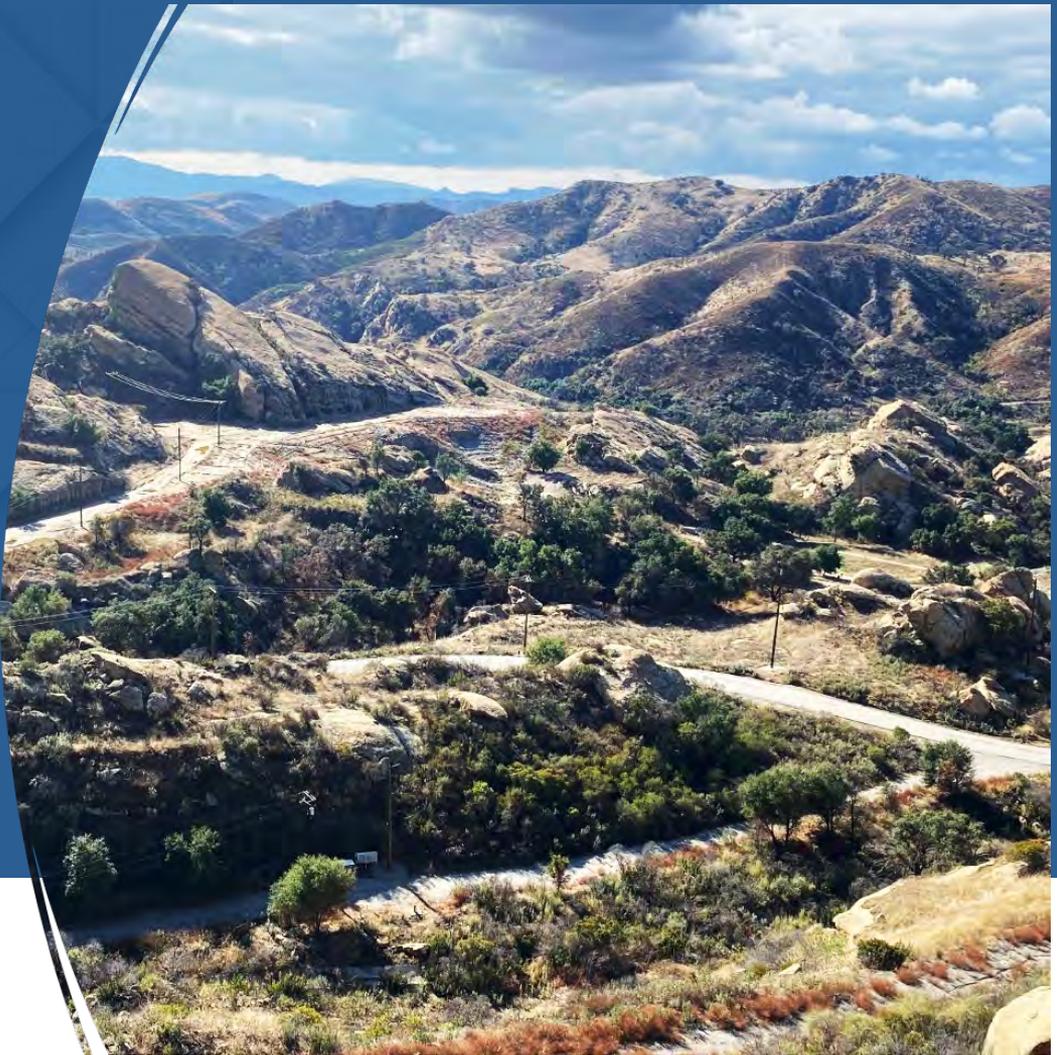


Santa Susana Field Laboratory (SSFL) Stormwater Public Meeting

November 4, 2025

PRESENTED BY

SSFL Surface Water Expert Panel



Meeting Orientation

Meeting Objectives

- For the Surface Water Expert Panel (Panel) to update the public on stormwater sampling results and management activities at SSFL, and
- To allow the public an opportunity to ask additional stormwater-related questions of the Panel

Agenda

- 1:00 – 4:00 pm Site Tour at SSFL
- 6:00 – 7:30 pm Panel Presentation
- 7:30 – 8:00 pm Questions and Answers

Meeting Orientation

Proposed Ground Rules

- Keep questions brief and focus on topics addressed by the Surface Water Expert Panel
- We will answer your questions after the presentation (please raise your hand and wait for the microphone)
- Questions unrelated to the topics of this meeting will be documented and answered, as feasible, at a later date
- Please treat everyone in the meeting with kindness and respect

Outline

1. Panel Introduction and Site Background
2. Site Drainage and Receiving Waters
3. Existing BMPs and SWTs
4. ISE Activity Updates
5. Pond Infiltration Study Update
6. 2023/24 and 2024/25 Stormwater Sampling Results
7. Exceedance Source Investigation
8. BMP Recommendations
9. Stormwater Human Health Risk Assessment (HHRA) Update
10. Conclusions

1

Panel Introduction and Site Background

Surface Water Expert Panel Introduction

- Dr. Bob Gearheart, PE, California State Polytechnic University, Humboldt, Emeritus
- Jon Jones, PE, Wright Water Engineers
- Dr. Bob Pitt, PE, University of Alabama, Emeritus
- Dr. Michael K. Stenstrom, PE, University of California, Los Angeles
- Dr. Greg Pasternack, PE, University of California, Davis
- Panel consultant: Geosyntec Consultants



Panel's Origin

- The Los Angeles Regional Water Quality Control Board (Regional Board) issued a Cease and Desist Order in 2007 requiring Boeing to design and implement Engineered Natural Treatment Systems (ENTS) for stormwater discharges at SSFL outfalls
- Boeing was required to form an independent panel of experts to provide technical oversight on ENTS designs, leading to the creation of the **Surface Water Expert Panel (Panel)**
- Panel selection began in November 2007
- Boeing, with Geosyntec's assistance, identified experts in stormwater hydrology and ENTS design
- Six panelists were selected, in consultation with the Regional Board



Panel's Scope

Ongoing Responsibilities (2015 & 2023 Permit)

- Review NPDES compliance and BMP performance data
- Investigate site-wide stormwater pollutant sources
- Recommend new BMPs or BMP improvements
- Review Stormwater Human Health Risk Assessment
- Conduct public outreach
- Review Stormwater Pollution Prevention Plans (SWPPPs) for site cleanup

Memorandum of Understanding – NPDES Permit

- Establish background stormwater thresholds
- Perform post-cleanup stormwater modeling
- Develop post-cleanup stormwater monitoring plan



Dr. Josselyn Retirement and Replacement Process

- Dr. Josselyn retired in 2022, prompting Panel to request replacement
- Regional Board March 2024 letter requested Panel identify qualified candidates with expertise in:
 - Remediation and restoration related to hazardous waste sites
 - Stream hydrodynamics and revegetation
 - BMP implementation addressing stormwater quantity and quality
- Panel provided list, Regional Board sought input from NGOs, and Regional Board selected top 5 in Oct 2024
- Geosyntec screened these for interest and availability; 3 said 'yes'
- Panel picked their top 2, met each, and recommended both
- Regional Board selected final candidate, requiring no prior work for Boeing



New Panel Member Spotlight: Dr. Greg Pasternack

- Joined the Panel in early 2025
- Professor in Land, Air, and Water Resources at University of California, Davis
- Expertise in:
 - Basic physical and ecological science
 - Development of methods and software for designing more natural, functional environments
 - Technology transfer to get concepts, methods, and results into the hands of practitioners, regulators, and stakeholders



SSFL Overview

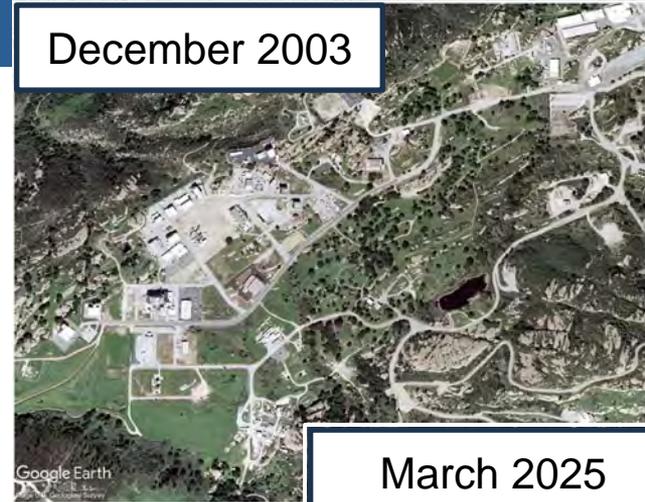
- Former rocket testing and energy research facility in Santa Susana Mountains
- Industrial activities have ceased and facilities removal is underway
 - Nuclear energy research operations ceased in 1989
 - Rocket engine testing operations ended in 2006



SSFL Overview

Current Activity Onsite:

- Environmental monitoring/sampling
- Management of numerous stormwater Best Management Practices (BMPs) to treat stormwater and reduce erosion
- Remediation planning
- Demolition of facility structures

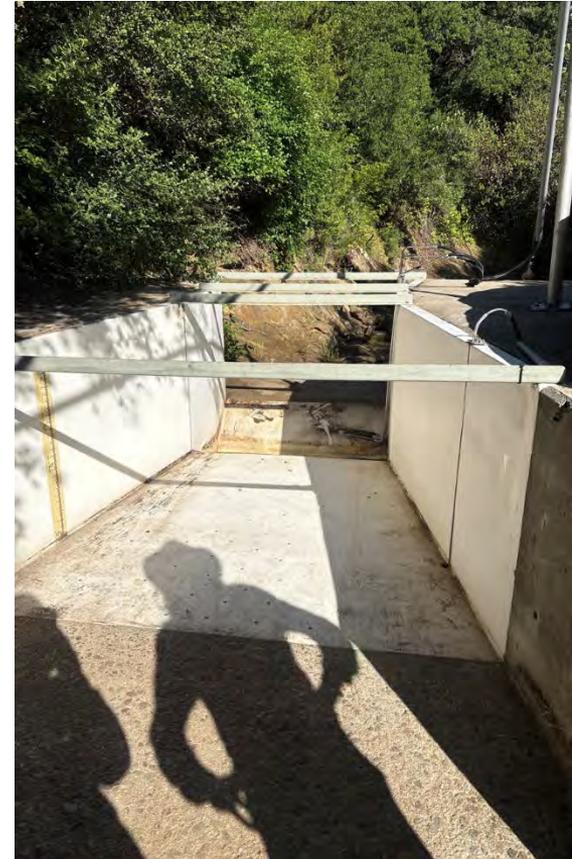


SSFL Stormwater Quality is Regulated by a NPDES Permit

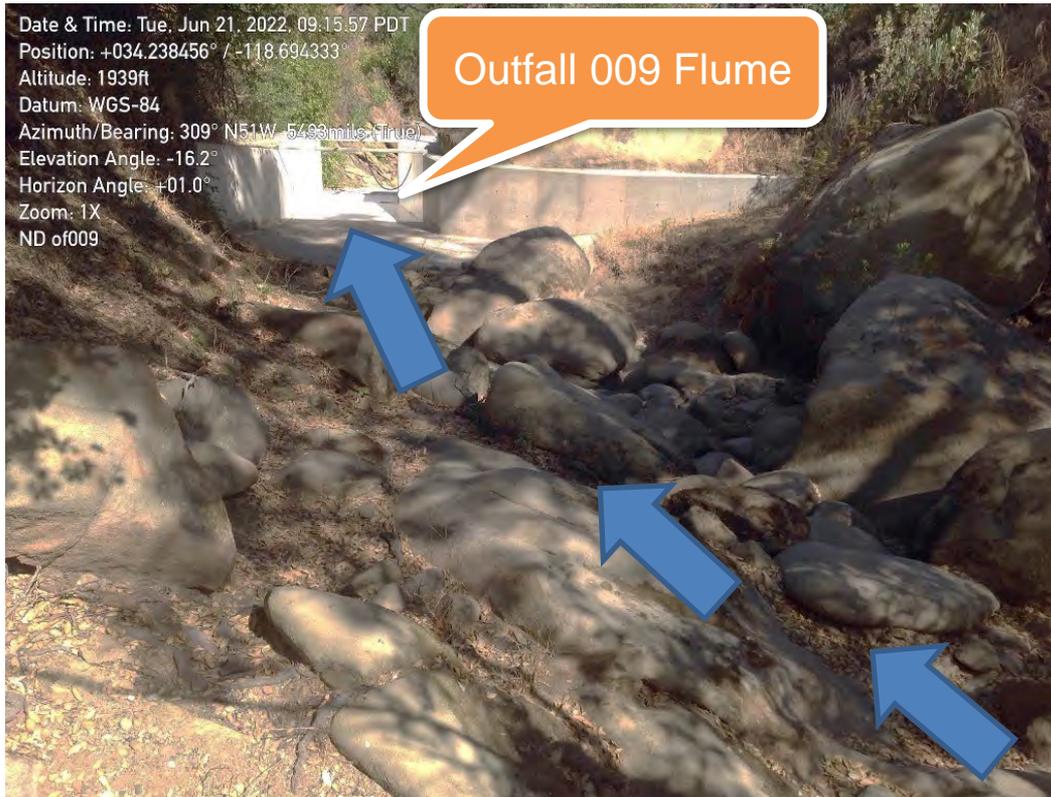
National Pollutant Discharge Elimination System (NPDES)

