

# HUMBUG CREEK STUDY MEMORANDUM

## Prepared by:

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## Prepared For:

**US Bureau of Land Management  
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In September 2008, Tetra Tech and Pro-Mack Mining assisted the U.S. Bureau of Land Management (BLM) and US Geological Survey (USGS) personnel in a site characterization study near the confluence of the South Yuba River and Humbug Creek. The site characterization was performed (1) to estimate the amount of free mercury available for transport to the environment and (2) to collect samples for the purpose of performing a bench scale treatability study. The treatability study will attempt to determine the effectiveness of using traditional dredging techniques as a method to remove heavy minerals and free liquid mercury from the environment. River sediment was separated by size fraction at the study site to quantify mercury content in various size fractions and to reduce the weight and volume of sample that needed to be carried out from the site.

The remainder of this memorandum discusses project background and summarizes daily field activities. Tetra Tech and Pro-Mack mining were on site to assist with sample collection and logistics only. Analytical results and study conclusions will be provided by the USGS personnel.

## **Project Background**

Sediment present in the vicinity of the confluence of the Humbug Creek and South Yuba River was believed to contain free liquid mercury. The mercury may have come from historic hydraulic mining activities that occurred at the Malakoff Diggins Hydraulic Mine as well as sources upstream on the South Yuba River. Humbug Creek is the primary drainage from the mine. This mercury may be available to be physically transported down stream and may become available for chemical reactions in sediments and water, methylation and accumulation in downstream biota.

## **Field Activities**

**Day 1 - Mobilization:** On September 15, 2008, Tetra Tech sub-contracted El-Aero Helicopters to assist in transportation of field equipment from the staging area located at the Crystal Hill Mine Site to Humbug South Yuba confluence. El Aero transported seven netted

cargo loads between the staging area and the site where Pro-Mack and Tetra tech personnel offloaded the equipment and assisted the USGS personnel with set up. El Aero flight time was approximately 1 hour and 45 minutes.

**Day 2 - Test Pit 1:** On September 16, 2008 Pro-Mack hand excavated a test pit on the gravel bar at the confluence of the South Yuba River and Humbug Creek. The test pit location was agreed upon by the USGS and BLM during a previous site meeting. The excavation did not reach bedrock due to time constraints. All material from the test pit was weighed and separated on site by size fraction so that the smallest size fractions could be used for later experiments off site.

Tetra Tech assisted the USGS with screening of material and provided oversight of the excavation. Tetra Tech also conducted mercury vapor monitoring throughout the day. Mercury vapor readings were conducted with a Jerome 431-X meter. All measured mercury vapor readings were below the permissible exposure limit (PEL of 0.05 milligrams per cubic meter ( $\text{mg}/\text{m}^3$ )). Mercury vapor readings are included in Appendix A.

While screening was being conducted Pro-Mack also tested a recirculating suction device that could be used to move river sediment similar to how a dredge would but would capture the tailings and process water in a settling tank. The solids would then settle out in the tank and the process water would be reused in the test pit for suction instead of being discharged to the water body. A single 30 minute test was conducted with the recirculating unit to remove sediment from the bottom of the first test pit. The USGS collected a sample of the “first flush” process water. After the 30 minute test the remaining process water was allowed to settle overnight. Photographs of the site work are included in Appendix B.

After the recirculation test was completed the test pit was refilled and returned to its original state on the gravel bar.

**Day 3 – Test Pit 2:** On September 17, 2008 a new test pit was hand excavated on the north bank of the South Yuba River immediately downstream of the Humbug Creek confluence. This location was selected because it was hypothesized that relatively more mercury could be recovered here due to the eddy likely present at higher flows and the likelihood of reaching bedrock during the excavation. All material from the test pit was weighed but only a representative fraction was separated on site by size fraction. Pro-Mack was able to excavate down to bedrock and clean the cracks they believed to be most likely to contain mercury deposits. However, minimal amounts of visible mercury were noted by Pro-Mack personnel. After samples were collected the remaining coarse material was used to refill the test pit and return to its original state on the river bank.

