DATA TRANSMITTAL REPORT
MINE YARD SURFACE MATERIAL CHARACTERIZATION
2007 WORK PLAN

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I certify under penalty of law that I have examined and am familiar with this Work Plan, and to my knowledge, the report is true, complete, and accurate.

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1.0 PURPOSE

This data transmittal report presents field and laboratory data from the Mine Yard area soil sampling at the Empire Mine State Historic Park (SHP), Grass Valley, California in accordance with the Mine Yard Surface Material Characterization 2007 Action Work Plan (Work Plan) (MFG 2007). The purpose of this work was to delineate potential mine and mill materials in the surface materials of the Mine Yard area. The Mine Yard area includes the open area between the Empire Mine historic buildings and the Stamp Mill foundation, as depicted on Figure 1. The Mine Yard characterization also included the unpaved area of the Visitor's Center parking lot.

2.0 SUMMARY OF SAMPLE COLLECTION ACTIVITES

2.1 Site Characterization

The Mine Yard area was divided into three sampling sites: the Mine Yard, the Visitor's Center Parking Lot, and the Stamp Mill. According to the Work Plan, the following sampling activities were completed at the three sites:

- Visual survey and characterization of surface materials, including visual identification of potential mine and mill materials.
- Field in-situ X-ray fluorescence (XRF) measurements for arsenic and lead concentrations of surface soil. The in-situ XRF measurements were performed on a 50-foot grid within the Mine Yard, Visitor's Center Parking Lot and Stamp Mill foundation area.
- Collection of surface soil samples (0 to 2-inch depth) at twenty percent of the in-situ XRF measurements locations within the Mine Yard, Visitor's Center Parking Lot and Stamp Mill foundation area for ex-situ XRF analysis of arsenic and lead concentrations, and laboratory analysis of CAM-17 metal concentrations and State of California Modified Waste Extraction Test (DI WET) metal concentrations.
- Collection of subsurface soil samples (6 to 12-inch depth) from the Stamp Mill foundation area for laboratory analysis of CAM-17 metal concentrations and DI WET metal concentrations.
- Collection of fines contained within the gravel covering the existing roadway area within the Mine Yard for ex-situ XRF analysis of arsenic and lead concentrations and laboratory analysis of CAM-17 metal concentrations.
- In-situ XRF measurements for arsenic and lead concentrations of surface materials within the drip zones of the historic buildings within the Mine Yard, and the collection of surface samples (0 to 2-inch depth) within the drip zones for laboratory analysis of CAM-17 metal concentrations and DI WET metal concentrations.

Figure 1 shows the sampling grids developed by the field personnel for the three sites. Table 1 provides a summary of the total number of sample locations at each of the sites, as well as the number of samples collected for each type of analysis. The sampling regime for each site is detailed individually in the following sections.

2.1.1 Mine Yard Surface Characterization

The Mine Yard, excluding the Visitor's Center Parking Lot and Stamp Mill foundation area, is approximately 700 feet long by 400 feet wide, narrowing on the western end. The Mine Yard contains 10 buildings and a collection of historic mining equipment as an exhibit for park visitors. The northern perimeter of the Mine Yard is defined by a rock wall, with the Visitor's Center Parking Lot located north of the rock wall. The southern perimeter of the Mine Yard is also defined by a rock wall, with the Empire Mine waste rock pile located south of the wall.

In-situ XRF surface measurements were performed at a total of 61 locations. The in-situ XRF measurements were performed using a portable Niton XRF 702 XLp spectrum analyzer directly on the soil surface at the 50-foot grid intervals developed by the field sampling personnel (Figure 1). The XRF measurements were performed as described in the Work Plan in accordance with *EPA Method 6200 – Field Portable X-ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment*. A majority of the in-situ XRF measurement locations had a gravel surface covering the underlying material. Therefore, the gravel covering was removed to analyze the underlying materials. A total of 11 surface samples (0 to 2-inch depth) were collected for additional analysis. The collected samples were analyzed by ex-situ XRF after sieving (minus 60-mesh) according to EPA Method 6200, and then submitted for laboratory analysis of CAM-17 total metals. Two of the samples submitted to the laboratory were also analyzed for DI WET metals (California Waste Extraction Test procedure using deionized water instead of citric acid).

Gravel samples were collected from a one square-foot area at five locations in the roadway area of the Mine Yard (Figure 1). These five samples were sieved (minus 60-mesh) in the field to produce a sample of roadway fines. The samples were analyzed by ex-situ XRF for arsenic and lead, and were submitted for laboratory analysis of CAM-17 total metals.

In-situ XRF measurements were also made at 38 locations within the drip zones of the historic buildings (Figure 1). The in-situ measurements were performed at 50-foot intervals along the exterior perimeter of the buildings, within 6 to 30 inches from the exterior walls. Surface samples (0 to 2-inch depth) were collected at eight of these locations for further analysis. The samples were analyzed for arsenic and lead concentrations by ex-situ XRF after sieving (minus 60-mesh) according to EPA Method 6200, and then submitted for laboratory analysis of CAM-17 total metals. Two of the samples submitted to the laboratory were also analyzed for DI WET metals.

2.1.2 Visitors Center Parking Lot Characterization

The Visitor's Center Parking Lot is approximately 175 feet long and 150 feet wide. The surface material was generally gravel with an underlying hardpan soil. The parking lot is bordered by forest to the north and east, the Visitor's Center to the west, and by the rock wall to the south along the northern boundary of the Mine Yard. East Empire Street is located to the north of the parking lot. The parking lot surface was asphalted in the months following the sampling event.

A total of 10 in-situ XRF surface measurements were taken within the parking lot area (Figure 1). The in-situ XRF measurements were performed directly on the soil surface along the 50-foot grid pattern.

Where present, loose gravel was removed prior to the in-situ XRF measurements. Surface soil samples (0-2 inches) were collected at two of the locations for additional analysis. The samples were analyzed for arsenic and lead concentrations by ex-situ XRF after sieving (minus 60-mesh) according to EPA Method 6200, and then submitted for laboratory analysis of CAM-17 total metals and DI WET metals.

2.1.3 Stamp Mill Area Characterization

The Stamp Mill foundations are located southwest of the Mine Yard and are surrounded by fencing that precludes public access. The site is bordered by the Hardrock Trail to the west, the Empire waste rock pile to the south, and the Mine Yard to the north and east. The ground surface within the Stamp Mill foundation area consists of concrete, highly weathered rock, soils, and finely ground dust. Several small piles of possible waste rock were observed at the north end of the Stamp Mill area.

The 50-foot sampling grid in the Stamp Mill area was modified by field sampling personnel due to the presence of concrete foundations. A concrete foundation slab is present throughout the eastern portion of the Stamp Mill, with no surface material available for sampling. As shown on Figure 1, sampling locations B0, C0, D0, and E0 were moved 25 feet to the east on the upper foundation area where surface material was available for sampling. However, sampling locations A0 and F0 remained on the original 50-foot grid at points located south and north of the concrete foundation, respectively.

In-situ XRF surface measurements were performed at 12 locations within the Stamp Mill (Figure 1). Six surface (0-2 inches) and six subsurface (6-12 inches) samples were collected for further analysis. The samples were analyzed for arsenic and lead concentrations by ex-situ XRF after sieving (minus 60-mesh) according to EPA Method 6200, and analyzed by the laboratory for CAM-17 total metals. Two of the samples were also analyzed for DI WET metals.

3.0 SUMMARY OF XRF AND LABORATORY METALS CONCENTRATION RESULTS

In-situ XRF measurements for arsenic and lead concentrations of surface materials were performed on a 50-foot grid within the Mine Yard, Stamp Mill and Visitors Center Parking Lot. Surface samples (0 to 2-inch depth) were collected from a subset of these measurement locations for ex-situ XRF analysis of arsenic and lead concentrations and laboratory analysis of CAM-17 total metals. Laboratory analysis of the samples was performed by SVL Analytical (SVL) in Kellogg, Idaho. The ex-situ XRF and laboratory analyses provide arsenic and lead concentration data to correlate with the in-situ XRF measurements and to evaluate detection limits of the in-situ XRF measurements, and provide data for the CAM-17 metal constituents that cannot be measured by the portable XRF instrument.

As described in Section 4.0, a regression analysis was performed to correlate the arsenic and lead concentrations determined by in-situ XRF with concentrations determined by ex-situ XRF and by the laboratory. The in-situ XRF measurements were performed directly on the soil surface. The ex-situ XRF and laboratory analyses were performed on the minus 60-mesh sieve fraction (<0.25 mm) of the collected soil samples. The correlations allow the in-situ XRF arsenic and lead concentrations to be expressed as minus 60-mesh predicted laboratory concentrations. The in-situ XRF arsenic and lead concentrations shown on figures in this report are in-situ XRF values which have been correlated to laboratory values based on the regression analysis presented in Section 4.0. The in-situ XRF and laboratory analyses of surface samples in the Mine Yard, Stamp Mill and Visitors Center Parking Lot are presented in the following sections.

3.1 Mine Yard

3.1.1 XRF Analysis

The arsenic and lead concentrations determined by in-situ XRF measurements for surface soils along the 50-foot grid within the Mine Yard and at 50-foot intervals along the drip zone of the buildings are provided in Table 2. The correlated arsenic and lead concentrations, determined by the regression analysis between the in-situ XRF measurements and the laboratory analysis of collected samples, are also provided in Table 2. The correlated arsenic and lead concentrations are presented in Figures 2 through 5.

The in-situ XRF values shown in Table 2 are provided without regard to the detection limits of the XRF measurements for arsenic and lead. While the XRF is capable of determining arsenic and lead concentrations below these detection limits, concentrations measured below the detection limits are considered to be estimated values and not a quantitative measurement. The detection limits for XRF analysis of arsenic and lead concentrations were calculated according to EPA Method 6200 using

site-specific soil samples. The detection limit is defined as three times the standard deviation of replicate XRF analysis of low-concentration samples. The detection limits for arsenic and lead were calculated to be 29 mg/kg and 41 mg/kg, respectively. These detection limits were then multiplied by the regression factors determined from correlation with the laboratory results (Section 4.0), which resulted in correlated detection limits of 39 mg/kg for arsenic and 47 mg/kg for lead. XRF correlated arsenic and lead concentrations less than these limits are shown in Table 2 as "<39 mg/kg" for arsenic and "<47 mg/kg" for lead. As shown in Table 2, the underlying soils beneath the graveled portions of the Mine Yard were below the correlated XRF arsenic detection limit of 39 mg/kg at many of the sample locations.

Additional data was collected within the drip zone locations. Along buildings where a downspout collected stormwater via rain gutters, the in-situ XRF measurement was taken at the downspout outlet location. If no downspout existed, in-situ XRF measurements were performed at 50-foot intervals around the drip line of the historic buildings. Arsenic and lead concentrations of the drip zone locations are presented in Table 2. The in-situ correlated XRF arsenic concentrations at drip zone locations DZWS-3 and DZBS-2 (near the welding and blacksmith shops) appear to be affected by spectral interference due to scatter in the XRF analysis caused by high iron concentrations (726,065 and 364,331 mg/kg). Residual slag, iron shavings, and/or foundry debris present at these locations might be the source of this iron. A soil sample was collected at location DZWS-3 for laboratory analysis. The in-situ correlated XRF value for arsenic was 391 mg/kg, while the arsenic concentration determined by laboratory analysis was 94.3 mg/kg.

Gravel fines samples were collected along the gravel roadway that transects the Mine Yard area. No in-situ measurements were taken from the gravel fines.

3.1.2 Total Metals Laboratory Analysis

As discussed previously, samples were collected for every one in five in-situ XRF measurement locations and analyzed by the laboratory to assess and develop regression curves for the in-situ XRF measurements performed directly on the ground surface for arsenic and lead. In addition, laboratory analysis was conducted for the other CAM-17 metal constituents. In all, 24 of the in-situ surface locations were sampled and submitted for laboratory analysis of CAM-17 metals: 11 from the Mine Yard area, 8 from the drip zones, and 5 from the gravel fines. The total metals concentrations of the collected samples are shown in Table 5. The total metal concentrations analyzed by the laboratory for arsenic and lead are also shown on Figures 2 through 5.

3.1.3 DI WET Analysis

A portion of the collected samples were also analyzed by DI WET. The DI WET analysis was performed using deionized water instead of citric acid, as specified in the Work Plan. Two samples were analyzed for DI WET from the Mine Yard and the drip zones. Laboratory analysis of the DI WET leachate was performed for CAM-17 metals. The DI WET results are provided in Table 6.

3.2 Visitor's Center Parking Lot

3.2.1 XRF Analysis

Arsenic and lead concentrations were determined by in-situ XRF measurements at 10 locations within the Visitor's Center Parking Lot. The in-situ measurements were performed on the 50-foot grid directly on the soil surface using the portable Niton XRF 702 XLp spectrum analyzer. As previously described, loose gravel, where present, was removed prior to the in-situ XRF measurements. The arsenic and lead concentrations determined by the in-situ XRF measurements and correlated laboratory values are presented in Figures 2 through 5. The in-situ XRF and correlated values for arsenic and lead are provided in Table 3.

3.2.2 Total Metals Laboratory Analysis

Soil samples were collected at two of the in-situ measurement locations within the parking lot and submitted for laboratory analysis of CAM-17 total metals. The total metals concentrations for the samples are shown in Table 5. The arsenic and lead concentrations analyzed by the laboratory are also shown on Figures 2 through 5.

3.2.3 DI WET Analysis

The two parking lot samples were also analyzed for DI WET. The DI WET analysis was performed using deionized water instead of citric acid, as specified in the Work Plan. Laboratory analysis of the DI WET leachate was performed for CAM-17 metals. The DI WET results are provided in Table 6.

3.3 Stamp Mill Area

3.3.1 XRF Analysis

Arsenic and lead concentrations were determined by in-situ XRF measurements at 12 locations within the Stamp Mill area. The arsenic and lead concentrations determined by the in-situ XRF measurements and correlated to laboratory data are presented in Figures 6 and 7. The in-situ XRF and correlated values for arsenic and lead are also provided in Table 4.

3.3.2 Total Metals Analysis

Surface and subsurface samples were collected at six of the in-situ XRF measurements within the Stamp Mill area and submitted for laboratory analyses of CAM-17 total metals. The total metals concentrations for the samples are provided in Table 5. The total metal concentrations for arsenic, lead, and mercury are also shown on Figures 6 through 8.

3.3.3 DI WET Analysis

Two of the surface and two of the subsurface samples collected within the Stamp Mill area were also analyzed by the laboratory for DI WET metals. The DI WET analysis was performed using deionized water instead of citric acid, as specified in the Work Plan. Laboratory analysis of the DI WET leachate was performed for CAM-17 metals. The DI WET results are provided in Table 6.

4.0 CORRELATION OF XRF AND LABORATORY CONCENTRATIONS FOR ARSENIC AND LEAD

As previously described, soil samples were collected at 20 percent of the in-situ XRF measurement locations. Ex-situ XRF and laboratory analyses were performed on the minus 60-mesh sieve fraction (<0.25 mm) of the collected soil samples. The ex-situ XRF and total metals analyses provide metals concentration data to confirm and correlate with the in-situ XRF measurements. Correlations were developed for arsenic and lead concentrations analyzed by in-situ XRF, ex-situ XRF, and the laboratory through linear regression. The regression graphs and equations are shown on Figures 9-16. The correlations allow the in-situ XRF concentration determined in the field to be expressed as a minus 60-mesh correlated laboratory concentration.

The XRF readings become less accurate if constituent concentrations are above a particular threshold specific to each analyte. Therefore, regressions were developed using an analyte concentration maximum limits and comparing those to regressions of the data without concentration limits. The regression which resulted in the best correlation of the data, defined as the regression with the higher R^2 value, was used. To increase the sample size and thereby reinforce the correlation, in-situ XRF, ex-situ XRF, and laboratory data from the 2007 Trails, Mine Yard, and Cyanide Plant Work Plans were used to develop the correlation. Correlation of the ex-situ XRF and laboratory analysis of the minus 60-mesh sieve soil samples for lead and arsenic, with and without concentration limits, are shown on Figures 9 - 12.

The ex-situ XRF and laboratory analyses for lead concentrations of the minus 60-mesh sieve soil samples are related by the following linear regression equation (Figure 10):

$$\text{Laboratory lead conc.} = \text{ex-situ XRF lead conc. } (<5000 \text{ mg/kg}) \times 1.00 \quad (R^2 = 0.99)$$

The ex-situ XRF and laboratory analyses for arsenic concentrations of the minus 60-mesh sieve soil samples are related by the following linear regression equations (Figure 12):

$$\text{Laboratory arsenic conc. (mg/kg)} = \text{ex-situ XRF arsenic conc. } (<1500 \text{ mg/kg}) \times 1.105 \quad (R^2 = 0.98)$$

Regressions were also developed for arsenic and lead concentrations between the in-situ XRF analysis and the ex-situ XRF analysis of the minus 60-mesh sieve surface samples. The in-situ XRF and ex-situ XRF lead correlations are shown on Figures 13 and 14, and the arsenic correlations are shown on Figures 15 and 16. The lead concentrations determined by in-situ XRF analysis are related to the ex-situ XRF analysis by the following linear regression equation (Figure 13):

$$\text{Ex-situ lead conc. (mg/kg)} = \text{In-situ XRF lead conc. (mg/kg)} \times 1.14 \ (R^2 = 0.93)$$

The arsenic concentrations determined by in-situ XRF analysis are related to the ex-situ XRF analysis by the following linear regression equation (Figure 15):

Ex-situ arsenic conc. (mg/kg) = In-situ XRF arsenic conc. (mg/kg) x 1.21 (R^2 = 0.83)

5.0 REFERENCES

MFG, Inc., 2007. Mine Yard Surface Material Characterization 2007 Work Plan, Empire Mine State Historic Park. July 16.

TABLES

Table 1 Mine Yard, Visitor's Center Parking Lot, and Stamp Mill Sample Summary

Site Sampling Location	Field In-Situ XRF Measurements	Field Ex-Situ XRF Measurements	Laboratory Measurements	
			CAM-17 Metals	DI WET
Mine Yard Surface (0-2 inches)	61	11	11	2
Mine Yard roadway gravel fines	0	5	5	0
Visitor's Center Parking Lot surface	10	3	2	2
Stamp Mill surface (0-2 inches)	12	6	6	2
Stamp Mill subsurface (6-12 inches)	0	6	6	2
Historic Building Drip Zones (0-2 inches)	38	8	8	2

Table 2 Mine Yard In-situ XRF Analysis for Lead and Arsenic

Sample ID	In-situ XRF Lead Concentration (mg/kg)	Correlated Lead Concentration (mg/kg)	In-situ XRF Arsenic Concentration (mg/kg)	Correlated Arsenic Concentration (mg/kg)
MY-A150	117	133	31	42
MY-A200	43	49	38	51
MY-A250	41	<47	20	<39
MY-A300	55	63	28	<39
MY-A350	52	59	25	<39
MY-A400	312	356	22	<39
MY-A450	372	424	58	78
MY-A650	96	110	65	87
MY-B100	58	66	41	55
MY-B150	56	64	25	<39
MY-B200	34	<47	34	45
MY-B250	62	71	15	<39
MY-B300	50	57	15	<39
MY-B350	33	<47	37	50
MY-B400	202	231	32	44
MY-B600	57	64	8	<39
MY-C100	28	<47	33	44
MY-C150	52	59	30	40
MY-C200	30	<47	27	<39
MY-C250	51	58	26	<39
MY-C300	43	49	40	54
MY-C350	61	69	20	<39
MY-C400	22	<47	32	42
MY-C450	49	56	33	44
MY-C500	45	51	14	<39
MY-C550	34	<47	20	<39
MY-C600	34	<47	31	42
MY-D100	56	64	26	<39
MY-D150	51	58	26	<39
MY-D200	61	69	13	<39
MY-D250	49	56	26	<39
MY-D300	42	48	33	44
MY-D350	25	<47	42	56
MY-D400	51	58	23	<39
MY-D450	31	<47	37	49
MY-D500	39	<47	34	46
MY-E50	52	59	23	<39
MY-E150	36	<47	44	59
MY-E200	128	146	42	56
MY-E300	87	99	36	48
MY-E350	28	<47	29	<39
MY-E400	27	<47	30	40
MY-E500	49	56	19	<39

Table 2 Mine Yard In-situ XRF Analysis for Lead and Arsenic (continued)

Sample ID	In-situ XRF Lead Concentration (mg/kg)	Correlated Lead Concentration (mg/kg)	In-situ XRF Arsenic Concentration (mg/kg)	Correlated Arsenic Concentration (mg/kg)
MY-F0	247	282	238	319
MY-F150	554	632	96	128
MY-F200	550	627	234	313
MY-F250	41	47	30	40
MY-F300	804	916	103	138
MY-F500	188	214	341	457
MY-G0	142	162	143	192
MY-G50	85	97	98	131
MY-G100	139	158	139	186
MY-G150	224	256	78	104
MY-G200	865	986	197	264
MY-G250	68	78	87	117
MY-G300	203	232	720	965
MY-G350	145	165	748	1002
MY-G400	117	134	228	306
MY-G450	2560	2918	846	1133
MY-G500	90	102	433	580
DZBS-1	1485	1693	91	122
DZBS-2	913	1041	99	132
DZBS-3	62	71	89	119
DZBS-4	33	<47	16	<39
DZCH-1	1211	1381	105	140
DZCH-2	45	51	50	67
DZCH-3	20	<47	30	41
DZCH-4	62	70	41	55
DZCH-5	91	104	93	125
DZDB-1	42	48	43	58
DZDB-2	34	<47	23	<39
DZHH-1	289	330	26	<39
DZHH-2	44	50	19	<39
DZHH-3	349	398	154	206
DZHH-4	63	71	85	114
DZMO-1	364	415	145	194
DZMO-2	58	66	35	47
DZMO-3	66	76	49	66
DZMO-4	47	53	30	40
DZMO-5	113	129	27	<39
DZMO-6	222	254	64	85
DZMS-1	49	56	20	<39
DZMS-2	150	171	38	51
DZMS-3	106	121	59	78
DZMS-4	267	304	68	92
DZTR-1	194	221	179	240
DZVC-1	83	95	65	87

Table 2 Mine Yard In-situ XRF Analysis for Lead and Arsenic (continued)

Sample ID	In-situ XRF Lead Concentration (mg/kg)	Correlated Lead Concentration (mg/kg)	In-situ XRF Arsenic Concentration (mg/kg)	Correlated Arsenic Concentration (mg/kg)
DZVC-2	71	81	28	<39
DZVC-3	52	59	27	<39
DZVC-4	468	534	212	284
DZVC-5	58	66	27	<39
DZVC-6	173	198	133	178
DZWS-1	108	123	121	162
DZWS-2	42	48	25	<39
DZWS-3	986	1124	292	391
DZWS-4	142	162	94	125

Table 3 Parking Lot In-Situ XRF Lead and Arsenic Values

Sample ID	In-situ XRF Lead Concentration (mg/kg)	Correlated Lead Concentration (mg/kg)	In-situ XRF Arsenic Concentration (mg/kg)	Correlated Arsenic Concentration (mg/kg)
PK-B150	17.86	<47	59	79
PK-B200	57.66	66	20	<39
PK-B250	52.59	60	32	42
PK-B300	54.13	62	42	56
PK-C150	27.22	<47	46	61
PK-C200	70.33	80	45	60
PK-C250	44.25	50	33	44
PK-C300	49.57	57	18	<39
PK-D200	37.48	<47	28	<39
PK-D250	44.25	50	28	<39

Table 4 Stamp Mill In-Situ XRF Lead and Arsenic Values

Sample ID	In-situ XRF Lead Concentration (mg/kg)	Correlated Lead Concentration (mg/kg)	In-situ XRF Arsenic Concentration (mg/kg)	Correlated Arsenic Concentration (mg/kg)
SM-A0	321.08	366	297	398
SM-A50	226.9	259	311	416
SM-B0	140.38	160	230	309
SM-B50	401.29	457	272	364
SM-C0	88.78	101	360	483
SM-C50	573.43	654	372	498
SM-D0	130.35	149	355	476
SM-D50	437.02	498	600	805
SM-E0	261.2	298	1239	1661
SM-E50	897.87	1024	284	380
SM-F0	150.64	172	961	1288
SM-F50	124.75	142	120	160

Table 5 Laboratory Total Metals Analysis of Mine Yard, Parking Lot, and Stamp Mill Samples

Sample ID	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Mine Yard Surface Samples (0-2 inches)																	
MY-A350	<2.0	20	90.3	0.321	3.72	23.6	17.2	30.1	20.1	0.378	1.7	12.7	<4.0	0.53	<1.5	74.8	126
MY-A450	8	66.2	139	0.279	32.7	25.2	11.1	143	510	17.2	1.73	20.1	<4.0	41.1	<1.5	202	1110
MY-C150	<2.0	6.3	59	0.302	3.18	10.2	14.3	17.6	9	0.062	2.2	10.7	<4.0	<0.5	<1.5	66.6	68.9
MY-C250	<2.0	5.5	116	0.365	2.02	7.17	14.8	24.7	7.43	0.047	2.23	11.6	<4.0	<0.5	<1.5	50.5	66.4
MY-C300	<2.0	5.6	92.9	0.338	2.13	7.92	13.2	17.7	8.73	0.045	1.99	5.59	<4.0	<0.5	<1.5	54.5	67.9
MY-D100	<2.0	9.6	113	0.335	2.96	12.7	15.4	22.1	10.3	0.055	1.6	15.5	<4.0	<0.5	<1.5	56.8	77.1
MY-D500	<2.0	5.4	101	0.309	2.85	10.6	14.1	16.8	9.81	0.092	1.9	9.65	<4.0	<0.5	<1.5	60.4	67.2
MY-E200	<2.0	7.1	144	0.374	2.16	10.8	14.9	26.1	33.4	0.063	1.91	7.94	<4.0	<0.5	<1.5	46.7	312
MY-E400	4.3	56	90.4	<0.2	5.99	144	36	204	122	1.28	4.68	372	<4.0	1.42	<1.5	64.6	253
MY-E50	<2.0	5.8	48.8	0.26	2.01	6.31	12.1	20.7	7.99	0.068	2.63	3.06	<4.0	<0.5	<1.5	55	62.6
MY-G350	<2.0	2120	165	0.503	10.5	41.1	44	277	191	1.57	3.73	9.57	<4.0	3.24	<1.5	94.3	314
Mine Yard Surface Roadway Gravel Fines																	
MY-GRV-01	<2.0	10.3	163	0.288	3	21.8	18.6	73.9	10.9	0.125	1.83	19.2	<4.0	<0.5	<1.5	67.9	66.5
MY-GRV-02	<2.0	144	71.8	0.215	3.49	22.7	9.01	48.9	99.6	0.257	1.92	14.5	<4.0	1.26	<1.5	73.6	142
MY-GRV-03	<2.0	6.7	196	0.299	3.08	23	20	80.7	7.5	0.14	1.89	18.8	<4.0	<0.5	<1.5	69	67.9
MY-GRV-04	<2.0	6.4	175	0.242	2.87	20	17.3	60.9	10.2	0.132	1.18	14.3	<4.0	<0.5	<1.5	60.9	64.1
MY-GRV-05	<2.0	3.9	34.3	<0.2	1.17	6.42	7.38	12.5	5.93	<0.033	1.24	7.03	<4.0	<0.5	<1.5	38.6	34.6
Visitor's Center Parking Lot Surface																	
PK-C300	<2.0	10.9	106	0.203	2.33	13.8	12.2	49.4	12	0.093	1.41	11.9	<4.0	<0.5	<1.5	36.7	81.7
PK-D200	<2.0	13.4	96.5	0.203	2.06	19.3	8.56	39	41	0.375	1.97	16.1	<4.0	0.79	<1.5	33.5	79.1
Stamp Mill Surface (0-2 inches)																	
SM-A0	<2.0	437	319	0.413	14.6	84.6	30.7	421	652	61.8	11.7	60.6	<4.0	10.6	<1.5	87.2	1140
SM-B50	2.3	682	346	0.29	26.5	31.8	17.3	325	2420	47.2	3.9	7.56	<4.0	52.9	<1.5	151	1500
SM-C0	4.6	936	91.4	1.01	10.6	29.6	64.9	230	156	24.3	8.86	27.2	<4.0	4.92	<1.5	53.4	315
SM-D50	7.3	1000	199	0.51	9.81	39.1	30.4	270	490	108	5.12	30.7	<4.0	28.7	<1.5	110	514
SM-E0	5.8	1490	101	0.557	15.4	20.5	72.8	198	478	70.7	3.77	41.7	<4.0	6.88	<1.5	62.7	491
SM-F50	4.1	77.3	123	0.487	6.45	42.2	10.6	74.7	118	5.67	2.62	15.9	<4.0	3.67	<1.5	229	110

Table 5 Laboratory Total Metals Analysis of Mine Yard, Parking Lot, and Stamp Mill Samples (continued)

Sample ID	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Stamp Mill Subsurface (6-12 inches)																	
SM-A0-6	6.5	536	309	0.477	12.6	95.7	27.4	499	571	34.3	16.6	89.1	<4.0	14.1	<1.5	83.7	1270
SM-B50-6	2.6	554	264	0.39	14.4	31.7	21.3	250	1030	25.5	3.41	9.07	<4.0	23.9	<1.5	151	598
SM-C0-06	5.2	854	110	0.998	10.8	52.8	65	238	181	9.33	12.6	32.1	<4.0	4.89	<1.5	55.3	348
SM-D50-6	6.1	1210	143	0.602	8.37	35.7	37.2	216	214	22	4.72	30.6	<4.0	7.02	<1.5	123	354
SM-E0-6	<2.0	1710	79.1	0.597	18.1	15.4	84.1	235	500	75	2.95	37.8	<4.0	7.3	<1.5	55.4	473
SM-F50-6	4	95.1	125	0.517	6.94	41.4	11.4	86.7	154	4.83	2.6	20	<4.0	4.28	<1.5	219	167
Historic Building Drip Zones (0-2 inches)																	
DZ-BS4-01	<2.0	8	84.5	0.213	1.48	11.9	10.6	17.9	8.4	0.042	1.59	22.1	<4.0	<0.5	<1.5	40.5	234
DZ-CH5-0	2	90.1	49.3	0.35	6.01	69.2	23.6	79.7	61	0.172	1.17	186	<4.0	0.96	<1.5	265	4940
DZ-M05-0	<2.0	22.9	72.5	0.217	5.18	16.3	8.66	63.7	129	1.5	1.4	10.8	<4.0	11.1	<1.5	108	299
DZ-MS2-0	2.4	77.1	290	0.261	15.3	26.2	15.8	1030	547	69.7	3.73	13.4	<4.0	6.27	<1.5	39.2	1270
DZ-TR1-0	<2.0	306	167	0.295	10.5	29.1	14.5	107	205	0.935	2.36	10.7	<4.0	3.27	<1.5	96.4	1460
DZ-VC1-0	<2.0	32.8	115	0.484	5.95	52.9	12.4	52.2	41.9	0.513	2.21	13.4	<4.0	0.56	<1.5	219	1060
DZ-VC6-0	<2.0	203	87.1	0.279	5.55	28.5	12.3	59.2	185	1.9	1.74	10.7	<4.0	2.09	<1.5	150	985
DZWS-3	7.7	94.3	606	<0.2	29.8	420	39.9	792	1180	2.7	65.3	240	<4.0	3.71	<1.5	53.9	1810

Table 6 Laboratory DI WET Results of Mine Yard, Parking Lot, and Stamp Mill Samples

Sample ID	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Mine Yard and Drip Zone (0-2 inches) Samples																	
MY-A350-0	<0.020	<0.025	0.016	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00020	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010
MY-E50-0	<0.020	<0.025	0.0042	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00020	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010
Historic Building Drip Zones																	
DZ-BS4	<0.020	<0.025	0.0098	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00020	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	0.019
DZ-WS3	<0.020	<0.025	0.369	<0.0020	<0.0020	<0.0060	<0.0060	0.04	<0.0075	<0.00020	0.064	0.014	<0.04	<0.0050	<0.015	<0.0050	<0.010
Visine's Center Parking Lot Surface																	
PK-C300	<0.020	0.026	0.0978	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00020	0.015	<0.010	<0.04	<0.0050	0.019	<0.0050	<0.010
PK-D200	<0.020	0.048	0.127	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00020	0.014	<0.010	<0.04	<0.0050	0.018	<0.0050	0.044
Stamp Mill Surface (0-2 inches) Samples																	
SM-E0-0	<0.020	0.039	0.0036	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00020	0.013	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010
SM-F50-0	<0.020	<0.025	0.0246	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00020	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010
Stamp Mill Subsurface (0-6 inches) Samples																	
SM-E0-6	<0.020	0.041	0.0023	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00020	0.011	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010
SM-F50-6	<0.020	<0.025	0.0125	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00020	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010

FIGURES

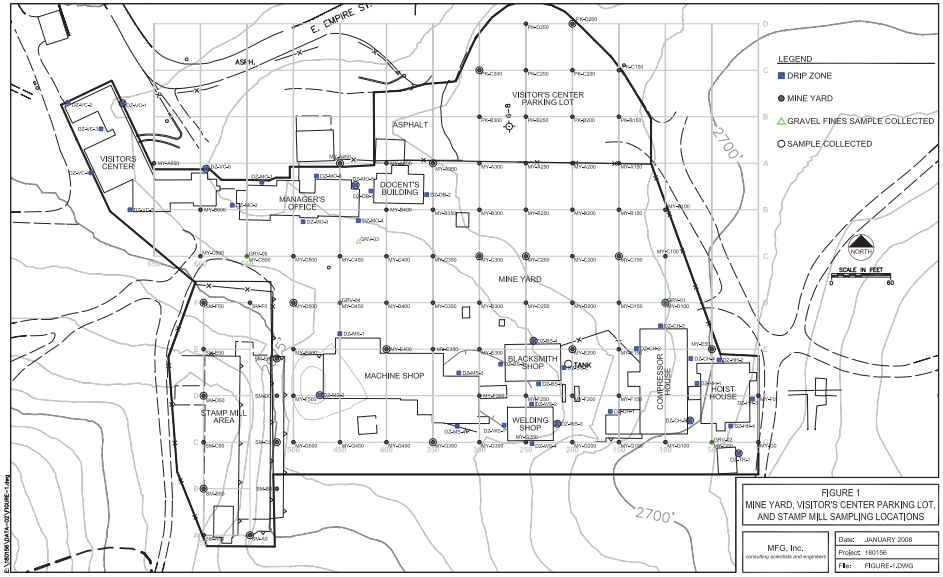


FIGURE 1
MINE YARD, VISITOR'S CENTER PARKING LOT, AND STAMP MILL SAMPLING LOCATIONS

MFG, Inc.
consulting scientists and engineers

Date:	JANUARY 2008
Project:	180156
File:	FIGURE-1.DWG

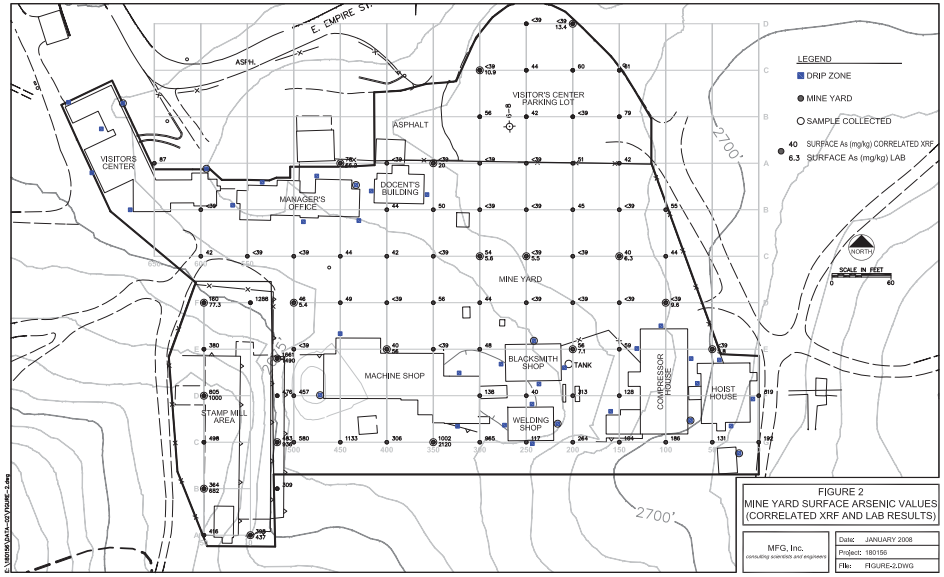


FIGURE 2
MINE YARD SURFACE ARSENIC VALUES (CORRELATED XRF AND LAB RESULTS)

MFG, Inc.
consulting scientists and engineers

Date:	JANUARY 2008
Project:	180156
File:	FIGURE-2.DWG

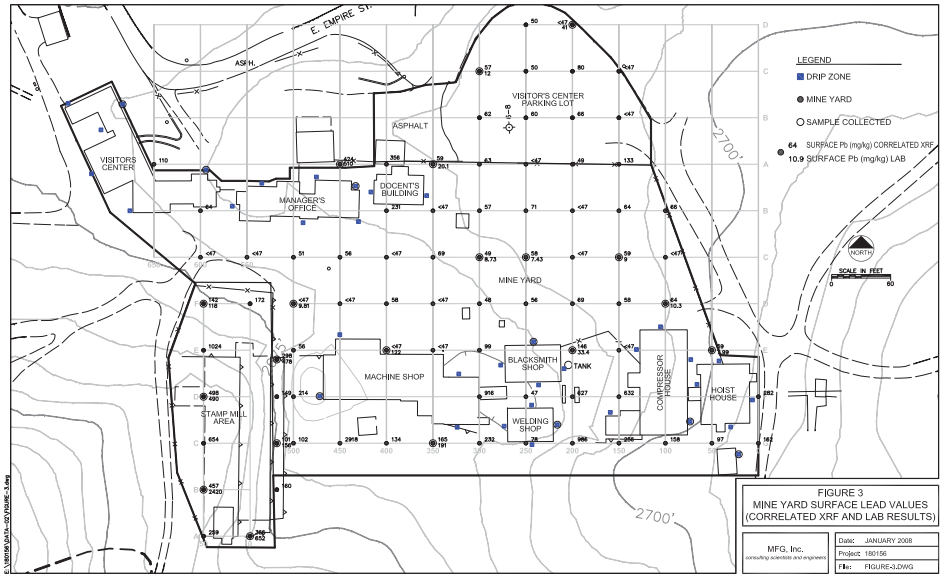


FIGURE 3
MINE YARD SURFACE LEAD VALUES
(CORRELATED XRF AND LAB RESULTS)

MFG, Inc.
consulting scientists and engineers

Date: JANUARY 2008
Project: 180156
File: FIGURE-3.DWG

E:\180156\Work-02\FIGURE-3.dwg

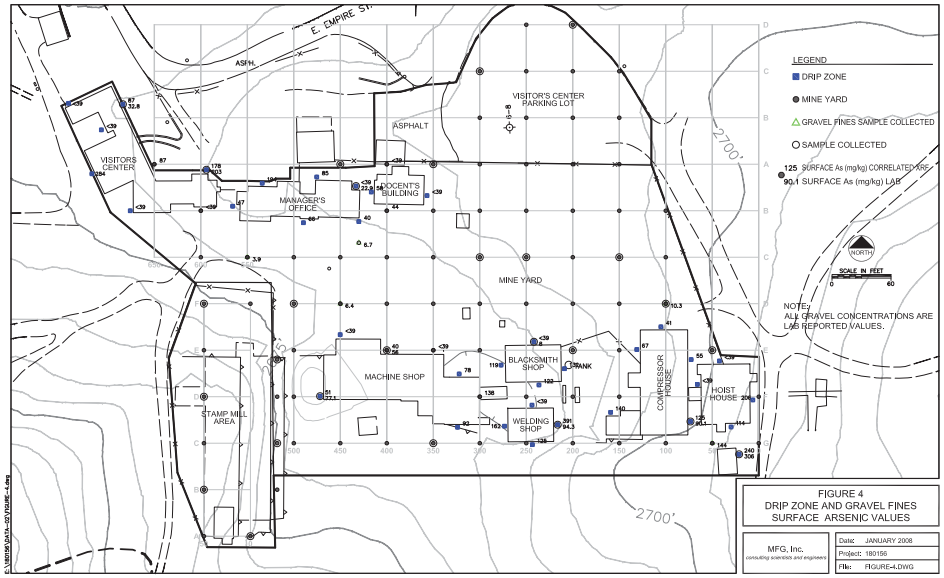


FIGURE 4
DRIP ZONE AND GRAVEL FINES
SURFACE ARSENIC VALUES

MFG, Inc.
consulting scientists and engineers

Date: JANUARY 2008
Project: 180156
File: FIGURE-4.DWG

E:\180156\Work-02\FIGURE-4.dwg

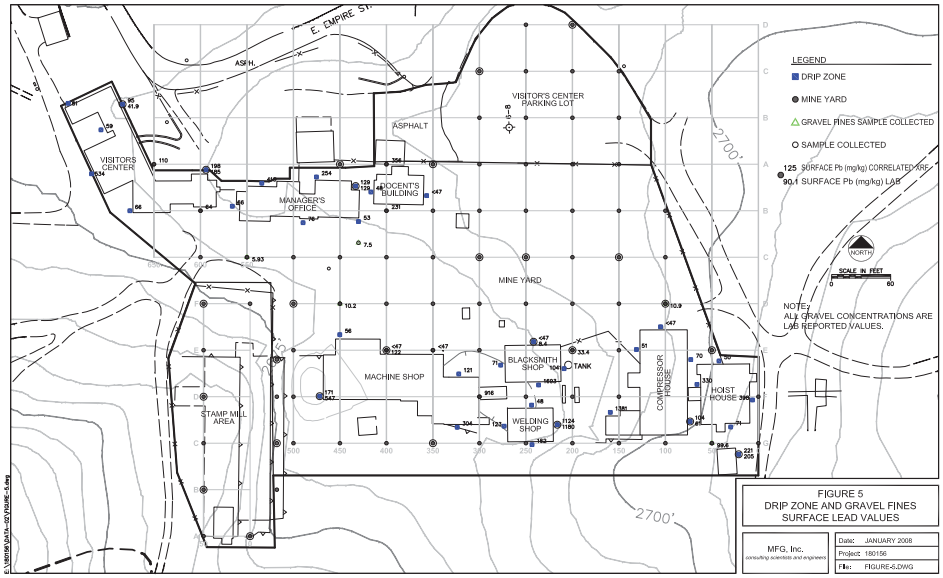
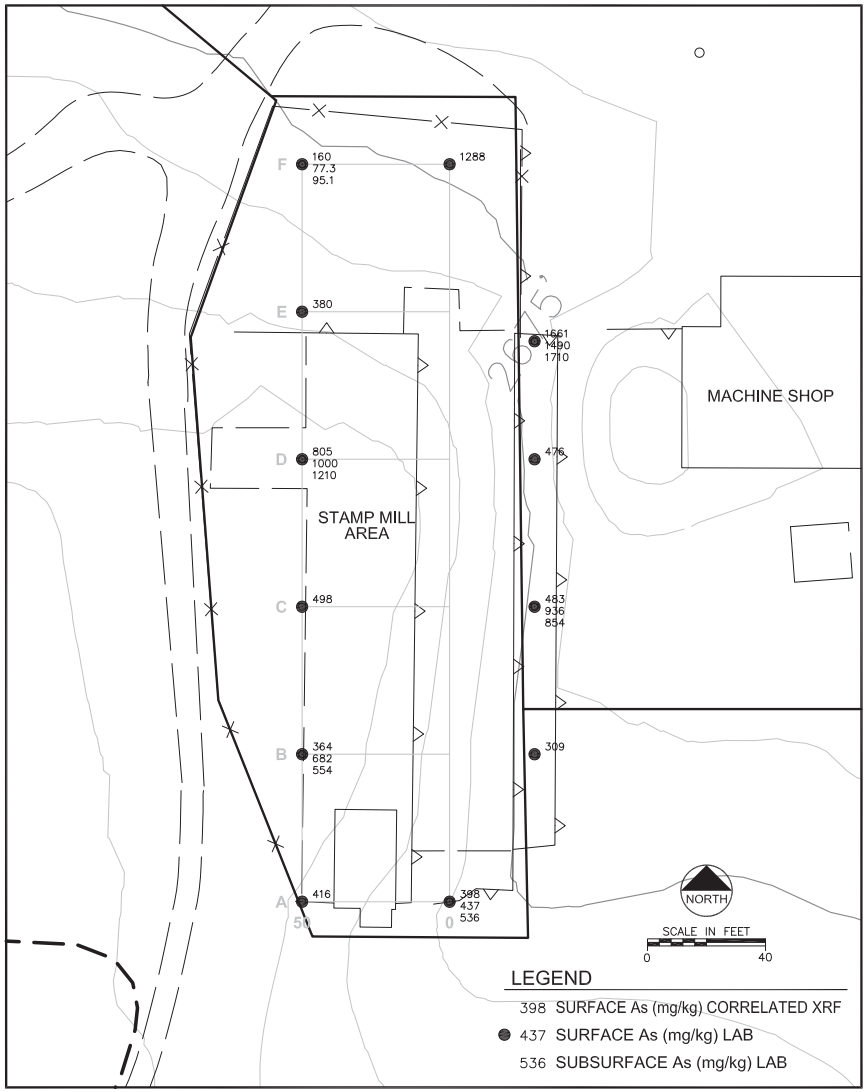


FIGURE 5
DRIP ZONE AND GRAVEL FINES SURFACE LEAD VALUES

MFG, Inc.
consulting scientists and engineers

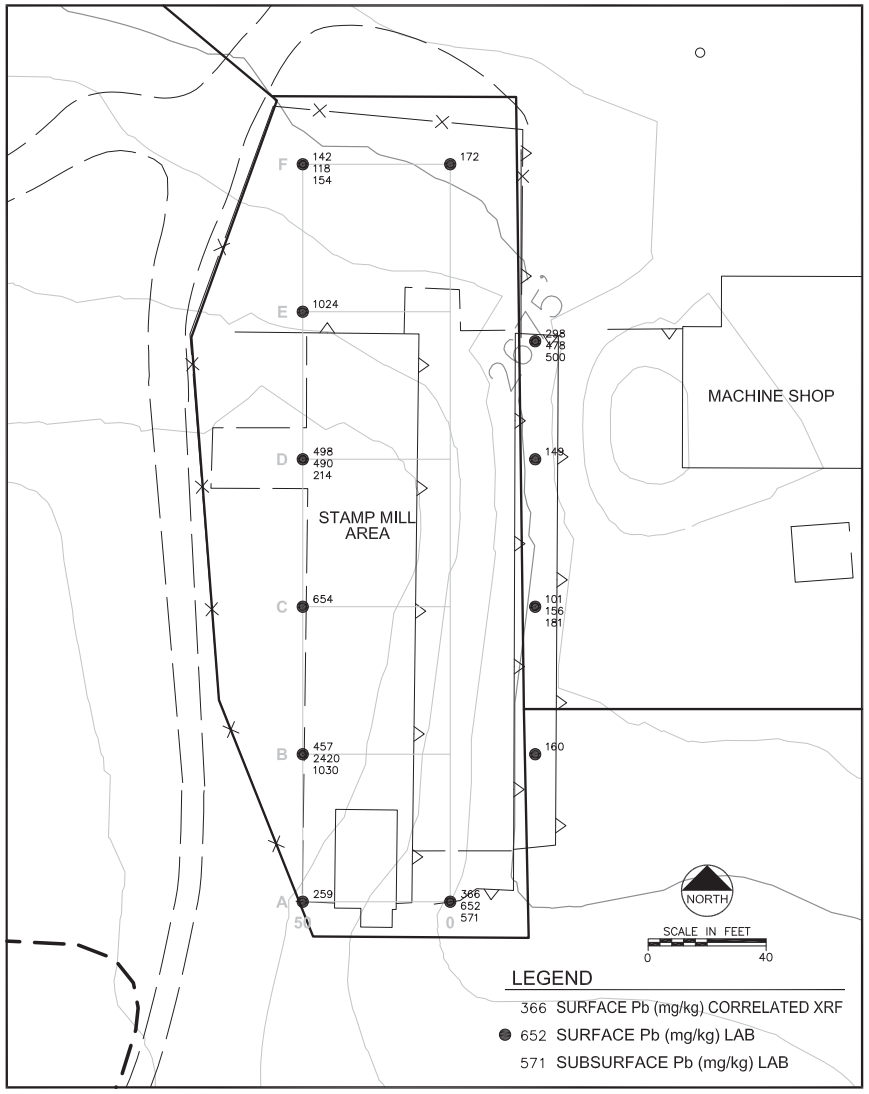
Date:	JANUARY 2008
Project:	180156
File:	FIGURE-5.DWG



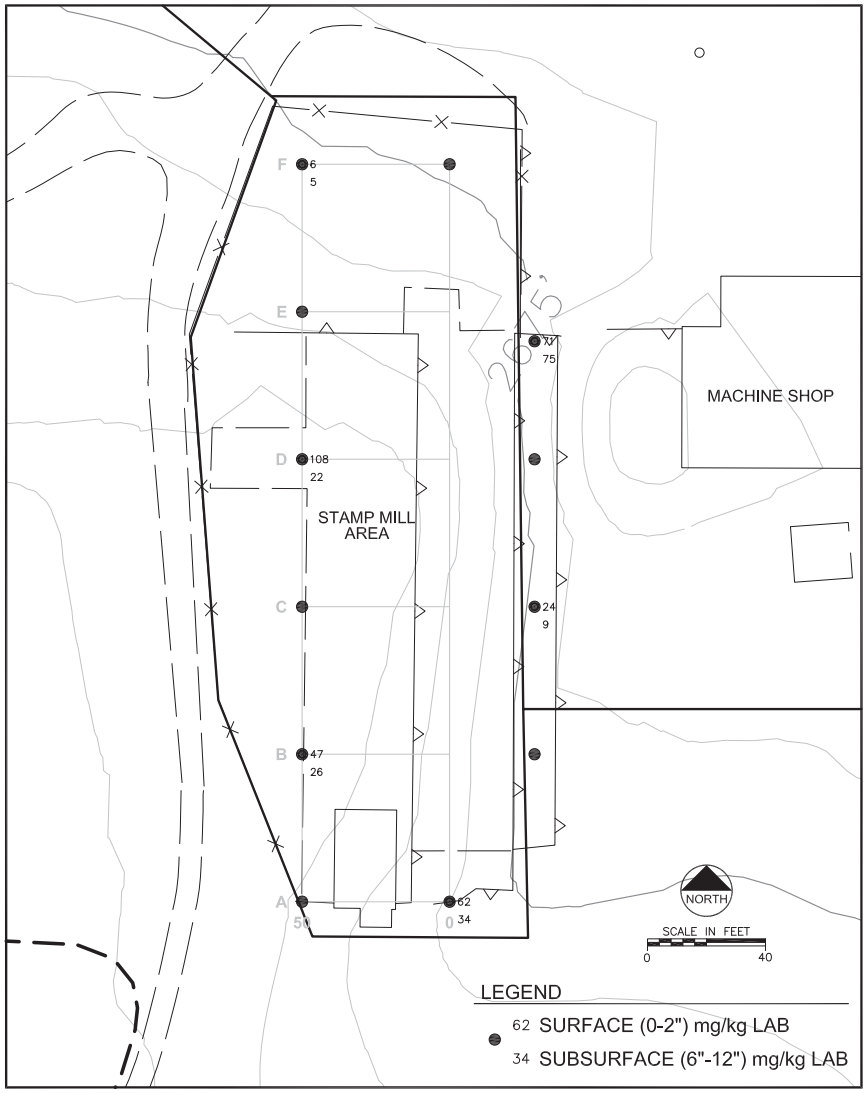
MFG, Inc.
consulting scientists and engineers

FIGURE 6
STAMP MILL SURFACE AND SUBSURFACE ARSENIC VALUES

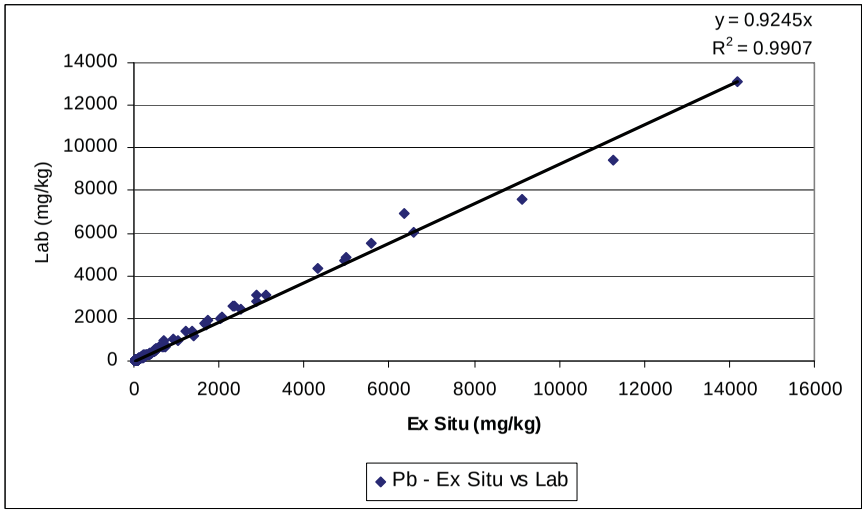
Date:	JANUARY 2008
Project:	180156
File:	FIGURE-6.DWG



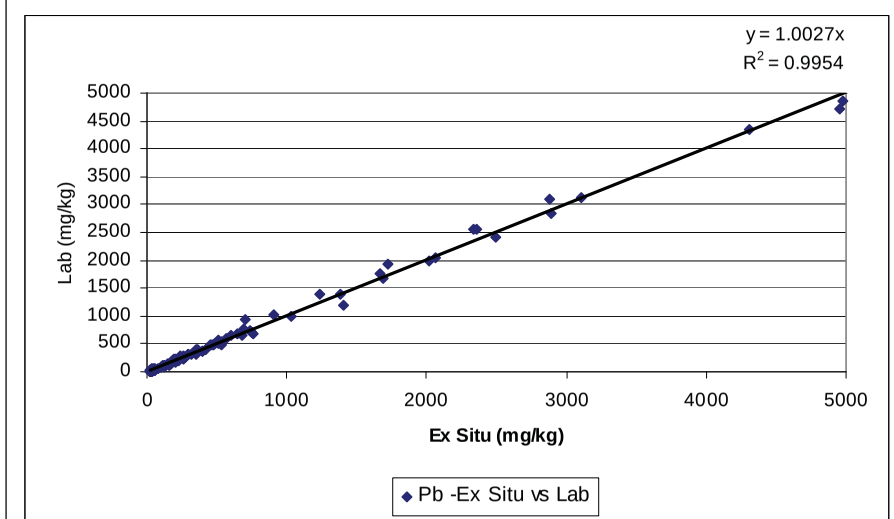
MFG, Inc. *consulting scientists and engineers*	FIGURE 7 STAMP MILL SURFACEAND SUBSURFACE LEAD VALUES	Date: JANUARY 2008 Project: 180156 File: FIGURE-7.DWG



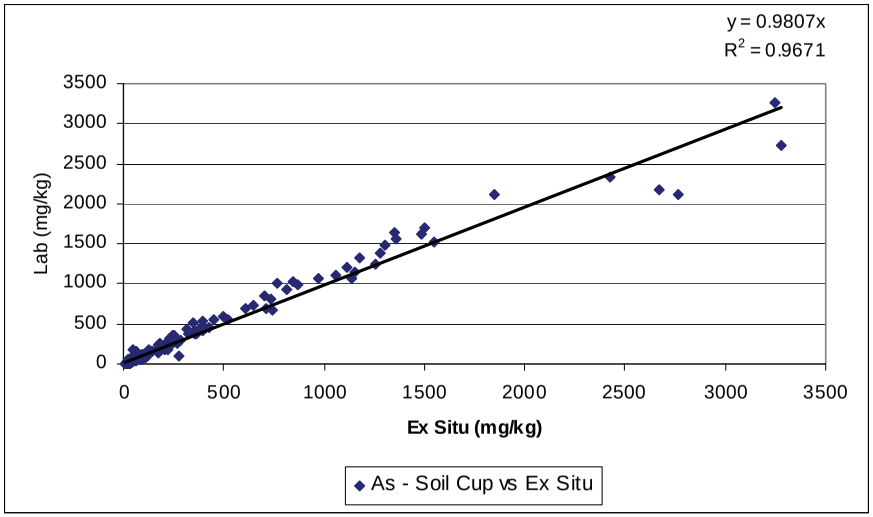
MFG, Inc. *consulting scientists and engineers*	FIGURE 8 STAMP MILL SURFACE AND SUBSURFACE MERCURY VALUES	Date: JANUARY 2008 Project: 180156 File: FIGURE-8.DWG



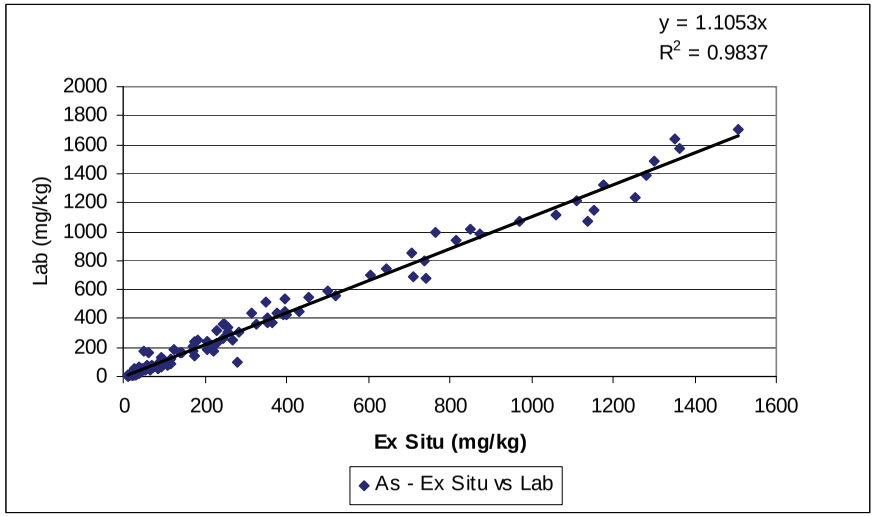
MFG, Inc. *consulting scientists and engineers*	FIGURE 9 LEAD EX-SITU XRF VS. LAB CORRELATION	Date: JANUARY 2008 Project: P:\010156…\MYSM DTR FLD File: CORRELATIONS.ppt



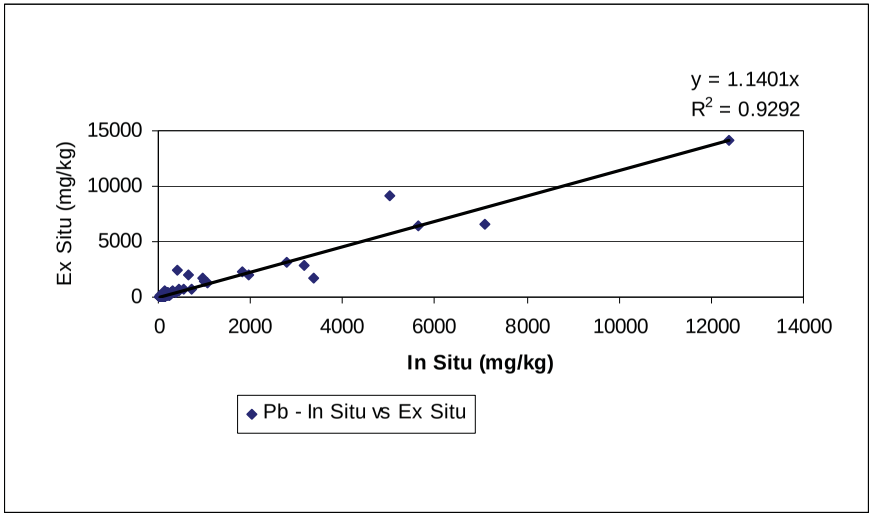
MFG, Inc. *consulting scientists and engineers*	FIGURE 10 LEAD EX-SITU XRF < 5000 VS LAB CORRELATION	Date: JANUARY 2008 Project: P:\010156...\MYSM DTR FLD File: CORRELATIONS.ppt



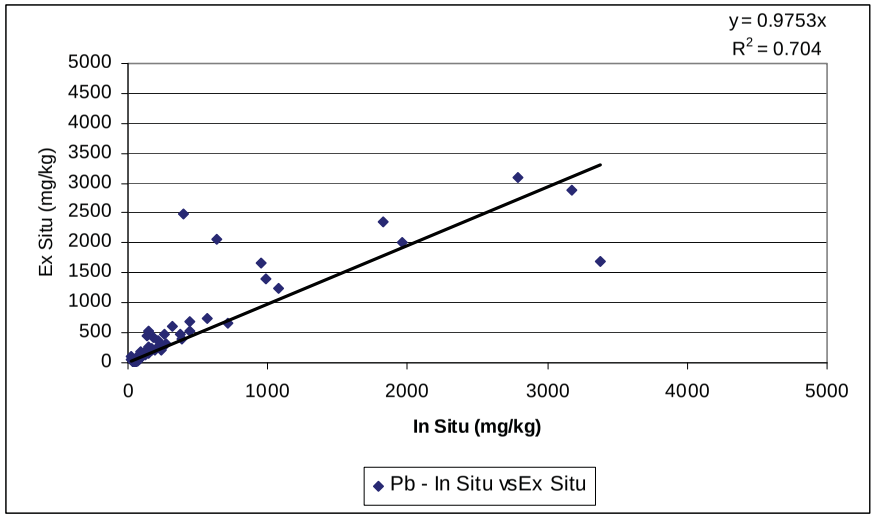
MFG, Inc. *consulting scientists and engineers*	FIGURE 11 ARSENIC EX-SITU XRF VS. LAB CORRELATION	Date: JANUARY 2008 Project: P:\010156…\MYSM DTR FLD File: CORRELATIONS.ppt



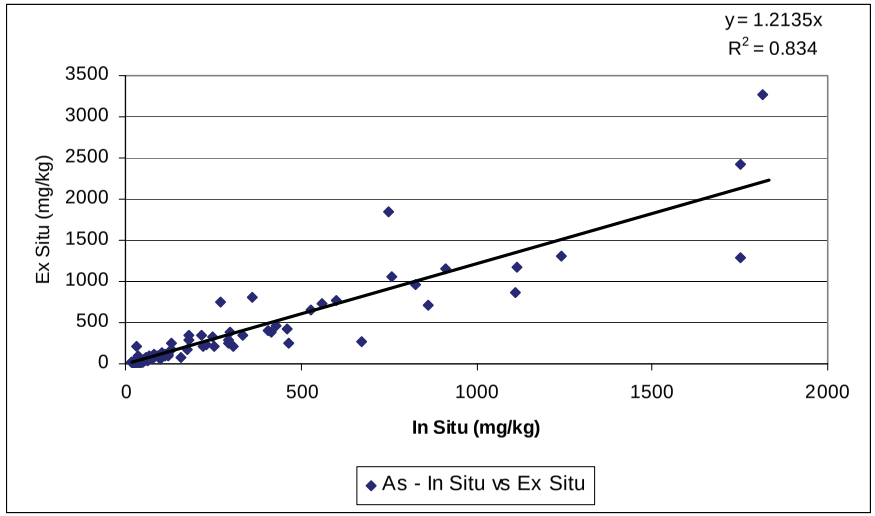
MFG, Inc. *consulting scientists and engineers*	FIGURE 12 ARSENIC EX-SITU XRF < 1500 VS LAB CORRELATION	Date: JANUARY 2008 Project: P:\010156...\MYSM DTR FLD File: CORRELATIONS.ppt



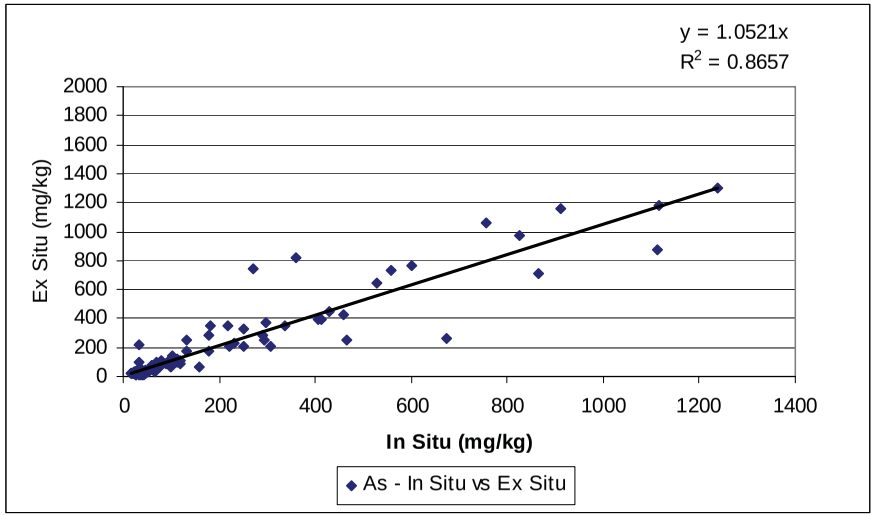
MFG, Inc. *consulting scientists and engineers*	FIGURE 13 LEAD IN-SITU VS. EX-SITU XRF CORRELATION	Date: JANUARY 2008 Project: P:\010156…\MYSM DTR FLD File: CORRELATIONS.ppt



MFG, Inc. *consulting scientists and engineers*	FIGURE 14 LEAD IN-SITU < 5000 VS EX-SITU XRF CORRELATION	Date: JANUARY 2008 Project: P:\010156...\MYSM DTR FLD File: CORRELATIONS.ppt



MFG, Inc. *consulting scientists and engineers*	FIGURE 15 ARSENIC IN-SITU VS. EX-SITU XRF CORRELATION	Date: JANUARY 2008 Project: P:\010156…\MYSM DTR FLD File: CORRELATIONS.ppt



MFG, Inc. *consulting scientists and engineers*	FIGURE 16 ARSENIC IN-SITU < 1500 VS EX-SITU XRF CORRELATION	Date: JANUARY 2008 Project: P:\010156...\MYSM DTR FLD File: CORRELATIONS.ppt

Appendix C-2:
Cyanide Plant and Adit Project Area
2008 Data Transmittal Report

DATA TRANSMITTAL REPORT
FOR THE
CYANIDE PLANT AND ADIT PROJECT
2007 ACTION WORK PLAN

FEBRUARY 2008

Prepared by:

MFG, INC.
consulting scientists and engineers

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Fort Collins, Colorado 80525
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Fax: (970) 223-7171

I certify under penalty of law that I have examined and am familiar with this report, and to my knowledge, the report is true, complete, and accurate.

Eileen M. Dornfest, Certified Engineering Geologist

PROFESSIONAL GEOLOGIST
EILEEN MARIE DORNFEST
No. 2437
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

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1.0 PURPOSE

This Data Transmittal Report presents field and laboratory data from soil sampling at the Cyanide (CN) Plant and Adit Project Area at the Empire Mine State Historic Park (SHP), Grass Valley, California in accordance with the Cyanide Plant and Adit Project Area 2007 Action Work Plan (Work Plan) (MFG, 2007). Sampling in the CN Plant and Adit Project Area included the CN Plant and Adit Project Area, the interior CN Plant Foundations, and the CN Plant/Adit Project Area test pits. The evaluation of this data and alternatives analysis will follow in a subsequent Alternative Actions report.

