Santa Susana Field Laboratory Post-Wildfire Stormwater Update

STORMWATER EXPERT PANEL

LARWQCB MEETING | MAY 9, 2019

With support from

Geosyntec consultants

Outline

NPDES Permit

Stormwater Expert Panel

Woolsey Wildfire Overview

2018-19 SSFL Permit Initial Sample Results – Preliminary Review

- Water year
- Outfall discharges
- Exceedances

Preliminary Conclusions

Looking Ahead

Santa Susana Field Laboratory

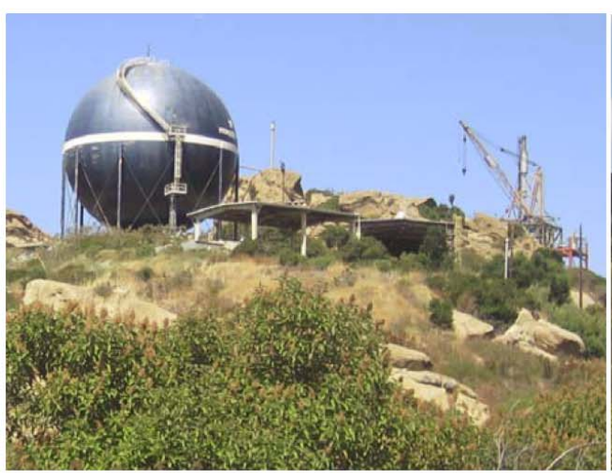
Former rocket testing and energy research facility

Industrial activities have ceased and facilities removal is underway

- Energy research operations ceased in 1989
- Rocket engine testing operations ended in 2006

Current activities include environmental monitoring/sampling, remediation planning, and demolition

Numerous stormwater Best Management Practices (BMPs) to treat developed and undeveloped areas

