Lab Characterization of Red Devil Samples

For

Wilder Corporation
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By

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METALS TREATMENT TECHNOLOGIES

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EXECUTIVE SUMMARY

- Twenty-seven samples were collected from various locations on the Red Devil site which represent all the RCRA waste stream types.
- Totals analyses of the 27 samples by X-ray fluorescence (XRF) show that the site has significant arsenic levels; the highest is 8.2% and the average for the 27 samples is 0.22%. The amount of mercury on site is low; the highest is 0.2% and the average is 0.036%. The amount of lead is also low; the highest is 0.044%; the average is 0.01%.
- The one wood sample and the three brick samples were studied in detail and show that most of the lead and mercury contamination is on the surface. Most of the arsenic is on the surface of the wood sample. The arsenic is only on the surface of two of the bricks and throughout one brick.
- TCLP analyses show that seven samples failed for arsenic; most are near the retort, one near the chemical building, and one near the mess hall/bunk house. Three samples failed for mercury; near the retort area. No samples failed for TCLP lead.
- A good correlation exists between TCLP arsenic and total arsenic. A total arsenic concentration greater than 0.38% should fail the TCLP. On average 2.5% of the total arsenic leached in the TCLP. Some correlation also exists for Hg.

1.0 INTRODUCTION AND BACKGROUND

The Red Devil mine and processing mill in Red Devil Alaska is earmarked for remediation. This facility mined mercury ore (cinnabar) and converted the mercury sulfide to the metallic state in an on-site retort. The mine and mill has been shut down since 1981 and since then has been the subject of several environmental studies which are summarized in a recent Harting ESE report ("Conceptual Solid Waste Management Plan", 4/30/01).

Metals Treatment Technologies, LLC, Wheat Ridge, Colorado has been retained by Wilder Corporation to conduct an on-site and laboratory characterization of various samples from many locations on the site. This charaterization will then be the basis for completing a laboratory program designed to chemically stabilize the RCRA metals As, Hg, and Pb to TCLP criteria. The results from the laboratory program will then be used to design and perform an on-site remediation. While these samples provide an opportunity to assess overall contamination levels of the waste stream components, they are not adequate in themselves for establishing a comprehensive site characterization, MT2recommends that this treatability study data be considered in conjunction with previous characterization data.

The information in this report is the laboratory characterization phase of the program. The results of the on-site characterization were outlined in a previous report (" Field Sampling Report", Nov. 13, 2001). The laboratory treatability/stabilization phase of the program has just been initiated and is scheduled to be completed on Feb. 29, 2002. The final treatability report which will delineate the remediation chemicals and application mode will be issued on March 15, 2002 and the on site remediation will begin next spring.

2.0 SAMPLE CHARACTERIZATION

2.1 Sample Descriptions

Mr. Paul DeWitt, MT2, visited the Red Devil site October 16 and 17, 2001 and completed a site characterization. The results of this study are presented in a recent MT^2report (" Field Sampling Report", Nov. 13, 2001). At that time he collected 27 samples for the laboratory phase of the site characterization. The samples were collected on a day when the site and the weather were wet and consequently the samples were all damp. Approximately 1-2 lbs. of each sample was triple bagged and shipped to the MT2laboratory in Wheat Ridge Colorado. The samples arrived in good order and were logged in and given a MT^2laboratortry number.

Samples from all the waste types outlined in Table 5.1 of the earlier Harding ESE Report (4/30/01) were received. A brief description of all the samples, the MT2 laboratory sample number, and the waste type are presented in Table 1, below.

