



## MORE INFORMATION ABOUT THE CORONA AND TWIN PEAKS MINES

The Corona and Twin Peaks Mines are inactive mercury mines located in the northwest corner of Napa County, in the East Mayacmas Mercury District. Recent investigations by Tuleyome's project team documented that these mines continue to release iron, sulfate, nickel, and mercury downstream to James Creek and beyond.

This mining legacy contributes to the listing of the following waterbodies as impaired: James Creek (nickel and mercury), Lake Berryessa (mercury), and lower Putah Creek (mercury and boron). James Creek has been identified as prime trout habitat. Lower Putah Creek is a wild trout stream that drains into the Yolo Bypass, a nationally recognized fish rearing, wildlife habitat, farming, and flood control area with some of the highest mercury concentrations in the Bay-Delta. Fish consumption advisories are posted for Lake Berryessa and for lower Putah Creek because of fish mercury contamination.

The Corona and Twin Peaks Mine Drainage Treatment Project began in 2012 with a grant from the State of California's Ecosystem Restoration Program. In 2013, the project was put on hold for two reasons:

- The landowner died and the property title passed into a trust before the public benefit component was finalized.
- Our monitoring indicated that the mine tunnel's drainage was more significant than anticipated and an in-situ treatment method should be attempted.

Since that time Tuleyome's project team worked largely *pro bono* to:

- Finalize the environmental compliance work with the Central Valley Water Board
- Obtain external peer review of the in-situ treatment methodology
- Revise the project scope and budget based on knowledge gained and to address peer review comments
- Finalize a land transfer options agreement between the current landowner and the Napa County Regional Park and Open Space District to complete the public land donation component of the project.
- Coordinate with concerned neighboring land owners.

This project could serve as an example site cleanup to promote similar work planned through a Brownfields Assessment Project funded by US EPA. We are also pursuing matching funding through Napa County's Measure A (Napa Flood Protection and Watershed Improvement Expenditure Plan). This project is particularly important for demonstrating how non-profit organizations can work with private landowners and regional, state, and federal agencies to address our legacy of abandon mine sites. Furthermore, this project will document the use of semi-passive biogeochemical technologies to address mine drainage. It will significantly improve the quality of receiving waters, and reduce or eliminate their toxicity effects.



# Corona and Twin Peaks Mine Drainage Treatment Project ~ Treatment Process Description ~

Natural geologic processes created an unusual pyrite and cinnabar ore body at the site. The rock also contains naturally elevated nickel concentrations. Mining excavations have allowed air and water to circulate through the remaining rock and generate acid. The acidic water drains through the rock and dissolves nickel and iron.

Acid drainage flows out of the mountainside at three locations: Boilerhouse Adit, Twin Peaks Adit, and Corona Drain Tunnel. Acid drainage from the Boilerhouse Adit and Twin Peaks Adit is collected and piped into infiltration trenches. These trenches prevent the drainage from flowing to nearby creeks. Drainage from the Corona Drain Tunnel flows directly into Kidd Creek.