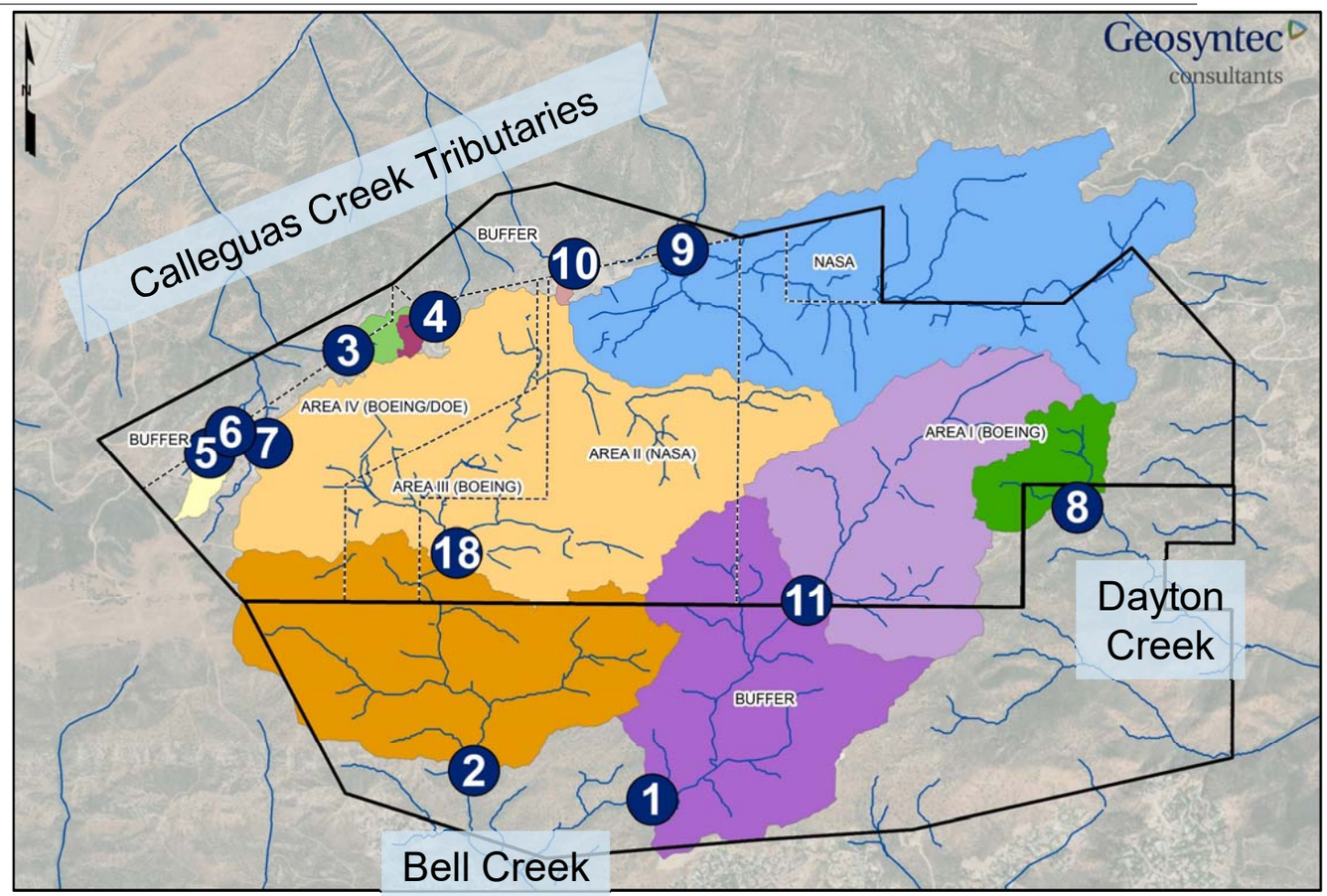


NPDES Permit

Stormwater discharges at SSFL are regulated by the LARWQCB

Individual NPDES permit issued in 2015, which requires:

- Composite sampling at 12 stormwater outfalls; and
- Compliance with approximately 50 Numeric Effluent Limits (NELs) – protective of both human health and aquatic life.



Stormwater Expert Panel

Independent panel formed in response to the 2007 Cease and Desist Order from the RWQCB

- *"…a panel to review site conditions, modeled flow, contaminants of concern, and evaluate the BMPs capable of providing the required treatment to meet the final effluent limits."*

Ongoing Charge (2015 Permit)

- Investigate potential site-wide stormwater pollutant sources
- Analyze NPDES compliance and BMP performance monitoring data
- Make recommendations for new BMPs or improvements to existing BMPs
- Review Stormwater Human Health Risk Assessment (HHRA)
- Public outreach

Members

- Dr. Bob Gearheart, P.E., Humboldt State University
- Jon Jones, P.E., Wright Water Engineers
- Dr. Michael Josselyn, WRA Consultants
- Dr. Bob Pitt, P.E., University of Alabama
- Dr. Michael Stenstrom, P.E., University of California, Los Angeles

