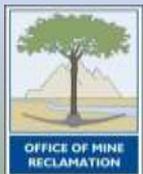




CHEMICAL REMEDIATION COORDINATION AT BODIE STATE HISTORIC PARK (SHP): U.S. EPA, State Parks, CA Dept. of Conservation

AML Forum Meeting
Sacramento, California
June 3, 2009

Greg Marquis, Engineering Geologist
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Office of Mine Reclamation
California Dept. of Conservation



Background

Bodie

- Located in Mono County in the hills north of Mono Lake.
- Heavily mined area with peak mining production in 1870s.



The Standard Mill (top left) is the most prominent building in the park.



Background

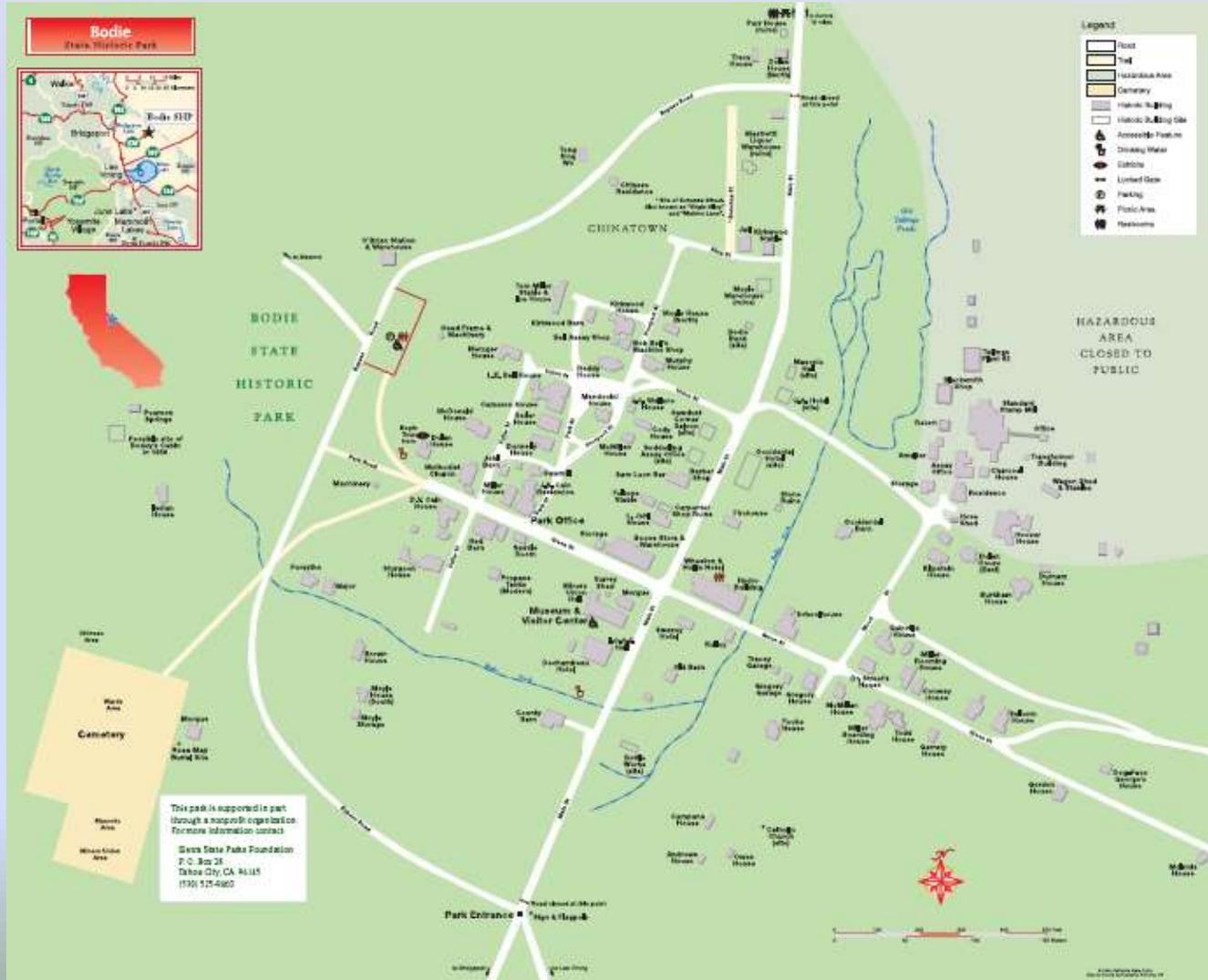
Bodie

- Became Bodie State Historic Park (SHP) in 1962.
- Now owned and managed by the State Department of Parks and Recreation (State Parks).