TABLE 1 SITE SAMPLE DESCRIPTIONS

MT2 Lab Sample No.	Waste Type	Sample Description
10--5	Retort Bldg. Foundation	Drilling dust from Foundation- Retort Drillings by URS
10--6	Retort Furnace Slag	Soil- like slag sample. NE end of retort. URS RDSlag-01
10--7	Retort Building Debris	Soil from under retort bldg. Foundation+Debris north of foundation
10--8	As-Hg Impacted Soil	Material from hillside, HgS ore & slag
10--9	Pb-Impacted Building Debris	Scrapings from inside of cast iron pipe
10--10	Retort Building Debris	Wood, middle of debris pile
10--11	Retort Furnace Slag	Slag, purple color
10--12	As-Hg Impacted Soil	Soil from As-Hg Impacted Soil
10--13	As-Hg Impacted Soil	From Fuel Tanks, north
10--14	As-Hg Impacted Soil	Soil, down gradient sample
10--15	Pb-Impacted Building Debris	Soil debris pile along road to retort
10--16	Pb-Impacted Soil	Soil midway from retort ops and settling pond
10--17	Pb-Impacted Soil	Soil near old chemical storage bldg.
10--18	Pb-Impacted Soil	Soil, center of sedimentation pond
10--19	Warehouse	Soil, for Warehouse, west side
10--20	As-Hg Impacted Soil	Soil, near shop debris and shaft
10--21	Pb-Impacted Soil	Soil, Pb impacted between old chemical /powerhouse bldgs.
10--22	Retort Building Debris	Soil, slag and dump area, down gradient (PCB's?)
10--23	As-Hg Impacted Soil	Soil, down-gradient SE of pond
10--24	Retort Building Debris	Soil, under fines old retort furnace
10--25	Mess Hall Bunkhouse	Soil, down-gradient mess hall/bunk
10--26	Houses	Soil, down-gradient from House # 3
10--27	Houses	Soil, incl. Roof/floor debris between Houses # 5, #1
10--28	Refractory Bricks	Stored Brick from retort bldg. foundation
10--29	Refractory Bricks	Furnace brick from pile under chemical bldg., green
10--30	Refractory Bricks	Furnace brick down-gradient of retort
10--31	Ore	Ore sample, orange from bank above retort /silo

2.2 Totals Analyses by NitonX-ray Fluorescence (XRF)

2.2.1 Sample Preparation

All 27 samples arrived in plastic bags in good order. The sample preparation procedures for the totals analyses by Niton X-ray determinations are presented below for soil, bricks, and wood.

- Soil and soil-like samples-- Blend in the bags and break up any lumps larger then 3/8 inches.
- Bricks (MT^2#10-28, -29, -30)—Present as-received surfaces, filed (1/16 inch deep) surfaces, and inner sections of broken bricks to the X-ray beam.
- Wood ($MT^2$10—9)—Present as-received, filed (1/16 inch deep), and cut end-on surfaces to the x-ray beam.

2.2.2 Niton Determinations

2.2.2.1 Procedure

The determination of total metal concentrations in site samples is necessary for correlation to TCLP results, health and safety needs, and planning a laboratory stabilization program. Total assays are normally determined by fixed lab, wet analytical techniques which are time consuming and can lead to inaccurate results because of the small sample that is run. A newer technique was used by MT^2called X-ray fluorescence (XRF) which determines total metal concentrations in samples without sample dissolution and is consequently faster. The instrument utilized is a Niton Series 700 portable non-dispersive x-ray fluorescence unit.

Soil samples are measured with the Niton through the plastic sample bag. The calibrated Niton is pressed against a flat portion of the soil in the bag which is relatively rock-free and a 60 second reading taken. Usually 2 to 4 reading on different portions of the bag are carried out and the average is calculated. Readings for bricks and wood are taken by pressing the Niton against the side of the brick or the piece of wood. The reading are hand recorded as well as ported into a PC. The Niton instrument can measure up to 25 elements. Detection limits for the Niton are influenced by recording time, matrix, and element. Typical detection limits for a soil matrix for a 60 second reading are (ppm): As 100, Pb 70, Hg 70, Fe 1000, Mn 2200, Co 700, Ni 500, Cu 200, Zn 150.

The XRF instrument calibration is conducted so as to ensure the instrument delivers the most accurate results it can. The Niton is initially self-calibrated (and every hour thereafter). In addition a series of determinations of laboratory control samples (LCS) is completed to ensure that the instrument is operating correctly before site sample are run. All QA/QC data are maintained in MT^2 laboratory notebooks and computers.

2.2.2.2 Data for Lab Samples

A table of the averages of the results for all the site samples is presented in Table 2. The table lists the results for As, Hg, Pb, which are the elements of most interest; iron which is typically the highest concentration metal for these samples; as well as the next two highest concentration elements. (The results are presented as ppm or mg/kg. which can be converted to percent by moving the decimal point four places to the right.) Also listed is the natural pH of the sample. The RCRA TCLP pH method was used to measure the natural pH; that is, to slurry 5 gms. of sample in 96 mls. of water and measure the pH with a glass electrode.