Woolsey Wildfire Overview

WILDFIRE EXTENT

SSFL RESPONSE / REPAIRS / CONTROLS

WATERSHED RESPONSE

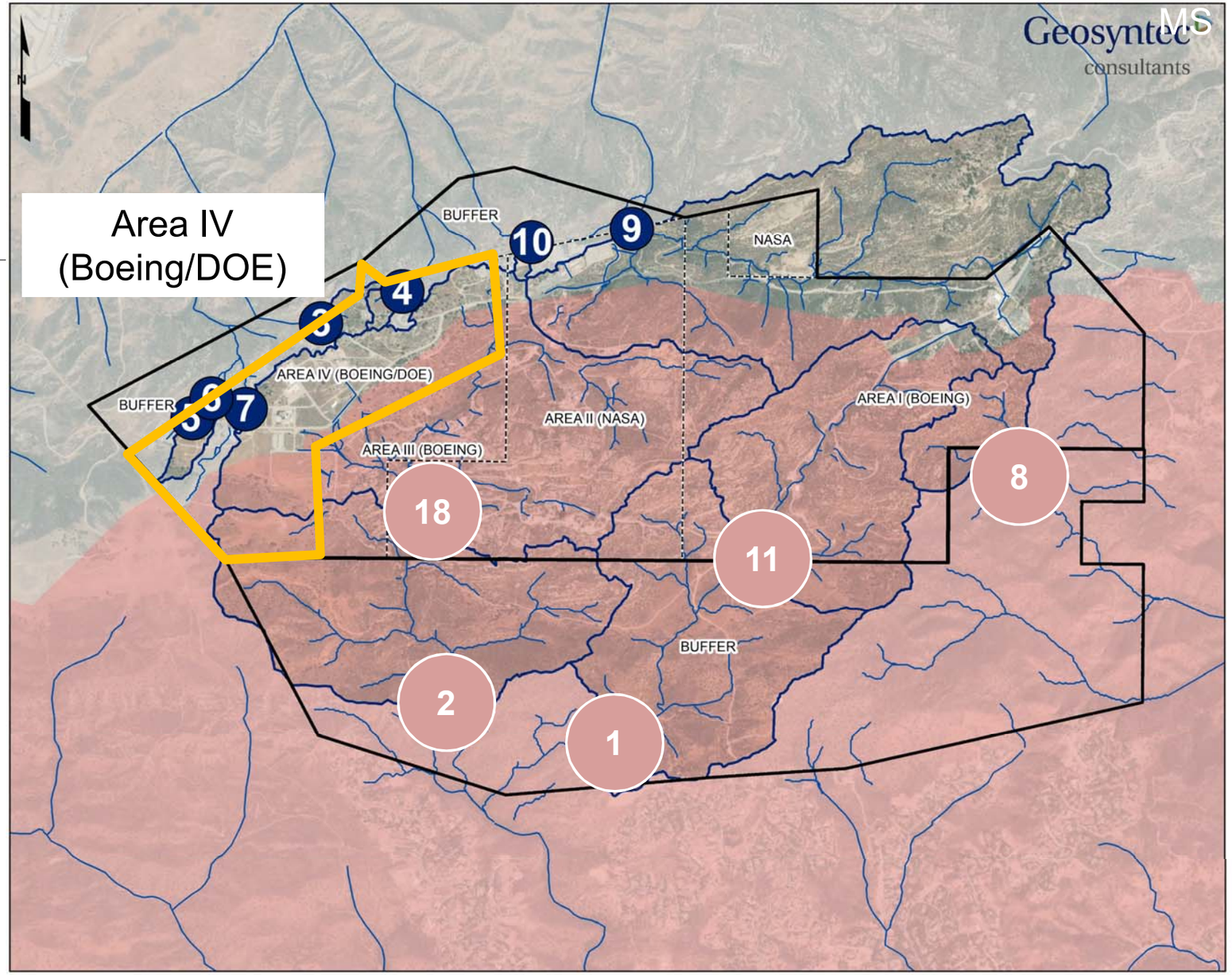
Woolsey Wildfire Extent

79% of site burned

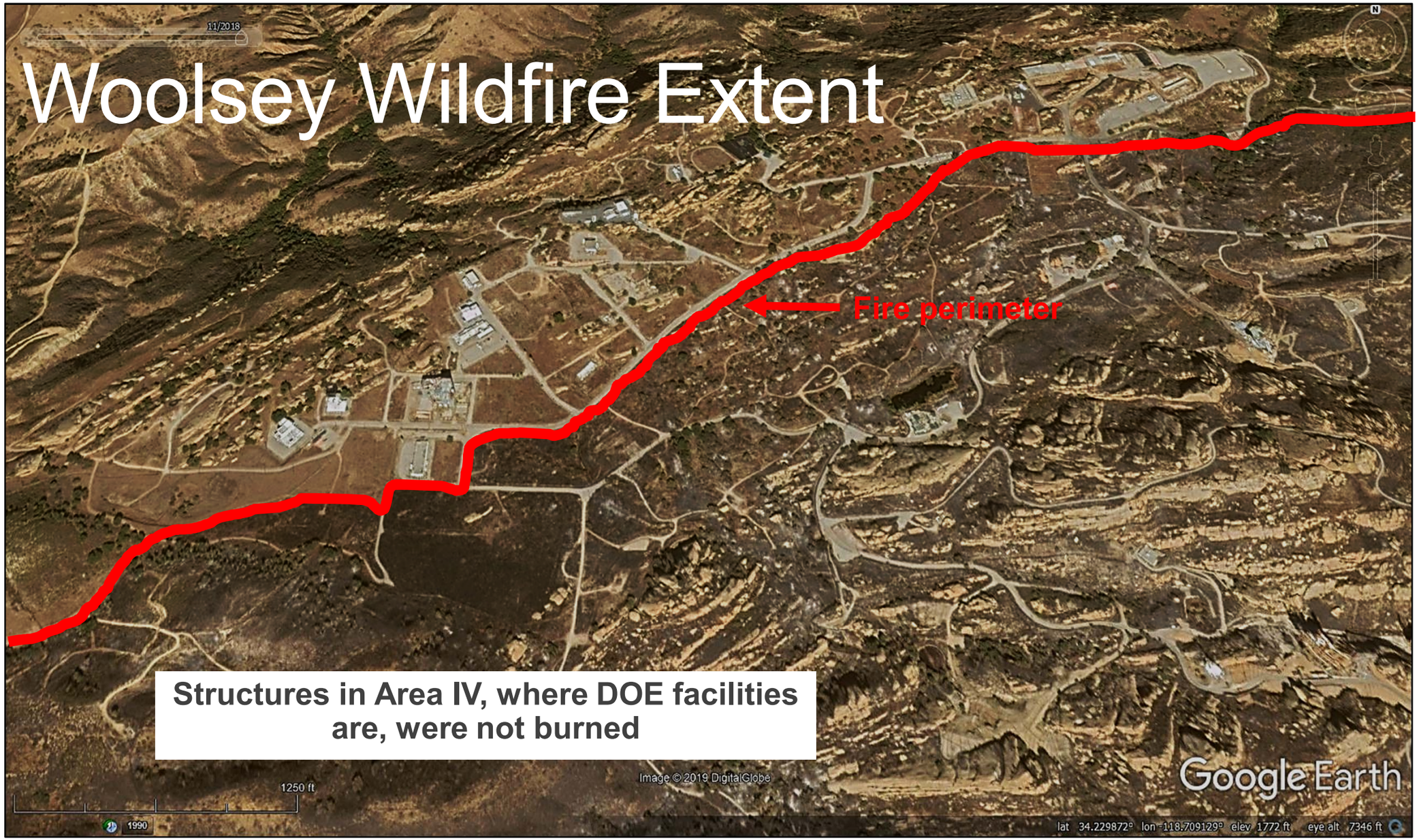
Outfall watersheds most impacted:

