic patterns
    - *Mainly low burn severity and mosaic in pattern*

- Rim Fire impacts are limited in the HH basin
  - Field measurements indicate that infiltration and hydrophobicity are within the normal range for soil and vegetation types
  - Limnology and Chemistry monitoring show no changes
  - Field observations showed some rill erosion but with limited sediment delivery potential
  - Erosion modeling results indicate 1% increase in total potential sediment erosion

Positive Outlook

- The Rainy Season has had a Delayed START!
  - Storms have had low precipitation accumulations
  - Natural needle and leaf fall has accumulated as a beneficial ground cover
  - Ash layer has slowly consolidated and become less mobile
  - Ground forbs are already sprouting
  - Mitigation work has had the opportunity to be implemented

Acknowledgements & Thanks!

- WQD: Moccasin & Millbrae Laboratories, Field Services
- NRLMD: Moccasin Biologists, Watershed Forester, Tuolumne-Alameda Policy & Planning
- Water Enterprise: Hydrology & Water Systems Modeling
- HHWP: Water & Power Planning, Watershed Keepers