

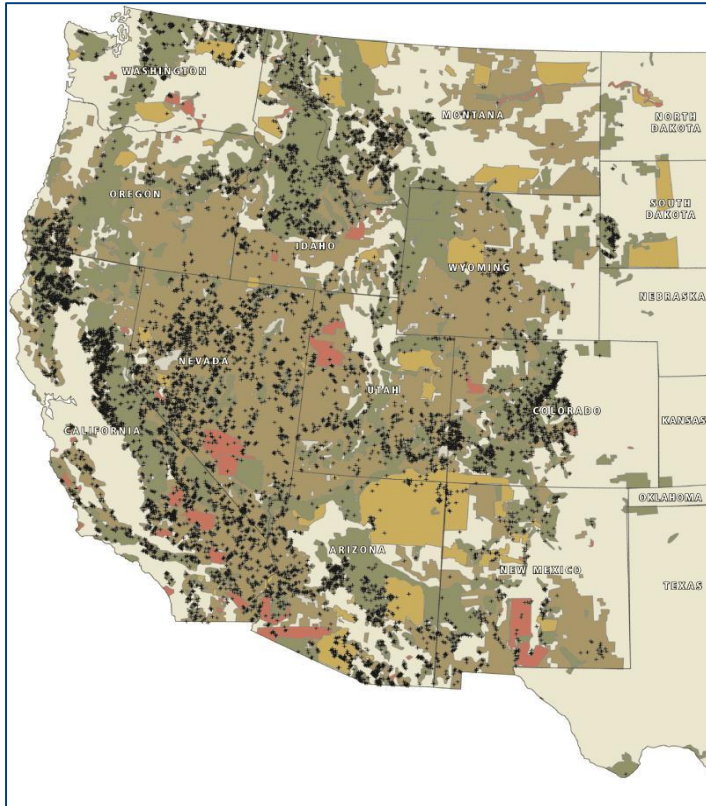
Restoration in Leavenworth Creek Watershed

Lauren Duncan

Abandoned Mine
Restoration Project
Manager



Mining Legacy in the Western United States



- Over 500,000 abandoned mines in the Western U.S.
- 40% of western watershed headwaters are polluted with mine wastes
- Approximately 100,000 abandoned mines exist on public lands today in 13 western states


Mining Legacy in Colorado



- ✎ Approximately 23,000 abandoned mines in Colorado
- ✎ > 80% of Colorado's most impaired waterways are the result of mining operations.
- ✎ Total of 5,105 abandoned mines on BLM and USFS land