Tetra Tech recorded mercury vapor readings from the Jerome 431-X meter. All measured mercury vapor readings were below the PEL of  $0.05 \text{ mg}/\text{m}^3$ . Mercury vapor readings for each day are included in Appendix A.

**Day 4 – Spot Tests:** On September 18, 2008 a 10 different river features were examined by Pro-Mack personnel in search of mercury in order to help characterize the site. Pro-Mack

personnel removed sediment from features likely to contain gold, free liquid mercury and amalgam. The sediment that was removed was panned down to black sands and heavy metals which were collected for further analysis by the USGS. Detailed notes pertaining to each spot test is included in Appendix C.

Tetra Tech recorded mercury vapor readings from the Jerome 431-X meter. All measured mercury vapor readings were below the PEL of 0.05 mg/m<sup>3</sup>. Mercury vapor readings for each day are included in Appendix A.

**Day 5 - Demobilization:** On September 19, 2008, Tetra Tech sub-contracted El-Aero Helicopters to assist in transportation of field equipment from the Humbug South Yuba confluence back to the staging area located at the Crystal Hill Mine Site. El Aero transported seven netted cargo loads between the site and the staging area where Pro-Mack and Tetra tech personnel offloaded the equipment and assisted the USGS personnel with equipment breakdown. El Aero flight time was approximately 1 hour and 45 minutes.

## **Appendix A**

### **Mercury Vapor Readings**



TETRA TECH EM, INC.

MERCURY VAPOR FIELD DATA SHEET

Project Name: Humbug Cr
Project Location: Nevada City
Project Number:
Sampling Personnel: M. Wetfer

Analyzer Make/Model: Jerome 431-X
Analyzer Serial Number: 431-4219
Operation Method:
Calibration: Factory

Table with columns: Test Number, Duration (Seconds), Date, Time, Sample ID, Sample (Real, QC), Mercury, Analytes mg/m3. Contains 13 rows of data including sample times, locations like 'Camp (back ground)', 'Humbug Bridge', and 'Pit area no activity', and mercury concentrations ranging from 0.003 to 0.018.





MERCURY VAPOR FIELD DATA SHEET

Project Name: Humboldt Cr
Project Location: Nevada City
Project Number:
Sampling Personnel: M. Welter

Analyzer Make/Model: Jerome 431-X
Analyzer Serial Number: 431-4219
Operation Method:
Calibration: Factory

Table with columns: Test Number, Duration (Seconds), Date, Time, Sample ID, Sample (Real, QC), and Analytes (Mercury). Contains 5 rows of handwritten data.

## **Appendix B**

### **Photograph Log**





**Photograph 1**

**Humbug Creek**

September 15, 2008. Equipment staging for transport from Crystal Hill to Humbug Creek site. View North.



**Photograph 2**

**Humbug Creek**

September 16, 2008. Processing area set up to separate size fractions from test pit excavation. View east.



**Photograph 3**

**Humbug Creek**

September 16, 2008. Test for recycling and settling apparatus used by Pro-Mack. View south..



**Photograph 4**

**Humbug Creek**

September 16, 2008. View of first test pit on gravel bar after it was back filled. View southwest.





**Photograph 4**

**Humbug Creek**

September 17, 2008. View of second test pit on north bank of South Yuba River just downstream of Humbug Creek confluence. View northeast.



**Photograph 5**

**Humbug Creek**

September 17, 2008. Pro-Mack personnel excavating at second test pit. View north.



**Photograph 6**

**Humbug Creek**

September 17, 2008. Pro-Mack personnel excavating at second test pit. Note orange color due to iron oxidation. View down.



**Photograph 7**

**Humbug Creek**

September 17, 2008. View of second test pit after excavation. Note bare bedrock was reached and cleaned. View northeast.





**Photograph 8**

**Humbug Creek**

September 17, 2008. View of second test pit after excavation. Note bare bedrock was reached and cleaned. View north.