The data show that the natural pH for most of the samples is in the neutral range (4.7 to 7.5); the average for the 27 samples is 6.4. Only the drilling dust from the retort foundation (which may contain caustic Portland cement) was significantly out of this range (11.8).

The totals assays show that there is significant As present on the site; the highest sample is 8.2% and the average for the 27 samples is 0.22 %. The amount of Hg (total) on site is rather low; the highest is 0.2 % and the average is 0.036%. The Pb totals are also low; the highest is 0.044% and the average of the 27 samples is 0.01%. All samples contain iron; the highest is 3%. Many of the sample contain Mn.

Because four samples were non-soil (bricks, wood) they were examined in more detail. Niton reading of all sides were recorded and the results averaged to give an indication of the surface metals content. In addition the sides were filed down (1/16 inch) and reread so as to give an idea of the amount of totals metal on the surface. A summary of this data is presented in Table 3 below and detailed results are presented in Appendix A.

TABLE 3 TOTAL ANALYSES OF BRICKS AND WOOD, ppm

MT² Lab No.	Waste Type	Description And Location	Not Scraped				Scraped			
			As	Hg	Pb	Fe	As	Hg	Pb	Fe
10—10	RBD	Wood, middle of debris pile	670	111	37	5.5K	160	34	11	0.9K
10—28	RB	Retort bldg. Foundation	1.4K	1214	64	8.8K	1404	386	68	7.3K
10—29	RB	Under chemical building	25.9	21	13	9.8K	69	86	28	9K
10--30	RB	Down-gradient of retort	56.7K	5.4K	0	17.1K	10.7K	2K	0	10.2K

Notes: RBD = Retort Building Debris; RF = Refractory Bricks

The data show that scraping the wood removed much of the As, Hg, Pb and Fe, indicating that much of the metals' contamination is on the surface. For the bricks from near the retort it appears the much of the Hg is on the surface, but for As its not as clear cut. For the brick from the chemical building it appears that the metal is scattered throughput the brick.

In order to get a direct idea of how contaminated the inside of the wood and brick are they were split and the totals metal determined on the exposed section. The data is presented in Table 4 below.

TABLE 4 NEWLY EXPOSED WOOD AND BRICK TOTAL ASSAYS

MT^2 Lab No.	Waste Type	Description And Location	Exposed Section Assays, ppm			
			As	Hg	Pb	Fe
10—10	RBD	Wood, middle of debris pile	481	0	0	4.1K
10—28	RB	Retort bldg. Foundation	179	29	89	5.3K
10—29	RB	Under chemical building	0	0	0	8.2K
10--30	RB	Down-gradient of retort	12.5K	0	0	5.4K

Notes: RBD = Retort Building Debris; RF = Refractory Bricks

The exposed section data shows for wood that no Hg or Pb is present inside the wood, however some As may be. For the bricks the data show that very little Hg or Pb are present within them. For As however two of the bricks show little As but one of the bricks does show some As.

2.3 Toxicity Characteristic Leaching Procedure(TCLP) Data

2.3.1 Sample Preparation and Procedure

The sample preparation procedures for the TCLP are:

- Soil and soil-like samples— Blend in the bags and break up any lumps larger then 3/8 inches.
- Wood (MT^2# 10-10)-- Sawed into ¼ inch sections and break-up with a chisel to pieces less than 3/8 inches. This is required by the TCLP procedure and wouldn't necessarily be stabilized in the field in this way.
- Bricks (MT#10-28, -29, -30)-- Score and slice off a ½ inch section and rubblize with a hammer in a plastic bag to less than 3/8 inches.

A short description of the US EPA TCLP is presented in Appendix B. The TCLP was run on all 27 samples and TCLP data is found in Table 5 and detailed TCLP data in Appendix C. The RCRA TCLP pass/fail criteria for the filtrate concentration is (ppm): Pb 5, As 5, Hg 0.2.

2.3.2 Data

The data in Table 5 show that only some of the samples are TCLP-hazardous. For As seven out of the 21 samples run are RCRA hazardous. Three samples are TCLP-hazardous for Hg. None are hazardous for Pb (zero out of 27).

