Application of MercLok™ to Remediate an Abandoned Mercury Mine

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MCCORD ENVIRONMENTAL

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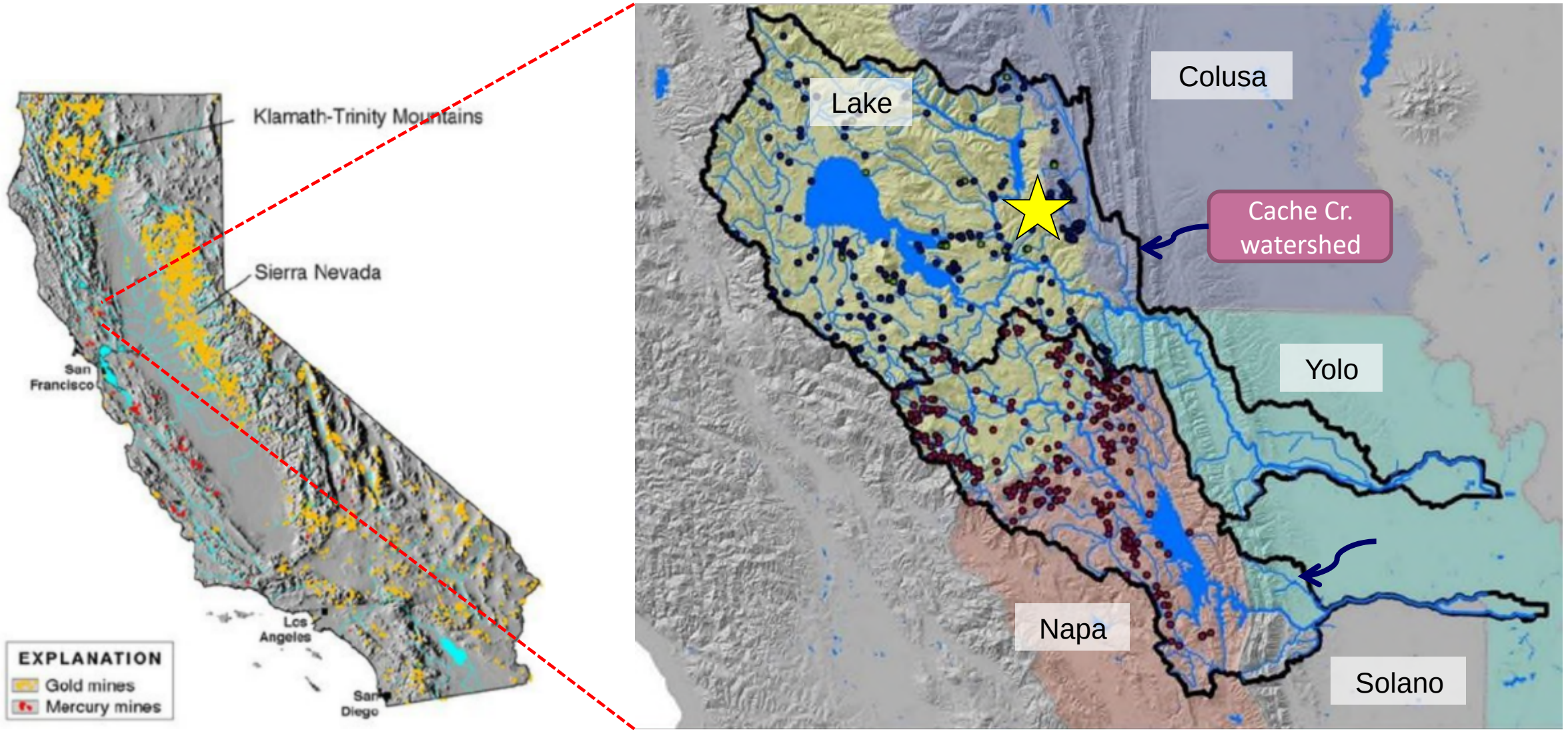
Outline

- Background & Mine Site Description
- Project Planning & Design
- Project Implementation

BACKGROUND &
MINE SITE DESCRIPTION

California's Mining Legacy



Legacy Mercury Mines and their Environmental Impacts

- Mercury in soil, sediment, water → biota
- Fish consumption advisories
- Encumbered property
- Costly HazMat remediation

Limited Remedial Options for Calcines

- Off-site transport for disposal as a hazardous waste
- On-site engineered repository with liner(s); surface & groundwater monitoring