**Photograph 8**

**Humbug Creek**

September 17, 2008. View of second test pit after it was backfilled. View northeast.



**Photograph 9**

**Humbug Creek**

September 17, 2008. USGS personnel compositing second test pit samples. View southwest.



**Photograph 10**

**Humbug Creek**

September 18, 2008. Pannings from spot tests. Note substantial stained gold but minimal free mercury. View down.



**Photograph 11**

**Humbug Creek**

September 18, 2008. Pro-Mack crew spot conducting spot tests in middle of South Yuba River downstream of Humbug Creek. Minimal free mercury was found in this area where previous dredgers have claimed to find upwards of 20 pound pools of free mercury. View northwest.

## **Appendix C**

### **Spot Test Field Notes**



### Test Pit Notes

SITE #	LAT/LONG	CRACK DESCR.	TIME START/STOP	NOTES
1/Dale	39° 20.282 N, 120° 55.888 W ±32'	-Parallel to flow -Crack outlet faces downstream -4" x 27"	11:10-11:45	-River left side of gravel bar -Crack on gravel bar side of river
2/Ken	39° 20.282 N, 120° 55.888 W ±32'	-Facing up stream -30° off flow -6" deep - 2' deep -6"-12" wide	11:15-12:30	-River left , not on gravel bar -3-4' off of river bank -Hg amalgamated during panning
3/Mark	39° 20.282 N, 120° 55.888 W ±32'	-Perpendicular to flow -crack outlet faces up stream -4"x18"	11:30-12:15	-River right below bank + gravel bar
4/Mark	39° 20.282 N, 120° 55.888 W ±32'	-18"x3" -2" deep -perp to flow -upstream end of eddy	12:15-13:00	-River left, upstream end of eddy -1/2 penny wt gold
5/Dave and Mark	39° 20.282 N, 120° 55.888 W ±32'	-perp. to flow -river center -8'x2"x6 (LxWxD)	15:00-16:20	-W/ compacted gravel, appears no previous mining -Expected substancial gold/Hg but found none
6/Dave and Mark	39° 20.282 N, 120° 55.888 W ±32'	-perp. to flow -2' downstream of #5 -4'x1.5"x1.5"	15:00-16:20	-Compacted gravel -Bottom composed of pyrite vein
7/Ken and Dale	39° 20.282 N, 120° 55.888 W ±32'	-Bowl swept bedrock -18" water -Below small waterfall -12" deep	14:50-15:00	-Gold Flakes, very small -2 pans of material only -Small bowl
8/ Ken and Dale	39° 20.282 N, 120° 55.888 W ±32'	-Bedrock crack -4' long -Parallel to flow -12" w at top, 3" w at bottom	15:00-16:00	
9/Dave and Mark	39° 20.282 N, 120° 55.888 W ±32'	-Parallel to flow -5'x2"x1"	15:00-16:20	-River center - Low spot in river channel
10/Dave and Mark	39° 20.282 N, 120° 55.888 W ±32'	-15'x1.5'x1' -Perpendicular to flow	15:00-16:20	-River center -20' downstream of #5

Loc 5, 6, 9, 10 in pool below camp

## RECOVERY TABLE

SITE #	[CC EST.] BLACK SAND	[0-3] CLEAN GOLD	[0-3] Hg- STAINED GOLD	[0-3] AMALGAM	[0-3] LIQUID Hg	[LESS THAN] <1, [GREATER THAN] >1 Hg/Au RATIO
1/Dale	1tbs	1	2	1	1	<1
2/Ken	2tbs	1	2	2	1	1
3/Mark	3/4 tbs	1	2	1	0	<1
4/Mark	1/4 cup	3 (1 pan)	1	0	0	<1
5/Dave + Mark	none	1	1	0	0	<1
7/Dale and Ken	1tsp	1-2	0	1	0	<1
8/Dale and Ken	1tbs	1-2	0	0	0	<<1

0= Not  
 1=Trace  
 2=Med  
 3=Abundant