- Governs the discharge of pollutants into U.S. waters (Clean Water Act)
- Permits are issued by Los Angeles Regional Water Quality Control Board (Regional Board)
 - 2023 Permit¹ is the most recent update, effective January 1, 2024

¹Previously, discharges were regulated by 2015 Permit limits and Outfalls 001 & 002 benchmarks



NPDES Outfall Example: Outfall 009



- All creek flow is directed through the flume to enable flow measurement and water sampling
- Outfalls also equipped with autosamplers to enable 24/7 composite sampling

SSFL 2023 NPDES Permit Requirements Overview

- The 2023 Permit requires:
 - Composite sampling at 12 stormwater outfalls
 - Influent sampling at 2 active stormwater treatment systems
 - Compliance with up to 58 stormwater permit limits – protective of both human health and aquatic life
 - Additional monitoring in 1st and 2nd discharge events of the first year of the 2023 Permit (over 500 analytes, including those in the SRAM¹, PCBs as Congeners, and PFAS)
- Permit limits are for a wide range of constituents, including:
 - Dioxins (TCDD TEQ): 2.8E-08 µg/L
 - Total Lead: 5.2 µg/L
 - Mercury: 0.1 µg/L or 0.024 µg/L²

¹Standardized Risk Assessment Methodology

²Mercury limit is 0.1 µg/L at Outfalls 001, 002, 011, and 018 and 0.024 µg/L at all other outfalls

SSFL Voluntary Monitoring

In addition to required compliance monitoring, monitoring is also conducted voluntarily per Panel recommendation:

Offsite Background Monitoring

- **Undeveloped natural background and ambient background locations (for comparison with SSFL stormwater)**

BMP Performance (Outfall 009 watershed)

- **Distributed passive media filter BMPs, to monitor treatment effectiveness**

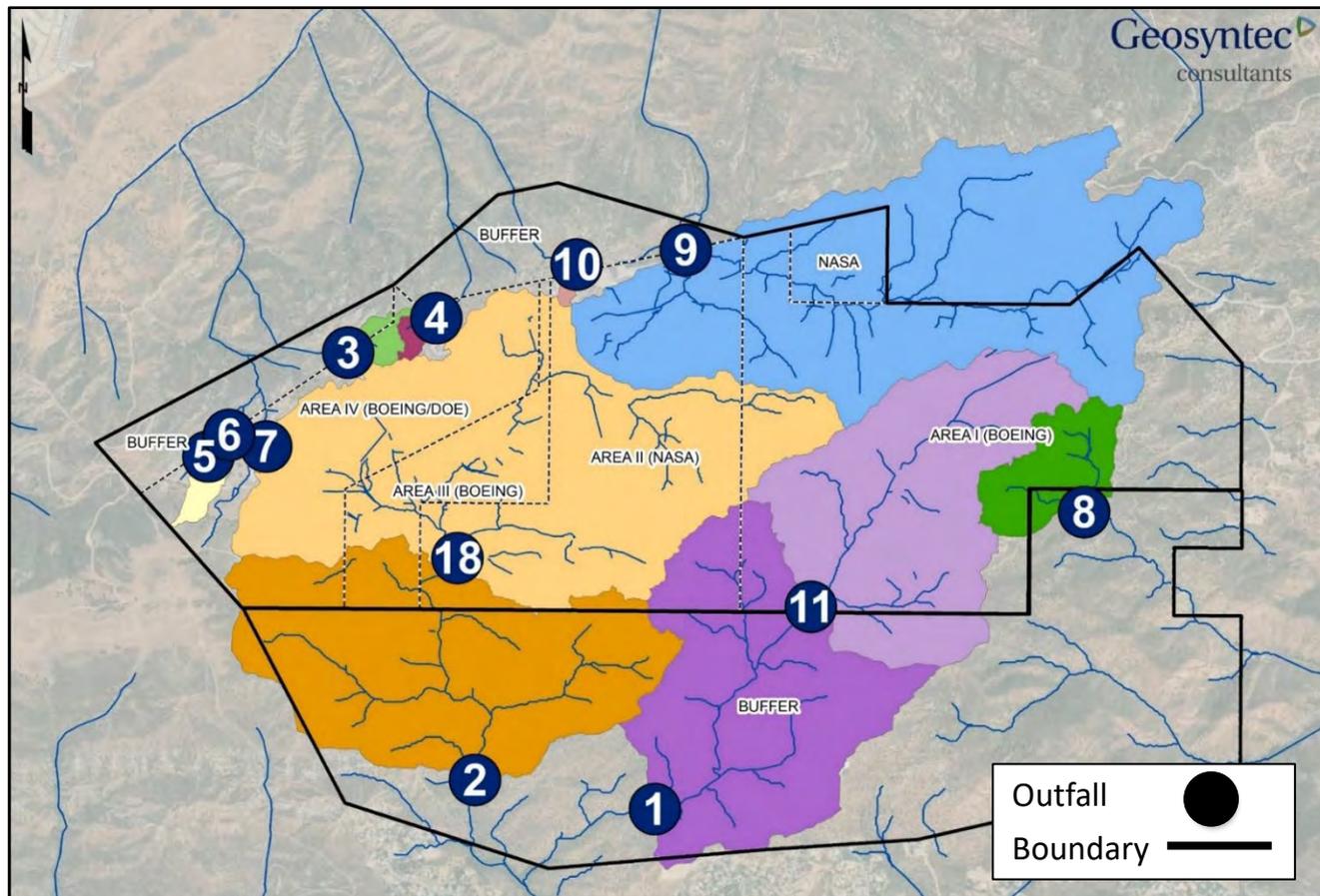
BMP Subareas (mostly Outfall 009 watershed)

- **To identify areas where additional BMPs may be necessary**

2 Site Drainage & Receiving Waters

Surface Water Flow On and Off SSFL

NPDES Outfalls and Watersheds at SSFL

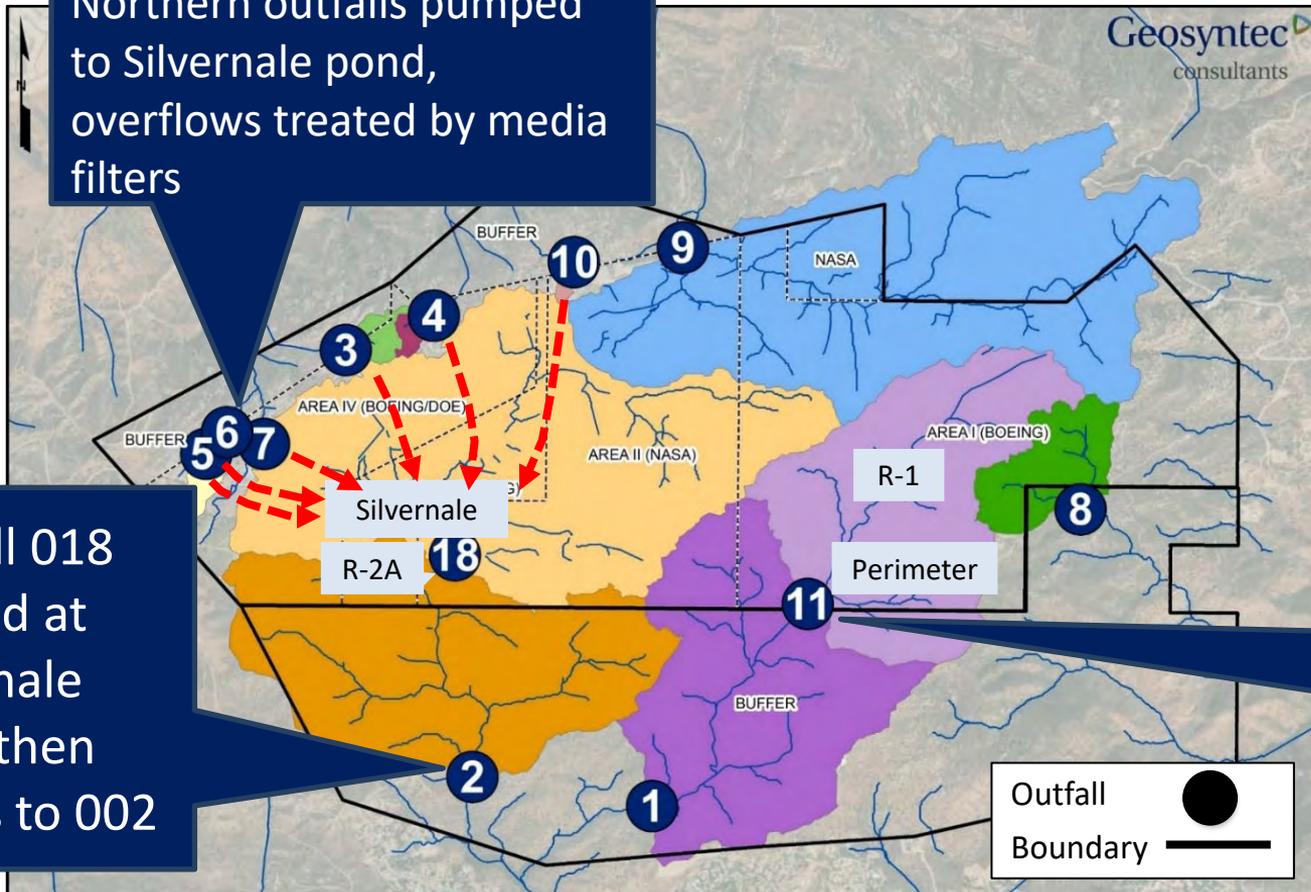


NPDES Outfalls and Watersheds SSFL

Northern outfalls pumped to Silvernale pond, overflows treated by media filters

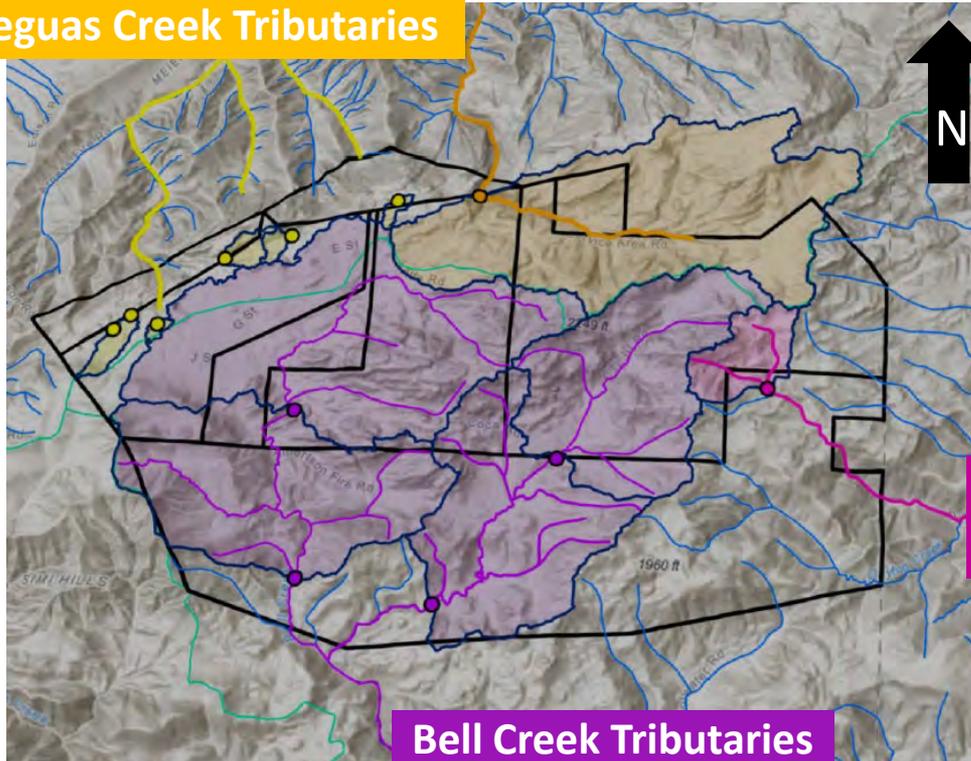
Outfall 018 treated at Silvernale Pond then drains to 002