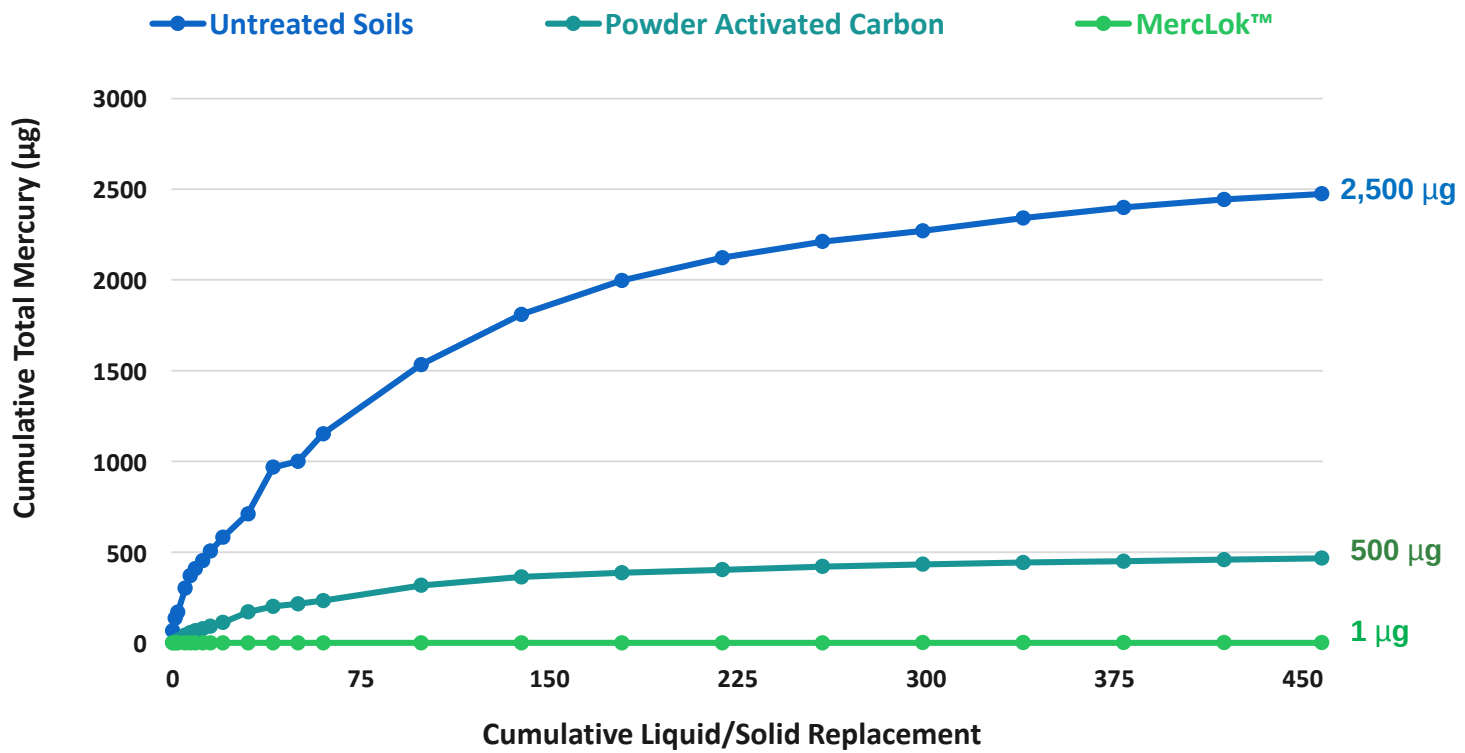
MercLok Provides Another Option

Amend & manage on-site in accordance with Title 27:

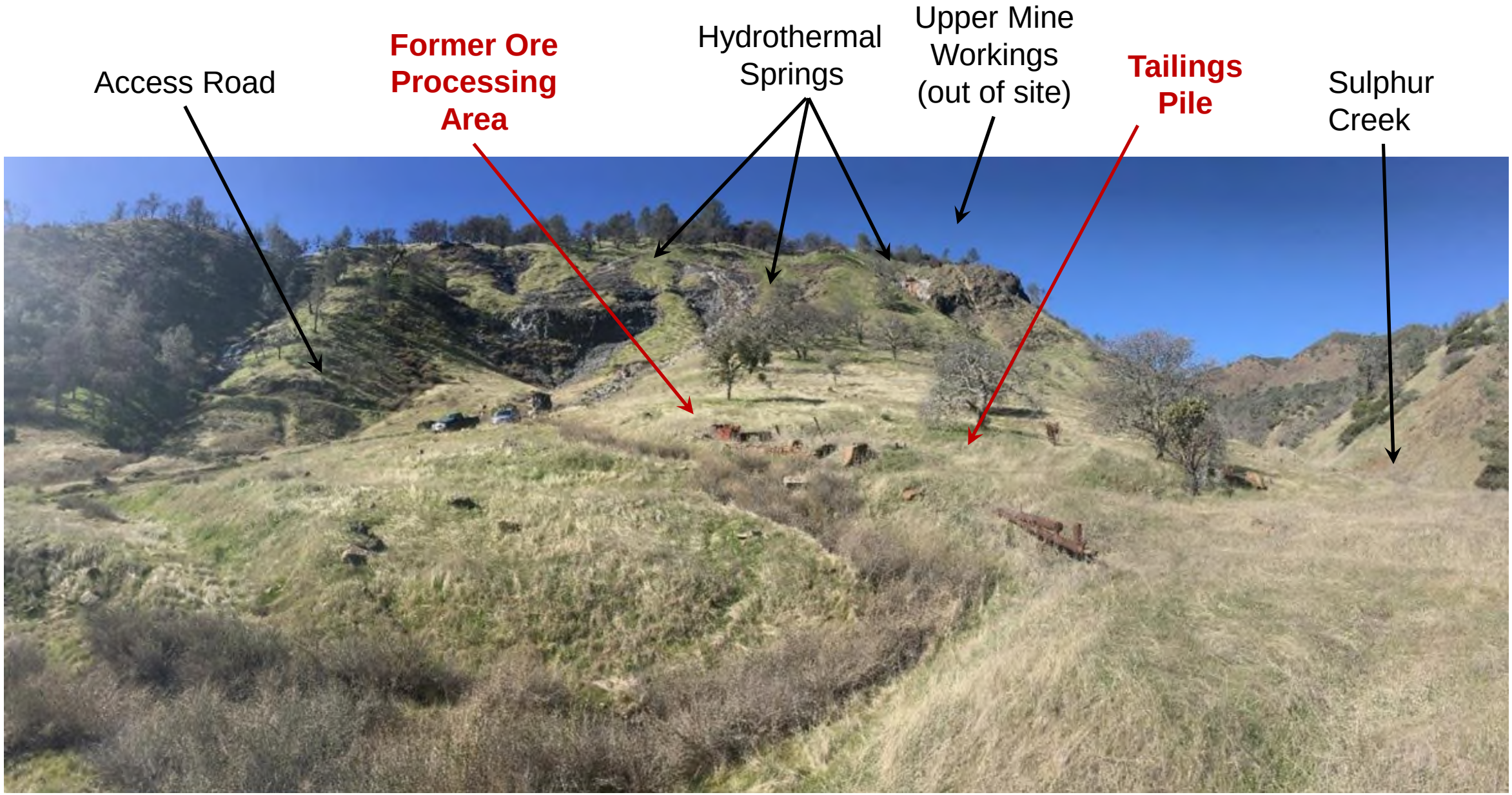
- Minimizes Hg leachability (<0.2 mg/L by STLC hazardous material limit)
- Title 27-compliant with exemptions: no liner & minimal monitoring