2.0 SUMMARY OF SAMPLE COLLECTION ACTIVITES

The CN Plant/Adit Project Area was divided into distinct sampling sites: the CN Plant and Adit Project Area, the interior CN Plant Foundations, and the CN Plant/Adit Project Area test pits. The field sampling was conducted by MFG, Inc. In accordance with the Work Plan, the following sampling activities were completed:

- Visual survey and characterization of surface materials, including visual identification of potential mine and mill materials.
- Field in-situ X-ray fluorescence (XRF) measurements for arsenic and lead concentrations of surface soil. The in-situ XRF measurements were performed on a 50-foot grid in the CN Plant and Adit Project Area and on a 25-foot grid within the interior CN Plant Foundations.
- Collection of surface (0 to 2-inch depth) and subsurface (6 to 12-inch depth) soil samples at twenty percent of the in-situ XRF measurements locations for ex-situ XRF analysis of arsenic and lead concentrations, and laboratory analysis of the samples for selected metals (arsenic, cadmium, lead, and mercury). Selected samples were also analyzed for CAM-17 metal concentrations, weak-acid dissociable (WAD) cyanide, acid-base accounting (ABA), and State of California Modified Waste Extraction Test (DI WET) metal concentrations.
- Collection of subsurface samples from test pits for ex-situ XRF analysis of arsenic and lead concentrations, and laboratory analysis for CAM-17 metal concentrations, WAD cyanide, ABA, and DI WET metal concentrations.

Figures 1 and 2 show the sampling grids developed by the field sampling personnel for the CN Plant and Adit Project Area (Figure 1) and the interior CN Plant Foundations (Figure 2). Table 1 summarizes the number of field in-situ XRF measurements and the number of samples collected for each type of laboratory analysis. The sampling regime for each site is detailed individually in the following sections.

2.1 CN Plant and Adit Project Area

The CN Plant and Adit Project Area, as sampled in the field, is approximately 800 feet long by 400 feet wide, at its widest and longest point (Figure 1). In-situ XRF surface measurements were performed at 130 locations. The in-situ XRF measurements were performed using a portable Niton XRF 702 XLp spectrum analyzer directly on the soil surface at the 50-foot grid intervals developed by the field sampling personnel (Figure 1). Surface (0-2 inches) and subsurface (6-12 inches) samples were collected at 20 percent of the in-situ XRF locations for further analysis. A total of 26 surface and 26 subsurface soil samples were collected. These samples were analyzed by ex-situ XRF after sieving according to EPA Method 6200 for arsenic and lead. The surface and subsurface samples were then submitted for laboratory analysis, as summarized in Table 1. Laboratory analysis of the samples was performed by SVL Analytical (SVL), in Kellogg, Idaho. SVL is accredited (NELAP) by the California Department of Health Services. The laboratory analytical reports for the samples are provided in Attachment A.

Based on visual observations during surface and subsurface sampling, the CN Plant and Adit Project Area materials consisted of red silty clay to silty sand with occasional rock fragments and cobbles/boulders, varying in moisture content between dry to slightly moist. The plant community in the area consists of pine and oak trees with an understory of shrubs and grass species.

2.2 CN Plant Interior Foundation

The CN Plant Foundations have an interior area of approximately 16,000 square feet (Figures 1 and 2). In-situ XRF measurements were performed at 42 locations. The in-situ XRF measurements were performed directly on the soil surface at 25-foot grid intervals developed by the field sampling personnel within the foundation area (Figure 2). Surface (0-2 inches) and subsurface (6-12 inches) samples were collected at eight of the in-situ XRF locations for further analysis. These samples were analyzed by ex-situ XRF after sieving according to EPA Method 6200 for arsenic and lead. The surface and subsurface samples were then submitted for laboratory analysis, as summarized in Table 1.

2.3 CN Plant and Adit Project Test Pits

As identified in the Work Plan, test pits were excavated at specific locations to provide further delineation of mine and mill related materials with respect to depth. Nine test pits (TP-1, TP-2, TP-3, TP-4, TP-5A, TP-5B, TP-6A, TP-6B, and TP-6C) were excavated on September 27, 2007 within the CN Plant and Adit Project Area at locations shown on Figure 1. The test pits were excavated to depths varying from approximately 5 to 12 feet below the ground surface. Depending on access considerations, subsurface material types, and necessary test pit depths, the test pits were excavated with either a track-mounted mini-excavator or a track-mounted excavator capable of excavating to a depth of approximately 18 feet. Test pit logs are presented in Attachment B.

Prior to excavation, surface (0-2 inches) and shallow subsurface (6-12 inches deep) samples were collected at each of the primary six test pits (TP-1 through TP-6). The surface and shallow subsurface samples were analyzed for CAM-17 metals. Deep subsurface samples were collected from the nine test pits, as described in the Work Plan. Samples were collected of different material types, if present, in each test pit, as visually determined by field personnel. The samples were submitted for laboratory analysis, as shown in Table 1.

The first test pit, TP-1 was located in the gravel area near the end of the Adit Project motor tracks within the footprint of the proposed Maintenance Shop. TP-2 was located within the footprint of the proposed Adit Project Embarkation Center, upgradient of the motor tracks in the upland forested region adjacent to the Red Dirt Pile. TP-3 was located approximately 50 feet southeast of the CN Plant Foundations. TP-4

was located approximately 100 feet south of the CN Plant Foundations. Test pits TP-5 and TP-6 both consisted of multiple test pits strategically placed across the cross-section of the conveyance channel. TP-6A, TP-6B, and TP-6C were located at the western end of the conveyance channel, and TP-5A and TP-5B were located further upstream in the conveyance channel.

Material observed in TP-1 consisted of red silty clay with little to no gravel below a depth of 16 inches. The uppermost 16 inches of the test pit consisted primarily of crushed gravel. Bulk samples were collected from depths of 0 inches to 6 inches, 6 inches to 12 inches, 18 inches to 36 inches, 36 inches to 48 inches, and at 96 inches. The test pit extended to a depth of eight feet below the ground surface and measured approximately one foot wide by eight feet long.

Material observed in TP-2 consisted of crushed gravel with some sand lenses to a depth of 18 inches. Zones of yellowish orange clay were observed from a depth of 60 inches to the bottom of the test pit at 84 inches below the ground surface. Bulk samples from TP-2 were collected from depths of 0 inches to 6 inches, 6 inches to 12 inches, 18 inches to 30 inches, 30 inches to 48 inches, and at 84 inches. The test pit extended to a depth of approximately seven feet below the ground surface and was approximately one foot wide by eight feet long.

Material observed in TP-3 consisted of reddish brown silty clay with sand and gravel, and zones of yellowish-orange sand to a depth of 36 inches. Below a depth of 36 inches the material consisted of cobble and boulder sized rock with reddish brown silty sandy clay to the bottom of the excavation. Bulk samples were collected from depths of 0 inches to 6 inches, 6 inches to 12 inches, 12 inches to 30 inches and at 91 inches. The test pit extended to a depth of 7.6 feet below ground surface, and was approximately four feet wide by ten feet long.

Material in TP-4 consisted of yellowish brown clayey silt with sand and gravel, with cobble sized rock and trace wood debris to a depth of 30 inches. Yellowish brown clayey silt with abundant sand and gravel was present from a depth of 30 inches to 48 inches. Broken rock was encountered at a depth of 48 inches. Bulk samples were collected from depths of 0 inches to 6 inches, 6 inches to 12 inches, 18 inches to 30 inches, 30 inches to 48 inches, and at 70 inches below ground surface. The test pit extended to a depth of 5.8 feet below ground surface and was four feet wide by 12 feet long.

Test pit TP5 consisted of two adjacent test pits excavated across the conveyance channel, TP-5A and TP-5B. Samples collected from TP-5A were designated as “middle of channel” and samples collected from TP-5B were designated as “bottom of channel”. Material observed in TP-5A consisted of dry tan silty sand tailing to a depth of 24 inches, underlain by striated gray, yellow and tan silty clay and sand

tailing from 24 inches to 114 inches below the ground surface. Reddish brown highly fractured weathered bedrock with gray clay along fractured surfaces was encountered at a depth of approximately 9.5 feet. Bulk samples were collected from the following depths in TP-5A: 0 inches to 6 inches, 6 inches to 12 inches, 12 inches to 30 inches, 30 inches to 48 inches, and at 120 inches. Material observed in TP-5B consisted of slightly moist, gray, and yellowish brown, red and dark red, fine- to coarse-grained sand from 0 feet to 6 feet below the ground surface. Fractured rock was encountered underlying the sand to the bottom of the test pit. The test pit depth measured from the mid-slope of the channel was ten feet. Bulk samples were collected from the following depths in TP-5B: 12 inches to 30 inches, 30 inches to 48 inches, 64 inches, 72 inches, and at 90 inches.

TP-6 consisted of three adjacent test pits extending outward from the conveyance channel. Material observed in TP-6A consisted of reddish brown sand with silt, with gravel and cobble sized rock from 0 feet to 8 feet below ground surface. Stratified yellow and red sand layers were also observed throughout the test pit depth, with a gray sand layer at a depth of 16 to 24 inches. TP-6A extended to a depth of ten feet. Bulk samples were collected from the following depths in TP-6A: 0 inches to 6 inches, 6 inches to 12 inches, 12 inches to 30 inches, 30 inches to 48 inches, 80 inches, and at 120 inches. Material observed in TP-6B consisted of sand and silt with colors varying from white to red to a depth of 132 inches. Weathered bedrock was encountered in TP-6B at a depth of approximately 11 feet and extended to the bottom of the test pit at 12 feet below ground surface. Bulk samples were collected from the following depths in TP-6B: 18 inches to 30 inches, 30 inches to 48 inches, 60 inches, 120 inches, 126 inches to 132 inches, 132 inches to 144 inches, and at 144 inches. Material observed in TP-6C consisted of silty clay fill with sand and gravel to a depth of 20 inches. Reddish brown native silty clay was encountered from a depth of 20 inches to the bottom of the test pit. Test pit TP-6C extended to a depth of eight feet below the ground surface. Bulk samples were collected from the following depths in TP-6C: 12 inches to 30 inches, 30 inches to 48 inches, and at 96 inches.

3.0 SUMMARY OF XRF AND LABORATORY METALS CONCENTRATION RESULTS

In-situ XRF measurements for arsenic and lead concentrations of surface soil were performed on a 50-foot grid in the CN Plant and Adit Project Area and on a 25-foot grid within the interior CN Plant Foundations. Surface and shallow subsurface samples were collected at 20 percent of these surface locations. The samples were submitted for laboratory analysis as shown in Table 1. Laboratory analysis of the samples was performed by SVL. The in-situ XRF data were correlated to the laboratory results for total arsenic and lead through regression analysis, as described in Section 4. All in-situ XRF values presented in this report are laboratory correlated. The results of the XRF and laboratory analyses are described in the following sections.

3.1 CN Plant and Adit Project Area

3.1.1 XRF Analysis

In-situ XRF analysis of metal concentrations of surface soils throughout the CN Plant and Adit Project Area were performed using a portable Niton XRF 702 XLp spectrum analyzer. The XRF measurements were performed as described in the Work Plan in accordance with *EPA Method 6200 - Field Portable X-ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment*. The results of the in-situ and correlated in-situ XRF analysis for arsenic and lead are provided in Table 2. The arsenic and lead concentrations determined by in-situ XRF measurements and correlated to laboratory data, as well as the laboratory results for the CN Plant and Adit Project Area, are presented in Figure 3 and Figure 4, respectively.

3.1.2 Total Metals and WAD Cyanide Laboratory Analysis

As discussed previously, samples were collected at every one in five in-situ XRF measurement locations and analyzed by the laboratory to assess metal content and develop regression curves for the in-situ XRF measurements performed directly on the ground surface for arsenic and lead. A total of 14 surface samples and 14 subsurface samples were collected and submitted to the laboratory for analysis of CAM-17 metals. An additional 12 surface and 12 subsurface samples were analyzed for selected metals (arsenic, cadmium, lead, and mercury). The total metals concentrations of the samples are shown in Table 3. The arsenic and lead concentrations analyzed by the laboratory are also shown on Figures 3 and 4.

In addition, 10 surface samples and 14 subsurface samples were analyzed for WAD cyanide. The WAD cyanide concentrations are provided in Table 3. Four of the surface samples had detectable levels of WAD cyanide, with concentrations ranging from 0.66 mg/Kg to 6.16 mg/Kg. The maximum WAD

cyanide concentration was at sample location G350, which is located southwest of the CN Plant foundation. WAD cyanide was detected in two of the subsurface samples: 1.01 mg/Kg at location H700 and 1.78 mg/Kg at location H350.

3.1.3 Acid Base Accounting

Acid Base Accounting (ABA) and paste pH testing were conducted on a total of 14 samples collected from the CN Plant and Adit Project Area (seven surface and seven subsurface samples). The ABA and paste pH results for the samples are provided in Table 4.

3.1.4 DI WET Analysis

DI WET analysis was conducted on the same set of samples analyzed for ABA and paste pH (seven surface and seven subsurface samples). The DI WET testing was performed according to the California Waste Extraction Test, except deionized water was used instead of citric acid for leaching of the samples. Laboratory analysis of the DI WET leachate was performed for CAM-17 metals. The DI WET results are provided in Table 5.

3.2 CN Plant Interior Foundation

3.2.1 XRF Analysis

A total of 42 in-situ XRF measurements for arsenic and lead concentrations were performed of surface soils within the interior CN Plant foundation. The measurement locations were identified by the lower foundation (LF) and the upper foundation (UF) areas. The correlated arsenic and lead concentrations determined by the in-situ XRF measurements and correlated to laboratory data are presented in Figure 5 and Figure 6. The results of the in-situ and correlated XRF analysis for arsenic and lead are provided in Table 6.

3.2.2 Total Metals Analysis and WAD Cyanide

Soil samples were collected at 16 (eight surface and eight subsurface) of the in-situ XRF measurement locations within the foundation area and submitted for laboratory analysis of CAM-17 metals and WAD cyanide. The total metals and WAD cyanide concentrations for the samples are shown in Table 7. The arsenic and lead concentrations analyzed by the laboratory are also shown on Figures 5 and 6.

3.2.3 ABA Analysis

Acid Base Accounting (ABA) and paste pH tests were conducted for 16 samples (eight surface and eight subsurface samples) collected within the interior CN Plant foundation. The ABA and paste pH results for the samples are provided in Table 4.

3.2.4 DI WET Analysis

DI WET testing was also conducted on the 16 samples (eight surface and eight subsurface samples) analyzed for ABA and paste pH. Laboratory analysis of the DI WET leachate was performed for CAM-17 metals. The DI WET results are provided in Table 5.

3.3 CN Plant and Adit Project Area Test Pits

3.3.1 Total Metals Analysis and WAD Cyanide

A total of 33 deep subsurface samples, 6 shallow subsurface (6-12 inches), and 6 surface (0-2 inches) samples collected from the test pits were analyzed, as shown in Table 1. The surface (0-2 inches) and shallow subsurface (6-12 inches) samples were submitted for laboratory analysis of CAM-17 metals. All the deep subsurface soils samples collected from the test pits were submitted for laboratory analysis of CAM-17 metals and WAD cyanide. The total metals and WAD cyanide concentrations for the samples are shown in Table 8.

3.3.2 ABA Analysis

Acid Base Accounting (ABA) was conducted on 23 of the soil samples collected from the test pits, with paste pH being analyzed for 22 of the samples. The laboratory results for the ABA and paste pH testing of the samples tested are provided in Table 9.

3.3.3 DI WET Analysis

A total of 24 test pit samples were also analyzed by DI WET. Laboratory analysis of the DI WET leachate was performed for CAM-17 total metals. The DI WET results are provided in Table 10.

4.0 CORRELATION OF XRF AND LABORATORY CONCENTRATIONS FOR ARSENIC AND LEAD

As previously described, soil samples were collected at 20 percent of the in-situ XRF measurement locations. Ex-situ XRF and laboratory analyses were performed on the minus 60-mesh sieve fraction (<0.25 mm) of the collected soil samples. The ex-situ XRF and total metals analyses provide metals concentration data to confirm and correlate with the in-situ XRF measurements. Correlations were developed for arsenic and lead concentrations analyzed by in-situ XRF, ex-situ XRF, and the laboratory through linear regression. The regression graphs and equations are shown on Figures 7 through 14. The correlations allow the in-situ XRF concentration determined in the field to be expressed as a minus 60-mesh correlated laboratory concentration.

The XRF readings become less accurate if constituent concentrations are above a particular threshold specific to each analyte. Therefore, regressions were developed using an analyte concentration maximum limits and comparing those to regressions of the data without concentration limits. The regression which resulted in the best correlation of the data, defined as the regression with the higher R^2 value, was used. To increase the sample size and thereby reinforce the correlation, in-situ XRF, ex-situ XRF, and laboratory data from the 2007 Trails, Mine Yard, and Cyanide Plant and Adit Project Work Plans were used to develop the correlation. Correlation of the ex-situ XRF and laboratory analysis of the minus 60-mesh sieve soil samples for lead and arsenic, with and without concentration limits, are shown on Figures 7 through 10.

The ex-situ XRF and laboratory analyses for lead concentrations of the minus 60-mesh sieve soil samples are related by the following linear regression equation (Figure 8):

$$\text{Laboratory lead conc.} = \text{ex-situ XRF lead conc. } (<5000\ \text{mg/Kg}) \times 1.00 \quad (R^2 = 0.99)$$

The ex-situ XRF and laboratory analyses for arsenic concentrations of the minus 60-mesh sieve soil samples are related by the following linear regression equations (Figure 10):

$$\text{Laboratory arsenic conc. (mg/Kg)} = \text{ex-situ XRF arsenic conc. } (<1500\ \text{mg/Kg}) \times 1.105 \quad (R^2 = 0.98)$$

Regressions were also developed for arsenic and lead concentrations between the in-situ XRF analysis and the ex-situ XRF analysis of the minus 60-mesh sieve surface samples. The in-situ XRF and ex-situ XRF lead correlations are shown on Figures 11 and 12, and the arsenic correlations are shown on Figures 13 and 14. The lead concentrations determined by in-situ XRF analysis are related to the ex-situ XRF analysis by the following linear regression equation (Figure 11):

$$\text{Ex-situ lead conc. (mg/Kg)} = \text{In-situ XRF lead conc. (mg/Kg)} \times 1.14 \ (R^2 = 0.93)$$

The arsenic concentrations determined by in-situ XRF analysis are related to the ex-situ XRF analysis by the following linear regression equation (Figure 13):

$$\text{Ex-situ arsenic conc. (mg/Kg)} = \text{In-situ XRF arsenic conc. (mg/Kg)} \times 1.21 \ (R^2 = 0.83)$$

5.0 REFERENCES

MFG, Inc., 2007. Final Cyanide Plant and Adit Project Area 2007 Action Work Plan, Empire Mine State Historic Park. Prepared for California Department of State Parks and Recreation, Empire Mine State Historic Park and Newmont USA, Ltd. July 16.

TABLES

Table 1 Summary of Field and Laboratory Chemical Analyses

Sampling Location	Field In-Situ XRF Measurements	Field Ex-Situ XRF Measurements	Number of Laboratory Analysis				
			Selected Metals	WAD CN	CAM-17 Metals	ABA and Paste pH	DI Wet
CN Plant and Adit Project Area							
Surface Materials (0-2 inches)	130	26	12	10	14	7	7
Shallow subsurface materials (6-12 inches)	0	26	12	14	14	7	7
CN Plant Foundation							
Surface Materials (0-2 inches)	42	8	0	8	8	8	8
Shallow subsurface materials (6-12 inches)	0	8	0	8	8	8	8
CN Plant and Adit Project Areas Test Pits							
Surface Materials (0-2 inches)	12	6	0	0	6	0	0
Shallow subsurface materials (6-12 inches)	0	6	0	0	6	0	0
Deep subsurface materials (1-12 feet)	0	33	0	33	33	23	24

Table 2 In-situ XRF and Correlated XRF Analysis for Arsenic and Lead in CN Plant and Adit Project Area (mg/Kg)

Sample ID	In-Situ XRF Arsenic Concentration	Correlated XRF Arsenic Concentration	In-Situ XRF Lead Concentration	Correlated XRF Lead Concentration
A0	284	381	201	230
B0	260	348	516	589
C50	248	332	147	168
C100	63	85	137	156
B100	466	625	144	164
A100	31	42	20	<47.0
A50	139	186	3189	3635
B50	69	93	101	115
A150	166	223	191	217
B150	111	149	108	124
C150	252	337	397	452
D150	126	168	208	237
D100	202	271	291	332
E100	1114	1493	206	235
E150	250	335	234	266
D200	245	328	1126	1283
E200	272	365	417	476
F200	477	639	773	881
G200	275	368	664	757
G150	217	290	72	82
F150	116	155	194	221
H200	373	500	203	232
H150	393	526	361	411
H100	382	511	201	229
I100	336	450	388	442
C200	442	593	138	158
B200	47	63	145	166
C250	1151	1542	208	237
B250	120	161	320	365
D250	292	392	719	819
I200	579	775	244	279
I250	493	660	8357	9527
H350	406	544	9304	10607
G350	8315	11142	7101	8095
G400	1895	2539	4774	5442
H400	808	1082	11887	13551
E400	352	472	724	825
D400	69	92	67	76
C400	54	73	66	75
C350	53	72	67	77
C300	91	122	62	70
C450	45	61	63	72

Table 2 In-situ XRF and Correlated XRF Analysis for Arsenic and Lead in CN Plant and Adit Project Area (mg/Kg) (continued)

Sample ID	In-Situ XRF Arsenic Concentration	Correlated XRF Arsenic Concentration	In-Situ XRF Lead Concentration	Correlated XRF Lead Concentration
D450	61	81	53	60
E450	160	214	159	181
F450	1752	2348	5630	6419
G450	2392	3206	3770	4298
H450	2197	2944	3910	4458
I450	1270	1702	3713	4232
I500	672	900	3383	3857
H500	372	499	788	898
G500	1112	1490	3572	4073
F500	1943	2604	7467	8513
E500	34	45	89	101
D500	43	58	68	78
C500	56	75	66	75
D550	77	103	47	53
E550	45	60	45	51
F550	192	257	177	202
G550	433	580	2172	2476
H550	864	1158	2790	3181
I550	39	52	79	90
J550	66	88	68	77
K600	142	190	411	469
J600	29	<39	73	84
I600	460	616	1080	1231
H600	80	107	317	362
G600	89	119	118	134
F600	15	<39	20	<47
E600	53	71	46	52
E650	34	46	133	152
F650	195	262	114	130
G650	161	216	137	156
H650	44	59	89	101
I650	26	<39	92	104
H700	1750	2346	5035	5740
G700	222	297	250	285
F700	298	400	196	224
E700	556	745	1314	1498
D700	81	109	202	230
E750	1111	1489	3174	3619
D750	83	111	214	244
F750	408	546	683	778
G750	252	337	316	360
H750	48	64	89	102

Table 2 In-situ XRF and Correlated XRF Analysis for Arsenic and Lead in CN Plant and Adit Project Area (mg/Kg) (continued)

Sample ID	In-Situ XRF Arsenic Concentration	Correlated XRF Arsenic Concentration	In-Situ XRF Lead Concentration	Correlated XRF Lead Concentration
I750	53	70	57	65
J800	132	176	949	1082
I800	194	260	545	621
H800	87	117	50	57
G800	98	132	107	122
F800	406	543	566	645
E800	38	51	80	91
D800	181	243	216	246
C800	66	88	113	129
C850	96	129	231	263
D850	558	748	177	202
E850	36	48	71	81
F850	306	410	444	507
G850	74	100	160	182
H850	88	118	94	107
I850	93	124	129	147
J850	87	116	41	<47
J900	34	46	60	69
I900	39	53	61	69
H900	187	251	86	98
G900	75	100	84	96
F900	252	337	278	316
E900	192	257	374	426
D900	815	1092	400	456
C900	68	91	175	199
D950	133	178	143	163
C1000	30	40	106	121
C950	52	70	224	256
E950	88	118	123	140
F950	209	280	854	973
G950	190	255	219	250
H950	180	241	104	118
I950	126	169	124	141
J950	68	91	86	98
J1000	55	74	61	70
I1000	63	84	110	125
H1000	81	108	106	121
G1000	891	1193	110	125
F1000	79	105	166	189
E1000	230	309	1142	1302
D1000	231	309	248	283
D1050	1115	1494	1821	2076

Table 2 In-situ XRF and Correlated XRF Analysis for Arsenic and Lead in CN Plant and Adit Project Area (mg/Kg) (continued)

Sample ID	In-Situ XRF Arsenic Concentration	Correlated XRF Arsenic Concentration	In-Situ XRF Lead Concentration	Correlated XRF Lead Concentration
E1050	72	97	144	164
F1050	182	245	511	582
G1050	67	90	111	126
H1050	58	77	65	74

Table 3 Total Metals Laboratory Results (mg/Kg) for CN Plant and Adit Project Area

Sample ID	WAD Cyanide	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Cyanide Plant and Adit Project Area Surface Soil Samples (0 inches to 2 inches)																		
CN-B100-0	<0.500	4.7	263	139	0.271	2.06	45.9	8.81	78.0	122	12.4	2.50	9.16	<4.0	4.81	<1.5	210	99.4
CN-B150-0		4.3	118	75.7	0.237	1.37	24.6	9.66	67.3	93.0	19.2	2.80	8.94	<4.0	3.11	<1.5	103	103
CN-C350-0		4.1	33.0	93.7	0.382	1.50	63.6	9.37	75.5	<0.75	1.42	2.28	13.4	<4.0	0.99	<1.5	285	64.7
CN-C900-0			104			11.5				252	3.62							
CN-D250-0			338			9.36				693	33.3							
CN-D500-0			18.0			0.83				18.7	0.45							
CN-D800-0			510			7.48				402	2.1							
CN-D850-0		4.2	803	76.6	0.368	4.39	29.6	34.2	155	393	5.72	3.61	20.6	<4.0	3.29	<1.5	101	237
CN-D950-0			357			9.32				275	1.70							
CN-D1000-0	<0.500	2.0	320	74.1	<0.200	10.1	7.84	13.4	96.3	249	2.43	2.76	14.5	<4.0	1.55	<1.5	22.4	218
CN-D1050-0	<0.500	8.2	1320	402	<0.200	5.00	15.8	<0.60	73.7	2560	16.7	11.8	<1.00	5.8	14.4	<1.5	94.0	96.7
CN-E150-0			366			2.9				192	4.00							
CN-E650-0	0.295	2.7	120	107	<0.200	6.08	6.05	10.8	91.8	220	2.02	2.75	6.58	<4.0	2.21	<1.5	17.6	164
CN-E750-0			981			8.46				3090	7.00							
CN-F450-0			1390			8.13				6960	175							
CN-F800-0	<0.500	4.8	429	236	0.429	3.67	58.1	8.02	109	718	7.38	3.13	10.40	<4.0	4.41	<1.5	226	84.5
CN-F850-0			241			0.78				772	6.95							
CN-F900-0	<0.500	4.4	239	169	0.375	2.28	44.7	15.7	89.6	324	4.52	2.34	14.20	<4.0	2.66	<1.5	242	63.2
CN-G150-0			409			2.38				96.3	2.35							
CN-G350-0	6.16	21.0	2830	343	<0.200	21.7	41.9	2.26	323	6040	415	8.41	<1.00	<4.0	138	<1.5	194	976
CN-H550-0	0.66	6.3	685	528	0.240	7.26	40.2	2.39	109	3120	182	4.14	4.05	<4.0	17.9	<1.5	234	150
CN-H700-0	1.23	11.0	2330	500	<0.200	25.5	18.6	1.43	175	7570	50.8	21.7	9.33	10.6	31.6	<1.5	101	469
CN-H750-0	<0.500	3.2	26.2	204	0.473	0.86	45.2	11.3	50.0	39.7	0.400	2.29	23.6	<4.0	0.63	<1.5	201	39.7
CN-I100-0	<0.500	2.8	371	83.3	0.286	4.91	51.7	30.9	105	358	2.02	3.25	192	<4.0	1.92	<1.5	69.8	197
CN-I500-0			256			6.68				1670	11.6							
CN-I600-0			449			1.98				1400	12.5							

Table 3 Total Metals Laboratory Results (mg/Kg) for CN Plant and Adit Project Area (continued)

Sample ID	WAD Cyanide	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Cyanide Plant and Adit Project Area Subsurface Soil Samples (6 inches to 12 inches)																		
CN-B100-6	<0.500	4.6	170	108	0.458	2.09	55.9	10.7	84.7	19.4	7.90	1.74	17.4	<4.0	1.62	<1.5	290	49.5
CN-B150-6	<0.500	<2.0	47.5	58.2	<0.200	1.47	13.6	5.71	29.8	34.1	5.92	2.81	5.86	<4.0	1.30	<1.5	49.9	66.4
CN-C350-6	<0.500	3.8	30.7	90.7	0.356	1.47	60.0	8.40	79.5	<0.75	2.68	2.01	13.5	<4.0	1.63	<1.5	279	45.4
CN-C900-6			69.3			15.0				282	2.18							
CN-D250-6			447			10.3				1930	45.0							
CN-D500-6			16.4			1.17				15.2	0.195							
CN-D800-6			439			12.2				389	1.73							
CN-D850-6	<0.500	4.3	1020	80.9	0.411	4.53	33.2	38.2	144	128	2.18	3.16	18.6	<4.0	2.12	<1.5	115	167
CN-D950-6			243			8.20				226	1.45							
CN-D1000-6	<0.500	<2.0	186	99.7	<0.200	10.8	7.35	10.4	76.4	950	2.33	3.14	8.20	<4.0	4.05	<1.5	22.6	248
CN-D1050-6	<0.500	5.8	1570	359	<0.200	5.78	17.7	1.34	66.0	1390	10.9	8.87	6.45	<4.0	8.84	<1.5	86.6	109
CN-E150-6			1640			4.55				185	3.7							
CN-E650-6	<0.500	4.5	160	227	<0.200	1.71	6.29	4.10	86.6	371	7.28	2.52	5.98	<4.0	4.52	<1.5	18.7	78.3
CN-E750-6			1530			7.22				4360	66.7							
CN-F450-6			1070			2.82				5500	19.7							
CN-F800-6	<0.500	3.6	376	193	0.287	5.00	25.7	7.69	92.8	663	8.95	3.07	12.8	<4.0	4.35	<1.5	95.0	121
CN-F850-6			127			1.87				303	5.1							
CN-F900-6	<0.500	3.7	221	145	0.421	1.98	38.0	11.1	73.9	171	4.27	2.15	14.7	<4.0	2.05	<1.5	215	45.7
CN-G150-6			303			2.41				86.9	2.63							
CN-G350-6	1.78	20.3	1240	267	<0.200	19.6	30.7	2.65	446	4730	149	12.2	6.70	<4.0	69.9	<1.5	144	871
CN-H550-6	<0.500	4.5	228	274	0.332	2.30	35.2	1.42	86.8	688	5.20	2.42	11.6	<4.0	4.50	<1.5	197	51.0
CN-H700-6	1.01	9.4	3270	450	0.232	8.22	30.5	1.46	164	4870	33.2	14.0	17.1	5.9	17.8	<1.5	138	169
CN-H750-6	<0.500	3.0	18.1	229	0.516	0.75	47.7	12.7	57.4	8.04	<0.033	2.50	27.3	<4.0	<0.50	<1.5	213	30.7
CN-I100-6	<0.500	3.3	699	103	0.353	5.25	51.5	31.4	130	316	2.13	3.29	172	<4.0	2.80	<1.5	83.1	182
CN-I500-6			92.2			2.11				489	5.33							
CN-I600-6			29.2			1.30				68.2	0.917							

Table 4 ABA and Paste pH Laboratory Results for CN Plant/Adit Project Area and Foundation Interior

Sample ID	Net Neutralizing Potential $TCaCO_3$/kT	Acid Generating Potential $TCaCO_3$/kT	Acid Neutralizing Potential $TCaCO_3$/kT	Non-Ext Sulfur, S %	pH Paste (S.U.)	Pyritic Sulfur, S %	Sulfate Sulfur, S %	Total Sulfur, S %
CN Plant and Adit Project Area Shallow Surface Materials (0-2 inches)								
CN-B100-0	-2.8	2.8	<0.3	0.01	6.50	0.09	0.08	0.18
CN-D1050-0	-20.0	20.0	<0.3	<0.01	4.04	0.64	0.95	1.59
CN-E650-0	10.2	1.6	11.8	<0.01	7.66	0.05	0.05	0.10
CN-F900-0	-1.6	1.6	<0.3	<0.01	5.91	0.05	0.02	0.07
CN-G350-0	-13.4	13.4	<0.3	<0.01	3.89	0.43	1.26	1.69
CN-H700-0	-39.7	39.7	<0.3	0.01	4.14	1.27	1.15	2.43
CN-H750-0	-0.9	0.9	<0.3	<0.01	6.29	0.03	<0.01	0.03
CN Plant and Adit Project Area Shallow Subsurface Materials (6-12 inches)								
CN-B100-6	0.0	<0.3	<0.3	<0.01	5.87	<0.01	0.03	0.03
CN-D1050-6	-7.5	7.5	<0.3	0.01	4.42	0.24	0.47	0.72
CN-E650-6	-1.3	1.3	<0.3	<0.01	6.50	0.04	0.26	0.30
CN-F900-6	-1.3	1.3	<0.3	<0.01	5.59	0.04	0.04	0.08
CN-G350-6	-9.1	9.1	<0.3	0.01	5.10	0.29	0.76	1.06
CN-H700-6	-19.7	19.7	<0.3	0.02	3.82	0.63	0.75	1.40
CN-H750-6	-0.3	0.3	<0.3	0.01	6.11	0.01	<0.01	0.02
CN-I100-6								
CN Plant Foundation Interior Surface Materials (0-2 inches)								
LF-A0-0	75.6	6.6	82.1	<0.01	8.34	0.21	0.06	0.27
LF-A75-0	-47.2	47.2	<0.3	0.05	2.28	1.51	1.61	3.17
LF-F0-0	-6.9	6.9	<0.3	0.01	4.75	0.22	0.47	0.70
UF-F50-0	4.1	18.4	22.6	<0.01	7.53	0.59	0.28	0.87
UF-A50-0	20.7	3.4	24.1	<0.01	7.84	0.11	0.02	0.13
UF-C50-0	46.1	3.1	49.3	<0.01	8.14	0.10	0.04	0.14
UF-K25-0	7.4	5.9	13.3	<0.01	7.09	0.19	0.10	0.29
UF-SR-0	-10.9	10.9	<0.3	<0.01	6.71	0.35	0.51	0.86
CN Plant Foundation Interior Shallow Subsurface Materials (6-12 inches)								
LF-A0-6	72.2	10.9	83.1	<0.01	8.26	0.35	0.09	0.44
LF-A75-6	-49.1	49.1	<0.3	0.06	3.66	1.57	1.55	3.18
LF-F0-6	-18.1	18.1	<0.3	<0.01	3.66	0.58	0.56	1.14
UF-F50-6	11.7	11.9	23.6	<0.01	7.78	0.38	0.15	0.53
UF-A50-6	4.6	3.1	7.7	<0.01	7.76	0.10	0.03	0.13
UF-C50-6	54.9	3.1	58.0	<0.01	8.3	0.10	0.02	0.12
UF-K25-6	33.4	2.5	35.9	<0.01	6.32	0.08	0.05	0.13
UF-SR-6	-5.2	6.3	1.0	<0.01	7.24	0.20	0.29	0.49

Table 5 DI WET Laboratory Results (mg/L) for the CN Plant and Adit Project Area and Foundation Interior

Sample ID	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Cyanide Plant and Adit Project Area Surface Soil Samples (0 inches to 2 inches)																	
CN-B100-0	<0.020	0.016	0.0159	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	0.00043	<0.008	<0.010	<0.04	<0.0050	<0.015	0.0085	0.013
CN-D1050-0	<0.020	<0.009	0.0460	<0.0020	0.0090	<0.0060	0.0098	0.021	<0.0075	<0.00043	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	0.150
CN-E650-0	<0.020	<0.009	0.0265	<0.0020	<0.0020	<0.0060	<0.0060	0.015	<0.0075	<0.00043	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010
CN-F900-0	<0.020	<0.009	0.0206	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00043	<0.008	<0.010	<0.04	<0.0050	<0.015	0.0079	0.014
CN-G350-0	<0.020	0.011	0.0128	<0.0020	0.5350	<0.0060	0.0809	0.339	0.0325	<0.00043	<0.008	0.167	<0.04	<0.0050	<0.015	<0.0050	18.8
CN-H700-0	<0.020	0.018	0.0848	<0.0020	0.0252	<0.0060	<0.0060	0.011	0.0152	0.00050	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	0.465
CN-H750-0	<0.020	0.009	0.2510	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00043	<0.008	<0.010	<0.04	<0.0050	<0.015	0.0132	0.052
Cyanide Plant and Adit Project Area Subsurface Soil Samples (6 inches to 12 inches)																	
CN-B100-6	<0.020	<0.009	0.0063	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00043	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010
CN-D1050-6	<0.020	<0.009	0.0476	<0.0020	0.0122	<0.0060	0.0094	0.015	<0.0075	<0.00043	<0.008	0.013	<0.04	<0.0050	<0.015	<0.0050	0.140
CN-E650-6	<0.020	<0.009	0.0179	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00043	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	0.011
CN-F900-6	<0.020	0.015	0.0203	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	0.00045	<0.008	<0.010	<0.04	<0.0050	<0.015	0.0119	<0.010
CN-G350-6	<0.020	<0.009	0.0151	<0.0020	0.3530	<0.0060	0.0457	0.644	0.1720	<0.00043	<0.008	0.069	<0.04	<0.0050	<0.015	<0.0050	13.4
CN-H700-6	<0.020	<0.009	0.0685	<0.0020	0.0475	<0.0060	<0.0060	0.032	0.0122	<0.00043	<0.008	0.010	<0.04	<0.0050	<0.015	<0.0050	0.728
CN-H750-6	<0.020	<0.009	0.0210	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	<0.00043	<0.008	<0.010	<0.04	<0.0050	<0.015	0.0091	0.013
Interior Cyanide Plant Foundation Surface Soil Samples (0 inches to 2 inches)																	
LF-A0-0	<0.020	0.015	0.0437	<0.0020	<0.0020	<0.0060	<0.0060	0.031	<0.0075	0.00111	0.014	<0.010	<0.04	<0.0050	<0.015	<0.0050	0.012
LF-A75-0	<0.020	0.569	0.0204	<0.0020	0.1330	0.0118	0.0639	0.814	<0.0075	0.23800	0.021	0.098	<0.04	<0.0050	<0.015	0.0068	1.99
LF-F0-0	<0.020	<0.009	0.0402	<0.0020	0.0205	<0.0060	0.0149	0.082	0.0620	<0.00043	0.009	0.040	<0.04	<0.0050	0.017	<0.0050	0.330
UF-A50-0	<0.020	0.025	0.0657	<0.0020	<0.0020	<0.0060	<0.0060	0.025	0.0104	0.00761	0.019	<0.010	<0.04	<0.0050	0.020	<0.0050	0.047
UF-C50-0	<0.020	0.027	0.0342	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	0.00039	0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010
UF-F50-0	<0.020	0.013	0.1930	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	0.00896	0.018	<0.010	<0.04	<0.0050	0.020	<0.0050	0.026
UF-K25-0	<0.020	0.015	0.0223	<0.0020	<0.0020	<0.0060	<0.0060	0.014	0.0140	0.00031	0.016	<0.010	<0.04	<0.0050	0.017	<0.0050	0.023
UF-SR-0	<0.020	<0.009	0.0074	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	0.00021	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010

Table 5 DI WET Laboratory Results (mg/L) for the CN Plant and Adit Project Area and Foundation (continued)

Sample ID	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Interior Cyanide Plant Foundation Subsurface Soil Samples (6 inches to 12 inches)																	
LF-A0-6	<0.020	<0.009	0.0337	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	0.00054	0.015	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010
LF-A75-6	<0.020	0.015	0.0368	<0.0020	0.0044	<0.0060	<0.0060	0.027	<0.0075	0.00047	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	0.079
LF-F0-6	<0.020	0.015	0.0599	<0.0020	0.0170	<0.0060	0.0173	0.149	0.1930	<0.00043	<0.008	0.057	<0.04	<0.0050	<0.015	<0.0050	0.403
UF-A50-6	<0.020	0.015	0.0648	<0.0020	<0.0020	<0.0060	<0.0060	0.012	<0.0075	0.00486	0.018	<0.010	<0.04	<0.0050	0.019	<0.0050	0.059
UF-C50-6	<0.020	0.106	0.0443	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	0.00023	0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010
UF-F50-6	<0.020	0.012	0.0517	<0.0020	<0.0020	<0.0060	<0.0060	0.012	0.0119	0.00248	0.014	<0.010	<0.04	<0.0050	<0.015	<0.0050	0.030
UF-K25-6	<0.020	0.024	0.0219	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	0.00268	0.013	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010
UF-SR-6	<0.020	<0.009	0.0239	<0.0020	<0.0020	<0.0060	<0.0060	<0.010	<0.0075	0.00038	<0.008	<0.010	<0.04	<0.0050	<0.015	<0.0050	<0.010

Table 6 In-situ XRF and Correlated XRF Analysis for Arsenic and Lead in Interior CN Plant Foundation (mg/Kg)

SAMPLE ID	In-Situ XRF Arsenic Concentration	Correlated Arsenic Concentration	In-Situ XRF Lead Concentration	Correlated Lead Concentration
LF-A100	636	852	1936	2207
LF-A75	1813	2430	12369	14100
LF-A50	1202	1611	4691	5348
LF-A25	700	938	2437	2779
LF-A0	157	210	957	1092
LF-B50	3413	4573	51247	58421
LF-B25	1656	2219	6321	7206
LF-B0	1115	1494	5081	5792
LF-C0	1662	2227	5854	6674
LF-D0	1098	1471	3218	3668
LF-E0	1476	1978	3548	4045
LF-F0	1835	2458	2302	2624
LF-G0	1877	2515	2845	3244
UF-A50	19	<39	131	150
UF-A25	308	413	852	971
UF-B50	138	185	675	769
UF-B25	61	81	268	305
UF-C50	56	76	43	50
UF-C25	176	236	424	483
UF-D50	879	1178	3318	3782
UF-E50	529	709	522	595
UF-E50	428	574	1965	2240
UF-G50	334	448	3377	3849
UF-H50	1142	1530	202	230
UF-I50	1617	2167	2012	2293
UF-SR	757	1014	640	729
UF-K25	103	138	225	257
UF-K0	1394	1868	124	142
UF-J0	321	430	1448	1651
UF-I25	425	569	124	141
UF-I25	590	790	204	233
UF-I0	58	78	4185	4771
UF-H25	599	803	1184	1349
UF-G25	299	401	730	832
UF-F25	150	200	614	700
UF-E25	192	258	501	571
UF-D25	644	863	2887	3292
UF-C0	118	158	767	875
UF-D0	467	626	1692	1929
UF-E0	85	114	236	270
UF-F0	225	302	769	877
UF-G0	171	229	484	552

Table 7 Total Metals Laboratory Analysis for Interior CN Plant Foundation (mg/Kg)

Sample ID	WAD Cyanide	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Interior Cyanide Plant Foundation Surface Soil Samples (0 inches to 2 inches)																		
LF-A0-0	<0.500	<2.0	79.5	267	0.255	12.4	24.1	8.18	3270	1770	16.3	2.69	28.3	<4.0	48.0	<1.5	27.7	3670
LF-A75-0	1.41	9.1	2730	408	<0.200	39.6	6.03	4.48	222	13100	17.0	20.4	11.8	12.3	54.7	<1.5	8.64	613
LF-F0-0	0.500	<2.0	1820	288	<0.200	6.47	29.1	4.88	146	2460	<3.30	8.75	13.0	4.0	12.5	<1.5	182	107
UF-A50-0	<0.500	<2.0	51.3	49.8	<0.200	5.98	10.2	5.38	113	474	8.67	1.49	7.07	<4.0	12.7	<1.5	17.1	550
UF-C50-0	<0.500	<2.0	172	170	<0.200	5.08	7.26	6.07	44.3	35.0	2.05	1.41	4.52	<4.0	0.95	<1.5	23.3	114
UF-F50-0	0.764	<2.0	545	234	0.265	32.1	17.8	20.3	366	2000	12.3	3.67	25.4	<4.0	41.5	<1.5	41.8	2050
UF-K25-0	<0.500	<2.0	165	55.5	0.212	6.28	6.45	9.38	79.9	317	3.83	1.46	10.4	<4.0	15.2	<1.5	22.2	564
UF-SR-0	8.43	12.2	1110	215	0.346	13.4	28.0	24.3	719	2040	4.00	15.6	57.8	<4.0	51.5	<1.5	79.8	469
Interior Cyanide Plant Foundation Subsurface Soil Samples (6 inches to 12 inches)																		
LF-A0-6	<0.500	<2.0	65.5	177	0.247	13.0	11.0	8.51	1020	745	6.33	1.71	13.2	<4.0	19.8	<1.5	23.0	1220
LF-A75-6	0.676	7.9	2170	346	<0.200	12.7	5.87	3.00	199	9400	19.8	27.9	7.35	9.3	40.4	<1.5	14.9	231
LF-F0-6	<0.500	<2.0	1620	418	<0.200	8.21	31.0	5.17	174	2830	3.67	9.63	22.3	4.4	17.8	<1.5	178	152
UF-A50-6	<0.500	<2.0	65.1	81.6	<0.200	6.09	15.9	6.23	144	593	8.67	2.00	9.13	<4.0	16.2	<1.5	33.3	929
UF-C50-6	<0.500	<2.0	163	191	<0.200	4.07	6.55	6.06	39.8	20.8	1.12	1.42	4.45	<4.0	0.50	<1.5	22.0	96.5
UF-F50-6	<0.500	<2.0	361	127	0.221	16.3	10.8	14.5	214	983	6.33	2.67	15.8	<4.0	14.6	<1.5	35.3	882
UF-K25-6	<0.500	<2.0	256	98.4	0.202	7.33	6.68	8.71	109	193	7.03	1.39	9.74	<4.0	16.9	<1.5	20.0	563
UF-SR-6	7.54	18.9	586	235	0.319	12.8	18.10	19.6	858	2560	4.67	18.2	51.5	<4.0	55.2	<1.5	55.5	600

Table 8 Total Metals Laboratory Results for CN Plant and Adit Project Area Test Pits (mg/Kg)

Sample ID	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Cyanide (WAD)	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
TP1 0"-6"	<2.0	173	129	0.357	1.42	37.8	21.3	123	N/A	111	3.67	1.68	21.2	<4.0	<0.50	<1.5	112	70.3
TP1 6"-12"	<2.0	101	152	0.532	0.84	43.9	18.2	98.1	N/A	29.0	0.473	1.53	13.2	<4.0	<0.50	<1.5	170	51.2
TP1 18"-36"	8.5	202	37.7	0.731	1.37	39.0	2.47	89.6	<0.500	8.53	0.243	1.87	<1.00	<4.0	<0.50	<1.5	285	11.9
TP1 36"-48"	4.7	132	29.4	0.739	0.91	34.8	<0.60	76.6	<0.500	7.57	0.242	0.88	<1.00	<4.0	<0.50	<1.5	317	5.36
TP1 96"	3.3	55.0	59.5	0.597	0.64	34.6	1.08	80.8	<0.500	6.06	0.132	0.82	7.29	<4.0	<0.50	<1.5	319	5.56
TP2 0"-6"	<2.0	618	154	0.513	2.21	43.1	5.84	136	N/A	514	5.67	2.11	<1.00	<4.0	1.59	<1.5	196	56.5
TP2 6"-12"	<2.0	737	113	0.455	2.59	46.9	4.68	132	N/A	441	4.83	1.46	<1.00	<4.0	1.15	<1.5	198	50.0
TP2 18"-30"	<2.0	234	57.2	0.411	1.45	42.0	1.09	82.6	<0.500	94.3	1.17	0.98	4.24	<4.0	<0.50	<1.5	201	24.3
TP2 30"-48"	<2.0	207	39.4	0.574	1.31	82.2	0.96	93.4	<0.500	64.2	0.648	<0.80	6.96	<4.0	<0.50	<1.5	249	23.9
TP2 84"	<2.0	65.6	49.2	0.444	1.31	187	3.09	97.2	<0.500	25.6	0.245	<0.80	16.0	<4.0	<0.50	<1.5	272	35.4
TP3 0"-6"	6.1	1910	400	<0.200	19.5	18.4	3.68	183	N/A	4130	52.7	16.5	<1.00	6.0	32.6	<1.5	113	368
TP3 6"-12"	<2.0	1090	363	0.224	7.66	54.4	11.5	175	N/A	1590	22.2	5.93	<1.00	<4.0	12.8	<1.5	268	149
TP3 12"-30"	3.3	170	112	0.564	1.93	71.0	9.99	159	<0.500	124	3.05	1.71	13.6	<4.0	<0.50	<1.5	344	69.4
TP3 91"	4.3	209	147	0.546	2.77	61.3	5.14	181	<0.500	91.1	11.0	1.91	6.66	<4.0	<0.50	<1.5	342	92.3
TP4 0"-6"	2.5	2160	506	<0.200	11.3	19.1	5.27	154	N/A	4790	87.0	15.2	<1.00	9.0	32.5	<1.5	124	237
TP4 6"-12"	<2.0	1320	307	0.251	3.32	33.1	8.06	168	N/A	676	11.3	3.44	<1.00	<4.0	5.04	<1.5	230	75.2
TP4 18"-30"	5.0	517	222	0.534	1.87	54.3	1.04	181	<0.500	151	8.03	1.27	<1.00	<4.0	<0.50	<1.5	339	30.2
TP4 30"-48"	4.9	646	227	0.455	1.87	52.5	2.43	169	<0.500	375	11.2	2.08	<1.00	<4.0	<0.50	<1.5	313	40.6
TP4 70"	4.0	660	189	0.462	2.51	110	4.70	151	<0.500	265	8.88	8.92	10.0	<4.0	<0.50	<1.5	239	36.1
TP5 0"-6"	<2.0	558	195	<0.200	3.55	7.68	2.95	59.4	N/A	1280	13.3	5.04	<1.00	<4.0	6.86	<1.5	36.6	95.4
TP5 6"-12"	2.7	510	210	<0.200	1.78	5.20	2.84	57.5	N/A	1180	15.3	4.87	<1.00	<4.0	7.07	<1.5	25.7	57.5
TP5A 12"-30 MIDDLE	4.5	1060	145	0.281	2.44	30.6	2.73	147	0.765	1520	12.5	3.68	5.61	<4.0	8.3	<1.5	183	69.2
TP5B 12"-30 BOTTOM	3.9	1050	172	<0.200	2.11	9.93	1.14	72.2	1.16	1070	27.3	4.23	<1.00	<4.0	6.04	<1.5	42.0	65.2
TP5A 30"-48 MIDDLE	3.6	614	130	0.232	1.95	28.1	3.36	153	1.14	969	12.1	2.54	4.52	<4.0	3.78	<1.5	162	63.8
TP5B 30"-48 BOTTOM	<2.0	130	15.4	<0.200	0.24	7.79	0.68	54.9	0.599	83.5	4.23	0.96	<1.00	<4.0	2.86	<1.5	17.4	36.5
TP5B 64" BOTTOM	2.6	385	80.7	<0.200	0.62	16.9	2.44	129	1.99	365	13.3	1.72	2.84	<4.0	2.49	<1.5	52.0	46.5
TP5B 72" BOTTOM	2.5	473	102	<0.200	0.84	12.3	1.80	88.2	2.00	481	9.33	2.72	<1.00	<4.0	4.13	<1.5	53.3	48.4
TP5B 90"	2.8	255	61.4	0.258	1.04	27.0	3.47	153	1.64	104	26.7	2.15	5.19	<4.0	<0.50	<1.5	160	50.9
TP5A 120" MIDDLE	2.6	200	225	0.698	1.71	33.0	10.6	165	<0.500	152	2.52	1.85	11.2	<4.0	<0.50	<1.5	259	65.1
TP6 0"-6"	<2.0	609	54.4	<0.200	4.34	9.57	6.01	76.3	N/A	597	3.83	1.90	<1.00	<4.0	1.95	<1.5	30.5	141
TP6 6"-12"	<2.0	75.2	46.5	0.330	14.1	4.98	11.6	258	N/A	94.6	0.933	1.20	14.2	<4.0	<0.50	<1.5	17.2	335
TP6A 12"-30" BOTTOM	<2.0	158	60.8	<0.200	0.85	8.87	2.67	56.2	0.780	264	6.75	1.08	<1.00	<4.0	13.7	<1.5	35.9	43.7
TP6A 30"-48" BOTTOM	4.1	218	130	0.289	1.44	23.6	8.29	113	0.578	121	3.63	1.90	10.7	<4.0	6.88	<1.5	155	85.7
TP6A 80 " BOTTOM	3.3	82.2	248	0.522	2.02	31.1	51.9	138	<0.500	29.9	0.733	1.89	25.7	<4.0	1.76	<1.5	290	87.8
TP6A 120 "	3.5	34.0	318	0.511	1.43	13.9	41.3	144	<0.500	46.0	0.208	2.25	18.9	<4.0	<0.50	<1.5	197	85.8
TP6B18"-30" MIDDLE	3.4	49.2	46.1	<0.200	8.38	5.69	8.07	85.2	<0.500	705	2.97	2.88	5.74	<4.0	0.69	<1.5	16.1	210
TP6B 30"-48" MIDDLE	2.7	156	40.0	<0.200	12.2	5.10	9.06	45.9	<0.500	165	1.37	3.24	5.95	<4.0	2.80	<1.5	18.5	443
TP6B 60" MIDDLE	<2.0	307	45.1	<0.200	1.94	5.55	2.90	46.9	<0.500	437	0.900	1.10	2.99	<4.0	1.59	<1.5	22.7	203
TP6B 120 " MIDDLE	2.7	269	37.9	<0.200	0.82	23.1	2.53	162	1.63	64.8	12.0	1.49	5.22	<4.0	32.1	<1.5	96.3	59.0
TP6B 126"-132" MIDDLE	2.1	253	32.5	<0.200	0.59	8.45	3.19	26.8	<0.500	142	1.52	1.09	2.62	<4.0	3.25	<1.5	38.0	78.0
TP6B 132"-144" MIDDLE	2.9	120	214	0.474	1.90	32.1	14.5	136	<0.500	19.5	1.07	2.19	16.6	<4.0	<0.50	<1.5	256	67.7
TP6B 144" MIDDLE	2.7	222	120	0.279	1.35	21.9	10.9	81.0	<0.500	144	1.00	1.34	9.22	<4.0	3.80	<1.5	162	81.0
TP6C 12"-30"	2.9	186	99.0	0.219	0.85	27.0	5.53	57.4	<0.500	197	1.93	1.76	7.80	<4.0	0.62	<1.5	92.0	86.9
TP6C 30"-48"	2.9	119	83.1	<0.200	1.94	17.4	6.52	52.8	<0.500	81.6	1.95	1.55	6.88	<4.0	1.58	<1.5	62.5	104
TP6C 96 "	2.1	147	55.4	0.759	1.58	53.5	8.51	228	0.829	25.6	0.383	3.26	9.67	<4.0	2.36	<1.5	220	53.7

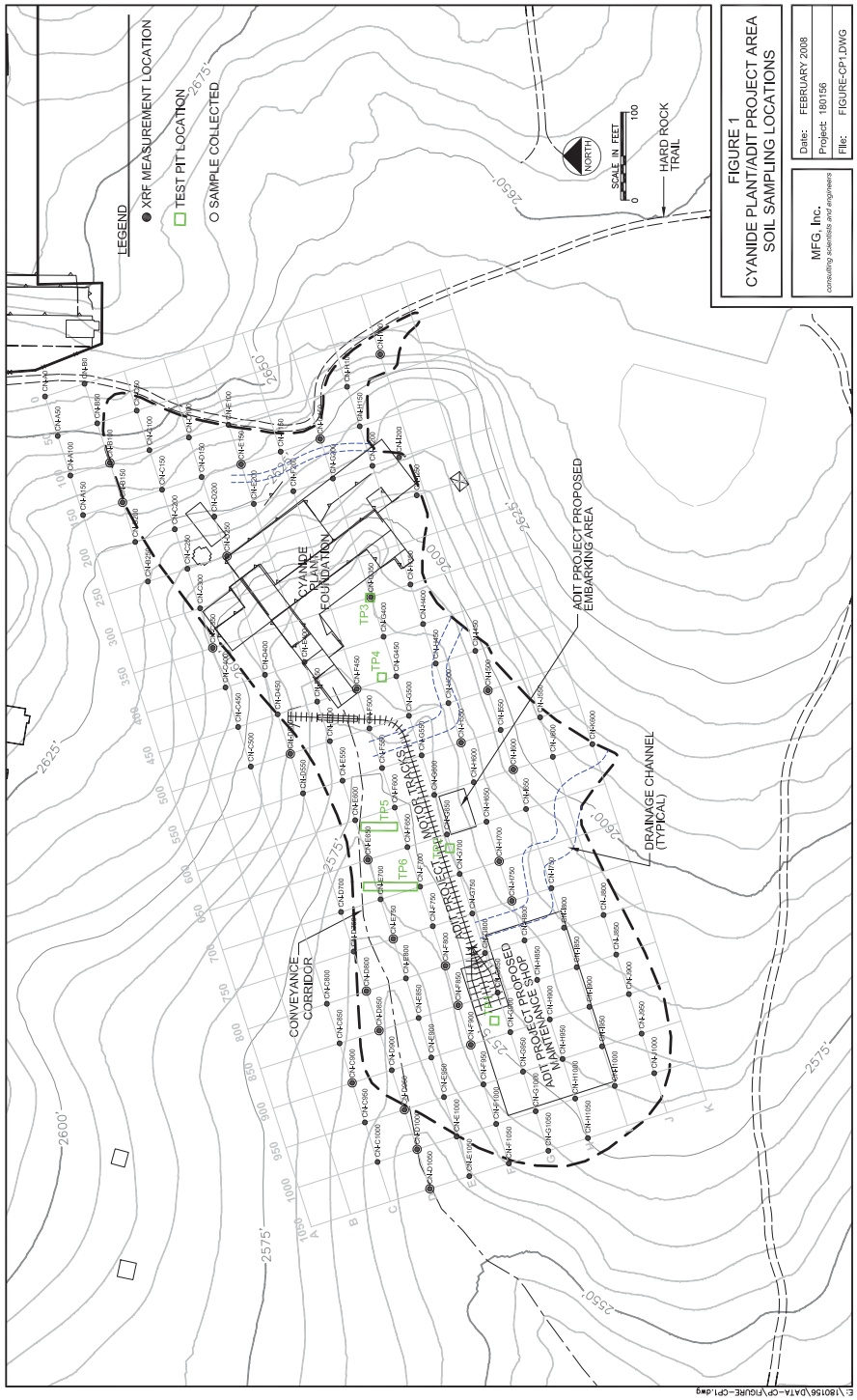
Table 9 ABA Laboratory Results for CN Plant and Adit Project Area Test Pits

Sample ID	Net Neutralizing Potential $TCaCO_3$/kT	Acid Generating Potential $TCaCO_3$/kT	Acid Neutralizing Potential $TCaCO_3$/kT	Non-Ext Sulfur, S %	pH Paste (S.U.)	Pyritic Sulfur, S %	Sulfate Sulfur, S %	Total Sulfur, S %
TP1 36"-48"	-0.28	0.28	<0.3	0.01	4.86	0.009	0.01	0.03
TP1 96"	0.009	-0.009	<0.3	0.01	4.44	-0.0003	0.02	0.03
TP2 18"-30"	-1.79	1.79	<0.3	0.01	3.68	0.06	0.17	0.24
TP2 84"	-1.45	1.45	<0.3	0.02	3.71	0.05	0.15	0.21
TP3 12"-30"	-2.13	2.13	<0.3	0.02	3.84	0.07	0.16	0.24
TP3 91"	-0.69	0.69	<0.3	0.01	3.78	0.02	0.15	0.19
TP4 18"-30"	-2.24	2.24	<0.3	0.02	3.44	0.07	0.32	0.40
TP4 30"-48"	-2.62	2.62	<0.3	0.01	3.51	0.08	0.29	0.39
TP4 70"	-2.00	2.00	<0.3	0.01	3.61	0.06	0.20	0.28
TP5A 12"-30" MIDDLE	-4.28	4.28	<0.3	<0.01	3.58	0.14	0.30	0.44
TP5B 12"-30" BOTTOM	-3.93	3.93	<0.3	0.04	3.67	0.13	0.38	0.55
TP5B 30"-48" BOTTOM	-1.17	1.17	<0.3	<0.01	3.96	0.04	0.12	0.16
TP5B 64" BOTTOM	-1.28	1.28	<0.3	<0.01	3.95	0.04	0.19	0.23
TP5B 90"	-1.77	1.77	<0.3	0.01	3.71	0.06	0.66	0.72
TP6A 12"-30" BOTTOM	-1.56	1.56	<0.3	<0.01	3.63	0.05	0.30	0.35
TP6A 120"	-0.54	0.54	<0.3	0.01	4.53	0.02	0.08	0.11
TP6B 18"-30" MIDDLE	35.9	11.5	47.4	<0.01	7.76	0.37	0.07	0.44
TP6B 30"-48" MIDDLE	7.29	28.31	35.6	<0.01	-	0.91	0.15	1.06
TP6B 60" MIDDLE	-1.39	1.39	<0.3	<0.01	3.65	0.04	0.26	0.31
TP6B 126"-132" MIDDLE	-0.88	0.88	<0.3	<0.01	3.39	0.03	0.18	0.21
TP6B 132"-144" MIDDLE	-1.72	1.72	<0.3	0.02	3.57	0.05	0.16	0.23
TP6C 12"-30"	-2.19	2.19	<0.3	<0.01	4.04	0.07	0.19	0.26
TP6C 96"	-1.07	1.07	<0.3	0.02	3.96	0.03	0.12	0.17

Table 10 DI WET Laboratory Results for CN Plant and Adit Project Area Test Pits (mg/L)

Sample ID	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
TP-1 36"-48"	<0.200	0.264	<10.0	<0.0200	<0.100	<0.500	<0.0600	0.208	<0.500	0.0002	<0.0800	0.124	<0.500	<0.500	<0.150	2.12	<0.100
TP-1 96"	<0.200	0.171	<10.0	<0.0200	<0.100	<0.500	<0.0600	0.477	<0.500	<0.0002	<0.0800	0.124	<0.500	<0.500	<0.150	2.19	<0.100
TP-2 18"-30"	<0.200	2.10	<10.0	<0.0200	<0.100	<0.500	<0.0600	1.61	<0.500	0.0006	<0.0800	<0.100	<0.500	<0.500	<0.150	0.534	0.681
TP-2 84"	<0.200	0.392	<10.0	<0.0200	<0.100	<0.500	<0.0600	2.45	<0.500	<0.0002	<0.0800	0.174	<0.500	<0.500	<0.150	0.967	1.41
TP-3 12"-30"	1.46	0.411	<10.0	<0.0200	<0.100	<0.500	0.939	3.75	2.92	0.0012	<0.0800	0.168	<0.500	<0.500	<0.150	1.23	2.07
TP-3 91"	<0.200	1.33	<10.0	<0.0200	0.161	<0.500	0.452	2.49	0.932	0.0093	<0.0800	<0.100	<0.500	<0.500	<0.150	1.21	5.01
TP-4 18"-30"	<0.200	0.601	<10.0	<0.0200	<0.100	<0.500	<0.0600	2.10	<0.500	0.002	<0.0800	<0.100	<0.500	<0.500	<0.150	0.48	0.202
TP-4 30"-48"	<0.200	0.685	<10.0	<0.0200	<0.100	<0.500	0.0764	2.28	<0.500	0.0015	<0.0800	<0.100	<0.500	<0.500	<0.150	0.444	0.249
TP-4 70"	<0.200	0.922	<10.0	<0.0200	<0.100	<0.500	0.207	2.03	<0.500	0.0009	<0.0800	<0.100	<0.500	<0.500	<0.150	0.745	0.334
TP-5B 12"-30" BOTTOM	0.207	14.9	<10.0	<0.0200	<0.100	<0.500	<0.0600	0.852	<0.500	0.0035	<0.0800	<0.100	<0.500	<0.500	<0.150	0.654	0.292
TP-5B 30"-48" BOTTOM	<0.200	10.8	<10.0	<0.0200	<0.100	<0.500	<0.0600	0.375	<0.500	0.0042	<0.0800	<0.100	<0.500	<0.500	<0.150	0.352	0.596
TP-5B 64" BOTTOM	<0.200	9.78	<10.0	<0.0200	<0.100	<0.500	<0.0600	1.18	<0.500	0.0081	<0.0800	0.104	<0.500	<0.500	<0.150	0.394	0.429
TP-5A 12"-30" MIDDLE	<0.200	9.20	<10.0	<0.0200	<0.100	<0.500	0.0687	2.17	0.682	0.0021	<0.0800	<0.100	<0.500	<0.500	<0.150	0.857	0.773
TP-5B 90"	<0.200	1.03	<10.0	<0.0200	<0.100	<0.500	<0.0600	2.18	1.93	0.0039	0.1240	<0.100	<0.500	<0.500	0.168	0.39	0.506
TP6A 12"-30" BOTTOM	<0.200	2.65	<10.0	<0.0200	<0.100	<0.500	0.0667	0.796	<0.500	0.0062	<0.0800	<0.100	<0.500	<0.500	<0.150	0.369	0.566
TP6A 120"	<0.200	0.309	<10.0	<0.0200	<0.100	<0.500	0.509	5.65	4.31	<0.0002	<0.0800	0.165	<0.500	<0.500	<0.150	1.02	1.58
TP6B 18"-30" MIDDLE	<0.200	0.851	<10.0	<0.0200	0.671	<0.500	0.271	1.44	45.3	<0.0002	0.1730	0.251	<0.500	<0.500	0.275	<0.0500	11.8
TP6B 60" MIDDLE	<0.200	0.965	<10.0	<0.0200	<0.100	<0.500	<0.0600	0.426	<0.500	0.0012	<0.0800	<0.100	<0.500	<0.500	<0.150	0.223	0.493
TP6B 126"-132" MIDDLE	<0.200	0.905	<10.0	<0.0200	<0.100	<0.500	<0.0600	0.737	3.18	0.0018	<0.0800	<0.100	<0.500	<0.500	<0.150	0.869	0.469
TP6B 132"-144" MIDDLE	<0.200	0.282	<10.0	<0.0200	<0.100	<0.500	0.144	3.09	0.987	0.0004	<0.0800	0.151	<0.500	<0.500	<0.150	1.52	1.49
TP6C 12"-30"	<0.200	2.76	<10.0	<0.0200	0.101	<0.500	0.265	1.05	0.552	0.0005	<0.0800	<0.100	<0.500	<0.500	<0.150	0.388	0.815
TP6C 96"	<0.200	0.304	<10.0	<0.0200	<0.100	<0.500	0.484	5.34	4.08	0.0008	<0.0800	0.154	<0.500	<0.500	<0.150	0.967	1.52