TU's Role in Mine Reclamation Work



 Focus on watersheds that exceed State water quality standards

- Grant funded
- Private funding
- Federal and State



Our Program Goals



The People

The Environment

The Place

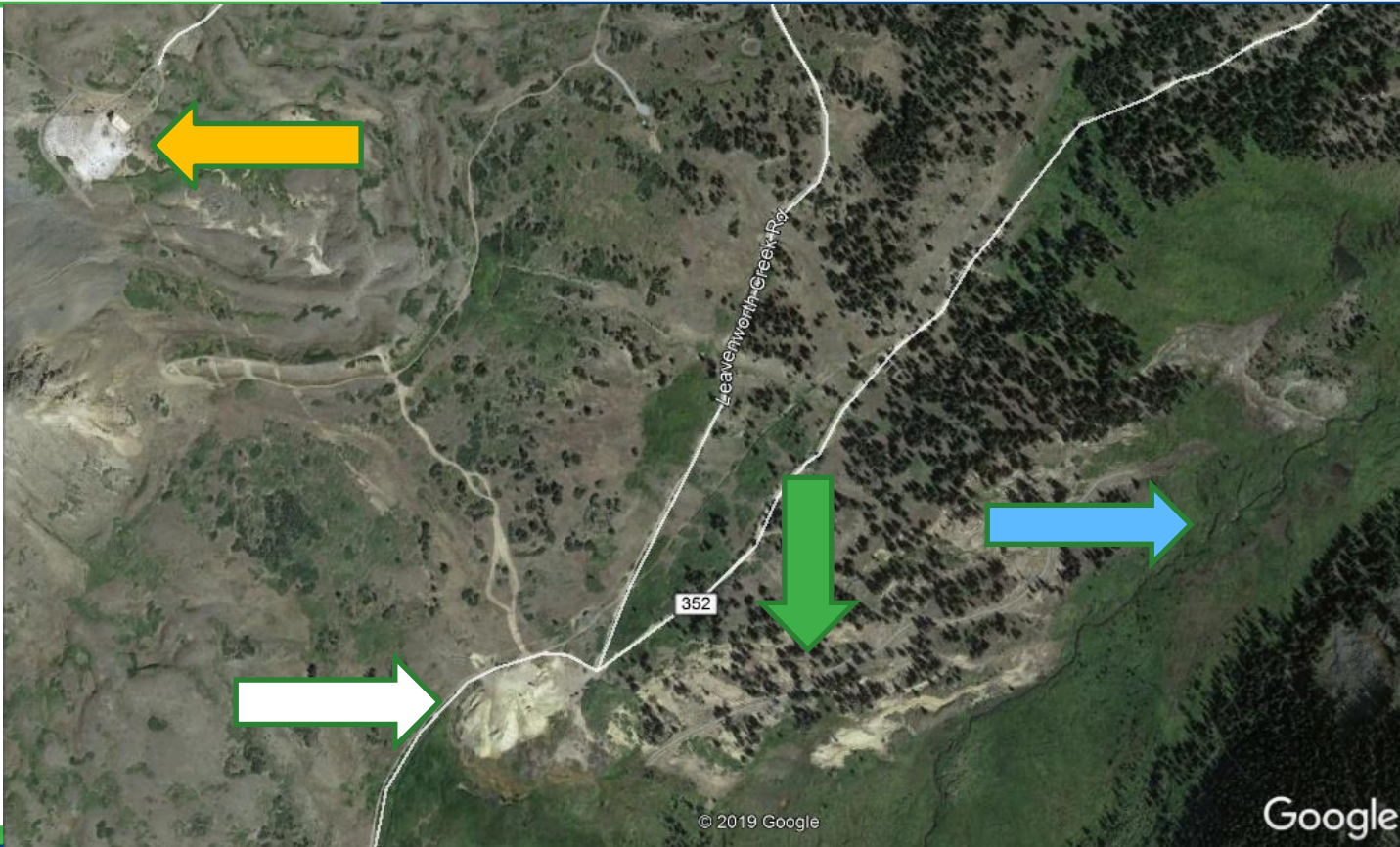
Leavenworth Creek Watershed



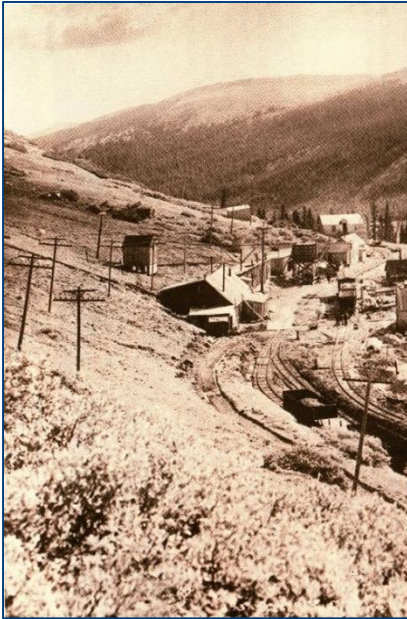
- ❧ Headwater stream flowing into South Clear Creek.
- ❧ Located in historic Argentine Mining District
- ❧ Development and production began in late 1860's through 1920s. Some reports extend production into mid 1950s.



Leavenworth Creek Watershed – Location



Waldorf Mine/Mill and Santiago Mine



Sampling Results – Leavenworth Creek



- ✎ Leavenworth Creek heavily sampled for WQ between 2011-2013 at 27 sites.
- ✎ Waldorf Dispersed tailings showed concentrations of Cd, Pb, Zn, and Cu above benchmark screening levels.
- ✎ Zinc loading rates increased from 8.2 tons/yr upstream of dispersed tailings to 12.5 tons/yr below dispersed area.

Restoration Timeline



2014-
2015

*Initial
Drainage
Control*



2015-
2016

Santiago



2017

*Dispersed
Tailings*



2018-
2021

Waldorf

2014 Planning



- ✎ Initial plan in 2014 focused on doing it all!
- ✎ Estimates exceeded available budget by over \$100,000.
- ✎ Hauling costs too high given site location & access
 - Helicopter/hauling rates for amendments were large portion of budget

Refining the Plan – Winter/Spring 2015



- ✎ Several brainstorming sessions held with project partners DRMS, USFS, EPA, CDPHE, and Freeport McMoRan.
 - Burying and capping tailings in two large repositories vs. treating in-situ with amendments
 - Large repositories would act as riprap source for 0.47 mile of single thread channel
 - Repositories would supply clean fill material for floodplain adjacent to channel
- ✎ Additional funding received through NFF

2015 Project – Before/After



2015 Project – Before/After



2015 Project – Before/After



2015-2016 Santiago Mine and Mill



- ✎ Process began with completion of Engineering Evaluation and Cost Analysis
- ✎ Evaluated Volunteer and Recreation visitor screening levels given the large OHV and visitor traffic seen at the Site.
 - Levels of arsenic, iron and lead in the material on site exceeded both the Site Interpretive Volunteer Exceedances Screening Levels and the Recreational Visitor levels

Mine Waste Capping and Re-Grading



Mill Clean-up and Decontamination



Preservation of Ore Bin Features



2017 Project Goals in Dispersed Tailings

- ✎ Reduction of sediment loading
- ✎ Reduction of exposure pathways
- ✎ Establishment of native veg and riparian corridor



2017 Design Considerations

- ❧ Ponding and surface flow concerns
- ❧ Development of an appropriate repository
- ❧ Hauling and material cost concerns as 2015 work



2017 Project – Before/After



2017 Project Accomplishments – Before/After



Preliminary Results



What's Next?

- ✎ Source control and revegetation
- ✎ Manage future surges or “blowouts” from the Wilcox Tunnel Portal
- ✎ Maintain the historic appearance and nature of the site.



Key Takeaways

- ❏ Capabilities of partner-based restoration
- ❏ Importance of planning for the future and patience...
- ❏ Importance of taking a step back and reassessing
- ❏ Tying together multiple interests in watershed-wide restoration efforts