- Outfall 011/001
- Outfall 018/002
- Outfall 008

Last wildfire was in 2005 (Topanga)



Woolsey Wildfire Extent



Effects of Wildfire

- Lost vegetative cover
- Lost plant litter
- Increased soil hydrophobicity (water repellent)
- Burned material including plastic sampler housing, metal platforms, batteries, HDPE pipelines, PVC fixtures, utility poles, etc.
- Temporarily damaged stormwater controls (e.g., Storm Water Treatment System, conveyance pipes, etc.)

Burned HDPE pipe in Outfall 011 watershed

Hydrologic and Water Quality Response

- Increased runoff (frequency and volume)
- New pollutant sources (burned materials)
- Increased soil exposure and associated constituent mobilization

With time these effects will be reversed with vegetative regrowth and as soil infiltration characteristics return to pre-wildfire conditions.

Previous studies of water quality following wildfires in mostly undeveloped areas show an increase in many constituents

	Constituent	Multiplicative Increase Pre- to Post-Fire Conc.	References
Metals	Arsenic*	7	Burton et al., 2016 [2006 Station Fire, CA]
	Copper*	8-36	Burton et al., 2016 [2006 Station Fire, CA]; Stein et al., 2012 [Multiple Fires, CA]
	Nickel*	50	Burton et al., 2016 [2006 Station Fire, CA]
	Mercury	13	Burton et al., 2016 [2006 Station Fire, CA]
	Lead*	800	Burton et al., 2016 [2006 Station Fire, CA]
	Selenium*	7	Burton et al., 2016 [2006 Station Fire, CA]
	Zinc*	15-60	Burton et al., 2016 [2006 Station Fire, CA]; Stein et al,. 2012 [Multiple Fires, CA]
Nutrients	Nitrate+Nitrite*	292	Stein et al., 2012 [Multiple Fires, CA]
	Total Phosphorus	100	Stein et al., 2012 [Multiple Fires, CA]
	Total Suspended Solids	2-1000	Stein et al., 2012 [Multiple Fires, CA], Burke et al., 2013 and Burton et al., 2016 [2006 Station Fire, CA], 2007 Phase 1 SSFL Post-Fire Watershed Response Study
Organic Pollutants	Polycyclic Aromatic Hydrocarbons	3.6-4	Stein et al., 2012 [Multiple Fires, CA]; Chen et al., 2018 [2013 Rim Fire, CA]