FIGURES



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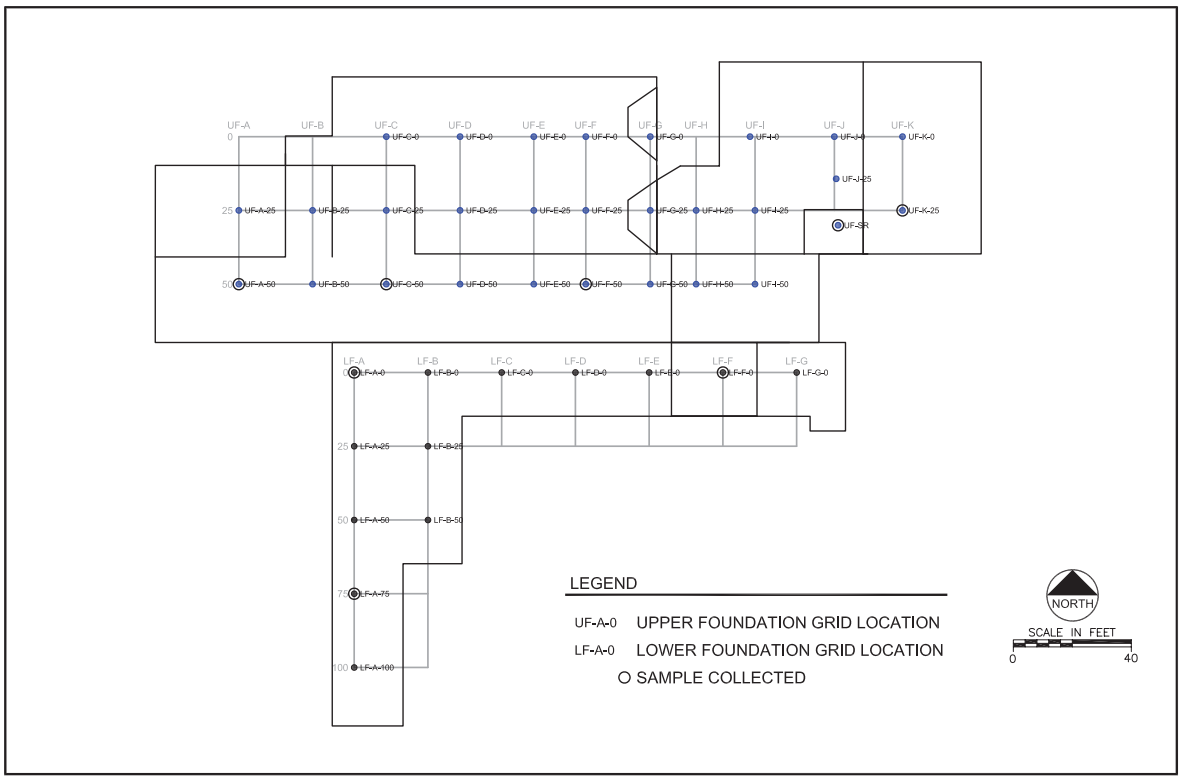

MFG, Inc. *consulting scientists and engineers*	FIGURE 2 CYANIDE PLANT INTERIOR FOUNDATION SOIL SAMPLING LOCATIONS	Date: FEBRUARY 2008 Project: 180156 File: FIGURE-CP2.DWG

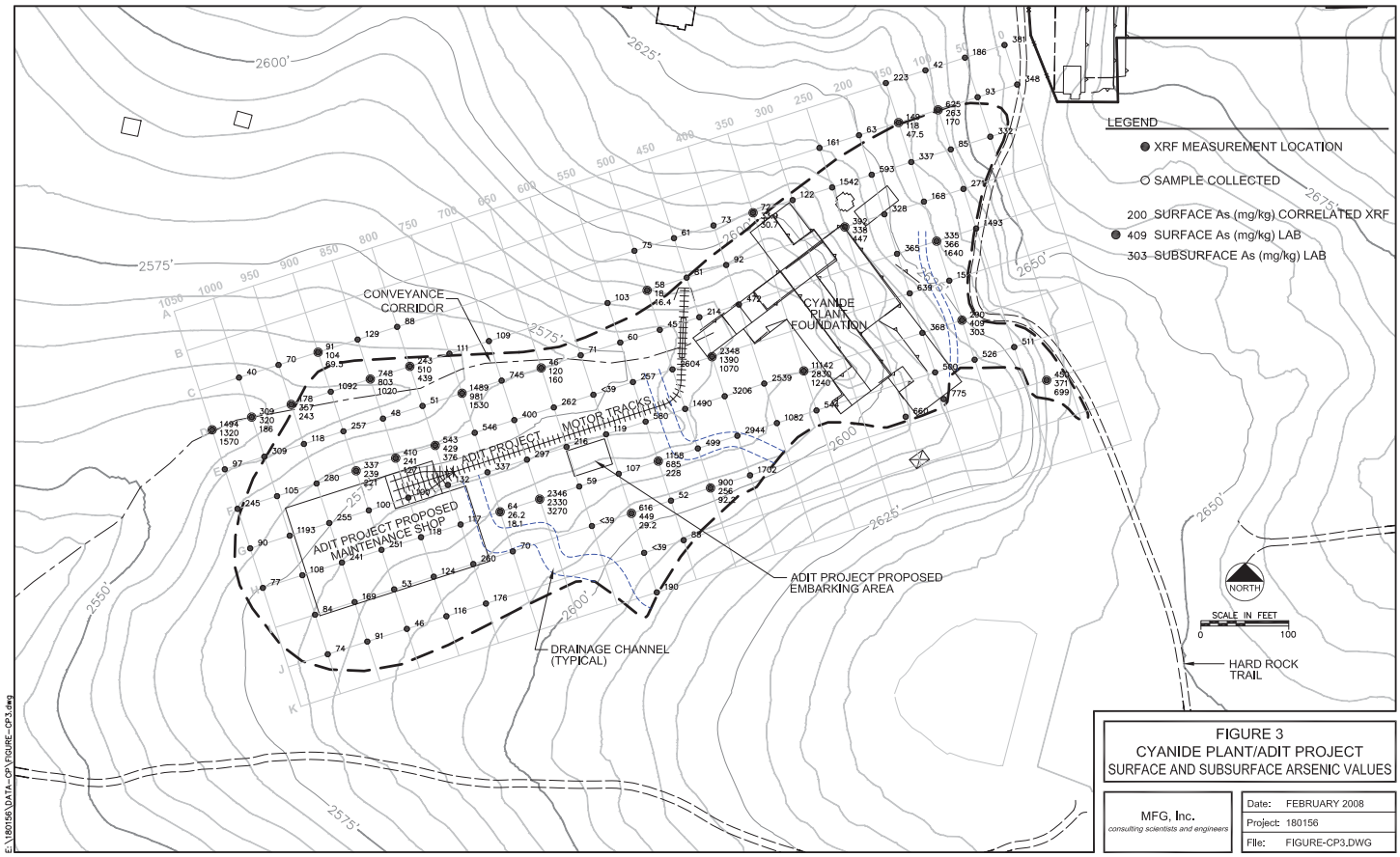

FIGURE 3 CYANIDE PLANT/ADIT PROJECT SURFACE AND SUBSURFACE ARSENIC VALUES		
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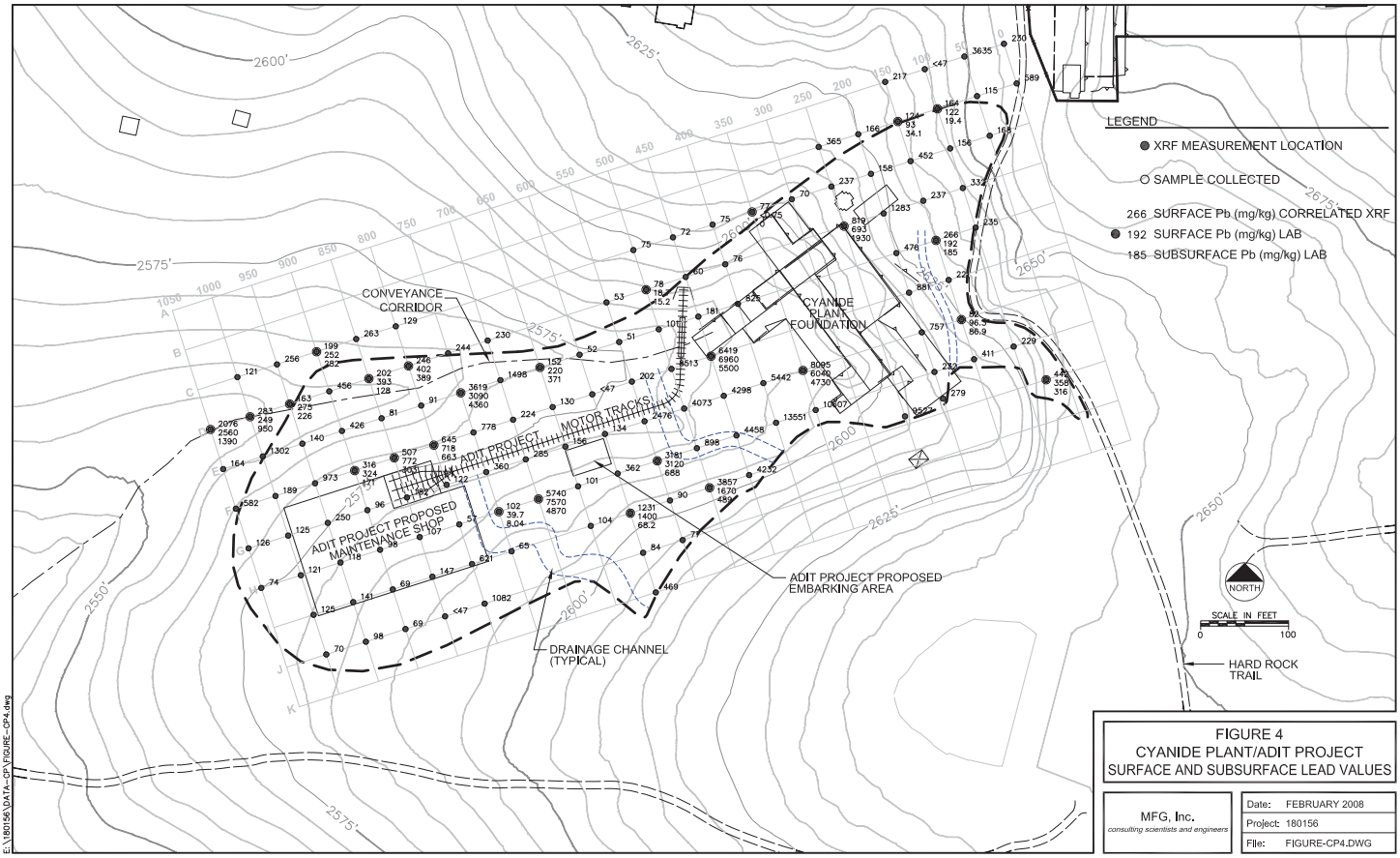

FIGURE 4
CYANIDE PLANT/ADIT PROJECT
SURFACE AND SUBSURFACE LEAD VALUES

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Project:	180156
File:	FIGURE-CP4.DWG

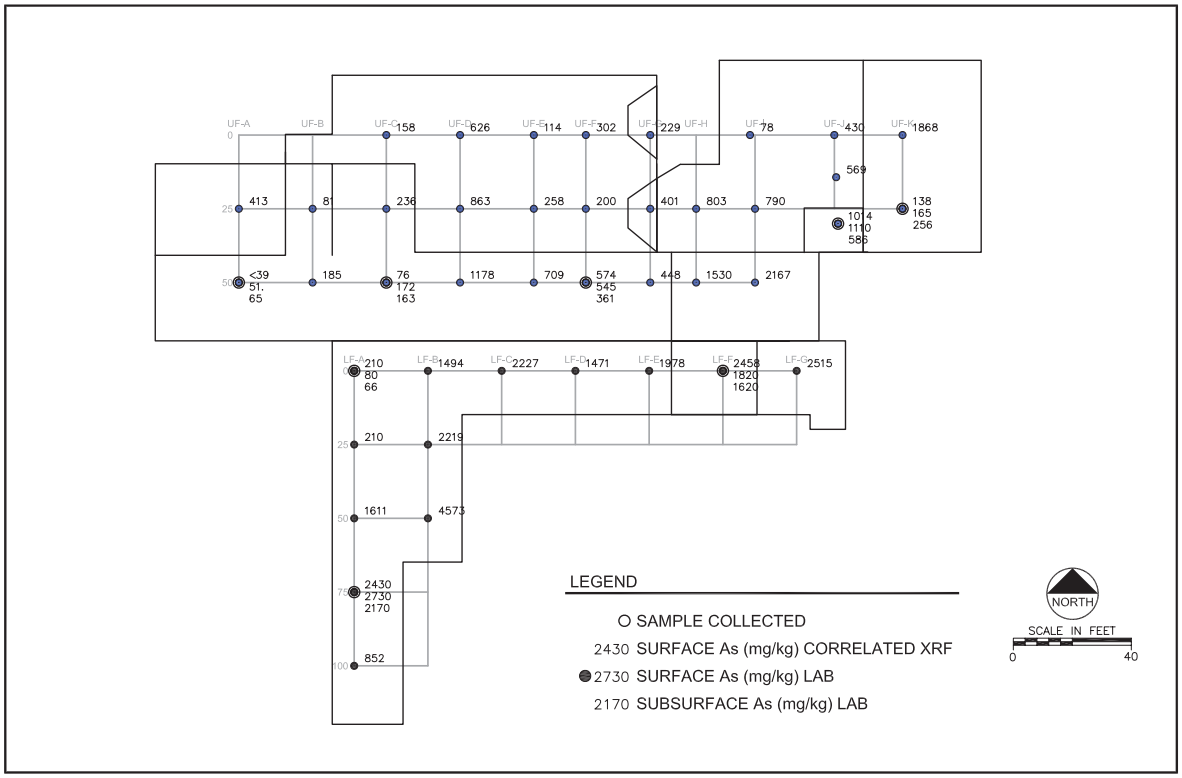

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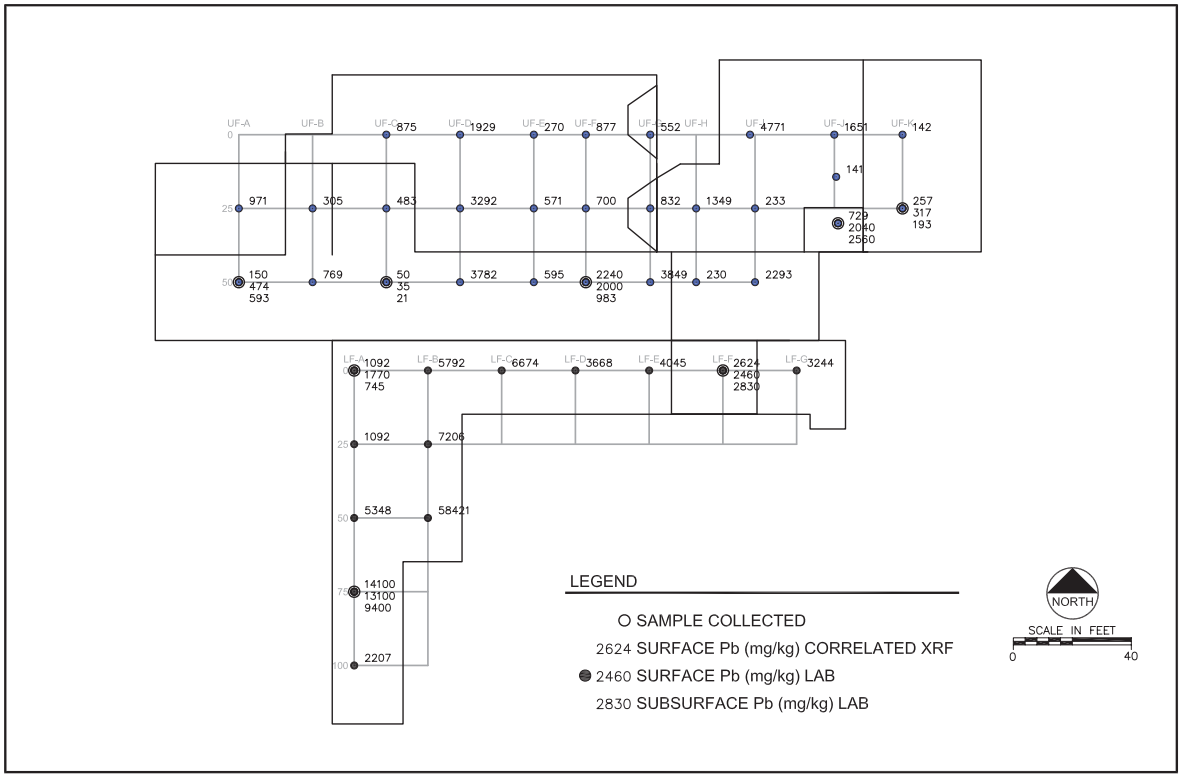
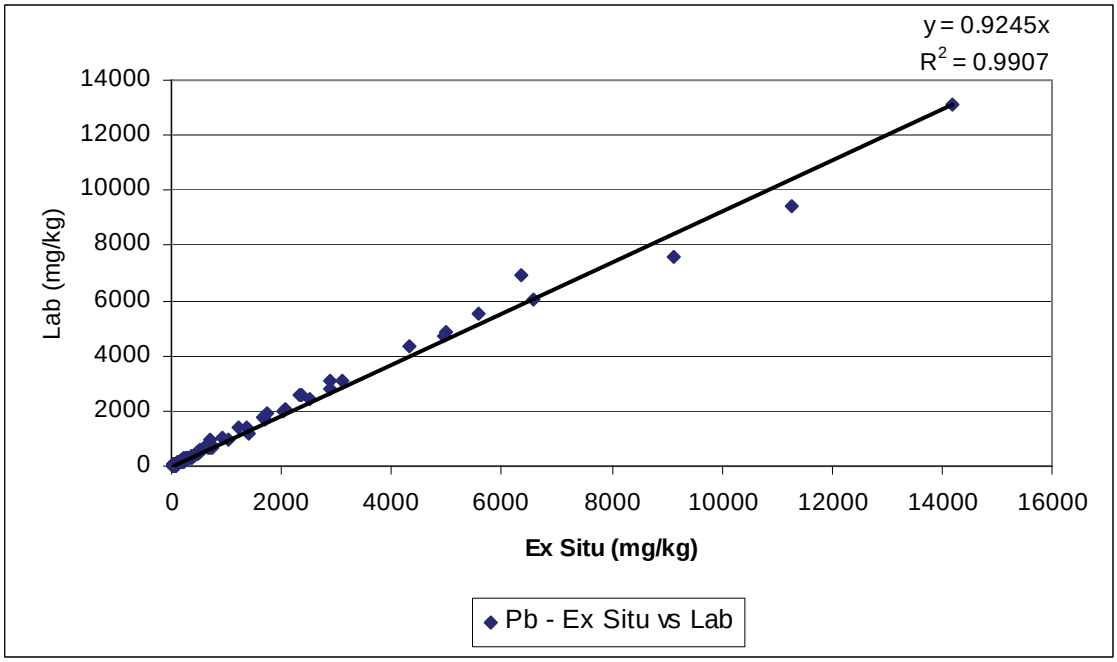
FIGURE 5
CYANIDE PLANT INTERIOR FOUNDATION
SURFACE AND SUBSURFACE ARSENIC VALUES

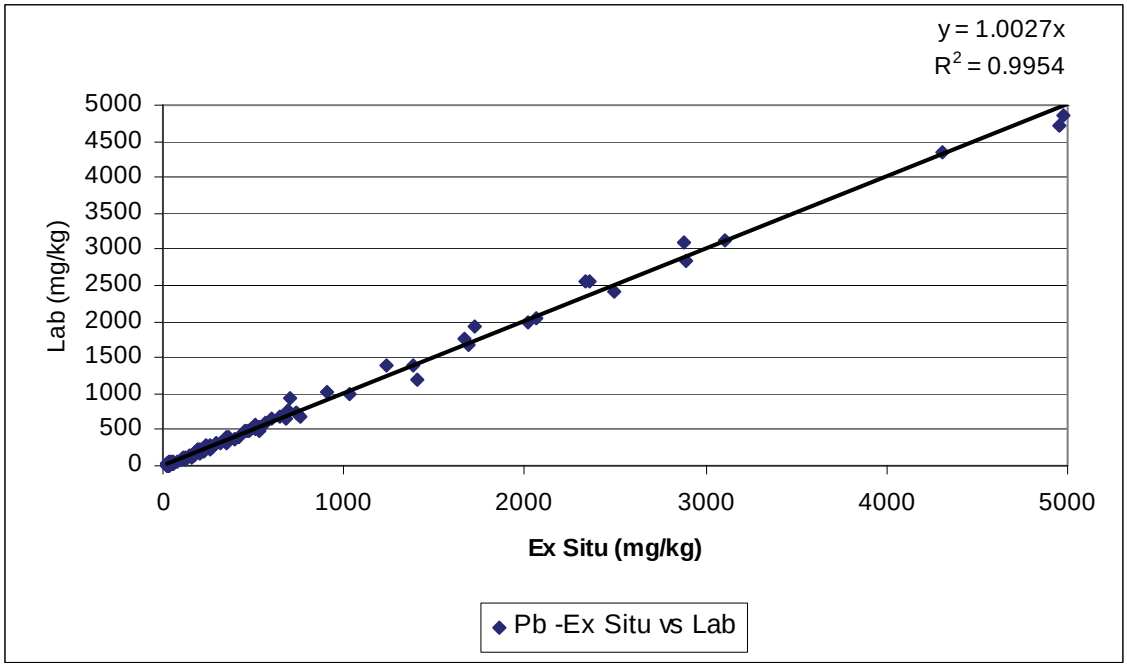
Date:	FEBRUARY 2008
Project:	180156
File:	FIGURE-CP5.DWG



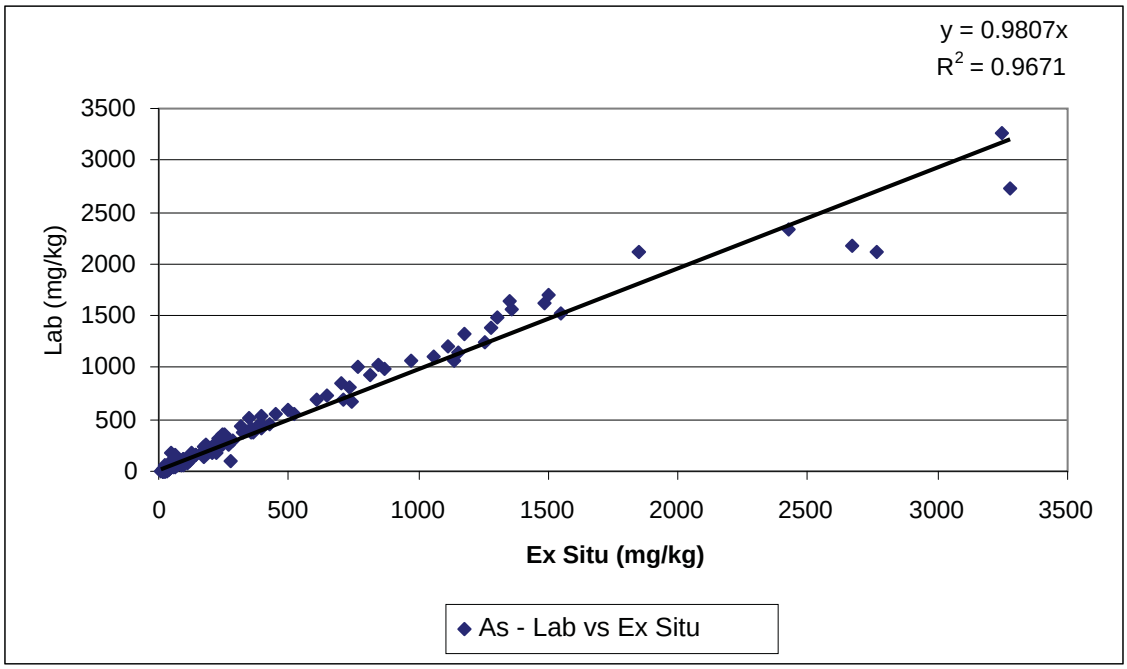
MFG, Inc. *consulting scientists and engineers*	FIGURE 6 CYANIDE PLANT INTERIOR FOUNDATION SURFACE AND SUBSURFACE LEAD VALUES	Date: FEBRUARY 2008 Project: 180156 File: FIGURE-CP6.DWG



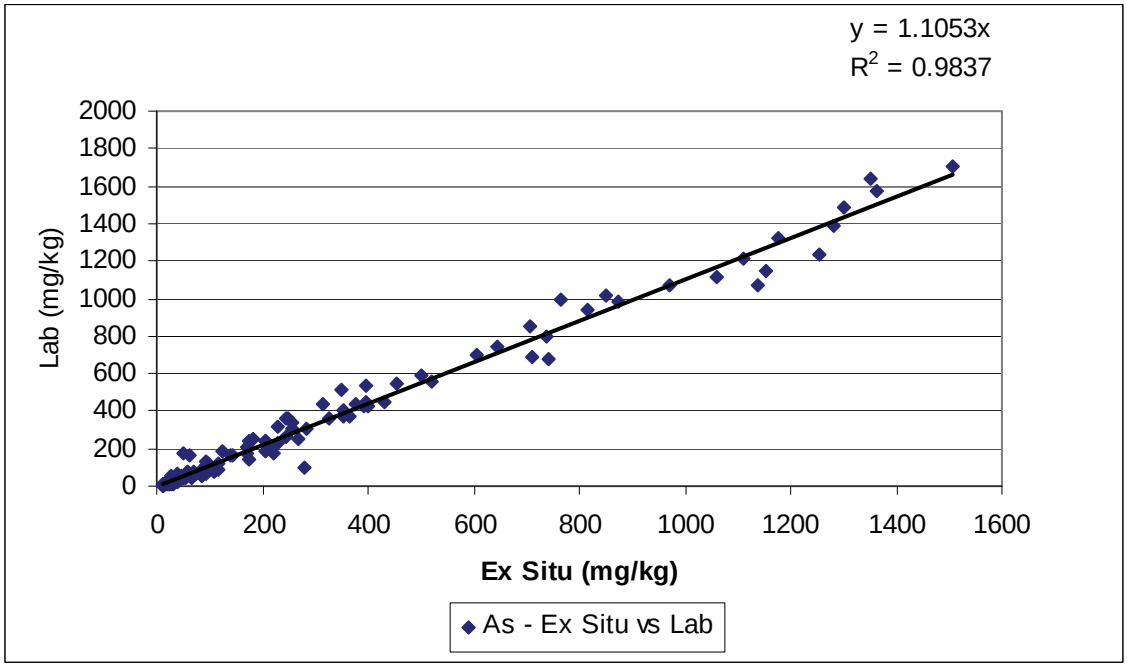
MFG, Inc. *consulting scientists and engineers*	FIGURE 7 LEAD EX-SITU XRF VS. LAB CORRELATION	Date: February 2008 Project: P:\010156…\CN DTR FLD File: CORRELATIONS.ppt



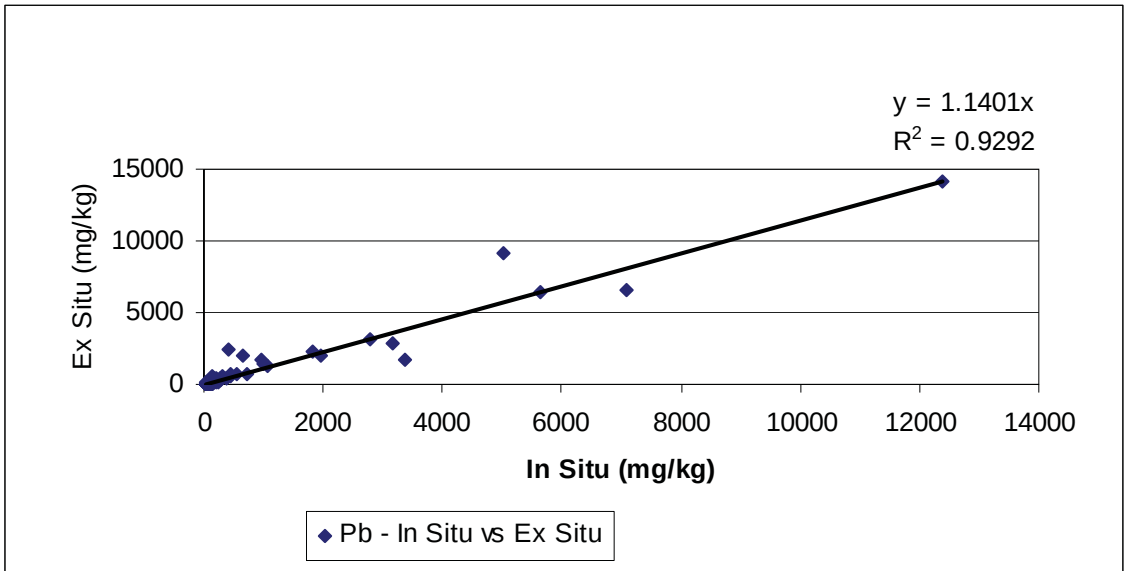
MFG, Inc. *consulting scientists and engineers*	FIGURE 8 LEAD EX-SITU XRF < 5000 VS LAB CORRELATION	Date: February 2008 Project: P:\010156…\CN DTR FLD File: CORRELATIONS.ppt



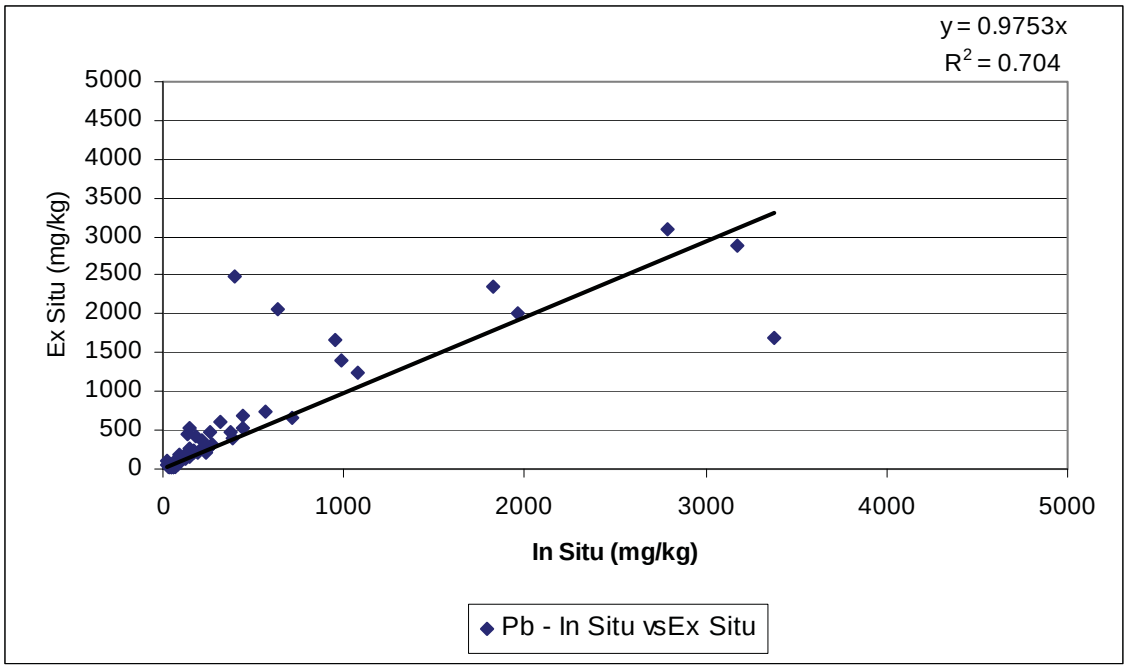
MFG, Inc. *consulting scientists and engineers*	FIGURE 9 ARSENIC EX-SITU XRF VS. LAB CORRELATION	Date: February 2008 Project: P:\010156…\CN DTR FLD File: CORRELATIONS.ppt



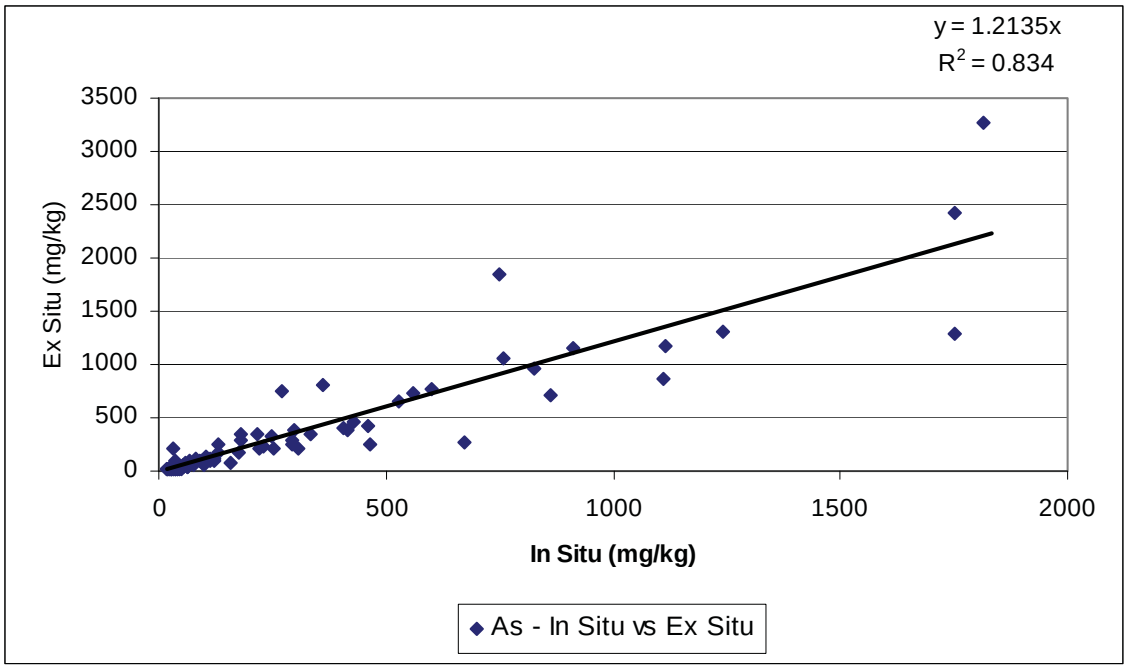
MFG, Inc. *consulting scientists and engineers*	FIGURE 10 ARSENIC EX-SITU XRF < 1500 VS LAB CORRELATION	Date: February 2008 Project: P:\010156…\CN DTR FLD File: CORRELATIONS.ppt



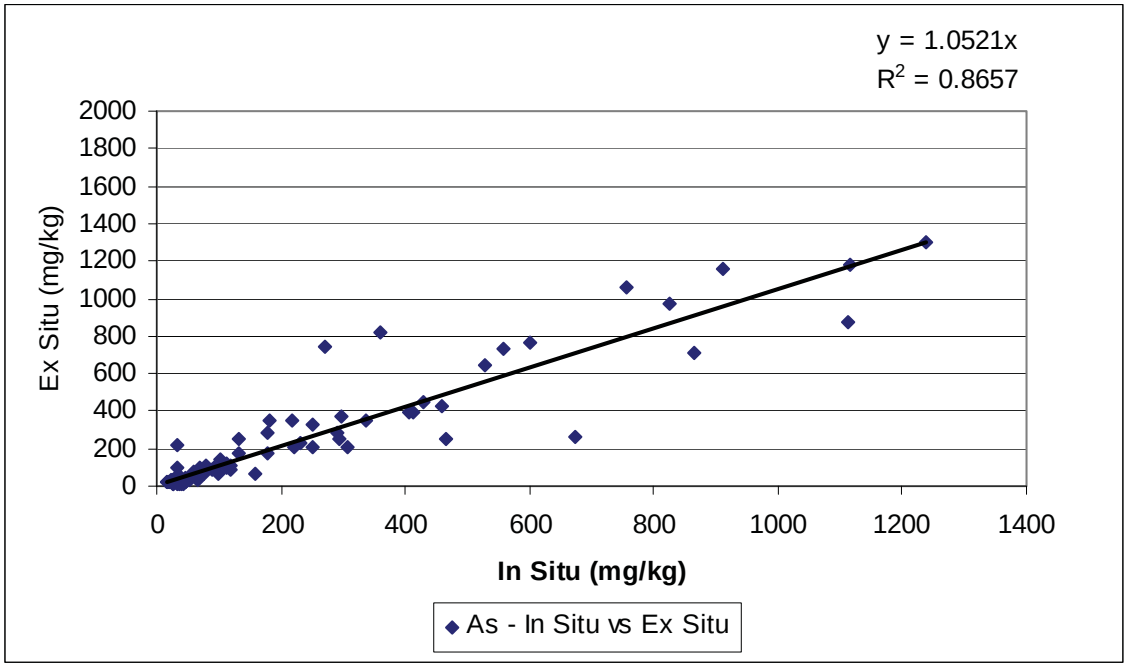
MFG, Inc. *consulting scientists and engineers*	FIGURE 11 LEAD IN-SITU VS. EX-SITU XRF CORRELATION	Date: February 2008 Project: P:\010156…\CN DTR FLD File: CORRELATIONS.ppt



MFG, Inc. *consulting scientists and engineers*	FIGURE 12 LEAD IN-SITU < 5000 VS EX-SITU XRF CORRELATION	Date: February 2008 Project: P:\010156…\CN DTR FLD File: CORRELATIONS.ppt



MFG, Inc. *consulting scientists and engineers*	FIGURE 13 ARSENIC IN-SITU VS. EX-SITU XRF CORRELATION	Date: February 2008 Project: P:\010156…\CN DTR FLD File: CORRELATIONS.ppt



MFG, Inc. *consulting scientists and engineers*	FIGURE 14 ARSENIC IN-SITU < 1500 VS EX-SITU XRF CORRELATION	Date: February 2008 Project: P:\010156…\CN DTR FLD File: CORRELATIONS.ppt

Additional Attachments are On-File with the Department of Parks and Recreation and on their Website:

http://www.parks.ca.gov/?page_id=981

Appendix C-3:
Conveyance Corridor 2008 Work Plan

FINAL
CONVEYANCE CORRIDOR
2008 WORK PLAN
EMPIRE MINE STATE HISTORIC PARK
JUNE 2008

Prepared by:

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I certify under penalty of law that I have examined and am familiar with this Work Plan, and to my knowledge, the report is true, complete, and accurate.

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Appendix A Conveyance Corridor Sampling and Analysis Plan

1.0 PURPOSE

This 2008 Work Plan for the Conveyance Corridor (Work Plan) at the Empire Mine State Historic Park (Park) describes the characterization and evaluation work for the Conveyance Corridor to be started in 2008 with the subsequent remedial actions analysis and development of an implementation plan for any remedial action scheduled to be conducted in 2009. The goal of this work is to complete the identified field investigations, evaluate the data as it applies to the Conceptual Site Model (CSM), assess remedial action alternatives, and implement any action(s) that may be identified for the area.

The work that will be performed pursuant to this Work Plan includes the following:

- Collection of characterization data to delineate the presence of tailing and waste rock materials and associated metal concentrations in the Conveyance Corridor. These data will be used to define the Conveyance Corridor boundary, and map the distribution of mine and mill materials and associated metal concentrations to better understand the CSM potential release, transport and exposure mechanisms related to the area.
- Completion of a Data Transmittal and Evaluation Report to present and evaluate the data with relationship to the CSM and determine if any additional data is required.
- Completion of a Remedial Actions Alterative Analysis to describe and assess a range of potential alternative remedial actions, and determine any specific action(s) to be implemented for the Conveyance Corridor.
- Development of an Implementation Plan for any remedial action(s) to be implemented.
- Completion of construction activities for any remedial action and development of a Completion Report to document any work efforts.

2.0 SITE DESCRIPTION

The Conveyance Corridor is located west of the Cyanide Plant, which was a component of the ore processing facilities at the Empire Mine. The location of the Conveyance Corridor and the Cyanide Plant at the Park is shown on Figure 1. During operation of the Cyanide Plant, gold was recovered from finely stamped ore by cyanide leaching. The tailing produced by this operation apparently were hydraulically transported to the Sand Dam area through the Conveyance Corridor, which follows the natural drainage downgradient of the Cyanide Plant. Residual deposits of tailing and, possibly, other mine and mill related materials exist within the Conveyance Corridor. Public access to the Conveyance Corridor is excluded by fencing. Only Park employees and other authorized personnel with the appropriate level of safety and health training are allowed access. The exclusion fencing will remain in place at least until evaluations are completed and identified work actions have been implemented.

2.1 Existing Data

A number of investigations have reported elevated metal concentrations (primarily arsenic and lead) in the Conveyance Corridor sediment and tailing materials. These data are summarized in the Phase I and II Data Gaps reports (MFG, 2006a, 2007a). The upper portion of the Conveyance Corridor, that area within the Cyanide Plant/Adit Project Area (Figure 2), was previously characterized in the work conducted as part of the Cyanide Plant and Adit Project Area Work Plan (MFG, 2008a).

Investigations conducted within the Park in 2006 and 2007 (MFG, 2006b, 2006c, 2008b) indicate that elevated concentrations of arsenic and lead, and in some instances cadmium, are commonly associated with tailing and waste rock materials. Based on these data, the occurrence of elevated concentrations of arsenic and lead, and to a lesser extent, cadmium, are reliable indicators of tailing and waste rock materials. In addition, mercury was used in the stamp milling process, and may be present in tailing. As such, these metals (arsenic, lead, cadmium, and mercury) will be analyzed for samples collected under this Work Plan as indicators of mine and mill materials.

Storm water monitoring station CC-1 was established in 2007 to examine storm water quality and flow conditions associated with the Conveyance Corridor (MFG, 2007b). In addition, storm water monitoring has been conducted within the Conveyance Corridor as part of the Industrial Storm Water Pollution Prevention Plan (DPR, 2007). Monitoring station CC-1 is located at the Old Hardrock Trail crossing at the Sand Dam. Conditions monitored during the 2007/2008 winter (wet) season identified that the Conveyance Corridor flows are intermittent, primarily dependent upon precipitation conditions associated with the wet season. Surface water quality monitoring at CC-1 during this period indicated that dissolved metal concentrations for aluminum, cadmium, copper, lead, and zinc exceeded the California Toxics Rule

(CTR) criteria for freshwater aquatic life. A spring or seep was also identified within the Conveyance Corridor (MFG, 2006a).

2.2 Conceptual Site Model and Data Gaps Identification

A conceptual site model (CSM) was developed for the Park (MFG, 2006a, 2007a) to describe potential release mechanisms, transport pathways, and exposure routes to receptors. Application of the CSM to the Conveyance Corridor indicates that the primary potential release mechanisms for metals from mine and mill materials are erosion by storm water runoff during periods of high precipitation and chemical weathering (MFG, 2007a). Wind erosion is a less likely release mechanism where surficial materials are covered with vegetation and organic litter and the area is protected from wind by large trees and understory vegetation.

The potential transport mechanisms (MFG, 2007a) for the Conveyance Corridor that could result from the potential release mechanisms of chemical weathering, water erosion and short-term wind erosion are:

- Storm water runoff;
- Leaching of metals and acidity to water resources following chemical weathering of tailing and waste rock materials; and
- Uptake of metals by plants growing in tailing and waste rock materials.

The potential exposure routes (MFG, 2007a) from these potential transport pathways for the Conveyance Corridor are:

- Dermal contact and incidental ingestion of mine and mill materials;
- Consumption of plants growing in tailing and waste rock materials; and
- Inhalation of airborne tailing or waste rock particulates.

The potential receptors for these areas include:

- Park visitors;
- Park docents;
- Park volunteers;
- Park employees; and
- Ecological.

The Data Gaps analysis report (MFG, 2007a) concluded that data are necessary to determine the full areal extent of the presence of mine and mill materials and associated potential for elevated metal concentrations in the Conveyance Corridor. The characterization portion of this Work Plan is designed to

fill these data gaps by identifying areas of mine and mill materials and obtaining metal concentration data; thus, providing information to update the CSM and determine if remedial action(s) may be necessary for this area.

3.0 CHARACTERIZATION

The purpose of the characterization work is to determine the presence of mine and mill materials in the Conveyance Corridor and delineate those materials through collection of field descriptions and data on metal concentrations, acid generation potential, and extractability of metals. These data will be used to update the CSM and determine if remedial action(s) may be necessary for the Conveyance Corridor.

The Conveyance Corridor is approximately 600 feet in length extending from the Cyanide Plant/Adit Project Area to the Hard Rock Trail, and encompasses an area of approximately 3.5 acres (Figure 2). To determine the presence of tailing and waste rock materials, the following combination of field analyses, field sampling, and laboratory analyses will be used:

- Field survey for visual identification of tailing and waste rock materials, such as deposits of tailing, waste rock, and mixtures of these materials with native soils;
- Field in-situ X-ray fluorescence (XRF) measurements of arsenic and lead concentrations in surface and subsurface materials;
- Collection of surface and subsurface samples for ex-situ XRF measurement of arsenic and lead;
- Collection of surface and subsurface samples for laboratory analysis of CAM-17 metals;
- Collection of surface and subsurface samples for laboratory analysis of weak-acid dissociable (WAD) cyanide;
- Collection of surface and subsurface soil samples for laboratory analysis of acid base accounting (ABA) and paste pH analyses; and
- Collection of surface and subsurface soil samples for laboratory analysis of State of California modified Waste Extraction Test (DI WET);
- Collection of vegetation samples for laboratory analysis of metals content; and
- Field survey during the wet season to identify and characterize the water quality of any springs or seeps that exist within the Conveyance Corridor.

Table 1 provides a summary of the estimated numbers of solid material samples to be collected for each type of analysis. Samples for laboratory geochemical analysis of CAM-17 metals, WAD cyanide, ABA, and modified DI WET testing will be analyzed by a designated California-certified analytical laboratory, following the chain-of-custody protocol described in Appendix A. The details of the Sampling and Analysis Plan are provided in Appendix A and include operation procedures for the field XRF instrument and sampling and analytical procedures. A California Department of Parks and Recreation (DPR) archeologist and biologist will be present to observe sampling activities, as determined necessary.

Table 1 Estimated Numbers of Solid Samples and Analyses for Characterization of the Conveyance Corridor

Sample Type	Field In-Situ XRF for Total As and Pb	Number of Samples Collected	Ex-Situ XRF for Total As and Pb	Laboratory Analyses and Tests		
				CAM-17 Metals and WAD CN	ABA and Paste pH	DI WET
Surface materials (0-2 inches)	36	8	8	8	4	4
Shallow subsurface materials (2-24 inches)	0	8	0	8	4	4
Deep subsurface materials (2-8 feet)	0	12	0	12	6	6
Estimated Totals	36	28	8	28	14	14

3.1 Sampling Area Definition

The approximate area of the Conveyance Corridor is shown on Figure 2. The exact boundary of the sampling area will be delineated and mapped in the field using GPS prior to conducting field work. This final boundary of the area will be the basis for field in-situ XRF measurements and sampling for ex-situ XRF and laboratory analyses.

3.2 Material Characterization

The material characterization work will consist of a visual survey, performing in-situ XRF measurements of the surface, and collecting surface and subsurface samples for ex-situ XRF and laboratory analysis. The analytical methods and sampling plan are described in the following sections.

3.2.1 Surface Material Visual Survey

A visual survey will be performed to identify and map areas of tailing and waste rock materials and to define the overall physical condition and configuration of the surface materials. The visual survey will document textures and potential presence of deposits of tailing or mixtures of tailing with organic soils, presence of defined storm water drainage paths, and vegetative cover.

3.2.2 Surface Material Field In-Situ XRF Measurements

Field in-situ XRF measurements will be performed to determine metal concentrations in the surface materials (top 2 inches) and confirm the presence or absence of tailing and waste rock materials in the area outlined during the visual survey. The XRF measurements will focus on analysis of arsenic and lead concentrations because these two metals have been found to be reliable indicators of mine and mill materials (MFG, 2006b).

The field in-situ XRF measurements will be conducted within the Conveyance Corridor on a grid with approximately 50-foot intervals between sample locations. To develop this grid, measurements will first

be made for a central transect along the long axis of the area. Measurements will then be made on transects perpendicular to the long axis at 50-foot intervals to the outer edge of the approximate area determined from the field visual survey. The 50-foot sampling grid should result in about 36 field in-situ XRF measurements of arsenic and lead concentrations in the surface materials (Table 1). Additional field in-situ XRF measurements may be made at the discretion of the field team to ensure that the entire area and the various types of materials present (based on color and texture) are characterized.

3.2.3 Surface Material Sampling for Ex-Situ Analyses

Surface samples (0-2 inch depth) will be collected from 20 percent of the field in-situ XRF measurement locations (eight samples based on the anticipated 36 measurements) for both ex-situ XRF measurements and laboratory analysis. The samples will be systematically collected at every fifth in-situ XRF measurement location, such that the collected samples are representative of the lateral extent of the Conveyance Corridor. Additional samples will be collected as deemed necessary by the field team to ensure that samples are collected of the various types of materials present (based on color and texture) and metals concentration range. The samples will be analyzed for arsenic and lead by ex-situ XRF after sieving of the samples according to EPA Method 6200 (Appendix A).

The surface samples (about eight samples) will be submitted for laboratory analysis of CAM-17 metals and WAD cyanide. The laboratory CAM-17 metals analyses will be used as a confirmatory check of the XRF results and also to provide concentration data for other potential indicators of tailing and waste rock materials (cadmium and mercury) that can not be or are not reliably measured at low concentrations with the XRF instrument. The analytical metal results for all the samples will be used to calibrate the field in-situ XRF measurements, using the calibration procedure developed during the 2006 Trails Priority Action work (MFG, 2006b).

Samples of surface soils (0 to 2 inches) from four locations will be submitted for laboratory analyses of ABA, paste pH, and DI WET (Table 1). These additional samples will be a subset of the samples analyzed for total metals and also judged to be representative of different material types (e.g., tailing, waste rock, soil) and range in arsenic concentrations determined by field in-situ XRF.

3.2.4 Subsurface Material Sampling

3.2.4.1 Shallow Subsurface Sampling

Shallow subsurface samples are defined as samples collected from depths of 2 to 24 inches. Shallow subsurface samples will be collected at the locations where surface samples are collected (about eight sample locations). Laboratory analysis of all the subsurface samples collected will be performed for

CAM-17 metals and WAD cyanide. A minimum of four shallow subsurface samples will be submitted for laboratory analyses of ABA, paste pH, and DI WET (Table 1).

3.2.4.2 Deep Subsurface Sampling

Deep samples (greater than 24 inches) will be collected from test trenches located on four transects spaced at approximately equal intervals along the length of the Conveyance Corridor. Three test trenches will be located on each transect where surface deposits of mine and materials are evident and co-located, to the extent possible, with surface and shallow subsurface sampling locations selected for laboratory analyses of total metals. The trench locations will be determined following the completion of the visual survey and surface in-situ XRF testing. The trenches will be located subject to physical access limitations and to minimize disturbance to vegetation. A Park archeologist will be present to observe trench excavations.

The trenches will be excavated to a minimum depth of four feet and until native material is observed up to a maximum depth of approximately eight feet (anticipated maximum excavation depth for a backhoe). A minimum of one sample will be taken from each trench. The deep subsurface samples will be submitted for laboratory analysis of CAM-17 metals and WAD cyanide. Approximately 12 total samples will be collected from the test trenches (Table 1).

Six of the deep subsurface samples will be analyzed for ABA, paste pH, and DI WET (Table 1). These additional samples will be a subset of the samples analyzed for CAM-17 metals and also judged to be representative of different material types (e.g., tailing, soil plus tailing, waste rock). The samples selected for DI WET will be analyzed for CAM-17 metals.

3.3 Vegetation Sampling

Plant tissue samples (current year leaf growth) will be collected from the following species: grass (composite of species), *Salix* sp. (willows), *Juncus* sp. (rush), *Quercus* sp. (oak), and *Rubus discolor* (Himalayan blackberry), if present. Three samples from each species will be collected, and each sample will be co-located as close to a soil sample location as possible, to correlate soil metals concentrations with plant tissue concentrations. The tissue samples will be washed, dried and weighed, and submitted for laboratory analysis of total metals.

3.4 Spring and Seep Survey

A reconnaissance survey will be performed to identify any springs or seeps that may exist within the Conveyance Corridor. If identified, the location coordinates of the springs or seeps will be mapped in the

field using GPS. If flowing, a water sample of each identified spring or seep will also be collected for laboratory analysis.

3.5 Analytical Methods

A summary of the analytical methods for the samples are provided in the following paragraphs. The Sampling and Analysis Plan provided in Appendix A describes the procedures for XRF analysis and instrument operation, sample collection, and laboratory analysis.

3.5.1 XRF Measurements

The XRF measurements will be conducted with a NITON XRF 700 Series instrument that uses a cadmium (Cd-109) radioisotope source for the measurement of inorganic metal concentrations. The field in-situ XRF measurements are performed directly on the soil surface. The procedure for ex-situ analyses with the XRF instrument is similar to the field in-situ procedure but is performed on a collected sample that is dried (if determined necessary) and sieved prior to measurement according to EPA Method 6200.

3.5.2 Total Metals

Laboratory analyses for total metal and WAD cyanide concentrations in soil samples will be conducted according to EPA Test Methods for Evaluating Solid Waste, Revised Methods SW-846. According to this method, samples are sieved and then digested for metals analysis by Method 3050. The digestants are then analyzed for metal concentrations by EPA methods. WAD cyanide is analyzed by Standard Method 4500 CN I. Dried vegetation samples will be ground prior to digestion by Method 3050 for metals analysis. Table 2 identifies the constituents and method detection limits.

3.5.3 Modified State of California Waste Extraction Test

The California modified WET procedure is intended to provide a measure of the reactivity of solid samples to release metals to solution. The modified WET procedure involves leaching 50 grams of a solid material with an equivalent volume of deionized water for 48 hours (Department of Toxic Substances Control in Title 22, California Code of Regulations, Division 4.5, Chapter 11, Appendix II). After 48 hours, the leachate is collected and passed through a 0.45-µm filter, preserved, and analyzed for dissolved metal concentrations.

3.5.4 Acid Base Accounting and Paste pH

Acid base accounting (ABA) and paste pH analyses are useful for assessing the potential for chemical weathering to mobilize metals through the generation of acidity from metal sulfide oxidation or reduce metal mobility through the generation of alkalinity from the dissolution of carbonate minerals. ABA analyses involve determinations of the acid generation potential (AGP) and acid neutralization potential

(ANP) according to EPA Method 600\2-078-54 (Sobek and others, 1978). The AGP will be evaluated by the LECO (modified Sobek) method, which provides the sulfur forms (non-extractable, pyritic, and sulfate sulfur) including total sulfide sulfur. The difference between the ANP and AGP gives the net neutralizing potential (NNP), which provides a measure of the long-term potential for acid generation or acid neutralization. The paste pH is determined for a 50:50 mixture of soil and water according to EPA Method 600\2-078-54 and provides a qualitative measure of the presence of readily available acidity (Sobek and others, 1978).

3.5.5 Spring or Seep Water Quality Analysis

Water samples will be collected from any identified springs or seeps, if flowing, and submitted for laboratory analysis for the parameters listed in Table 3. Both the total and dissolved forms of the metal constituents will be analyzed. The samples will be analyzed by a California-certified analytical laboratory (NELAP accredited). Sample collection, sampling handling, analytical, and quality assurance/quality control (QA/QC) procedures will be consistent with generally accepted practices and EPA guidance, as presented in the attached Field Sampling Plan (Attachment A).

Table 2 Sample Parameters, Analysis Methods and Method Detection Limits for Solid Samples

Parameter	Analytical Method	Target Method Detection Limit (mg/Kg)
Antimony	EPA 6010	2
Arsenic	EPA 6010	2.5
Barium	EPA 6010	0.2
Beryllium	EPA 6010	0.2
Cadmium	EPA 6010	0.2
Chromium	EPA 6010	0.6
Cobalt	EPA 6010	0.6
Copper	EPA 6010	1
Lead	EPA 6010	0.75
Mercury	EPA 7470	0.02
Molybdenum	EPA 6010	0.8
Nickel	EPA 6010	1
Selenium	EPA 6020	4
Silver	EPA 6010	0.5
Thallium	EPA 6010	1.5
Vanadium	EPA 6010	0.5
Zinc	EPA 6010	1
WAD Cyanide	SM 4500 CN I	0.01

Table 3 Parameter List for Analysis of Water Quality Samples

Analyte	
Metals (total and dissolved)	Aluminum, Antimony, Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Thallium, Vanadium, Zinc
Major cations and anions (dissolved)	Calcium, Magnesium, Potassium, Sodium, Chloride, Bicarbonate, Carbonate, Total Alkalinity, Nitrate/Nitrite, Sulfate, Silica, WAD Cyanide
General inorganic chemistry	pH, Conductivity, Total Dissolved Solids, Total Suspended Solids, Hardness
Field Parameters	pH, Conductivity, Temperature

4.0 ACTION PLAN

The Action Plan is comprised of four major components:

- A combined Data Transmittal and Evaluation Report;
- A Remedial Actions Analysis Report;
- An Implementation Plan Report; and
- A Completion Report.

The activities associated with these elements are described in the following sections.

4.1 Data Transmittal and Evaluation Report

The purpose of the Data Transmittal and Evaluation Report is to:

- Present and evaluate field and laboratory data, summarizing the results of the field investigation of conditions in the Conveyance Corridor, including a description of the area characterized.
- Update the CSM specific to the Conveyance Corridor with the additional field investigation data, and current and anticipated future land use.
- Determine if additional characterization data is required.
- Present a range of applicable action alternatives associated with the Conveyance Corridor.

4.2 Remedial Actions Analysis Report

The purpose of the Remedial Actions Analysis Report is to evaluate the range of applicable action alternatives, and to refine the action(s) recommended to be implemented to address identified exposure pathways from elevated metal concentrations associated with tailing and waste rock materials. The specific components of the Remedial Actions Analysis Report include:

- Refinement of the analysis of action(s) to address transport pathways and/or exposure pathways to elevated metal concentrations associated with tailing and waste rock materials.
- Evaluations of the alternative actions based on the effectiveness, permanency, and cost of the various specific actions.

Examples of remedial action(s) potentially applicable to the Conveyance Corridor include one or a combination of the following:

- No action. If the site characterization and data interpretation indicate that a specific area is not affected by tailing or waste rock materials, then no action would be appropriate.
- Placement of covers where appropriate. This action could involve covering with a vegetated soil cover or an engineered cover containing clean fill and infiltration barriers.
- In-situ vegetation of the tailing surface.

- Use of institutional controls (fencing, signs, etc.) to prevent access. This action would involve the installation and maintenance of fences and signage to prevent public access to certain areas of the Conveyance Corridor or areas that cannot be mitigated because of specific Park uses (i.e., cultural and natural resource).
- Areas of cover would be re-vegetated with native plants.
- Removal of the tailing and/or the waste rock materials from the Conveyance Corridor.

These and possibly other remedial action(s) would be considered and refined based upon site-specific conditions and uses, effectiveness in eliminating potential transport mechanisms and exposure routes to tailing and waste rock materials, attaining Park user needs, and cost.

4.3 Implementation Plan

An Implementation Plan will be developed for the preferred action, if determined necessary. The purpose of the Implementation Plan is to present the engineering design for the preferred remedial action. The Implementation Plan will include the following components:

- Description of the action components (e.g., vegetation removal, grading, cover, seeding, drainage);
- Design analyses;
- Engineering plans and specifications;
- Construction schedule;
- Construction erosion control;
- Construction Storm Water Pollution Prevention Plan;
- Construction quality assurance plan;
- Procedures for design and construction modifications;
- Project organization and personnel; and
- Health and safety plan.

The implementation plan will also provide the basis for developing contractor bid packages.

4.4 Completion Report

A Completion Report will be submitted within 120 days of completion of any construction activities. The purpose of the Completion Report is to provide the following:

- Documentation of construction activities for the action;
- Operation and Maintenance plans for the constructed components;
- Description of any future land-use restrictions relevant to Park operation that may need to be taken into account because of the action; and
- Documentation that the constructed actions have achieved the performance objectives.

5.0 SCHEDULE

The schedule for this work is to complete field work and laboratory analysis by the end of 2008. The Data Transmittal and Evaluation Report will be submitted to the Department of Toxic Substances Control and the Central Valley Regional Water Quality Control Board within 120 days of receiving the final laboratory analysis. The Remedial Actions Analysis Report will be completed following submittal of the Data Transmittal and Evaluation Report within 60 days of receiving the necessary cultural, biological and land use surveys from DPR. The Implementation Plan, if necessary, will be prepared following agency review of the Remedial Actions Analysis Report. A Completion Report will be prepared and submitted within 120 days of completion of the any action construction. The schedule is dependent upon timely review and approval and completion of the CEQA process.

6.0 REFERENCES

DPR (California Department of Parks and Recreation), 2007. Industrial Storm Water Pollution Prevention Plan Including Monitoring and Reporting Requirements for California State Parks, Empire Mine State Historic Park, 2007-2008 Season. Prepared by DPR, Northern Service Center and Revised by Burleson Consulting, Inc. October.

MFG, Inc. (MFG), 2006a. Data Gaps Report for the Empire Mine State Historic Park Phase 1: Existing Data. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. December.

MFG, Inc. (MFG), 2006b. Data Transmittal and Addendum for the Trails 2006 Priority Action Work Plan, Empire Mine State Historic Park. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. December.

MFG, Inc. (MFG), 2006c. Data Transmittal Report for the Red Dirt Pile Priority Action Work Plan, Empire Mine State Historic Park. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. December.

MFG, Inc. (MFG), 2007a. Data Gaps Report for the Empire Mine State Historic Park Phase 2: Data Gaps Analysis. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. January 15.

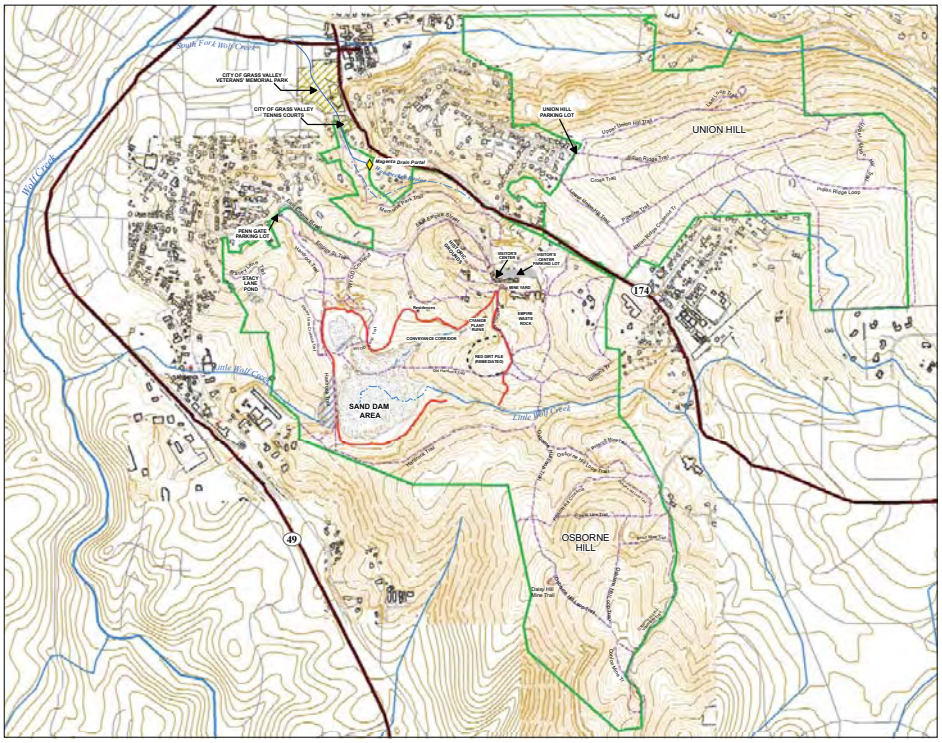
MFG, Inc. (MFG), 2007b. Surface Water Monitoring, 2007 Work Plan, Empire Mine State Historic Park. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. June 22.

MFG, Inc. (MFG), 2008a. Data Transmittal Report for the Cyanide Plant and Adit Project 2007 Action Work Plan, Empire Mine State Park. February 19.

MFG, Inc. (MFG), 2008b. Osborne Hill Area Trails Data Evaluation and Alternative Action Analysis Report, Empire Mine State Park. April 21.

Sobek, A.A., W.A. Schuller, J.R. Freeman, and R.M. Smith, 1978. Field and laboratory methods applicable to overburden and minesoils, EPA 600/2-78-054, 203pp.

FIGURES



LEGEND

- PARK BOUNDARY
- PARK TRAILS
- HISTORIC GROUNDS AREA
- CLOSED AREA

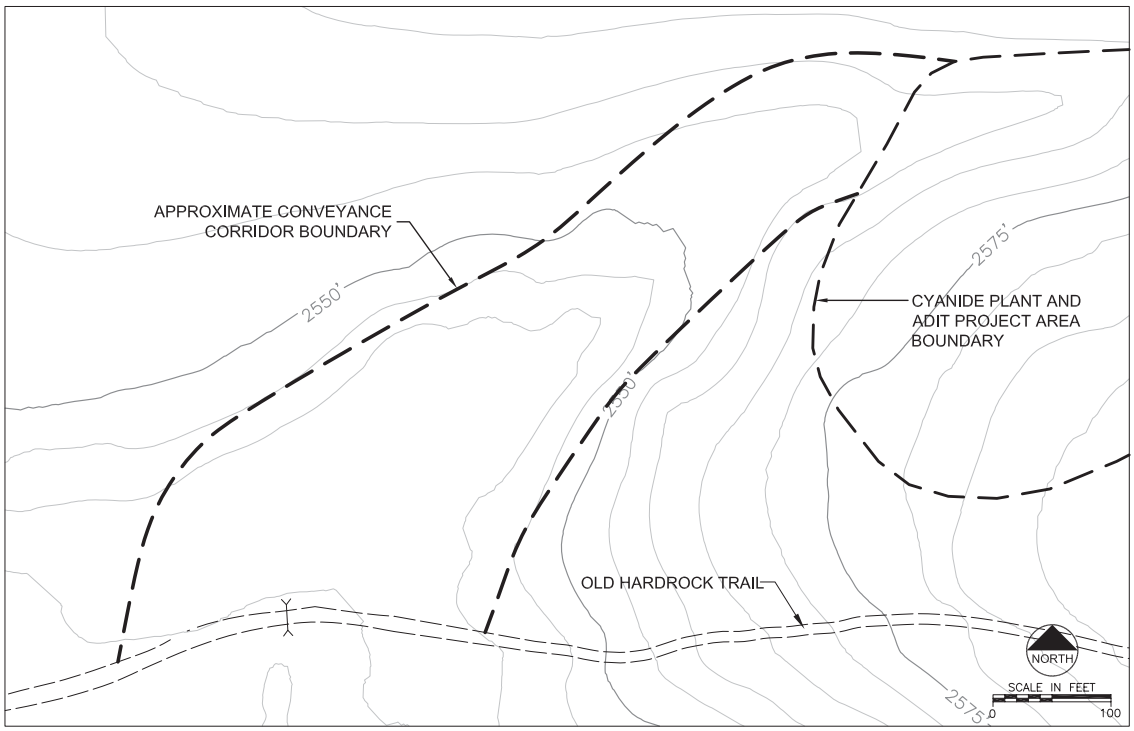
NORTH

0 Feet 2,000

Notes:
Coordinates in NAD 1983 StatePlane California II FIPS 0402

FIGURE 1
EMPIRE MINE STATE HISTORIC PARK
SITE FEATURES

MFG, Inc *consulting scientists and engineers*	Date: JUNE 2008
	Project: 180156
	File: 2008EmpireMineSiteFeatures.mxd



MFG, Inc. *consulting scientists and engineers*	FIGURE 2 CONVEYANCE CORRIDOR AREA	Date: MAY 2008
		Project: 180156
		File: FIG-CONV-01

Additional Attachments are On-File with the Department of Parks and Recreation and on their Website:

http://www.parks.ca.gov/?page_id=981

Appendix C-4:
Sand Dam Area 2009 Data Transmittal Report

DATA TRANSMITTAL AND EVALUATION REPORT
FOR THE
SAND DAM AREA
2008 ACTION WORK PLAN

FEBRUARY 2009

Prepared by:

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I certify under penalty of law that I have examined and am familiar with this report, and to my knowledge, the report is true, complete, and accurate.