3.0 DATA INTREPERATION

3.1 Sorting and Correlation of Totals and TCLP Data

3.1.1 As

Table 6 combines the Niton totals assays and TCLP data and sorts the totals As data in descending order. The following information is obvious:

(1.) A reasonable correlation exists between the total As and the TCLP As concentration, except for the ore which may contain the mineral AsFeS2 which wouldn't leach in the TCLP.
(2.) The highest As level (8.2%) is in the fines under the old retort furnace. The average value for all 27 samples was 0.22% As.
(3.) Seven of the 21 samples run failed the TCLP As criteria. Five are in the vicinity of the retort area, one near the chemical building, and one near the mess hall/bunk house, and one near the warehouse.
(4.) A total As level greater than 0.38% will generate a TCLP concentration > 5 ppm.
(5.) On average only 2.5 % of the total As present in the feed samples leached in the TCLP. The high iron level or the presence of the mineral arsenopyrite would account for this.

3.1.2 Hg

Table 7 combines the Niton totals assays and TCLP data and sorts the totals Hg data in descending order. The following information is obvious:

(1.) The highest total Hg levels are found in the retort area, the slag, bricks from the retort area, and As-Hg impacted soils (hillside, pond).
(2.) Only three of the 21 samples run for TCLP are RCRA TCLP-hazardous (6.09, 2.19, 0.26 ppm); they are from the highest Hg total samples and are from the retort area.
(3.) The average total Hg concentration for all 27 samples is 0.036%.
(4.) Seven samples are above 260 ppm Hg total including the ore sample.

3.1.2 Pb

Table 8 combines the Niton totals assays and TCLP data and sorts the totals Pb data in descending order. The following information is obvious:

(1.) No samples are RCRA TCLP hazardous of the 27 samples run. None are even close to the 5.0 ppm criteria.
(2.) The highest totals Pb sample is 0.045%. The average of all 27 samples is 0.01%.

(4.) The highest totals Pb samples are found in the mess hall/bunk house area, the warehouse area, scrapings from inside the pipe, the dump area, and the hillside area.

3.2 Placement of TCLP Data on the Site

Because a reasonable number of samples failed the TCLP for As, MT2will locate the samples on the site that failed the As TCLP tests. This will give the Ecobond field applicators an idea of what areas to focus on. The areas the samples were taken from that failed the TCLP for As are the retort area, the mess hall/bunk house area, and the warehouse. Details are listed below:

- Soil from under the retort
- Furnace brick down gradient of retort
- Debris north of retort
- Soil-like slag from NE end of retort
- Soil near old chemical storage building
- Soil from the warehouse area

The three samples which failed the TCLP for Hg are found around the retort area; two soils and a brick.

No samples failed the TCLP for Pb.

3.3 Environmental Interpretation of Data

It is not the objective of this report to interpret environmental regulations for the Red Devil site but in order to establish the stabilization formulations some target criteria must be known. MT2assumes that the RCRA TCLP goals are the stabilization targets; that is TCLP levels of (ppm): As 5, Hg 0.2, Pb 5.

The report issued by Harting ESE ("Conceptual Solid Waste Management Plan", 4/30/01) discusses the impact of environmental regulations and rulings for the Red Devil site. It appears that an on site landfill may be constructed and that the RCRA-hazardous waste placed in this landfill. We further assume that the RCRA TCLP criteria will still apply to this situation and that all waste must be stabilized to the RCRA TCLP criteria as stated above.

One item of note is the ruling under the LDR that any material greater than 260 ppm total Hg is classified as a "high level" waste and must be retorted. The Niton totals analyses found 7 samples that are above this level and presumably must be retorted. Most of these samples are from the retort area, one is ore material, and two are from the pond area and the hillside area. However, the site may be exempt from the LDR regulations and so the material may be disposed onsite in an engineered landfill and it is assumed that the RCRA TCLP criteria of 0.2 ppm applies to waste disposed in the on site landfill.

3.4 Correlation of Lab and On-site Totals Niton Data

The on-site totals analyses have been reported in the earlier MT^2 report(11/13/01, "Field Sampling Report"). A good correlation of these field results for As and Hg with the lab total analyses exists. Consequently these two data sets along with the existing data will be used to direct the lab stabilization and on site stabilization program. In addition these correlations will allow a determination of what site locations would fail the TCLP for As and Hg merely from on-site Niton XRF data. This will be useful during the remediation phase.