Waste pile at Bodie (town in background)

Site Map



Agencies Involved

- State Parks (landowner, cultural resources, visitor control, etc.)
- U.S. Environmental Protection Agency (USEPA) Region 9 (regulator and project implementer)
- Department of Conservation, AMLU (coordinator & funding)
- Department of Toxic Substances Control (DTSC) & Regional Board (regulators and project review as needed)



The Standard Mill



Contaminants



- Mercury (**Hg**) from ore processing
 - Elemental form in tailings piles
 - Vapor form within the Standard Mill building
- Lead (**Pb**) from the assay process
 - In sediment and dust near assay areas
 - In cupels (absorbed lead oxide)
- Arsenic (**As**) associated with gold-rich mineral deposits
- PCBs in transformers in Wheaton-Hollis Hotel



Cupel



Relative size of a cupel



Contaminated Area Photos



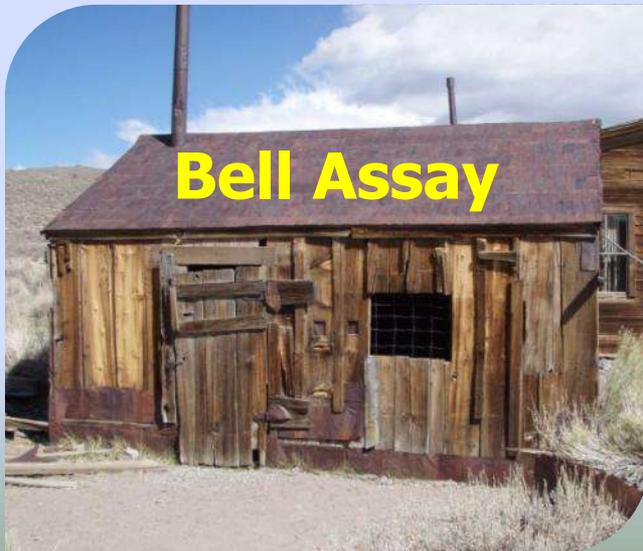
Standard Mill slope



Wheaton-Hollis Hotel



Bell Assay



Tailings



Sampling



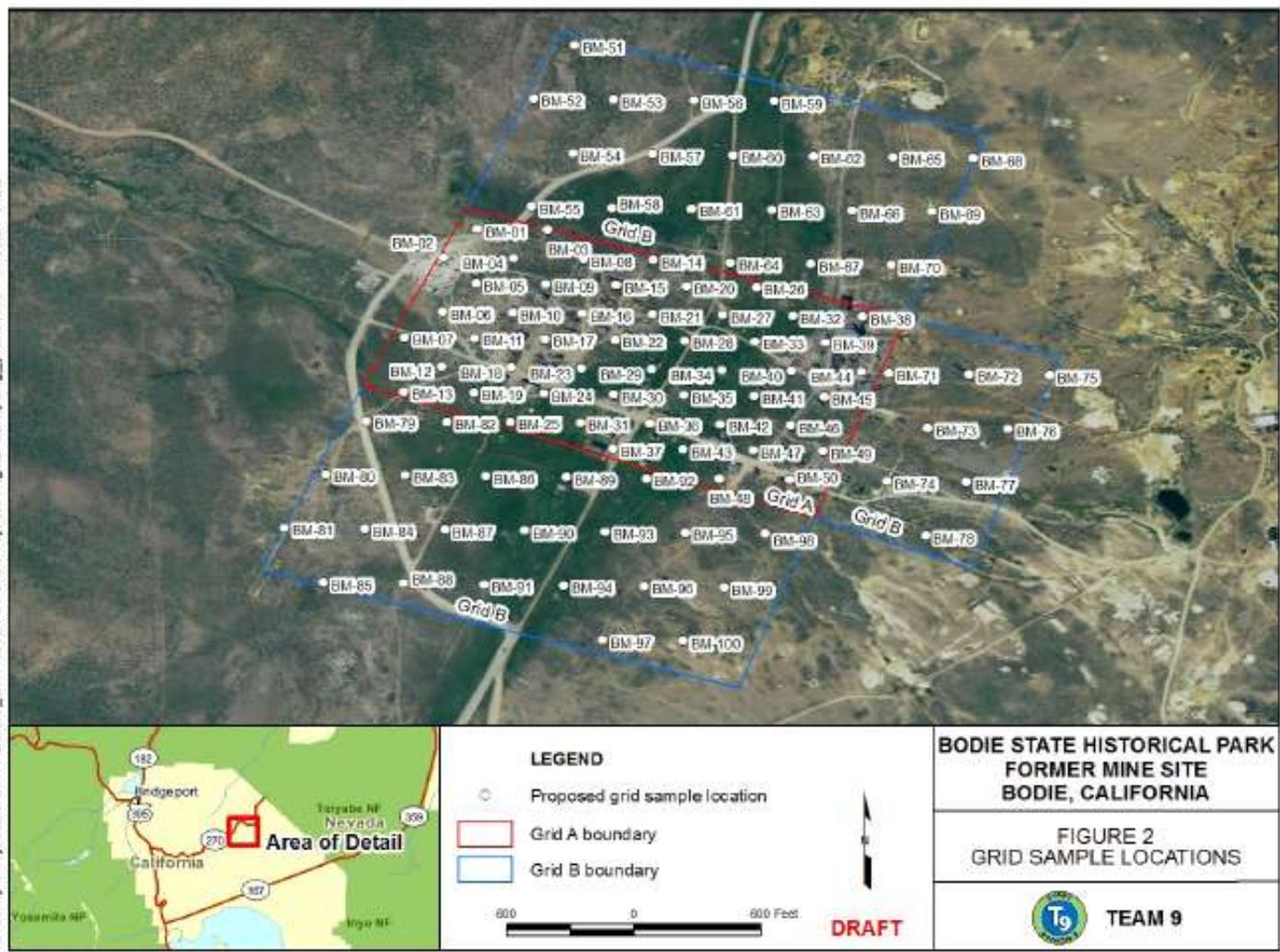
- Soil samples
 - X-ray fluorescence (XRF) unit used in the field; subset of samples sent to a laboratory for QA/QC
 - Two sampling grids established:
 - Smaller grid within the town
 - Larger grid encompassing an 88-acre section of the Park
 - Multiple sampling depths (up to 5 feet) in some areas