Outfall 011 treated at R-1 Pond then drains to 001



Regulated SSFL Outfalls and Major Receiving Waters

Calleguas Creek Tributaries



Dayton Creek
to LA River

Bell Creek Tributaries
to LA River

3

Existing BMPs and SWTs

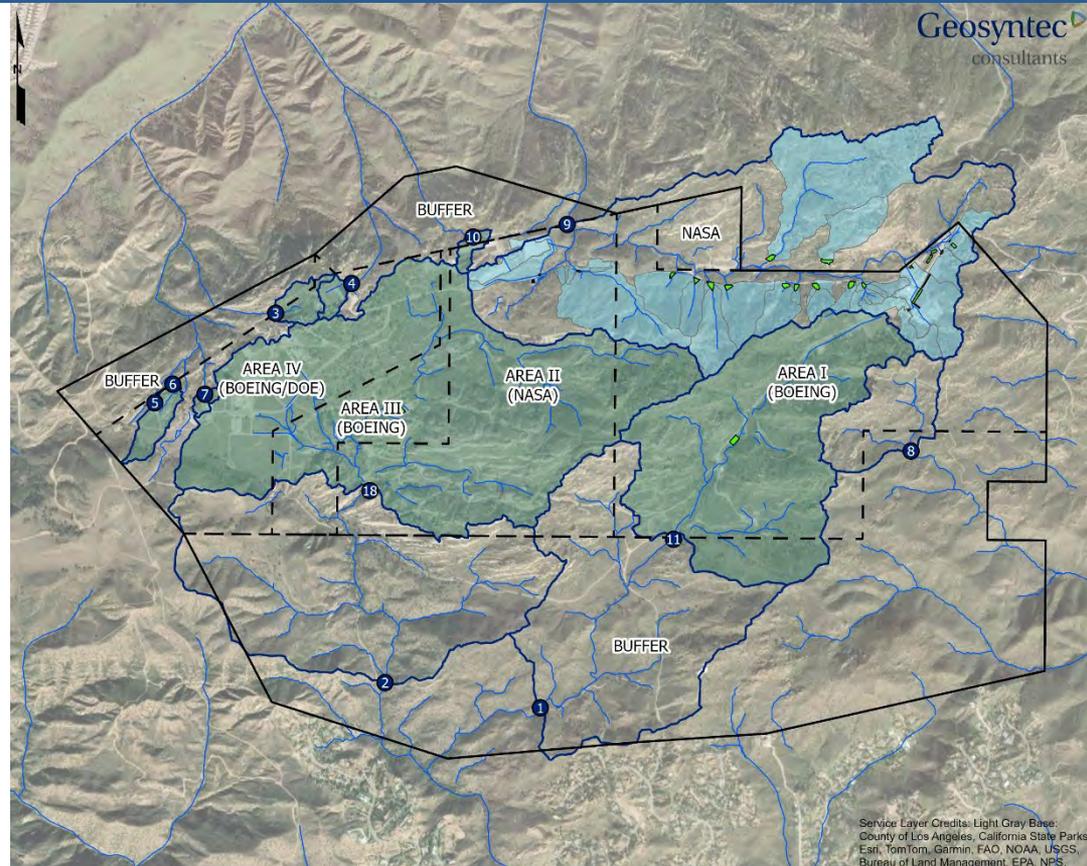
- Stormwater control summary
- Passive and active BMP summary

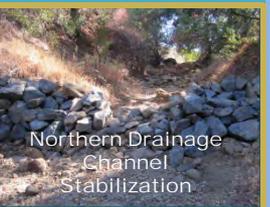
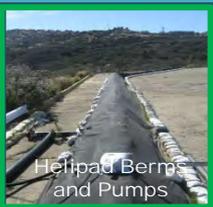
Existing Stormwater Controls

- **Distributed Passive Treatment BMPs**
 - Constructed at prioritized locations in Outfall 009 watershed
 - Include multiple treatment processes and filtration media targeting NPDES exceeding constituents
- **Active stormwater treatment systems (SWTS)**
 - Advanced treatment train (requires power, chemical addition, pressurized vessels)
 - Outfall 011 and 018 watersheds
- **Erosion controls**
 - Implemented site-wide
 - Designed to hold soils in place, especially where surface soils are contaminated

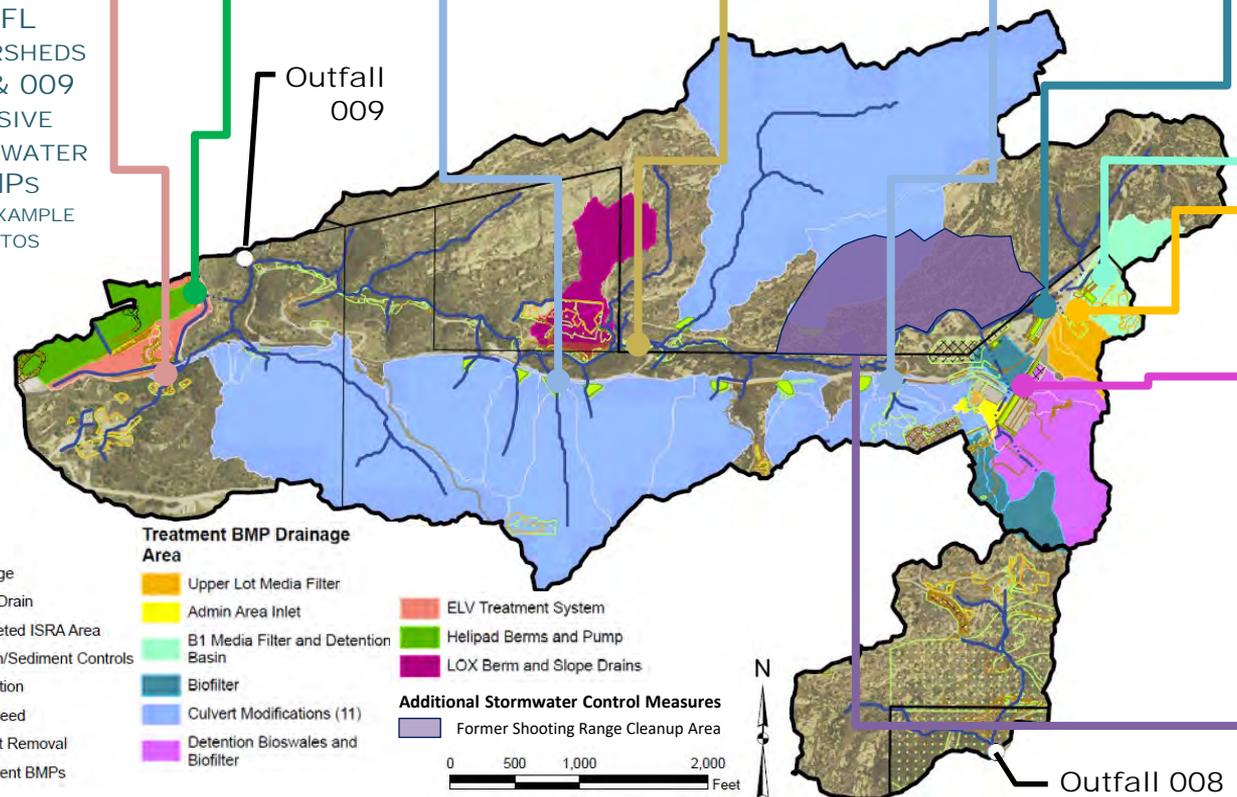


Spatial Distribution of Existing Stormwater Controls





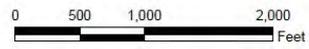
SSFL
WATERSHEDS
008 & 009
PASSIVE
STORMWATER
BMPs
WITH EXAMPLE
PHOTOS



Legend

- Drainage
 - - - Storm Drain
 - ▭ Completed ISRA Area
 - ▭ Erosion/Sediment Controls
 - ▭ Demolition
 - ▭ Hydroseed
 - ▭ Asphalt Removal
 - ▭ Treatment BMPs
- Treatment BMP Drainage Area**
- ▭ Upper Lot Media Filter
 - ▭ Admin Area Inlet
 - ▭ B1 Media Filter and Detention Basin
 - ▭ Biofilter

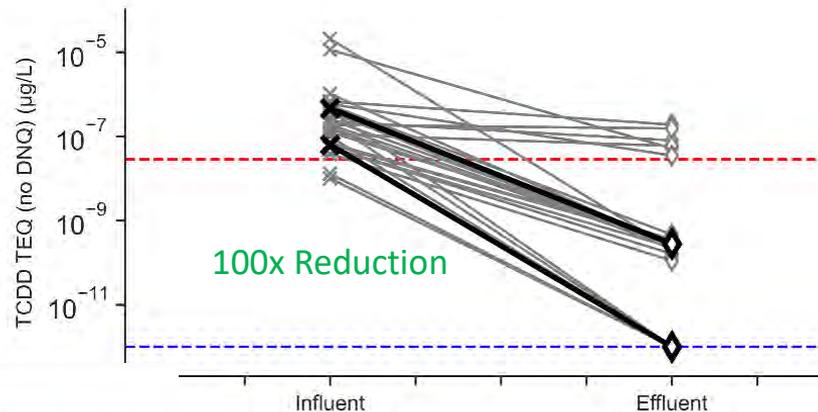
- ▭ ELV Treatment System
 - ▭ Hellipad Berms and Pump
 - ▭ LOX Berm and Slope Drains
- Additional Stormwater Control Measures**
- ▭ Culvert Modifications (11)
 - ▭ Former Shooting Range Cleanup Area