Long-term

Stability Confirmed by Column Study



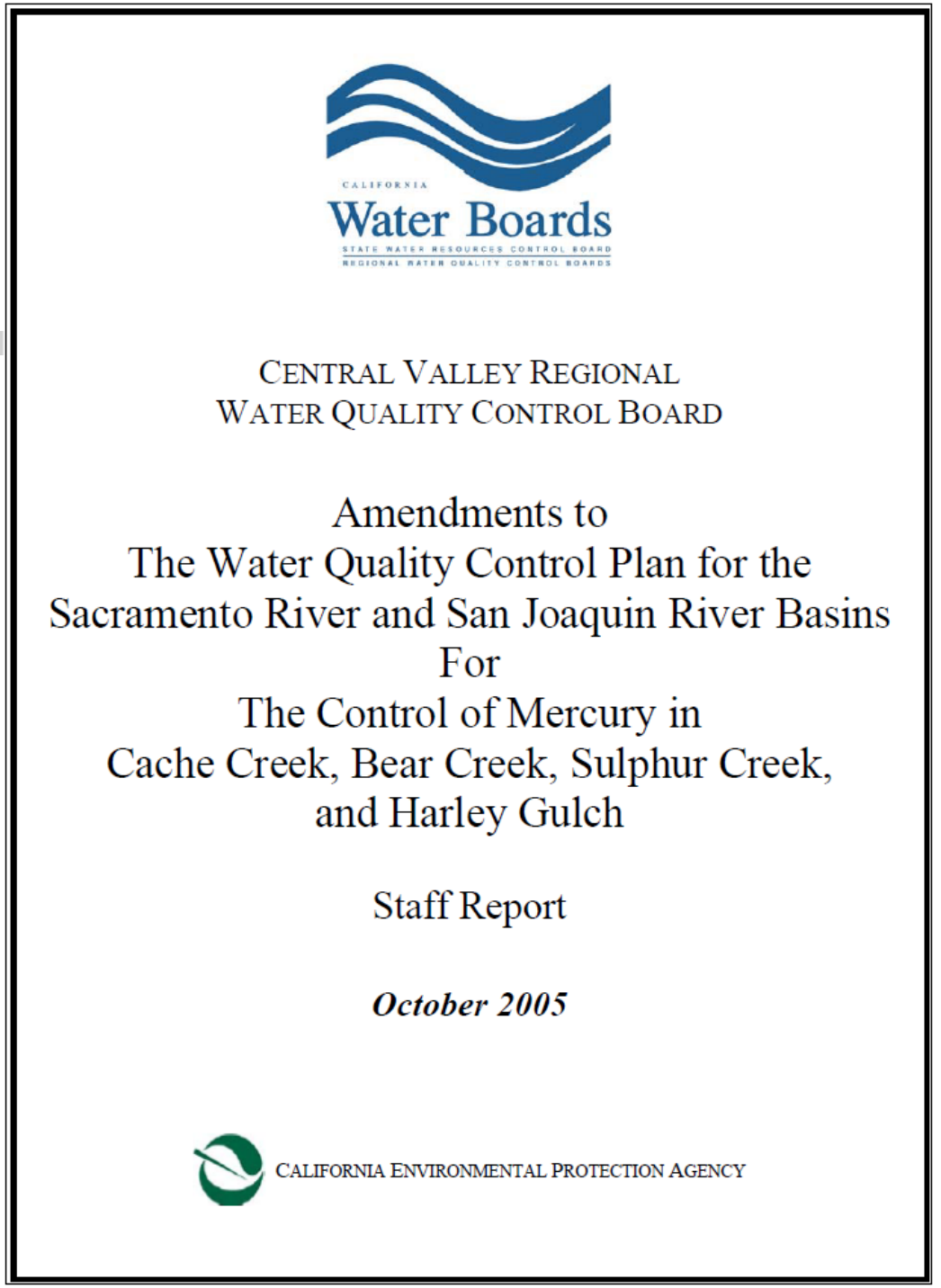
- The column treated with **MercLok** showed 99.9% reduction in cumulative mercury leached from the soil.
- The **MercLok** treated column showed a final cumulative value two orders of magnitude lower than the powdered activated carbon.
- The robust stability of the mercury on the **MercLok** was maintained even when extending the cumulative liquid/ solid (L/S) replacement in the EPA Method 1314 to 45 times the prescribed value of 10 L/S.



Panoramic view of Elgin Mine from Sulphur Creek, view to west. Remnant processing equipment is in foreground, hot spring seeps are above on the steep slope, and mine workings are in the upper right (beyond rock).

Regulatory *Plan* (2005)

- Sulphur Creek Hg TMDL: est. 3 kg THg/yr
- Remediation Goal: 95% THg load reduction
- 4,000 yd^3 waste rock: $400K + $18.5K/yr O&M
- 0.3 cfs hotspring: $800K + $300K/yr O&M



CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

CENTRAL VALLEY REGIONAL
WATER QUALITY CONTROL BOARD

Amendments to
The Water Quality Control Plan for the
Sacramento River and San Joaquin River Basins
For
The Control of Mercury in
Cache Creek, Bear Creek, Sulphur Creek,
and Harley Gulch

Staff Report

October 2005

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

Regulatory *Order* (2009)

- Characterization & Monitoring Plans
- Water supply well survey
- Remediation Plan
- Remediation
- Ground and Surface Water Monitoring & Reporting
- Reimburse Board staff time

New Information!