***Parameters exceeding SSFL NPDES limits in 2018-19 samples**

Example SSFL Response, Repairs, and Controls

Hydromulch applied and fiber rolls installed

Burned HDPE pipelines replaced to direct runoff to storm water treatment system (SWTS)

Debris removed and ash vacuumed from burned areas

Repair and maintenance of stormwater BMPs, including SWTS, and sampling stations

Majority of repairs completed prior to first runoff producing storm

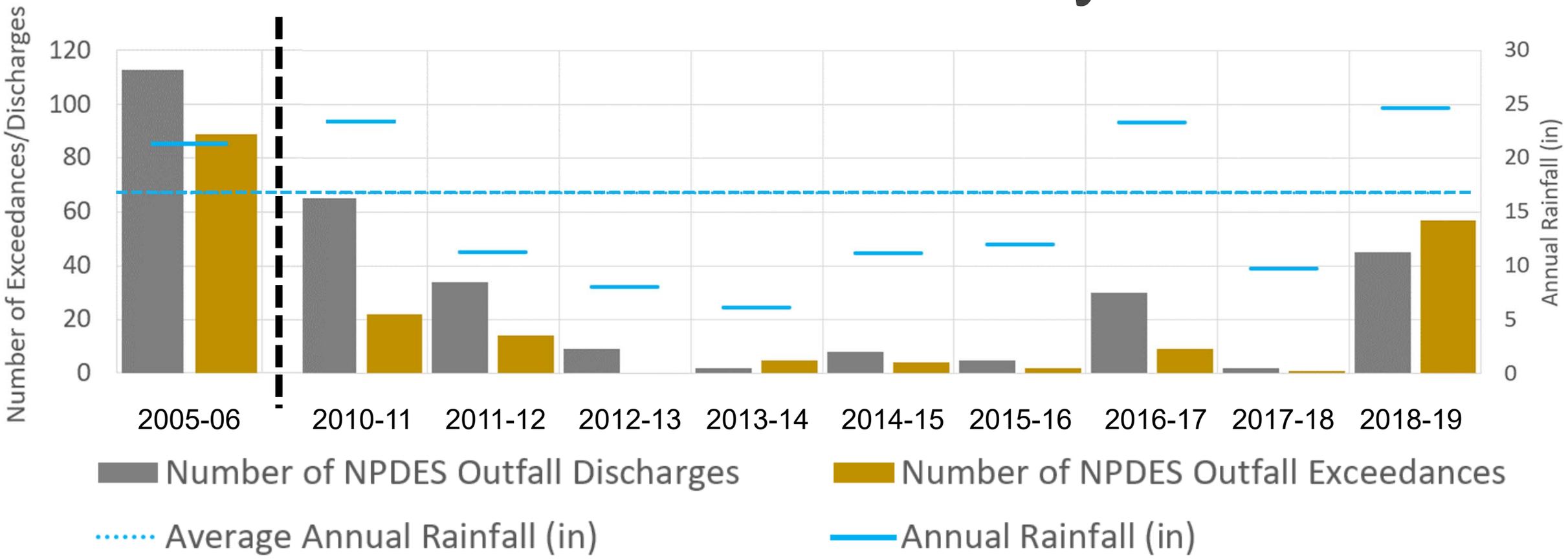
2018-19 SSFL Permit Initial Sample Results Preliminary Review

WATER YEAR REVIEW

OUTFALL DISCHARGES

EXCEEDANCES

Recent Exceedance History



Water Year Review (Oct 2018 – Present)

Year/ Wildfire	Total Rainfall in Year following (% of Average)	Number of Flow Events	Number of Discharge Samples	Exceedances (as compared to 2015 Permit effluent limitations)		% of SSFL Burned
				Benchmark (Outfalls 001 and 002)	Permit Limit (all other outfalls)	
2019 Woolsey	24.79-in* (150%)	13[a]	45	33[b]	24[b]	79%

Discharges counted as one per outfall per event, including 7-day follow-up samples; exceedances counted as one per parameter per outfall per event; discharge samples, exceedances, and rainfall through 3/31/2019.