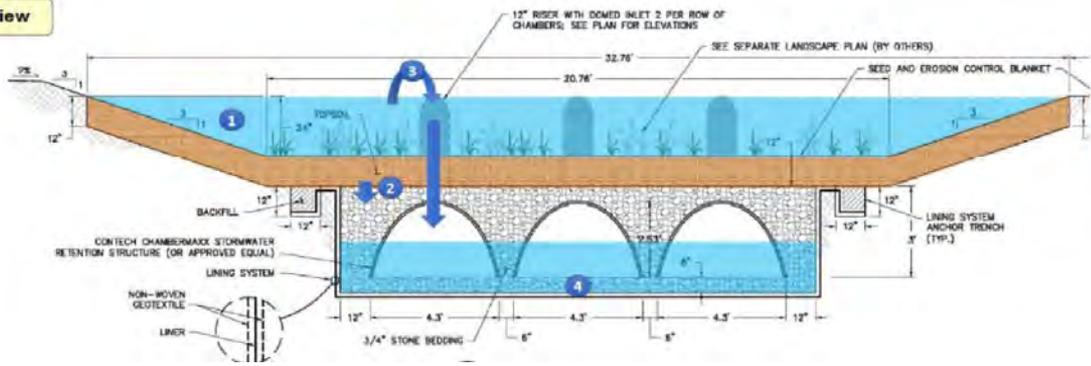
Distributed Passive BMPs: Detention Bioswale Example



Dioxins at Southern Detention Bioswale



Profile View



Legend

- × Weighted Average (ILBMP0008 - 91%, ILBMP0004 - 9%)
- △ ILBMP0008
- ◇ ILBMP0005
- - - Permit Limit
- - - Typical Detection Limit
- 2015/2016 through 2021/2022
- 2022/2023

Active Stormwater Treatment Systems (SWTSs)



- Ponds for flow equalization and sedimentation pretreatment
- Screen filters
- pH adjustment (chemical addition)
- ACTIFLO to remove solids, metals, and organics via
 - Coagulation (chemical addition)
 - Flocculation
 - Settled solids removed and transported offsite
- Potassium permanganate-coated sand filter, then bag filters
- Granular Activated Carbon (GAC) filter, for organics removal, if needed
- Treated stormwater discharged at outfalls
- Silvernale SWTS treats >880 acres, at 1200 GPM

4

ISE Activity Updates

ISE Soil Cleanup Projects

- Two early cleanup actions¹ were ordered by DTSC
 - Former Shooting Range (completed 2025)
 - Area 1 Burn Pit (A1BP) (in progress)
- Stormwater Pollution Prevention Plans (SWPPPs) in place and Expert Panel recommended stormwater BMPs throughout ISE cleanup

¹Imminent and Substantial Endangerment Determination and Consent Order (ISE Order)

Former Shooting Range

ISE Order issued on March 25, 2022



Remediation commences in May 2023



Impacted soil excavation and stabilization measures in place by October 2025

- Located in Outfall 009 Watershed
 - Mountains Recreation and Conservation Authority (MRCA) Sage Ranch property
- Vegetation recovery period (post-excavation) is underway and will be inspected to evaluate regrowth



Former Shooting Range **before** remediation
June 2022



Former Shooting Range **after** remediation
June 2025

Former Shooting Range

- March 12, 2025 Site Visit



Area 1 Burn Pit



- Located in Outfall 011 Watershed
- ~17,700 cubic yards of soil removed by October 2025



A1BP **before** remediation
September 2021



A1BP **during** remediation
May 2025

A1BP Updates

Stormwater Controls:

- Excavation scheduled during dry season to minimize runoff risk
- Stormwater from western side diverted to SWTS
- Maintain existing BMPs and install final stabilization measures where work is complete

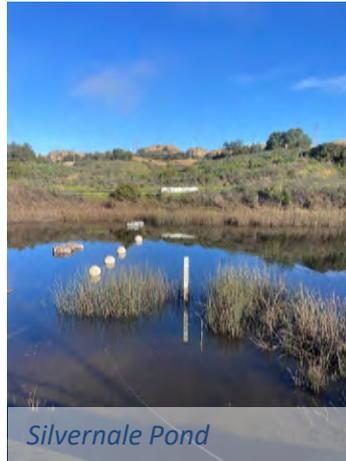


March 12, 2025 Site Visit

5

Pond Infiltration Study Update

In response to questions raised by the public, the Panel recommended that pond infiltration rates be measured.



Pond Infiltration Study Update

- Water levels measured over several months with ponded water present
- Infiltration rates calculated after subtracting evaporation when water levels not affected by precipitation

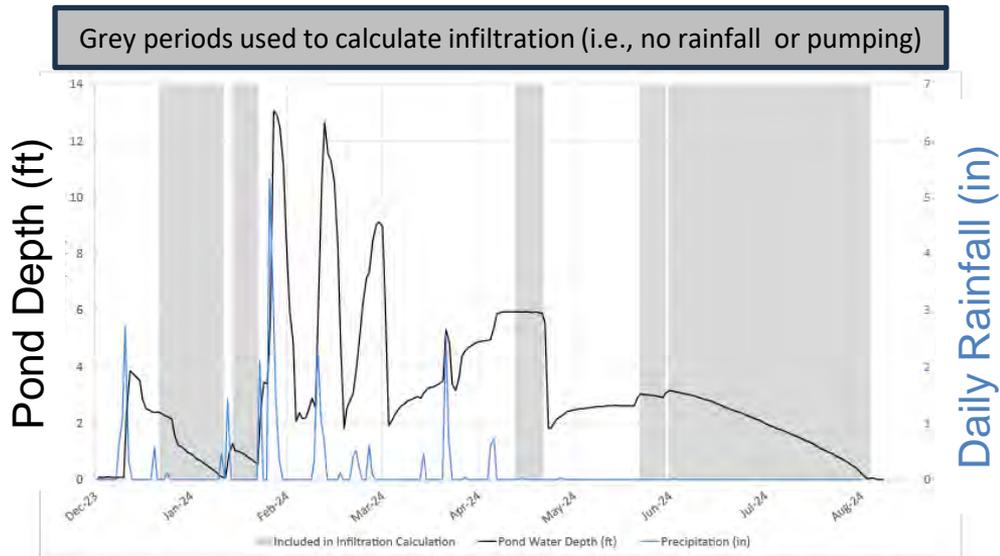
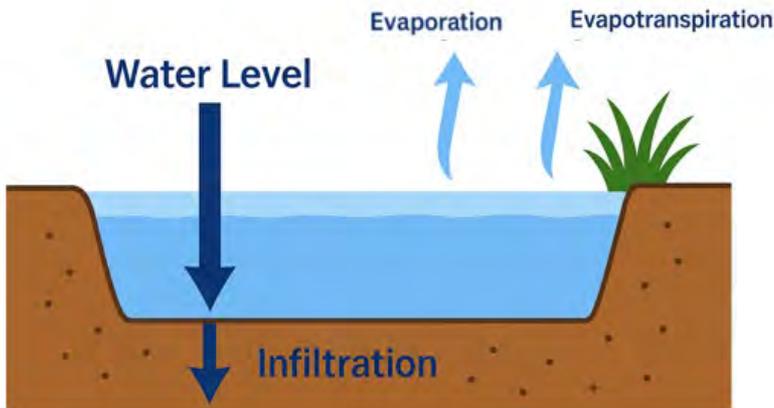


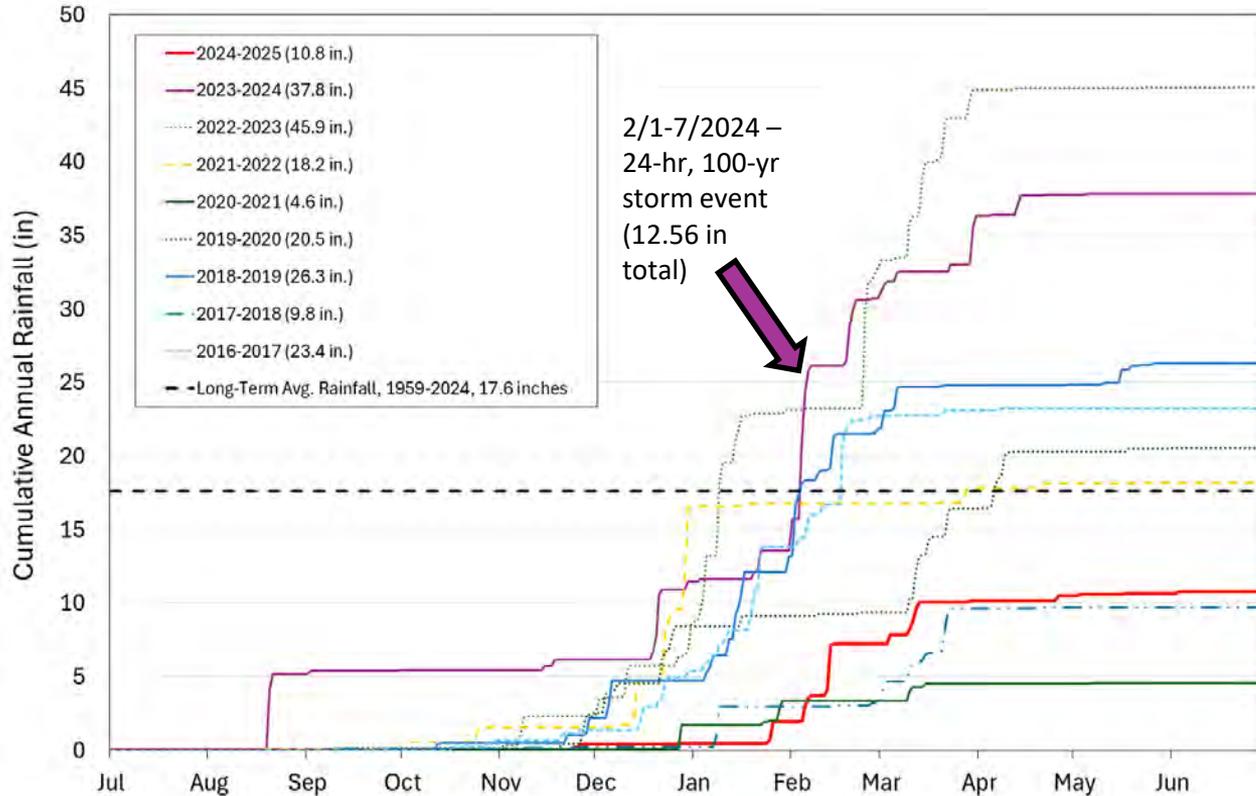
Figure 5. Water Depth and Precipitation at R-1 Pond: December 12, 2023 – August 21, 2024

Results confirm that stormwater infiltration in the ponds at SSFL is at or below the least conductive soils identified by the USDA-NCRS (i.e., clay) and therefore **unlikely to contribute significant transport of COPCs to groundwater.**