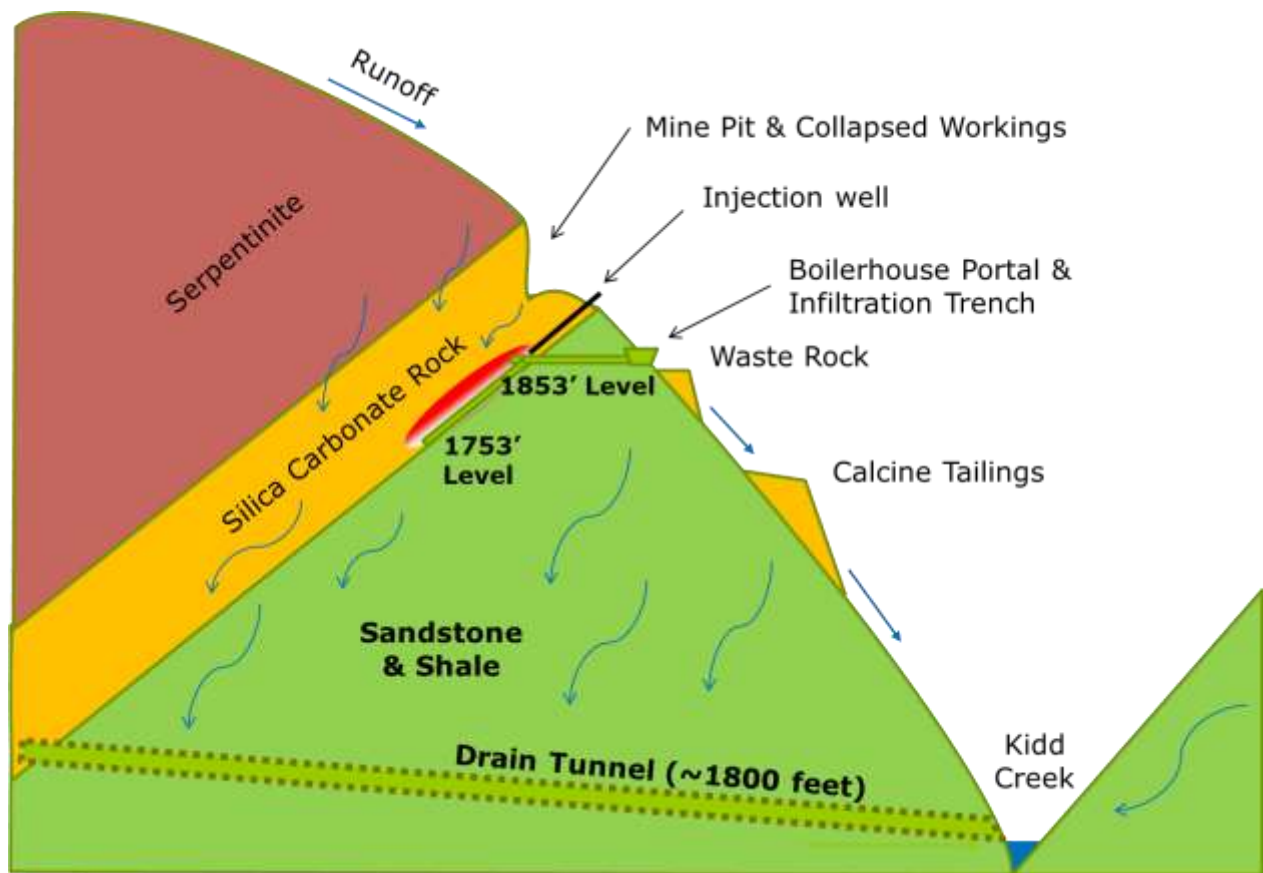
Tuleyome's project includes three treatment components: (1) improve the infiltration trenches, (2) inject subsurface chemical amendments to reduce the concentrations of acid and metals draining from the mountainside, and (3) treat remaining discharges from the tunnel.

**(1) Infiltration Trenches:** Sand filter basins are being constructed to allow collection and storage of iron oxides that form as the acid drainage oxidizes. Trench piping systems are being improved to allow better distribution of flowing water, and the trenches are being realigned.

**(2) Subsurface Chemical Amendment:** Two wells were constructed to allow injection of bacteria, nutrients and chemicals near Corona Mine's known ore bodies (**Figure 1**). Tracer tests confirmed that chemicals released at the injection wells would flow out at the drain tunnel and infiltration trench. These components are being injected in a controlled manner via IW-1:

- **Bacteria:** Sulfate-reducing bacteria will hopefully create a biofilm to prevent the contact of oxygen and water with pyrite. This will prevent acid creation by circulating water and oxygen. The sulfate reducing bacteria will also create sulfide to precipitate iron and nickel.
- **Ethanol:** Provides carbon to feed the bacteria.
- **Nutrients:** Feed the bacteria.
- **Sodium Hydroxide:** Raise the pH to optimal level for bacteria, and precipitate any extra manganese and iron that could be mobilized by the bacteria.

**(3) Drain Tunnel Treatment:** After the effects of subsurface chemical amendment are quantified, the remaining drain tunnel discharge will be collected and treated. That treatment is expected to include collecting solids in a filtration basin, piping the filtrate and infiltrating it downstream at a land disposal site.



**Figure 1: Conceptual Model of Corona Mine Workings and Injection Well.** Pyrite-rich ore in the silica carbonate rock is exposed to oxygen and water in underground mine workings, creating iron- and nickel-enriched acid drainage. Subsurface chemicals are being added to neutralize acid and encourage bacterial growth on the ore body and.

**Notes:**

- IW-1 was advanced into an underground mine opening.
- Stope: underground void created by removing ore during mining.
- Tracer released from IW-1 was detected at the Boilerhouse Portal and the Drain Tunnel.
- Injection of bacterial culture, fertilizer, ethanol and NaOH started on June 26, 2017. No effects were detected at the Boilerhouse Portal or the Drain Tunnel through \*\* October 2017. The team expects to see effects of the injection soon after seasonal rain begins in October.
- Injection rates were based initially on flow rate at Boilerhouse Portal, titration of acid drainage using 25% NaOH, and professional judgement.