PROFESSIONAL GEOLOGIST
KEITH STEVEN THOMPSON
No. 5572
STATE OF CALIFORNIA

Keith Steven Thompson, California Professional Geologist

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Attachment D	Correlation of XRF and Laboratory Concentrations for Arsenic and Lead

1.0 PURPOSE

This Data Transmittal and Evaluation Report presents field and laboratory data from sampling at the Sand Dam Area at the Empire Mine State Historic Park (SHP), Grass Valley, California in accordance with the *Sand Dam 2008 Work Plan* (Work Plan) (MFG, 2008a). The purpose of this work is to delineate potential mine and mill materials (waste rock and tailing) within the Sand Dam Area and characterize those materials through collection of field data for metal concentrations, acid generation potential, and metal(s) solubility. Investigations in the Sand Dam Area (Area) included the delineation of the tailing and waste rock materials by performing field in-situ and X-ray fluorescence (XRF) analysis of surface material samples, collecting surface and subsurface materials for further analysis, collecting vegetation samples for laboratory analysis of total metals concentrations, and collecting surface water sampling for laboratory analysis of water quality. These data are evaluated as they apply to the Conceptual Site Model (CSM).

2.0 SUMMARY OF SAMPLE COLLECTION ACTIVITES

In accordance with the Work Plan, the following sampling activities were completed at the Sand Dam Area:

- Visual survey and characterization of surface materials, including visual identification of potential mine and mill materials (waste rock and tailing);
- Performing field in-situ XRF measurements of arsenic and lead concentrations of surface materials (tailing and/or soil). In-situ XRF measurements were performed on a 100-foot by 200- foot grid;
- Collecting surface (0 to 2-inch depth) and shallow subsurface (2 to 24-inch depth) material samples at twenty percent of the in-situ XRF measurements locations for ex-situ XRF analysis of arsenic and lead concentrations, and laboratory analysis of the samples for selected metals (arsenic, cadmium, lead, and mercury). Selected samples were also analyzed for CAM-17 metal concentrations, weak-acid dissociable (WAD) cyanide, acid-base accounting (ABA) and paste pH, and State of California Modified Waste Extraction Test (DI WET) CAM-17 metal and WAD cyanide concentrations;
- Collecting subsurface samples from boreholes for laboratory analysis of CAM-17 metals, WAD cyanide, DI-WET metal and WAD cyanide concentrations, ABA, and paste pH;
- Collecting surface and subsurface samples from two waste rock embankments for laboratory analysis of CAM-17 metals, WAD cyanide, DI-WET CAM-17 metals, ABA, and paste pH;
- Collecting vegetation samples for laboratory analysis of CAM-17 metals;
- Installing piezometers in boreholes where water was encountered for monthly water level measurements; and
- Collecting monthly water samples from the underflow drainage at the toe of the main embankment for laboratory analysis.

Material sampling activities were performed in September 2008 by MFG, Inc. Figure 1 identifies the material sampling locations for the Sand Dam Area. Table 1 summarizes the number of field in-situ XRF measurements and the number of material samples collected for each type of laboratory analysis. Monthly water sampling of the underflow drainage and monthly monitoring of piezometer water levels began in September 2008. Laboratory analysis of the material samples was performed by SVL Analytical (SVL), in Kellogg, Idaho. Laboratory analysis of the water quality samples was performed by ACZ Laboratories (ACZ), in Steamboat Springs, Colorado. SVL and ACZ are accredited (NELAP) by the California Department of Public Health Services. The certified laboratory analytical reports and chain of custody records for the samples are provided in Attachment A.

2.1 Visual Survey and Characterization

A visual survey was performed to identify and delineate the extent of surface mill tailing and waste rock materials, to define the overall physical condition and configuration of the surface materials, and to define the boundary of the Sand Dam sampling area. The Sand Dam area and associated tailing footprint is approximately 28 acres and is approximately 1,900 feet long and 1,800 feet wide at its longest and widest dimensions (Figure 1). Based on observations of materials during surface sampling and subsurface sampling from boreholes, the majority of the Sand Dam Area materials consist of gray sandy tailing. The estimated volume of tailing in the Sand Dam Area is approximately 720,000 cubic yards. The Sand Dam Embankment and the North Sand Dam Embankment (Figure 1) are constructed of waste rock. Waste rock comprising the surface of the Sand Dam Embankment consists of diabase with minor visible sulfide mineralization and oxidation products. The Sand Dam Embankment footprint is approximately three acres and is approximately 875 feet long, 325 feet wide, and 70 feet high at its longest, widest, and highest dimensions. The Sand Dam Embankment was constructed from approximately 390,000 cubic yards of waste rock. The North Embankment separates the northwestern section of the Sand Dam tailing from the main body of the Sand Dam tailing. Waste rock comprising the North Embankment consists of diabase with quartz and/or calcite with minor visible sulfide mineralization and oxidation products. The North Embankment footprint is approximately 0.23 acres and is approximately 260 feet long, 30 feet wide, and 10 feet high. The North Embankment is estimated to contain approximately 2,200 cubic yards of waste rock.

Little Wolf Creek flows into the Sand Dam Area and exits through an outlet spillway at the southwest end of the Sand Dam Embankment. Seasonal ponding occurs near the outlet spillway during the wet season. An underflow drainage flows from the embankment toe near the vicinity of the Sand Dam outlet spillway. The tailing surface was dry during the sampling activities. The plant communities in the area were described in a previous characterization report (MFG, 2008b) and are primarily composed of hyrdophytic, hydrophtyic/upland transitional, Manzanita steppe, and upland vegetation.

2.2 Surface and Shallow Subsurface Characterization

In-situ XRF surface measurements were performed at a total of 93 locations. In-situ XRF measurements were performed using a portable Niton XRF 702 XLp spectrum analyzer placed directly on the ground surface at 100-foot by 200-foot grid intervals (Figure 1). XRF measurements were performed as described in the Work Plan in accordance with *EPA Method 6200 – Field Portable X-ray Fluorescence*

Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment (U.S. EPA, 2007). Surface (0 to 2-inch depth) and shallow subsurface (2 to 24-inch depth) samples were collected for further analysis at every fifth XRF measurement location, which corresponds to twenty percent of the in-situ XRF locations. A total of 19 surface and 19 shallow subsurface material samples were collected. The surface samples were sieved to less than 0.25 millimeters (mm) and analyzed for arsenic and lead by ex-situ XRF according to EPA Method 6200. Following analysis by ex-situ XRF, the sieved surface samples were then submitted to the laboratory for analysis of total metals, as summarized in Table 1. Six selected surface samples were split prior to sieving and submitted for laboratory analyses of WAD cyanide, ABA, paste pH, and DI WET total metals and WAD cyanide, as summarized in Table 1. The subsurface samples were submitted for laboratory analyses, as summarized in Table 1. Total metals analyses were conducted by the laboratory following EPA method 3050, which includes sieving to less than 2 mm. DI WET analyses were conducted by the laboratory according to California Waste Extraction Test procedures, modified to use deionized water, which includes sieving to less than 2 mm. ABA was conducted according to EPA method 600/2-78-054 (Sobek et al., 1978), which includes crushing the sample to 0.25 mm.

2.3 Borehole Sampling

Five boreholes were drilled by advancing 4.25-inch inside diameter (ID) hollow-stem augers with a CME 850 rubber track drill rig to collect deep subsurface samples within the Sand Dam tailing area (Figure 1). The locations of the boreholes were determined in the field at existing points of access to minimize disturbance to the ground surface and existing vegetation. Boreholes were drilled a minimum of five feet (or until drilling refusal) into the foundation material underlying the tailing. Continuous samples were collected with either split spoon samplers (2 or 2.5-inch ID) advanced with an automatic hydraulic hammer using modified standard penetration test methods or continuous dry auger coring (3-inch ID) methods. Composite samples were collected from the five boreholes according to the Work Plan at intervals of approximately five feet within the tailing and from the underlying foundation material. Discrete samples of the tailing and foundation material were composited in the field. Sample intervals were based on lithology and did not exceed 5-foot intervals. The samples were analyzed for CAM-17 metals, WAD cyanide, ABA, paste pH, and DI WET CAM-17 metals and WAD cyanide, as summarized in Table 1.

The tailing and foundation materials were logged with respect to material type, grain size, color and other observable physical characteristics. Borehole logs are provided in Attachment B. Borehole 1 (SD/B01) was drilled to a depth of 17.5 feet with six composite sampling intervals. Borehole 2 (SD/B02) was

drilled to a depth of 29 feet with four composite sampling intervals. Borehole 3 (SD/B03) was drilled to a depth of 35.5 feet with seven composite sampling intervals. Borehole 4 was located but not drilled as planned in the Work Plan due to restricted access by the presence of nearby riparian vegetation. Borehole 5 (SD/B05) was drilled to a depth of 46.5 feet with nine composite sampling intervals. Borehole 6 (SD/B06) was drilled to a depth of 25 feet with six discrete sampling intervals. Heaving sands were encountered in saturated tailings and caused plugging of the hollow-stem augers. The heaving sand reduced sample recovery. During drilling of boreholes SD/B03 and SD/B05, the heaving sands locked the core barrel within the augers and the augers were removed to free the core barrel. The boreholes collapsed when the augers were removed and a new borehole was re-drilled approximately five feet from the collapsed borehole location. The collapsed boreholes were abandoned with chip bentonite.

Pursuant to the Work Plan, piezometers were installed in three boreholes where subsurface water was encountered in the tailing (SD/B03, SD/B05, and SD/B06 - Figure 1). Heaving tailing sand prevented installation of the bentonite pellets and filter pack at the planned depths in the boreholes, but did not compromise the representativeness of water levels in the piezometers. Completion diagrams are provided in Attachment B. The water levels in the three piezometers were measured following installation, and except for November 2008, have been measured monthly through February 2009,.

2.4 Waste Rock Characterization

One backhoe test pit was excavated in the Sand Dam Embankment and one backhoe test pit was excavated in the North Embankment to characterize the waste rock (Figure 1). Waste rock samples from the embankments were collected at the surface (0 to 6-inch depth) and at a depth of five feet in the Sand Dam Embankment test pit and at a depth of three feet in the North Embankment test pit. The samples were analyzed by the laboratory for CAM-17 metals, WAD cyanide, ABA, paste pH, and DI WET CAM-17 metals, as summarized in Table 1. The test pit logs are provided in Attachment C.

2.5 Vegetation Sampling

Vegetation samples (plant leaf tissue) were collected from three locations co-located to material sample locations within the Sand Dam Area (Figure 1). Three of the five plant species planned for sampling in the Work Plan were present and collected, but not all species were present at each sampling location. The sampled species included *Salix* sp. (willow), *Rubus armeniacus* (Himalayan blackberry) and *Juncus sp.* (rush). A total of eight vegetation samples were collected from the three locations. Samples were washed and dried before laboratory analysis of CAM-17 metals.

2.6 Underflow Drainage Water Sampling

Monthly water quality sampling of the Sand Dam underflow drainage (SDT-1) commenced in September 2008, according to the Work Plan. Flow and field parameters (pH, specific conductance, and temperature) have been measured at the time of sample collection. Samples have been analyzed by the laboratory for metals, major cations and anions, and general inorganic chemistry pursuant to the Work Plan. Laboratory analytical reports of water quality samples are available through January 2009.

3.0 SUMMARY OF XRF AND LABORATORY METALS CONCENTRATION RESULTS

3.1 Surface and Shallow Subsurface Sampling

As described above, in-situ XRF measurements of surface materials for arsenic and lead concentrations were performed on a 100 foot by 200 foot grid in the Sand Dam Area. Surface and shallow subsurface samples were collected at 20 percent of these in-situ XRF measurement locations. The in-situ XRF data for surface samples were correlated to the laboratory results for total arsenic and lead using regression analysis, as described in Attachment D. The in-situ XRF and the laboratory-correlated XRF concentrations for arsenic and lead are presented in Table 2. The arsenic and lead concentrations determined by laboratory-correlated in-situ XRF measurements and laboratory sample analyses are presented on Figures 2 and 3. Results of the XRF and laboratory analyses are described in the following sections.

3.1.1 XRF Analysis

The results of the in-situ and laboratory-correlated XRF analyses for arsenic and lead concentrations are provided in Table 2. Nine of the 93 total laboratory-correlated XRF measurements in the Sand Dam Area were below the detection limit for arsenic of 19 milligrams per kilogram (mg/Kg). The maximum arsenic concentration was 2,274 mg/Kg at location H11+00. The average arsenic concentration of the laboratory-correlated XRF analyses within the area was 279 mg/Kg, and the median was 164 mg/Kg. The maximum lead concentration of the laboratory-correlated XRF analyses was 5,320 mg/Kg at the same location where the maximum arsenic concentration was observed (H11+00). The average lead concentration was 425 mg/Kg, and the median was 289 mg/Kg. Surface material at location H11+00, near the eastern edge of the Sand Dam tailing, consisted of reddish brown silty soil and was located on the eastern edge of the Sand Dam.

3.1.2 Total Metals and WAD Cyanide Laboratory Analysis

As discussed previously, samples were collected at twenty percent of the in-situ XRF measurement locations and analyzed by the laboratory to assess metal content and develop regression curves for the in-situ XRF measurements performed directly on the ground surface for arsenic and lead. A total of 19 surface samples and 19 subsurface samples were collected and submitted to the laboratory for analysis. Of those 38 samples, 26 samples were submitted for selected metals (arsenic, cadmium, lead and mercury) and 12 samples were submitted for CAM-17 metals and WAD cyanide. The total metals and WAD cyanide concentrations of the samples are shown in Table 3. The arsenic and lead concentrations analyzed by the laboratory are shown on Figures 2 and 3.

Laboratory analysis of arsenic concentrations in the surface samples (0 to 2-inch depth) ranged from 14.6 mg/Kg to 793 mg/Kg, averaged 254 mg/Kg, and had a median of 192 mg/Kg. Lead concentrations in the surface samples ranged from 16.2 mg/Kg to 1,070 mg/Kg, averaged 389 mg/Kg, and had a median of 256 mg/Kg. Cadmium concentrations ranged from less than 0.20 mg/Kg to 68.2 mg/Kg, and had an average concentration of 10.9 mg/Kg and a median of 7.9 mg/Kg. Mercury concentrations ranged from 0.160 mg/Kg to 24.2 mg/Kg, averaged 6.4 mg/Kg, and had a median of 3.2 mg/Kg. The maximum arsenic and lead concentrations of surface samples analyzed by the laboratory occurred at location B14+00.

Arsenic, lead, cadmium and mercury concentrations in the shallow subsurface samples (2 to 24-inch depth) were typically less than the surface samples (0 to 2-inch depth). Arsenic concentrations in the shallow subsurface samples (2 to 24-inch depth) ranged from 13.5 mg/Kg to 682 mg/Kg, averaged 162 mg/Kg, and had a median of 105 mg/Kg. Lead concentrations ranged from 11 mg/Kg to 1,060 mg/Kg, averaged 294 mg/Kg, and had a median of 158 mg/Kg. Cadmium concentrations ranged from 0.29 mg/Kg to 35.5 mg/Kg, averaged 4.83 mg/Kg, and had a median of 3.66 mg/Kg. Mercury concentrations ranged from 0.115 mg/Kg to 21.5 mg/Kg, averaged 5.86 mg/Kg, and had a median of 3.29 mg/Kg. The maximum arsenic, lead, and cadmium concentrations in the shallow subsurface samples occurred at location I11+00.

The CAM-17 metal concentrations of the 12 samples (six surface and six subsurface) are provided in Table 3. In addition, the six surface samples and six subsurface samples were analyzed for WAD cyanide (Table 3). The WAD cyanide concentrations of all 12 surface and shallow subsurface samples were below the laboratory detection limit.

3.1.3 Acid Base Accounting and paste pH Analysis

Acid Base Accounting (ABA) and paste pH testing were conducted on a total of six surface and six shallow subsurface samples collected from the Sand Dam Area. The ABA and paste pH results for the samples are provided in Table 4. Acid-base accounting and pH analyses are useful for assessing the potential for chemical weathering to mobilize metals through the generation of acidity from metal sulfide oxidation. Acid-base accounting involves determination of the acid generation potential (AGP) and acid neutralization potential (ANP) according to EPA Method 600/2-078-54 (Sobek and others, 1978). The AGP component of ABA provides information regarding the various forms of sulfur (S) (non-extractable-S, sulfide-S, and sulfate-S), including total-S. The difference between the ANP and AGP is the net neutralizing potential (NNP), which provides a measure of the potential net acid generation or neutralization potential and is presented as tons of calcium carbonate per thousand tons of the analyzed

material (T $CaCO_3$/kT). A measure of the readily-available acidity was carried out using a paste pH analysis (USDA, 1954).

The NNP for the surface samples ranged from -4.8 to 7.2 T $CaCO_3$/kT. The NNP for the shallow subsurface samples ranged from -3.9 to 39.2 T $CaCO_3$/kT. The pH of the samples (surface and shallow subsurface) exhibiting a negative NNP ranged from 4.48 to 6.24. The pH of the samples (surface and shallow subsurface) exhibiting a positive NNP ranged from 6.09 to 8.11.

3.1.4 DI WET Analysis

DI WET analysis was conducted on the same set of samples analyzed for ABA and paste pH (six surface and six subsurface samples). Laboratory analysis of the DI WET leachate was performed for CAM-17 metals and WAD cyanide. The DI WET results are provided in Table 5.

DI WET concentrations of antimony, beryllium, mercury, silver, selenium, thallium, vanadium, and WAD cyanide were below the laboratory detection limits for the surface samples. DI WET concentrations of chromium, selenium, thallium, and WAD cyanide were below the laboratory detection limits for all the shallow subsurface samples, and the DI WET concentrations of antimony, beryllium, cobalt, nickel, and vanadium were below the laboratory detection limit in five of the six shallow subsurface samples.

3.2 Borehole Sampling

3.2.1 Water Levels

Piezometers were installed in three (SD/B03, SD/B05 and SD/B06) of the five boreholes in the Sand Dam Area where subsurface water was encountered in the tailing. The water level in each piezometer was measured initially following installation and, except for November 2008, has been measured monthly (Table 6) to date. The initial water levels in piezometers SD/B03, SD/B05 and SD/B06 on September 26, 2008 ranged from 12.42 to 24.44 feet below ground surface (bgs). On February 11, 2009, the water levels in the piezometers ranged from 2.29 to 16.00 feet bgs, increasing approximately 9.1 to 11.3 feet from October 2008 to February 2009. According to the Work Plan, water levels will be measured in the Sand Dam piezometers for one year from the date of installation.

3.2.2 Total Metals Analysis and WAD Cyanide

Material samples were collected at discrete intervals in five boreholes within the Sand Dam area. The discrete samples of the tailing and foundation material were composited in the field based on lithology; the interval over which the discrete samples were composited did not exceed five feet. A total of 32

composite samples were collected from the following five boreholes: SD/B01, SD/B02, SD/B03, SD/B05, and SD/B06. A total of six samples were collected from SD/B01, four samples from SD/B02, seven samples from SD/B03, nine samples from SD/B05, and six samples from SD/B06. All samples were submitted for laboratory analysis of CAM-17 metals, WAD cyanide, DI-WET extraction for CAM-17 metals, ABA and paste pH. The total metals and WAD cyanide concentrations for the borehole samples are shown in Table 7.

Thallium and WAD cyanide concentrations were below the laboratory detection limits in all 32 samples. Antimony and selenium concentrations were below the laboratory detection limits in 31 of the 32 samples. The average arsenic concentration for all of the boreholes samples was 41.5 mg/Kg, with a median of 18.2 mg/Kg. The maximum arsenic concentration of 585 mg/Kg occurred in foundation material at borehole SD/B01 (12.5 to 15 feet bgs). The material at this depth consisted of dark brown clayey silt. The average lead concentration was 63.2 mg/Kg, the median concentration was 43.4 mg/Kg, and the maximum lead concentration was 288 mg/Kg (SD/B01 from 10 to 12.3 feet bgs). The material at this depth consisted of wet greenish gray clay (tailing slimes). The average mercury concentration for all of the borehole samples was 0.964 mg/Kg, and the median was 0.468 mg/Kg. The maximum mercury concentration was 5.52 mg/Kg and occurred at the same location as the maximum lead concentration (SD/B01, 10 feet to 12.3 feet bgs). The average cadmium concentration for all the borehole samples was 3.70 mg/Kg and the median was 3.38 mg/Kg. The maximum reported cadmium concentration of 10.9 mg/Kg also occurred at borehole SD/B01 from 10 feet to 12.3 feet bgs. Arsenic, cadmium, lead, mercury, and zinc concentrations were generally lower in the native material samples than in tailing samples from the same borehole.

3.2.3 ABA and paste pH Analysis

The 32 samples from the boreholes were submitted for Acid Base Accounting (ABA) and paste pH analyses. The ABA and paste pH results for the samples are provided in Table 8. The ABA values ranged from <0.3 to 71.1 T $CaCO_3$/kT, and demonstrated a net neutralizing potential in 29 of the 32 samples analyzed. None of the samples submitted for ABA analysis had significant acid generating material. The paste pH for the 32 samples ranged from 5.29 to 8.26. The percentage of total sulfur content for all 32 samples was under 1.5 percent.

3.2.4 DI WET Analysis

The 32 samples from the boreholes were also submitted for DI WET analysis. Laboratory analysis of the DI WET leachate was performed for CAM-17 metals and WAD cyanide. The DI WET results are

provided in Table 9. DI WET WAD cyanide, selenium, silver, and thallium concentrations were below the laboratory detection limits in all of the samples. Beryllium and chromium concentrations were below the laboratory detection limit in 31 of the 32 samples. Cadmium and lead concentrations were below the laboratory detection limit in 30 of the 32 samples. Nickel concentrations were below detection in 29 of the 32 samples.

3.3 Waste Rock Embankment Test Pit Samples

3.3.1 Total Metals Analysis

Surface (0 to 6-inch depth) and subsurface (3 or 5 feet) samples were collected in two test pits: one test pit at the main waste rock embankment (SD) and one test pit at the northern waste rock embankment (SDB) of the interior Sand Dam Area. A total of four waste rock samples were collected, a surface sample and a subsurface sample from each of the two test pits. The total metals and WAD cyanide concentrations for the samples are shown in Table 3.

WAD cyanide, antimony, selenium, and thallium concentrations were below the laboratory detection limits for all four waste rock samples. The maximum arsenic and mercury concentrations were 60.9 mg/Kg and 1.77 mg/Kg, respectively, both at the main waste rock embankment (SD/01/05) at a depth of five feet. The maximum lead concentration of 88.5 mg/Kg occurred in the surface sample at the main waste rock embankment test pit (SD/02/06). The maximum cadmium concentration of 6.78 mg/Kg occurred in the surface sample (SDB/02/06) of the north waste rock embankment.

3.3.2 ABA and paste pH Analysis

Acid Base Accounting (ABA) and paste pH analyses were conducted on the four embankment samples. The ABA and paste pH results for the samples are provided in Table 4. Laboratory results for the four samples demonstrated net neutralizing potential, ranging from 20.8 to 54.1 T $CaCO_3$/kT. None of the samples had significant acid generating potential. The paste pH for the four samples ranged from 6.98 to 7.83. The percentage of total sulfur content for all four samples was less than 0.5 percent.

3.3.3 DI WET Analysis

DI WET testing was also conducted on the four waste rock embankment samples. Laboratory analysis of the DI WET leachate was performed for CAM-17 metals. The DI WET results for the waste rock samples are provided in Table 5. The DI WET antimony, beryllium, chromium, selenium, silver and thallium concentrations were below the laboratory detection limits for the four waste rock samples.

3.4 Vegetation Samples

Laboratory analysis of the plant tissue samples was performed for CAM-17 metals. The results are provided in Table 10. Antimony, arsenic, beryllium, mercury, silver, thallium and vanadium concentrations were below the laboratory detection limits. Chromium and lead concentrations were below laboratory detection in seven of the eight samples. The highest cadmium (24.1 mg/Kg), cobalt (7 mg/Kg), selenium (0.16 mg/Kg), and zinc (448 mg/Kg) concentrations were in willow samples.

3.5 Water Quality Sampling

Monthly water flow and quality monitoring of the Sand Dam underflow drainage (SDT-1) was initiated in September 2008. Table 11 provides a summary of the field water quality parameters (flow, pH, conductivity, and temperature) measured during each sampling event through January 2009. Based on the monthly monitoring of the underflow drainage performed to date, the flow has ranged from 0.039 cubic feet per second (cfs) to 0.41 cfs, the temperature has ranged from 7.8 ^{o}C to 12.4 ^{o}C, the specific conductance has ranged between 332 microsiemens per centimeter (uS/cm) to 428 uS/cm, and the pH has ranged from 6.03 to 7.64. Table 12 provides the laboratory analyses results of the water quality samples collected at SDT-1 through January 2009. A sample collection for WAD cyanide analysis was inadvertently omitted during the initial September sampling event.

4.0 DATA EVALUATION

4.1 Total Metals and WAD Cyanide

Total metal concentrations from the Sand Dam Area were compared to the California Human Health Screening Levels (CHHSLs) for residential and commercial/industrial use (California Environmental Protection Agency [CEPA], 2005) as a conservative screening level assessment to identify potential constituents of concern to human health. If metal concentrations are less than the CHHSLs, then the metal concentrations are considered to be below thresholds for risk to human health. The residential CHHSLs were developed using an exposure scenario of 350 days per year for 30 years, and the commercial/industrial CHHSLs were developed using an exposure scenario of 250 days per year for 20 years. The area is closed to park visitors and access to much of the area is physically challenging due to an extensive understory of Himalayan blackberry. The Old Hardrock Trail transverses a portion of the area, but is currently closed. Future land use in the area is expected to be limited to controlled recreational use, such as hiking or wildlife observation, along established pathways. Given the Park setting, residential uses of the Sand Dam Area do not currently exist and are unlikely to exist in the future. Metals which are less than the residential CHHSLs are therefore conservatively below thresholds for risk to human health and are eliminated as constituents of concern. Furthermore, potential human health exposure to surface materials due to possible future controlled recreational uses in the Sand Dam Area is also considered less than that for the commercial/industrial exposure scenario. As such, metal concentrations less than the commercial/industrial CHHSLs are not considered potential constituents of concern to human health.

A total of 38 surface and shallow-subsurface samples, 4 surface and subsurface waste rock samples, and 32 borehole samples were submitted to the laboratory for total metals analysis. Antimony, barium, beryllium, chromium, cobalt, copper, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc concentrations were all below the residential CHHSLs in all of the samples submitted. These metals are eliminated as constituents of concern to human health. Lead concentrations in all but one of the 93 laboratory-correlated XRF surface measurements were below the commercial/industrial CHHSLs. Mercury and lead concentrations were below the commercial/industrial CHHSLs (180 mg/Kg and 3,500 mg/Kg) in all the samples submitted. Cadmium concentrations exceeded the industrial CHHSL of 7.5 mg/Kg at nine of the surface locations and two of the subsurface locations, as well as one borehole sample. Arsenic concentrations of all samples exceeded both the residential and industrial/commercial CHHSLs.

CAM-17 metals concentrations in plant tissue were within the reported normal range for plants (Kabata-Pendias, 2001), with the exception of cadmium and zinc concentrations. Cadmium and zinc concentrations in all plant tissue samples are below benchmarks based on lowest observed adverse effects levels (LOAELs) for terrestrial wildlife (Sample et al., 1996).

4.2 Acid Base Accounting and Paste pH

Modified Sulfide/Sulfur Acid Base Accounting (ABA) was conducted on 12 samples from the Sand Dam Area (six surface and six shallow subsurface), 32 samples from the boreholes, and 4 samples from the waste rock embankment. Modified Sulfide/Sulfur ABA analysis speciates the reactive pyritic sulfur from the non-reactive sulfate and non-reactive sulfur. The net neutralizing potential (NNP) is determined by subtracting the acid generating potential (AGP) from the acid neutralizing potential (ANP) associated with the reactive sulfur speciation. Therefore, a negative NNP value indicates that a sample has the potential to generate acidity, while a positive NNP value indicates that a sample has the potential to neutralize acidity. Guidelines established for interpretation of ABA results (USEPA, 1999) identify that materials with NNP values less than -20 tons calcium carbonate ($CaCO_3$) per 1,000 tons (parts per thousand $CaCO_3$, or ppt $CaCO_3$) are acid generating, while materials with NNP values greater than +20 ppt $CaCO_3$ are acid neutralizing. Samples with NNP values between -20 and +20 ppt $CaCO_3$ are uncertain with respect to acid generation or neutralization (USEPA, 1999). The four waste rock samples, two of the 12 surface and shallow-subsurface samples, and 22 of the 32 borehole samples submitted for ABA analyses showed NNP greater than 20 ppt $CaCO_3$. The remaining samples submitted for ABA analyses were uncertain with respect to acid generation or neutralization.

4.3 DI Wet Extractions

The CAM-17 metals concentrations from the DI WET extractions of all samples are below the EPA storm water benchmark values (Federal Register, 1995), with the exception of cadmium, which exceeded the stormwater benchmark of 0.0159 mg/L in two of the surface samples (A16+00 at 0.0254 mg/L and E11+00 at 0.0261 mg/L).

4.4 Underflow Drainage Water

The dissolved metal concentrations of the underflow drainage water quality samples were compared to the California Toxics Rule (CTR) water quality criteria for protection of freshwater aquatic life. While the CTR criteria are not necessarily applicable or relevant to the underflow drainage, the comparison provides a conservative evaluation of the data. For CTR criteria that are hardness dependent, the hardness concentration analyzed for each sample was used to calculate the CTR criteria. All dissolved metal

constituents analyzed for samples from the underflow drainage were less than the chronic and acute CTR criteria for freshwater aquatic life. The following dissolved metals were below laboratory method detection limits: aluminum, antimony, chromium, lead, manganese, mercury, thallium and vanadium.

Total metal concentrations for the sample collected on September 19, 2008, particularly for aluminum, iron and manganese, were considerably higher than the dissolved metal concentrations for the sample and the range of total metal concentrations analyzed for other samples. The subsequent data suggests that the higher total metal concentrations for the September 19, 2008 sample may have been biased by suspended particulates during sampling.

5.0 UPDATED CONCEPTUAL SITE MODEL

The Phase 2 Data Gaps evaluation (MFG, 2007a) identified mine and mill materials as a potential source of metals to receptors. The primary data gaps which were identified for the Sand Dam Area relate to identification and characterization of the tailing and waste rock with respect to their areal extent, sulfide mineral content, and metal concentrations. Elevated metal concentrations of surface materials may extend beyond the eastern boundary of the Sand Dam Area defined in the Work Plan. Additional characterization data may be necessary to fully delineate the extent of elevated metal concentrations potentially associated with mine and mill materials east of sampling location I11+00. The additional data may be necessary to fill the identified data gaps, update the Conceptual Site Model (CSM) as necessary, and subsequently, in a future Remedial Actions Analysis Report, evaluate the range of applicable action alternatives associated with the Sand Dam Area.

The potential release mechanisms for COCs which have been identified for the Sand Dam Area include wind and water erosion, direct transport, and surface water runoff/chemical weathering (MFG, 2007a). Monthly surface water quality samples have been collected in Little Wolf Creek below the Sand Dam since September 2007 (MFG, 2007b; 2008c; 2008d; 2008e; 2008f; 2009) Evaluation of the underdrain water quality data and surface water quality data in Little Wolf Creek below the Sand Dam collected to date, as well as the ABA and DI WET data presented in this report, indicates that surface water runoff/geochemical weathering of tailing and waste rock in the area is not a potential release mechanism. All water quality data and DI WET results are below applicable water quality criteria. The ABA analyses indicate that the material is not acid generating.

The CSM identified potential pathways for transport of COCs from sources to potential receptors in the Sand Dam Area as dust, soil, surface water, and plant uptake (MFG, 2007a). The concentrations of the CAM-17 metals, with the exception of arsenic concentrations, cadmium concentrations in 11 of the 38 samples (surface and shallow subsurface), and lead concentrations in one of the 93 laboratory-correlated XRF measurements, are below the residential and/or commercial/industrial CHHSLs. The CHHSLs are considered safe for incidental ingestion, inhalation, and dermal exposure for residential and/or commercial industrial exposures. The potential exposures to human receptors at the Sand Dam Area are significantly less than the exposures used to calculate the CHHSLs for residential and commercial/industrial scenarios. Arsenic, cadmium, and lead in surface and shallow subsurface materials remain as potential COCs for human receptors. The metals concentrations in vegetation samples were within normal ranges, with the exception of cadmium and zinc. However, the cadmium and zinc concentrations of vegetation samples are within benchmark values for terrestrial wildlife.

The potential release mechanism eliminated from the CSM based on data presented in this report consists of surface water runoff/chemical weathering. The potential transport pathways eliminated include surface water runoff, plant uptake and, for those metals that are no longer of concern to human receptors, dust and soil. The remaining potential release mechanisms and transport pathways posited in the CSM (MFG, 2007a) still exist.

6.0 ALTERNATIVE ACTIONS

The potential Alternative Actions identified in the Work Plan for the Sand Dam Area are described below.

- No action. The No Action option would be to maintain the existing surfaces.
- Placement of a cover where appropriate. This action would involve covering identified surface mine or mill materials with either a vegetated soil cover or an engineered soil cover containing clean fill and infiltration barriers. This action would also include a cover consisting of road base, gravel or other appropriate materials to isolate mine or mill materials and eliminate potential exposure along controlled access pathways in certain areas. Cover materials would be clean imported fill consistent with the DTSC Clean Fill Advisory (DTSC, 2001).
- In-situ vegetation of the bare ground areas of the tailing surface with native plants.
- Continued use of institutional controls (fencing, signs, etc.) to prevent or control access to the Sand Dam or certain areas of the Sand Dam. This action would involve the continued maintenance of fences and signage to prevent public access to the Sand Dam Area, or to restrict access to specific areas for limited recreational use.
- Partial or complete removal of the tailing and/or the waste rock embankment materials from the Sand Dam Area.

7.0 REFERENCES

California Environmental Protection Agency (CEPA), 2005. Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties. January 2005. http://www.calepa.ca.gov/Brownfields/documents/2005/CHHSLsGuide.pdf

Federal Register, 1995. Vol. 60, No. 189, September 29. p. 50826.

Kabata-Pedias, A. 2001. Trace Elements in Soils and Plants. Third Edition. Boca Rotan: CRC Press. 413 pp.

MFG, Inc. (MFG), 2007a. Data Gaps Report for the Empire Mine State Historic Park, Phase 2: Data Gaps Analysis. Fort Collins, Colorado. January 15.

MFG, Inc. (MFG), 2007b. Surface and Irrigation Well Water Monitoring, Quarterly Data Transmittal Report, Third Quarter 2007. Fort Collins, CO. November.

MFG, Inc. (MFG), 2008a. Sand Dam Area 2008 Work Plan, Empire Mine State Historic Park. MFG, Inc., Fort Collins, Colorado. June.

MFG, Inc. (MFG), 2008b. Sand Dam Area Marshland Characterization Survey Report, Empire Mine State Historic Park. Fort Collins, Colorado. January 10.

MFG, Inc. (MFG), 2008c. Surface and Irrigation Well Water Monitoring, Quarterly Data Transmittal Report, Fourth Quarter 2007. Fort Collins, CO. February.

MFG, Inc. (MFG), 2008d. Surface and Irrigation Well Water Monitoring, Quarterly Data Transmittal Report, First Quarter 2008. Fort Collins, CO. May.

MFG, Inc. (MFG), 2008e. Surface and Irrigation Well Water Monitoring, Quarterly Data Transmittal Report, Second Quarter 2008. Fort Collins, CO. September.

MFG, Inc. (MFG), 2008f. Surface and Irrigation Well Water Monitoring, Quarterly Data Transmittal Report, Third Quarter 2008. Fort Collins, CO. November.

MFG, Inc. (MFG), 2009. Surface and Irrigation Well Water Monitoring, Quarterly Data Transmittal Report, Fourth Quarter 2008. Fort Collins, CO. February.

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. ES/ER/TM-86/R3. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Sobek, A.A., W.A. Schuller, J.R. Freeman, and R.M. Smith, 1978. Field and Laboratory Methods Applicable to Overburden and Minesoils, EPA 600/2-78-054, 203 pp.

United States Department of Agriculture (USDA), 1954. L.A. Richards (ed). Diagnosis and Improvement of saline and alkali soils. USDA Handbook No. 60, USDA, Washington, D.C.

United States Environmental Protection Agency (USEPA), 1999. EPA and Hardrock Mining: A Sourcebook for Industry in the Northwest and Alaska. Draft Guidance Document from EPA Region 10. EPA-10-R-99-016.

United States Environmental Protection Agency (USEPA), 2007. Method 6200 - Field Portable X-ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment. Revision 0. February 2007. http://www.epa.gov/epawaste/hazard/testmethods/sw846/pdfs/6200.pdf

TABLES

Table 1 Summary of Field and Laboratory Material Analyses

Sample Type	Field In-Situ XRF for Total As and Pb	Number of Samples Collected	Ex-Situ XRF for Total As and Pb	As, Pb, Cd and Hg	Number of Laboratory Analyses		
					CAM-17 Metals and WAD CN	ABA and Paste pH	DI Wet Cam 17 Metals and WAD CN
TAILING AREA							
Surface Materials (0-2 inches)	93	19	19	19	6	6	6
Shallow subsurface materials (2-24 inches)	0	19	0	19	6	6	6
Deep subsurface materials (5 feet and greater)	0	32	0	0	32	32	32
WASTE ROCK EMBANKMENT							
Surface materials	0	2	0	0	2	2	2
Subsurface materials	0	2	0	0	2	2	2
VEGETATION SAMPLES							
Leaf Tissue	0	7	0	0	7*	0	0
Totals	93	77	19	38	55	48	48

*WAD CN not analyzed for vegetation samples

Table 2 In-situ XRF and Correlated XRF Concentrations (mg/Kg)

Sample ID	In-Situ XRF Arsenic Concentration	Correlated XRF Arsenic Concentration	In-Situ XRF Lead Concentration	Correlated XRF Lead Concentration
SD A00+00	93	97	116	110
SD A01+00	144	149	307	292
SD A02+00	76	79	113	108
SD A03+00	154	160	284	270
SD A04+00	132	137	384	365
SD A05+00	0	<19	122	116
SD A06+00	9	<19	47	44
SD A07+00	16	<19	106	100
SD A08+00	290	301	463	440
SD A09+00	388	403	937	890
SD A10+00	202	209	134	127
SD A11+00	264	274	376	358
SD A12+00	560	581	623	592
SD A13+00	1,051	1,092	1,227	1,166
SD A14+00	373	387	279	265
SD A15+00	169	175	702	667
SD A16+00	228	237	885	841
SD A17+00	8	<19	40	38
SD B00+00	158	164	489	464
SD B01+00	371	385	545	518
SD B02+00	216	225	457	434
SD B03+00	140	146	140	133
SD B04+00	152	158	221	210
SD B05+00	137	142	232	220
SD B06+00	57	60	158	150
SD B07+00	51	53	135	129
SD B08+00	33	34	104	99
SD B09+00	611	634	1,955	1,857
SD B10+00	844	876	2,216	2,105
SD B11+00	461	478	1,193	1,134
SD B12+00	155	161	392	373
SD B13+00	68	70	186	177
SD B14+00	530	550	482	458
SD B15+00	778	808	572	543
SD B16+00	882	916	832	791
SD B17+00	567	589	424	403
SD B18+00	25	<19	19	<21
SD C02+00	-3	<19	35	33
SD C03+00	20	20	43	40
SD C04+00	4	<19	40	38
SD C05+00	132	137	204	194
SD C06+00	29	30	89	85
SD C07+00	58	60	177	168
SD C08+00	24	25	81	77
SD C09+00	782	812	2,108	2,003
SD C10+00	581	603	381	362
SD C11+00	244	253	434	412
SD C12+00	73	76	127	121

Table 2 In-situ XRF and Correlated XRF Concentrations (mg/Kg) (continued)

Sample ID	In-Situ XRF Arsenic Concentration	Correlated XRF Arsenic Concentration	In-Situ XRF Lead Concentration	Correlated XRF Lead Concentration
SD C13+00	68	71	311	296
SD C14+00	186	194	320	304
SD C15+00	175	182	819	778
SD C16+00	235	244	683	649
SD C17+00	191	198	691	657
SD C18+00	74	77	74	71
SD D05+00	26	27	27	25
SD D06+00	66	69	156	148
SD D07+00	1,228	1,275	1,684	1,600
SD D08+00	162	168	371	353
SD D09+00	155	160	311	295
SD D10+00	391	406	285	271
SD D11+00	250	259	316	301
SD D12+00	72	75	123	117
SD D13+00	242	251	343	325
SD D14+00	129	133	360	342
SD D15+00	242	252	440	418
SD D16+00	246	256	527	501
SD D17+00	494	513	506	481
SD D18+00	26	27	63	60
SD E08+00	277	288	124	118
SD E09+00	32	33	83	79
SD E10+00	897	931	910	21
SD E11+00	176	183	328	311
SD E12+00	53	55	92	88
SD E13+00	212	220	254	241
SD E14+00	372	386	891	847
SD E15+00	147	153	450	428
SD E16+00	173	180	497	472
SD E17+00	13	<19	40	38
SD EF08+00	183	190	139	132
SD F09+00	618	642	471	447
SD F10+00	473	491	319	303
SD F11+00	28	29	100	95
SD F12+00	436	452	305	289
SD F13+00	137	142	276	262
SD F14+00	39	41	204	194
SD F15+00	2	<19	40	38
SD G10+00	278	289	570	541
SD G11+00	70	72	89	85
SD G12+00	42	43	103	98
SD G13+00	21	22	66	63
SD H11+00	2,191	2,274	5,599	5,320
SD H12+00	29	30	37	35
SD I11+00	272	283	454	432

Table 3 Total Metals and WAD Cyanide Laboratory Results for Surface, Shallow Subsurface, and Waste Rock Embankment Samples (mg/Kg)

Sample ID	WAD Cyanide	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Surface Material Samples (0 to 2 inch depth)																		
SD/A03+00/00/01			159			1.30				193	2.63							
SD/A8+00/00/01			312			0.42				424	6.83							
SD/A11+00/00/01	<0.500	<2.0	278	101	0.279	7.27	6.76	16.9	338	307	5.88	5.86	6.10	<1.00	1.98	<1.5	21.1	163
SD/A16+00/00/01	<0.500	7.3	231	236	0.521	14.8	10.3	26.1	644	1050	24.2	16.1	10.6	<1.00	2.69	<1.5	31.2	438
SD/A17+00/00/01			14.6			<0.20				16.2	0.160							
SD/B01+00/00/01			261			2.97				478	16.4							
SD/B06+00/00/01			99.1			11.8				164	3.08							
SD/B12+00/00/01			172			4.03				253	1.98							
SD/B14+00/00/01	<0.500	<2.0	793	125	1.50	18.1	24.2	123	304	1070	9.50	3.70	31.1	8.18	2.75	<1.5	76.3	551
SD/C06+00/00/01			135			13.6				256	2.10							
SD/C17+00/00/01			259			9.85				711	19.0							
SD/D06+00/00/01			126			8.53				205	3.02							
SD/D12+00/00/01	<0.500	<2.0	64.8	49.3	<0.200	3.13	10.2	6.05	40.6	79.0	0.458	1.11	6.72	<1.00	<0.50	<1.5	28.4	122
SD/E11+00/00/01	<0.500	<2.0	192	148	0.495	6.85	23.7	26.1	98.4	202	3.38	2.10	14.0	<1.00	0.84	<1.5	75.2	222
SD/E15+00/00/01			185			1.25				575	9.65							
SD/F10+00/00/01			685			0.95				352	3.68							
SD/F12+00/00/01			356			13.2				240	3.09							
SD/F14+00/00/01			122			9.61				237	2.48							
SD/I11+00/00/01	<0.500	<2.0	377	256	1.32	68.2	25.3	445	120	572	3.20	2.69	75.2	12.4	<0.50	2.5	84.9	657
Subsurface Material Samples (2 to 24 inch depth)																		
SD/A3+00/02/01			155			1.65				222	6.39							
SD/A8+00/02/01			252			0.37				444	14.9							
SD/A11+00/02/01	<0.500	<2.0	75.5	81.5	<0.200	3.66	4.53	7.94	93.7	86.0	1.97	2.07	4.11	<1.00	0.54	<1.5	17.4	109
SD/A16+00/02/01	<0.500	6.7	258	201	<0.200	0.29	8.71	5.42	412	942	21.5	13.8	<1.00	<1.00	2.81	<1.5	27.8	147
SD/A17+00/02/01			13.5			0.67				11.0	0.115							
SD/B01+00/02/01			210			0.94				384	13.2							
SD/B06+00/02/01			82.2			5.11				138	3.29							
SD/B12+00/02/01			40.7			1.90				50.0	0.625							
SD/B14+00/02/01	<0.500	<2.0	236	127	0.281	4.34	12.8	10.4	113	471	6.44	2.72	10.0	<1.00	2.58	<1.5	34.0	189
SD/C6+00/02/01			18.7			3.70				63.4	0.690							
SD/C17+00/02/01			337			1.46				624	15.5							
SD/D06+00/02/01			105			5.50				95.5	1.50							
SD/D12+00/02/01	<0.500	<2.0	30.6	85.7	<0.200	2.03	6.81	4.35	24.7	30.2	0.272	1.09	3.06	<1.00	<0.50	<1.5	23.3	74.2
SD/E11+00/02/01	<0.500	<2.0	228	197	0.286	8.09	14.8	9.29	90.3	466	5.67	2.79	9.12	1.09	2.32	<1.5	46.9	212

Table 3 Total Metals and WAD Cyanide Laboratory Results for Surface, Shallow Subsurface, and Waste Rock Embankment Samples (mg/Kg) (continued)

Sample ID	WAD Cyanide	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Subsurface Material Samples (2 to 24 inch depth) (continued)																		
SD/E15+00/02/01			32.7			2.58				50.1	5.62							
SD/F10+00/02/01			149			4.15				121	0.337							
SD/F12+00/02/01			90.7			4.15				158	1.55							
SD/F14+00/02/01			88.2			5.74				175	3.09							
SD/I11+00/02/01	<0.500	<2.0	682	197	0.806	35.5	22.8	178	100	1060	8.63	4.07	35.2	7.86	4.12	<1.5	81.7	339
Waste Rock Embankment Samples																		
WR/SD/01/05	<0.500	<2.0	60.9	103	0.208	0.35	7.59	11.3	107	21.1	1.77	1.2	7.08	<1.00	<0.50	<1.5	36.7	42.7
WR/SD/02/06	<0.500	<2.0	54.2	102	0.289	1.21	8.16	17.7	71	88.5	0.993	1.9	3.87	<1.00	0.63	<1.5	32.8	89.2
WR/SDB/01/10	<0.500	<2.0	37.8	172	0.331	2.42	9.35	12.4	90	84.0	1.48	3.4	6.60	<1.00	0.89	<1.5	42.0	87.3
WR/SDB/02/06	<0.500	<2.0	49.6	119	0.400	6.78	21.4	13.2	128	87.3	1.63	2.2	5.49	<1.00	1.71	<1.5	91.8	151

Table 4 ABA and Paste pH Laboratory Results for Surface, Shallow Subsurface, and Waste Rock Embankment Samples

Sample ID	Net Neutralizing Potential $TCaCO_3/kT$	Acid Generating Potential $TCaCO_3/kT$	Acid Neutralizing Potential $TCaCO_3/kT$	Non-Ext Sulfur, S %	pH Paste (S.U.)	Pyritic Sulfur, S %	Sulfate Sulfur, S %	Total Sulfur, S %
Surface Material Samples (0 to 2 inch depth)								
SD/A11+00/00/01	4.7	2.6	7.3	<0.01	6.99	0.08	0.17	0.25
SD/A16+00/00/01	-3.8	3.8	<0.3	<0.01	6.15	0.12	0.22	0.34
SD/B14+00/00/01	-4.8	4.8	<0.3	<0.01	6.06	0.15	0.06	0.21
SD/D12+00/00/01	7.2	0.8	8.0	<0.01	6.97	0.03	0.08	0.10
SD/E11+00/00/01	-4.3	4.3	<0.3	<0.01	5.07	0.14	0.14	0.28
SD/I11+00/00/01	-2.0	2.5	0.5	<0.01	6.06	0.08	0.09	0.17
Subsurface Material Samples (2 to 24 inch depth)								
SD/A11+00/02/01	39.2	8.8	47.9	<0.01	8.06	0.28	0.11	0.39
SD/A16+00/02/01	-2.7	2.7	<0.3	<0.01	4.48	0.09	2.59	2.68
SD/B14+00/02/01	-0.4	0.4	<0.3	<0.01	6.24	0.01	0.03	0.04
SD/D12+00/02/01	39.2	<0.3	39.2	<0.01	8.11	<0.01	<0.01	<0.01
SD/E11+00/02/01	1.6	1.5	3.1	<0.01	6.09	0.05	0.06	0.11
SD/I11+00/02/01	-3.9	3.9	<0.3	<0.01	5.86	0.12	0.19	0.31
Waste Rock Embankment Samples								
WR/SD/01/05	54.1	4.6	58.7	<0.01	7.83	0.15	0.09	0.24
WR/SD/02/06	20.8	10.6	31.4	<0.01	7.09	0.34	0.09	0.43
WR/SDB/01/10	27.1	8.5	35.6	<0.01	7.63	0.27	0.06	0.33
WR/SDB/02/06	24.7	1.6	26.3	<0.01	6.98	0.05	0.02	0.07

Table 5 DI WET Laboratory Results (mg/L) for Surface, Shallow Subsurface, and Waste Rock Embankment Samples

Sample ID	WAD CN	Sb	As	Ba	Be	Cd	Cr	Co	Cu
Surface Material Samples (0 to 2 inch depth)									
SD/A11+00/00/01	<0.0100	<0.00300	<0.00300	0.0404	<0.000100	0.000213	0.00115	0.00201	0.00697
SD/A16+00/00/01	<0.0100	<0.00300	<0.00300	0.0293	<0.000100	0.0254	<0.00100	0.00453	0.00585
SD/B14+00/00/01	<0.0100	<0.00300	<0.00300	0.0288	<0.000100	0.00108	<0.00100	<0.00100	0.00422
SD/D12+00/00/01	<0.0100	<0.00300	0.0141	0.0290	<0.000100	0.000565	0.00125	0.00208	0.0121
SD/E11+00/00/01	<0.0100	<0.00300	<0.00300	0.0473	<0.000100	0.0261	<0.00100	0.106	0.00549
SD/I11+00/00/01	<0.0100	<0.00300	<0.00300	0.0221	<0.000100	<0.000200	<0.00100	<0.00100	<0.00100
Subsurface Material Samples (2 to 24 inch depth)									
SD/A11+00/02/01	<0.0100	0.00556	0.00923	0.0136	<0.000100	<0.000200	<0.00100	<0.00100	0.00295
SD/A16+00/02/01	<0.0100	<0.00300	<0.00300	0.0193	0.000144	0.0146	<0.00100	0.0335	0.0546
SD/B14+00/02/01	<0.0100	<0.00300	0.00634	0.0175	<0.000100	0.000366	<0.00100	<0.00100	0.00788
SD/D12+00/02/01	<0.0100	<0.00300	0.0109	0.0149	<0.000100	0.000246	<0.00100	<0.00100	0.00431
SD/E11+00/02/01	<0.0100	<0.00300	0.0116	0.0303	<0.000100	0.00131	<0.00100	<0.00100	0.00722
SD/I11+00/02/01	<0.0100	<0.00300	0.00397	0.0108	<0.000100	<0.000200	<0.00100	<0.00100	<0.00100
Waste Rock Embankment Samples									
WR/SD/01/05	-	<0.00300	0.0148	0.0105	<0.000100	<0.000200	<0.00100	<0.00100	0.00342
WR/SD/02/06	-	<0.00300	0.00434	0.0684	<0.000100	0.000570	<0.00100	0.00673	0.0208
WR/SDB/01/10	-	<0.00300	<0.00300	0.0329	<0.000100	<0.000200	<0.00100	0.00104	0.00432
WR/SDB/02/06	-	<0.00300	0.00383	0.0398	<0.000100	0.000862	<0.00100	0.00224	0.0504

Table 5 DI WET Laboratory Results (mg/L) for Surface, Shallow Subsurface, and Waste Rock Embankment Samples (continued)

Sample ID	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Surface Material Samples (0 to 2 inch depth)									
SD/A11+00/00/01	0.00571	<0.0002	0.00308	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00347
SD/A16+00/00/01	<0.00300	<0.0002	<0.00100	0.00554	<0.00300	<0.000100	<0.00100	<0.00100	0.0804
SD/B14+00/00/01	<0.00300	<0.0002	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00642
SD/D12+00/00/01	0.0110	<0.0002	<0.00100	0.00106	<0.00300	<0.000100	<0.00100	<0.00100	0.0161
SD/E11+00/00/01	<0.00300	<0.0002	<0.00100	0.0146	<0.00300	<0.000100	<0.00100	<0.00100	0.385
SD/I11+00/00/01	<0.00300	<0.0002	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.0131
Subsurface Material Samples (2 to 24 inch depth)									
SD/A11+00/02/01	<0.00300	0.0003	0.0133	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00274
SD/A16+00/02/01	0.0405	<0.0002	<0.00100	0.0137	<0.00300	<0.000100	<0.00100	<0.00100	0.151
SD/B14+00/02/01	0.0260	0.0005	<0.00100	<0.00100	<0.00300	0.000138	<0.00100	<0.00100	0.0138
SD/D12+00/02/01	0.00399	<0.0002	0.00286	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00648
SD/E11+00/02/01	0.0587	0.0006	<0.00100	<0.00100	<0.00300	0.000205	<0.00100	0.00141	0.0180
SD/I11+00/02/01	0.00807	0.00020	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00341
Waste Rock Embankment Samples									
WR/SD/01/05	<0.00300	0.0002	0.00331	<0.00100	<0.00300	<0.000100	<0.00100	0.00203	0.00100
WR/SD/02/06	0.00304	0.0009	0.00250	0.00169	<0.00300	<0.000100	<0.00100	<0.00100	0.0121
WR/SDB/01/10	<0.00300	<0.0002	0.0153	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00195
WR/SDB/02/06	<0.00300	0.0003	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	0.00192	0.0174

Table 6 Water Levels in Piezometers

Piezometer*	Depth to Water (feet bgs)				
Date	9/26/2008 (Initial)	10/21/2008	12/17/2008	1/16/2009	2/11/2009
SD/B03	14.95	15.91	12.00	8.30	6.80
SD/B05	24.44	25.33	20.70	16.61	16.00
SD/B06	12.42	13.55	6.62	2.81	2.29

*Piezometers were not installed at SD/B01 and SD/B02

Table 7 Total Metals and WAD Cyanide Laboratory Results (mg/Kg) for Borehole Samples

Sample ID	Depth Interval	WAD Cyanide	Sb	As	Ba	Be	Cd	Cr	Co	Cu
Deep Subsurface Samples (5 feet and deeper)										
SD/B01/0-4.5/01	0 to 4.5 feet	<0.500	2.6	95.2	93.0	<0.200	3.60	4.94	9.19	278
SD/B01/5-7.3/01	5 feet to 7.3 feet	<0.500	<2.0	28.5	60.2	<0.200	3.68	4.65	5.34	55.8
SD/B01/7.3-10/01	7.3 feet to 10 feet	<0.500	<2.0	44.0	88.2	<0.200	7.31	6.74	6.35	69.5
SD/B01/10-12.3/01	10 feet to 12.3 feet	<0.500	<2.0	35.5	149	0.289	10.9	5.80	6.95	72.4
SD/B01/12.5-15/01	12.5 feet to 15 feet	<0.500	<2.0	585	87.2	0.586	<0.20	32.6	17.9	34.6
SD/B01/15-17.5/01	15 feet to 17.5 feet	<0.500	<2.0	3.2	886	0.382	<0.20	5.47	<0.60	24.3
SD/B02/0-4.5/01	0 to 4.5 feet	<0.500	<2.0	25.9	63.3	<0.200	4.33	4.98	5.64	53.5
SD/B02/4.5-9.5/01	4.5 feet to 9.5 feet	<0.500	<2.0	21.9	57.9	<0.200	2.48	2.83	4.41	39.6
SD/B02/13.5-17/01	13.5 feet to 17 feet	<0.500	<2.0	<2.5	966	1.12	<0.20	2.04	8.21	38.4
SD/B02/17-19.5/01	17 feet to 19.5 feet	<0.500	<2.0	<2.5	307	1.03	<0.20	1.28	21.2	35.9
SD/B03/0-4.5/01	0 feet to 4.5 feet	<0.500	<2.0	29.7	60.2	<0.200	3.61	5.22	5.20	37.2
SD/B03/5-10/01	5 feet to 10 feet	<0.500	<2.0	17.4	38.1	<0.200	2.91	3.71	4.14	28.6
SD/B03/10-15/01	10 feet to 15 feet	<0.500	<2.0	20.2	43.4	<0.200	4.41	2.38	4.33	56.5
SD/B03/20-22.5/01	20 feet to 22.5 feet	<0.500	<2.0	12.3	30.5	<0.200	3.38	3.69	3.45	37.1
SD/B03/29.5-30/01	29.5 feet to 30 feet	<0.500	<2.0	16.8	33.2	<0.200	3.16	4.69	4.95	34.8
SD/B03/32-33.5/01	32 feet to 33.5 feet	<0.500	<2.0	3.3	73.6	0.452	<0.20	3.85	2.45	41.3
SD/B03/34-35.5/01	34 feet to 35.5 feet	<0.500	<2.0	3.0	110	0.287	<0.20	5.22	7.82	42.0
SD/B05/0-4.5/01	0 feet to 4.5 feet	<0.500	<2.0	35.7	98.8	<0.200	3.94	4.86	5.08	58.5
SD/B05/5-10/01	5 feet to 10 feet	<0.500	<2.0	18.0	58.1	<0.200	3.37	3.36	4.04	38.7
SD/B05/10-15/01	10 feet to 15 feet	<0.500	<2.0	18.3	45.9	<0.200	3.64	3.27	4.14	28.9
SD/B05/15-20/01	15 feet to 20 feet	<0.500	<2.0	10.2	29.1	<0.200	1.96	3.50	3.64	29.7
SD/B05/25-30/01	25 feet to 30 feet	<0.500	<2.0	9.9	42.0	<0.200	3.08	3.52	3.27	29.1
SD/B05/30-35/01	30 feet to 35 feet	<0.500	<2.0	6.9	38.4	<0.200	1.25	3.13	3.20	37.0
SD/B05/35.5-39.5/01	35.5 feet to 39.5 feet	<0.500	<2.0	11.1	24.8	<0.200	5.93	2.87	3.34	36.7
SD/B05/42-43/01	42 feet to 43 feet	<0.500	<2.0	15.0	32.7	<0.200	2.26	3.08	3.87	37.1
SD/B05/45-46.5/01	45 feet to 46.5 feet	<0.500	<2.0	15.5	196	0.377	<0.20	8.16	9.52	40.2
SD/B06/0-5/01	0 feet to 5 feet	<0.500	<2.0	19.5	43.9	<0.200	0.80	7.87	3.54	14.8
SD/B06/5-10/01	5 feet to 10 feet	<0.500	<2.0	17.9	37.8	<0.200	1.87	4.27	3.82	24.3
SD/B06/10-15/01	10 feet to 15 feet	<0.500	<2.0	22.2	37.3	<0.200	4.10	3.12	4.63	41.8
SD/B06/15-17.5/01	15 feet to 17.5 feet	<0.500	<2.0	20.0	39.7	<0.200	3.16	13.9	4.24	31.7
SD/B06/21-23.5/01	21 feet to 23.5 feet	<0.500	<2.0	<2.5	54.8	0.338	<0.20	183	2.19	82.0
SD/B06/23.5-25/01	23.5 feet to 25 feet	<0.500	<2.0	<2.5	56.4	0.587	<0.20	26.4	2.16	37.2

Table 7 Total Metals and WAD Cyanide Laboratory Results (mg/Kg) for Borehole Samples (continued)

Sample ID	Depth Interval	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Deep Subsurface Samples (5 feet and deeper)										
SD/B01/0-4.5/01	0 to 4.5 feet	191	5.40	2.19	2.66	<1.00	1.97	<1.5	16.0	118
SD/B01/5-7.3/01	5 feet to 7.3 feet	92.5	1.94	1.08	2.77	<1.00	0.66	<1.5	13.9	113
SD/B01/7.3-10/01	7.3 feet to 10 feet	212	2.77	1.82	2.55	<1.00	0.91	<1.5	18.1	183
SD/B01/10-12.3/01	10 feet to 12.3 feet	288	5.52	2.51	1.76	<1.00	0.78	<1.5	21.4	253
SD/B01/12.5-15/01	12.5 feet to 15 feet	20.5	2.70	1.36	<1.00	<1.00	<0.50	<1.5	140	18.5
SD/B01/15-17.5/01	15 feet to 17.5 feet	1.63	0.110	1.08	<1.00	<1.00	<0.50	<1.5	83.5	3.12
SD/B02/0-4.5/01	0 to 4.5 feet	73.6	0.547	1.42	3.71	<1.00	<0.50	<1.5	17.8	123
SD/B02/4.5-9.5/01	4.5 feet to 9.5 feet	76.2	1.28	1.83	2.28	<1.00	1.60	<1.5	14.7	104
SD/B02/13.5-17/01	13.5 feet to 17 feet	0.86	<0.033	<0.80	11.7	<1.00	<0.50	<1.5	61.0	37.0
SD/B02/17-19.5/01	17 feet to 19.5 feet	<0.75	<0.033	1.22	5.79	<1.00	<0.50	<1.5	135	51.3
SD/B03/0-4.5/01	0 feet to 4.5 feet	87.9	0.823	1.32	4.04	<1.00	<0.50	<1.5	15.9	110
SD/B03/5-10/01	5 feet to 10 feet	52.1	0.602	1.15	2.62	<1.00	<0.50	<1.5	14.3	92.0
SD/B03/10-15/01	10 feet to 15 feet	73.0	0.508	1.00	2.21	<1.00	1.13	<1.5	10.7	148
SD/B03/20-22.5/01	20 feet to 22.5 feet	41.1	0.372	1.04	2.70	<1.00	<0.50	<1.5	11.9	114
SD/B03/29.5-30/01	29.5 feet to 30 feet	49.9	0.602	1.31	3.81	<1.00	0.61	<1.5	16.7	113
SD/B03/32-33.5/01	32 feet to 33.5 feet	2.42	0.075	<0.80	3.89	<1.00	<0.50	<1.5	117	13.9
SD/B03/34-35.5/01	34 feet to 35.5 feet	1.14	0.043	0.99	7.49	<1.00	<0.50	<1.5	220	22.2
SD/B05/0-4.5/01	0 feet to 4.5 feet	110	0.222	1.17	4.49	<1.00	0.66	<1.5	15.1	112
SD/B05/5-10/01	5 feet to 10 feet	66.1	0.562	1.22	2.16	<1.00	<0.50	<1.5	13.1	94.5
SD/B05/10-15/01	10 feet to 15 feet	62.7	0.523	1.21	1.90	<1.00	<0.50	<1.5	13.5	103
SD/B05/15-20/01	15 feet to 20 feet	32.4	0.347	1.32	1.89	<1.00	<0.50	<1.5	13.4	82.0
SD/B05/25-30/01	25 feet to 30 feet	32.9	0.523	1.10	1.87	<1.00	<0.50	<1.5	12.3	110
SD/B05/30-35/01	30 feet to 35 feet	27.4	0.308	0.86	1.37	<1.00	<0.50	<1.5	12.3	68.9
SD/B05/35.5-39.5/01	35.5 feet to 39.5 feet	30.1	0.427	0.96	1.54	<1.00	<0.50	<1.5	13.9	148
SD/B05/42-43/01	42 feet to 43 feet	40.8	0.422	0.99	1.64	<1.00	<0.50	<1.5	14.3	92.1
SD/B05/45-46.5/01	45 feet to 46.5 feet	6.55	0.135	<0.80	6.12	<1.00	<0.50	<1.5	99.9	15.0
SD/B06/0-5/01	0 feet to 5 feet	13.3	0.133	0.84	3.59	<1.00	<0.50	<1.5	22.2	50.2
SD/B06/5-10/01	5 feet to 10 feet	43.4	0.368	1.36	2.46	<1.00	<0.50	<1.5	15.6	68.4
SD/B06/10-15/01	10 feet to 15 feet	42.6	0.352	1.13	2.75	<1.00	1.32	<1.5	14.3	115
SD/B06/15-17.5/01	15 feet to 17.5 feet	59.5	1.20	1.49	3.84	<1.00	<0.50	<1.5	20.8	114
SD/B06/21-23.5/01	21 feet to 23.5 feet	<0.75	0.092	2.69	9.37	1.94	<0.50	<1.5	162	14.3
SD/B06/23.5-25/01	23.5 feet to 25 feet	<0.75	0.037	1.67	13.2	<1.00	<0.50	<1.5	85.5	15.0