Grid Sample Locations



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Sampling (continued)



- Soil samples (continued)
 - Targeted (biased) sampling
 - Standard Mill and surrounding area
 - Bell Assay
 - Soderling Assay
 - Rose Assay (later sampling)
 - Tailings Piles
 - Wheaton-Hollis Hotel
 - Picnic Area
- Wipe samples (Pb, PCBs)
- Mercury vapor sampling (Lumex)



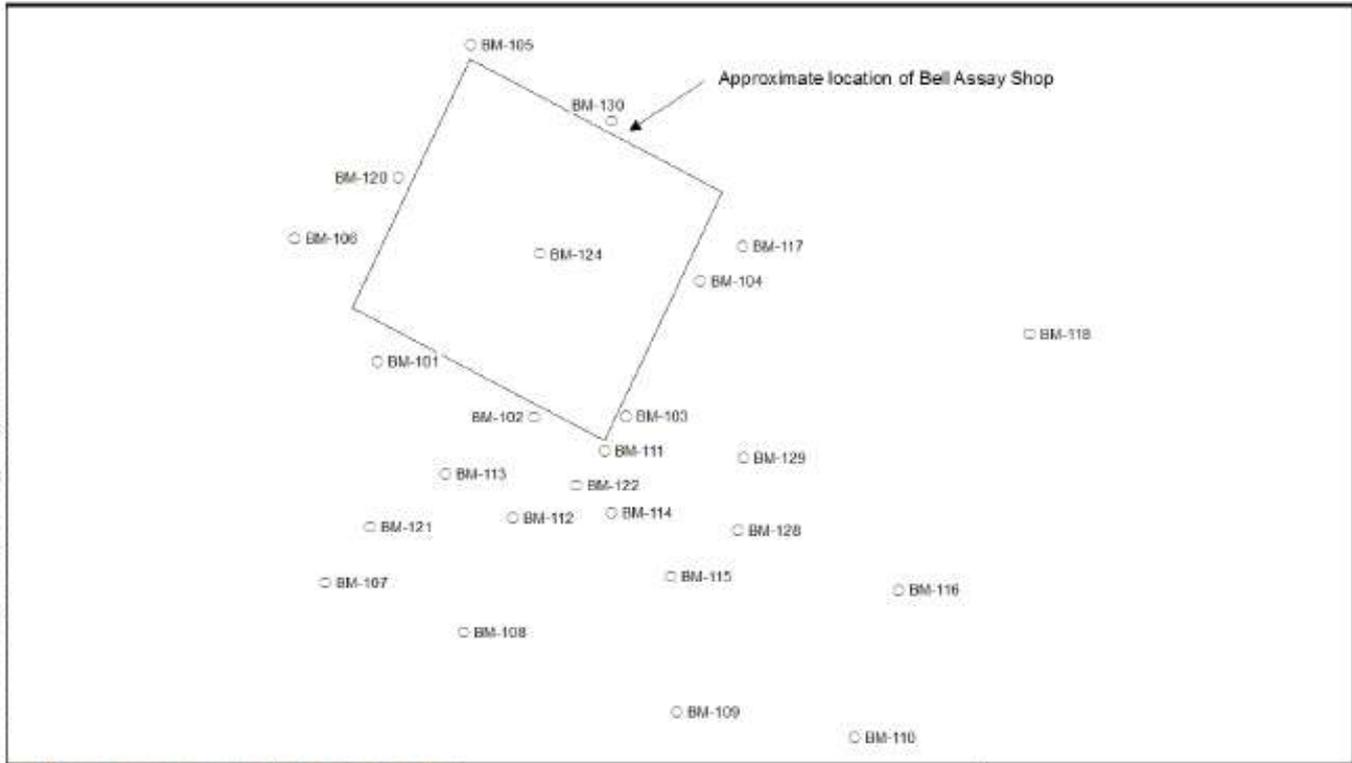
Bret Moxley (USEPA) uses an XRF on dust in the Wheaton-Hollis Hotel's kitchen.