6

2023/24 and 2024/25 Results

Total Rainfall by Reporting Year



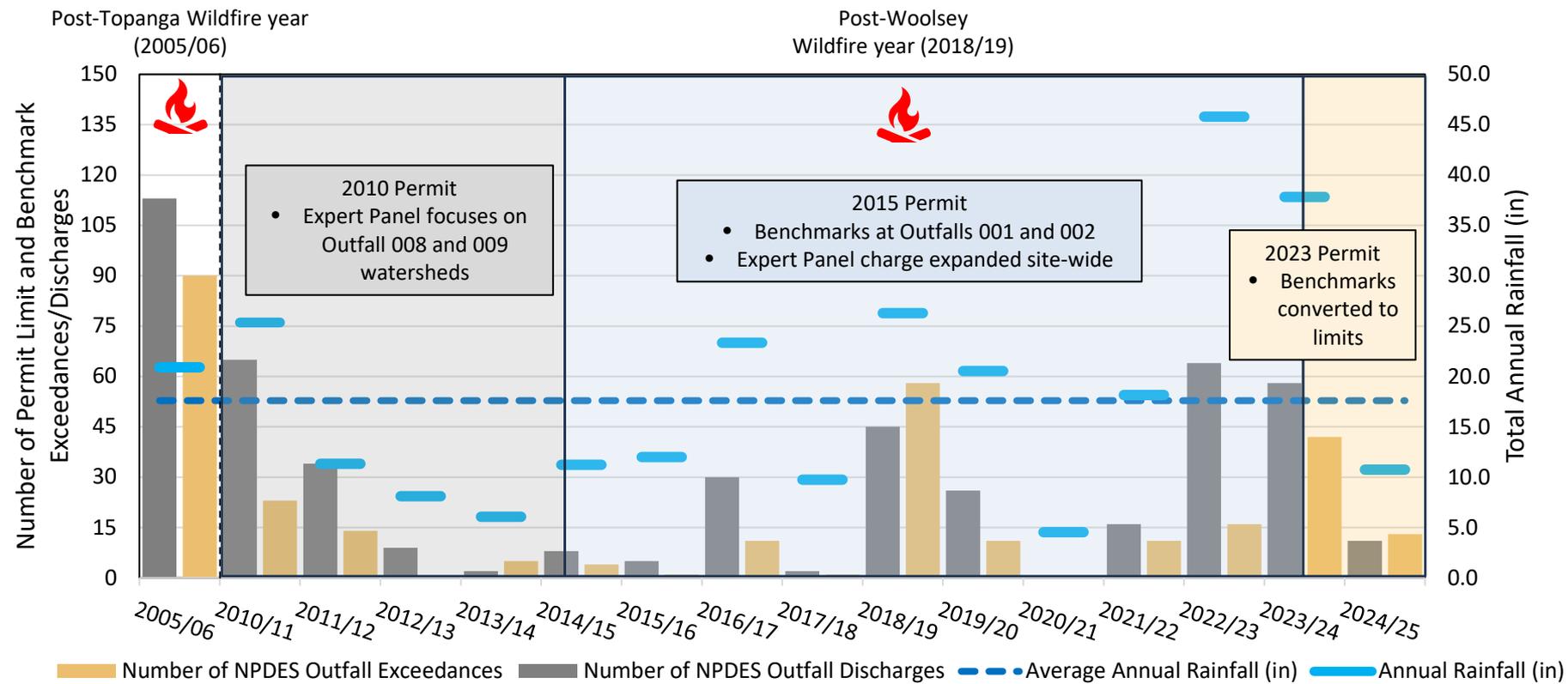
2023/24: 37.8 in

- 2x greater than average annual rainfall
- First 100-year storm event in recorded data at site (66 years)

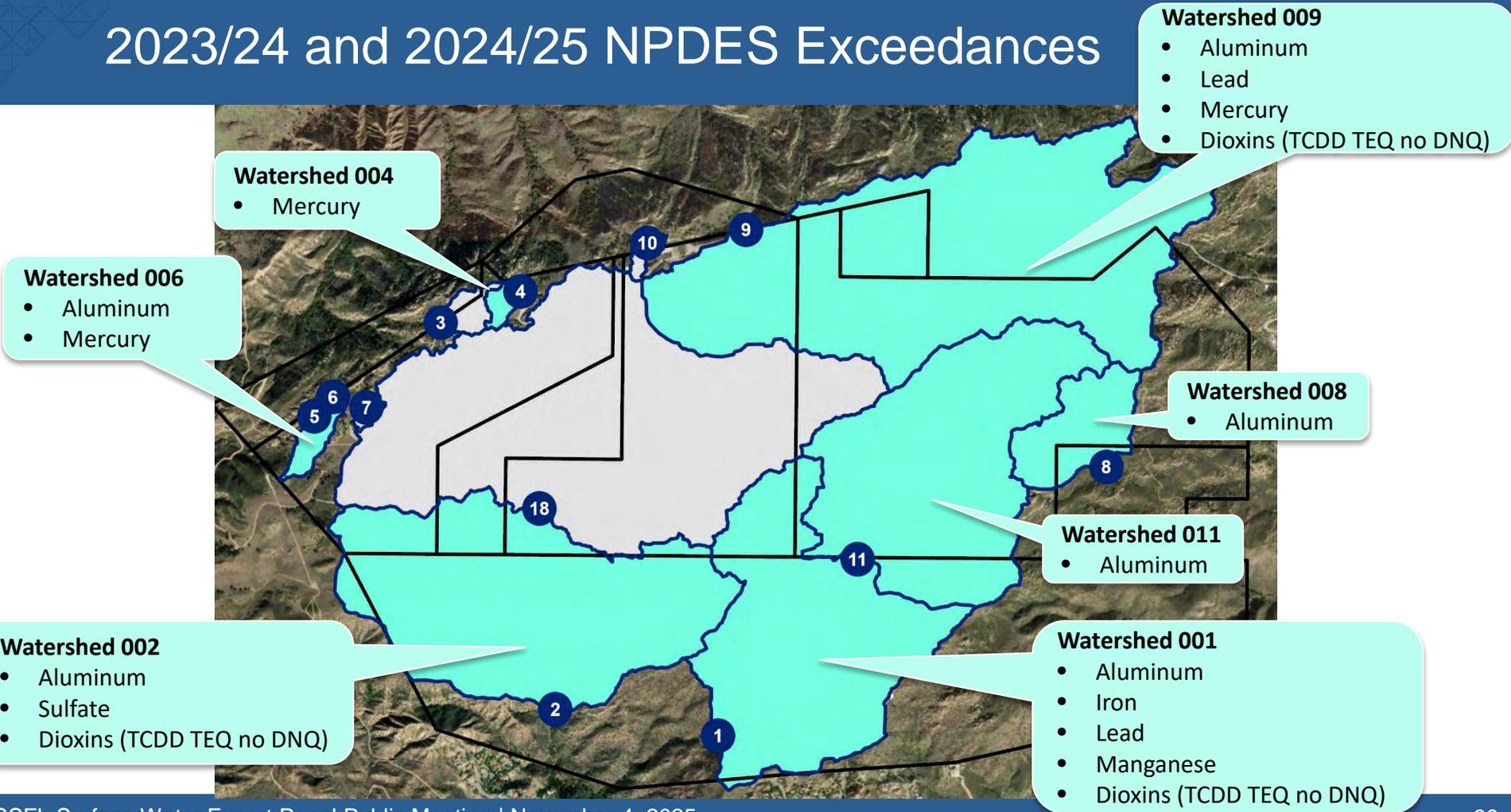
2024/25: 10.8 in.

- 0.65x of average annual rainfall

Historical Overview – NPDES Sampling

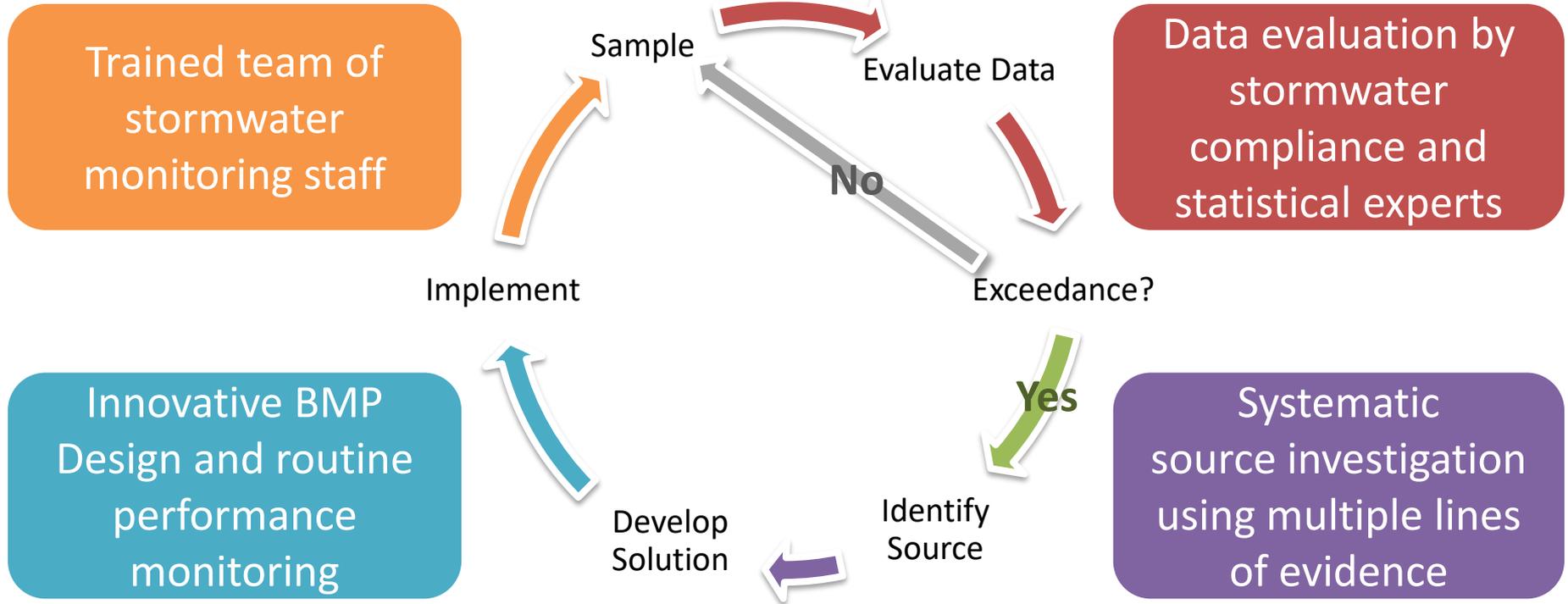


2023/24 and 2024/25 NPDES Exceedances



7 Exceedance Source Investigation

Panel's Process for Stormwater Quality Management



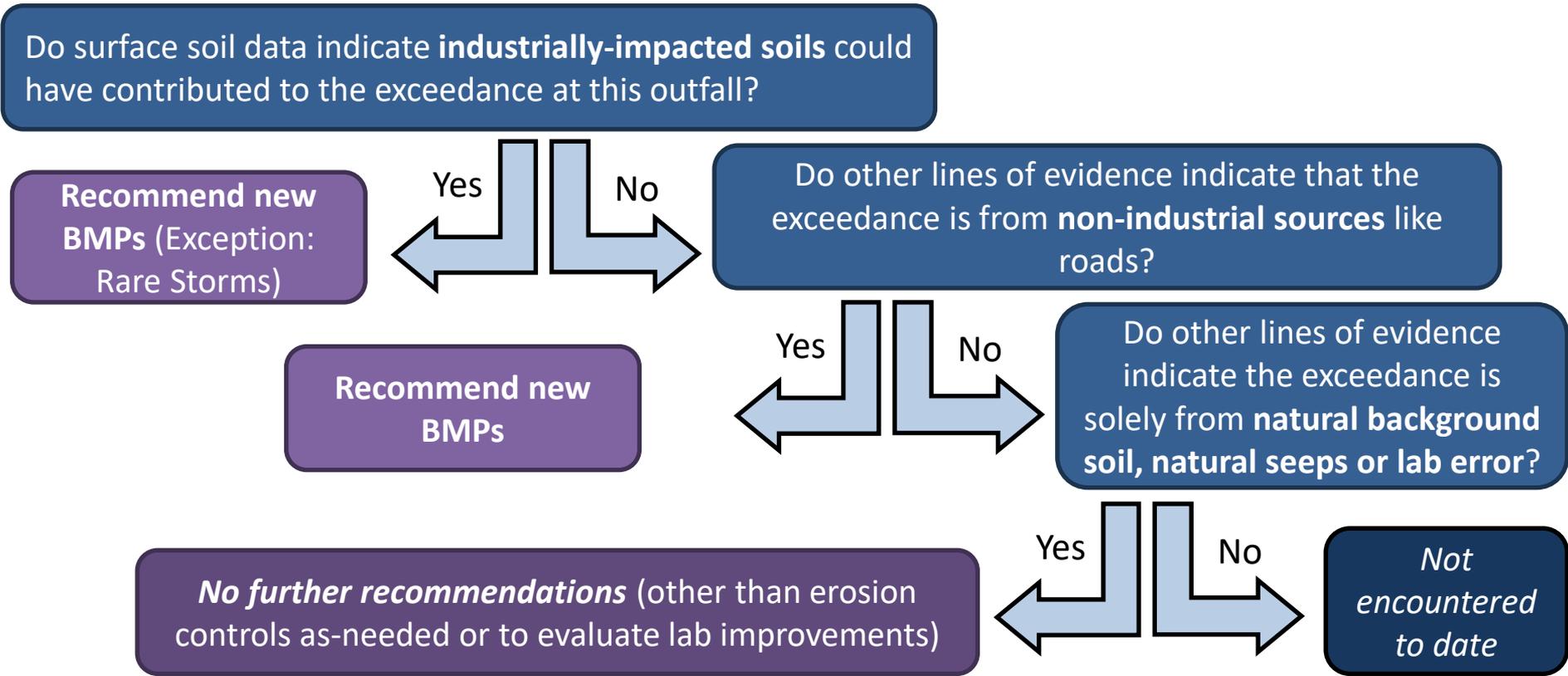
Exceedance Source Investigation Overview