% of site burned based on burn perimeter map; [a] Three of the 13 flow events were 7-day follow up samples (no rain); [b] Preliminary - some results pending

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2019 Woolsey	24.79-in* (150%)	13[a]	45	33[b]	24[b]	79%
2005 Topanga	21.3-in (126%)	17	113*	18	71	97%

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*The construction of the Outfall 018 stormwater treatment system decreased the number of discharges and exceedances

Post-Wildfire Runoff Volume Effects Restricted to Small Events in Burned Watersheds in Woolsey Wildfire at SSFL

- Statistically significant change in fully and partially burned watersheds for storms <2-inches
- No statistically significant change in unburned watersheds

	Storm Size	
	<2-in	>2-in
Burned watersheds	**Significant increase (7X)**	No significant difference
Unburned watersheds	No significant difference	No significant difference

Where were the 2018-19 exceedances?

Outfalls that burned had 55 of the 57 exceedances

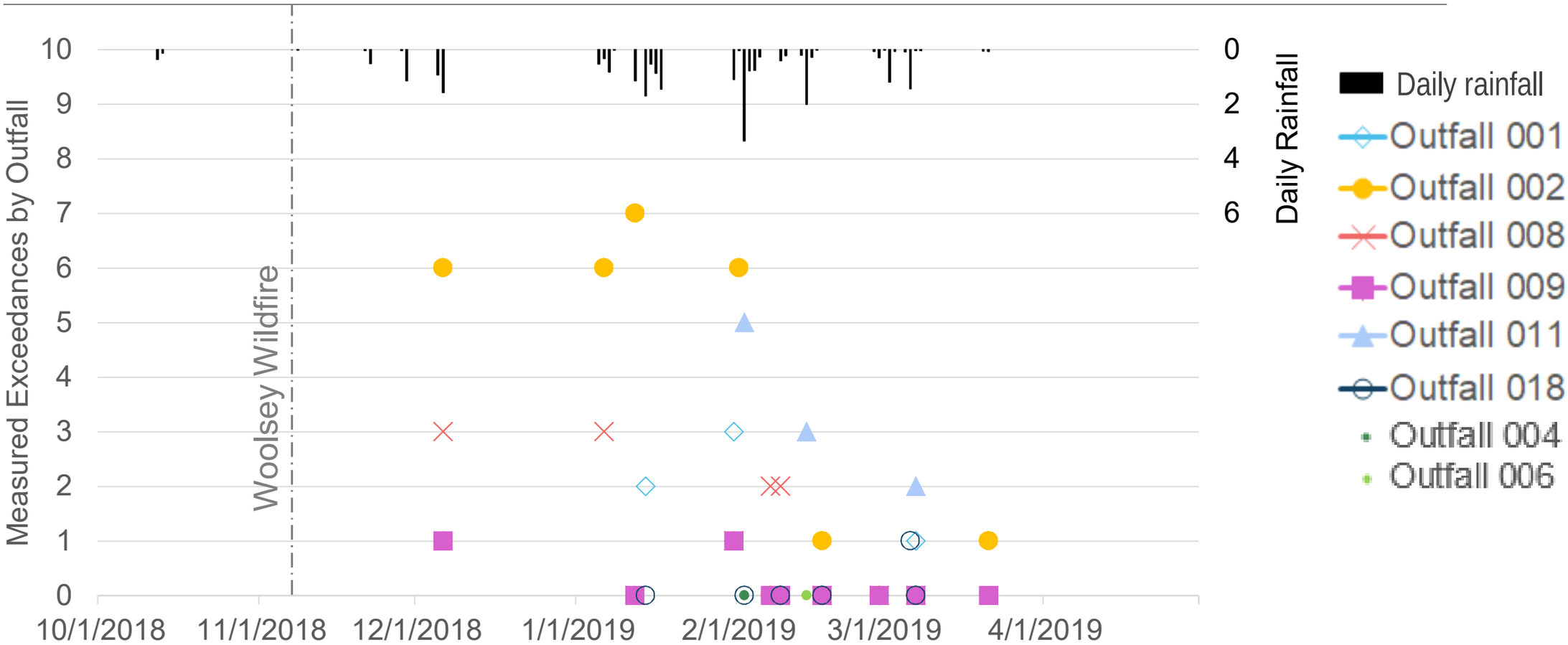
Outfall 018 burned, but because of storage capacity and advanced treatment, only had one exceedance (pH)

Outfall 009 burned much less, and because it had many structural treatment BMPs, only had two exceedances