Table 8 ABA and Paste pH Laboratory Analysis for Borehole Samples

Sample ID	Depth Interval	Net Neutralizing Potential $TCaCO_3/kT$	Acid Generating Potential $TCaCO_3/kT$	Acid Neutralizing Potential $TCaCO_3/kT$	Non-Ext Sulfur, S %	pH Paste (S.U.)	Pyritic Sulfur, S %	Sulfate Sulfur, S %	Total Sulfur, S %
Deep Subsurface Samples (5 feet and deeper)									
SD/B01/0-4.5/01	0 to 4.5 feet	2.0	15.6	17.6	<0.01	6.57	0.50	0.92	1.42
SD/B01/5-7.3/01	5 feet to 7.3 feet	38.1	7.8	45.9	<0.01	7.77	0.25	0.08	0.33
SD/B01/7.3-10/01	7.3 feet to 10 feet	55.3	10.1	65.4	<0.01	7.65	0.32	0.33	0.66
SD/B01/10-12.3/01	10 feet to 12.3 feet	71.0	13.9	84.9	<0.01	7.75	0.44	0.15	0.59
SD/B01/12.5-15/01	12.5 feet to 15 feet	1.1	<0.3	1.1	<0.01	6.55	<0.01	0.08	0.08
SD/B01/15-17.5/01	15 feet to 17.5 feet	<0.3	<0.3	<0.3	<0.01	5.76	<0.01	0.01	0.01
SD/B02/0-4.5/01	0 to 4.5 feet	42.7	2.5	45.2	<0.01	7.74	0.08	<0.01	0.08
SD/B02/4.5-9.5/01	4.5 feet to 9.5 feet	55.5	<0.3	55.5	<0.01	7.67	<0.01	<0.01	<0.01
SD/B02/13.5-17/01	13.5 feet to 17 feet	3.2	<0.3	3.2	<0.01	5.72	<0.01	0.02	0.02
SD/B02/17-19.5/01	17 feet to 19.5 feet	10.4	<0.3	10.4	<0.01	5.74	<0.01	<0.01	<0.01
SD/B03/0-4.5/01	0 feet to 4.5 feet	35.0	<0.3	35.0	<0.01	7.69	<0.01	<0.01	<0.01
SD/B03/5-10/01	5 feet to 10 feet	42.7	<0.3	42.7	<0.01	8.16	<0.01	<0.01	<0.01
SD/B03/10-15/01	10 feet to 15 feet	45.9	4.5	50.4	<0.01	8.08	0.14	0.02	0.17
SD/B03/20-22.5/01	20 feet to 22.5 feet	42.8	2.4	45.2	<0.01	8.12	0.08	0.04	0.12
SD/B03/29.5-30/01	29.5 feet to 30 feet	43.1	3.4	46.5	<0.01	7.95	0.11	0.04	0.15
SD/B03/32-33.5/01	32 feet to 33.5 feet	<0.3	<0.3	<0.3	<0.01	6.49	<0.01	0.02	0.02
SD/B03/34-35.5/01	34 feet to 35.5 feet	3.2	<0.3	3.2	<0.01	6.61	<0.01	<0.01	<0.01
SD/B05/0-4.5/01	0 feet to 4.5 feet	46.0	4.4	50.4	<0.01	7.92	0.14	0.05	0.19
SD/B05/5-10/01	5 feet to 10 feet	47.8	<0.3	47.8	<0.01	8.17	<0.01	<0.01	<0.01
SD/B05/10-15/01	10 feet to 15 feet	58.1	<0.3	58.1	<0.01	7.90	<0.01	<0.01	<0.01
SD/B05/15-20/01	15 feet to 20 feet	49.1	<0.3	49.1	<0.01	8.10	<0.01	<0.01	<0.01
SD/B05/25-30/01	25 feet to 30 feet	48.6	3.1	51.7	<0.01	8.10	0.10	0.04	0.14
SD/B05/30-35/01	30 feet to 35 feet	50.9	2.0	52.9	<0.01	8.11	0.06	0.05	0.12
SD/B05/35.5-39.5/01	35.5 feet to 39.5 feet	48.9	2.8	51.7	<0.01	8.26	0.09	0.06	0.15
SD/B05/42-43/01	42 feet to 43 feet	48.3	3.4	51.7	<0.01	8.03	0.11	0.03	0.14
SD/B05/45-46.5/01	45 feet to 46.5 feet	4.2	<0.3	4.2	<0.01	6.35	<0.01	<0.01	0.01
SD/B06/0-5/01	0 feet to 5 feet	37.5	<0.3	37.5	<0.01	8.11	<0.01	<0.01	<0.01
SD/B06/5-10/01	5 feet to 10 feet	42.6	2.6	45.2	<0.01	8.11	0.08	0.04	0.12
SD/B06/10-15/01	10 feet to 15 feet	40.5	8.6	49.1	<0.01	7.93	0.27	0.08	0.35
SD/B06/15-17.5/01	15 feet to 17.5 feet	29.6	2.8	32.4	<0.01	7.03	0.09	0.08	0.17
SD/B06/21-23.5/01	21 feet to 23.5 feet	<0.3	<0.3	<0.3	<0.01	5.29	<0.01	0.02	0.02
SD/B06/23.5-25/01	23.5 feet to 25 feet	8.2	<0.3	8.2	<0.01	5.77	<0.01	0.02	0.02

Table 9 DI WET Laboratory Results for Borehole Samples (mg/L)

Sample ID	Depth Interval	WAD CN	Sb	As	Ba	Be	Cd	Cr	Co	Cu
Deep Subsurface Material Samples (5 feet and deeper)										
SD/B01/0-4.5/01	0 to 4.5 feet	<0.010	0.00646	<0.00300	0.0226	<0.000100	0.000955	<0.00100	0.00268	0.00171
SD/B01/5-7.3/01	5 feet to 7.3 feet	<0.010	0.0145	<0.00300	0.00631	<0.000100	<0.000200	<0.00100	<0.00100	0.00146
SD/B01/7.3-10/01	7.3 feet to 10 feet	<0.010	<0.00300	<0.00300	0.0158	<0.000100	0.00222	<0.00100	0.00581	0.00339
SD/B01/10-12.3/01	10 feet to 12.3 feet	<0.010	0.00364	0.00375	0.0423	<0.000100	<0.000200	<0.00100	0.00121	<0.00100
SD/B01/12.5-15/01	12.5 feet to 15 feet	<0.010	<0.00300	0.0988	0.0499	<0.000100	<0.000200	<0.00100	0.00259	0.00117
SD/B01/15-17.5/01	15 feet to 17.5 feet	<0.010	<0.00300	0.00671	0.0307	<0.000100	<0.000200	<0.00100	<0.00100	0.00572
SD/B02/0-4.5/01	0 to 4.5 feet	<0.010	<0.00300	0.0107	0.0119	<0.000100	<0.000200	<0.00100	<0.00100	0.00177
SD/B02/4.5-9.5/01	4.5 feet to 9.5 feet	<0.010	<0.00300	0.00522	0.0185	<0.000100	<0.000200	<0.00100	<0.00100	<0.00100
SD/B02/13.5-17/01	13.5 feet to 17 feet	<0.010	<0.00300	<0.00300	0.122	0.000171	<0.000200	0.00175	0.00106	0.0106
SD/B02/17-19.5/01	17 feet to 19.5 feet	<0.010	<0.00300	<0.00300	0.00621	<0.000100	<0.000200	<0.00100	<0.00100	<0.00100
SD/B03/0-4.5/01	0 feet to 4.5 feet	<0.010	<0.00300	0.0129	0.00576	<0.000100	<0.000200	<0.00100	<0.00100	0.00407
SD/B03/5-10/01	5 feet to 10 feet	<0.010	<0.00300	0.0178	0.00472	<0.000100	<0.000200	<0.00100	<0.00100	<0.00100
SD/B03/10-15/01	10 feet to 15 feet	<0.010	<0.00300	0.0146	0.00748	<0.000100	<0.000200	<0.00100	<0.00100	0.00110
SD/B03/20-22.5/01	20 feet to 22.5 feet	<0.010	0.00330	0.00865	0.00828	<0.000100	<0.000200	<0.00100	<0.00100	0.00108
SD/B03/29.5-30/01	29.5 feet to 30 feet	<0.010	<0.00300	0.0113	0.0114	<0.000100	<0.000200	<0.00100	<0.00100	0.00202
SD/B03/32-33.5/01	32 feet to 33.5 feet	<0.010	<0.00300	0.00394	0.0268	<0.000100	<0.000200	<0.00100	<0.00100	0.00100
SD/B03/34-35.5/01	34 feet to 35.5 feet	<0.010	<0.00300	<0.00300	0.00803	<0.000100	<0.000200	<0.00100	0.00123	<0.00100
SD/B05/0-4.5/01	0 feet to 4.5 feet	<0.010	<0.00300	0.00879	0.0257	<0.000100	<0.000200	<0.00100	<0.00100	0.00186
SD/B05/5-10/01	5 feet to 10 feet	<0.010	<0.00300	0.0118	0.00766	<0.000100	<0.000200	<0.00100	<0.00100	0.00104
SD/B05/10-15/01	10 feet to 15 feet	<0.010	<0.00300	0.00919	0.00691	<0.000100	<0.000200	<0.00100	<0.00100	0.00122
SD/B05/15-20/01	15 feet to 20 feet	<0.010	<0.00300	0.0223	0.00657	<0.000100	<0.000200	<0.00100	<0.00100	<0.00100
SD/B05/25-30/01	25 feet to 30 feet	<0.010	<0.00300	0.0119	0.00788	<0.000100	<0.000200	<0.00100	<0.00100	<0.00100
SD/B05/30-35/01	30 feet to 35 feet	<0.010	<0.00300	0.0109	0.0112	<0.000100	<0.000200	<0.00100	<0.00100	<0.00100
SD/B05/35.5-39.5/01	35.5 feet to 39.5 feet	<0.010	0.0141	0.0137	0.0128	<0.000100	<0.000200	<0.00100	<0.00100	0.00115
SD/B05/42-43/01	42 feet to 43 feet	<0.010	0.00999	0.0127	0.0158	<0.000100	<0.000200	<0.00100	<0.00100	0.00187
SD/B05/45-46.5/01	45 feet to 46.5 feet	<0.010	<0.00300	<0.00300	0.0956	<0.000100	<0.000200	<0.00100	0.00142	<0.00100
SD/B06/0-5/01	0 feet to 5 feet	<0.010	<0.00300	0.0164	0.0166	<0.000100	<0.000200	<0.00100	<0.00100	0.00198
SD/B06/5-10/01	5 feet to 10 feet	<0.010	<0.00300	0.0129	0.0101	<0.000100	<0.000200	<0.00100	<0.00100	0.00158
SD/B06/10-15/01	10 feet to 15 feet	<0.010	<0.00300	0.0158	0.0190	<0.000100	<0.000200	<0.00100	<0.00100	<0.00100
SD/B06/15-17.5/01	15 feet to 17.5 feet	<0.010	<0.00300	<0.00300	0.0484	<0.000100	<0.000200	<0.00100	0.00131	0.00199
SD/B06/21-23.5/01	21 feet to 23.5 feet	<0.010	<0.00300	<0.00300	0.0199	<0.000100	<0.000200	<0.00100	0.00349	<0.00100
SD/B06/23.5-25/01	23.5 feet to 25 feet	<0.010	<0.00300	<0.00300	0.0108	<0.000100	<0.000200	<0.00100	0.00117	<0.00100

Table 9 DI WET Laboratory Results for Borehole Samples (mg/L) (continued)

Sample ID	Depth Interval	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Deep Subsurface Material Samples (5 feet and deeper)										
SD/B01/0-4.5/01	0 to 4.5 feet	<0.00300	<0.0002	0.00430	0.00136	<0.00300	<0.000100	<0.00100	<0.00100	0.00454
SD/B01/5-7.3/01	5 feet to 7.3 feet	<0.00300	<0.0002	0.00936	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00209
SD/B01/7.3-10/01	7.3 feet to 10 feet	<0.00300	<0.0002	0.00397	0.00318	<0.00300	<0.000100	<0.00100	<0.00100	0.0137
SD/B01/10-12.3/01	10 feet to 12.3 feet	<0.00300	<0.0002	0.00869	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00369
SD/B01/12.5-15/01	12.5 feet to 15 feet	<0.00300	<0.0002	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00524
SD/B01/15-17.5/01	15 feet to 17.5 feet	<0.00300	<0.0002	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00888
SD/B02/0-4.5/01	0 to 4.5 feet	<0.00300	<0.0002	0.00626	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00260
SD/B02/4.5-9.5/01	4.5 feet to 9.5 feet	<0.00300	0.0003	0.0277	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00192
SD/B02/13.5-17/01	13.5 feet to 17 feet	<0.00300	0.0005	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	0.0319	0.00835
SD/B02/17-19.5/01	17 feet to 19.5 feet	<0.00300	<0.0002	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00260
SD/B03/0-4.5/01	0 feet to 4.5 feet	<0.00300	<0.0002	0.00264	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00101
SD/B03/5-10/01	5 feet to 10 feet	<0.00300	<0.0002	0.00962	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00229
SD/B03/10-15/01	10 feet to 15 feet	<0.00300	0.0002	0.00238	<0.00100	<0.00300	<0.000100	<0.00100	0.00136	0.0172
SD/B03/20-22.5/01	20 feet to 22.5 feet	0.00390	<0.0002	0.00189	<0.00100	<0.00300	<0.000100	<0.00100	0.00120	0.00954
SD/B03/29.5-30/01	29.5 feet to 30 feet	<0.00300	<0.0002	0.00417	<0.00100	<0.00300	<0.000100	<0.00100	0.00366	<0.00100
SD/B03/32-33.5/01	32 feet to 33.5 feet	<0.00300	0.0003	0.00128	<0.00100	<0.00300	<0.000100	<0.00100	0.00524	0.00129
SD/B03/34-35.5/01	34 feet to 35.5 feet	0.00603	<0.0002	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	0.00104	0.00934
SD/B05/0-4.5/01	0 feet to 4.5 feet	<0.00300	0.0003	0.0104	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00246
SD/B05/5-10/01	5 feet to 10 feet	<0.00300	0.0002	0.00932	<0.00100	<0.00300	<0.000100	<0.00100	0.00107	0.00198
SD/B05/10-15/01	10 feet to 15 feet	<0.00300	0.0006	0.0162	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00335
SD/B05/15-20/01	15 feet to 20 feet	<0.00300	<0.0002	0.00375	<0.00100	<0.00300	<0.000100	<0.00100	0.00149	0.00209
SD/B05/25-30/01	25 feet to 30 feet	<0.00300	<0.0002	0.00560	<0.00100	<0.00300	<0.000100	<0.00100	0.00110	0.00131
SD/B05/30-35/01	30 feet to 35 feet	<0.00300	<0.0002	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	0.00282	0.00337
SD/B05/35.5-39.5/01	35.5 feet to 39.5 feet	<0.00300	<0.0002	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	0.00452	0.00164
SD/B05/42-43/01	42 feet to 43 feet	<0.00300	0.0004	0.00272	<0.00100	<0.00300	<0.000100	<0.00100	0.00385	0.00185
SD/B05/45-46.5/01	45 feet to 46.5 feet	<0.00300	<0.0002	0.00399	<0.00100	<0.00300	<0.000100	<0.00100	0.00497	0.00612
SD/B06/0-5/01	0 feet to 5 feet	<0.00300	<0.0002	0.00826	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00273
SD/B06/5-10/01	5 feet to 10 feet	<0.00300	<0.0002	0.00962	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00613
SD/B06/10-15/01	10 feet to 15 feet	<0.00300	<0.0002	0.00486	<0.00100	<0.00300	<0.000100	<0.00100	0.00113	0.00153
SD/B06/15-17.5/01	15 feet to 17.5 feet	<0.00300	0.0003	0.00274	<0.00100	<0.00300	<0.000100	<0.00100	0.00122	0.00944
SD/B06/21-23.5/01	21 feet to 23.5 feet	<0.00300	<0.0002	<0.00100	0.00268	<0.00300	<0.000100	<0.00100	<0.00100	0.00675
SD/B06/23.5-25/01	23.5 feet to 25 feet	<0.00300	<0.0002	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00428

Table 10 Total Metals Analysis for Vegetation Samples (mg/Kg)

Sample ID	Species Type	Sb	As	Ba	Be	Cd	Cr	Co	Cu
SD/B14+00/HB/01	Himalyan Blackberry	<2	<4	58.1	<0.2	1.3	<1	1	5
SD/B14+00/JU/01	Juncus sp.	<2	<8	20.8	<0.2	6.3	<1	<1	5
SD/B14+00/SA/01	Willow	<2	<4	44.7	<0.2	10.2	<1	2	7
SD/E11+00/HB/01	Himalyan Blackberry	<2	<4	27.2	<0.2	6.0	1	2	7
SD/E11+00/JU/01	Juncus sp.	<2	<8	33.2	<0.2	12.4	<1	<1	9
SD/E11+00/SA/01	Willow	<2	<4	34.3	<0.2	24.1	<1	7	6
SD/I11+00/HB/01	Himalyan Blackberry	<2	<4	60.6	<0.2	0.5	<1	<1	8
SD/I11+00/SA/01	Willow	<2	<4	70.8	<0.2	17.4	<1	2	6

Sample ID	Species Type	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
SD/B14+00/HB/01	Himalyan Blackberry	8	<0.1	1	<1	0.08	<1	<30	<0.5	31
SD/B14+00/JU/01	Juncus sp.	<4	<0.09	<1	<1	0.05	<1	<30	<0.5	43
SD/B14+00/SA/01	Willow	<4	<0.09	<1	1	0.16	<1	<30	<0.5	448
SD/E11+00/HB/01	Himalyan Blackberry	<4	<0.1	<1	2	0.07	<1	<30	<0.5	37
SD/E11+00/JU/01	Juncus sp.	<4	<0.09	<1	<1	0.05	<1	<30	<0.5	63
SD/E11+00/SA/01	Willow	<4	<0.09	<1	1	0.09	<1	<30	<0.5	362
SD/I11+00/HB/01	Himalyan Blackberry	<4	<0.09	1	1	<0.05	<1	<30	<0.5	25
SD/I11+00/SA/01	Willow	<4	<0.09	<1	2	<0.05	<1	<30	<0.5	345

Table 11 Underflow Monitoring Sampling Summary and Field Parameter Data

Location	Sample Date	Sample Time	Flow (cfs)	pH (std. units)	Specific Conductance (uS/cm)	Temp (°C)
SDT-1	9/19/2008	9:30	0.049	6.03	332	NR
SDT-1	10/21/2008	14:00	0.044	6.36	336	11.3
SDT-1	11/18/2008	16:15	0.039	7.50	390	12.4
SDT-1	12/16/2008	12:15	0.051	6.69	428	10.5
SDT-1	1/16/2009	11:30	0.41	7.64	338	7.8

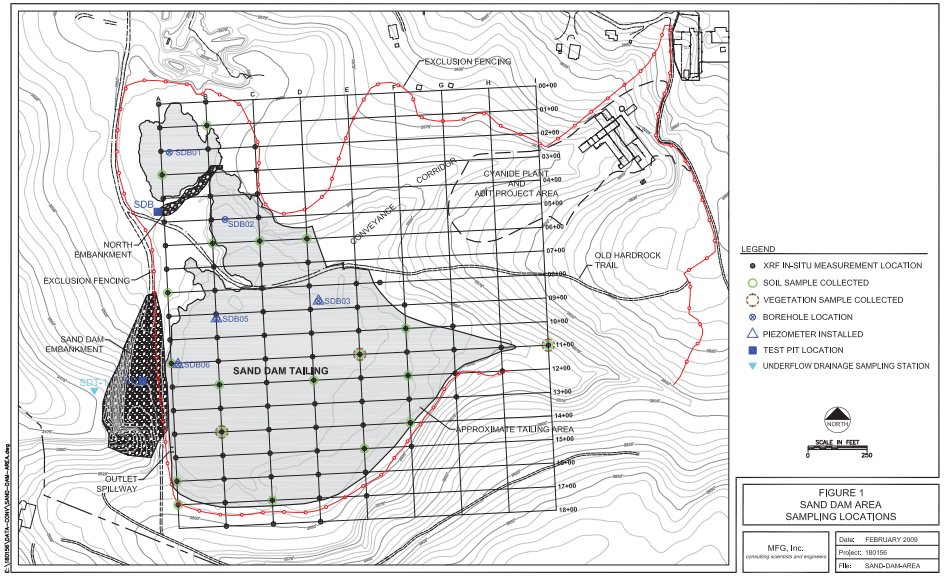
NR=not recorded

Table 12 Sand Dam Underflow Water Quality Laboratory Results

Sample Location		SDT		SDT		SDT		SDT		SDT	
Sample Date		9/19/2008		10/21/2008		11/18/2008		12/16/2008		1/16/2009	
Sample ID		SDT-01-190908		SDT-01-102108		SDT-01-111808		SDT-01-121608		SDT-01-011609	
Analyte	Type	Conc.	Lab Qual	Conc.	Lab Qual	Conc.	Lab Qual	Conc.	Lab Qual	Conc.	Lab Qual
Aluminum	Dissolved	<0.03	U	<0.03	U	<0.03	U	<0.03	U	<0.03	U
	Total	1.71		0.20	B	0.31		0.17	B	0.13	B
Antimony	Dissolved	<0.004	U	<0.0004	U	<0.004	U	<0.004	U	<0.004	U
	Total	<0.004	U	<0.0004	U	<0.004	U	<0.004	U	<0.004	U
Arsenic	Dissolved	0.0034		0.0032		0.0040		0.0045		0.003	B
	Total	0.0207		0.0096		0.0159		0.0100		0.0042	
Barium	Dissolved	0.0263		0.0272		0.0266		0.0313		0.0248	
	Total	0.0412		0.0315		0.0334		0.0350		0.0297	
Cadmium	Dissolved	0.0002	B	0.0002	B	0.0002	B	0.0002	B	<0.0002	U
	Total	0.0030		0.0012		0.0017		0.0012		0.0003	B
Calcium	Dissolved	61.8		65.0		64.9		71.4		40.7	
Chromium	Dissolved	<0.0001	U	<0.0001	U	<0.0001	U	<0.0001	U	<0.0001	U
	Total	0.0008		0.0004	B	<0.0001	U	<0.0001	U	<0.0001	U
Cobalt	Dissolved	0.00039		0.00032		0.00047		0.00061		0.0003	B
	Total	0.00700		0.00263		0.00359		0.00241		0.00067	
Copper	Dissolved	<0.0005	U	0.0010	B	<0.0005	U	0.0007	B	<0.0005	U
	Total	0.0242		0.0052		0.0091		0.0050		0.0024	B
Iron	Dissolved	<0.02	U	<0.02	U	<0.02	U	<0.02	U	<0.02	U
	Total	2.48		0.50		0.88		0.50		0.14	
Lead	Dissolved	<0.0001	U	<0.0001	U	<0.0001	U	<0.0001	U	0.0002	B
	Total	0.0110		0.0031		0.0047		0.0028		0.0007	
Magnesium	Dissolved	5.5		5.5		5.8		6.4		4.9	
Manganese	Dissolved	<0.005	U	<0.005	U	<0.005	U	<0.005	U	<0.005	U
	Total	0.623		0.234		0.352		0.267		0.036	
Mercury	Dissolved	<0.002	U	<0.002	U	<0.002	U	<0.002	U	<0.002	U
	Total	0.0018		<0.002	U	0.0005	B	<0.002	U	<0.002	U
Nickel	Dissolved	0.0013	B	0.0011	B	0.0022	B	0.0017	B	0.002	B
	Total	0.0035		0.0025	B	0.0038		0.0022	B	0.0025	B
Potassium	Dissolved	1.3	B	1.7	B	1.2	B	1.3	B	1.2	B
Silica	Dissolved	11.0		11.2		12.5		12.7		13.5	
Sodium	Dissolved	4.5		4.8		4.7		4.8		4.4	
Thallium	Dissolved	<0.0001	U	<0.0001	U	<0.0001	U	<0.0001	U	0.0003	B
	Total	<0.0001	U	0.0002	B	<0.0001	U	<0.0001	U	0.0002	B
Vanadium	Dissolved	<0.0002	U	<0.0002	U	<0.0002	U	<0.0002	U	0.0013	B
	Total	0.0030		0.0003	B	0.0006	B	0.0002	B	0.0005	B
Zinc	Dissolved	0.004	B	0.005	B	0.004	B	0.008	B	0.005	B
	Total	0.061		0.027		0.035		0.028		0.008	B
Bicarbonate		111		108		117		122		67	
Carbonate		<2	U	4	B	<2	U	<2	U	<2	U
Chloride		4	B	4	B	4	B	4	B	5	B
Cyanide, WAD		-		<0.005	U	<0.005	U	<0.005	U	<0.005	U
Hardness as CaCO3		177		185		186		205		122	
Nitrate/Nitrite as N		0.10	B	0.06	B	0.07	B	0.06	B	0.43	
pH		8.1	H	8.4	H	8.2	H	8.2	H	8.2	H
Specific Conductance		367		353		362		380		68	
Sulfate		56		60		64		82		47	
TDS		211		221		227		256		160	
TSS		5	B	6	B	5	B	<5	U	<5	U
Total Alkalinity		111		112		117		122		67	

All reported concentrations are in mg/L except for pH (s.u.) and specific conductance (umohs/sm)
Lab Qualifiers: B- Estimated value, analyte detected at values less than Reporting Limit and greater than Method Detection Limit. < and U – Analyte less than Method Detection Limit. H- Holding time exceeded.

FIGURES


EXCLUSION FENCING
CORRIDOR
CYANIDE PLANT AND ADIT PROJECT AREA
CONVEYANCE
OLD HARDROCK TRAIL
NORTH EMBANKMENT
EXCLUSION FENCING
SAND DAM EMBANKMENT
SDB
SDB01
SDB02
SDB03
SDB05
SDB06
SDT-01
SAND DAM TAILING
APPROXIMATE TAILING AREA
OUTLET SPILLWAY
00+00
01+00
02+00
03+00
04+00
05+00
06+00
07+00
08+00
09+00
10+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00
18+00
LEGEND
XRF IN-SITU MEASUREMENT LOCATION
SOIL SAMPLE COLLECTED
VEGETATION SAMPLE COLLECTED
BOREHOLE LOCATION
PIEZOMETER INSTALLED
TEST PIT LOCATION
UNDERFLOW DRAINAGE SAMPLING STATION
NORTH
SCALE IN FEET
0
250
FIGURE 1
SAND DAM AREA
SAMPLING LOCATIONS
MFG, Inc.
consulting scientists and engineers
Date: FEBRUARY 2009
Project: 180156
File: SAND-DAM-AREA

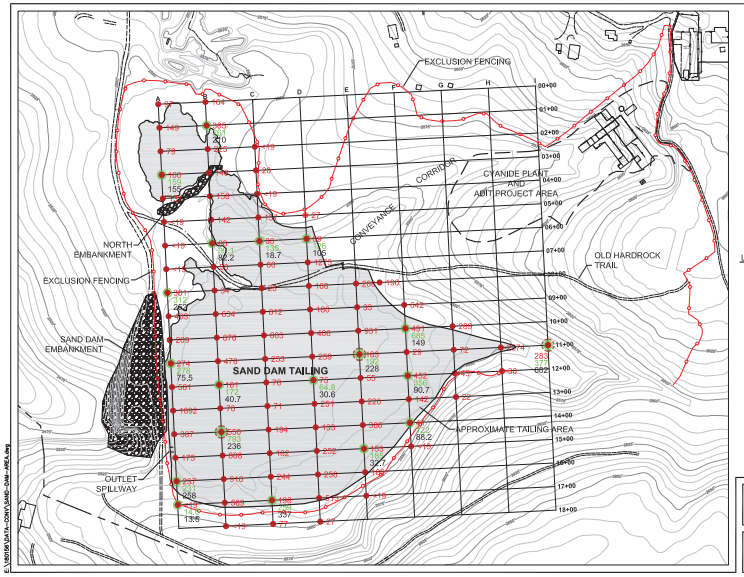


FIGURE 2
SAND DAM AREA
ARSENIC CONCENTRATIONS

MFG, Inc.
consulting scientists and engineers

Date: FEBRUARY 2009
Project: 180156
File: SAND-DAM-AREA

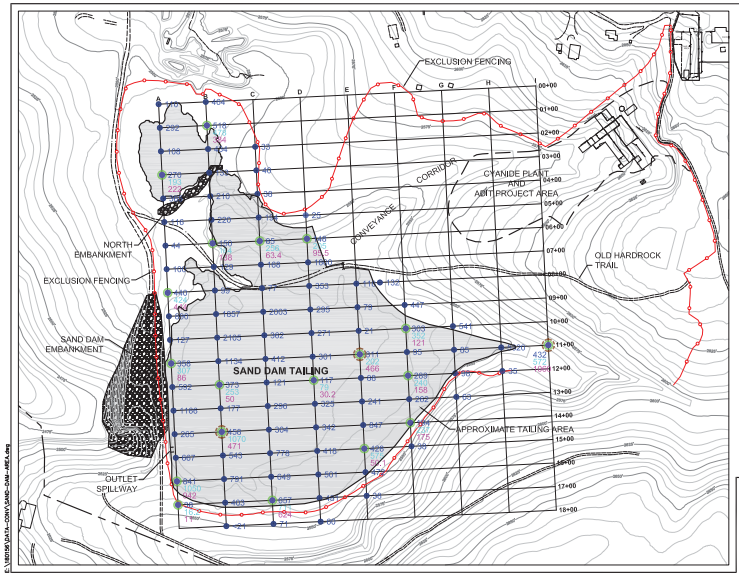


FIGURE 3
SAND DAM AREA
LEAD CONCENTRATIONS

MFG, Inc.
consulting scientists and engineers

Date: FEBRUARY 2009
Project: 180156
File: SAND-DAM-AREA

Additional Attachments are On-File with the Department of Parks and Recreation and on their Website:

http://www.parks.ca.gov/?page_id=981

Appendix C-5:
Historic Mine and Mill 2009 Data Transmittal Report

DRAFT
DATA TRANSMITTAL AND EVALUATION REPORT
FOR THE
HISTORIC MINE AND MILL SITES
2008 WORK PLAN
EMPIRE MINE STATE HISTORIC PARK
MARCH 2009

Prepared by:

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consulting scientists and engineers

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Fort Collins, CO 80525
(970) 223-9600
FAX: (970) 223-7171

I certify under penalty of law that I have examined and am familiar with this Work Plan, and to my knowledge, the report is true, complete, and accurate.

Keith Steven Thompson, California Professional Geologist

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1.0 PURPOSE

This Data Transmittal Report presents field and laboratory data from historic mining and milling sites at the Empire Mine State Historic Park (SHP), Grass Valley, California. This investigation was conducted in accordance with the Historic Mine and Mill Sites 2008 Work Plan (Work Plan) (MFG, 2008a), which consisted of characterizing the physical conditions and geochemical properties of 13 waste rock areas.

2.0 SUMMARY OF SAMPLE COLLECTION AND SITE CHARACTERIZATION

The objectives of the Work Plan (MFG, 2008a) were to: (1) conduct a visual characterization of the 13 identified waste rock areas in the Park (configuration, erosional features, vegetation, and geologic lithology) and (2) characterize geochemical properties related to the waste rock materials including metals concentrations, pH and acid generation potential (AGP). A waste rock area is defined as a discrete waste rock pile associated with a particular mine location or source. A total of 30 waste rock areas, which range in size from less than 0.10 to 4.7 acres, have been identified in the Park (Table 1, Figure 1). The 2007 Historic Mine and Mill Survey (MFG, 2008b) described 28 waste rock areas, with two additional waste rock areas being identified during surveys performed under this Work Plan. Each area was classified according to size, human accessibility, and proximity to existing trails or other Park facilities (MFG, 2008b). Accessibility was defined as easy (accessible by walking over even terrain with no impeding vegetation), moderate (accessible by foot only with moderate exertion over uneven terrain and/or through impeding vegetation), or difficult (accessible by foot only with strong exertion over steep terrain and/or through dense, impeding vegetation). Proximity was defined as either a primary Park feature, adjacent to a primary Park feature (less than 100 feet from trails/facilities), or distant from a primary Park feature (greater than 100 feet from trails/facilities).

Using this classification, 11 of the 30 sites were selected for characterization because they have waste rock areas that are relatively large, are classified as either a primary Park feature or adjacent to a Park feature, and are easily accessible. These 11 sites are:

- Betsy Mine – The Betsy Mine consists of a waste rock pile (0.87 acre) located at the intersection of the Betsy Mine/Osborne Hill Loop trails and is associated with a backfilled shaft to the south containing scattered waste rock (0.15 acre).
- Conlon Mine – The Conlon Mine contains an approximately 40-foot high, elongated waste rock pile (1.0 acre) which is located in a surface drainage and adjacent to the Conlon Mine trail.
- Daisy Hill Mine – The Daisy Hill Mine contains a 40-foot high conical waste rock pile (0.23 acre) which is directly adjacent to the Osborne Hill Loop trail. The perimeter of this waste rock pile is bordered by a small foot path.
- Empire Mine – The Empire Mine contains the largest historic waste rock area in the Park (4.7 acre) and is located directly south of the Historic Grounds.
- Josephine Lode – The Josephine Lode waste rock pile (0.17 acre) is located in a wooded area and directly adjacent to the intersection of the Power Line/Osborne Hill Loop trails.

- Orleans Mine/Mill – The Orleans Mine contains remnant building foundations and mining equipment. This area contains scattered waste rock and an elongated waste rock pile (0.5 acre).
- Pennsylvania Mine/Mill – The Pennsylvania Mine area contains building foundations and is located at the Hardrock trailhead. The Hardrock Trail was constructed across the surface of the Pennsylvania Mine waste rock area, which is approximately 40 feet thick and covers approximately 2.7 acres.
- Prescott Hill Mine – The Prescott Hill Mine contains foundations of a remnant mining and milling operation and is located adjacent to the Prescott Hill Crosscut and Osborne Hill Loop trails. The total area of the Prescott Hill Mine waste rock is approximately 2.9 acres, which is intersected by a natural drainage to Little Wolf Creek.
- Rowe Mine – The Rowe Mine is located adjacent to the Memorial Park trail and contains building foundations and a headframe. The Rowe Mine waste rock area includes a 10-foot high waste rock pile (0.45 acre) to the north (Rowe-A) and a larger 35-foot high elongated waste rock pile to the south (1.4 acre) (Rowe-B).
- Sebastopol Mine – The Sebastopol Mine and associated waste rock area are located directly adjacent to the Osborne Hill Loop trail. The waste rock is scattered over an approximately 0.54-acre area.
- WYOD Mine/Mill – The WYOD Mine contains building foundations and mining equipment directly adjacent to the Hardrock Trail. The WYOD Mine waste rock area is approximately 1.6 acres.

The following two waste rock areas, which are distant from existing trails and not easily accessible, were also characterized due to their proximity to surface drainages:

- Heuston Hill Mine – The Heuston Hill Mine contains a waste rock pile that is approximately 40 feet high and covers approximately 0.55 acres on a gently sloping wooded hillside.
- Woodbury Mine – The Woodbury Mine contains scattered waste rock over an approximate area of 0.31 acres. A few waste rock piles extend to an approximate height of 30 feet. The waste rock is located on a gently sloping, wooded hillside.

Two waste rock embankments in the Sand Dam Area (Sand Dam-A and Sand Dam-B) and one waste rock embankment in the Stacy Lane Pond Area (Stacy Lane Pond Embankment) (Figure 1) are also adjacent to existing trails and easily accessible (Table 1). These three waste rock embankments are addressed in separate Work Plans (MFG, 2008c, 2008d) and Data Transmittal and Evaluation Reports (MFG, 2009a, 2009b).

2.1 Visual Characterization

A visual survey of the 13 areas was performed to characterize the overall composition and configuration of the waste rock materials. At each area, waste rock geologic lithology and the presence of sulfide

mineralization, as identifiable with a hand lens, were determined and recorded on approximately 50-foot centers. The areal extent of each area was determined by delineating the waste rock boundary with a hand-held GPS unit, and used in conjunction with visual estimates of pile heights to determine approximate volume estimates for each of the 13 waste rock areas. For each area, the topography, erosional features (rills, gullies), proximity to surface drainages, and vegetation of the waste rock and surrounding areas were observed and recorded. Plant basal and litter cover were estimated using the Daubenmire Method (Daubenmire, 1959) with a 20- x 50-cm frame on approximately 50-foot centers.

2.2 Waste Rock Sampling

Waste rock samples were collected from the surface (0 to 6 inches) and subsurface (intended in the Work Plan to be a minimum depth of four feet; see next paragraph for qualifiers) for geochemical characterization. One surface composite sample of each waste rock lithologic type was collected from each of the 13 areas. Three surface composite samples were collected for each waste rock lithology per acre for each waste rock area greater than or equal to one acre in size. The composite samples were collected using a stainless-steel hand trowel or shovel and then passed through a stainless-steel (1-inch mesh) sieve.

Subsurface waste rock samples were collected by backhoe test pit excavation from the seven largest waste rock deposits: (1) Empire Mine, (2) Pennsylvania Mine, (3) WYOD Mine, (4) Prescott Hill Mine, (5) Rowe Mine-Waste Rock Area B, (6) Betsy Mine, and (7) Conlon Mine (Figure 1). Test pits were excavated using a John Deere 310-D backhoe. According to the Work Plan, the subsurface samples were to be collected at a minimum depth of four feet or until back hoe refusal. Backhoe access to five of the locations was restricted to the side slopes of the waste rock area, and continual sloughing of material into the excavations restricted sampling to shallower depths. Once each test pit excavation was completed, a composite subsurface sample from the bottom of the pit, not including sloughed materials, was collected using a stainless-steel hand trowel or shovel, and then passed through a stainless-steel (1-inch mesh) sieve.

All surface and subsurface samples were stored in Ziploc® bags under dry ice prior to shipping to the laboratory. Before collection of each sample, sampling equipment was decontaminated by brushing with a laboratory detergent solution, followed by rinsing with distilled water.

2.3 Analytical Methods

Laboratory analyses were performed by SVL Analytical, Inc. (SVL) of Kellogg, Idaho. SVL is accredited (NELAP) by the California Department of Public Health Services. The samples were analyzed

for acid-base accounting (ABA) and past pH, total metals concentrations, and water-soluble metal con concentrations by the State of California Modified Waste Extraction Test (DI WET). The analytical methods are summarized in Sections 2.3.1 through 2.3.3, and Table 2 summarizes the number and types of geochemical tests performed on the samples.

2.3.1 Acid Base Accounting and Paste pH

ABA and paste pH analyses are useful for assessing the potential for chemical weathering and metals mobility through the generation of acidity from metal sulfide oxidation. ABA involves determination of the acid generation potential (AGP) and acid neutralization potential (ANP) according to EPA Method 600/2-078-54 (Sobek and others, 1978). The AGP component of ABA provides information regarding the various forms of sulfur (S) (non-extractable-S, sulfide-S, and sulfate-S), including total-S. The difference between the ANP and AGP is the ABA, which provides a measure of the potential net acid generation or neutralization potential and is presented in terms of tons of calcium carbonate per thousand tons of the analyzed material (T $CaCO_3$/kT). A measure of the readily-available acidity was determined by paste pH analysis (USDA, 1954). The ABA and paste pH analyses were conducted on a single surface composite and each subsurface composite sample from each waste rock area.

2.3.2 Total Metals

The waste rock surface composite and subsurface composite samples were analyzed for total arsenic, lead, and cadmium. A composite sample from each waste rock area was analyzed for total CAM-17 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc). Laboratory analyses for total metal concentrations were conducted according to USEPA Method 3050 (USEPA, 1986).

2.3.3 Modified State of California Waste Extraction Test (DI WET)

Each sample analyzed for total CAM-17 metals was also analyzed for water-soluble CAM-17 metals using the DI WET procedure. The DI WET procedure involves leaching 50 grams of a solid material with an equivalent volume of deionized water for 48 hours (Department of Toxic Substances Control in Title 22, California Code of Regulations, Division 4.5, Chapter 11, Appendix II). After 48 hours, the leachate is collected and passed through a 0.45-micron filter, preserved, and analyzed for dissolved metal concentrations.

3.0 VISUAL CHARACTERIZATION RESULTS

Visual characterization of the 13 waste rock areas (Section 2.0) included an evaluation of the topography and configuration, areal extent, erosional features, proximity to surface drainages, lithology, and degree of sulfide mineralization. An evaluation of vegetation types and measurement of total cover (plant basal plus litter cover) was also conducted. The detailed results of the visual characterization are provided in Appendix A, and detailed vegetation type and cover data are provided in Appendix B. Waste rock area test pit logs and visual descriptions of the waste rock materials are provided in Appendix C.

The visual characterization results for each of the 13 waste rock areas are presented on Figures 2 through 14. Each figure depicts the areal footprint of the respective waste rock area and the approximate location of each surface sample collection and test pit. Each figure contains a table which summarizes the topography, configuration, areal extent, approximate volume, geologic lithology, vegetation type, plant basal and litter cover.

Visual characterization results indicate that most waste rock areas are located in gently-sloping wooded areas away from surface drainages. The waste piles are usually conical or elongated and have steep side slopes. Erosional features are generally absent, with the exception of small-scale erosion along some trail surfaces associated with a waste rock area (Betsy, Conlon, Daisy Hill, and Orleans), and limited larger-scale erosional gullies at a few other locations (Pennsylvania, Rowe-B, and WYOD). The lithology of most waste rock areas is dominated by diabase exhibiting various degrees of weathering and iron oxide staining; however, the Empire, Pennsylvania, Rowe-B, and WYOD waste rock areas contain a large percentage (generally 50 percent) of granodiorite exhibiting various degrees of alteration. Where present, sulfide mineralization is generally described as finely-disseminated, with most mineralization associated with veining. Information regarding the areal extent and configuration of the deposits was used to calculate estimated waste rock volumes. The estimated waste rock volumes are presented in Table 3 and ranged from 1,640 cubic yards at the Woodbury Mine to 87,000 cubic yards at the Pennsylvania Mine.

Vegetation types in the waste rock areas are dominated by Ponderosa pine, manzanita, oak, Douglas-fir, and various grasses. Basal vegetative cover ranged from 2.9 percent at the Betsy Mine to 32.5 percent at the Prescott Hill Mine. Canopy cover was not determined for the areas. The range in litter cover was from 5.9 percent at the WYOD Mine to 77.5 percent at the Josephine Load Mine. The Daisy Hill Mine waste rock contained the lowest amount of bare ground (2.5 percent), while the WYOD Mine waste rock contained the greatest amount of bare ground (84.3 percent). Because the cover measurements were conducted during Fall of 2008, the dormant season, the basal cover measurements are considered to be minimum values when compared to anticipated Spring and Summer conditions.

4.0 GEOCHEMICAL RESULTS AND EVALUATION

Geochemical characterization of the waste rock materials included analysis of surface (0 to 6 inches) and subsurface samples for ABA, paste pH, total CAM-17 metals, and DI WET extractable CAM-17 metals. The geochemical results for all samples are summarized in Sections 4.1 through 4.4, and the laboratory analytical reports and chain-of-custody forms are provided in Appendix D.

4.1 Acid-Base Accounting and Paste pH

The ABA values for the 14 surface samples (Table 4) ranged from -3.69 to 44.8 T $CaCO_3$/kT. Nine of the samples are classified as non-acid-generating, while five are classified as acid-generating based upon their negative ABA values. The majority of the samples exhibiting negative ABA values also had pH values less than 5, whereas most samples with positive ABA values had pH values greater than 6.

The ABA and paste pH values of the waste rock areas are generally lower in surface samples collected from the Osborne Hill Area when compared to those from the Central Area (Figure 15). All surface samples which exhibited a negative ABA, and hence a potential to produce acidity, were collected from the Osborne Hill Area, with the exception of a sample collected from a localized zone of highly-weathered material at the WYOD Mine (Central Area). However, the low ABA and pH values are not particularly related to the sulfide-S content or lithology of waste rock within a given area, but rather to the ANP of the waste rock. For example, waste rock samples containing the highest sulfide-S content (e.g., Pennsylvania and Prescott Hill Mines) also contained high ANP values such that the overall ABA was highly positive (Table 4, Figure 15).

The ABA values for the subsurface waste rock samples (Table 5) ranged from -14.2 to 138 T $CaCO_3$/kT, with only one subsurface sample (from the Betsy Mine) displaying a negative ABA value. The pH values of the subsurface samples ranged from 6.02 to 7.98, indicating an absence of readily-available acidity.

4.2 Total CAM-17 Metal Results

Selected surface and subsurface waste rock samples were analyzed for total CAM-17 metals, with a larger set of surface samples analyzed for total arsenic, cadmium, and lead (Table 2). Table 6 lists the total arsenic, cadmium, and lead concentrations for all samples, and Figure 16 compares their mean surface concentrations between locations. Lead concentrations range from 17.3 to 1,480 mg/Kg, cadmium concentrations range from less than 0.2 to 11.8 mg/Kg, and arsenic concentrations range from 10.1 to 15,300 mg/Kg.

Total metal concentrations from the waste rock area were compared to the California Human Health Screening Levels (CHHSLs) for residential and commercial/industrial use (California Environmental Protection Agency [CEPA], 2005) as a conservative screening level assessment to identify potential constituents of concern to human health. If metal concentrations are less than the CHHSLs, then the metal concentrations are considered to be below thresholds for risk to human health. The residential CHHSLs were developed using an exposure scenario of 350 days per year for 30 years, and the commercial/industrial CHHSLs were developed using an exposure scenario of 250 days per year for 20 years. Future land use in the area is expected to be limited to controlled recreational use, such as hiking or wildlife observation, along established trails and pathways. Given the Park setting, residential uses of the majority of the waste rock areas are unlikely to exist in the future. Metals present at concentrations below the residential CHHSLs are therefore conservatively below thresholds for risk to human health and are eliminated as constituents of concern. Furthermore, potential human health exposure to surface materials due to possible future controlled recreational uses in the waste rock areas is also considered less than that for the commercial/industrial exposure scenario. As such, metal concentrations less than the commercial/industrial CHHSLs are not considered potential constituents of concern to human health.

Antimony, barium, beryllium, chromium, cobalt, copper, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc concentrations are all below residential CHHSLs. Lead concentrations are below the commercial/industrial CHHSL for lead (3,500 mg/Kg). Cadmium concentrations in two samples from the Pennsylvania Mine (Table 6) are greater than the commercial/industrial CHHSL of 7.5 mg/Kg. Arsenic concentrations exceed the commercial/industrial CHHSL of 0.24 mg/Kg in all samples.

The maximum arsenic concentrations measured in waste rock are associated with the Osborne Hill Area (Figure 16). For example, most of the surface samples from the Betsy, Conlon, Prescott Hill, Sebastopol, and Woodbury Mines contain arsenic concentrations greater than 1,000 mg/kg, and range between 936 and 15,300 mg/kg, with a mean arsenic concentration of 2,250 mg/kg. Arsenic concentrations in waste rock samples collected from the Pennsylvania Mine and the Rowe Mine-B were less than 270 mg/kg (Table 6). In 2006, the DTSC Human and Ecological Risk Division (HERD) recommended a remediation goal for arsenic on trail surfaces of 270 mg/kg (Klein, 2006), based upon the exposure scenario of a runner using a trail four days a week for a one hour duration over 30 years.

4.3 DI WET CAM-17 Metal Results

Each surface and subsurface sample analyzed for total CAM-17 metals (Section 4.2) was also analyzed for DI WET-soluble CAM-17 metals. In general, the DI WET-soluble metal concentrations were low, with 60 percent of the surface metal concentrations (Table 9) and 79 percent of the subsurface metal

concentrations (Table 10) below the respective laboratory reporting limits. All of the soluble selenium, silver, and thallium concentrations were below laboratory reporting limits for surface samples. For the subsurface samples, all of the soluble antimony, beryllium, cadmium, selenium, silver, thallium, and vanadium concentrations were below laboratory reporting limits (Table 10).

The remaining CAM-17 metal concentrations that were above the laboratory reporting limit in either the surface or subsurface DI WET sample collections were evaluated in comparison to the applicable USEPA (1995) stormwater benchmark values (Federal Register, 1995). Concentrations of the CAM-17 metals from the DI WET extractions of all samples are below the stormwater benchmark values, with the exception of arsenic, which was greater than the stormwater benchmark value of 0.16854 mg/L for three of the 17 surface samples (Betsy, Heuston Hill, and Woodbury Mines). A single subsurface sample was greater than the stormwater benchmark value for arsenic at the Prescott Hill Mine (Table 10). The four sample locations where DI WET arsenic concentrations were greater than the stormwater benchmark (Betsy, Heuston Hill, Woodbury, and Prescott Hill Mines) also contain the highest surface mean total arsenic concentrations for the 13 waste rock areas (Figure 16). The relationship between DI WET-soluble arsenic and total arsenic concentrations in surface samples (Figure 17) suggests that the stormwater benchmark for arsenic is exceeded only in samples containing greater than 5,000 mg/Kg total arsenic.

5.0 UPDATE OF CONCEPTUAL SITE MODEL

The Phase 2 Data Gaps evaluation (MFG, 2007) identified mine and mill materials as a potential source of metals to receptors. The primary data gaps identified for waste rock related to identification and characterization of waste rock piles in the Central and Osborne Hill areas with respect to their areal extent, sulfide mineral content, and metal concentrations (MFG, 2007). Based upon the findings of the current study, adequate information has been collected to fill the identified data gaps, update the Conceptual Site Model (CSM) as necessary, and subsequently, prepare a Remedial Actions Analysis Report to evaluate the range of applicable action alternatives associated with the waste rock areas initially identified for additional characterization (MFG, 2008a).

An update of the CSM applied to the 13 waste rock areas is summarized in Table 11. Waste rock source characterization primarily identified arsenic above the designated CHHSLs at most of the 13 waste rock areas. The remaining 17 locations (Table 1) present little risk to receptors, because the moderate to difficult accessibility and absence of adjacent surface drainages will limit direct human contact and impacts to stormwater. All of the total CAM-17 metal concentrations from the Rowe Mine-B samples were below risk-based standards; therefore, the Rowe Mine-B waste rock deposit is not a source of constituents of concern (COCs) to receptors.

The potential release mechanisms for COCs which have been identified for waste rock include wind and water erosion, direct transport, and surface water runoff/chemical weathering (MFG, 2007). Based on the visual characterization results of erosional features and total cover (Section 3.0), wind and water erosion is not an expected release mechanism for the Betsy, Daisy Hill, Josephine Load, Orleans, Prescott Hill, Sebastopol, or Woodbury Mines. Evaluation of the DI WET data presented in this report indicate that surface water runoff/chemical weathering is not a potential release mechanism for all constituents at the 13 identified locations, with the exception of arsenic at the Betsy, Heuston Hill, and Woodbury Mines (Table 11).

The potential pathways for transport of COCs from mine and mill source materials to potential receptors are dust, soil, sediment, surface water, and plant uptake (MFG, 2007). The concentrations of the CAM-17 metals, with the exception of arsenic concentrations at all locations except the Pennsylvania Mine and Rowe Mine-B areas and cadmium at the Pennsylvania Mine area, are below the residential and /or commercial/industrial CHHSLs. The CHHSLs are considered safe for incidental ingestion, inhalation, and dermal exposure for residential and/or commercial industrial exposures. The potential exposures to human receptors at the waste rock areas are significantly less than the exposures used to calculate the

CHHSLs for residential and commercial/industrial scenarios. Arsenic (at all sites except Pennsylvania Mine and Rowe Mine-B) and cadmium (at Pennsylvania Mine) in surface and shallow subsurface materials remain as potential COCs for human receptors. Dust and soil can be eliminated as potential transport pathways to receptors for those metals that are no longer of concern (Table 11).

The potential release mechanism eliminated from the CSM based on data presented in this report consists of surface water runoff/chemical weathering. The potential transport pathways eliminated include dust and soil for those metals that are no longer of concern to human receptors. The remaining potential release mechanisms and transport pathways posited in the CSM (MFG, 2007) still exist.

6.0 APPLICABLE ALTERNATIVE ACTIONS

Examples of the potential remedial action(s) applicable to the waste rock materials include one or a combination of the following:

- No action. The waste rock areas would be left in their current condition, with no remediation or institutional controls.
- Placement of covers where appropriate. This action would involve regrading or stabilizing waste rock slopes and covering with a soil cover, an engineered clean-fill cover, or rock armoring. Soil covers would be re-vegetated with native plants. Cribbing, gabions and/or baskets would be used in certain areas to stabilize slopes or over-cut materials. Road construction would be required to access waste rock areas.
- Grading and in-situ vegetation of the waste rock materials where appropriate. Areas would be re-vegetated with native plants.
- Use of institutional controls (fencing, signs, etc.) to prevent or control access. This action would involve the installation and maintenance of fences and signage to preclude public access to certain sites or to restrict access to specific pathways for limited recreational use.
- Consolidation or relocation of waste rock materials from specific waste rock areas.
- Installation of engineered stormwater diversion or collection systems to control potential stormwater run-on or run-off.

The refinement of these and possibly other action(s) would be considered and refined based on site-specific conditions and uses, effectiveness in eliminating potential transport mechanisms and exposure routes to waste rock materials, attaining Park user needs, and cost.

7.0 REFERENCES

Daubenmire, R.F. 1959. Canopy coverage method of vegetation analysis. Northwest Science 33: 43-64.

Federal Register, 1995. Vol. 60, No. 189, September 29. p. 50826.

Klein, Kimiko to Perry Myers, 2006. Memorandum regarding Remediation Goals for the Recreational Runner on Trails, Empire Mine State Historical (sic) Park, Grass Valley, September 29, 2006, Department of Toxic Substances Control. P. Myers

MFG, Inc. (MFG), 2007. Data Gaps Report for the Empire Mine State Historic Park, Phase 2: Data Gaps Analysis. Prepared for the California Department of Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. January 15.

MFG, Inc. (MFG), 2008a. Historic Mine and Mill Sites, 2008 Work Plan, Empire Mine State Historic Park . Prepared for the California Department of Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. June.

MFG, Inc. (MFG), 2008b. Historic Mine and Mill Site Survey, Empire Mine State Historic Park. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. March.

MFG, Inc. (MFG), 2008c. Sand Dam Area 2008 Work Plan, Empire Mine State Historic Park . Prepared for the California Department of Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. June.

MFG, Inc. (MFG), 2008d. Stacy Lane Pond, 2008 Work Plan, Empire Mine State Historic Park . Prepared for the California Department of Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. June.

MFG, Inc. (MFG), 2008e. Conveyance Corridor 2008 Work Plan, Empire Mine State Historic Park. Prepared for the California Department of Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. May.

Sobek, A.A., W.A. Schuller, J.R. Freeman, and R.M. Smith, 1978. Field and Laboratory Methods Applicable to Overburden and Minesoils, EPA 600/2-78-054, 203 pp.

United States Department of Agriculture (USDA), 1954. L.A. Richards (ed). Diagnosis and Improvement of saline and alkali soils. USDA Handbook No. 60, USDA, Washington, D.C.

USEPA, 1986. Test Methods for Evaluating Solid Wastes, 3rd Edition. SW-846. USEPA Office of Solid Waste and Emergency Response, Washington, DC.

FIGURES

TABLES

Table 1 Mine and Mill Materials Identified During the 2007-2008 Historic Mine and Mill Site Survey

Mine/Mill/Area	Topography/General Area Description	Associated Mine/Mill Materials (Tailing or Waste Rock)	Proximity to Existing Trails/Facilities	Accessibility
Betsy Mine	Gently sloping wooded hillside	Scattered waste rock (0.15 acre) adjacent to shaft, larger waste rock pile (0.55 acre) north of shaft	Primary Park Feature	Easy access
Boundary Mine	Gently sloping wooded area Uneven terrain	Scattered waste rock in area (0.09 acre)	Distant	Moderate access
Cassidy Mine	Gently sloping wooded area	Scattered waste rock (0.15 acre) surrounding main disturbance area	Distant	Moderate access
Conlon Mine	Gently sloping wooded area	Elongated waste rock pile (1 acre) approx. 40 ft high; smaller conical pile 12 ft high	Primary Park Feature	Easy access
Conveyance Corridor	Flat wooded terrace	Conical waste rock pile approx. 15 ft high	Distant	Difficult
Daisy Hill Waste Rock	Gently sloping wooded area	Conical waste rock pile (0.06 acre) approx. 40 ft in height	Primary Park Feature	Easy access
Empire Mine	Historic grounds area	Waste rock area (4.7 acre) south of mine yard	Primary Park Feature	Easy access
Heuston Hill Mine	Gently sloping wooded hillside	Waste rock area (0.55 acre) approx. 40 ft high	Distant	Difficult access
Josephine Lode	Gently sloping wooded hillside, manzanita	Scattered waste rock pile (0.17 acre) in densely wooded area	Adjacent to Powerline/Osborne Hill Loop Trail intersection	Easy access
Madison Hill Mine	Steep dense wooded hillside, rock outcrop, excavation	Scattered waste rock (0.07 acre) surrounding shaft	Distant	Difficult access
Magenta Mine	Steeply sloping wooded area near Hwy 174	Scattered waste rock (0.17 acre) surrounding shaft	Distant	Moderate access
Old Incline	Gently sloping wooded area	Conical and slightly elongated waste rock pile (12 ft high)	Adjacent to Osborne Hill Loop Trail	Moderate Access
Orleans Mill	Flat wooded area at trail intersection	Scattered waste rock around mill foundations No mill materials identified	Primary Park Feature	Easy access
Orleans Mine	Gently sloping wooded area	Scattered, elongated waste rock piles (0.5 acre)	Primary Park Feature	Easy access
Pennsylvania Mine	Flat open area at trailhead	Waste rock (2.7 acre) sloping to the west approx. 40 ft high	Primary Park Feature	Easy access
Prescott Hill Mill	Flat to gently-sloping wooded area	Waste rock (1.5 acre) up to 50 ft high No mill materials identified	Primary Park Feature (designated Prescott Hill Mine)	Easy access

Table 1 Mine and Mill Materials Identified During the 2007-2008 Historic Mine and Mill Site Survey (continued)

Mine/Mill/Area	Topography/General Area Description	Associated Mine/Mill Materials (Tailing or Waste Rock)	Proximity to Existing Trails/Facilities	Accessibility
Prescott Hill Mine	Flat wooded area	Scattered waste rock (1.4 acre) in wooded and densely-vegetated area	Adjacent to Prescott Hill Crosscut Trail	Easy access
Rich Hill Mine	Gently sloping wooded area	Scattered waste rock (0.05 acre) approx. 130 ft to the east of former shaft	Distant	Moderate access
Rowe Mine-A	Flat, open area located between Rowe shaft and Highway 174	0.60 acre waste rock (10 ft high) with associated shaft and workings	Adjacent to Memorial Park Trail	Moderate access
Rowe Mine-B	Flat, open area between woods and Park	1.4 acre waste rock pile (35 ft high) with associated shaft and workings	Primary Park Feature	Easy Access
Sebastopol Mine	Gently sloping wooded area with large excavation	Scattered waste rock (0.54 acre)	Adjacent to Osborne Hill Loop Trail	Easy access
Sand Dam Area	Large open flat area with patches of trees and marshland vegetation	Waste Rock embankment (Sand Dam-A, 3.0 acres and Sand Dam-B, 0.23 acres) and mill tailing	Adjacent to Hardrock/Old Hardrock Trails	Sand Dam-A = Easy access (Sand Dam-B and tailing inside exclusion fencing)
Shaft-47	Gently sloping wooded area, thick underbrush	Waste rock (0.12 acre) surrounding shaft, and scattered waste rock (0.11 acre) directly southwest of shaft	Distant	Moderate access
Shaft-49	Gently sloping wooded area, thick underbrush	Scattered waste rock in area	Distant	Difficult access
Stacy Lane Pond	Flat wooded area with underbrush	Waste rock embankment (0.25 acre) contains approx. 0.75 acre of tailing	Adjacent to Stacey Lane Trail	Easy Access
Waste Rock-A	Gently sloping wooded area Thick underbrush	Waste rock area (0. 15 acre) of unidentified origin	Distant	Difficult access
Waste Rock-B	Gently-sloping manzanita covered hillside above Little Wolf Creek	Waste rock (less than 0.01 acre) approx. 8 ft high	Distant	Difficult access Within Closed Area fencing
Waste Rock-C	On steep hillside north of Pines Porch administrative building/parking lot	Two elongated waste rock piles (0.12 acre and 0.13 acre) approx. 10 ft high	Distant	Moderately accessible
Woodbury Mine	Gently sloping wooded natural drainage channel	Scattered waste rock (0.31 acre) and a few 30 ft high waste rock piles	Distant	Moderate access
WYOD Mine	Flat wooded area	Open scattered waste rock piles (1.6 acre)	Adjacent to Hardrock Trail	Easy access
Yankee Jack Mine	Gently sloping, dense wooded area	Scattered waste rock area (0.21 acre)	Distant	Moderate access

Table 2 Geochemical Testing Summary for Waste Rock Characterization

Sample Type	Laboratory Analyses			
	ABA Paste pH	Total As, Pb and Cd	Total Metals (CAM-17)	DI WET Metals (CAM-17)
Surface Materials (0 to 6 inches)	14	55	14	14
Subsurface Materials (greater than 48 inches)	7	7	7	7
Totals	21	62	21	21

Table 3 Estimated Waste Rock Volumes

Waste Rock Deposit	Estimated Area (acres)	Estimated Volume (cubic yards)
Betsy Mine	0.70	12,400
Conlon Mine	1.0	61,900
Daisy Hill	0.06	4,860
Empire Mine	4.7	18,900
Heuston Hill Mine	0.55	17,800
Josephine Load	0.17	1,820
Orleans Mine	0.50	1,350
Pennsylvania Mine	2.7	87,000
Prescott Hill Mine	1.5	30,800
Rowe Mine-A	0.60	10,900
Rowe Mine-B	1.4	66,400
Sebastopol Mine	0.54	8,630
Woodbury Mine	0.31	1,640
WYOD	1.6	78,500

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Table 4 Acid-Base Accounting Data for Surface Waste Rock Samples (0 to 6 Inches)

Location	Sample ID	pH	ABA	AGP	ANP	Sulfide-S	Sulfate-S	Total-S	Non-extractable-S
			----------TCaCO$_3$/kt----------			---------- % ----------			
Betsy Mine	WR/BET/02/06	5.49	-3.69	3.69	-0.3	0.12	0.23	0.34	<0.01
Conlon Mine	WR/CON/02/06	5.31	12.3	1.73	14	0.06	0.004	0.06	<0.01
Daisy Hill Mine	WR/DH/01/06	4.28	-2.52	3.12	0.6	0.10	0.2	0.3	<0.01
Empire Mine	WR/EMP/02/06	6.60	10.2	4.88	15.1	0.16	0.1	0.26	<0.01
Heuston Hill Mine	WR/HEU/01/06	6.75	11.2	3.44	14.6	0.11	0.05	0.16	<0.01
Josephine Load	WR/JOS/01/06	4.45	-1.45	1.45	-0.3	0.05	0.23	0.28	<0.01
Orleans Mine	WR/ORL/01/06	7.38	22.3	6.7	29	0.21	0.1	0.33	<0.01
Pennsylvania Mine	WR/PEN/02/06	7.38	19.9	7.38	27.3	0.24	0.006	0.24	<0.01
Prescott Hill Mine	WR/PRE/02/06	7.70	44.8	14.9	59.7	0.48	0.14	0.62	<0.01
Rowe Mine-B	WR/ROW/02/06	6.51	41.1	3.44	44.5	0.11	0.05	0.16	<0.01
Sebastopol Mine	WR/SEB/01/06	4.97	-0.66	0.96	0.3	0.03	0.13	0.16	<0.01
Woodbury Mine	WR/WBY/01/06	6.56	1.71	6.19	7.9	0.20	0.16	0.35	<0.01
WYOD Mine (Unoxidized)	WR/WYOD/02/06	7.63	31.5	9.44	40.9	0.30	0.08	0.38	<0.01
WYOD Mine (Oxidized)	WR/WYOD/05/06	4.72	-2.45	3.05	0.6	0.10	0.12	0.22	<0.01

Table 5 **Acid-Base Accounting Data for Subsurface Waste Rock Test Pit Samples**

Location	Sample ID	Depth (ft)	pH	ABA	AGP	ANP	Sulfide-S	Sulfate-S	Total-S	Non-Extractable-S
				----------TCaCO$_3$/kT----------			----------%----------			
Betsy Mine	WR/BET/01/15	3.5	6.23	-14.2	14.8	0.6	0.47	0.39	0.86	<0.01
Conlon Mine	WR/CON/01/10	2.0	6.02	3.05	4.25	7.3	0.14	0.07	0.20	<0.01
Empire Mine	WR/EMP/01/05	5.0	7.02	26.2	4.75	30.9	0.15	0.15	0.30	<0.01
Pennsylvania Mine	WR/PEN/01/04	4.0	7.98	44.1	4.81	48.9	0.15	0.04	0.20	<0.01
Prescott Hill Mine	WR/PRE/01/03	3.0	7.78	138	10.1	148	0.32	0.1	0.43	<0.01
Rowe Mine-B	WR/ROW/01/15	3.0	7.10	28.7	8.44	37.1	0.27	0.22	0.49	<0.01
WYOD Mine	WR/WYOD/01/03	3.0	7.27	33.8	15.1	48.9	0.48	0.02	0.50	<0.01

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Table 6 **Total Arsenic, Cadmium, and Lead (mg/kg) for all Surface and Subsurface Waste Rock Samples**

Location	Sample ID	Arsenic	Cadmium	Lead
Surface Samples (0 to 6 inches)				
Betsy Mine	WR/BET/02/06	8600	<0.2	46.6
Conlon Mine	WR/CON/02/06	936	<0.2	27.2
Conlon Mine	WR/CON/03/06	4250	<0.2	22.3
Conlon Mine	WR/CON/04/06	3130	<0.2	17.3
Daisy Hill	WR/DH/01/06	5810	<0.2	78.2
Empire Mine	WR/EMP/02/06	866	0.71	112
Empire Mine	WR/EMP/03/06	565	6.85	548
Empire Mine	WR/EMP/04/06	1040	1.89	216
Empire Mine	WR/EMP/05/06	561	2	98.3
Empire Mine	WR/EMP/06/06	686	1.17	78
Empire Mine	WR/EMP/07/06	275	1.01	62.3
Empire Mine	WR/EMP/08/06	849	3	744
Empire Mine	WR/EMP/09/06	1270	0.54	87.8
Empire Mine	WR/EMP/10/06	1600	<0.2	93.1
Empire Mine	WR/EMP/11/06	1030	3.84	137
Empire Mine	WR/EMP/12/06	614	1.24	119
Empire Mine	WR/EMP/13/06	509	0.4	42.5
Empire Mine	WR/EMP/14/06	475	<0.2	44.2
Empire Mine	WR/EMP/15/06	387	0.5	93
Empire Mine	WR/EMP/16/06	752	0.77	885
Heuston Hill Mine	WR/HEU/01/06	5810	0.71	69.3
Josephine Load	WR/JOS/01/06	3580	<0.2	24.3
Orleans Mine	WR/ORL/01/06	268	<0.2	20.4
Pennsylvania Mine	WR/PEN/02/06	17.8	2.02	91.2
Pennsylvania Mine	WR/PEN/03/06	10.1	3.9	50.7
Pennsylvania Mine	WR/PEN/04/06	33.5	6.9	240
Pennsylvania Mine	WR/PEN/05/06	13.1	1.81	177
Pennsylvania Mine	WR/PEN/06/06	16.3	4.85	226
Pennsylvania Mine	WR/PEN/07/06	14.1	5.96	112
Pennsylvania Mine	WR/PEN/08/06	29.7	11.8	775
Pennsylvania Mine	WR/PEN/09/06	23.4	10	1480
Pennsylvania Mine	WR/PEN/10/06	14.2	1.66	58.8
Prescott Hill Mine	WR/PRE/02/06	8340	<0.2	23.7
Prescott Hill Mine	WR/PRE/03/06	6890	<0.2	26.1
Prescott Hill Mine	WR/PRE/04/06	4480	<0.2	29.5
Prescott Hill Mine	WR/PRE/05/06	7410	1.85	23.1
Prescott Hill Mine	WR/PRE/06/06	10800	1.66	48.7
Prescott Hill Mine	WR/PRE/07/06	8600	1.99	61.9
Prescott Hill Mine	WR/PRE/08/06	4730	1.9	299
Prescott Hill Mine	WR/PRE/09/06	7380	2.98	106
Prescott Hill Mine	WR/PRE/10/06	15300	1.45	88.7
Rowe Mine-B	WR/ROW/02/06	64.3	1.73	89.5
Rowe Mine-B	WR/ROW/03/06	46.5	0.75	66.4
Rowe Mine-B	WR/ROW/04/06	229	2.27	102
Rowe Mine-B	WR/ROW/05/06	77.7	2.88	149
Rowe Mine-B	WR/ROW/06/06	37.9	0.23	84.8
Rowe Mine-B	WR/ROW/07/06	38.1	2.01	128
Sebastopol	WR/SEB/01/06	2460	<0.2	20.8

Table 6 Total Arsenic, Cadmium, and Lead (mg/kg) for all Surface and Subsurface Waste Rock Samples (continued)

Location	Sample ID	Arsenic	Cadmium	Lead
Surface Samples (0 to 6 inches) (continued)				
Woodbury Mine	WR/WBY/01/06	8210	<0.2	22.2
WYOD (Unoxidized)	WR/WYOD/02/06	81.5	0.51	45.3
WYOD (Unoxidized)	WR/WYOD/03/06	64	<0.2	41.3
WYOD (Unoxidized)	WR/WYOD/04/06	105	0.34	51.2
WYOD (Oxidized)	WR/WYOD/05/06	308	<0.2	24.9
WYOD (Oxidized)	WR/WYOD/06/06	155	<0.2	20.9
WYOD (Oxidized)	WR/WYOD/07/06	257	<0.2	38.7
Subsurface Samples				
Betsy Mine Test Pit (3.5 ft)	WR/BET/01/15	8700	<0.2	72.4
Conlon Mine Test Pit (2.0 ft)	WR/CON/01/10	677	<0.2	24.6
Empire Mine Test Pit (5.0 ft)	WR/EMP/01/05	701	3.02	136
Pennsylvania Mine Test Pit (4.0 ft)	WR/PEN/01/04	23.9	2.94	195
Prescott Hill Mine Test Pit (3.0 ft)	WR/PRE/01/03	4330	0.24	20.2
Rowe Mine-B Test Pit (3.0 ft)	WR/ROW/01/15	56.3	0.82	66
WYOD Test Pit (3.0 ft)	WR/WYOD/01/03	65.3	0.65	35.3

Table7 Total CAM-17 Metal Concentrations (mg/kg) for Surface (0 to 6 Inches) Waste Rock Samples

Location	Betsy Mine	Conlon Mine	Daisy Hill Mine	Empire Mine	Heuston Hill Mine	Josephine Load	Orleans Mine	Pennsylvania Mine
Sample ID	**WR/BET/02/06**	**WR/CON/02/06**	**WR/DH/01/06**	**WR/EMP/02/06**	**WR/HEU/01/06**	**WR/JOS/01/06**	**WR/ORL/01/06**	**WR/PEN/02/06**
Date	**9/19/2008**	**9/19/2008**	**9/19/2008**	**9/20/2008**	**9/20/2008**	**9/19/2008**	**9/20/2008**	**9/21/2008**
Antimony	3.5	<2	6.6	<2	2.6	11.7	<2	<2
Arsenic	8600	936	5810	866	5810	3580	268	17.8
Barium	30.2	66.5	54.5	70.7	44.4	52.5	68.6	79.1
Beryllium	0.203	0.383	0.532	0.455	0.556	0.344	0.236	0.245
Cadmium	<0.2	<0.2	<0.2	0.71	0.71	<0.2	<0.2	2.02
Chromium	5.68	166	69.8	42.9	15.2	3.88	39.7	6.30
Cobalt	11.2	26.3	39.7	28.1	31.5	24.3	26.5	7.40
Copper	66.0	59.1	76.2	152	155	82.5	151	66.6
Lead	46.6	27.2	78.2	112	69.3	24.3	20.4	91.2
Mercury	0.400	0.235	0.232	0.723	0.243	0.113	2.52	0.600
Molybdenum	1.32	0.860	5.69	3.67	1.27	1.63	1.37	1.50
Nickel	1.32	73.8	31.4	21.7	8.70	2.42	26.8	3.81
Selenium	<1	<1	<1	<1	<1	<1	<1	<1
Silver	0.660	<0.5	0.530	0.980	<0.5	<0.5	<0.5	0.830
Thallium	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Vanadium	37.9	107	126	118	109	93.3	87.6	22.8
Zinc	33.8	45.8	57.2	145	111	37.0	62.5	133

Table 7 Total CAM-17 Metal Concentrations (mg/kg) for Surface (0 to 6 Inches) Waste Rock Samples (continued)

Location	Prescott Hill Mine	Rowe Mine-B	Sebastopol Mine	Woodbury Mine	WYOD Mine (Unoxidized)	WYOD Mine (Oxidized)
Sample ID	**WR/PRE/02/06**	**WR/ROW/02/06**	**WR/SEB/01/06**	**WR/WBY/01/06**	**WR/WYOD/02/06**	**WR/WYOD/05/06**
Date	**9/20/2008**	**9/20/2008**	**9/19/2008**	**9/19/2008**	**9/20/2008**	**9/20/2008**
Antimony	3.1	<2	3.2	3.0	<2	<2
Arsenic	8340	64.3	2460	8210	81.5	308
Barium	35.7	108	111	36.2	133	44.7
Beryllium	0.483	0.276	0.573	0.497	0.574	<0.2
Cadmium	<0.2	1.73	<0.2	<0.2	0.51	<0.2
Chromium	7.97	12.6	7.97	8.18	4.86	6.70
Cobalt	29.5	9.21	50.7	21.5	21.3	3.62
Copper	133	208	62.5	75.5	68.7	56.8
Lead	23.7	89.5	20.8	22.2	45.3	24.9
Mercury	0.130	2.22	0.158	0.470	0.433	0.677
Molybdenum	1.22	1.87	1.81	1.49	2.51	5.09
Nickel	19.2	15.4	1.47	4.05	9.17	2.01
Selenium	<1	<1	<1	<1	<1	<1
Silver	0.920	1.49	<0.5	<0.5	7.82	1.49
Thallium	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Vanadium	36.5	25.2	72.1	75.0	19.9	60.5
Zinc	93.2	96.3	63.2	43.2	131	15.8

[1] Mean calculated using one-half the laboratory reporting limit for non-detect values except when all values were below detection.