Variety of sources at SSFL are evaluated to determine their potential to contribute to stormwater exceedances:

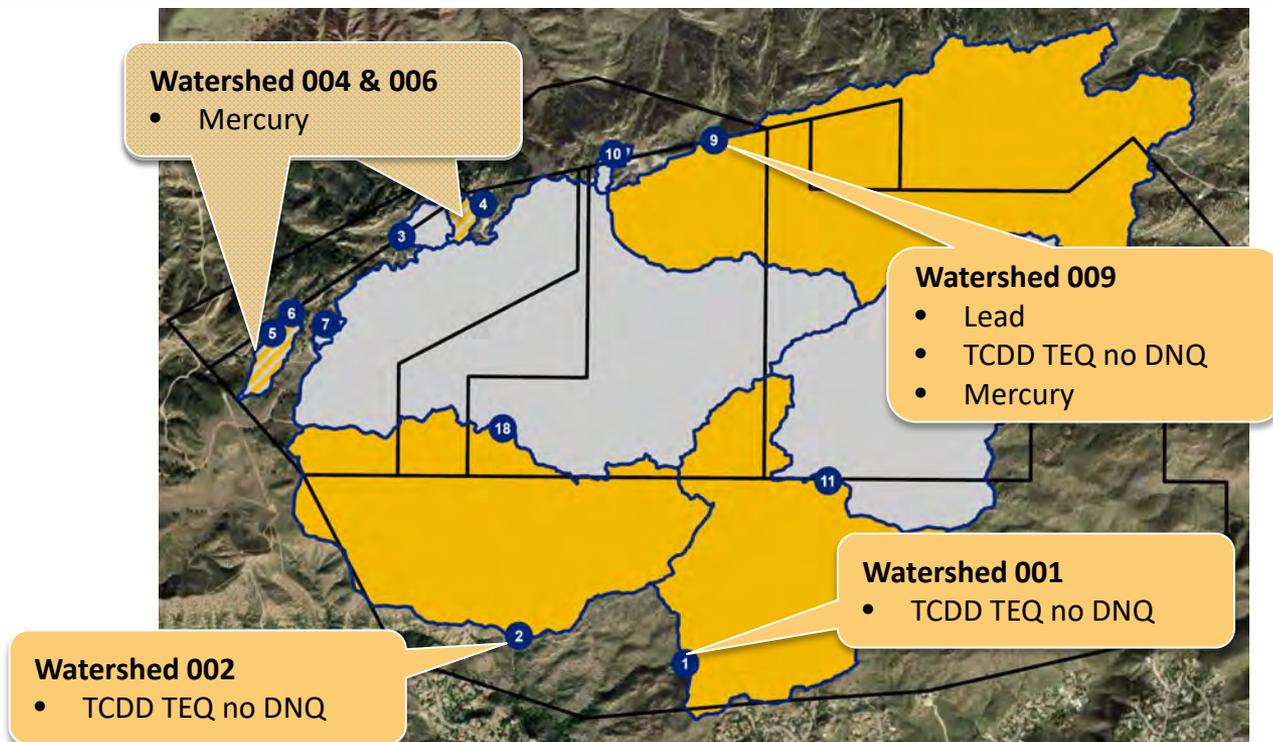
- Industrially-impacted onsite soils
- Background and non-industrial sources

Sources
Industrially-impacted Onsite Soils
Pavement Solids
Treated Wood
Atmospheric Deposition
Wildfire Ash
Offsite Background and Ambient (Non-Industrial) Stormwater

Causes of Exceedance Determination Process



Watersheds with Exceedances potentially attributed* to industrially-impacted Soils (2023/24 and 2024/25)



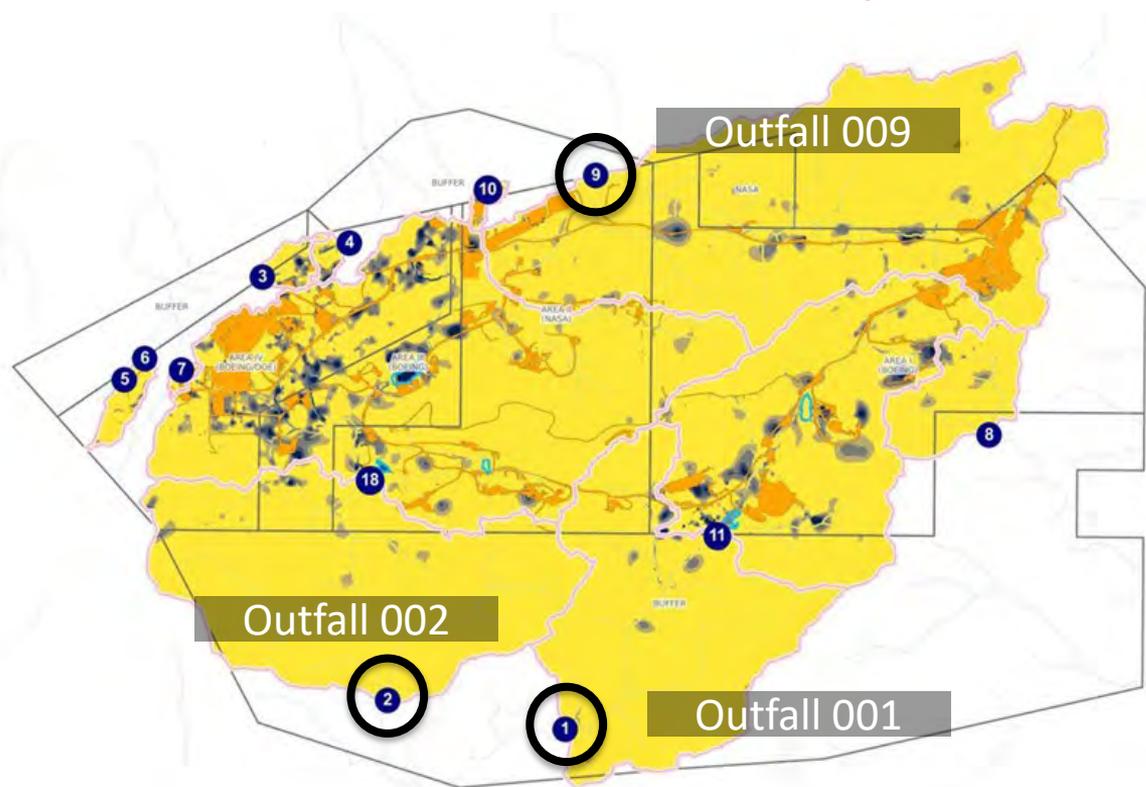
Non-hashed yellow indicated exceeding watersheds and grey non-exceeding. Note Watersheds 004 and 006 are hashed because the exceedances were associated with extreme storm events that are normally treated.

Exceedances with industrially impacted soils identified as at least one of the sources have been prioritized. Additional non-industrial sources may also have also been identified

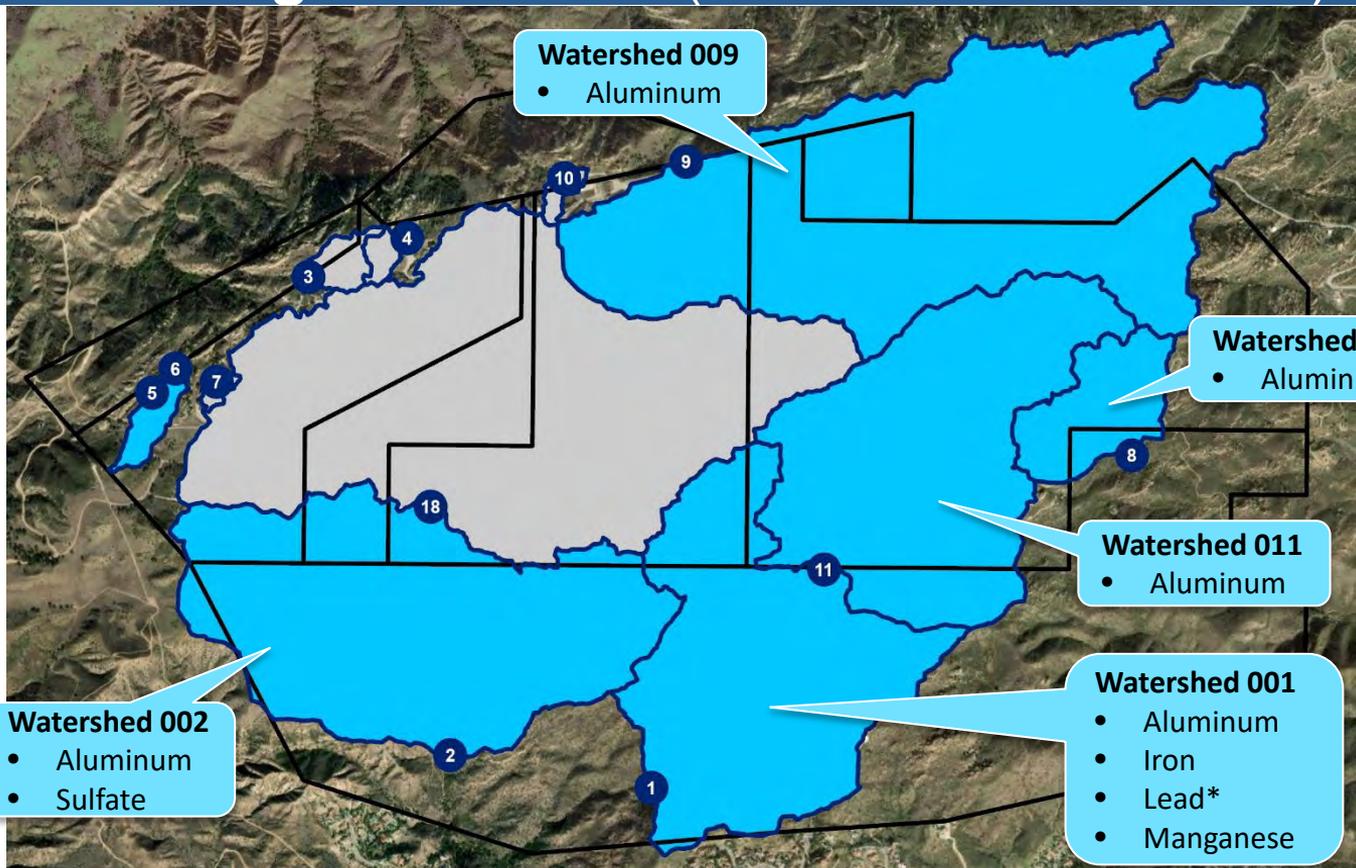
Exceeding Parameters Potentially from Industrially-impacted Surface Soils: Dioxins Example

Draft and Preliminary

- Blue areas show surface soils above anticipated clean-up thresholds; orange shows pavement or roof (i.e., no soil exposure)
- **Circled outfalls** had dioxin exceedances in past 2 rainy seasons
- Smaller western watersheds are pumped to and treated at Silvernale, along with watersheds 011 and 018



Watersheds with Exceedances Solely Attributed to **Natural Background Soils** (2023/24 and 2024/25)