4.0 RAMIFICATIONS FOR THE LAB STABILIZATION PROGRAM

The samples that fail the RCRA criteria will be the primary targets for the laboratory stabilization study.

From the lab characterization study the metal which failed the TCLP the most and seems to be scattered over a reasonable area of the site is arsenic. MT^2 has had extensive experience in As stabilization and a lab program has already been formulated and initiated. Furthermore, because a large portion of the waste on site is in the form of a large debris pile, Ecobond-As in a liquid state will be included in the study. It appears that most of the As is on the surface of the wood and bricks and this fact will be used in the study.

A test program will be completed on three Hg TCLP-hazardous samples and a recommendation for application to areas that are suspected to contain Hg will be formulated. It is our experience the elemental Hg has limited solubility in the TCLP lixiviant unless there is an oxidant (eg., Fe(III)) in the TCLP leach solution or there is a large air-filled headspace in the TCLP leach vessel. This may account for the low number of samples that failed the TCLP for Hg even though shows of elemental Hg were seen on the site.

None of the samples failed the TCLP for Pb; in fact, none were even close to the 5.0 ppm TCLP criteria. Yet it is reported in previous literature that some sections of the site failed TCLP Pb. And so a stabilization formulation and application plan will be offered that can stabilize any areas that contain Pb.

Table 2
Red Devil XRF Totals Analyses

MT2 Site Sample No.(1)	MT2 Lab Sample No.(2)	Waste Type	Sample Description	Natural pH (3)	Totals Assay (Niton),ppm (4)					
					As	Hg	Pb	Fe	Other(6)	Other(6)
1	10--5	Retort Bldg. Foundation	Drilling dust from Foundation-Retort.Drilling by URS	11.82	76.1	24.55	<DL	12.5K	Sr - 152	
1A	10--6	Retort Furnace Slag	Soil- like slag sample.NE end of retort. URS RDSlag-01	4.76	7530	1955	<DL	25.2K	Cr - 6380	Ni - 3210
2	10--7	Retort Building Debris	Soil from under retort bldg. Foundation+Debris north of foundation	6.32	8270	970.5	<DL	15.0K	Ni - 1220	Zn - 379
3	10--8	As-Hg Impacted Soil	Material from hillside, HgS ore & slag	6.59	2605	1248	120	15.4K	Mn - 9.8K	
4	10--9	Pb-Impacted Building Debris	Wood, middle of debris pile	6.16	1008.5	109.4	111	24.0K	Zr - 166	Sr - 105.8
5	10--10	Retort Building Debris	Scrapings from inside of cast iron piping in debris pile	5.8	2435	82.6	199	21.0K	Zn - 132	
6	10--11	Retort Furnace Slag	Slag, purple color	6.68	1610	111.5	50.5	12.2K	Sr - 245	Zn - 62
7	10--12	As-Hg Impacted Soil	Soil from As-Hg Imapcted Soil	6.2	413.5	27.2	29.4	16.5K	Mn - 1069	Zr - 111
8	10--13	As-Hg Impacted Soil	From Fuel Tanks, north	6.3	487.5	60.5	35.5	14.6K	Mn - 1045	
9	10--14	As-Hg Impacted Soil	Soil, down gradient sample	5.4	503	63.55	41.1	16.1K	Mn - 751	
10	10--15	Pb-Impacted Building Debris	Soil debris pile along road to retort	5.09	197.5	<DL	21	12.1K	Mn - 759	
11	10--16	Pb-Impacted Soil	Soil midway from retort ops and settling pond	4.75	319.5	23	22.6	17.4K	Zr - 147	
12	10--17	Pb-Impacted Soil	Soil near old chemical storage bldg.	7.09	4570	74.85	<DL	20.9K	Zn - 293	Sr - 198
13	10--18	Pb-Impacted Soil	Soil, center of sedimention pond	6.33	3435	241	<DL	20.5K	Mn - 1700	
14	10--19	Warehouse	Soil, for Warehouse, west side	6.55	2270	135.5	325	17.3K	Mn - 1098	
15	10--20	As-Hg Impacted Soil	Soil, near shop debris and shaft	7.11	1625	68.65	33	17.1K	Mn - 1815	
16	10--21	Pb-Impacted Soil	Soil, Pb impacted between old chemical /powerhouse bldgs.	7.19	1560	63.1	<DL	18.5K	Mn - 645	
17	10--22	Retort Building Debris	Soil, slag and dump area, downgradient (PCB's?)	6.52	2505	426	173	17.7K	Mn - 1300	
18	10--23	As-Hg Impacted Soil	Soil, downgradient SE of pond	7.02	2690	502.5	<DL	18.0K	Mn - 1780	
19	10--24	Retort Building Debris	Soil, under fines old retort furnace	6.23	82.2K	250.5	<DL	29.5K	Mn - 2450	
20	10--25	Mess Hall Bunkhouse	Soil, downgradient messhall/bunk	6.17	3815	204.5	449	12.6K	Mn - 554	
21	10--26	Houses	Soil, downgraident form House # 3	6.06	2560	128.5	34	17.0K		
22	10--27	Houses	Soil, incl. Roof/floor debris betw. Houses # 5, 1	6.87	196.5	68.35	31.2	5305	Mn - 502	Zn - 73
23	10--28	Refractory Bricks	Stored Brick from retort bldg. foundation	6.22	84.8	<DL	30	9.4K	Cu - 666	Sr - 79.7
24	10--29	Refractory Bricks	Furnace brick from pile under chemical bldg., green	7.49	1904	64.9	59.5	7700	Sr - 510	Cu - 382
25	10--30	Refractory Bricks	Furnace brick downgradinet of retort	3.8	44.3K	1785	<DL	15.9K	Sr - 399	Mn - 2400
Ore	10--31	Ore	Ore sample, orange from bank above retort /silo	6.25	14.4K	264.5	<DL	11.3K	Mn - 965	
			AVERAGE	**6.4**	**2195**	**358**	**104**	**6503**		