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Table 8 Total CAM-17 Metal Concentrations (mg/Kg) for Subsurface Waste Rock Test Pit Samples

Location	Betsy Mine	Conlon Mine	Empire Mine	Pennsylvania Mine	Prescott Hill Mine	Rowe Mine-B	WYOD Mine
Sample ID	**WR/BET/01/15**	**WR/CON/01/10**	**WR/EMP/01/05**	**WR/PEN/01/04**	**WR/PRE/01/03**	**WR/ROW/01/15**	**WR/WYOD/01/03**
Depth (ft)	**3.5**	**2.0**	**5.0**	**4.0**	**3.0**	**3.0**	**3.0**
Antimony	3.4	<2	<2	<2	2.5	<2	<2
Arsenic	8700	677	701	23.9	4330	56.3	65.3
Barium	24.1	54.8	66.3	95.9	34.3	102	119
Beryllium	<0.2	0.412	0.364	0.226	0.301	0.253	0.434
Cadmium	<0.2	<0.2	3.02	2.94	0.24	0.82	0.65
Chromium	1.15	62.4	18.1	6.94	47.1	6.44	8.33
Cobalt	10.1	33.8	23.5	10.4	30.1	9.41	13.6
Copper	57.1	57.4	113	105	142	48.6	52.5
Lead	72.4	24.6	136	195	20.2	66	35.3
Mercury	0.142	0.715	1.09	0.268	1.06	1.68	0.292
Molybdenum	1.89	1.25	2.38	1.69	2.3	1.03	1.6
Nickel	1.58	19.2	15.6	5.7	55.1	7.91	8.55
Selenium	1.14	<1	<1	<1	<1	<1	<1
Silver	1.21	<0.5	0.51	2.41	<0.5	1.81	0.54
Thallium	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Vanadium	5.91	131	64.9	27.3	75.6	35.1	30.5
Zinc	79.1	82.8	247	92.4	148	89.3	119

[1] Mean calculated using one-half the laboratory reporting limit for non-detect values except when all values were below detection.

Table 9 DI WET CAM-17 Metal Concentrations (mg/L) for Surface (0 to 6 Inches) Waste Rock Samples

Location	Betsy Mine	Conlon Mine	Daisy Hill Mine	Empire Mine	Heuston Hill Mine	Josephine Load	Orleans Mine	Pennsylvania Mine
Sample ID	**WR/BET/02/06**	**WR/CON/02/06**	**WR/DH/01/06**	**WR/EMP/02/06**	**WR/HEU/01/06**	**WR/JOS/01/06**	**WR/ORL/01/06**	**WR/PEN/02/06**
Date	**9/19/2008**	**9/19/2008**	**9/19/2008**	**9/20/2008**	**9/20/2008**	**9/19/2008**	**9/20/2008**	**9/21/2008**
Antimony	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.00532
Arsenic	0.340	0.0393	0.157	0.00489	0.257	0.0132	0.0247	<0.003
Barium	0.00217	0.00306	0.00841	0.00667	0.00329	0.00229	0.0148	0.0643
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cadmium	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00142
Chromium	<0.001	0.00346	<0.001	<0.001	<0.001	<0.001	0.00105	<0.001
Cobalt	0.00260	0.00356	0.0408	0.00226	0.00364	0.00447	0.00519	0.00717
Copper	0.00595	0.00581	0.00430	0.00287	0.0160	<0.001	0.00973	0.0387
Lead	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Mercury	0.000200	0.00100	<0.0002	<0.0002	0.000400	0.000200	0.000400	<0.0002
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.00206	0.00109
Nickel	<0.001	0.00233	0.00481	0.00189	0.00116	<0.001	0.00195	0.00156
Selenium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Silver	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.001	0.00270	<0.001	<0.001	<0.001	<0.001	0.00100	<0.001
Zinc	0.0101	0.00380	0.0131	0.00248	0.0202	0.00270	0.00865	0.0271

Table 9 DI WET CAM-17 Metal Concentrations (mg/L) for Surface (0 to 6 Inches) Waste Rock Samples (continued)

Location	Prescott Hill Mine	Rowe Mine-B	Sebastopol Mine	Woodbury Mine	WYOD Mine (Unoxidized)	WYOD Mine (Oxidized)
Sample ID	**WR/PRE/02/06**	**WR/ROW/02/06**	**WR/SEB/01/06**	**WR/WBY/01/06**	**WR/WYOD/02/06**	**WR/WYOD/05/06**
Date	9/20/2008	9/20/2008	9/19/2008	9/19/2008	9/20/2008	9/20/2008
Antimony	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Arsenic	0.0345	0.0131	0.0180	0.322	<0.003	<0.003
Barium	<0.001	0.151	0.00990	0.00629	0.0296	0.0119
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cadmium	<0.0002	0.000713	<0.0002	<0.0002	<0.0002	<0.0002
Chromium	<0.001	0.00204	<0.001	<0.001	0.00127	<0.001
Cobalt	<0.001	0.0116	0.00287	0.00189	<0.001	0.00121
Copper	0.00359	0.0274	0.00634	0.0118	0.00381	0.00286
Lead	<0.003	0.00524	<0.003	<0.003	<0.003	<0.003
Mercury	0.000200	0.00110	<0.0002	0.000200	<0.0002	<0.0002
Molybdenum	<0.001	0.00269	<0.001	<0.001	0.00189	<0.001
Nickel	<0.001	0.0100	<0.001	0.00205	<0.001	0.00136
Selenium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Silver	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.001	0.00295	<0.001	0.00298	<0.001	<0.001
Zinc	<0.001	0.0246	0.0193	0.0348	0.00174	0.0127

[1] Mean calculated using one-half the laboratory reporting limit for non-detect values except when all values were below detection.

Table 10 DI WET CAM-17 Metal Concentrations (mg/L) for Subsurface Waste Rock Samples

Location	Betsy Mine	Conlon Mine	Empire Mine	Pennsylvania Mine	Prescott Hill Mine	Rowe Mine-B	WYOD Mine
Sample ID	**WR/BET/01/15**	**WR/CON/01/10**	**WR/EMP/01/05**	**WR/PEN/01/04**	**WR/PRE/01/03**	**WR/ROW/01/15**	**WR/WYOD/01/03**
Date	**9/18/2008**	**9/18/2008**	**9/18/2008**	**9/18/2008**	**9/18/2008**	**9/18/2008**	**9/18/2008**
Depth (ft)	**3.5**	**2.0**	**5.0**	**4.0**	**3.0**	**3.0**	**3.0**
Antimony	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Arsenic	0.167	0.00433	0.0233	0.00504	0.355	0.00692	<0.003
Barium	<0.001	0.00129	0.00850	0.0135	0.00146	0.0638	0.0393
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cadmium	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	0.00139	0.00100
Cobalt	<0.001	<0.001	0.00179	<0.001	0.00120	0.00542	0.00164
Copper	0.00101	<0.001	0.00165	0.00265	0.00207	0.0115	0.00469
Lead	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.0139
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00100	<0.0002
Molybdenum	<0.001	<0.001	0.00321	0.00661	0.00710	0.00196	0.00225
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	0.00195	<0.001
Selenium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Silver	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	0.0130	0.00103	0.00179	0.00355	<0.001	0.00432	0.00305

[1] Mean calculated using one-half the laboratory reporting limit for non-detect values except when all values were below detection.

DRAFT

Table 11 Update Summary of the Conceptual Site Model (CSM) for Waste Rock Areas

Mine Area	Proximity Class (MFG, 2008a)	Accessibility Class (MFG, 2008a)	Area/Volume	Total Metals Exceeding CHHSLs [1]	Surface DI-WET Metals Exceeding Stormwater Criteria [2]	Erosion Potential [3]	CSM Potential Release Mechanisms Eliminated [4]	CSM Potential Pathways Eliminated [4]
Betsy	Primary Park Feature	Easy	1 acre 12,400 cy	Arsenic	Arsenic	No	**Wind/Water Erosion** *Surface Water Runoff/Chemical Weathering* *Direct Transport*	*Dust* *Soil*
Conlon	Primary Park Feature	Easy	1 acre 61,900 cy	Arsenic	None	Yes	*Wind/Water Erosion* **Surface Water Runoff/Chemical Weathering** *Direct Transport*	*Dust* *Soil*
Daisy Hill	Primary Park Feature	Easy	0.23 acres 4,860 cy	Arsenic	None	No	**Wind/Water Erosion** **Surface Water Runoff/Chemical Weathering** *Direct Transport*	*Dust* *Soil*
Empire	Primary Park Feature	Easy	4.7 acres 18,900 cy	Arsenic	None	Yes	*Wind/Water Erosion* **Surface Water Runoff/Chemical Weathering** *Direct Transport*	*Dust* *Soil*
Heuston Hill	Distant	Difficult	0.55 acres 17,800 cy	Arsenic	Arsenic	Yes	*Wind/Water Erosion* *Surface Water Runoff/Chemical Weathering* *Direct Transport*	*Dust* *Soil*
Josephine Load	Adjacent	Easy	0.17 acres 1,820 cy	Arsenic	None	No	**Wind/Water Erosion** **Surface Water Runoff/Chemical Weathering** *Direct Transport*	*Dust* *Soil*
Orleans	Primary Park Feature	Easy	0.5 acres 1,350 cy	Arsenic	None	No	**Wind/Water Erosion** **Surface Water Runoff/Chemical Weathering** *Direct Transport*	*Dust* *Soil*

Table 11 Update Summary of the Conceptual Site Model (CSM) for Waste Rock Areas (continued)

Mine Area	Proximity Class (MFG, 2008a)	Accessibility Class (MFG, 2008a)	Area/Volume	Total Metals Exceeding CHHSLs [1]	Surface DI-WET Metals Exceeding Stormwater Criteria [2]	Erosion Potential [3]	CSM Potential Release Mechanisms Eliminated [4]	CSM Potential Pathways Eliminated [4]
Pennsylvania	Primary Park Feature	Easy	2.7 acres 87,000 cy	Cadmium	None	Yes	*Wind/Water Erosion* **Surface Water Runoff/Chemical Weathering** *Direct Transport*	*Dust* *Soil*
Prescott Hill	Primary Park Feature	Easy	2.9 acres 30,800 cy	Arsenic	None	No	**Wind/Water Erosion** **Surface Water Runoff/Chemical Weathering** *Direct Transport*	*Dust* *Soil*
Rowe – B	Primary Park Feature	Easy	1.9 acres 66,40 cy	None	None	No	**Wind/Water Erosion** **Surface Water Runoff/Chemical Weathering** **Direct Transport**	**Dust** **Soil**
Sebastopol	Adjacent	Easy	0.54 acres 8,630 cy	Arsenic	None	No	**Wind/Water Erosion** **Surface Water Runoff/Chemical Weathering** Direct Transport	*Dust* *Soil*
Woodbury	Distant	Moderate	0.31 acres 1,640 cy	Arsenic	Arsenic	No	**Wind/Water Erosion** *Surface Water Runoff/Chemical Weathering* *Direct Transport*	*Dust* *Soil*
WYOD	Adjacent	Easy	1.6 acres 78,500 cy	Arsenic	None	Yes	*Wind/Water Erosion* **Surface Water Runoff/Chemical Weathering** *Direct Transport*	*Dust* *Soil*

[1] Refers to the Commercial/Industrial California Human Health Screening Levels for metals (California EPA, 2005). The 2006 DTSC-HERD remediation goal of 270 mg/kg used to evaluate arsenic.
[2] Refers to USEPA (1995) Stormwater Benchmark Values.
[3] Based on the results of visual characterization (Figures 2-14).
[4] Potential release mechanisms and potential pathways shown in bold have been completely eliminated, while those shown in italics have been eliminated for those metals which are no longer of concern.

Additional Attachments are On-File with the Department of Parks and Recreation and on their Website:

http://www.parks.ca.gov/?page_id=981

Appendix C-6:
Magenta Drain Assessment 2007 Work Plan

FINAL
MAGENTA DRAIN ASSESSMENT
2007 WORK PLAN
EMPIRE MINE STATE HISTORIC PARK
JULY 16, 2007

Prepared for:

CALIFORNIA DEPARTMENT OF STATE PARKS AND RECREATION
EMPIRE MINE STATE HISTORIC PARK

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I certify under penalty of law that I have examined and am familiar with this Work Plan, and to my knowledge, the report is true, complete, and accurate.

Eileen M. Dornfest, Certified Engineering Geologist

PROFESSIONAL GEOLOGIST
EILEEN MARIE DORNFEST
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APPENDIX

Appendix A Bench-Scale Testing Of Coagulation/Filtration and Oxidation/Adsorption Technologies
Appendix B Field Sampling Plan for Irrigation Well Water Monitoring

1.0 PURPOSE

This 2007 Work Plan for the Magenta Drain at the Empire Mine State Historic Park (Park) describes an assessment to provide additional data regarding water treatment technologies and characterization of the hydrogeology of the Magenta Drain. The two primary elements of the 2007 assessment are:

- Perform a screening level evaluation, and bench-scale and pilot-scale treatability testing on applicable water treatment technologies for water flowing from the Magenta Drain portal.
- Characterize the Magenta Drain hydrogeology to determine potential surface water or groundwater sources contributing water to the portal flow and to determine the potential seasonal variability of contributing sources.

The results of this assessment will be provided in data transmittal reports.

2.0 SITE DESCRIPTION

The Magenta Drain is a mine tunnel that was constructed to drain water from the underground workings of the Empire Mine. The Empire Mine and other mines in the Park were flooded when mining activities ended in 1956. The Magenta Drain tunnel continues to collect water from the underground mine workings associated with the Empire Mine, and it is assumed that it might also collect water from possible surface water flow(s) and/or shallow groundwater along its length. Water flowing from the Magenta Drain portal drains to a surface channel, which then flows to an unnamed creek, historically referred to as Woodpecker Ravine. The Magenta Drain portal is located at the northern edge of the Park, as shown on Figure 1. Since August 2006, the quality of the Magenta Drain water at the portal has been monitored according to the California State Parks and Recreation (CDPR) NPDES permit (CA0085171). Additional flow and water quality data for the Magenta Drain have also been collected since August 2006 according to the 2006 Magenta Drain Monitoring Program (MFG, 2006a; 2006b; 2007b).

In 1977 and 1981, the Park drilled two wells, referred to as Irrigation Well #1 and #2, just to the southwest of the Mine Yard (Figure 1). Water from these wells is pumped to storage tanks and used for non-potable water applications within the Park, including watering lawns and gardens and Park maintenance activities. The irrigation wells intercept mine pool water in the vicinity of the Empire Shaft at a depth of about 240 below ground surface. The Magenta Drain connects to the Empire Shaft at about the 400-foot level (Woodward, 1992). The water level of the Empire Shaft mine pool where the irrigation wells are completed is controlled at least in part by connections to the Magenta Drain.

2.1 Existing Data

Monitoring of water flowing from the Magenta Drain portal has been performed since August 2006 in accordance with the 2006 Magenta Drain Work Plan (MFG, 2006a). Flow rate, pH, electrical conductivity, temperature, and precipitation data are recorded at 15-minute intervals. Water quality samples are periodically collected for laboratory analysis. In addition, a transducer and data logger were installed in Irrigation Well #1 in September 2006 to monitor the groundwater level of the mine pool simultaneously with monitoring of the Magenta Drain flow rate. An in-line flow meter was installed in the pumping system during December 2006 to quantify pumping volumes associated with operation of the irrigation system. The data reported from these monitoring systems (MFG, 2006b, 2007b) are summarized in the following sections.

2.1.1 Magenta Drain Water Quality

Water flowing from the Magenta Drain can be characterized as near-neutral in pH with positive alkalinities and variable dissolved oxygen concentrations (MFG, 2006b; 2007b). Based on 2006 water

quality data, arsenic, iron, and manganese are identified as the constituents of concern (MFG, 2006b; 2006c; 2007a; 2007b).

2.1.2 Magenta Drain Flow Rate

Monitoring data collected since August 2006 indicates that flow rates from the Magenta Drain portal ranged from 27 to 238 gpm during the third quarter of 2006 (MFG, 2006b) and from 27 to 202 gpm during the fourth quarter of 2006 (MFG, 2007b).

2.1.3 Groundwater Hydrogeology

The groundwater level of the Empire Shaft mine pool has been monitored since September 2006 at Irrigation Well #1. Water from Well #1 is assumed to be produced from flooded portions of the Empire Shaft. In addition, pumping volumes associated with operation of the irrigation system have been monitored since December 2006. These data allow correlation of the mine pool water level with flow rates from the Magenta Drain portal. The correlation shows that as the groundwater level of the Empire Shaft mine pool is lowered during pumping, flow from the Magenta Drain portal decreases (MFG, 2006b, 2007b). These data indicate that a substantial fraction of the water in the Magenta Drain is derived from water within the Empire Shaft and its associated underground mine workings and that the Empire Shaft mine pool is hydrologically connected to the Magenta Drain.

2.2 Conceptual Site Model and Data Gaps Identification

A conceptual site model (CSM) was developed in MFG (2006c, 2007a) to describe potential release mechanisms, transport pathways, and exposure routes to receptors. Application of the CSM to flow from the Magenta Drain indicates that chemical weathering of mineralized rocks in underground portions of the Magenta Drain tunnel is a potential release mechanism for arsenic, iron, and manganese to the drain water. The oxidation of the iron upon exposure to air at the Magenta Drain portal produces iron oxyhydroxide precipitates. These precipitates accumulate in the Magenta Drain channel as arsenic, iron and manganese-bearing precipitates. Surface water transport of the precipitates is a second potential release mechanism for the Magenta Drain.

The potential transport pathways for the Magenta Drain include surface water, sediments, and plant uptake. Dissolved metal constituents are transported in the surface water and as the iron, arsenic and manganese precipitate from solution. The resulting particles settle out as channel sediments or are absorbed onto rocks/soils contained within the channel. Plants growing in these sediments and exposed to the Magenta Drain water may take up metals, thereby providing a potential exposure pathway for wildlife.

The potential exposure routes for the Magenta Drain water include incidental dermal contact with the sediments and water in the channel. Other possible human exposure routes are incidental ingestion of sediments, water, and plants from the channel. Wildlife using the channel may also ingest water and plants growing in sediments and water of the Magenta Drain channel.

Woodpecker Ravine flows through the City of Grass Valley Memorial Park downstream of the Park boundaries. Public access to the creek through Memorial Park and most of the channel upgradient of Memorial Park is controlled by a fence that is posted with warning signs. A small group of homes known as the Happy Dale subdivision is located near the Magenta Drain portal. One side of the Magenta Drain channel downstream of the portal has been fenced with warning signs in the Happy Dale area. People living in the subdivision along the drainage channel are potential receptors to the Magenta Drain water and sediments. The wildlife and plant communities around the Magenta Drain channel are also potential receptor groups.

The Data Gaps analysis report (MFG, 2007b) concluded that there are no data gaps for the Magenta Drain that prevent characterization and understanding of the Magenta Drain elements of the CSM. The data to be collected by this Work Plan will contribute to the assessment of water management alternatives for the Magenta Drain.

3.0 WATER TREATMENT TECHNOLOGIES ASSESSMENT

Determination and evaluation of an applicable water treatment technology or technologies is a several step process. The work described in the following sections explains these steps, which include:

- Screening level evaluation of potentially applicable water treatment technologies and selection of two or three technologies for further evaluation through bench-scale testing
- Bench-scale testing of two or three water treatment technologies selected during the screening evaluation and selection of one or two most promising technologies for pilot-scale testing
- Pilot-scale testing of the one or two most promising technologies identified during bench-scale testing
- Reporting of results.

3.1 Literature Review/Screening Level Evaluation

As the first step in the water treatment technologies assessment, a literature review will be performed to evaluate all types of treatment technologies that may potentially be viable for treatment of water from the Magenta Drain to reduce the concentrations of constituents of concern. For the Magenta Drain water, these analytes include arsenic, iron, and manganese. The technologies for reducing the concentrations of these analytes may include both active and passive treatment technologies. The literature review process involves a screening-level evaluation of the potential of each treatment method for meeting the treatment goals. This screening-level evaluation serves as the decision-making tool for identifying the potential technologies to be investigated further. The criteria that will be evaluated for each of the technologies are shown in Table 1 and described in the following sections.

Table 1 Screening-Level Water Treatment Technology Evaluation Criteria

Criterion	Description
1. Treated Water Quality	Ability to consistently meet applicable treatment standards.
2. Variability in Raw Water Composition and Quantity	Is process effectiveness significantly affected by raw water quality and/or changes in raw water quantity.
3. Residuals Management	Handling and disposal of treatment residuals.
4. Cost Analysis	Rating of relative costs for capital equipment and facilities, operation, maintenance.

3.1.1 Treated Water Quality

Potentially, several treatment technologies will reduce the concentrations of the constituents of concern to less than the applicable water quality standards. However, the concentration of other solutes can increase as a result of some treatments. Therefore, while constituents of concern concentrations may be reduced during treatment, other analytes may increase and exceed regulatory limits or change the quality of the

water. Thus, it necessary to evaluate the expected chemistry of the treated water for potential increases in concentration of all solutes that may be added as part of treatment to make sure that they do not cause problems in complying with regulatory limits in addition to evaluating whether the treatment technology will also achieve compliance for the constituents of concern.

3.1.2 Variability in Raw Water Composition and Quantity

Several technologies may effectively treat water that has a consistent chemical characteristic or composition. However, if the chemical composition of the raw water changes at different times of the year, then some technologies may not be as effective or easily modified to accommodate the changing conditions. In addition, there are likely to be large seasonal changes in the amount of water flowing from the Magenta Drain, requiring that any effective water treatment technology be capable of being operated over a range of volumetric rates. Thus, an important criterion for evaluating water treatment technologies is the capability to adapt to changes in chemical composition and quantity of the raw water.

3.1.3 Residuals Management

Residuals or by-product generation and management are important aspects of a treatment technology. For each technology under consideration, the quantity and type of residuals will be estimated (based on previous studies), as well as the disposal alternatives. These disposal alternatives will depend on the form of the waste (liquid vs. solid), as well as other waste properties (e.g., toxicity or the concentration of contaminants in the waste leachates).

3.1.4 Cost Analysis

An important part of the screen level assessment is an analysis of potential costs of a water treatment technology. Because of the high degree of uncertainty inherent in this level of evaluation, dollar value costs for each alternative will likely be uncertain. Thus, a more meaningful method for purposes of comparison is to assign a rating value from 1 to 4 to the estimated costs to provide a relative measure of cost for each alternative. In this approach, the individual costs for different components of the treatment technology are generally assigned rating values such that lower relative costs receive a higher rating (i.e., a “4” indicates the lowest relative cost).

3.1.5 Selection of Potential Technologies for Bench-Scale Testing

The criteria described above will be used to evaluate the potential of each treatment alternative for application to the Magenta Drain water. These criteria will be evaluated by means of screening-level evaluations where each of the criterion is given the same relative weight. Different technologies can be rated for each criterion, using a 4-point scale. On this scale, a low value “1“ would indicate a less

desirable rating (i.e., high cost or low feasibility), while a high value “4“ would indicate a more desirable rating (i.e., low cost or high feasibility).

Based on the results of the literature review, two or three technologies would be selected for further evaluation by bench-scale and/or pilot-scale testing.

3.2 Bench-Scale Treatability Tests

It is anticipated that between two and three technologies identified during the literature review and screening-level evaluation will be tested at the bench-scale level. For each of the technologies, the focus of the bench-scale tests will be to establish the technical feasibility of meeting the current water quality standards, to identify operational parameters and potential limitations, and determine cost estimates. In certain situations, where the technologies and water chemistry are well understood and proven on waters with similar characteristics, it may be possible to bypass bench-scale testing and proceed directly to pilot-scale testing. However, the pilot-scale system must be designed to allow a great deal of flexibility in operation and testing to skip bench-scale tests.

Based on the known characteristics of the Magenta Drain water, examples of two technologies that would likely pass the literature review and screening level evaluation are:

- Metal salt (i.e., ferric sulfate) coagulation followed by media filtration
- Oxidization and adsorption by manganese greensand.

The following sections summarize the bench-scale testing for these two treatment technology examples. Appendix A provides a detailed discussion of the bench-scale work that will be performed if coagulation/filtration and oxidization/adsorption example technologies were selected for testing. These examples provide indications of the scope of work required for bench-scale testing.

3.2.1 Bench-scale Treatability Testing Design

Coagulation and filtration treatment testing can be performed as batch tests with high- and low-energy mixing. Operational parameters that will be investigated include:

- Chemical concentration dose
- Operating pH
- Mixing conditions and flocculant requirements
- Particle settling and filtration
- Effects from competing anions
- Residual characterization.

Adsorption (i.e., greensand) treatment testing can be setup as flow-through columns. Operational parameters that will be investigated include:

- Adsorption capacity (with and without pH adjustment)
- Empty bed contact times
- Regeneration and cleaning cycles
- Effects from competing anions
- Solids loading
- Residual characterization.

It is estimated that a minimum of 750 gallons of Magenta Drain water will be required for the bench-scale testing. The bench-scale testing will be conducted in Grass Valley to minimize potential chemical changes of Magenta Drain water caused by storage and transport of the water to a distant laboratory. Conducting the bench-scale tests in Grass Valley also allows collection of fresh Magenta Drain water on an as-needed basis during testing. Custody of the water will be maintained during sample collection, transport, and bench-scale testing. All residuals or by-products (solids and brines) and the wastewater (treated water) generated from the bench-scale treatability testing will be contained. Samples of the solids, brines and the treated water will be submitted for laboratory analyses. Any remaining solids, brines and treated water not submitted as samples for laboratory analyses will be managed and disposed as required by applicable regulatory standards.

It is anticipated that about 40 to 50 samples will be analyzed for constituents of concern and other analytes (Tables 2 and 3) during the bench-scale testing. The actual number will be dependent on the technologies tested and their effectiveness. A strict quality assurance/quality control (QA/QC) program will be implemented as part of this program to ensure that the data from the sample analyses will be suitable for their intended use. The two major components of the QA/QC program will be:

- Sampling, preservation, and shipping protocols
- Validation of the laboratory data.

Standard operating procedures (SOPs) based on EPA, United States Geological Survey (USGS), and industry protocols will be strictly followed. Because of the importance of the laboratory analysis, Quality Assurance/Quality Control (QA/QC) samples will be collected at a frequency of one set of QA/QC samples for every 20 test samples collected. The field QA/QC samples will consist of field blanks and field duplicates. In addition, the laboratory will run additional internal QA/QC samples, consisting of blanks, replicates, matrix spikes, and laboratory control samples. The laboratory results will be validated following

EPA functional guidelines. In addition to the typical EPA validation process, cation-anion balances for the full suite analyses and total versus dissolved comparisons will be made (when applicable). If data do not pass the criteria, then the data will be qualified to define the appropriate use of the data.

3.2.2 Evaluation of Bench-Scale Test Results and Selection of Technologies for Pilot-Scale Testing

The results of the bench-scale tests will be evaluated according to several criteria, including:

- Effectiveness of removal of the constituents of concern (arsenic, iron, and manganese)
- Rate of production of by-products and waste management
- Ease of operation and maintenance
- Order-of-magnitude costs associated with the treatment process.

The evaluation of bench-scale testing results will focus on determining whether or not the treatment technology can consistently and reliably meet or exceed the water quality standards for the constituents of concern, as defined by the final effluent limitations specified in the Magenta Drain NPDES permit (Order No. R5-2006-0058). Other criteria that will be important are the rate of production of by-products and chemical character of the wastes produced with the technology. A technology may reduce analytes concentrations effectively, but if the by-products require special handling and disposal, then the costs may be prohibitive.

In addition, the bench-scale data will be evaluated to discern trends that may be useful in predicting the behavior of certain technologies. This prediction capability could be very useful if the technology is applied at a larger scale. For example, in a greensand-based technology, increasing pH values prior to breakthrough for the constituents of concern may increase the adsorption capacity.

3.3 On-site Pilot-Scale Treatability Test

An on-site pilot-scale treatability test would be performed to determine the applicability of selected water treatment technologies for managing the quality of water flowing from the Magenta Drain portal. The goal of the pilot-scale tests is to determine if a selected technology or technologies is effective in reducing concentrations of constituents of concern under small-scale, dynamic (i.e., non-static) conditions. While bench-scale testing can identify potentially feasible treatment technologies, pilot-scale treatability testing must be performed to determine if a selected technology will perform efficiently and effectively under realistic operating conditions. The pilot-scale tests are designed to generate the essential information necessary to confirm the bench-scale results in a continuous operation mode. The testing will be designed to confirm the technical feasibility of meeting the final effluent limitations specified in the Magenta Drain

NPDES permit (Order No. R5-2006-0058) and to provide scale-up design parameters for full-scale design.

The pilot-scale treatability tests will be designed to define the treatment factors that affect the operational conditions and limitations of technologies as applied to the Magenta Drain water. These factors include analyte removal efficiencies, seasonal water quality variations, filtration effectiveness, chemical demands, residual (i.e., waste) characterization and management, process unit requirements, reliability and repeatability, and degree of possible automation. Representative operational criteria will also be investigated to provide data necessary for the design, detailed costing, and construction of a full-scale treatment system.

Based on the known characteristics of the Magenta Drain water and experience with similar water types, examples of two possible technologies likely to demonstrate the best treatment potential from the literature review and bench-scale testing include:

- Metal salt (i.e., ferric sulfate) coagulation followed by media filtration
- Oxidization and adsorption by manganese greensand.

The following sections describe the pilot-scale testing for these two example treatment technologies. If different or additional technologies are identified during the literature review and bench-scale testing, then the pilot-scale testing will be modified to include those technologies.

3.3.1 Pilot-Scale Testing System

The pilot-scale testing will need to be conducted near the portal of the Magenta Drain using a manually operated, portable pilot-scale system. The components of the system will likely need to be specifically assembled for conducting treatability testing of the Magenta Drain water. Tests performed during pilot testing will be run in a similar manner to the tests described in bench-scale testing. However, the pilot tests will be focused on testing chemical and physical combinations that were shown to be effective during bench-scale testing. Pilot-scale testing will be run under dynamic (i.e., flowing) conditions, unlike the bench-scale testing, where in the case of flocculation/filtration, the tests will be run as batch tests.

Figure 2 presents the basic schematic design of a pilot-scale system for the two example treatment technologies. The filter and greensand design and operation will be similar to the following design:

Mixed-media filter:

- Column diameter — 6 inches
- Media depth — 30 inches
- Media — Anthracite, Sand, Garnet
- Hydraulic loading — 3 - 4 gallons per minute per foot squared (gpm/ft^2).

Greensand oxidizer/filter:

- Column diameter — 6 inches
- Media depth — 30 inches
- Media — Manganese Greensand ($KMnO_4$ Conditioned)
- Hydraulic loading — 3 - 4 gpm/ft^2

Precision chemical feed pumps will be used to add chemicals during the pilot-scale tests. Flux (flow) rates during the testing can be expected to range from 3 to 4 gallons per minute per square foot for the media filter and greensand columns, with test run times of a few hours to a few days. If initial pilot testing indicates excessive solids loading, a roughing (i.e., pretreatment) filter can be added to the schematic design shown in Figure 2.

During initial pilot-scale testing, the system will be used for rapid tests of several treatment scenarios that include combinations of coagulants, oxidizers, and pH adjustments to verify and expand on the data collected during bench-scale testing. Based on the current characteristics of the Magenta Drain water, it is anticipated that the pilot-scale treatability testing for the two example treatment technologies would include the following test scenarios:

- Coagulation/Filtration pilot-scale testing: (1) optimization of oxidizer addition (e.g., sodium hypochlorite or potassium permanganate), (2) optimization of coagulant enhancer doses, (3) determination of the sensitivity of metals reduction to variations in the pH range of approximately 6.0 to 7.5, (4) evaluation of a pH adjustment by chemical addition (e.g., calcium hydroxide and sodium hydroxide) and by aeration, (5) determination of flocculent characteristics, (6) evaluation of the filter operational parameters, including run times, frequency and duration of backwash (cleaning) cycles, and direct filtration effectiveness, and (7) determination of waste characteristics.
- Manganese greensand pilot-scale testing: (1) evaluation of varying doses of chemical oxidizer(s) (e.g., sodium hypochlorite and potassium permanganate), (2) determination of sensitivity of metals reduction to variations in the pH range of approximately 6.0 to 7.5, (3) evaluation of both calcium hydroxide and sodium hydroxide for pH adjustment, (5) evaluation of the greensand operational parameters, including bed volumes of water treated to

breakthrough, and duration/effectiveness of regeneration and backwash (cleaning) cycles, and (6) determination of evaluation of the potassium permanganate waste regenerate.

After the initial series of treatment tests and after the analytical results from these tests have been received, several longer terms tests may be performed to optimize the treatment operation and verify long term results.

3.3.2 Pilot-Scale Testing Duration

The pilot-scale system will potentially be run, at intermittent intervals, over a six-week period. Initial verification and optimization testing will be conducted for approximately two weeks. During this testing, samples of treated water will be collected for laboratory analyses. After the initial two-week period, the pilot-scale testing will be temporarily shut down while the analyses are being performed and results evaluated. The laboratory analysis and data evaluation can be expected to take approximately two weeks.

The analytical data from the verification and optimization pilot treatability testing will be evaluated to identify the most effective treatment processes and determine if additional testing is necessary. If it is determined that additional treatability testing is required to better define operational parameters and optimize treatment efficiency, then the pilot-scale system will need to be restarted and additional testing will be performed. It is expected that the second pilot-scale run would require from one to two weeks to obtain the additional data for optimizing treatment performance.

3.3.3 Water Quality Analyses

Water samples that are produced by the various treatment scenarios will be collected during operation of the pilot-scale system to provide data on system operation and treatment efficiencies for metal removal. Parameters that will be measured in the field during pilot-scale testing include pH, turbidity, conductivity, total and ferrous iron, manganese, and arsenic. Field analytical tests for manganese and arsenic are susceptible to interferences from other analytes. Thus, if initial testing shows that these interferences exist, then these field analytical tests will be discontinued. In addition, it is anticipated that between 20 and 40 samples of treated water will be collected and sent to a commercial analytical laboratory for determination of the concentrations of the analytes listed in Table 2. Approximately eight samples will be collected and analyzed for the full suite of cations, anions, metals, and other parameters listed in Table 3. Both total recoverable and dissolved analyses will be performed to determine the effectiveness of coagulation, adsorption, and filtration from the both the mixed-media filter and greensand column. A quality assurance/quality control (QA/QC) program will be implemented as part of this program to ensure that the data from the sample analyses will be suitable for their intended use as described in Section 3.2.1.

Table 2 Typical Laboratory Analyses for Bench- and Pilot-Scale Testing

Parameter	EPA Method	Target Detection Limit (mg/L)
Arsenic, total rec. & dissolved	M200.8 ICP-MS	0.0001
Iron, total rec. & dissolved	M200.8 ICP-MS	0.1
Manganese, total rec. & dissolved	M200.8 ICP-MS	0.0005
Total Dissolved Solids	M160.1 – Gravimetric	10
Total Suspended Solids	M160.2	10

Table 3 Typical Full Suite Laboratory Analyses for Bench- and Pilot-Scale Testing

Parameter	EPA Method	Target Detection Limit (mg/L)
Aluminum, acid sol. & dissolved	M200.7 ICP	0.03
Antimony, total & dissolved	M200.8 ICP-MS	0.0004
Arsenic, total rec. & dissolved	M200.8 ICP-MS	0.0001
Barium, total rec. & dissolved	M200.7 ICP	0.003
Cadmium, total rec. & dissolved	M200.8 ICP-MS	0.0001
Calcium, total	M200.7 ICP	0.2
Chromium, total rec. & dissolved	M200.8 ICP-MS	0.0001
Chromium (hex), total rec. & dissolved	SM3500D	0.005
Cobalt, total rec. & dissolved	M200.8 ICP-MS	0.00005
Copper, total rec. & dissolved	M200.8 ICP-MS	0.0005
Iron, total rec. & dissolved	M200.7 ICP	0.02
Lead, total rec. & dissolved	M200.8 ICP-MS	0.0001
Magnesium, total	M200.7 ICP	0.2
Manganese, total rec. & dissolved	M200.8 ICP-MS	0.0005
Mercury, total	M1631, Atomic Fluorescence	0.5 ng/L
Nickel, total rec. & dissolved	M200.8 ICP-MS	0.0006
Potassium, total	M200.7 ICP	0.3
Silica, total & dissolved	M200.7 ICP	0.2
Sodium, total	M200.7 ICP	0.3
Thallium, total rec. & dissolved	M200.8 ICP-MS	0.0001
Vanadium, total rec. & dissolved	M200.8 ICP-MS	0.0002
Zinc, total rec. & dissolved	M200.8 ICP-MS	0.002
Chemical Oxygen Demand (COD)	M410.4	10
Chloride	M325.2 – Colorimetric	1
Conductivity	M120.1 – Meter	1 umhos/cm
Phosphorus, total	M365.1 – Auto Ascorb	0.01
pH	M150.1 – Electrometric	0.1
Total Dissolved Solids	M160.1 – Gravimetric	10
Total Settleable Solids	M160.5	0.1 ml/L-hr
Total Suspended Solids	M160.2	10
Color	M110.2	15 color units
Sulfate	M375.4 – Gravimetric	10
Hydroxide as $CaCO_3$	SM2320B – Titration	2
Alkalinity	SM2320B – Titration	2
Carbonate as $CaCO_3$	Included with Alkalinity	2
Bicarbonate as $CaCO_3$	Included with Alkalinity	2

3.3.4 Backwash Solids Chemical Analyses

A primary consideration during the pilot-testing is the chemical and physical characteristics of the backwash suspended solids that will be generated in the treatment processes. Thus, a minimum of one sample of backwash settled solids will be collected for analysis by the California Waste Extraction Test (WET). If sufficient backwash settled solids are available, then a second sample will be tested. The results of these analyses will allow evaluation of solids handling requirements, including volume estimates, on-site storage needs, dewatering equipment selection (if necessary), and disposal options.

3.3.5 Required Site Conditions and Utilities for Pilot-Scale Testing

The pilot-scale testing will be conducted near the portal of the Magenta Drain, such that a constant flow of fresh Magenta Drain water can be supplied to the pilot-scale system for the duration of the testing. The pilot-scale system will be secured in a portable trailer situated near the Magenta Drain portal. An onsite source of electricity will be needed either from a connection to the local power grid or by a generator.

3.3.6 Residuals Management

All residuals or by-products (solids and brines) generated from the pilot-scale treatability testing will be contained and samples will be submitted for laboratory testing. Any remaining solids and brines not submitted as samples for laboratory analyses will be managed and disposed as required by applicable regulatory standards.

The expected quality of the treated water generated during the pilot-scale treatability testing will have been characterized during the bench-scale treatability testing. These data will be evaluated prior to the pilot-scale treatability to define appropriate management requirements for the treated water. It is expected that the treated water generated during the pilot-scale treatability testing will achieve the interim effluent limits specified in the Magenta Drain NPDES permit and the interim, performance-based effluent limits specified in the Time Schedule Order for the Magenta Drain. As such, it is expected that the treated water will be returned to the drainage ditch near the Magenta Drain portal. The treated water flow rate is expected to be about one gpm during the pilot-scale treatability testing, which is negligible compared to the flow rate from the Magenta Drain. Therefore, it is expected that the treated water will not change the flow and only improve water quality for measured parameters compared to the Magenta Drain discharge.

3.3.7 Preliminary Site Requirements

During the pilot-scale testing, a preliminary reconnaissance of possible treatment plant locations will be performed. This investigation will consist of looking at areas that are either large enough, or could be enlarged, to allow construction of a treatment plant. This investigation will also evaluate access to

potential treatment plant location(s), approximate distances to utilities, elevation changes between the treatment plant location and the Magenta Drain portal, and the presence of any obstructions between the portal and potential treatment plant locations.

3.3.8 Evaluation of Pilot-Scale Testing Results

The results of the pilot-scale tests will be evaluated according to several criteria, including:

- Effectiveness of removal of the constituents of concern (arsenic, iron, and manganese)
- Rate of production and characteristics of by-products and waste management
- Ease of operation and maintenance
- Order-of-magnitude costs associated with the treatment process.

The water quality results of the pilot-scale testing will be evaluated with respect to the final effluent limitations specified in the Magenta Drain NPDES permit (Order No. R5-2006-0058). A data transmittal report will be prepared to summarize the results of the bench-scale and pilot-scale treatability testing. A conceptual level cost estimate will be included for the technology(ies) identified from the pilot-scale results evaluation. A preliminary treatment plant site plan, using existing maps and information, will also be included in the report.

4.0 HYDROGEOLOGY ASSESSMENT

Recently collected data of the Magenta Drain flow rate and the mine pool water level measured in Irrigation Well #1 indicates that a relationship exists between the mine pool water level and the flow rate from the Magenta Drain (MFG, 2006b, 2007b). A decrease in the flow from the Magenta Drain occurs in response to drawdown of the mine pool water level caused by intermittent pumping for irrigation water withdrawal. The relationship indicates that a substantial fraction of the water in the Magenta Drain is probably derived from underground mine workings associated with the Empire Mine Shaft. The Magenta Drain tunnel might also collect water from possible surface water infiltration and/or shallow groundwater recharge along its length. The purpose of this hydrogeology assessment is to better define the relationship between the mine pool water level and Magenta Drain flow, and to assess other potential sources of flow to the tunnel. The hydrogeology assessment is comprised of two elements:

- Field characterization of surface hydrogeologic features
- Pumping tests on the Parks irrigation wells.

The field investigations for these efforts are described below.

4.1 Field Characterization of Surface Hydrogeologic Features

The Magenta Drain tunnel extends for approximately 3000 feet from the Empire Shaft to a portal in Woodpecker Ravine (Figure 3). The tunnel was constructed to drain water from the mine workings associated with the Empire Mine Shaft but may also collect surface water infiltration and shallow groundwater along its length. The purpose of this field characterization work is to identify surface drainage features in the topography above the trace of the tunnel that might be indicative of pathways for surface water to enter the tunnel. This work will be conducted in two parts. The first part is a review of available historic literature for information on surface and subsurface connections to the Magenta Drain and geological reports on surface geology and joint structure in the area of the Magenta Drain. The second part will involve a field survey of the ground above the underground trace of the Magenta Drain tunnel to identify and map drainage features where infiltration may occur, and springs and seeps where shallow groundwater may reach the surface. Ideally, this field survey will be conducted on a rainy day when surface water flow is apparent. Information gained from the literature review will be used to guide the field survey for specific mine or geologic features that may be indicative of hydrologic connections to the Magenta Drain.

4.2 Pumping Test of Park Irrigation Wells

A pumping test will be conducted using one of the existing irrigation wells at the Park. These wells tap water from the flooded underground mine workings associated with the Empire Mine Shaft. The purpose of the pumping test is to determine the extent to which withdrawal of water from the irrigation wells affects the rate of flow from the Magenta Drain tunnel. If lowering of the water level in the underground mine pool can stop or greatly reduce the rate of flow from the Magenta Drain, a smaller water treatment capacity may be needed for the Magenta Drain or other possible water management techniques might be possible. This type of hydrologic control may be considered in the analysis of management alternatives for the Magenta Drain water.

Before the pump test is conducted, the available hydrogeologic data will be compiled and analyzed to establish a baseline understanding of the hydrologic relationships of the Park irrigation wells, the Empire Shaft mine pool, and the Magenta Drain. The data considered for this analysis will include:

- A review of mine maps to identify potential intersections of workings with the Magenta Drain tunnel and development of a map of the surface trace of the tunnel
- A survey to obtain precise elevations for the Magenta Drain portal and the well heads for the irrigation wells
- A review of available completion data for the irrigation wells (e.g., screened depth and interval, pump capacity)
- A review of the Park irrigation system (e.g., storage tank capacity, well head plumbing, electrical connections)
- A review of the existing monitoring data to define the relationship between Magenta Drain flow rate and groundwater elevation in the irrigation wells, the relationship between Magenta Drain flow rate and volume of water pumped during irrigation cycles, and rate of groundwater level recovery after irrigation pumping ends.

A pump test of the irrigation wells will occur during the next dry season and will use the existing pumps to recover water for a sustained period of time of approximately 12 to 72 hours. This pump test will be used to obtain information about the existing pumping system and the response of the hydrogeologic system to prolonged pumping and recovery of that system. The existing irrigation system will be used to manage the water generated by the pump test to the extent possible by use of the storage tanks and continuous operation of the irrigation system. However, supplemental use of mechanical evaporation systems may also be needed to manage the pumped water. If mechanical evaporation systems are needed, their location and operation will be determined in consultation with the Department of Toxic Substances Control (DTSC) and the Central Valley Region Water Quality Control Board (CVRWQCB).

The data that will be obtained during this pump test will include:

- Simultaneous data on Magenta Drain portal flow rate, groundwater elevation of the Empire Shaft mine pool and volume of water pumped.
- Rate of groundwater elevation recovery in the irrigation well after pumping ends.
- Water quality for samples collected at the start of the pump test, at the lowest groundwater level obtained during the pump test, and after the groundwater elevation has recovered, to evaluate possible changes in water chemistry due to groundwater drawdown and recovery. In addition, pH, conductivity, and temperature will be continuously monitored during pumping. Samples will be collected, handled and analyzed in accordance with the water quality sampling and handling procedures specified in the Sampling and Analysis Plan provided in Appendix B. The water samples collected from the irrigation well will be analyzed for the constituents shown in Table 2.

Table 2 Parameter List for Irrigation Well Water Quality Samples

Analyte	
Metals (total and dissolved)	Aluminum, Antimony, Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Thallium, Vanadium, Zinc
Major cations and anions (dissolved)	Calcium, Magnesium, Potassium, Sodium, Chloride, Bicarbonate, Carbonate, Total Alkalinity, Nitrate/Nitrite, Sulfate, Silica, Free Cyanide
General inorganic chemistry	pH, Conductivity, Total Dissolved Solids, Hardness
Field Parameters	pH, Conductivity, Temperature

After the completion of the pump test, the data will be analyzed to determine the relationship between water level and flow rate from the Magenta Drain. Based on this analysis, additional pump tests may be conducted at a later date.

5.0 DATA TRANSMITTAL REPORTS

The results of the water treatment and hydrogeologic assessments will be presented in two Data Transmittal reports. One report will provide the results of the water treatability testing. The second report will provide the results of the hydrogeologic characterization. These reports will be submitted to the Department of Toxic Substances Control and the Central Valley Regional Water Quality Control Board within 90 days of completing each specific assessment.

6.0 SCHEDULE

The current schedule for this Work Plan is to complete the hydrogeologic and water treatment assessments during the summer and fall of 2007 and submit the data transmittal reports by the end of 2007. The field characterization of surface hydrogeologic features would be initiated as soon as possible following approval of this Work Plan. It is anticipated that the pumping test would be conducted during the summer of 2007. The bench-scale treatability testing would be started in the summer of 2007 after completion of the literature review. Depending on the results of the bench-scale testing, pilot-scale treatability testing would be conducted later in the summer or fall of 2007. The schedule is dependent upon timely review and approval, completion of the California Environmental Quality Act (CEQA) process, and the final issuance of an agency Order prior to the initiation of the 2007 work.

7.0 REFERENCES

MFG, Inc. (MFG), 2006a. Sampling and Monitoring Program for the Magenta Drain Tunnel at the Empire Mine State Historic Park Grass Valley, California. Prepared by MFG, Inc., Fort Collins, Colorado. July.

MFG, Inc. (MFG), 2006b. Quarterly Data Transmittal Report July through September 2006. Magenta Drain Tunnel, Empire Mine State Historic Park, Grass Valley, California. Prepared by MFG, Inc., Fort Collins, Colorado. December.

MFG, Inc. (MFG), 2006c. Data Gaps Report for the Empire Mine State Historic Park Phase 1: Existing Data. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. December.

MFG, Inc. (MFG), 2007a. Data Gaps Report for the Empire Mine State Historic Park Phase 2: Data Gaps Analysis. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. January 15.

MFG, Inc. (MFG), 2007b. Quarterly Data Transmittal Report October through December 2006. Magenta Drain Tunnel, Empire Mine State Historic Park, Grass Valley, California. Prepared by MFG, Inc., Fort Collins, Colorado. February.

Woodward Construction, Inc. (Woodward), 1992. Stability Status Inspection Report of Magenta Drain Tunnel. Prepared by Woodward Construction, Inc. for Empire Mine Park Association and the California Department of Parks and Recreation. October.

FIGURES

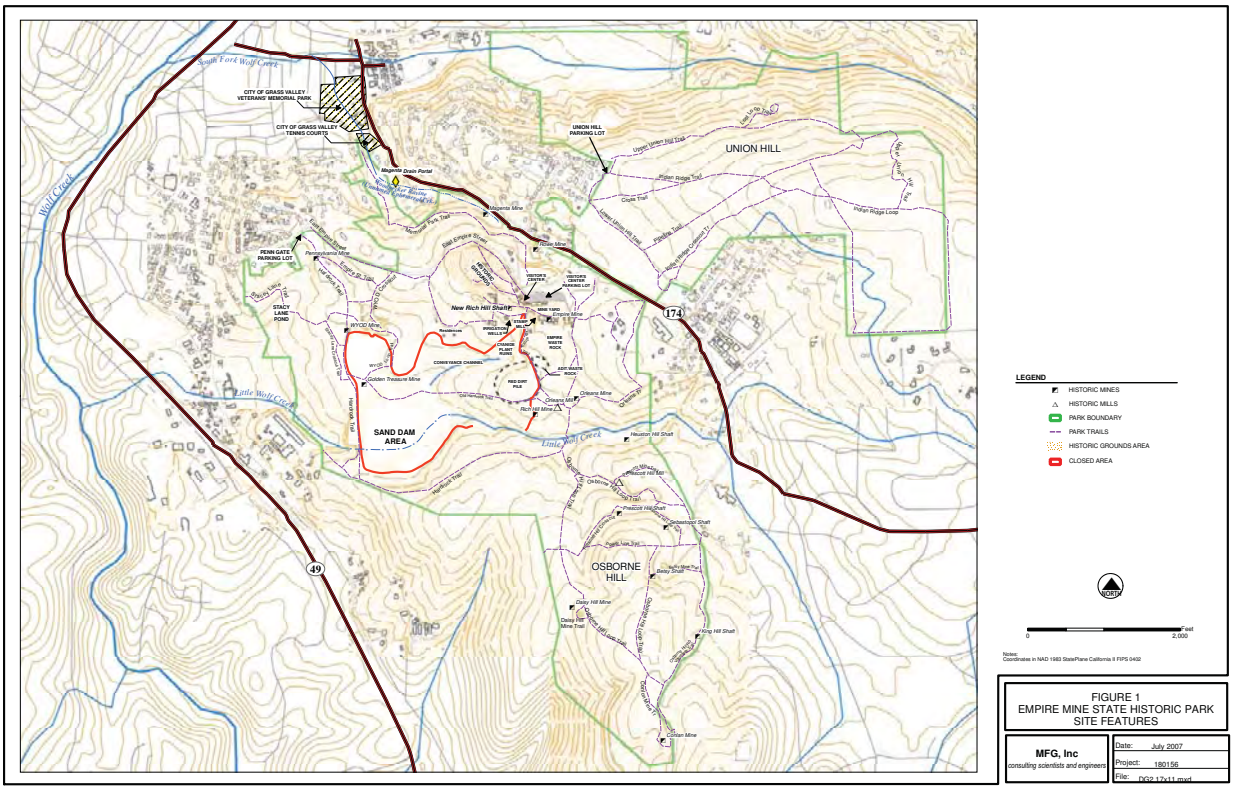

FIGURE 1
EMPIRE MINE STATE HISTORIC PARK
SITE FEATURES

MFG, Inc
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Date: July 2007
Project: 180156
File: DG2.17x11.mxd

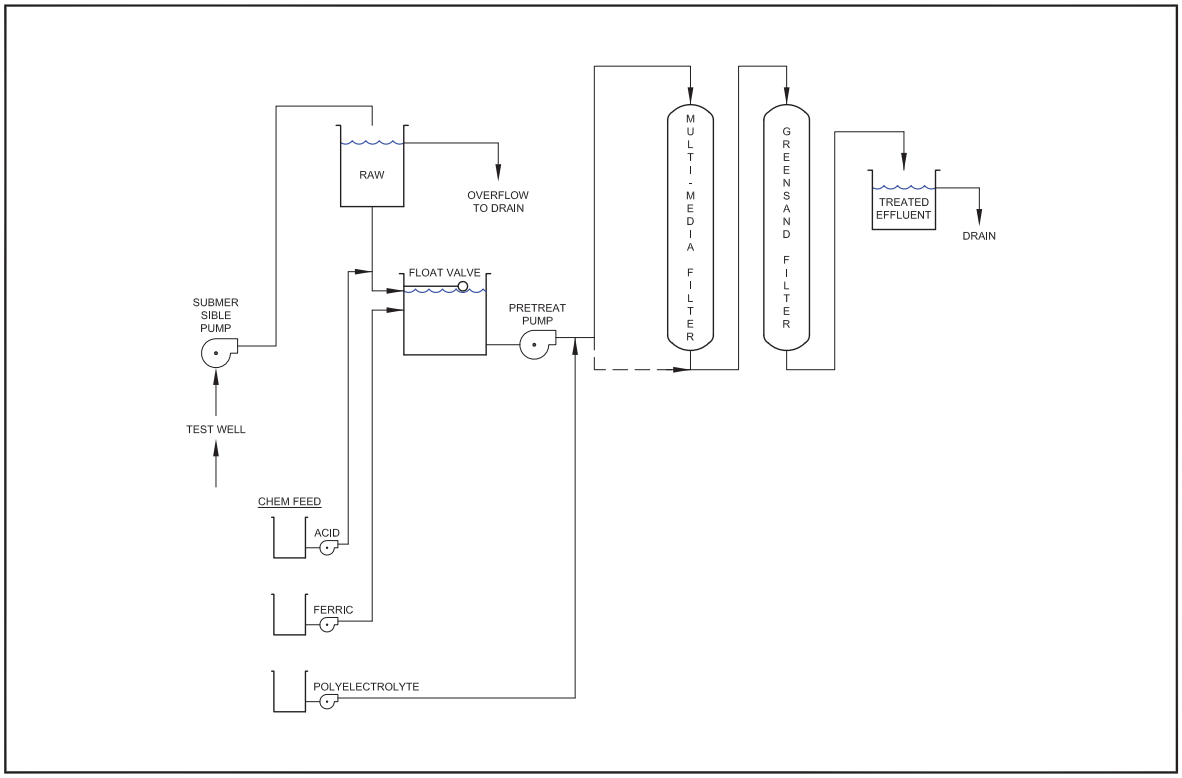

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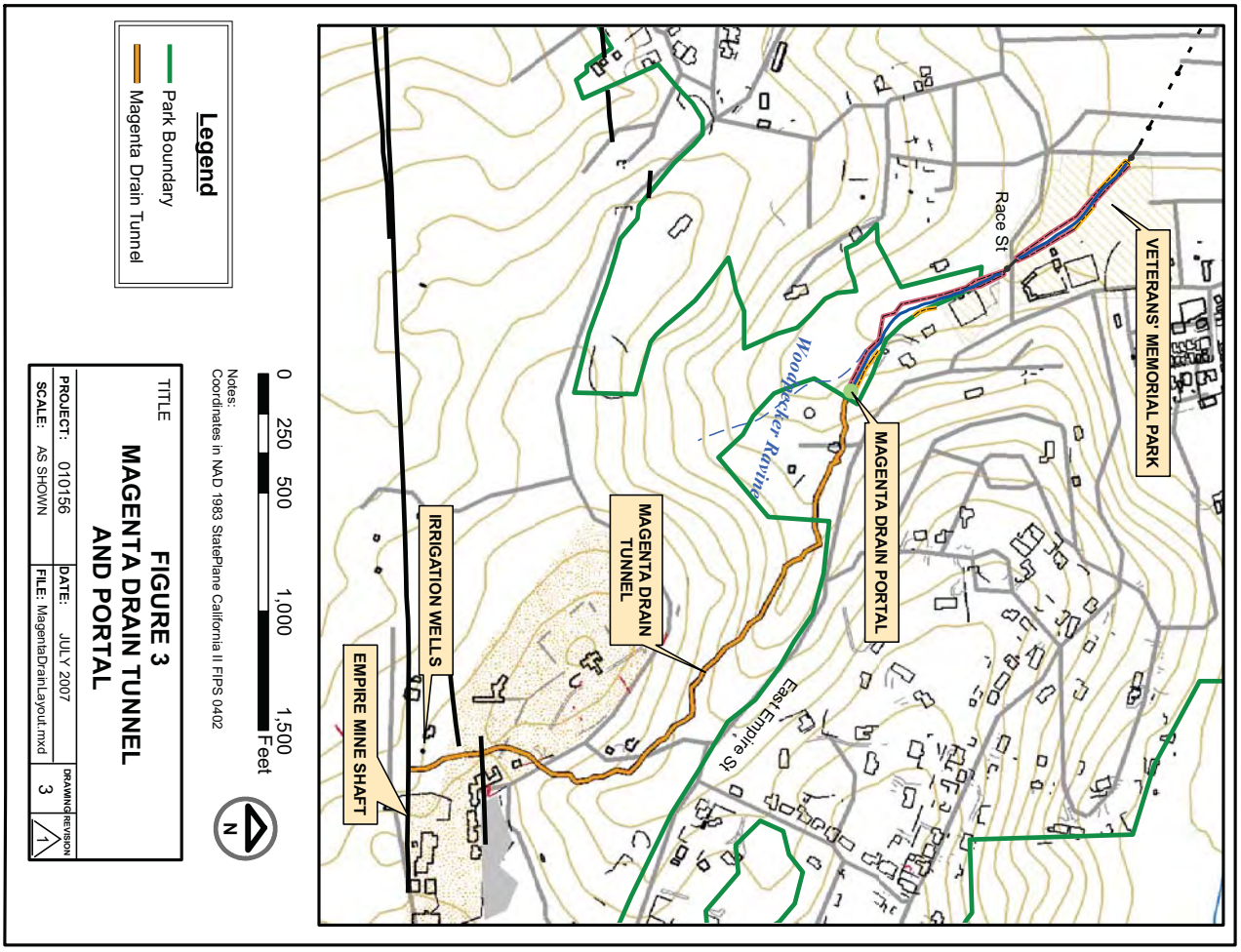
FIGURE 2
BASIC SCHEMATIC OF PILOT-SCALE SYSTEM

Date:	July 2007
Project:	180156
File:	SCHEM-001.DWG



Notes:
Coordinates in NAD 1983 StatePlane California II FIPS 0402

TITLE
FIGURE 3
MAGENTA DRAIN TUNNEL AND PORTAL

PROJECT: 010156	DATE: JULY 2007	DRAWING	REVISION
SCALE: AS SHOWN	FILE: MagentaDrainLayout.mxd	3	1

Additional Attachments are On-File with the Department of Parks and Recreation and on their Website:

http://www.parks.ca.gov/?page_id=981

Appendix C-7:
Stacy Lane Pond 2009 Data Transmittal Report

DATA TRANSMITTAL AND EVALUATION REPORT
FOR THE
STACY LANE POND
2008 ACTION WORK PLAN

FEBRUARY 2009

Prepared by:

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I certify under penalty of law that I have examined and am familiar with this report, and to my knowledge, the report is true, complete, and accurate.

Keith Steven Thompson, California Professional Geologist

PROFESSIONAL GEOLOGIST
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No. 5572
STATE OF CALIFORNIA

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Attachment B	Borehole Logs
Attachment C	Waste Rock Embankment Test Pit Log
Attachment D	Correlation of XRF and Laboratory Concentrations for Arsenic and Lead

1.0 PURPOSE

This Data Transmittal and Evaluation Report presents field and laboratory data from sampling at the Stacy Lane Pond Area at the Empire Mine State Historic Park (SHP), Grass Valley, California pursuant to the *Stacy Lane Pond 2008 Work Plan* (Work Plan) (MFG, 2008a). The purpose of this work is to delineate potential mine and mill materials in the Stacy Lane Pond Area and characterize those materials through collection of field descriptions and data on metal concentrations, acid generation potential, and metal solubility. Investigations in the Stacy Lane Pond Area included the delineation of tailing and waste rock, collection of surface and subsurface soils, tailing, and waste rock for further analysis, and collection of vegetation samples for laboratory analysis of total metals concentration. These data are evaluated as they apply to the Conceptual Site Model (CSM).