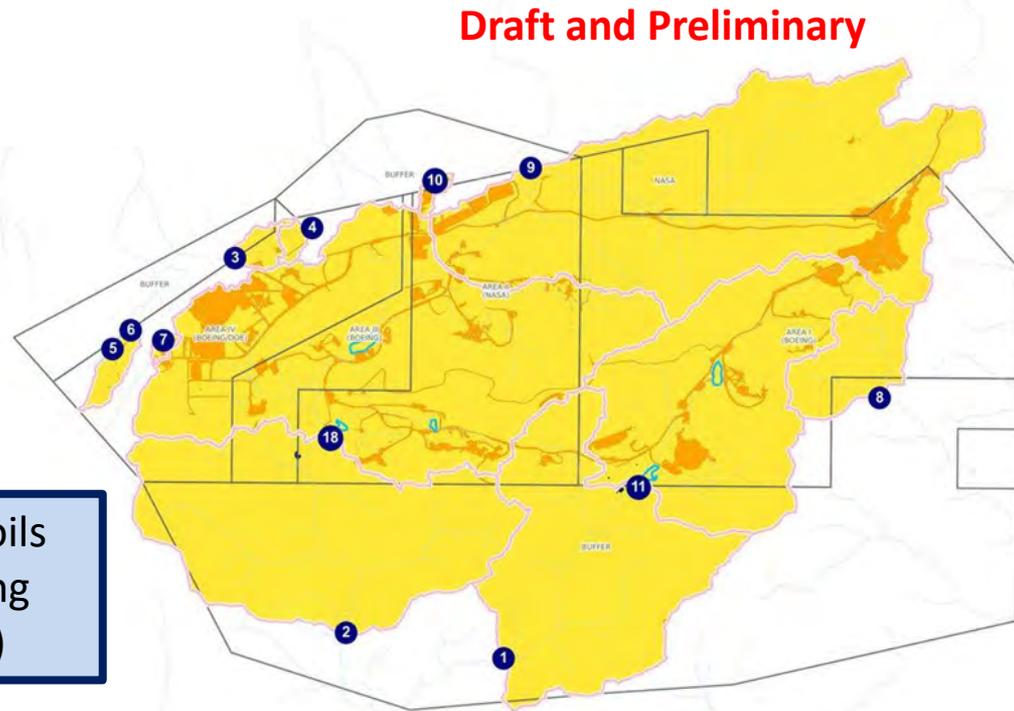
- Iron, manganese, and sulfate limits based on drinking water taste/odor (not health-based)
- Iron removed from current permit (effective Jan 1, 2024)

*Multiple lines of evidence are the basis for these conclusions, including lead in Watershed 001

Exceeding Parameters From Natural Background Soils: Aluminum, Iron, and Manganese

- Blue areas (*few and very small*) show surface soils above anticipated clean-up thresholds for manganese; orange shows pavement or roof (i.e., no soil exposure)
- Other forensic lines of evidence also support this conclusion

$\leq 0.02\%$ of area with surface soils above cleanup thresholds (using background threshold for iron)



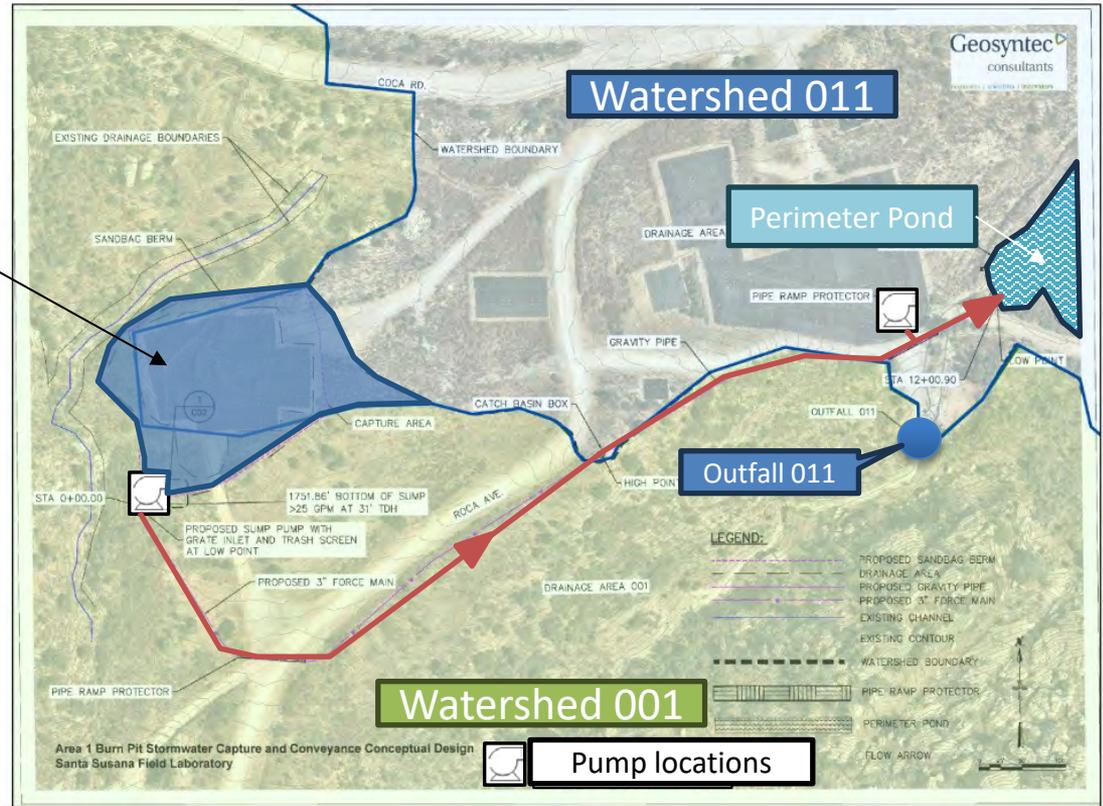
8 BMP Recommendation Highlights

- All of these highlighted BMP recommendations address exceedances from industrially-impacted soils

Watersheds 001 & 011: Western A1BP Diversion to Perimeter Pond/SWTS

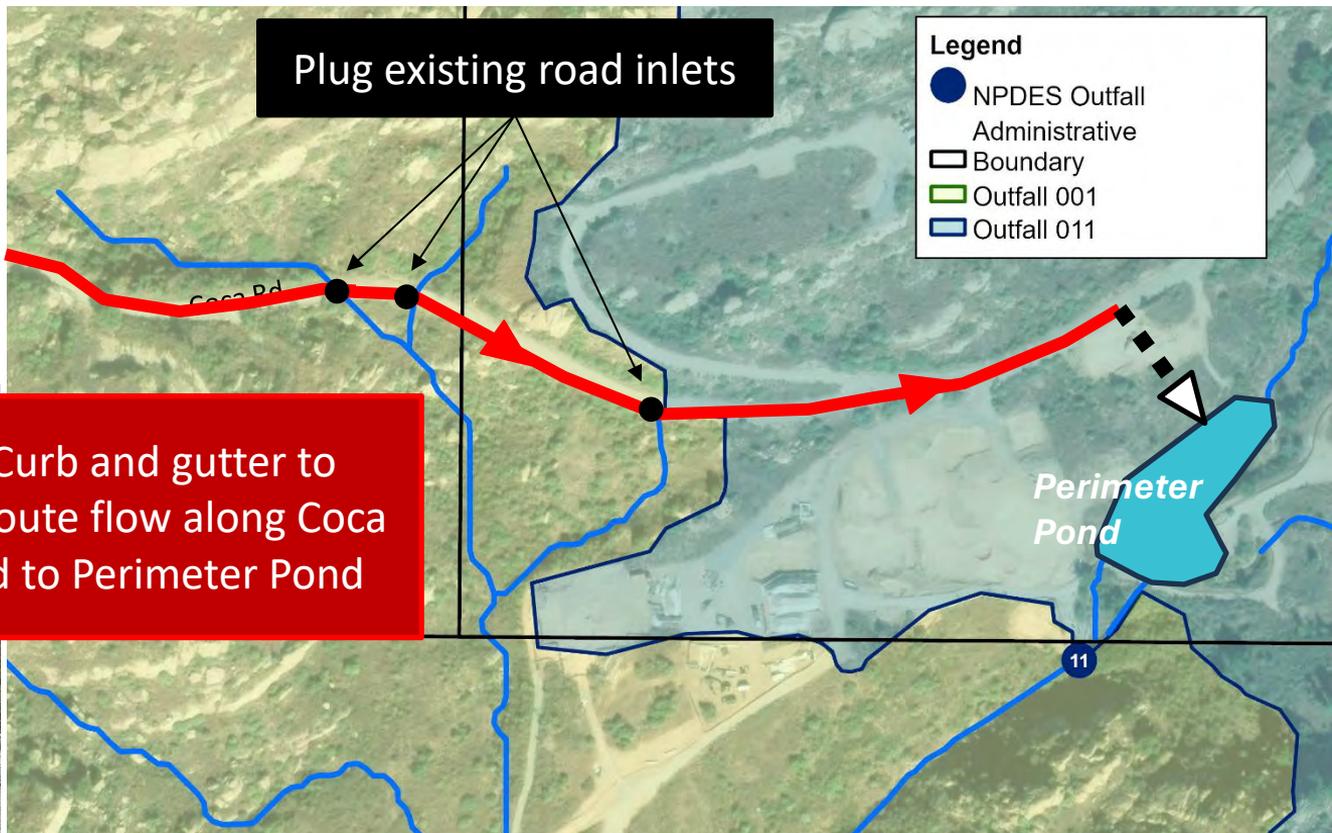


- Stormwater from western portion of A1BP originally flowed to outfall 001 (no treatment)
- This stormwater is now captured and diverted to Perimeter Pond, treated at SWTS, and discharged and sampled at outfall 011



Watersheds 001 & 011: Diversion of Coca Rd Stormwater to Perimeter Pond/SWTS

Coca Road stormwater previously flowed to OF001 (untreated), will later flow to OF011 (treated) via Perimeter Pond