- 2002-2021: Background soils ~ waste rock THg
- 2013: Hydrothermal springs explain Hg levels in Sulphur Creek (USGS)
- 2019: Mapped limited extent of calcine tailings
- 2021: MercLok reduces Hg leachability from calcines *below HazMat criteria and background*

PROJECT PLANNING & DESIGN

Objectives

- Protect water quality
- Relieve landowner of non-relevant regulatory requirements
- Show that the MercLok amendment can minimize mercury leaching & facilitate efficient on-site calcine remediation

Pre-Plan Calcines & Soil Sampling (2021)

Pre-Plan Calcine Test Results

Table 4: Comparison of Mercury in Untreated and Amended Calcines

Material	Total Hg mg/kg (wet weight)	TCLP Extract Hg mg/L	STLC Extract Hg mg/L	DI WET Extract Hg mg/L
Untreated Retort Calcines	379	<0.010	0.441	0.2
Amended Retort Calcines	239 to 318	NA	0.119 to 0.184	<0.0010
N Pile Calcines	865	0.0496	1.13	3.46
Background Soil	259	<0.010	0.0224	0.0445
Regulatory Threshold	20	0.2	0.2	0.00005

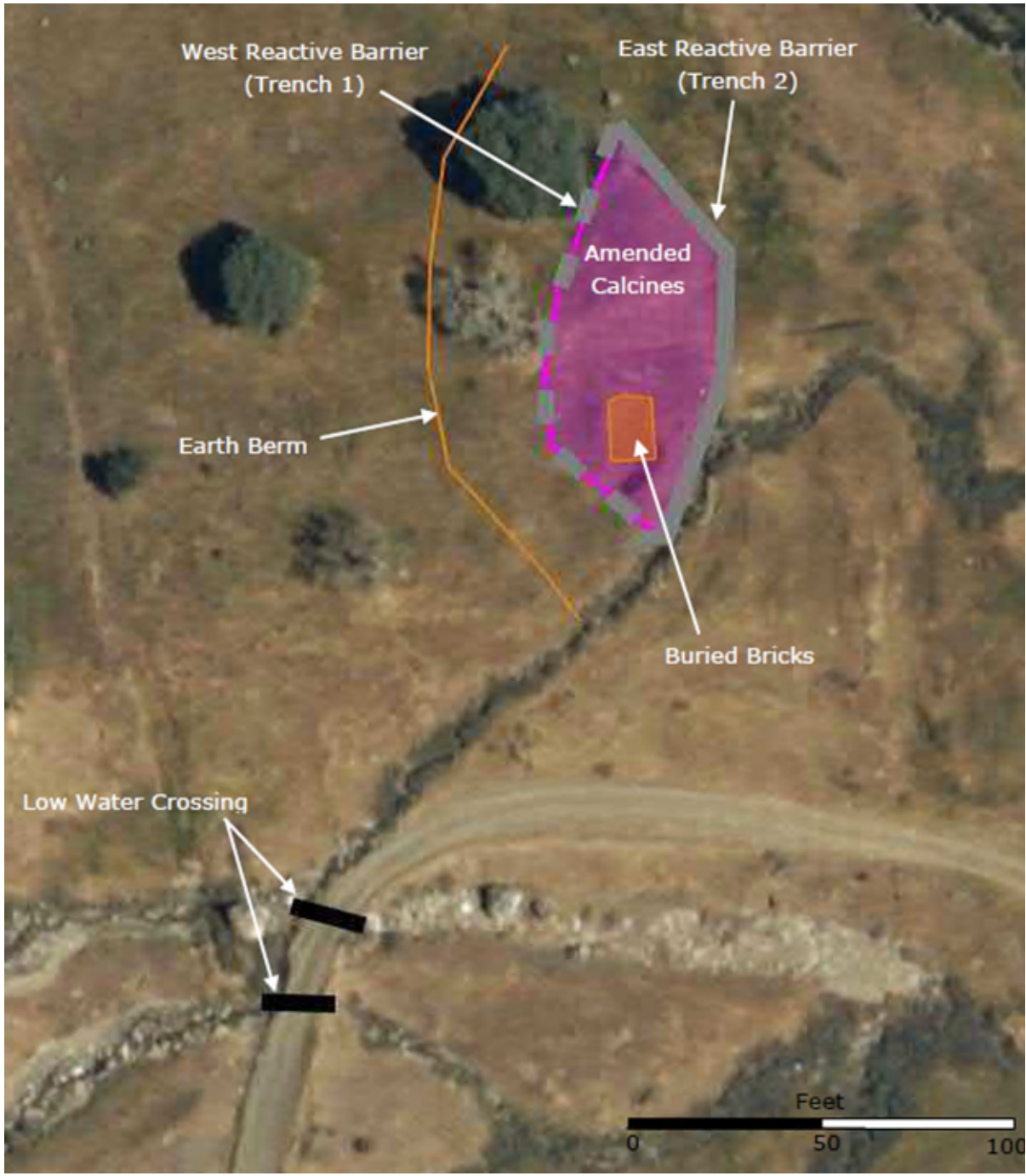
Notes: TCLP = Toxicity Characteristic Leaching Potential
STLC = soluble Limit Threshold Concentration
DI WET = Deionized Waste Extraction Test
mg/kg = milligrams per kilogram
mg/L = milligrams per liter