Event Dates	Event Total (in)	Outfall Samples/Effluent Limit or Benchmark Exceedances*												Total
		001	002	003	004	005	006	007	008	009	010	011	018	
10/12-13/2018	0.48													0
11/21-22/2019	0.55			Note: A '0' indicates that an outfall sample was collected, but that no exceedances were measured.										0
11/28-29/2018	1.17													0
12/5-6/2018	2.51		6						3	1				10
1/5-7/2019	1.69		6						3					9
1/12-17/2019	5.68	2	7						0	0			0	9
1/31-2/5/2019	6.27	3	6		0				1	1		5	0	16
2/7-8/2019	No rain (7-day sample)	0	0						2	0				2
2/9-16/2019	3.12	0	0				0		2	0		3	0	5
2/17-18/2019	No rain (7-day sample)	0	1						0	0			0	1
2/27-3/7/2019	3.18	0	0						0	0		2	1	3
3/7-8/2019	No rain (7-day sample)	1	0						0	0				1
3/20-21/2019 **	0.11		1							0				1
Total	**24.79**	**6**	**27**	**NF**	**0**	**NF**	**0**	**NF**	**11**	**2**	**NF**	**10**	**1**	**57**

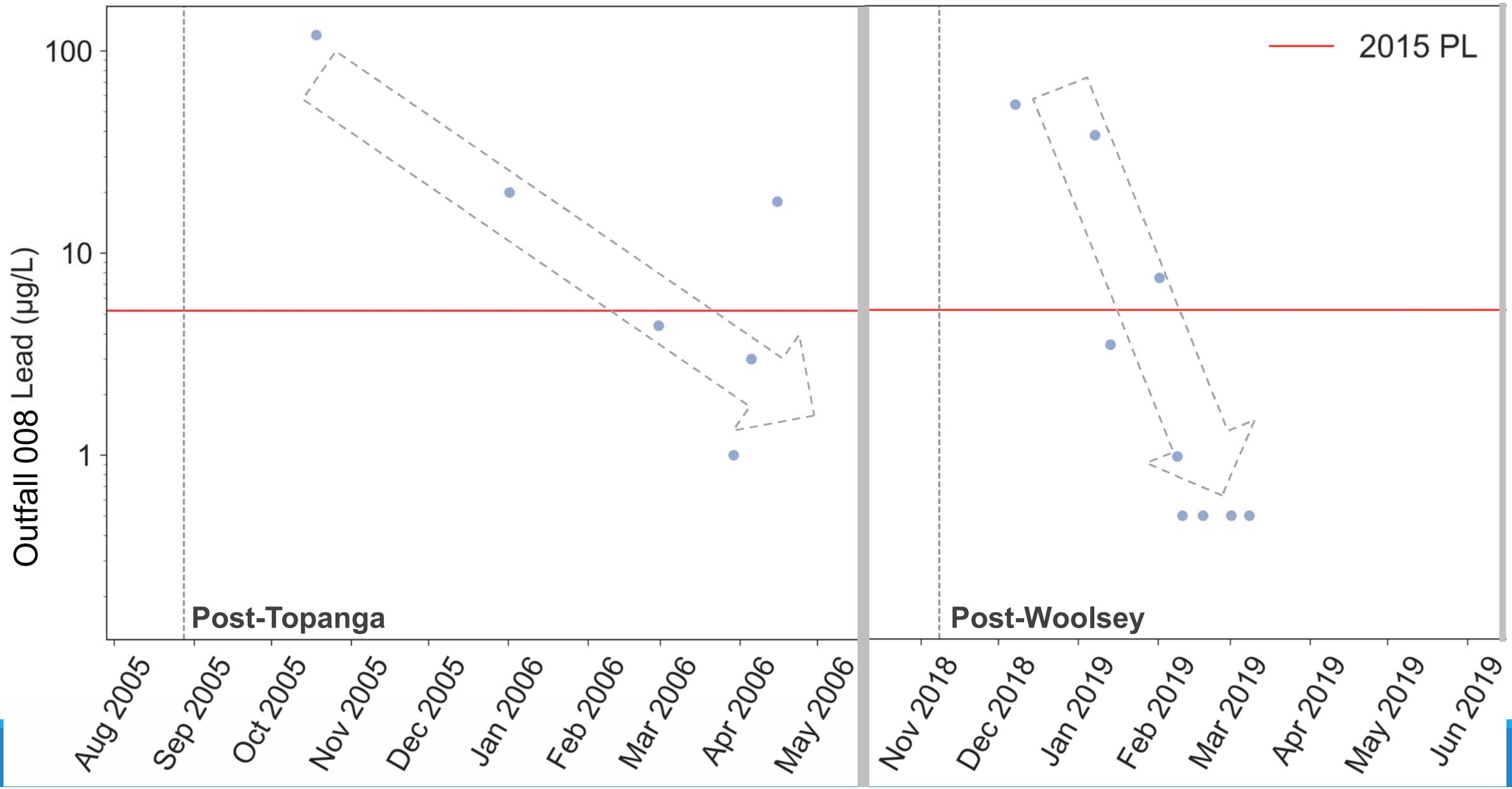
*Results 10/1/18 - 3/31/18. **Gross alpha and Rad pending. Pink cells = burned; green cells = partially burned. NF = no flow.