Curb and gutter to reroute flow along Coca Rd to Perimeter Pond

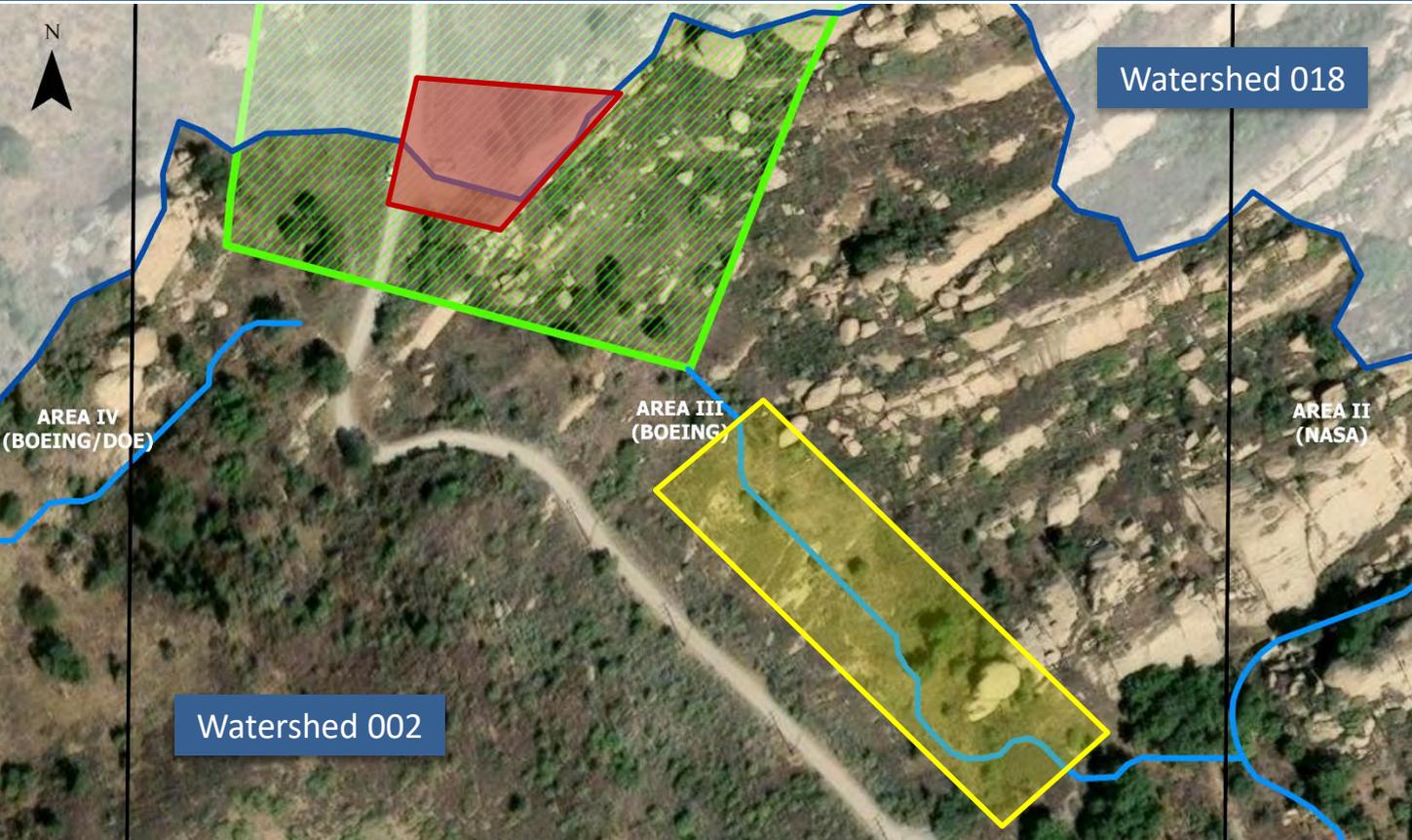


Watersheds 001 & 011 : Erosion Controls at A1BP

- Implemented temporary stabilization BMPs at inactive areas (i.e., hydromulch)
- Final stabilization BMPs at locations where work is complete
- Install stabilized channels along concentrated flow paths



Watershed 002: Erosion control of dioxin impacted soils near STL-IV RFI area



-  DTSC RFI Area: STL-IV
-  Erosion controls within STL-IV
-  In-channel rock check structures

STL-IV RFI Area near boundary of 002 and 018 Watersheds



Watershed 009: CM-12 Reconstruction

- CM-12 is located within the Former Shooting Range ISE area
- Impacted by excavation activities
- Important BMP for reducing particulate-bound COPCs entering the Northern Drainage



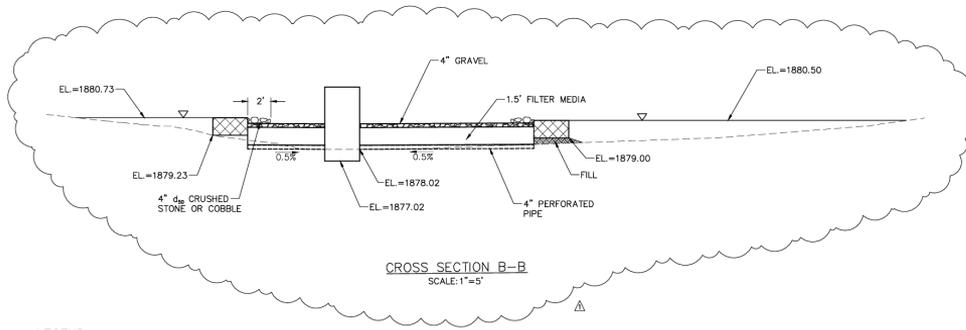
Watershed 009: Shooting Range Stabilization and Sage Ranch Rd.

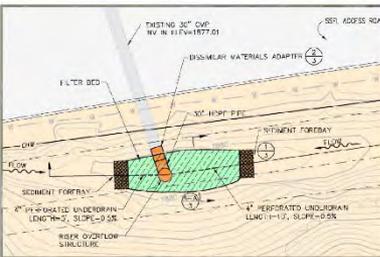
- Implementation of Shooting range erosion controls
 - (e.g., armored channelized areas, jute netting, staked wattles, and mulch)
- Improvements to Sage Ranch Road near Northern Drainage



B1 Media Filter

- Stormwater from B1 Media Filter subarea found to have highest mercury concentrations in 009 watershed





Media Filter Detail

Replacement Media Mix:

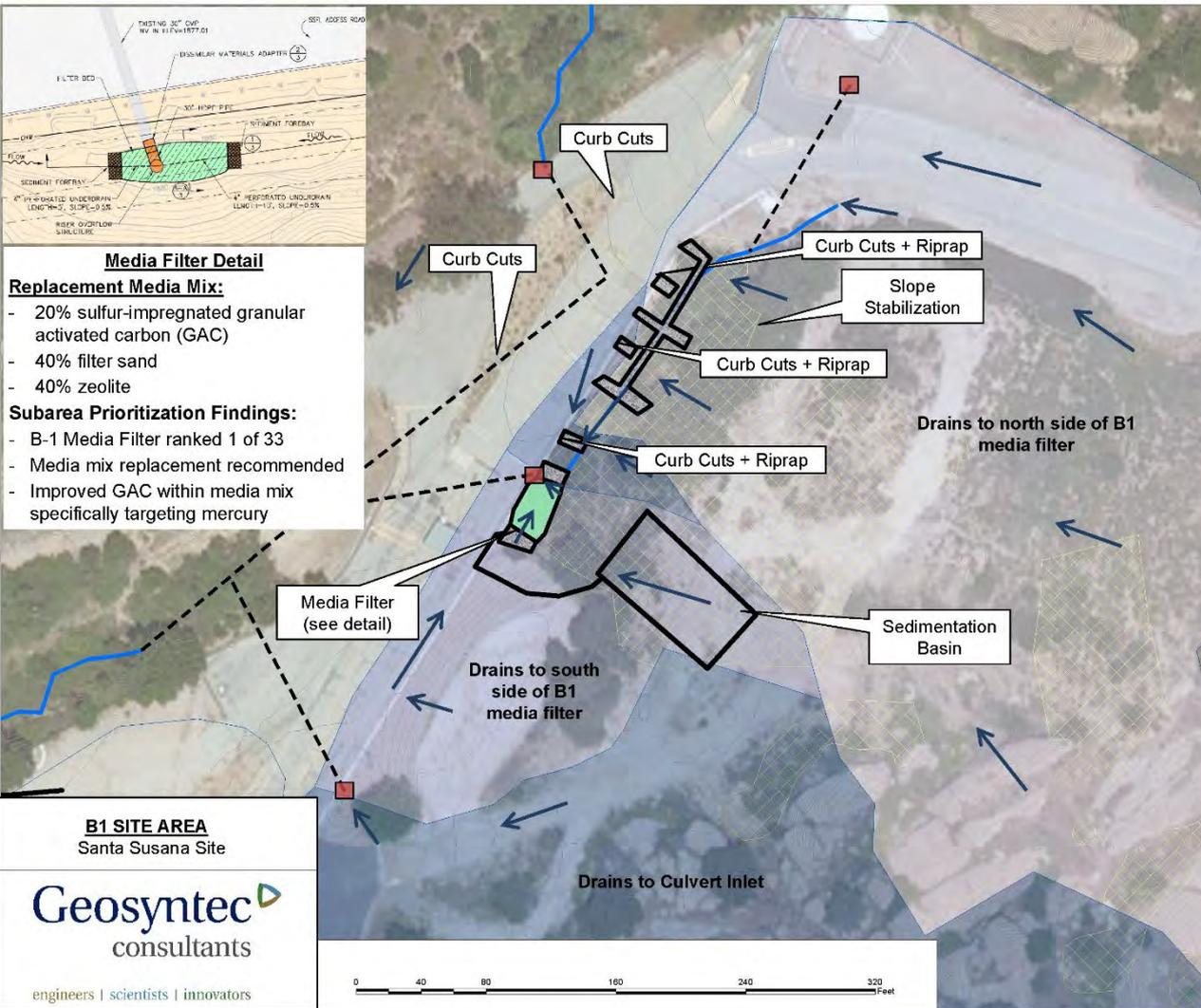
- 20% sulfur-impregnated granular activated carbon (GAC)
- 40% filter sand
- 40% zeolite

Subarea Prioritization Findings:

- B-1 Media Filter ranked 1 of 33
- Media mix replacement recommended
- Improved GAC within media mix specifically targeting mercury

LEGEND

- Natural Drainage
- - - Storm Drains
- ▨ Completed ISRA Area
- ➔ Flow Arrow
- ▒ Check Dams with Curb Cuts along Road
- Culvert Inlet



B1 SITE AREA
Santa Susana Site



engineers | scientists | innovators

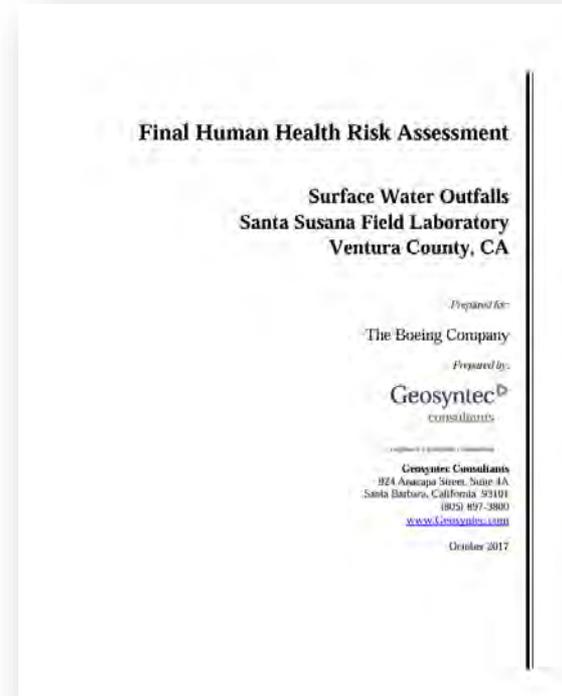


9

Stormwater Human Health Risk Assessment (HHRA)

HHRA Overview for 2023/24 and 2024/25

- Original [HHRA](#) completed in 2017 (publicly available)
- Comparison of 2023/24 and 2024/25 data reaffirmed that SSFL stormwater **does not pose an elevated risk through the evaluated recreational exposure pathways**, including intermittent and limited-contact recreational exposure to SSFL creeks
- Only annual average concentrations to exceed health-based **drinking water standards** were:
 - Aluminum
 - Lead (only at Outfall 009 in 2023/24)
- These parameters are highly particle-associated, subject to filtration removal through soils during infiltration in downstream creek beds



10

Conclusions

Key Takeaways

- **SSFL stormwater quality and permit compliance continues to improve**, especially for parameters associated with surface soil contamination
- The Panel has recommended BMP improvements and these continue to be implemented
- Creeks are still safe for public recreation
- A1BP ISE excavation is nearing completion
- Shooting Range ISE excavation is complete and revegetation is ongoing

Thank you for attending

- Questions
 - Please raise your hand and the microphone will be brought to you
- For further details on SSFL stormwater -- including Expert Panel Annual Reports, Panel presentations, Stormwater HHRA, NPDES Permit, and historic technical reports -- see:
www.boeing.com/principles/environment/santa-susana
- Additional Information Available Online:
 - Groundwater factsheet: [08.16.21 Santa Susana Groundwater 081621A.pdf \(boeing.com\)](#)
 - MOU FAQs: [Santa Susana Field Laboratory FAQ \(ca.gov\)](#)
 - DTSC SSFL Myths and facts: [Myths & Facts Regarding Boeing's Comprehensive Cleanup Framework at SSFL](#)
 - DTSC FAQs: [Boeing Settlement Agreement FAQs | Department of Toxic Substances Control \(ca.gov\)](#)