Planning

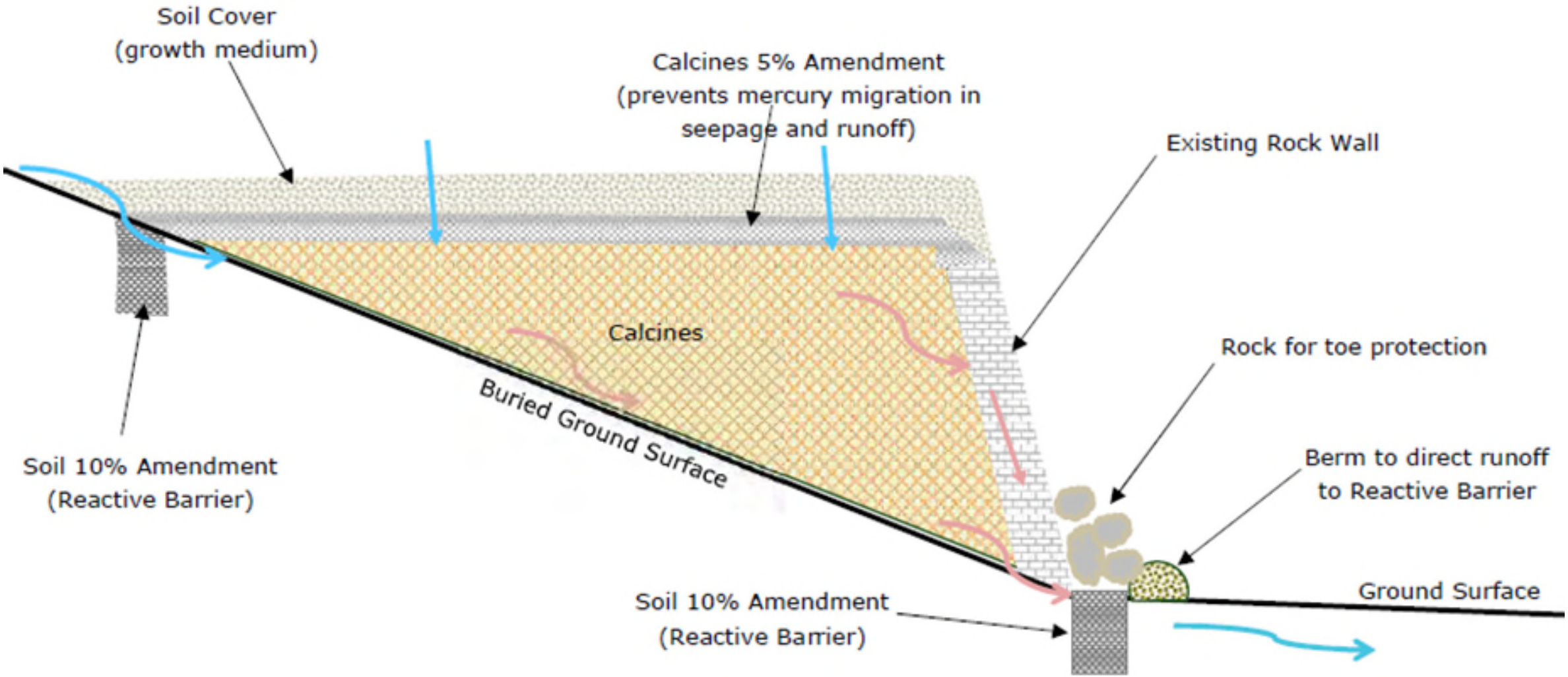
- Synthesize regional & site-specific information
- Address CAO provisions
- Show MercLok-amended calcines are **Title 27 compliant** when managed under site conditions

Site Plan

- **Crossings** protect road
- **Berm** controls run-on
- **Barriers** control seepage
- **Cap** minimized Hg mobility
- Brick **repository** prevents exposure



Calcines ➔ In-place Repository



PROJECT IMPLEMENTATION

Hydrated in Sacks

- Minimize dust
- 900 lb. + 160 gal. water

Capping

- Grid areas for even dosing
- Manual & machine to spread, mix, level
- Spray water to distribute