2.0 SUMMARY OF SAMPLE COLLECTION ACTIVITES

In accordance with the Work Plan, the following sampling activities were completed at the Stacy Lane Pond (SLP) Area:

- Visual survey and characterization of surface materials, including visual identification of potential mine and mill materials.
- Field in-situ X-ray fluorescence (XRF) measurements for arsenic and lead concentrations of surface materials. The in-situ XRF measurements were performed on a 50-foot grid.
- Collection of surface (0 to 2-inch depth) and shallow subsurface (2 to 24-inch depth) samples at twenty percent of the in-situ XRF measurement locations for ex-situ XRF analysis of arsenic and lead concentrations and laboratory analysis of the samples for arsenic, cadmium, lead, and mercury. Selected samples were also analyzed for CAM-17 metal concentrations, weak-acid dissociable (WAD) cyanide, acid-base accounting (ABA), paste pH, and State of California Modified Waste Extraction Test (DI WET) metal and WAD cyanide concentrations.
- Collection of subsurface samples from two boreholes for laboratory analysis of CAM-17 metals, WAD cyanide, ABA, paste pH, and DI WET CAM-17 metal and WAD cyanide concentrations.
- Collection of surface and subsurface samples from the waste rock embankment for laboratory analysis of CAM-17 metals, WAD cyanide, ABA, paste pH, and DI WET CAM-17 metal and WAD cyanide concentrations.
- Collection of vegetation tissue samples for laboratory analysis of CAM-17 metal concentrations.
- Installation of piezometers in each of the two boreholes for monthly water level measurements.

Sampling activities were performed in September 2008 by MFG, Inc. Figure 1 identifies the sampling locations for the SLP Area. Table 1 summarizes the number of field in-situ XRF measurements and the number of samples collected for ex-situ XRF and laboratory analyses. Laboratory analyses of the samples were performed by SVL Analytical (SVL), in Kellogg, Idaho. SVL is accredited (NELAP) by the California Department of Health Services. The laboratory analytical reports and chain of custody reports for the samples are provided in Attachment A.

2.1 Visual Survey and Characterization

A visual survey was performed to identify and delineate the extent of tailing and waste rock materials, to define the overall physical condition and configuration of the surface materials, and to define the boundary of the sampling area. The SLP Area consists of a swale-fill tailing deposit retained by a waste rock embankment. The estimated area of the tailing footprint is approximately 2.8 acres, and is

approximately 550 feet long by 350 feet wide at its longest and widest points (Figure 1). Based on visual, geochemical, and borehole observations during surface and shallow subsurface sampling, the SLP Area material consists of gray sandy tailing and contains containing approximately 51,000 cubic yards of tailing materials. The boundary of the tailing footprint is visually discernable from surrounding native soils by the presence of gray sandy tailing and the relatively flat topography of the tailing surface. Based on surface observations, the embankment is constructed of granodiorite/diabase waste rock similar in composition and texture to the Sand Dam tailing embankment and the Pennsylvania Mine waste rock pile. The SLP waste rock embankment is approximately 340 feet long by 100 feet wide and up to 28 feet in height. It is estimated that the embankment contains approximately 5,600 cubic yards of waste rock materials. The Stacy Lane Trail bisects the tailing footprint, as shown on Figure 1.

A depression exists within the tailing footprint that retains storm water from precipitation events; however, the depression was dry during the sampling activities. No evidence of storm water outflow from the depression was observed. The height of the waste rock embankment extends approximately three to five feet above the tailing surface, which serves to retain water from direct precipitation or storm water run-on within the tailing surface. The tailing surface was dry during sampling activities, and no evidence of storm water ponding was observed on the tailing surface. In addition, no evidence of storm water outflow from the tailing surface or erosion of tailing along the perimeter of the tailing footprint was observed.

The plant community in the area within the tailing footprint south of the depression consists of mature pine overstory, with an understory of small oak, poison oak, Himalayan blackberry, madrone, and grass species. The tailing surface in the southern area is covered throughout by a relatively thick (4-6 inches) litter layer. The area north of the depression is dominated more by grasses and Himalayan blackberry, with less pine. Open areas within and to the west and north of the tailing footprint have a thick understory of Himalayan blackberry. The area of the depression is mostly bare ground with a few mature willow and some oak seedlings.

2.2 Surface and Shallow Subsurface Characterization

In-situ XRF surface measurements were performed at a total of 72 locations. The in-situ XRF measurements were performed using a portable Niton XRF 702 XLp spectrum analyzer directly on the ground surface at the 50-foot grid intervals (Figure 1). The XRF measurements were performed as described in the Work Plan in accordance with *EPA Method 6200 – Field Portable X-ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment* (U.S. EPA, 2007). Surface (0 to 2-inch depth) and shallow subsurface (2 to 24-inch depth) samples were collected for further

analysis at every fifth XRF measurement location, which corresponds to twenty percent of the in-situ XRF locations. A total of 15 surface and 15 shallow subsurface samples were collected. The surface samples were sieved to less than 0.25 mm and analyzed for arsenic and lead by ex-situ XRF according to EPA Method 6200. Following analysis by ex-situ XRF, the sieved surface samples were then submitted for laboratory analysis of total metals as summarized in Table 1. Five selected surface samples were split prior to sieving, and submitted for laboratory analyses of WAD cyanide, ABA, paste pH, and DI WET total metals and WAD cyanide, as summarized in Table 1. The subsurface samples were submitted for laboratory analyses as summarized in Table 1. Total metals analyses were conducted by the laboratory following EPA method 3050, which includes sieving to less than 2 mm. DI WET analyses were conducted by the laboratory according to California Waste Extraction Test procedures, modified to use deionized water, which includes sieving to less than 2 mm. ABA was conducted according to EPA method 600/2-78-054, which includes crushing the sample to 0.25 mm.

2.3 Borehole Sampling

Two boreholes were drilled by advancing hollow-stem augers with a CME 850 rubber track drill rig to collect deep subsurface samples within the SLP tailing (Figure 1). Boreholes were drilled a minimum of five feet (or until drilling refusal) into the foundation material underlying the tailing. Composite samples were collected from the two boreholes at intervals of approximately five feet within the tailing and from the underlying foundation material. The samples were analyzed for CAM-17 metals, WAD cyanide, ABA, paste pH, and DI WET CAM-17 metals and WAD cyanide, as summarized in Table 1. Borehole 1 (SLP/B01) was drilled to a depth of 40 feet with ten composite sampling intervals. Borehole 2 (SLP/B02) was drilled to a depth of 27.5 feet with six composite sampling intervals. Subsurface water was present within the tailing during drilling of both boreholes. Piezometers were constructed in both boreholes, as shown by the completion diagrams provided in Attachment B. The water level in each piezometer was measured following installation and was measured in October, December, and January.

2.4 Waste Rock Characterization

The Stacy Lane Pond embankment is constructed of gravel to cobble-sized waste rock comprised of diabase, diorite and gabbro, with no visible sulfide mineralization (Figure 1). The waste rock embankment was sampled at the surface (0 to 6-inch depth) and at a depth of four feet in a backhoe test pit. The samples were analyzed by the laboratory for CAM-17 metals, WAD Cyanide, ABA, paste pH, and DI WET CAM-17 metals, as summarized in Table 1. The test pit log is provided in Attachment C.

2.5 Vegetation Sampling

Vegetation samples (plant leaf tissue) were collected from three locations co-located with surface sampling locations. Four of the five plant species selected in the Work Plan were present and collected, but not all species were present at each sampling location. These included *Salix* sp. (willow), *Quercus* sp. (oak), *Rubus armeniacus* (Himalayan blackberry) and grasses (composite of species). A total of seven samples were collected. Samples were washed and dried before laboratory analysis of CAM-17 metals.

3.0 SUMMARY OF XRF AND LABORATORY RESULTS

3.1 Surface and Shallow Subsurface Samples

As described above, in-situ XRF measurements of surface material for arsenic and lead concentrations were performed on a 50-foot grid in the Stacy Lane Pond area. Surface and shallow subsurface samples were collected at 20 percent of these XRF measurement locations. The in-situ XRF data for surface samples were correlated to the laboratory results for total arsenic and lead through regression analysis, as described in Attachment D. Both the directly measured in-situ XRF and the laboratory-correlated XRF concentrations for arsenic and lead are presented in Table 2. The arsenic and lead concentrations determined by laboratory-correlated in-situ XRF measurements and laboratory sample analyses are presented on Figures 2 and 3. The results of the XRF and laboratory analyses are described in the following sections.

3.1.1 XRF Analysis

The results of the in-situ and correlated in-situ XRF analyses for arsenic and lead are provided in Table 2. Twenty-five of the 72 total XRF measurements taken in the Stacy Lane Pond area were below the XRF detection limit for arsenic of 19 milligrams per kilogram ([mg/Kg]). The maximum arsenic concentration observed was 206 mg/Kg at data point SL A00+50, in native soil outside of the visually defined tailing footprint boundary. The average arsenic concentration of the laboratory-correlated XRF measurements was 40 mg/Kg, and the median was 23 mg/Kg. Lead concentrations ranged from less than 21 mg/Kg to 405 mg/Kg. The average lead concentration was 95 mg/Kg, and the median was 77 mg/Kg. The highest arsenic and lead concentrations occurred in native soil to the west of the tailing boundary (Figures 2 and 3).

3.1.2 Total Metals and WAD Cyanide Laboratory Analysis

As discussed previously, samples were collected at twenty percent of the in-situ XRF measurement locations and analyzed by the laboratory to assess metal content and develop regression curves for the in-situ XRF measurements performed directly on the ground surface for arsenic and lead. A total of 15 surface samples and 15 subsurface samples were collected and submitted to the laboratory for analysis. Of those 30 samples, 20 were submitted for selected metals (arsenic, cadmium, lead, mercury) and 10 were submitted for CAM-17 metals and WAD cyanide. The total metals and WAD cyanide concentrations of the samples are shown in Table 3. The arsenic and lead concentrations analyzed by the laboratory are shown on Figures 2 and 3. Antimony, selenium, thallium, and WAD cyanide concentrations were below the detection limit for all 10 surface and shallow subsurface samples analyzed by the laboratory.

Arsenic concentrations in the surface samples (0 to 2-inch depth) ranged from 3.8 mg/Kg to 113 mg/Kg, averaged 28 mg/Kg, and had a median of 21 mg/Kg. Lead concentrations ranged from 9.27 mg/Kg to 271 mg/Kg. The average lead concentration was 96 mg/Kg, and the median was 79 mg/Kg. Cadmium concentrations ranged from less than 0.20 mg/Kg to 4.22 mg/Kg, with an average concentration of 2.3 mg/Kg and median of 2.17 mg/Kg. Mercury concentrations of the surface samples ranged from 0.118 mg/Kg to 7.07 mg/kg, with an average of 2.1 mg/Kg and a median of 1 mg/Kg.

Arsenic concentrations in the shallow subsurface samples (2-24 inches) ranged from 4.4 mg/Kg to 127 mg/Kg, averaged 25 mg/Kg, and had a median of 15 mg/Kg. Lead concentrations ranged from 35.8 mg/Kg to 236 mg/Kg, averaged 82 mg/Kg, and had a median of 65 mg/Kg. Cadmium concentrations ranged from less than 0.20 mg/Kg to 5.63 mg/Kg, had an average of 2.1 mg/Kg and median of 1.8 mg/Kg. Mercury concentrations ranged from 0.130 mg/Kg to 7.65 mg/Kg and had an average of 2.2 mg/Kg and a median of 1.3 mg/Kg.

3.1.3 Acid Base Accounting and Paste pH Analysis

Acid Base Accounting (ABA) and paste pH testing were conducted on a total of five surface and five shallow subsurface samples collected from the SLP Area. The ABA and paste pH results for the samples are provided in Table 4. Eight of the ten samples demonstrated net neutralizing potential, with one result slightly negative and one result less than the reporting limit. None of the samples submitted for ABA analysis exhibited a pH value less than 5.

3.1.4 DI WET Analysis

DI WET analysis was conducted on the same set of samples analyzed for ABA and paste pH (five surface and five shallow subsurface samples). Laboratory analysis of the DI WET leachate was performed for CAM-17 metals and WAD cyanide. The DI WET results are provided in Table 5. DI WET antimony, selenium, silver, thallium, and WAD cyanide concentrations were below laboratory detection limits for all surface and shallow subsurface samples.

3.2 Borehole Samples

3.2.1 Water Levels

Piezometers were installed in each borehole at the Stacy Lane Pond area. The water level in each piezometer was measured following installation and has been monitored monthly (Table 6) to date. The initial water levels were 18.3 feet below ground surface (bgs) in B01 and 19.81 ft bgs in B02. The water levels declined in December to depths of 19.34 ft bgs and 20.78 ft bgs and increased in January to depths

of 15.6 ft bgs and 16.57 ft bgs. According to the Work Plan, water levels will be measured in the SLP piezometers for one year from the date of installation.

3.2.2 Total Metals Analysis and WAD Cyanide

Soil samples were collected at discrete intervals in two boreholes within the SLP Area. A total of 10 composite samples were collected from borehole 1 (SLP/B01), and 6 composite samples were collected from borehole 2 (SLP/B02). All samples were submitted for laboratory analysis of CAM-17 metals, WAD cyanide, DI-WET extraction, ABA, and paste pH. The total metals and WAD cyanide concentrations for the samples are shown in Table 7.

Antimony, selenium, thallium, and WAD cyanide concentrations were below the laboratory detection limits for all 16 samples. The average arsenic concentration for all borehole samples was 15.4 mg/Kg, and the median was 17.2 mg/Kg. The maximum arsenic concentration was 23.1 mg/Kg (SLP/B01 from 1.2 to 4.5 feet). The average lead concentration of the samples was 101 mg/Kg, and the median lead concentration was 88.3 mg/Kg. The maximum lead concentration was 215 mg/Kg (SLP/B01 from 9.6 to 12.5 feet). The average mercury concentration of the samples was 3.90 mg/Kg, and the median was 2.04 mg/Kg. The maximum mercury concentration was 10.6 mg/Kg (SLP/B01 from 5 to 9.6 feet). The average cadmium concentration of the samples was 3.91 mg/Kg, and the median was 3.37 mg/Kg. The maximum cadmium concentration was 7.08 mg/Kg (SLP/B01 from 1.2 to 4.5 feet). Metal concentrations of the underlying foundation material were similar to the metal concentrations of the tailing.

3.2.3 ABA and paste pH Analysis

The 16 samples from the two boreholes were submitted for Acid Base Accounting (ABA) and paste pH analyses. The ABA and paste pH results for the samples are provided in Table 8. Laboratory results for all 16 samples demonstrated net neutralizing potential. None of the samples submitted for ABA analysis identified significant acid generating potential. The paste pH for the 16 samples ranged from 6.85 to 8.02. The percentage of total sulfur content for all sixteen samples was less than one percent.

3.2.4 DI WET Analysis

The 16 samples from the two boreholes were also submitted for DI WET analysis. Laboratory analysis of the DI WET leachate was performed for CAM-17 metals and WAD cyanide. The DI WET results are provided in Table 9. DI Wet WAD cyanide, beryllium, selenium, and thallium concentrations were below the laboratory detection limit in all of the samples. Chromium, nickel, and silver concentrations were below the detection limit in 15 out of the 16 samples. Lead and cobalt concentrations were below the detection limit in 14 out of the 16 samples.

3.3 Waste Rock Embankment Test Pit Samples

3.3.1 Total Metals Analysis

A surface (0-6 inches) sample and a subsurface (4 feet) sample were collected from a test trench within the waste rock embankment. A total of two samples were collected. The total metals and WAD cyanide concentrations for the samples are shown in Table 3.

WAD cyanide, antimony, selenium, and thallium concentrations were below the detection limit for both embankment samples. The maximum arsenic (38.0 mg/Kg), cadmium (3.5 mg/Kg), lead (169 mg/Kg), and mercury (6.26 mg/Kg) concentrations were from the sample collected at a depth of four feet.

3.3.2 ABA and paste pH Analysis

Acid Base Accounting (ABA) and paste pH analyses were conducted on the two embankment samples. The ABA and paste pH results for the samples are provided in Table 4. Both samples demonstrated net neutralizing potential. Neither sample had significant acid generating potential. The paste pH was 6.78 for the surface sample and 7.46 for the subsurface sample. The total sulfur content for both samples was less than 0.5 percent.

3.3.3 DI WET Analysis

DI WET testing was also conducted on both of the waste rock embankment samples. Laboratory analysis of the DI WET leachate was performed for CAM-17 metals. The DI WET results are provided in Table 5. The DI Wet antimony, selenium, silver, and thallium concentrations were below laboratory detection limits in both samples.

3.4 Vegetation Samples

Laboratory analysis of the plant tissue samples was performed for CAM-17 metals. The results are provided in Table 10. Beryllium, chromium, lead, mercury, silver, thallium and vanadium concentrations were all below the detection limit. Arsenic, cobalt and molybdenum concentrations were below laboratory detection for five of the seven samples, and nickel concentrations were below detection for six of the seven samples. The highest cadmium (32.7 mg/Kg), cobalt (5 mg/Kg), selenium (0.15 mg/Kg), and zinc (473 mg/Kg) concentrations were in the willow samples.

4.0 DATA EVALUATION

4.1 Total Metals and WAD Cyanide

The total metal concentrations from the SLP Area were compared to the California Human Health Screening Levels (CHHSLs) for residential and commercial/industrial use (California Environmental Protection Agency [CEPA], 2005) as a screening level assessment to identify potential constituents of interest to human health. If soil metal concentrations are less than the CHHSLs, then the metal concentrations are considered to be below thresholds for risk to human health. The residential CHHSLs were developed using an exposure scenario of 350 days per year for 30 years, and the commercial/industrial CHHSLs were developed using an exposure scenario of 250 days per year for 20 years. Visitor use in the SLP Area includes hiking, jogging, biking, and equestrian use on the defined Stacy Lane Trail, and infrequent off-trail hiking. Parks staff and volunteer use includes hiking and patrolling the Stacy Lane Trail and occasional maintenance activities. The potential human health exposure to surface materials due to uses in the SLP Area is less than that for either the residential or commercial/industrial exposure scenarios. Therefore, even the commercial/industrial CHHSLs are conservative with respect to the uses in the SLP Area.

Antimony, barium, beryllium, chromium, cobalt, copper, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc concentrations were all below the respective residential CHHSLs. No WAD cyanide was detected in any of the samples. Lead concentrations were greater than the residential CHHSL of 150 mg/Kg in 11 of the 72 XRF measurements and in 10 of the samples analyzed by the laboratory. All lead concentrations were below the commercial/industrial CHHSL of 3,500 mg/Kg. Cadmium concentrations were greater than the residential CHHSL of 1.7 mg/Kg in 11 of the 15 surface samples and in 8 of the 15 shallow subsurface samples. Cadmium concentrations of all of the surface, shallow subsurface, waste rock and borehole samples were below the commercial/industrial CHHSL of 7.5 mg/Kg. Therefore, the concentrations of these metals are below the thresholds for risk to human health from exposure to these metals.

Arsenic concentrations of all samples exceeded both the residential and industrial/commercial use CHHSLs. In 2006, the DTSC, Human and Ecological Risk Division (HERD) recommended a remediation goal for arsenic on trail surfaces of 270 mg/Kg (Klein, 2006), based upon the exposure scenario of a runner using a trail four days a week for a one hour duration over 30 years. Previous investigations determined that surface concentrations of arsenic were less than 270 mg/Kg on the Stacy Lane Trail (MFG, 2006a). The highest laboratory-correlated in-situ XRF arsenic concentration of 206 mg/Kg (SL A00+50) is less than the HERD remediation goal for trail surfaces. Average arsenic

concentrations within the tailing footprint were 26.82 mg/Kg from XRF measurements and 20.56 mg/Kg from laboratory results. Average arsenic concentrations off the tailing footprint were 68.68 mg/Kg from XRF measurements and 50.25 mg/Kg from laboratory results.

CAM-17 metals concentrations in plant tissue were within the reported normal range for plants (Kabata-Pendias, 2001), with the exception of cadmium and zinc concentrations in the two *Salix* (willow) samples. This is an indicative trait of willow species, which are known cadmium and zinc accumulators (Dos Santos Utmazian and Wenzel, 2007; Vandecasteele et al., 2002). Cadmium concentrations (7.7 mg/Kg and 32.7 mg/Kg) and zinc concentrations (362 mg/Kg and 473 mg/Kg) are below benchmarks based on lowest observed adverse effects levels (LOAELs) for terrestrial wildlife (Sample et al., 1996).

4.2 Acid Base Accounting and Paste pH

Modified Sulfide/Sulfur Acid Base Accounting (ABA) was conducted on 10 samples from the SLP Area (five surface and five shallow subsurface), 16 samples from the boreholes, and 2 samples from the waste rock embankment. The Modified Sulfide/Sulfur ABA analysis speciates the reactive pyritic sulfur from the non-reactive sulfate and non-reactive sulfur. The net neutralizing potential (NNP) is determined by subtracting the acid generating potential (AGP) from the acid neutralizing potential (ANP) associated with the reactive sulfur speciation. Therefore, a negative NNP value indicates that a sample has the potential to generate acidity, while a positive NNP value indicates that a sample has the potential to neutralize acidity. Guidelines established for interpretation of ABA results (USEPA, 1999) identify that materials with NNP values less than -20 tons $CaCO_3$ per 1,000 tons (parts per thousand $CaCO_3$, or ppt $CaCO_3$) are acid generating, while materials with NNP values greater than +20 ppt $CaCO_3$ are acid neutralizing. Samples with NNP values between -20 and +20 ppt $CaCO_3$ are uncertain with respect to acid generation or neutralization (USEPA, 1999). One of the two waste rock samples, and 13 of 16 borehole samples submitted for ABA analyses showed NNP greater than 20 $CaCO_3$. All of the remaining samples submitted for ABA analyses showed NNP values between 0.4 and 20 ppt $CaCO_3$, with the exception of two shallow subsurface samples with NNP values of -0.5 and less than 0.3 ppt $CaCO_3$.

4.3 DI Wet Extractions

The CAM-17 metals concentrations from the DI WET extractions of the surface and shallow subsurface samples and the borehole samples are all below the EPA storm water benchmark values (Federal Register, 1995). The zinc concentration in the DI WET extraction of the surface waste rock embankment sample (0.0845 mg/L) exceeded the EPA storm water benchmark value of 0.065 mg/L. The other metal

concentrations from the DI WET extractions of the waste rock embankment samples were below the EPA storm water benchmark values.

When compared to total metal concentrations, the DI WET results from the samples in the SLP Area indicate that a very small fraction of the total metals content is water soluble. In most cases the percentage of DI WET-extractable metal concentrations are less than one percent of their total metal concentrations. Previous investigations at the Park determined that the proportion of DI WET-extractable arsenic and lead concentrations increases with sample pH below 4.5 (MFG, 2008b). The lowest pH measured from all of the samples collected within the SLP Area was 5.24. Evaluation of DI WET results indicates there is minimal potential for leaching of metals to storm water that contacts mine and mill materials in the SLP Area. WAD cyanide concentrations in the DI WET extractions of all samples from the SLP Area were below laboratory detection.

5.0 UPDATED CONCEPTUAL SITE MODEL

The conceptual site model (CSM) developed for the Park (MFG, 2006b, 2007) describes potential release mechanisms, transport pathways, and exposure routes to receptors at the Park. Application of the CSM to the SLP Area indicates that the primary potential release mechanisms for metals from tailing and waste rock materials are erosion by storm water runoff during periods of high precipitation and chemical weathering (MFG 2007, 2008a). Potential pathways defined in the Work Plan are storm water runoff, leaching of metals and acidity to water resources following chemical weathering of tailings and waste rock, and uptake of metals by plants growing in tailing and waste rock. The potential exposure routes are dermal contact and incidental ingestion of mine and mill materials, consumption of plants growing in tailing and waste rock, and inhalation of tailing or waste rock particulates. The objective of any remedial action for the Area is elimination of the potential release mechanisms, transport pathways, and exposure routes to receptors.

The 2008 site characterization provides surface and subsurface metal concentration data and other material characteristics to delineate the extent of historic mine and mill material and evaluate the potential for release of metals from this material. The evaluation of the results presented in Section 4.0 indicates that the material is not acid generating and that the materials have little potential to release soluble metals upon exposure to water, thereby eliminating leaching as a potential release mechanism.

The concentrations of the CAM-17 metals, with the exception of arsenic, are below the residential and/or commercial/industrial CHHSLs, which are considered safe for incidental ingestion, inhalation, and dermal exposure for residential and/or commercial industrial exposures. The exposures to human receptors at the Stacy Lane Pond Area are significantly less than the exposures used to calculate the CHHSLs for residential and commercial/industrial scenarios. The concentrations of arsenic are below the HERD recommended remediation goal.

The metals content of the vegetation was within normal ranges, with the exception of cadmium and zinc in the willow species. However, the cadmium and zinc concentrations are within benchmark values for terrestrial wildlife.

6.0 ALTERNATIVE ACTIONS

The potential Alternative Actions identified in the Work Plan for the SLP Area are described below.

- No Action. The No Action option would be to maintain the existing surfaces.
- Placement of covers where appropriate. This action would involve covering certain surface materials with a vegetated soil and/or an engineered cover containing clean fill and infiltration barriers.
- Use of institutional controls (fencing, signs, etc.) to prevent access. This action would involve the installation and maintenance of fences and signage to prevent public access.
- Removal and disposal of the tailing and/or the waste rock embankment materials from the Stacy Lane Pond area.

7.0 REFERENCES

Dos Santos Utmazian, M.N., and W.W. Wenzel. 2007. Cadmium and zinc accumulation in willow and poplar species grown on polluted soils. J. Plant Nutrition and Soil Science 170:265-272.

Federal Register, 1995. Vol. 60, No. 189, September 29. p. 50826.

Kabata-Pedias, A. 2001. Trace Elements in Soils and Plants. Third Edition. Boca Rotan: CRC Press. 413 pp.

Klein, Kimiko to Perry Myers, 2006. Memorandum regarding Remediation Goals for the Recreational Runner on Trails, Empire Mine State Historical (sic) Park, Grass Valley, September 29, 2006, Department of Toxic Substances Control. P. Myers

MFG, Inc. (MFG), 2006a. Data Transmittal and Addendum for the Trails 2006 Priority Action Work Plan, Empire Mine State Historic Park. MFG, Inc., Fort Collins, Colorado. December.

MFG, Inc. (MFG), 2006b. Data Gaps Report for the Empire Mine State Historic Park Phase 1: Existing Data. MFG, Inc., Fort Collins, Colorado. December.

MFG, Inc., 2007. Data Gaps Report for the Empire Mine State Historic Park Phase 2: Data Gaps Analysis. Fort Collins, Colorado. January 15.

MFG, Inc., 2008a. Stacy Land Pond 2008 Work Plan, Empire Mine State Historic Park. Fort Collins, Colorado. June 26.

MFG, Inc., 2008b. DRAFT Cyanide Plant and Adit Project Area Alternative Actions Report. Fort Collins, Colorado. June 2008.

MFG, Inc. (MFG), 2008c. Osborne Hill Area Trails Data Evaluation and Remedial Options Analysis Report, Empire Mine State Historic Park. MFG, Inc., Fort Collins, Colorado. July 2008.

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. ES/ER/TM-86/R3. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

United States Environmental Protection Agency (USEPA), 1999. EPA and Hardrock Mining: A Sourcebook for Industry in the Northwest and Alaska. Draft Guidance Document from EPA Region 10. EPA-10-R-99-016.

United States Environmental Protection Agency (USEPA), 2007. Method 6200 - Field Portable X-ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment. Revision 0. February 2007. http://www.epa.gov/epawaste/hazard/testmethods/sw846/pdfs/6200.pdf

Vandecasteele, B., B. De Vos, and F.M.G. Tack. 2002. Cadmium and zinc uptake by volunteer willow species and elder rooting in polluted dredged sediment disposal sites. Science of the Total Environment 229:191-205.

TABLES

Table 1 Summary of Field and Laboratory Analyses

Sample Type	Field In-Situ XRF Measurements	Number of Samples Collected	Ex-Situ XRF Measurements	Number of Laboratory Analyses			
				As, Pb, Cd and Hg	CAM-17 Metals and WAD CN	ABA and Paste pH	DI Wet Cam 17 Metals and WAD CN
TAILING AREA							
Surface Materials (0-2 inches)	72	15	15	15	5	5	5
Shallow subsurface materials (2-24 inches)	0	15	0	15	5	5	5
Deep subsurface materials (5-40 feet)	0	16	0		16	16	16
WASTE ROCK EMBANKMENT							
Surface materials	0	1	0		1	1	1
Subsurface materials (4 feet)	0	1	0		1	1	1
VEGETATION SAMPLES							
Leaf Tissue	0	7	0	0	7*	0	0
Totals	72	55	15	30	35	28	28

*WAD CN not analyzed for vegetation samples

Table 2 In-situ XRF and Correlated XRF Concentrations (mg/Kg)

Sample ID	In-Situ XRF Arsenic Concentration	Correlated XRF Arsenic Concentration	In-Situ XRF Lead Concentration	Correlated XRF Lead Concentration
SL A00+00	103	107	95	90
SL A00+50	198	206	72	69
SL B00+00	32	33	123	116
SL B00+50	6	<19	141	134
SL B01+00	12	<19	83	79
SL B01+50	143	148	124	118
SL B02+00	166	173	47	45
SL B02+50	113	117	42	40
SL C00+00	20	21	73	69
SL C00+50	12	<19	57	54
SL C01+00	25	26	54	51
SL C01+50	9	<19	67	64
SL C02+00	59	61	47	45
SL C02+50	26	27	62	59
SL C03+00	9	<19	128	121
SL D00+00	14	<19	136	129
SL D00+50	19	19	46	44
SL D01+00	17	<19	71	68
SL D01+50	19	20	59	56
SL D02+00	24	25	126	120
SL D02+50	28	29	117	111
SL D03+00	40	41	136	129
SL D03+50	41	43	87	82
SL D04+00	16	<19	106	101
SL E00+00	6	<19	106	101
SL E00+50	12	<19	45	42
SL E01+00	20	21	81	77
SL E01+50	20	21	94	89
SL E02+00	31	32	113	107
SL E02+50	14	<19	57	54
SL E03+00	3	<19	135	128
SL E03+50	22	23	57	54
SL E04+00	48	50	158	150
SL E04+50	59	62	426	405
SL F00+00	42	44	196	186
SL F00+50	11	<19	80	76
SL F01+00	31	33	184	175
SL F01+50	27	28	121	115
SL F02+00	11	<19	95	91
SL F02+50	20	21	39	37
SL F03+00	-3.51	<19	61	58
SL F03+50	4	<19	77	73
SL F04+00	28	29	81	77

Table 2 In-situ XRF and Correlated XRF Concentrations (mg/Kg) (continued)

Sample ID	In-Situ XRF Arsenic Concentration	Correlated XRF Arsenic Concentration	In-Situ XRF Lead Concentration	Correlated XRF Lead Concentration
SL F04+50	29	30	68	65
SL F05+00	91	94	301	286
SL F05+50	2	<19	104	99
SL G00+00	23	23	158	151
SL G00+50	23	23	159	151
SL G01+00	21	22	194	184
SL G01+50	17	<19	185	176
SL G02+00	15	<19	72	69
SL G02+50	19	20	57	54
SL G03+00	25	25	69	66
SL G03+50	28	29	121	115
SL G04+00	3	<19	56	53
SL G04+50	63	65	242	230
SL G05+00	16	<19	48	46
SL G05+50	24	25	32	30
SL H00+00	20	21	135	129
SL H00+50	9	<19	28	27
SL H01+00	74	77	53	50
SL H01+50	42	44	100	95
SL H02+00	114	118	129	123
SL H02+50	91	95	171	162
SL H03+00	27	28	67	63
SL H03+50	13	<19	68	65
SL H04+00	21	22	39	37
SL H04+50	25	26	72	68
SL H05+00	10	<19	36	34
SL H05+50	-1.8	<19	31	29
SL I04+50	129	134	20	<21
SL I05+50	33	34	46	43

Table 3 Total Metals and WAD Cyanide Laboratory Results for Surface, Shallow Subsurface, and Waste Rock Embankment Samples (mg/Kg)

Sample ID	WAD Cyanide	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Surface Soil Samples (0 inches to 2 inches)																		
SLP/B00+50/00/01			23.4			3.54				135	3.87							
SLP/C01+50/00/01			20.2			3.76				96.7	1.33							
SLP/C02+50/00/01			41.3			4.09				76.1	1.90							
SLP/D01+00/00/01	<0.500	<2.0	11.5	41.3	<0.200	2.87	3.76	3.17	17.5	36.2	0.475	1.04	1.94	<1.00	<0.50	<1.5	12.6	122
SLP/D02+50/00/01			15.2			1.95				79.1	3.65							
SLP/E00+00/00/01			9.70			1.75				73.3	1.01							
SLP/F01+50/00/01			16.9			2.17				113	1.78							
SLP/F03+50/00/01			21.8			2.63				78.8	0.728							
SLP/F05+00/00/01	<0.500	<2.0	113	157	0.729	1.14	19.7	10.3	112	271	0.333	1.47	8.60	<1.00	<0.50	<1.5	60.3	290
SLP/G02+00/00/01	<0.500	<2.0	20.2	45.3	0.214	0.93	6.45	4.02	30.9	67.0	0.758	1.27	10.2	<1.00	0.81	<1.5	19.6	99.6
SLP/G02+50/00/01			21.4			1.78				72.2	0.845							
SLP/H00+00/00/01			24.6			4.22				166	6.65							
SLP/H01+50/00/01	<0.500	<2.0	53.9	107	0.417	0.21	22.6	6.89	70.4	101	7.07	2.08	8.55	<1.00	2.48	<1.5	160	46.8
SLP/H04+50/00/01			30.3			3.05				63.9	0.828							
SLP/H05+50/00/01	<0.500	<2.0	3.8	32.8	0.593	<0.20	4.79	5.26	3.43	9.27	0.118	<0.80	2.22	<1.00	<0.50	<1.5	46.3	14.0
Subsurface Soil Samples (2 inches to 24 inches)																		
SLP/B00+50/02/01			26.3			3.82				161	5.62							
SLP/C01+50/02/01			14.3			3.00				66.8	1.28							
SLP/C02+50/02/01			10.5			2.08				35.8	0.987							
SLP/D01+00/02/01	<0.500	<2.0	14.7	78.6	0.210	1.80	3.07	4.06	54.4	103	3.07	<0.80	2.36	<1.00	0.76	<1.5	11.8	160
SLP/D02+50/02/01			12.3			0.38				48.3	0.673							
SLP/E00+00/02/01			16.3			1.59				85.2	1.45							
SLP/F01+50/02/01			15.4			2.98				78.0	1.52							
SLP/F03+50/02/01			17.0			5.63				52.5	0.702							
SLP/F05+00/02/01	<0.500	<2.0	127	144	0.679	1.03	16.4	10.3	607	236	3.23	1.30	6.45	<1.00	<0.50	<1.5	61.9	333
SLP/G02+00/02/01	<0.500	<2.0	9.0	53.8	<0.200	1.16	3.46	2.87	24.4	38.9	0.762	1.31	3.40	<1.00	<0.50	<1.5	11.7	73.9
SLP/G02+50/02/01			11.7			1.58				45.4	0.645							
SLP/H00+00/02/01			23.6			4.00				162	7.65							
SLP/H01+50/02/01	<0.500	<2.0	45.6	160	0.595	0.59	36.8	8.60	101	65.1	4.42	2.21	8.56	<1.00	1.32	<1.5	254	38.9
SLP/H04+50/02/01			21.1			2.01				45.6	0.730							
SLP/H05+50/02/01	<0.500	<2.0	4.4	32.6	0.518	<0.20	5.60	4.49	3.96	6.51	0.130	<0.80	<1.00	<1.00	<0.50	<1.5	58.8	8.20

Table 3 Total Metals and WAD Cyanide Laboratory Results for Surface, Shallow Subsurface, and Waste Rock Embankment Samples (mg/Kg) (continued)

Sample ID	WAD Cyanide	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Waste Rock Embankment Surface Sample																		
WR/SLP/02/06	<0.500	<2.0	14.3	132	0.297	1.36	5.60	6.60	27.3	62.6	1.59	1.80	2.10	<1.00	<0.50	<1.5	26.7	106
Waste Rock Embankment Subsurface Sample (4 foot)																		
WR/SLP/01/04	<0.500	<2.0	38.0	225	0.426	3.50	5.81	8.84	78.8	169	6.26	2.00	5.42	<1.00	0.81	<1.5	27.7	344

Table 4 ABA and Paste pH Laboratory Results for Surface, Shallow Subsurface, and Waste Rock Embankment Samples

Sample ID	Net Neutralizing Potential $TCaCO_3/kT$	Acid Generating Potential $TCaCO_3/kT$	Acid Neutralizing Potential $TCaCO_3/kT$	Non-Ext Sulfur, S %	pH Paste (S.U.)	Pyritic Sulfur, S %	Sulfate Sulfur, S %	Total Sulfur, S %
Surface Soil Samples (0 inches to 2 inches)								
SLP/D01+00/00/01	13.2	<0.3	13.2	<0.01	7.06	<0.01	<0.01	<0.01
SLP/F05+00/00/01	14.7	1.1	15.8	<0.01	5.66	0.03	<0.01	0.04
SLP/G02+00/00/01	8.1	1.1	9.2	<0.01	7.11	0.03	<0.01	0.03
SLP/H01+50/00/01	4.1	1.4	5.5	<0.01	5.81	0.05	<0.01	0.05
SLP/H05+50/00/01	13.2	<0.3	13.2	<0.01	5.41	<0.01	<0.01	<0.01
Subsurface Soil Samples (2 inches to 24 inches)								
SLP/D01+00/02/01	5.1	0.6	5.7	<0.01	6.36	0.02	<0.01	0.02
SLP/F05+00/02/01	<0.3	0.8	0.6	<0.01	5.68	0.03	<0.01	0.03
SLP/G02+00/02/01	5.0	0.7	5.7	<0.01	7.38	0.02	<0.01	0.03
SLP/H01+50/02/01	-0.5	0.5	<0.3	<0.01	5.71	0.02	0.01	0.03
SLP/H05+50/02/01	0.4	<0.3	0.4	<0.01	5.24	<0.01	<0.01	<0.01
Waste Rock Embankment Surface Sample								
WR/SLP/02/06	22.3	2.5	24.8	<0.01	6.78	0.08	0.02	0.10
Waste Rock Embankment Subsurface (4 foot) Sample								
WR/SLP/01/04	15.7	6.5	22.2	<0.01	7.46	0.21	<0.01	0.22

Table 5 DI WET Laboratory Results (mg/L) for Surface, Shallow Subsurface, and Waste Rock Embankment Samples

Sample ID	WAD CN	Sb	As	Ba	Be	Cd	Cr	Co	Cu
Surface Soil Samples (0 inches to 2 inches)									
SLP/D01+00/00/01	<0.010	<0.00300	0.00356	0.0107	<0.000100	<0.000200	<0.00100	<0.00100	0.00693
SLP/F05+00/00/01	<0.010	<0.00300	0.03060	0.0335	<0.000100	0.000247	0.00208	0.00639	0.0321
SLP/G02+00/00/01	<0.010	<0.00300	0.00324	0.00758	<0.000100	<0.000200	0.00156	<0.00100	0.0236
SLP/H01+50/00/01	<0.010	<0.00300	0.00594	0.00980	<0.000100	<0.000200	0.00191	0.00188	0.00924
SLP/H05+50/00/01	<0.010	<0.00300	0.00888	0.00874	<0.000100	<0.000200	0.00200	0.00715	0.0369
Subsurface Soil Samples (2 inches to 24 inches)									
SLP/D01+00/02/01	<0.010	<0.00300	<0.00300	0.0412	<0.000100	0.00116	<0.00100	<0.00100	0.00658
SLP/F05+00/02/01	<0.010	<0.00300	0.03640	0.0225	<0.000100	0.000240	0.00206	0.00199	0.0221
SLP/G02+00/02/01	<0.010	<0.00300	<0.00300	0.0104	<0.000100	<0.000200	<0.00100	<0.00100	0.0145
SLP/H01+50/02/01	<0.010	<0.00300	<0.00300	0.0094	<0.000100	<0.000200	0.00119	<0.00100	0.00543
SLP/H05+50/02/01	<0.010	<0.00300	<0.00300	0.0136	0.000147	<0.000200	0.00159	0.00161	0.00311
Waste Rock Embankment Surface Sample									
WR/SLP/02/06	--	<0.00300	0.0886	0.191	0.000123	0.000447	0.00244	0.0150	0.0130
Waste Rock Embankment Subsurface (4 foot) Sample									
WR/SLP/01/04	--	<0.00300	<0.00300	0.0261	<0.000100	<0.000200	<0.00100	0.00119	0.00820

Sample ID	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Surface Soil Samples (0 inches to 2 inches)									
SLP/D01+00/00/01	0.00409	<0.0002	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.0167
SLP/F05+00/00/01	0.0141	0.0004	<0.00100	0.00441	<0.00300	<0.000100	<0.00100	0.00524	0.0206
SLP/G02+00/00/01	<0.00300	0.0003	<0.00100	0.00110	<0.00300	<0.000100	<0.00100	0.00119	0.00421
SLP/H01+50/00/01	<0.00300	0.0005	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	0.00466	0.00378
SLP/H05+50/00/01	0.00402	0.0005	<0.00100	0.00221	<0.00300	<0.000100	<0.00100	0.0128	0.00909
Subsurface Soil Samples (2 inches to 24 inches)									
SLP/D01+00/02/01	0.00772	0.0004	<0.00100	0.00206	<0.00300	<0.000100	<0.00100	<0.00100	0.0114
SLP/F05+00/02/01	0.0432	0.0008	<0.00100	0.00229	<0.00300	<0.000100	<0.00100	0.00593	0.0372
SLP/G02+00/02/01	0.00561	0.0003	0.00210	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.00999
SLP/H01+50/02/01	<0.00300	0.0005	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	0.00388	0.00327
SLP/H05+50/02/01	<0.00300	<0.0002	<0.00100	<0.00100	<0.00300	<0.000100	<0.00100	0.00775	0.00986
Waste Rock Embankment Surface Sample									
WR/SLP/02/06	0.0256	0.0020	0.00551	0.00614	<0.00300	<0.000100	<0.00100	0.00920	0.0845
Waste Rock Embankment Subsurface (4 foot) Sample									
WR/SLP/01/04	0.00326	0.0007	0.0105	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.0154

Table 6 Water Level in Piezometers

Piezometer	Depth to Water (feet bgs)			
Date	9/26/2008 (Initial)	10/21/2008	12/17/2008	1/16/2009
SLP/B01	18.3	18.24	19.34	15.6
SLP/B02	19.81	19.93	20.78	16.57

Table 7 Total Metals and WAD Cyanide Laboratory Results (mg/Kg) for Borehole Samples

Sample ID	Depth Interval	WAD Cyanide	Sb	As	Ba	Be	Cd	Cr	Co	Cu
SLP/B01/0-1.2/01	0 to 1.2 feet	<0.500	<2.0	10.2	18.6	<0.200	1.81	2.97	3.46	41.6
SLP/B01/1.2-4.5/01	1.2 to 4.5 feet	<0.500	<2.0	23.1	255	0.429	7.08	4.15	5.89	95.8
SLP/B01/5-9.6/01	5 to 9.6 feet	<0.500	<2.0	20.3	239	0.473	5.66	5.42	4.79	97.5
SLP/B01/9.6-12.5/01	9.6 to 12.5 feet	<0.500	<2.0	21.0	189	0.370	6.77	3.91	5.34	83.9
SLP/B01/12.5-14.7/01	12.5 to 14.7 feet	<0.500	<2.0	19.9	175	0.334	4.86	3.65	5.51	101
SLP/B01/15-17.2/01	15 to 17.2 feet	<0.500	<2.0	20.7	194	0.414	4.83	4.25	6.27	95.2
SLP/B01/17.2-17.5/01	17.2 to 17.5 feet	<0.500	<2.0	9.1	79.0	<0.200	1.94	2.48	3.13	41.0
SLP/B01/20-25/01	20 to 25 feet	<0.500	<2.0	8.1	74.5	<0.200	2.85	2.59	2.85	36.8
SLP/B01/25-30/01	25 to 30 feet	<0.500	<2.0	8.5	104	<0.200	2.50	2.66	2.72	60.5
SLP/B01/35-40/01	35 to 40 feet	<0.500	<2.0	10.2	49.1	0.275	<0.20	1.16	5.90	277
SLP/B02/0-4.5/01	0 to 4.5 feet	<0.500	<2.0	16.7	132	<0.200	2.96	3.08	4.31	63.9
SLP/B02/5-10/01	5 to 10 feet	<0.500	<2.0	13.8	92.7	<0.200	3.21	3.44	3.92	68.1
SLP/B02/10-15/01	10 to 15 feet	<0.500	<2.0	11.4	85.9	<0.200	2.42	2.78	3.62	52.1
SLP/B02/15.5-17.1/01	15.5 to 17.1 feet	<0.500	<2.0	17.7	172	0.272	3.53	3.42	5.09	74.7
SLP/B02/17.2-22/01	17.2 to 22 feet	<0.500	<2.0	18.5	192	0.235	4.36	3.41	5.18	68.7
SLP/B02/22.5-27.5/01	22.5 to 27.5 feet	<0.500	<2.0	17.6	59.3	1.300	<0.20	9.30	4.51	153

Sample ID	Depth Interval	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
SLP/B01/0-1.2/01	0 to 1.2 feet	48.4	0.967	<0.80	2.10	<1.00	<0.50	<1.5	11.3	105
SLP/B01/1.2-4.5/01	1.2 to 4.5 feet	200	7.87	2.97	2.78	<1.00	0.83	<1.5	17.1	330
SLP/B01/5-9.6/01	5 to 9.6 feet	199	10.6	2.69	2.90	<1.00	1.03	<1.5	21.4	330
SLP/B01/9.6-12.5/01	9.6 to 12.5 feet	215	9.53	2.74	2.40	<1.00	1.48	<1.5	15.2	360
SLP/B01/12.5-14.7/01	12.5 to 14.7 feet	145	5.22	2.53	1.82	<1.00	1.50	<1.5	14.9	278
SLP/B01/15-17.2/01	15 to 17.2 feet	187	7.40	2.70	2.62	<1.00	2.46	<1.5	18.3	252
SLP/B01/17.2-17.5/01	17.2 to 17.5 feet	40.1	0.980	1.05	1.33	<1.00	0.83	<1.5	9.33	130
SLP/B01/20-25/01	20 to 25 feet	36.6	1.93	1.24	1.30	<1.00	1.17	<1.5	9.57	142
SLP/B01/25-30/01	25 to 30 feet	40.3	1.21	1.29	1.41	<1.00	0.88	<1.5	8.59	128
SLP/B01/35-40/01	35 to 40 feet	2.79	0.087	2.75	<1.00	<1.00	<0.50	<1.5	68.6	14.1
SLP/B02/0-4.5/01	0 to 4.5 feet	100	2.15	1.43	1.56	<1.00	0.60	<1.5	11.4	133
SLP/B02/5-10/01	5 to 10 feet	76.5	1.63	1.45	1.80	<1.00	0.52	<1.5	13.2	136
SLP/B02/10-15/01	10 to 15 feet	67.7	1.42	1.70	1.50	<1.00	1.12	<1.5	11.0	131
SLP/B02/15.5-17.1/01	15.5 to 17.1 feet	111	5.82	2.29	2.00	<1.00	1.86	<1.5	13.0	221
SLP/B02/17.2-22/01	17.2 to 22 feet	146	5.47	2.28	2.08	<1.00	3.16	<1.5	13.8	191
SLP/B02/22.5-27.5/01	22.5 to 27.5 feet	7.10	0.078	2.31	<1.00	<1.00	<0.50	<1.5	190	5.28

Table 8 ABA Analysis for Borehole Samples

Sample ID	Depth Interval	Net Neutralizing Potential $TCaCO_3/kT$	Acid Generating Potential $TCaCO_3/kT$	Acid Neutralizing Potential $TCaCO_3/kT$	Non-Ext Sulfur, S %	pH Paste (S.U.)	Pyritic Sulfur, S %	Sulfate Sulfur, S %	Total Sulfur, S %
SLP/B01/0-1.2/01	0 to 1.2 feet	9.2	<0.3	9.2	<0.01	6.85	<0.01	<0.01	<0.01
SLP/B01/1.2-4.5/01	1.2 to 4.5 feet	40.9	4.4	45.3	<0.01	7.56	0.14	0.07	0.21
SLP/B01/5-9.6/01	5 to 9.6 feet	51.8	5.9	57.7	<0.01	7.65	0.19	0.54	0.72
SLP/B01/9.6-12.5/01	9.6 to 12.5 feet	65.8	12.4	78.2	<0.01	7.79	0.4	0.16	0.56
SLP/B01/12.5-14.7/01	12.5 to 14.7 feet	60.8	15.4	76.2	<0.01	7.82	0.49	0.14	0.63
SLP/B01/15-17.2/01	15 to 17.2 feet	64.8	14.5	79.3	<0.01	7.85	0.46	0.14	0.60
SLP/B01/17.2-17.5/01	17.2 to 17.5 feet	39.5	8.4	47.9	<0.01	8.02	0.27	0.10	0.37
SLP/B01/20-25/01	20 to 25 feet	41.4	7.5	48.9	<0.01	7.91	0.24	0.05	0.29
SLP/B01/25-30/01	25 to 30 feet	45.7	7.4	53.1	<0.01	7.95	0.24	0.08	0.32
SLP/B01/35-40/01	35 to 40 feet	5.2	<0.3	5.2	<0.01	7.25	<0.01	<0.01	<0.01
SLP/B02/0-4.5/01	0 to 4.5 feet	31.6	5.8	37.4	<0.01	7.75	0.18	0.05	0.23
SLP/B02/5-10/01	5 to 10 feet	43.1	4.6	47.7	<0.01	7.76	0.15	0.03	0.18
SLP/B02/10-15/01	10 to 15 feet	41.7	4.7	46.4	<0.01	8.02	0.15	0.05	0.20
SLP/B02/15.5-17.1/01	15.5 to 17.1 feet	57.1	17.5	74.6	<0.01	7.93	0.56	0.14	0.70
SLP/B02/17.2-22/01	17.2 to 22 feet	65.1	18.5	83.6	<0.01	7.99	0.59	0.13	0.72
SLP/B02/22.5-27.5/01	22.5 to 27.5 feet	1.1	<0.3	1.1	<0.01	6.85	<0.01	<0.01	<0.01

Table 9 DIWET Laboratory Results for Borehole Samples (mg/L)

Sample ID	Depth Interval	WAD Cyanide	Sb	As	Ba	Be	Cd	Cr	Co	Cu
SLP/B01/0-1.2/01	0 to 1.2 feet	<0.010	<0.00300	0.00343	0.0058	<0.000100	0.000567	0.00101	<0.00100	0.0471
SLP/B01/1.2-4.5/01	1.2 to 4.5 feet	<0.010	<0.00300	<0.00300	0.0504	<0.000100	0.000410	<0.00100	<0.00100	0.0111
SLP/B01/5-9.6/01	5 to 9.6 feet	<0.010	<0.00300	<0.00300	0.0140	<0.000100	0.00298	<0.00100	0.00933	0.00302
SLP/B01/9.6-12.5/01	9.6 to 12.5 feet	<0.010	0.00801	0.00692	0.0459	<0.000100	<0.000200	<0.00100	0.00118	0.00123
SLP/B01/12.5-14.7/01	12.5 to 14.7 feet	<0.010	0.00479	0.00499	0.0466	<0.000100	<0.000200	<0.00100	<0.00100	<0.00100
SLP/B01/15-17.2/01	15 to 17.2 feet	<0.010	0.0119	0.00870	0.0556	<0.000100	<0.000200	<0.00100	<0.00100	0.00358
SLP/B01/17.2-17.5/01	17.2 to 17.5 feet	<0.010	<0.00300	0.00554	0.0281	<0.000100	<0.000200	<0.00100	<0.00100	<0.00100
SLP/B01/20-25/01	20 to 25 feet	<0.010	<0.00300	0.00376	0.0264	<0.000100	<0.000200	<0.00100	<0.00100	0.0152
SLP/B01/25-30/01	25 to 30 feet	<0.010	0.00334	0.00376	0.0459	<0.000100	<0.000200	<0.00100	<0.00100	0.0106
SLP/B01/35-40/01	35 to 40 feet	<0.010	<0.00300	<0.00300	0.0089	<0.000100	<0.000200	<0.00100	<0.00100	<0.00100
SLP/B02/0-4.5/01	0 to 4.5 feet	<0.010	<0.00300	<0.00300	0.0262	<0.000100	<0.000200	<0.00100	<0.00100	0.0131
SLP/B02/5-10/01	5 to 10 feet	<0.010	<0.00300	<0.00300	0.0347	<0.000100	<0.000200	<0.00100	<0.00100	0.00964
SLP/B02/10-15/01	10 to 15 feet	<0.010	<0.00300	<0.00300	0.0170	<0.000100	<0.000200	<0.00100	<0.00100	0.00209
SLP/B02/15.5-17.1/01	15.5 to 17.1 feet	<0.010	0.00336	<0.00300	0.0590	<0.000100	<0.000200	<0.00100	<0.00100	0.00316
SLP/B02/17.2-22/01	17.2 to 22 feet	<0.010	0.00388	<0.00300	0.0846	<0.000100	<0.000200	<0.00100	<0.00100	0.00254
SLP/B02/22.5-27.5/01	22.5 to 27.5 feet	<0.010	<0.00300	<0.00300	0.0210	<0.000100	<0.000200	<0.00100	<0.00100	0.00499

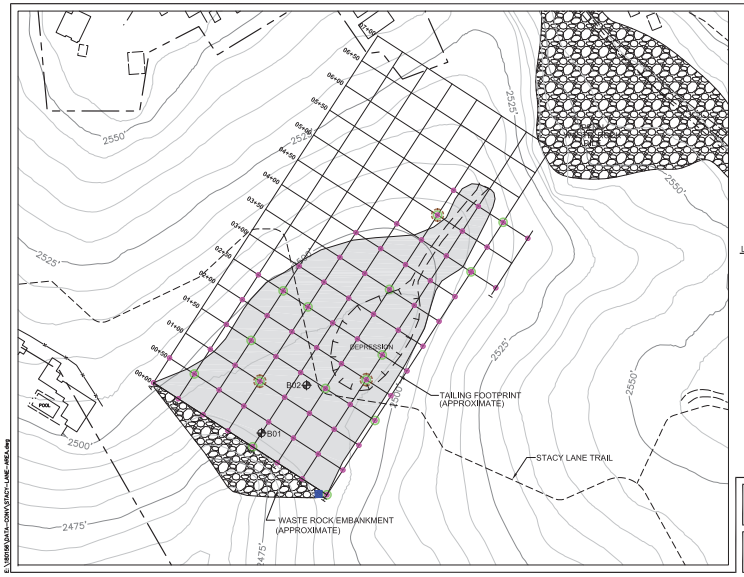
Sample ID	Depth Interval	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
SLP/B01/0-1.2/01	0 to 1.2 feet	0.0094	0.0008	<0.00100	<0.00100	<0.00300	0.000116	<0.00100	<0.00100	0.0196
SLP/B01/1.2-4.5/01	1.2 to 4.5 feet	<0.00300	0.0002	0.0291	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.0049
SLP/B01/5-9.6/01	5 to 9.6 feet	<0.00300	<0.0002	0.00812	0.00525	<0.00300	<0.000100	<0.00100	<0.00100	0.0126
SLP/B01/9.6-12.5/01	9.6 to 12.5 feet	<0.00300	<0.0002	0.00240	<0.00100	<0.00300	<0.000100	<0.00100	0.00176	0.0068
SLP/B01/12.5-14.7/01	12.5 to 14.7 feet	<0.00300	0.0003	0.00180	<0.00100	<0.00300	<0.000100	<0.00100	0.00154	0.0019
SLP/B01/15-17.2/01	15 to 17.2 feet	<0.00300	<0.0002	0.00286	<0.00100	<0.00300	<0.000100	<0.00100	0.00312	0.0023
SLP/B01/17.2-17.5/01	17.2 to 17.5 feet	<0.00300	<0.0002	0.00175	<0.00100	<0.00300	<0.000100	<0.00100	0.00278	0.003
SLP/B01/20-25/01	20 to 25 feet	<0.00300	<0.0002	0.00161	<0.00100	<0.00300	<0.000100	<0.00100	0.00294	0.0023
SLP/B01/25-30/01	25 to 30 feet	<0.00300	<0.0002	0.00425	<0.00100	<0.00300	<0.000100	<0.00100	0.00157	0.0016
SLP/B01/35-40/01	35 to 40 feet	<0.00300	0.0004	0.0320	<0.00100	<0.00300	<0.000100	<0.00100	0.00192	0.0057
SLP/B02/0-4.5/01	0 to 4.5 feet	0.00469	0.0006	0.0113	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.0092
SLP/B02/5-10/01	5 to 10 feet	<0.00300	0.0003	0.0186	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.0028
SLP/B02/10-15/01	10 to 15 feet	<0.00300	<0.0002	0.0126	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.004
SLP/B02/15.5-17.1/01	15.5 to 17.1 feet	<0.00300	0.0004	0.0116	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.0045
SLP/B02/17.2-22/01	17.2 to 22 feet	<0.00300	0.0007	0.00723	<0.00100	<0.00300	<0.000100	<0.00100	<0.00100	0.003
SLP/B02/22.5-27.5/01	22.5 to 27.5 feet	<0.00300	<0.0002	0.00163	<0.00100	<0.00300	<0.000100	<0.00100	0.0129	0.0025

Table 10 Total Metals Analysis for Vegetation Samples (mg/Kg)

Sample ID	Species	Sb	As	Ba	Be	Cd	Cr	Co	Cu
SLP/D01+00/HB/01	Himalayan Blackberry	2	<4	55.4	<0.2	0.8	<1	<1	4
SLP/D01+00/QU/01	Oak	5	<4	90.5	<0.2	0.6	<1	<1	5
SLP/D01+00/SA/01	Willow	4	<4	27.5	<0.2	32.7	<1	5	5
SLP/F05+00/AG/01	Grass	2	<4	21.1	<0.2	<0.5	<1	<1	2
SLP/F05+00/HB/01	Himalayan Blackberry	<2	4	38.7	<0.2	<0.5	<1	<1	4
SLP/G02+00/QU/01	Oak	4	<4	51.5	<0.2	<0.5	<1	<1	4
SLP/G02+00/SA/01	Willow	<2	5	50.8	<0.2	7.7	<1	3	4

Sample ID	Species	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
SLP/D01+00/HB/01	Himalayan Blackberry	<4	<0.1	2	<1	0.06	<1	<30	<0.5	23
SLP/D01+00/QU/01	Oak	<4	<0.09	1	<1	0.07	<1	<30	<0.5	131
SLP/D01+00/SA/01	Willow	<4	<0.1	<1	<1	0.15	<1	<30	<0.5	473
SLP/F05+00/AG/01	Grass	<4	<0.09	<1	<1	0.07	<1	<30	<0.5	26
SLP/F05+00/HB/01	Himalayan Blackberry	<4	<0.1	<1	2	0.07	<1	<30	<0.5	18
SLP/G02+00/QU/01	Oak	<4	<0.1	<1	<1	0.07	<1	<30	<0.5	93
SLP/G02+00/SA/01	Willow	<4	<0.09	<1	<1	0.37	<1	<30	<0.5	362

FIGURES



LEGEND

- XRF IN-SITU MEASUREMENT LOCATION
- SOIL SAMPLE COLLECTED
- VEGETATION SAMPLE COLLECTED
- BOREHOLE/PIEZOMETER LOCATION
- TEST PIT LOCATION

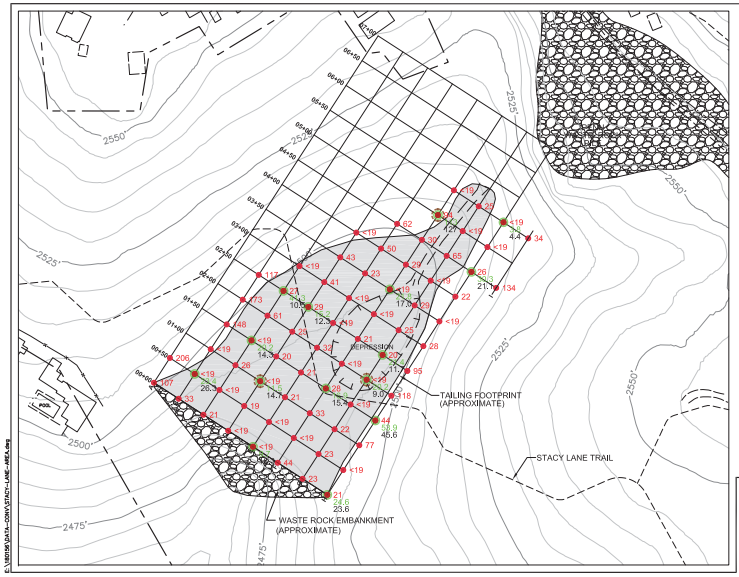
NORTH

SCALE IN FEET
0 100

FIGURE 1
STACY LANE POND AREA
SAMPLING LOCATIONS

MFG, Inc.
consulting scientists and engineers

Date: FEBRUARY 2009
Project: 180156
File: STACY-LANE-AREA



LEGEND

- XRF IN-SITU MEASUREMENT LOCATION
- SOIL SAMPLE COLLECTED
- VEGETATION SAMPLE COLLECTED
- <19 SURFACE As (mg/Kg) CORRELATED XRF
- 11.5 SURFACE As (mg/Kg) LAB RESULT
- 14.7 SUBSURFACE As (mg/Kg) LAB RESULT

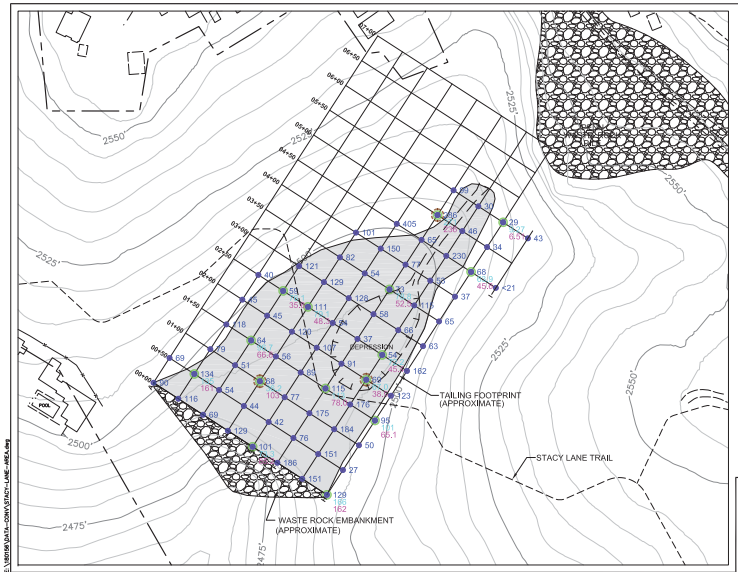
NORTH

SCALE IN FEET
0 100

FIGURE 2
STACY LANE POND AREA
ARSENIC CONCENTRATIONS

MFG, Inc.
consulting scientists and engineers

Date: FEBRUARY 2009
Project: 180156
File: STACY-LANE-AREA



LEGEND

- XRF IN-SITU MEASUREMENT LOCATION
- SOIL SAMPLE COLLECTED
- VEGETATION SAMPLE COLLECTED
- 134 SURFACE Pb (mg/Kg) CORRELATED XRF
- 135 SURFACE Pb (mg/Kg) LAB RESULT
- 161 SUBSURFACE Pb (mg/Kg) LAB RESULT

NORTH

SCALE IN FEET
0 100

FIGURE 3
STACY LANE POND AREA
LEAD CONCENTRATIONS

MFG, Inc.
consulting scientists and engineers

Date: FEBRUARY 2009
Project: 180156
File: STACY-LANE-AREA

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Additional Attachments are On-File with the Department of Parks and Recreation and on their Website:

http://www.parks.ca.gov/?page_id=981

Appendix C-8:
Historic Grounds Area 2009 Data Transmittal Report

DATA TRANSMITTAL AND EVALUATION REPORT
FOR THE
HISTORIC GROUNDS AREA 2008 WORK PLAN
EMPIRE MINE STATE HISTORIC PARK

FEBRUARY 2009

Prepared by:

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I certify under penalty of law that I have examined and am familiar with this report, and to my knowledge, the report is true, complete, and accurate.

PROFESSIONAL GEOLOGIST KEITH STEVEN THOMPSON No. 5572 STATE OF CALIFORNIA

Keith Steven Thompson, California Registered Geologist

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Attachment A Laboratory Reports
Attachment B Correlation of XRF and Laboratory Concentrations for Arsenic and Lead

1.0 PURPOSE

This Data Transmittal and Evaluation Report presents and evaluates field and laboratory data from soil sampling in the Historic Grounds Area at the Empire Mine State Historic Park (Park), Grass Valley, California pursuant to the Historic Grounds Area 2008 Work Plan (Work Plan) (MFG, 2008a). The purpose of this work was to delineate potential mine and mill materials in surface soils of the Historic Grounds Area. The Historic Grounds Area encompasses approximately 13.3 acres (Figure 1) comprised of the lawns, gardens and natural areas surrounding the Empire (Bourn) Cottage and other historic buildings. Sampling in the Historic Grounds Area included unpaved paths and roads, bare ground areas, and flower/garden beds.

2.0 SUMMARY OF SAMPLE COLLECTION ACTIVITES

The Historic Grounds Area was divided into sampling groups according to the following three areas: unpaved roads and paths, bare ground, and flower/garden beds. In accordance with the Work Plan, sampling activities were not performed in densely vegetated or lawn areas. The field sampling was conducted by MFG, Inc. In accordance with the Work Plan, the following sampling activities were completed:

- Visual survey and characterization of surface soil including visual evidence of mine and mill materials (tailing and waste rock).
- Field in-situ X-ray fluorescence (XRF) measurements for arsenic and lead concentrations in the surface soil. The in-situ XRF measurements were taken at 100-foot intervals along the center line of unpaved roads and paths and on a grid with spacing of approximately 50 feet in the bare ground and flower/garden beds, with a minimum of one measurement for each defined flower/garden bed or bare ground area.
- Collection of surface (0 to 2-inch depth) soil samples at twenty percent of the in-situ XRF measurement locations for ex-situ XRF analysis of arsenic and lead concentrations, and laboratory analysis of the samples for arsenic, cadmium, lead and mercury.
- Collection of shallow subsurface (6 to 12-inch depth) soil samples at twenty percent of the in-situ XRF measurement locations within flower/garden beds for ex-situ XRF analysis of arsenic and lead concentrations, and laboratory analysis of samples for arsenic, cadmium, lead and mercury.

Figure 1 identifies the sampling locations developed during the visual survey by the field sampling personnel. Table 1 summarizes the total number of field in-situ XRF measurements and the number of samples collected for ex-situ XRF and laboratory analysis in the three areas. XRF measurements were performed as described in the Work Plan according to *EPA Method 6200 - Field Portable X-ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment* using a portable Niton XRF 702 XLp spectrum analyzer. One sample was collected for every fifth in-situ XRF measurement location, which corresponds to twenty percent of the in-situ XRF measurements. Laboratory analysis of the samples was performed by SVL Analytical (SVL) in Kellogg, Idaho. SVL is accredited (NELAP) by the California Department of Health Services. The laboratory analytical reports and chain of custody report(s) for the samples are provided in Attachment A. The sampling regime is described in the following sections.