Bell Assay Shop Sample Locations

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LEGEND

- Bell Assay sample location

0 10 20 Feet

DRAFT

**BODIE STATE HISTORICAL PARK
FORMER MINE SITE
BODIE, CALIFORNIA**

**FIGURE 4
BELL ASSAY SHOP
SAMPLE LOCATIONS**

TEAM 9



Initial Sampling Results

- Elevated **Pb**
 - In Wheaton Hollis Hotel dust (up to 17,800 micrograms/wipe)
 - In and around Bell & Rose Assay buildings (>550 ppm lead action level, up to 4,560 ppm at Bell Assay)
 - On slope below Standard Mill (> 550 ppm action level)
- Elevated **Hg** vapor concentration inside Standard Mill (>1,000 nanograms/meter³ action level)
 - Major source of mercury vapor is from the basement
- Elevated **Hg** and **As** in tailings adjacent to Bodie Creek (up to 168 ppm As and 77.8 ppm Hg)
- Small amount of **PCBs** found in one transformer (transformers were previously drained)



Exposure & Remediation Considerations



- Potential employee and/or visitor exposure to:
 - Hg vapor during Standard Mill tours
 - Pb in soil in town and from cupel artifacts
 - Pb dust in Wheaton Hollis Hotel (closed to public; occasional use by employees)
- Potential environmental impacts from tailings:
 - Potential fish tissue impairment by Hg in Bodie Creek
 - Potential As, Hg, & methylmercury contributions downstream to Walker River and Walker Lake in Nevada
- Remediation considerations:
 - Effectiveness of remediation methods selected
 - Balance public health & safety and disruption to visitation
 - Protect artifacts/"historical fabric"



Other Challenges

- Weather and short project windows: Difficult if not impossible to conduct work in snow/frozen soil conditions



Photos taken on
May 22, 2008



Remediation: Assay Buildings



- Removal of top one foot of soil
- Placement of filter fabric
- Placement of clean fill
- Replacement of artifacts (where required)



Placement of clean fill in vicinity of assay buildings



Remediation: Standard Mill

Inside Standard Mill:

- Modified Radon Extraction System
 - Mill basement vapor barrier liner
 - Fans for removal of vapors from basement
 - Expulsion of vapors through existing smokestacks

Below Standard Mill:

- Placement of filter fabric
- Placement of minimum of one foot of clean fill
- Revegetation
- Fencing



Remediation: Wheaton Hollis Hotel



HEPA vacuuming inside
Wheaton-Hollis Hotel



Historic artifacts



Remediation: Tailings



- Stream diversion ditch (away from tailings)
 - Built for 100-year event (60 cubic feet/second)
 - Lined with 18 oz/ft² plastic liner and rip-rap
- Weir construction to slow flows
- Erosion control:
 - Organic material (compost)
 - Seeding of native grass



Physical Hazard Remediation



- The AMLU built fences at Bodie SHP in June, 2008
 - Repaired nine fences around physical hazards
 - Repaired two sections of perimeter fencing
 - Built one new fence around a mine shaft
- The AMLU supplied labor for the project and State Parks purchased materials.





Bodie Successes

- Protecting visitor and employee health and safety while preserving historic and cultural values
 - Hand excavated some areas around the Bell Assay due to concern for the building's stability
 - Avoided artifacts and vegetation with equipment and during excavations. Left artifacts in place when possible
 - Successfully located and characterized hot spots allowing for effective remediation with a smaller disturbed footprint
- Avoided disturbance to Park visitors during remediation
 - Staged equipment outside of the town
 - Used secondary roads away from visitors
 - Scheduled remediation activities around times of high visitation
- Successful coordination between several agencies, including state and federal

CONTACTS & QUESTIONS

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