Permeable Reactive Barrier

Confirmation Sampling Results

MercLok didn't add Hg

Good reproducibility

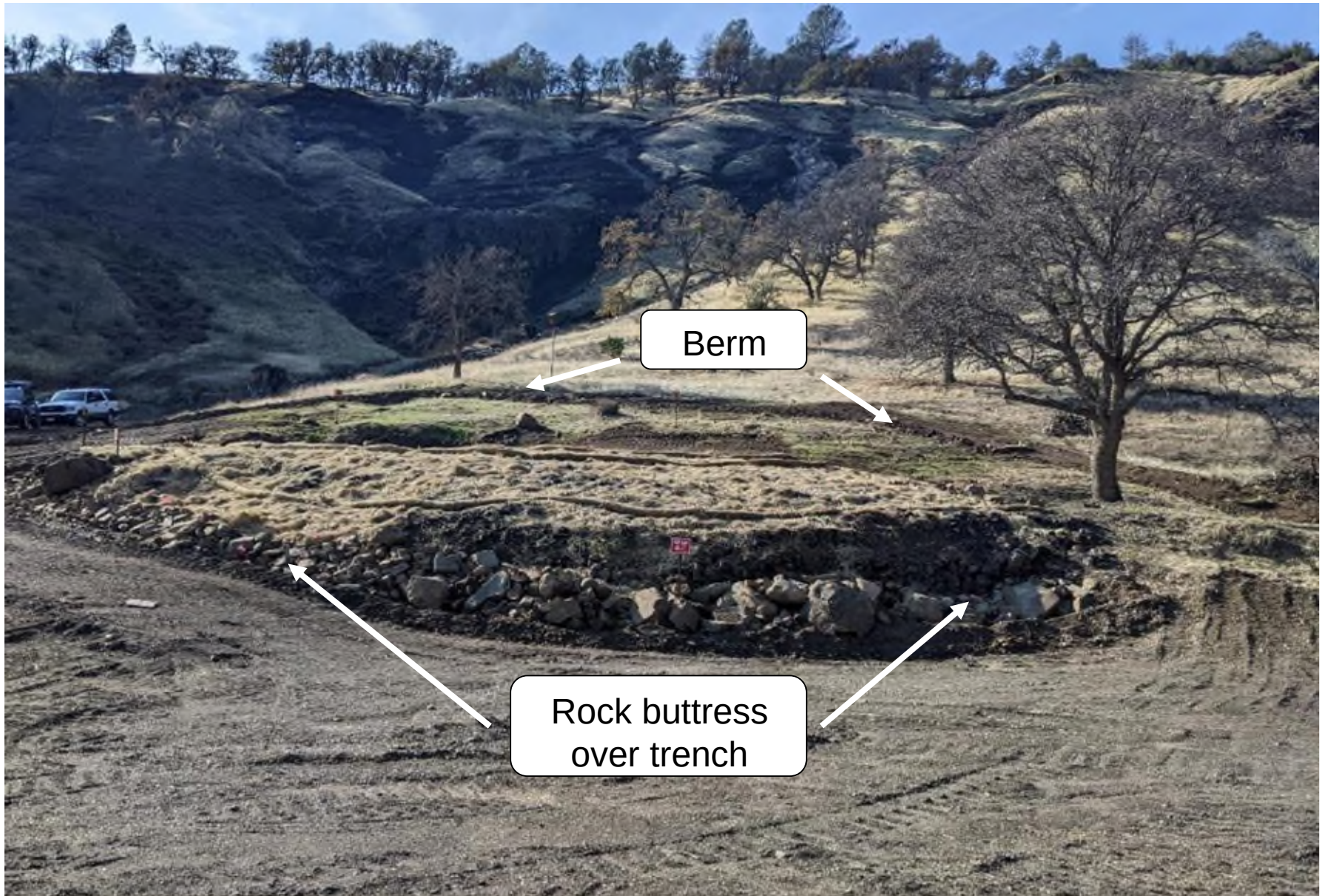
Hg naturally high →

Material	Total Hg (mg/kg wet wt.)	TCLP Extract Hg (mg/L)	STLC Extract Hg (mg/L)	DI WET Extract Hg (mg/L)
N Pile Calcines	865	0.0496	1.13	3.46
Untreated Retort Calcines	379	<0.010	0.441	0.2
Amended Retort Calcines	239-318	NA	0.119-0.184	<0.0010
Trench 1	19.9	NA	NA	NA
Trench 2	25.3	NA	0.00548	<0.0010
Area 1	66.9	NA	0.00710	<0.0010
Area 1 Duplicate	27.7	NA	0.00621	<0.0010
Area 2	48.5	NA	0.00493	<0.0010
Background Soil	259	<0.010	0.0224	0.0445
*Regulatory Thresholds**	*20*	*0.2*	*0.2*	*0.00005*