2.1 Unpaved Road and Paths

Based on visual observations during sampling, the majority of the unpaved roads and paths within the Historic Grounds Area are covered with gravel or pebble-sized material. The physical characteristics of the crushed, minus 3/4-inch gravel on the unpaved roads are visually similar to the imported gravel

covering within the mine yard area. The fines associated with the imported gravel covering in the mine yard area were previously evaluated and generally determined to contain low metal concentrations (MFG 2008c). Most of the pathway surfaces consist of rounded, quartz pebble-size material. As shown on Figure 1, the soil surface is exposed along a length of the access road near the northwest gate and on paths west and south of the Bourn Cottage lawn and pool area. No mine or mill materials were observed.

In-situ XRF surface measurements were performed directly on the ground surface at 37 locations along the unpaved roads and paths (Figure 1). Surface (0 to 2-inch depth) samples were collected at 20 percent of the in-situ XRF locations for further ex-situ XRF and laboratory analyses. A total of seven surface soil samples were collected. These samples were sieved (minus 60-mesh) and analyzed for arsenic and lead by ex-situ XRF according to EPA Method 6200. The sieved surface samples were then submitted for laboratory analysis for total arsenic, cadmium, lead and mercury, as summarized in Table 1.

2.2 Bare Ground Areas

In-situ XRF surface measurements were performed within the Historic Grounds Area at six bare ground locations where plant cover is nonexistent and the soil surface is exposed. No mine or mill materials were observed in these areas. The in-situ XRF measurements were performed directly on the soil surface at approximately 50-foot grid intervals within bare ground areas (Figure 1). Surface (0 to 2-inch depth) samples were collected at two of the in-situ XRF locations for further analysis. These samples were sieved (minus 60-mesh) and analyzed for arsenic and lead by ex-situ XRF according to EPA Method 6200. The sieved surface samples were then submitted for laboratory analysis for total arsenic, cadmium, lead and mercury, as summarized in Table 1.

2.3 Flower/Garden Beds

In-situ XRF measurements were performed at 25 locations. The in-situ XRF measurements were performed directly on the soil surface on a grid spacing of approximately 50-feet within the defined garden beds, as determined by field sampling personnel (Figure 1). No mine or mill materials were observed in the flower/garden beds. Surface (0 to 2-inch depth) and subsurface (6 to 12-inch depth) samples were collected at five of the in-situ XRF locations for further analysis. The samples were sieved (minus 60-mesh) and analyzed for arsenic and lead by ex-situ XRF according to EPA Method 6200. The sieved surface and subsurface samples were then submitted for laboratory analysis for total arsenic, cadmium, lead and mercury, as summarized in Table 1.

3.0 SUMMARY OF XRF AND LABORATORY METALS CONCENTRATION RESULTS

As described above, in-situ XRF measurements of surface soil for arsenic and lead concentrations were performed along the unpaved roads and paths, bare ground areas, and flower/garden beds within the Historic Grounds Area. Soil samples were collected at 20 percent of these in-situ XRF measurement locations for ex-situ XRF and laboratory analyses. Laboratory analysis of the soil samples was performed for total arsenic, cadmium, lead and mercury. The in-situ XRF data were correlated to the laboratory results for total arsenic and lead through regression analysis, as described in Attachment B. Both the directly measured in-situ XRF and the laboratory-correlated in-situ XRF values for arsenic and lead are presented in Table 2. The arsenic and lead concentrations determined by laboratory-correlated in-situ XRF measurements and laboratory sample analyses are presented on Figures 2 and 3. The results of the XRF and laboratory analyses are described in the following sections.

3.1 Unpaved Roads and Paths

3.1.1 XRF Analysis

The results of the in-situ XRF and laboratory-correlated in-situ XRF analysis for arsenic and lead are provided in Table 2. Twenty-two out of the 37 total XRF measurements taken along the roads and paths were below the XRF detection limit for arsenic of 19 milligrams per kilogram (mg/Kg). The average arsenic concentration was 41.7 mg/Kg, and the median concentration was 19 mg/Kg, or at the detection limit. The maximum arsenic concentration was 339 mg/Kg. Lead concentrations were below the detection limit of 21 mg/Kg in 19 out of the 37 total XRF measurements. The average lead concentration was 39.6 mg/Kg and the median was 21 mg/Kg, or the lower limit of detection. The maximum observed lead concentration was 369 mg/Kg.

3.1.2 Total Metals Laboratory Analysis

As discussed previously, samples were collected at twenty percent of the in-situ XRF measurement locations and analyzed by the laboratory to assess metal content and develop regression curves for the in-situ XRF measurements performed directly on the ground surface for arsenic and lead. A total of seven surface samples were submitted for laboratory analysis from the unpaved roads and paths. The arsenic, cadmium, lead and mercury concentrations of the surface samples are shown in Table 3. The arsenic and lead concentrations analyzed by the laboratory are also shown on Figures 2 and 3.

The arsenic concentrations from laboratory analysis of soil samples collected from the unpaved roads and paths ranged from 9.0 to 323 mg/Kg. The average arsenic concentration was 76.2 mg/Kg, and the median was 45.5 mg/Kg. The lead concentrations ranged from 5.02 to 62.7 mg/Kg. The average lead

concentration was 32.0 mg/Kg, and the median was 29.3 mg/Kg. The cadmium concentrations ranged from less than 0.2 mg/Kg to 1.03 mg/Kg. The average cadmium concentration was 0.69 mg/Kg, and the median concentration was 0.38 mg/Kg. The mercury concentrations ranged from 0.047 mg/Kg to 0.56 mg/Kg. The average mercury concentration was 0.248 mg/Kg, and the median was 0.285 mg/Kg.

3.2 Bare Ground Areas

3.2.1 XRF Analysis

A total of six in-situ XRF measurements were performed on the bare ground areas within the Historic Grounds. The results of the in-situ XRF and laboratory-correlated in-situ XRF analyses for arsenic and lead are provided in Table 2.

One of the six XRF measurements taken on bare ground was below the detection limit for arsenic. The average arsenic concentration was 38 mg/Kg, with a median of 26 mg/Kg. The maximum observed arsenic concentration was 77 mg/Kg. The average lead concentration was 108 mg/Kg, with a median of 65 mg/Kg. The maximum observed lead concentration was 269 mg/Kg.

3.2.2 Total Metals Laboratory Analysis

Two surface samples were collected and submitted to the laboratory for analyses of arsenic, cadmium, lead and mercury. The metal concentrations of the samples are shown in Table 3. The arsenic and lead concentrations analyzed by the laboratory are also shown on Figures 2 and 3.

3.3 Flower/Garden Beds

3.3.1 XRF Analysis

A total of 25 in-situ XRF measurements for arsenic and lead concentrations were performed on surface soils within the flower/garden beds. The results of the in-situ XRF and laboratory-correlated in-situ XRF analyses for arsenic and lead are provided in Table 2.

Eleven of the 25 XRF measurements within the flower/garden beds were below the XRF detection limit of 19 mg/Kg for arsenic. The average arsenic concentration was 29 mg/Kg, and the median was 21 mg/Kg. The highest observed arsenic concentration was 108 mg/Kg. The average lead concentration was 62 mg/Kg with a median of 44 mg/Kg. The maximum observed lead concentration within the flower/garden beds was 240 mg/Kg.

3.3.2 Total Metals Laboratory Analysis

A total of five surface (0 to 2 inches) and five subsurface (6 to 12 inches) samples were collected from the flower/garden beds. The laboratory reported arsenic concentrations in the surface samples ranged from 21.3 to 90 mg/Kg, averaged 43 mg/Kg and the median was 34 mg/Kg. The laboratory reported lead concentrations in the surface samples ranged from 43.9 to 81.2 mg/Kg. The average lead concentration was 61 mg/Kg, and the median was 54 mg/Kg.

The laboratory reported arsenic concentrations in the subsurface samples ranged from 11.0 to 74.6 mg/Kg, averaged 31 mg/Kg and had a median of 19 mg/Kg. The laboratory reported lead concentrations in the subsurface samples ranged from 34.1 to 104 mg/Kg. The average lead concentration was 60 mg/Kg and the median was 53 mg/Kg.

The cadmium concentrations of both the surface and subsurface samples ranged from less than 0.2 mg/Kg to 1.44 mg/Kg. The average cadmium concentration was 0.71 mg/Kg, and the median concentration was 0.68 mg/Kg. The mercury concentrations of both the surface and subsurface samples ranged from 0.293 mg/Kg to 0.728 mg/Kg. The average mercury concentration was 0.509 mg/Kg, and the median was 0.506 mg/Kg.

4.0 DATA EVALUATION

No mine or mill related materials were observed in the Historic Grounds Area. Nonetheless, the total metal concentrations from the Historic Grounds Area were compared to the California Human Health Screening Levels (CHHSLs) for residential and commercial/industrial land use (California Environmental Protection Agency [CEPA], 2005) as a screening level assessment to identify potential constituents of interest to human health. If soil metal concentrations are less than the CHHSLs for the respective use, then the metal concentrations are considered to be below thresholds for risk to human health. The residential CHHSLs were developed using an exposure scenario of 350 days per year for 30 years and the commercial/industrial CHHSLs were developed using an exposure scenario of 250 days per year for 20 years. Visitor uses include walking established roads and paths to tour the Historic Grounds Area and attending occasional social gatherings. Park staff and volunteer uses include maintenance of flower/garden beds, lawns and structures, as well as general housekeeping. Given this limited contact, the potential human exposure to soils in the Historic Grounds Area is less than that for either the residential or commercial/industrial exposure scenarios. Therefore, in this context, even the commercial/industrial CHHSLs are conservative with respect to the uses in the Historic Grounds Area.

Cadmium and mercury concentrations were less than residential CHHSLs of 1.7 mg/Kg and 18 mg/Kg, respectively, for all samples analyzed by the laboratory. Therefore, the concentrations of cadmium and mercury are below the thresholds for risk to human health from exposure to these metals.

Five of the 68 XRF measurements exceeded the residential CHHSL of 150 mg/Kg for lead. One of these locations was on a path (PA09+00), two were in exposed bare areas (BG2 and BG6) adjacent to historic structures, and two were in garden bed areas (G10 and G13). The lead concentrations that exceeded the residential CHHSL for the two sample locations adjacent to historic structures are suspected to be associated with use of lead based paint. Of the 19 samples submitted to the laboratory, the lead concentration of one sample from an exposed area near the Bourn Cottage (BG6, 154 mg/Kg) was above the residential CHHSL. All of the lead concentrations by XRF and laboratory analysis were below the commercial/industrial CHHSL of 3,500 mg/Kg.

Arsenic concentrations in the Historic Grounds Area were greater than the residential and commercial/industrial CHHSLs. In 2006, the DTSC, Human and Ecological Risk Division (HERD) recommended a remediation goal for arsenic on Park trail surfaces of 270 mg/Kg (Klein, 2006), based upon the exposure scenario of a runner using a trail four days a week for a one hour duration over 30 years. Previous investigations determined that arsenic concentrations greater than 200 mg/Kg may be indicative of areas where mine and mill materials exist (MFG, 2008b).

One in-situ XRF arsenic concentration (339 mg/Kg at PA09+00) of the 68 measurements and one laboratory arsenic concentration (323 mg/Kg at R16+00) of the 19 samples analyzed exceeded 200 mg/Kg. Both of these locations occurred on a path or road, and it was noted at both locations that the road/trail cover material and surface had been scoured away from these portions of the road/path by runoff. Figures 1 through 3 depict the portions of the paths and roads where the absence of gravel was observed during the sampling event.

5.0 UPDATED CONCEPTUAL SITE MODEL

The conceptual site model (CSM) developed for the Park (MFG, 2006b, 2007) describes potential release mechanisms, transport pathways, and exposure routes to receptors due to mine and mill materials. The CSM identifies wind and water erosion and chemical weathering as the potential release mechanisms for the Historic Grounds Area if mine or mill materials are present. Although no deposits of mine or mill materials were observed, arsenic concentrations of two sample locations (on the unpaved road near the northwest gate and on the unpaved path west of the Bourn Cottage lawn) were greater than 200 mg/Kg, which may be indicative of the potential presence of mine and mill materials. The presence of elevated arsenic concentrations at these locations may be related to windblown, water transported, or incidentally placed mine or mill materials. The elevated arsenic concentrations may also be due to natural weathering of mineralized bedrock. Application of the CSM to the Historic Grounds Area indicates that arsenic concentrations of surface soils at these two locations may be potential exposure routes of dermal contact, inhalation of dust and incidental ingestion for visitors and Park staff and volunteers. The objective of any remedial action for the Historic Grounds Area is elimination of these potential release mechanisms, transport pathways, and exposure pathways to receptors.

6.0 ALTERNATIVE ACTIONS

The Alternative Actions applicable to the Historic Grounds Area include no action, cover, or excavation of surface material and replacement with clean fill. These alternatives are described below.

6.1.1 No Action

The No Action option would be maintaining the existing surfaces without addressing potential exposure routes. This alternative would achieve the remedial objective for only those locations where elevated arsenic concentrations are not present.

6.1.2 Surface Cover

This remedial option would involve covering the affected path/road segments with a 3 to 6-inch thick layer of compacted cover material (road base, gravel or other appropriate materials). The cover material would be clean imported fill consistent with the DTSC Clean Fill Advisory (DTSC, 2001). Covering the surface of the few path/road segments where arsenic concentrations are elevated would isolate the materials and eliminate potential exposure pathways. Covering would require the preparation and implementation of an operation and maintenance plan to provide for long-term maintenance of the surface to ensure the cover remains intact.

6.1.3 Removal and Replacement

This remedial option would require removal of surface materials from path/road surfaces in locations where arsenic concentrations are elevated. The depth of soil excavation would vary depending on the extent of elevated arsenic concentrations. Conventional excavation could range to a depth of 6 to 12 inches. Excavated areas would be replaced with an appropriate surface material, as necessary, to restore any storm water drainage patterns or the particular land use(s). The cover material would consist of clean imported fill consistent with the DTSC Clean Fill Advisory (DTSC, 2001). Removal of the path/road surface on segments where arsenic concentrations exceed 200 mg/Kg and replacement with fill material would meet the remedial objective by eliminating the exposure pathway. This option would require proper management of the excavated material.

7.0 REFERENCES

California Environmental Protection Agency Department of Toxic Substances Control (DTSC), 2001. Information Advisory Clean Imported Fill Material. October, 2001. http://www.dtsc.ca.gov/Schools/upload/SMP_FS_Cleanfill-Schools.pdf

California Environmental Protection Agency (CEPA), 2005. Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties. January 2005. http://www.calepa.ca.gov/Brownfields/documents/2005/CHHSLsGuide.pdf

Klein, Kimiko to Perry Myers, 2006. Memorandum regarding Remediation Goals for the Recreational Runner on Trails, Empire Mine State Historical (sic) Park, Grass Valley, September 29, 2006, Department of Toxic Substances Control. P. Myers

MFG, Inc. (MFG), 2006a. Data Transmittal and Addendum for the Trails 2006 Priority Action Work Plan, Empire Mine State Historic Park. MFG, Inc., Fort Collins, Colorado. December.

MFG, Inc. (MFG), 2006b. Data Gaps Report for the Empire Mine State Historic Park Phase 1: Existing Data. MFG, Inc., Fort Collins, Colorado. December.

MFG, Inc. (MFG), 2007. Data Gaps Report for the Empire Mine State Historic Park Phase 2: Data Gaps Analysis. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. January 15.

MFG, Inc. (MFG), 2008a. Historic Grounds Area 2008 Work Plan, Empire Mine State Historic Park. MFG, Inc., Fort Collins, Colorado. June 26.

MFG, Inc. (MFG), 2008b. Osborne Hill Area Trails Data Evaluation and Remedial Options Analysis Report, Empire Mine State Historic Park. MFG, Inc., Fort Collins, Colorado. July 2008.

MFG, Inc. (MFG), 2008c. Data Transmittal Report Mine Yard Surface Material Characterization, 2007 Work Plan. Fort Collins, Colorado. January 2008.

Rose, A.W., H. E. Hawkes, and J.S. Webb. 1979. Geochemistry in Mineral Exploration, 2nd ed. London. New York. Academic Press.

TABLES

Table 1 Summary of Field and Laboratory Analyses

Sample Type	Field In-Situ XRF Measurements	Number of Samples Collected	Field Ex-Situ XRF Measurements	Number of Laboratory Analyses (As, Pb, Cd and Hg)
EXPOSED AREAS				
Surface Materials (0-2 inches)	6	2	2	2
FLOWER/GARDEN BED				
Surface Materials (0-2 inches)	25	5	5	5
Subsurface Materials (6-12 inches)	-	5	5	5
ROADS AND PATHS				
Surface Materials (0-2 inches)	37	7	7	7
Totals	68	19	19	19

Table 2 In-Situ XRF and Correlated XRF Concentrations (mg/Kg)

Sample ID	In-Situ XRF Arsenic Concentration	Correlated XRF Arsenic Concentration	In-Situ XRF Lead Concentration	Correlated XRF Lead Concentration
Exposed Areas				
HG BG1	22	22	64	61
HG BG2	19	20	283	269
HG BG3	16	<19	25	24
HG BG4	28	29	72	69
HG BG5	74	77	58	55
HG BG6	56	58	179	170
Flower/Garden Beds				
HG G1	10	<19	58	55
HG G2	10	<19	83	78
HG G3	16	<19	46	44
HG G4	24	25	38	37
HG G5	21	22	92	87
HG G6	21	22	43	41
HG G7	15	<19	42	40
HG G8	16	<19	92	87
HG G9	15	<19	46	43
HG G10	21	22	200	190
HG G11	35	36	53	50
HG G12	18	<19	71	68
HG G13	16	<19	253	240
HG G14	20	21	32	30
HG G15	80	83	68	64
HG G16	27	28	33	31
HG G17	22	23	39	37
HG G18	41	42	19	<21
HG G19	20	20	37	35
HG G20	34	35	36	34
HG G21	104	108	70	67
HG G22	14	<19	73	70
HG G23	13	<19	37	35
HG G24	26	27	73	69
HG G25	14	<19	29	28

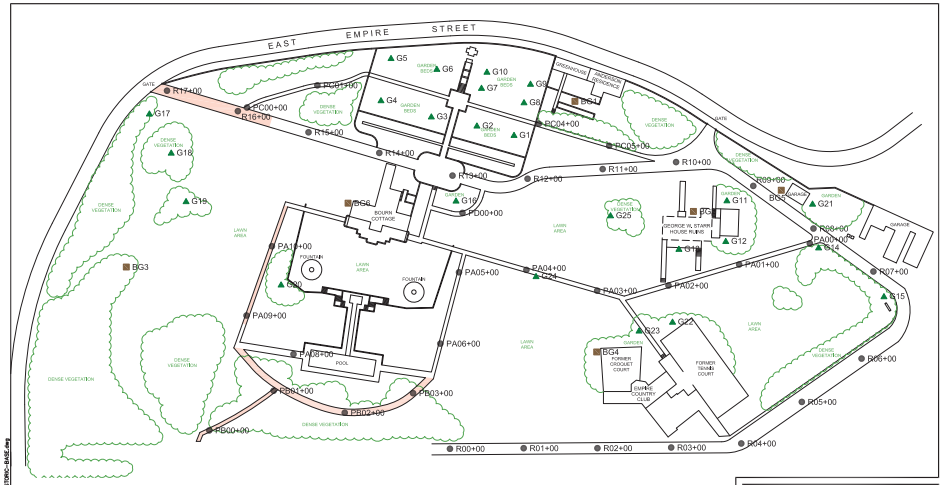
Table 2 XRF In-Situ and Correlated Concentrations (mg/Kg) (continued)

Sample ID	In-Situ XRF Arsenic Concentration	Correlated XRF Arsenic Concentration	In-Situ XRF Lead Concentration	Correlated XRF Lead Concentration
Unpaved Roads and Paths				
HG PA00+00	2	<19	10	<21
HG PA01+00	13	<19	16	<21
HG PA02+00	12	<19	31	30
HG PA03+00	7	<19	16	<21
HG PA04+00	14	<19	12	<21
HG PA05+00	22	23	20	<21
HG PA06+00	16	<19	35	33
HG PA08+00	21	22	51	49
HG PA09+00	327	339	388	369
HG PA10+00	72	74	134	127
HG PB00+00	11	<19	18	<21
HG PB01+00	47	48	19	<21
HG PB02+00	35	36	34	32
HG PB03+00	23	24	26	25
HG PC00+00	108	113	33	32
HG PC01+00	<3.15	<19	32	31
HG PC04+00	12	<19	14	<21
HG PC05+00	5	<19	16	<21
HG PD00+00	10	<19	22	<21
HG R00+00	45	47	61	58
HG R01+00	45	47	45	43
HG R02+00	22	23	19	<21
HG R03+00	<4.87	<19	60	57
HG R04+00	1	<19	17	<21
HG R05+00	6	<19	33	31
HG R06+00	14	<19	9	<21
HG R07+00	1	<19	18	<21
HG R08+00	5	<19	22	<21
HG R09+00	9	<19	20	<21
HG R10+00	20	20	41	39
HG R11+00	17	<19	0	<21
HG R12+00	<3.06	<19	13	<21
HG R13+00	<0.76	<19	26	25
HG R14+00	13	<19	26	25
HG R15+00	40	42	15	<21
HG R16+00	139	144	35	34
HG R17+00	120	124	29	27

Table 3 Total Metals Laboratory Results (mg/Kg)

Sample ID	As	Cd	Pb	Hg
Exposed Area Surface Soil Samples (0-2 inches)				
HG/BG1/00/01	27.0	0.64	60.6	0.268
HG/BG6/00/01	67.9	0.82	154	0.540
Unpaved Roads and Paths Surface Soil Samples (0-2 inches)				
HG/PA05+00/00/01	9.0	<0.20	5.02	0.047
HG/PB02+00/00/01	51.3	0.38	33.8	0.285
HG/PC01+00/00/01	15.5	<0.20	29.3	0.137
HG/R00+00/00/01	45.5	1.03	56.9	0.560
HG/R05+00/00/01	12.1	<0.20	7.23	0.067
HG/R10+00/00/01	76.9	0.87	62.7	0.302
HG/R16+00/00/01	323	0.48	29.3	0.338
Flower/Garden Beds Surface Soil Samples (0-2 inches)				
HG/G1/00/01	23.5	1.32	54.2	0.293
HG/G7/00/01	21.3	0.89	43.9	0.373
HG/G11/00/01	33.9	0.79	75.3	0.625
HG/G16/00/01	45.1	0.38	48.5	0.582
HG/G21/00/01	89.5	0.88	81.2	0.428
Flower/Garden Beds Subsurface Soil Samples (6-12 inches)				
HG/G1/02/01	33.3	1.44	53.2	0.552
HG/G7/02/01	18.6	0.57	46.4	0.460
HG/G11/02/01	11.0	<0.20	63.2	0.602
HG/G16/02/01	18.3	<0.20	34.1	0.728
HG/G21/02/01	74.6	0.46	104	0.442

FIGURES



LEGEND

- NATIVE SOIL EXPOSED (GRAVEL NOT PRESENT)
- PATH/ROAD SAMPLE LOCATIONS
- FLOWER/GARDEN BED SAMPLE LOCATIONS
- BARE GROUND SAMPLE LOCATIONS

NORTH

SCALE IN FEET 0 80

FIGURE 1
HISTORIC GROUNDS AREA
SAMPLING LOCATIONS

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Date: FEBRUARY 2009
Project: 180156
File: HISTORICBASE.DWG

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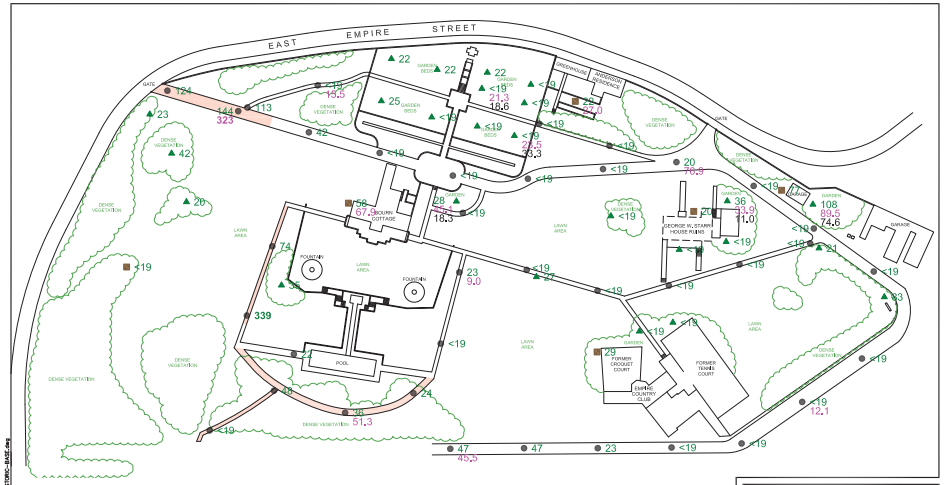

LEGEND

28	SURFACE As (mg/Kg) CORRELATED XRF	●	PATH/ROAD SAMPLE LOCATIONS
45.1	SURFACE As (mg/Kg) LABORATORY RESULTS	▲	FLOWER/GARDEN BED SAMPLE LOCATIONS
18.3	SUBSURFACE As (mg/Kg) LABORATORY RESULTS	■	BARE GROUND SAMPLE LOCATIONS
NOTE:	BOLD VALUES INDICATE ARSENIC CONCENTRATIONS GREATER THAN 200 MG/KG.	▭	NATIVE SOIL EXPOSED (GRAVEL NOT PRESENT)

NORTH

SCALE IN FEET 0 80

FIGURE 2
HISTORIC GROUNDS AREA
ARSENIC CONCENTRATIONS

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Date: FEBRUARY 2009
Project: 180156
File: HISTORICBASE.DWG

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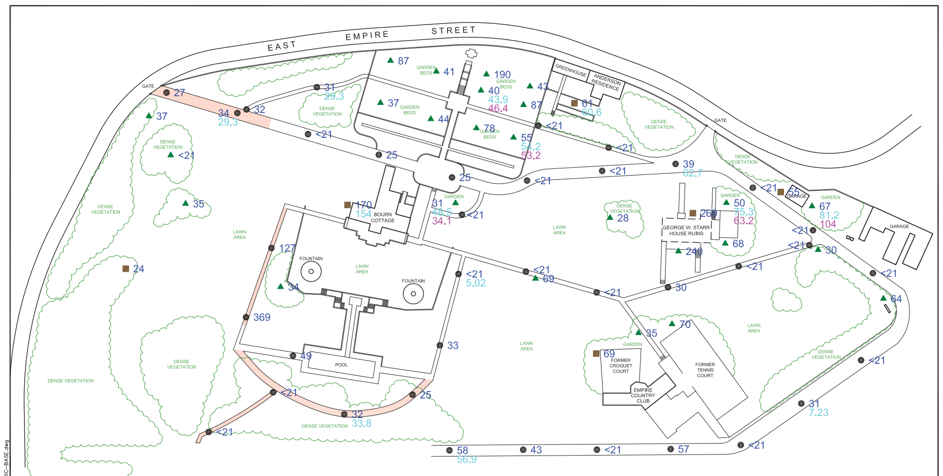

LEGEND

55 SURFACE Pb (mg/Kg) CORRELATED XRF

54.2 SURFACE Pb (mg/Kg) LABORATORY RESULTS

53.2 SUBSURFACE Pb (mg/Kg) LABORATORY RESULTS

● PATH/ROAD SAMPLE LOCATIONS

▲ FLOWER/GARDEN BED SAMPLE LOCATIONS

■ BARE GROUND SAMPLE LOCATIONS

NATIVE SOIL EXPOSED (GRAVEL NOT PRESENT)

FIGURE 3
HISTORIC GROUNDS AREA
LEAD CONCENTRATIONS

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Additional Attachments are On-File with the Department of Parks and Recreation and on their Website:

http://www.parks.ca.gov/?page_id=981

Appendix C-9:
Trails 2007 Action Work Plan

FINAL
TRAILS
2007 ACTION WORK PLAN
EMPIRE MINE STATE HISTORIC PARK
JULY 16, 2007

Prepared for:

CALIFORNIA DEPARTMENT OF STATE PARKS AND RECREATION
EMPIRE MINE STATE HISTORIC PARK

and

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I certify under penalty of law that I have examined and am familiar with this Work Plan, and to my knowledge, the report is true, complete, and accurate.

Eileen M. Dornfest, Certified Engineering Geologist

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Table 1 Trail Surface Laboratory Analysis Parameters, Methods, and Detection Limits

FIGURES

Figure 1 Empire Mine State Historic Park Site Features
Figure 2 Empire Mine State Historic Park Osborne Hills Trail

ATTACHMENT

Attachment A Sampling and Analysis Plan

1.0 PURPOSE

This Trails 2007 Action Work Plan (2007 Work Plan) for the Empire Mine State Historic Park (Park) describes the work that will be performed in 2007 to further the trails priority action that was initiated in 2006 pursuant to the Trails 2006 Priority Action Work Plan (MFG, 2006a). The purpose of the 2007 work is to conduct a trail engineering survey and field characterization, and then, if determined necessary, implement action(s) for trail segments in the Osborne Hill area.

During 2006, an investigation was conducted to characterize the mine and mill materials present on trail surfaces throughout the Park (MFG, 2006a) based on surface metal concentrations. The results of that investigation were presented in the Data Transmittal and Addendum for the Trails 2006 Priority Action Work Plan (MFG, 2006b). These results indicated that mine and mill materials exist within certain trail segments associated with nearby historic mining features. This finding was based on visual observation and measured concentrations of arsenic along trail surface materials. As a result, certain trail segments of the Hardrock, Osborne Hill Loop, Powerline, Betsy Mine, and Osborne Hill Road Volunteer trails have been or are scheduled to be covered to eliminate exposure pathways to trail users. In addition, the Prescott Hill Crosscut, Prescott Mine, Daisy Hill Mine, and Conlon Mine trails and certain segments of the Osborne Hill Loop and Osborne Hill Road Volunteer trails within the Osborne Hill area have been closed as an interim measure. The data gaps analysis and conceptual site model (CSM) of the Park features (MFG, 2007) concluded that additional data or evaluation are needed to more fully delineate areas of mine and mill materials along trails surfaces of the closed trail segments within the Osborne Hill area.

The 2007 work is intended to provide additional information and determine the appropriate action(s) to be taken for trails in the Osborne Hill area. The 2007 work includes:

- Conduct an engineering survey of trails in the Osborne Hill area to assess the condition of these trails with respect to CDPR's trail criteria and determine the future use of the trail or trail segment.
- Further assess trail surfaces to define the potential presence of mine and mill materials based on metal concentrations.
- Evaluate the 2007 data, identify the need for actions and, if determined necessary, develop implementation plans for those actions.

This Trails 2007 Action Work Plan has been prepared by MFG, Inc. (MFG) on behalf of Newmont USA Ltd. (Newmont) and the California Department of State Parks and Recreation (CDPR).

2.0 SITE DESCRIPTION

The Park has approximately 14 miles of trails used by visitors for hiking, jogging, mountain biking, and horseback riding, as shown on Figure 1. Trails within the Osborne Hill area are shown on Figure 2. The trails generally are constructed on native ground surfaces, thus the surfaces of the trails are comprised largely of native soils and sand to cobble-size rock fragments, and are often partially or fully covered by layers of organic litter. Trail surfaces adjacent to or adjoining historic mine features may contain mine or mill materials.

2.1 Existing Data

Metal concentrations along the surfaces of the entire trail network within the Park were investigated in 2006 pursuant to the Trails 2006 Priority Action Work Plan (MFG, 2006a). Metal concentrations were tested along 100- or 200-foot intervals of the trail surface to identify locations on the trails where mine or mill materials may occur. The results indicated (MFG, 2006b) that concentrations of most CAM-17 metals are low throughout the trail system, with the exceptions of arsenic and lead. Elevated levels of arsenic and lead were identified in surface soils on trail segments of the Hardrock, Osborne Hill Loop, Prescott Hill Crosscut, Daisy Hill Mine, Osborne Hill Road Volunteer, and Conlon Mine trails associated with nearby historic mining facilities.

These findings indicate that mine and mill materials are present on the surfaces of the specified trail segments. Overall, arsenic and lead concentrations appear to provide the best indicators of the locations of potential mine and mill material on the trail surfaces (MFG, 2006b). Trails data show that the highest concentrations of arsenic occur where the trails cross or come in close proximity to areas of historic mining and milling operations.

2.2 Conceptual Site Model and Data Gaps Identification

A conceptual site model (CSM) was developed in the Data Gaps reports (MFG 2006a, 2007) to address potential release mechanisms, transport pathways, and exposure routes to receptors. Application of the CSM to the trails indicates that metals from mine and mill materials in the trail surfaces may be potentially released by wind and water erosion or dust.

The potential transport pathways for metals derived from mine and mill materials in trail surface soils are:

- Dust generated locally by trail use (walking, jogging, horseback riding, mountain biking). However, data collected during the 2006 Trails Priority Action Work Plan (MFG, 2006a) indicates that personal air quality is not measurably affected by dusts along trail segments with known areas of elevated metal concentrations for the conditions that existed during sample collection.

- Water erosion where sloped portions of the trails form preferential pathways for runoff during periods of high rainfall and snowmelt, resulting in re-deposition of mine and mill materials in downgradient areas.
- Metal uptake by plants growing along the trails.

These potential transport pathways lead to potential exposure routes of dermal contact, inhalation of locally generated dust and incidental ingestion for Park visitors, employees or residents, who may use the trails.

The 2006 Trails Data Transmittal and Addendum (MFG, 2006b) and Data Gaps report (MFG, 2007) concluded that certain segments of trails contain mine and mill materials that are sources of metals with potentially complete pathways to receptors. Based on this, priority actions were developed which included placement of covers (road base material) over segments of the Hardrock Trail, Osborne Hill Loop Trail, Betsy Mine Trail, and Powerline Trail. In addition, the Prescott Hill Crosscut Trail, Daisy Hill Mine Trail, Conlon Mine Trail, and segments of the Osborne Hill Loop Trail and Osborne Hill Road Volunteer Trail were closed, as an interim measure, pending additional data collection, evaluation and potential future trails use (MFG, 2006c). While priority action was not necessary for the Prescott Mine Trail, this trail was closed since access to the trail was prevented by closure of the trails identified above. These trail segments are shown on Figure 2. The need for more detailed data concerning future trail use and metal concentrations for these closed trail segments was identified as a data gap (MFG, 2007). This 2007 Work Plan describes data collection to fill data gaps and to provide information on the necessity for further action for the trails in the Osborne Hill area.

3.0 CHARACTERIZATION

The trail characterization work within the Osborne Hill area that will be performed under this Work Plan includes:

- Performance of an engineering survey to assess the condition of trails with respect to CDPR trail design and engineering criteria and define the potential future use of specific trails or trail segments;
- Assessment of metal concentrations of surface soils for trails or trail segments where new trail construction or currently closed trails or trail segments are identified for potential future use.

A description of these characterization activities follows.

3.1 Trails Engineering Survey

This first task of the field characterization is to conduct an engineering survey of the trails in the Osborne Hill area, including those trail segments which are presently closed. The purpose of this survey is to assess the long-term CDPR trail management of the Osborne Hill trail network, which will specifically assess the condition of the trail segments with respect to CDPR engineering and design criteria for existing trails, and will identify and characterize the potential future use of the trail segments. The engineering survey will evaluate the trail grade, drainage, trail use (i.e., hiking, biking, equestrian, etc.), and potential for future trail use. The engineering survey will be completed by CDPR engineering personnel and will include recommendations for:

- New trail construction,
- Reconstruction of existing trail surfaces (trails or trail segments for which the metal concentrations of the trail surface were defined by the 2006 Trails Data Transmittal and Addendum),
- Continued use of an affected trail segment (trail surface with elevated arsenic concentrations defined by the 2006 Trails Data Transmittal and Addendum (MFG, 2006b) that was covered or closed), or
- Decommissioning (closure) of an affected trail segment.

As described in the following section, metal concentrations will be determined on surfaces of trail segments identified by the engineering survey for new trail construction, reconstruction of trail surfaces, and continued use of an affected trail surface. Trail segments identified for decommissioning will be closed in accordance with CDPR requirements. Decommissioning will include trail surface reclamation involving contouring of the trail surface to approximate adjoining topography, physical stabilization of the contoured surface through the establishment of native vegetative communities, and the discontinued public use of the trail surface.

3.2 Assessment of Trail Surface Soil Metal Concentration

An assessment will be performed of surface soils for trail segments within the Osborne Hill area to be constructed, existing trail segments to be reconstructed and closed trail segments that are to be re-opened for permanent use, as identified by the engineering survey. The assessment will consist of a visual survey to delineate the presence of mine and mill materials and the determination of metal concentrations of the trail soil surfaces. The purpose of the assessment is to identify any actions that need to be implemented to permit construction of new trail segments and the reconstruction or re-opening of closed trail segments.

A combination of field measurements of metals (arsenic and lead) and soil sampling and laboratory analysis of metals (CAM-17) will be performed. The field measurements will be conducted with a

portable, x-ray fluorescence (XRF) unit, as was done in the 2006 Trails Priority Action Work Plan (MFG, 2006a). Laboratory analyses will be conducted on soil samples collected from a subset of the field XRF measurement locations.

Metal concentrations will be determined on the surface soils along the proposed route of new trails to be constructed to confirm that mine and mill materials are not present. As previously described, certain trail segments in the Osborne Hill area were designated for covering and temporary closure in the 2006 Trails Data Transmittal and Addendum (MFG, 2006b) and were either covered or closed to visitors by fencing and signage in February 2007. The assessment will be performed for these affected trail segments that are to be reconstructed or are to be re-opened for permanent use. The assessment of affected trail segments will include evaluation of the metal concentration data of trail surfaces reported in the 2006 Trails Data Transmittal and Addendum (MFG, 2006b) and the additional measurement of surface metal concentrations to define the extent of the affected trail segment (beyond the points at which the trails were closed or covered).

The following sections describe the visual survey and the measurement of metal concentrations of the trail surfaces. The Sampling and Analysis Plan (SAP) presented in Attachment A provides additional details regarding operation of the field XRF unit and soil sampling procedures.

3.3 Trails Surface Visual Survey

A visual survey of trail segments within the Osborne Hill area will be conducted to identify the location and describe the extent and nature (texture and size distribution) of mine and mill materials on the surface of existing or new trail alignments. The description will include identification of nearby historic mine and mill features and the apparent relationship between these features and mine and mill materials in the trail surfaces, as well as other trail conditions, such as drainages, stormwater runoff or erosion, and surrounding vegetation cover and type. The findings of the visual survey will be recorded in field notes and the location of mine and mill materials and other features will be recorded by a hand-held GPS. The GPS location data will be transferred to maps and included in the field notes and data compilations.

3.4 Field In-situ XRF Measurements

Field in-situ XRF measurements will be performed to determine arsenic and lead concentrations at 50-foot intervals along trail surfaces identified by the engineering survey for new construction. Field in-situ XRF measurements will be performed to determine the arsenic and lead concentrations of affected trail segments identified for reconstruction and re-opening by the engineering survey at 50-foot intervals beyond the points where the trails were closed or covered. The field in-situ XRF measurements will

focus on arsenic concentrations because this metal has been found to be most characteristic of mine and mill materials during the 2006 Trails Priority Action Work Plan (MFG, 2006b). Lead concentrations will also be measured by field in-situ XRF because this metal has been found to be a useful secondary indicator of the potential presence of mine and mill materials (MFG, 2006b). Measurements will be conducted in the field in accordance with the Sampling and Analysis Plan provided in Attachment A.

3.5 Soil Sample Collection and Analysis

Samples of trail surface soil will be collected from 20 percent of the field in-situ XRF measurement locations for both ex-situ XRF measurements and laboratory analysis. The analytical results for these samples will be correlated with the field in-situ XRF measurements. Sample collection procedures and ex-situ XRF measurements will be conducted in accordance with the Sampling and Analysis Plan provided in Attachment A. The field XRF unit measures metal concentrations in approximately the top two inches of the trail surface. Therefore, the samples will be collected from the top two inches at locations that represent the range of the arsenic and lead concentrations measured by the field in-situ XRF measurements.

The samples will be analyzed for metals by ex-situ XRF after sieving according to EPA Method 6200 (Attachment A). Laboratory analysis of the samples will also be performed by a California certified analytical laboratory for CAM-17 metals according to EPA Method SW-846. Table 1 provides the parameters, analytical methods and detection limits. The procedure for correlation of the field in-situ XRF data to laboratory-measured concentrations will be the same as that presented in the 2006 Trails Data Transmittal and Addendum (MFG, 2006b).

Table 1 Trail Surface Laboratory Analysis Parameters, Methods, and Detection Limits

Parameter	Analytical Method	Target Method Detection Limit (mg/Kg)
Antimony	EPA 6010	2
Arsenic	EPA 6010	2.5
Barium	EPA 6010	0.2
Beryllium	EPA 6010	0.2
Cadmium	EPA 6010	0.2
Chromium	EPA 6010	0.6
Cobalt	EPA 6010	0.6
Copper	EPA 6010	1
Lead	EPA 6010	0.75
Mercury	EPA 7470	0.02
Molybdenum	EPA 6010	0.8
Nickel	EPA 6010	1
Selenium	M7742/Hydride	4
Silver	EPA 6010	0.5
Thallium	EPA 6010	1.5
Vanadium	EPA 6010	0.5
Zinc	EPA 6010	1

4.0 2007 ACTION PLAN

The 2007 Action Plan is comprised of three major components:

- A Data Transmittal and Action Evaluation Report
- An Implementation Plan Report
- A Completion Report.

The activities associated with these elements are described in the following sections.

4.1 Data Transmittal and Action Evaluation Report

The purpose of the Data Transmittal and Action Evaluation Report is to present and evaluate the field and laboratory data and evaluate the action(s) that will be implemented to eliminate potential exposure pathways from elevated metal concentrations associated with mine and mill materials on trail surfaces. The data will be evaluated to determine if action(s) are necessary for specific trail segments. If action(s) are necessary, then an evaluation will be performed to define the appropriate action(s) to be implemented for specific trail segments. The action evaluation and alternative analysis will refine the selection of the action(s) to be implemented for each trail segment based on the effectiveness of eliminating potential exposure pathways from elevated metal concentrations (performance objective), cost-effectiveness, and consistency with the Park's mission.

Examples of the potential work action(s) to be evaluated for trail surfaces include (but are not limited to) one or a combination of the following:

- No action
- Covering trail segments with 3 to 6 inches of compacted cover material (road base, gravel or other materials determined appropriate)
- Removal of mine and mill materials from trail surfaces to a depth of 6 to 12 inches and replacement of the removed material with appropriate new trail surface material
- Relocating trail segments away from mine and mill materials, or
- Decommissioning (closure) of trails.

4.2 Implementation Plan

After completion of the Data Transmittal and Action Evaluation, an Implementation Plan Report will be developed for the selected action(s). The Implementation Plan will provide detailed design and engineering specifications of the specific identified action(s) to allow construction to proceed. In

addition, the Implementation Plan will provide other necessary design and construction elements. Major elements of the Implementation Plan include:

- Action Design Detail
  - List of action components (e.g., cover, re-locating, removal, decommissioning)
  - Engineering plans and specifications for carrying out specific construction tasks
- Construction project organization
- Construction schedule
- Construction erosion and stormwater control
- Construction QA/QC
- Construction HASP.

The Implementation Plan will be suitable for developing bid packages for contractors to perform specific activities of the selected actions. In addition, institutional controls such as signage and education will be implemented to inform Park users and employees about the nature of the work and hazards present, and the temporary closure of trail segments while action work is in progress.

4.3 Completion Report

After completion of the construction activities, a Completion Report will be completed and submitted within 90 days of completion of the Implementation Plan. The Completion Report will provide the following:

- Documentation of action construction activities
- Operation and Maintenance plans for the constructed components
- Description of any future land-use restrictions relevant to Park operation that may need to be taken into account because of the action
- Documentation that the performance objectives for the selected action have been achieved (through confirmation sampling).

5.0 SCHEDULE

The schedule for this 2007 Work Plan is to complete field work and data analysis by the end of summer 2007 and to develop and submit the Data Transmittal and Action Evaluation Report to the Department of Toxic Substances Control and the Central Valley Regional Water Quality Control Board within 90 days of receiving the final laboratory analysis reports. The Implementation Plan will then be prepared following agency review of the Data Transmittal and Action Evaluation Report. A Completion Report will be completed and submitted within 90 days of completion of the action construction. The schedule is dependent upon agency review and approval, completion of the California Environmental Quality Act

(CEQA) process, and the final issuance of an agency Order prior to the initiation of the activities specified in this 2007 Work Plan.

6.0 REFERENCES

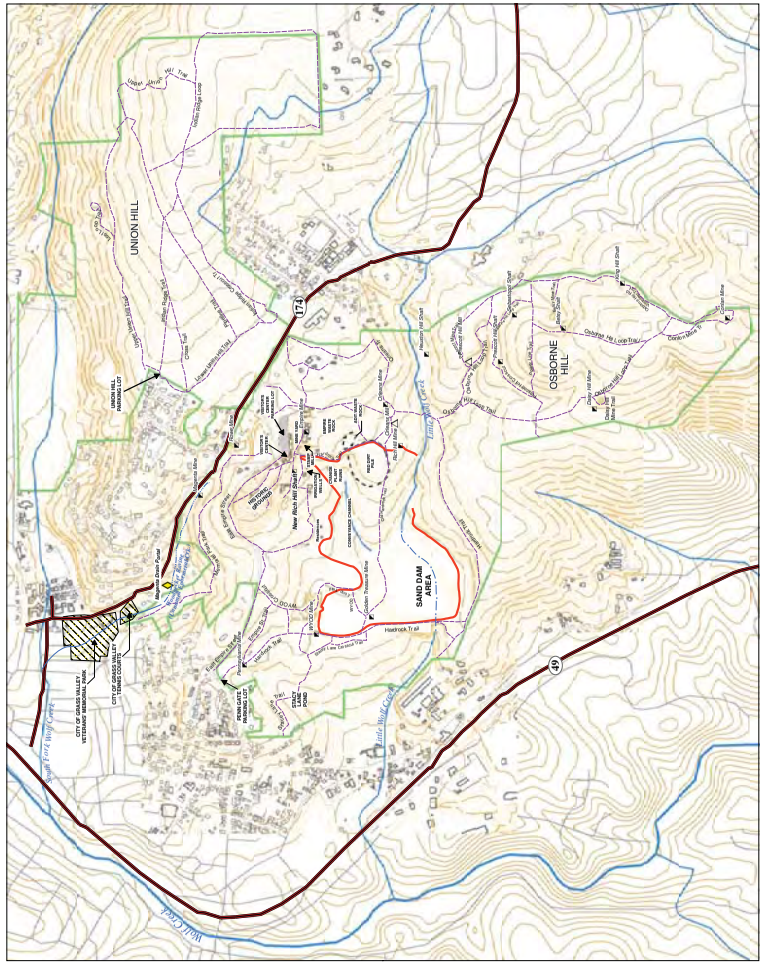
MFG, Inc., (MFG) 2006a. 2006 Trails Priority Action Work Plan Empire Mine State Historic Park. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. July 21.

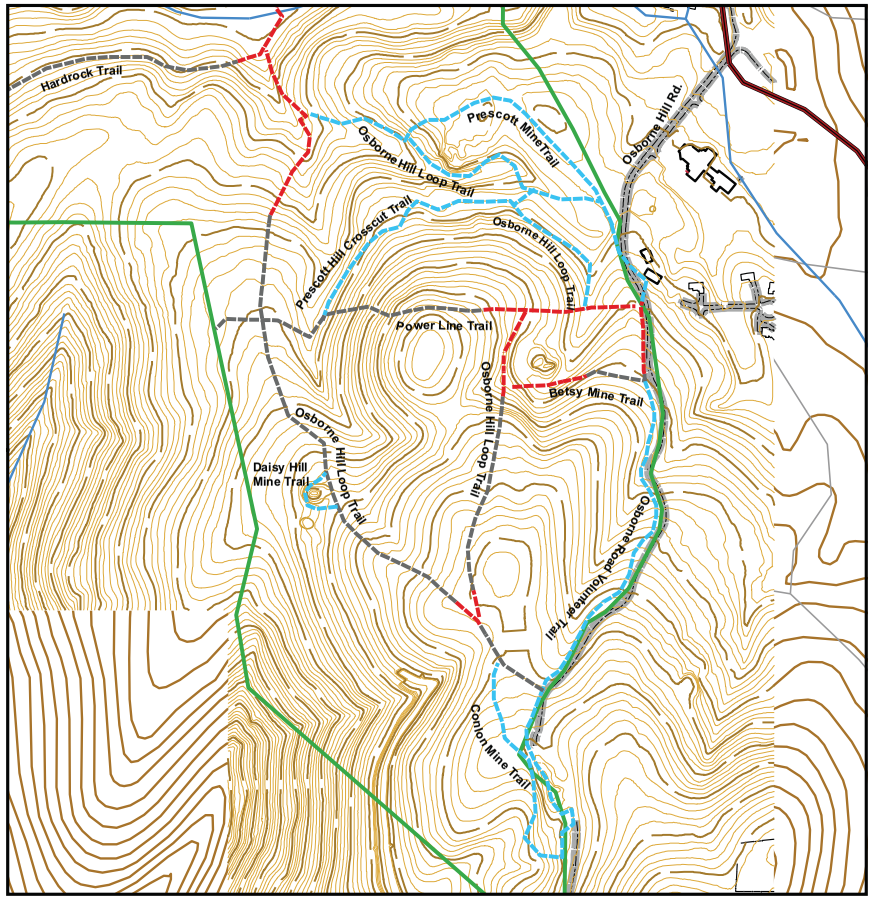
MFG, Inc. (MFG), 2006b. Data Transmittal and Addendum for the Trails 2006 Priority Action Work Plan, Empire Mine State Historic Park. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. December 4.

MFG, Inc. (MFG), 2006c. Data Gaps Report for the Empire Mine State Historic Park Phase 1: Existing Data. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. December 8.

MFG, Inc. (MFG), 2007. Data Gaps Report for the Empire Mine State Historic Park Phase 2: Data Gaps Analysis. Prepared for California Department Parks and Recreation and Newmont USA, Ltd. by MFG, Inc., Fort Collins, Colorado. January 15.

FIGURES





Legend

- Empire Mine State Historic Park
- Park Trails
- Trails Covered in 2006 and 2007
- Trails Closed in 2006

N

Notes:
Coordinates in NAD 1983 StatePlane California II FIPS 0402

0 375 750 1,500 Feet

TITLE

FIGURE 2
EMPIRE MINE STATE HISTORIC PARK
OSBORNE HILL TRAILS

PROJECT:	010156	DATE: JULY 2007	DRAWING	REVISION
SCALE:	AS SHOWN	FILE: TrailsMap.mxd	1	0

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Additional Attachments are On-File with the Department of Parks and Recreation and on their Website:

http://www.parks.ca.gov/?page_id=981

Appendix C-10:
Residences 2006 Action Work Plan

RESIDENCES
2006 PRIORITY ACTION WORK PLAN
EMPIRE MINE STATE HISTORIC PARK
JULY 2006

Prepared by:

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MFG Project No. 180156/102

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FIGURES

Figure 1 Minimum Soil Sampling in Yards Less Than or Equal to 5,000 Square Feet
Figure 2 Minimum Soil Sampling in Yards Greater Than or Equal to 5,000 Square Feet

APPENDIX

Appendix A Sampling and Analysis Plan

1.0 PURPOSE

The purpose of the 2006 Residential 2006 Priority Action Work Plan is to describe priority action measures to limit potential human health (HH) exposure pathways at eight residences, located within the Empire Mine State Historic Park (SHP), from natural or mine and mill related metals in soil, dust and interior surfaces. The exposure pathways will be eliminated by the implementation of prescribed actions presented in this work plan for the residential interiors, removal of soils from residential yards and gardens that exceed the specified criteria, and by examination of the potable and non-potable water sources.

The residences are currently occupied by employees of the California Department of Parks and Recreation (CDPR) who work at the SHP. The eight residences consist of six houses, which were constructed in the early to mid-1930s, and two trailer homes. Each of the residences has either a garage, storage shed, or both of these structures. Defined lawn areas are present at most of the residences that are irrigated with non-potable water pumped from the Empire Mine Shaft. Three of the residences have vegetable garden areas.

2.0 WORK PLAN

2.1 Description of Potential Sources

This work plan describes the specific nature of the potential sources that may exist in:

- Accumulation of household dust which could contain elevated metals in carpets and on surfaces in excess of the HH criteria
- Soils in residential yards and gardens that contain elevated metals in excess of HH criteria that pose a potential exposure pathway through direct contact or by vegetation uptake and consumption
- Use of non-potable water for irrigation of gardens and lawns and other domestic non-potable water use

2.2 Criteria for Priority Action

The potential presence of elevated metals at the SHP residences could be related to mine/mill related metals due to historic mine and milling operations dating from the early 1900s, the transport of associated materials containing metals by air, water, on clothing, the use of mine or mill materials as fill materials at the residences, or the natural presence of the metals within the soils at the residential locations.

2.2.1 Residential Soils

In the absence of background data, the California Human Health Screening Levels (CHHSLs) for residential land use where they exist for California Administrative Manual 17 (CAM 17) metals plus the USEPA Region 9 residential Preliminary Remediation Goal (PRG) for aluminum will be used as the criteria to identify soil to be removed in the residential yard and garden areas for the specific purpose of facilitating implementation of this priority action in a timely manner. The arsenic action level for residential soil will, however, be determined in consultation with the California Department of Toxic Substances Control (DTSC). Regardless of natural background metal concentrations for soil, soil in residential yards and gardens that contain concentrations higher than the residential CHHSLs, the USEPA PRG for aluminum, or the DTSC approved action level for arsenic will be addressed as part of this priority action.

2.2.2 Household Dust

This work plan assumes that each residential dwelling has been appropriately surveyed for asbestos containing materials (ACMs) and lead based paint. It is also assumed that all necessary ACM and lead based paint abatement has been performed in each residential dwelling prior to the implementation of this work plan. As discussed in Section 5, surfaces such as floors, carpets, draperies, window sills and upholstered furniture will be cleaned, removed or replaced within each residence to eliminate dust potentially containing lead. Following completion of the indoor priority action measures, confirmation

sampling will be performed to verify that household dust in the residences contains lead levels less than 250 $\mu g/ft^2$ on interior horizontal window surfaces and 50 $\mu g/ft^2$ of lead in dust on interior floor surfaces in accordance with Title 17, California Code of Regulations, Division 1, Chapter 8.

2.2.3 Water Supplies

Water samples will be collected from the residential potable and non-potable water sources. These samples will be analyzed and evaluated for CAM-17 metals. The collection of the potable and non-potable water samples will be completed to ensure the residence has been properly plumbed. If the potable water results indicate the residence is not properly plumbed, the potable water supply system will be re-plumbed to ensure appropriate potable water system distribution.

If the non-potable water sample results do not exceed the limitations contained within the State of California Proposition 65 requirements, no action will be taken. If the non-potable water sample results exceed the Proposition 65 requirements, the water source will be labeled "Non-Potable Water Supply – Do Not Drink" and any other requirements of Proposition 65 will be addressed.

3.0 SOIL SAMPLING METHOD

Soil within the defined yard and garden areas at all eight residential properties will be sampled. Soil sampling will be based on the criteria outlined in *Superfund Lead-Contaminated Residential Sites Handbook* by EPA. For residential yard areas with a total surface area of less than 5,000 square feet, five–point composite soil samples will be collected from each of the following locations: the front yard, the back yard, and the side yard. The front, back and side yard composites will be equally spaced within the respective portion of the yard, and will be outside of the drip zones and away from the influences of any other painted surfaces. Composites will consist of aliquots collected from the same depth interval (Figure 1).

For residential yards with a total surface area greater than 5,000 square feet, the yard will be divided into four quadrants of roughly equal surface area. The two quadrants in the front yard will encompass one half of the total yard size and the two quadrants in the back will encompass one half of the total yard size (Figure 2). One five point composite of aliquots collected at equal spacing and from the same depth interval will be obtained from each quadrant. Each aliquot will be collected away from influences of the drip zones and any other painted surfaces.

Prior to soil sampling, a yard plan will be developed and the location of all sampling points will be plotted on the plan. At the time of sampling, the sampling crew will designate discrete areas, such as driveways, play areas, parking areas, etc., on the plan, and indicate where samples are collected.

3.1 Drip Zones

A four-point composite sample will be collected from the drip zone of the residential homes. The composite sample will consist of a minimum of four aliquots collected between 6 and 30 inches from the exterior walls of the house. Each aliquot will generally be collected from the midpoint of each side of the house. Collection of additional aliquots shall be considered if other factors exist, such as bare spots and areas where runoff collects. Samples of the soil from downspout discharge areas will be sampled, if present.

3.2 Soil Sampling Equipment and Information Collection

The sampling equipment will include the following items: soil sampling probe, shovel, pick, trowel, stainless steel bowls, knife, measuring tape, sample bags, camera, log book, pen, pencil, and marker.

Information that will be collected from each sampling point will include the GPS location and sampling depth. All sampling equipment used for the extraction of soil will be decontaminated. Decontamination equipment will include, pump sprayers, spray bottles, deionized water, phosphate free soap solution,

scrub brushes, buckets, disposable gloves, etc. Procedures described in the Soil Sampling Analysis Plan will be followed.

3.3 Soil Sampling Locations and Depths

Composite samples will consist of discrete aliquots of equal amounts of soil. The soil from each aliquot will be collected into one clean container each. Sampling of residential soils will be conducted to a depth of 18 inches. Composite samples will be collected at 6-inch depth intervals, i.e. 0-6 inches, 6-12 inches 12-18 inches. Composites will consist of aliquots collected from the same depth interval. Five-point composite surface soil samples will also be collected from a depth of 0 to 1 inch. Procedures and analysis described in the Soil Sampling and Analysis Plan will be followed.

4.0 DUST SAMPLING METHOD

Dust samples within the eight residential homes will be collected after cleanup/removal activities have been completed. Samples will be evaluated for the presence of lead only. The following sampling method describes the confirmation sampling strategy, techniques, and quality control (QC) procedures necessary to perform the house dust sampling. These procedures ensure the precision, accuracy, and documentation of data generated during sampling activities.

4.1 Vacuum Sampling

High-efficiency particulate (HEPA) vacuum samples will be collected within each residence after cleanup is completed in each home. The HEPA vacuum cleaner dust sample will be obtained to quantify lead concentrations in house dust. Procedures for sampling, sample handling, documentation, and transport are described in the following subsections.

The vacuum dust sample will be used to confirm cleanup levels within the residence. Therefore, prior to sample collection the sampler will verify that the vacuum has been properly decontaminated from previous uses to ensure the collection of a representative sample. The vacuum dust sample and analysis will be performed according to procedures outlined in the Dust Sample Analysis and Plan.

4.2 Wipe Sampling

Wipe samples will be collected on hard surfaces such as floors and sills after cleaning. Dust wipe sampling will be conducted in accordance with ASTM Method 1728, Standard Practice for Field Collection of Settled Dust Samples Using Wipe Sampling Methods for Lead Determination by Atomic Spectrometry Techniques. The media used to collect dust wipe samples will be ghost wipes for surface lead dust sampling, a pre-wetted cellulose pad which constitutes an acceptable wipe material as defined in ASTM Method E 1792, Standard Specification for Wipe Sampling Materials for Lead in Surface Dust. Samples will be tested for lead in the laboratory by EPA Method 6010B. Procedures outlined in the Sample and Analysis Plan will be followed. The confirmation sampling will be performed to verify that household dust in the residences contains lead levels less than 250 $\mu g/ft^2$ on interior horizontal window surfaces and 50 $\mu g/ft^2$ on interior floor surfaces.

5.0 RESIDENCE PRIORITY ACTION MEASURES

Implementation of the remediation work plan will achieve the following results:

1) Reduce human contact with soil, dust and non-potable water above State of California and/or EPA action levels
2) Reduce metals bearing dust generation in the vicinity of the residential properties
3) Dispose of removed soil and household dust accumulations from residential areas in such a manner that human contact is prevented, and re-migration of these materials are controlled.

5.1 Residence Yards

For those residential yard or garden areas that equal or exceed the CHHSL action levels for CAM 17 metals, the EPA residential PRG for aluminum, and the DTSC approved action level for arsenic in the soils, the soils will be remediated. If soil remediation is required, the following action measures will be implemented:

- Removal of 12 inches of soil will be performed in areas that exceed the identified action levels. A maximum of 12 inches of clean imported soil will be used as backfill to reestablish original ground contour and to establish an adequate barrier if contaminated soil exists in the residential yard area below 12 inches in depth. A delineation fabric covering will be installed prior to the placement of the 12 inches of imported soil.
- Garden soils that exceed the CHHSLs for CAM 17 metals, aluminum and the DTSC approved action level for arsenic will be excavated to a maximum depth of 12 inches and receive 24 inches of clean replacement soil in a raised bed. The size of the replaced garden area will be the same as the existing garden area. Each residential area will be furnished with a garden area.
- During the excavation process, all existing sod and soil coverings will be removed and disposed of along with the soil. Larger trees and shrubs will be left in place. After spreading, compaction and grading, clean fill will be revegetated, as appropriate. The lawn areas of remediated yards will generally be revegetated with sod. Other remediated areas not currently planted with lawns, will be stabilized and seeded with native grasses to achieve a ground-cover. To the extent practicable, all yard landscaping will be returned to its original condition unless CDPR decides otherwise. Removed contaminated soils shall be disposed of at a DTSC approved facility.

Clean replacement material (including soil, gravel, etc.) will be selected in accordance with the State of California Department of Toxic Substances *Information Advisory, Clean Imported Fill* (2001) fact sheet. Replacement soil for yards, gardens, flower beds, and other landscaped yard areas will have properties that promote plant growth. Remediated areas that do not require revegetation may receive clean gravel instead of backfill soil. Unpaved roadways, driveways or parking areas in the vicinity of the residences will be paved after excavation activities have been completed to minimize future generation of fugitive dust.

Care will be taken to minimize or eliminate a need to remove trees, established landscapes (i.e. shrubs or bushes) or structural components (i.e. sidewalks, foundations, or retaining walls) during the implementation of the work plan. Excavation techniques will be implemented to avoid damage to root structures of trees.

5.2 Indoor Priority Action Measures

Dust removal measures will be implemented as described in this work plan. Surfaces such as floors, carpets, window sills and upholstered furniture will be cleaned to eliminate dust potentially containing lead. Confirmation sampling will be performed after the indoor priority action measures have been implemented. The residence will be cleaned as follows:

- Remove potential identified sources containing metals accumulations from the residence (i.e., carpet, draperies).
- HEPA Vacuum. Vacuum all surfaces in the house (including furniture) starting with ceilings and walls and work downwards. Work in a direction furthest from the entry of an individual room in a direction towards the entry.
- Wet Clean. Following thorough HEPA vacuuming, wash all hard surfaces with any suitable cleaning detergent following the same cleaning pattern (high to low/furthest from and toward entrance). Change the cleaning solution as it becomes dirty. Rinse all areas with a fresh cloth/mop. Do not reuse contaminated mops and cloths. Use a three bucket system for cleaning (Detergent solution in first bucket/rinse water for mop in second/surface rinse on floor).
- HEPA vacuum again as required in Step 2.
- Properly dispose of all cleaning and vacuum related materials.

Persons other than properly trained workers, skilled in observing the HASP, and protected with appropriate personal protective equipment and prescribed engineering controls will not be allowed in the work area until all work is completed. Work will be initiated on any second floors of residences. Clean up work will begin at the top and back corner in each room and move to the front entrance in a systematic motion.

Workers will prevent dust generation during cleanup by adhering to the following criteria during the cleanup process.

1) Seal doors, windows and other openings between clean up areas and other areas with materials such as fire-rated polyethylene; seal both sides (inside and outside) to provide a secondary dust barrier and prevent the doors and windows from being used.
2) Clean up must be conducted under negative pressure in relation to adjacent areas. This means that more air is exhausted from the area than is supplied so that dust

accumulations is contained within the work area, and no dust can enter other areas of the residence; exhaust air must be filtered with a HEPA filter.

6.0 IMPLEMENTATION PLAN

An Implementation Plan will be developed that will include:

- Schedule
- Contractor selection
- HASP

7.0 COMPLETION REPORT

Sixty days following completion of all 2006 residential priority activities, a completion report will be prepared and submitted to the California Department of Toxic Substance Control (DTSC) and the California Central Valley Regional Water Quality Control Board (CVRWQCB). The completion report will detail residential cleanup activities, areas and volumes of soil excavation, source and volume of replacement soil, excavated soil management and disposal, etc. The completion report will also specify maintenance activities that will be performed for the residential yard areas in which soil has been removed. Each portion of this work will be adequately recorded, mapped, supported by the applicable field log book and will be represented on appropriate figures.

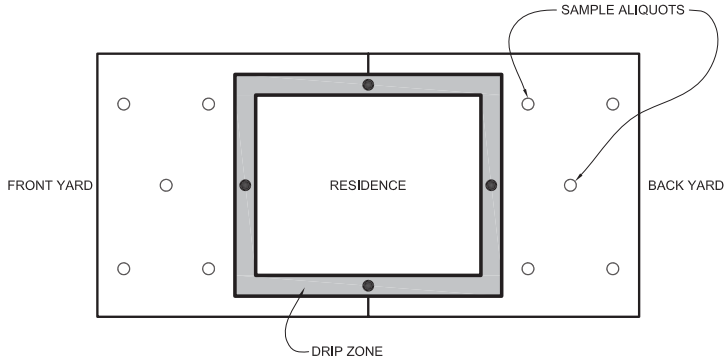

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FIGURE 1
MINIMUM SOIL SAMPLING IN YARDS
LESS THAN OR EQUAL TO 5,000 SQ. FT.

Date:	APRIL 2006
Project:	180156
File:	RESIDENCE-SAMPLE

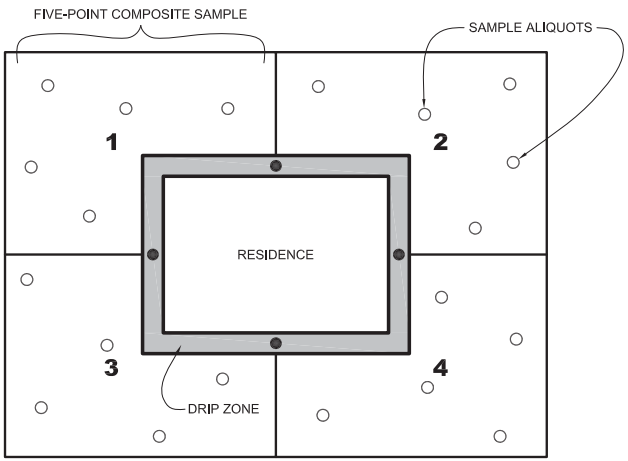

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FIGURE 2
MINIMUM SOIL SAMPLING IN YARDS
GREATER THAN 5,000 SQ. FT.

Date:	APRIL 2006
Project:	180156
File:	RESIDENCE-SAMPLE

Additional Attachments are On-File with the Department of Parks and Recreation and on their Website:

http://www.parks.ca.gov/?page_id=981