Number of Permit Limit and Benchmark Exceedances are Decreasing with Time



Example of stormwater concentrations returning to historically-normal levels

MJ



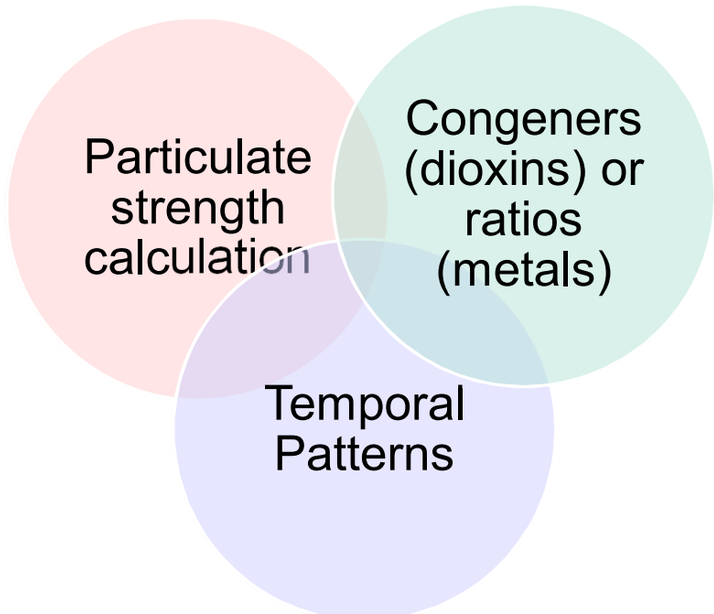
What sources most likely explain the 2018-19 NPDES outfall exceedances?

Potential Sources

- Fire retardants
- Ash
- Hydromulch
- Pavement solids
- Treated wood and adjacent soils
- Atmospheric deposition
- Natural background soils
- Former operational and contaminated areas

Annual Report in development, which will present findings on pollutant sources

Lines of Evidence



Other Lines of Evidence

- Experience from other wildfires
- Spatial patterns

Preliminary Observations

Exceedance	Primary Source
Most metals	Natural background soils
Dioxins	Pavement solids, soils near treated wood, and burned treated wood and pipes
Gross Alpha	Only naturally occurring radionuclides detected
Nitrates and Sulfates	Baseflow from groundwater discharges
Cyanide	Possibly burned sampling equipment
pH	Still under evaluation

Preliminary Conclusions

1) 2018-19 had a large number of discharges and a large number of exceedances
   - Rainfall was 150% of average
   - 80% of site burned
   - More runoff in burned watersheds compared to same size storm in prior years
   - Higher constituent concentrations in burned watersheds
2) 2018-19 SSFL NPDES results are generally consistent with findings from published studies that concentrations increase after wildfires
3) Concentrations over course of the season are returning to pre-fire levels due to post-fire response and vegetation recovery
4) 2018-19 exceeding concentrations are generally explained by greater:
   - Erosion of natural background soils (metals)
   - Ash from burned vegetation and pipe (metals)
   - Ash from burned pipe and treated wood (dioxins)
   - Groundwater discharge (nitrates and sulfates)

Our Annual Report will document additional findings and make new recommendations as necessary to address this year's exceedances.

Looking Ahead

July 2019

- Public Meeting: Review of 2018-19 NPDES results and source analysis
- Public Tour: Site condition/recovery

October 31, 2019

- Annual Report submitted to Regional Board