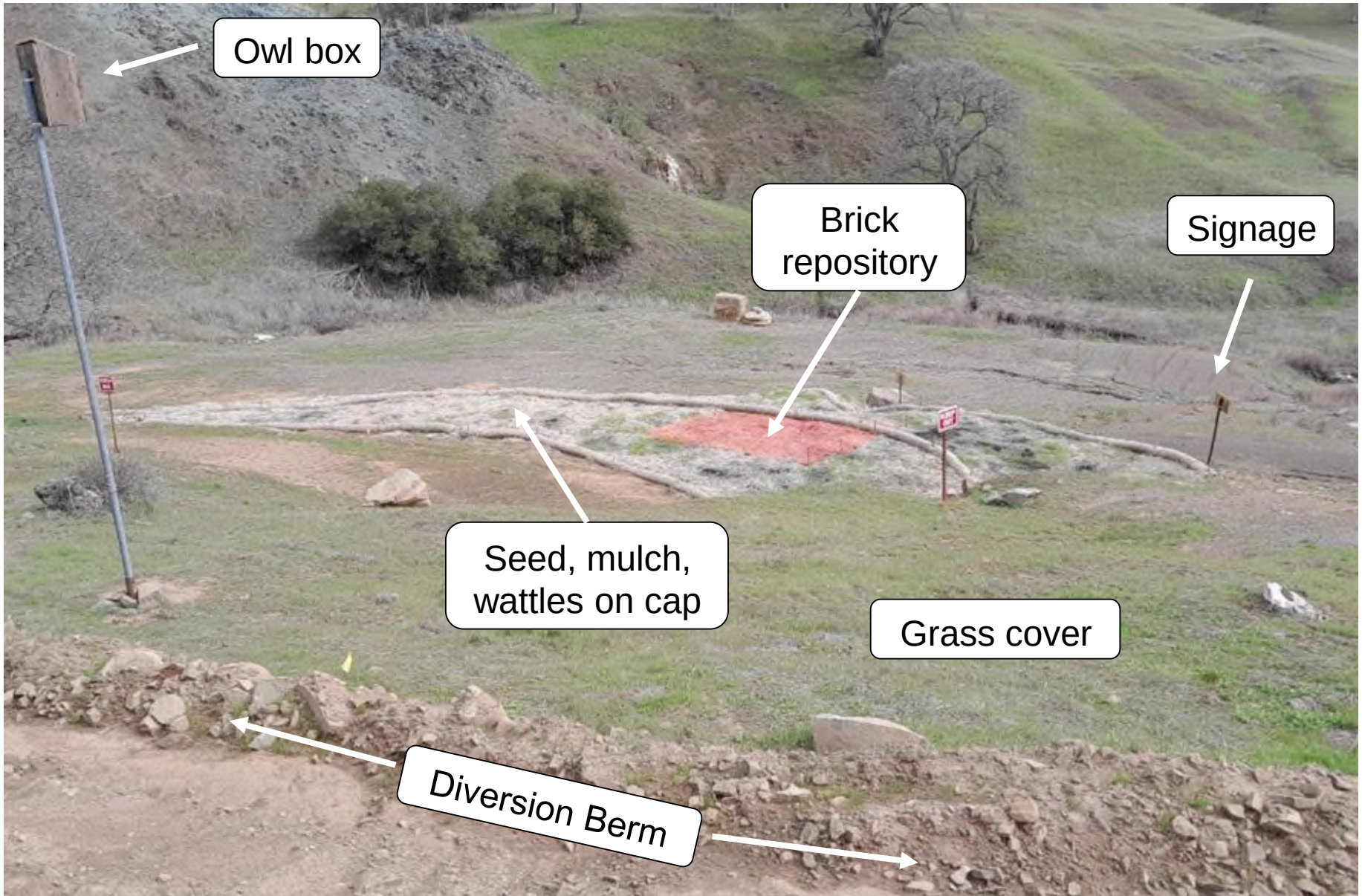
MercLok significantly lowered leachable Hg

* Values in red exceed these thresholds.

Nearly Done – From Below



Done – From Above



Six Months Later – From Below

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Q&A: Application of MercLok™ to Remediate an Abandoned Mercury Mine

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Webinar: MercLok Inquiry Form

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