Notes:

(1.) This is the sample number that Paul DeWitt placed on the samples as he collected them on site

(2.) This is sample number assigned to the sample in the MT2 laboratory.

(3.) The natural pH is measured by slurrying 5 gms. of the sample in 96 mls. of water and measureing the pH. This is the US EPA SW-846 TCLP procedure.

(4.) These assays are total metal concentrations in the sample as measure by a portable x-ray instrument (Niton, Series 700); they are the average of at least two measurements taken through the plastic sample bag.
Soil samples were blended in the bag and any lumps broken up before the measurement.
The ore sample (MT2 10--31) was crushed in the bag to minus 3/8 inch in the bag
Slices of the brick samples (MT2 10--28,-29,-30) were taken from the middle of the brick and crushed to minus 3/8 inch in a plastic bag.
The wood sample (MT2 10--10) was reduced minus 3/8 inch pieces with a saw and chisel.

(5.) These assays are AA determinations of the TCLP filtrates. Values in bold fail the RCRA hazardous waste criteria which is (ppm): As 5; Pb 5; Hg 0.2.

(6.) The "Other" columns contain Niton assay data for the highest and next highest total metals concentrations in the sample.

Table 5
TCLP Data

MT2 Site Sample No.(1)	MT2 Lab Sample No.(2)	Waste Type	Sample Description	TCLP Assays, ppm (3)			
				As	Hg	Pb	Pass/Fail
1	10--5	Retort Bldg. Foundation	Drilling dust from Foundation-Retort.Drilling by URS			0.20	
1A	10--6	Retort Furnace Slag	Soil- like slag sample.NE end of retort. URS RDSlag-01	**10.8**	**6.09**	0.00	**Fail-As/Hg**
2	10--7	Retort Building Debris	Soil from under retort bldg. Foundation+Debris north of foundation	**14.6**	**0.26**	0.30	**Fail-As/Hg**
3	10--8	As-Hg Impacted Soil	Material from hillside, HgS ore & slag	<0.5	0.015	0.00	
4	10--9	Pb-Impacted Building Debris	Scrapings from inside of cast iron piping in debris pile	2.0	0.15	0.50	
5	10--10	Retort Building Debris	Wood, middle of debris pile	3.0	0.17	1.10	
6	10--11	Retort Furnace Slag	Slag, purple color	1.5	0.02	0.70	
7	10--12	As-Hg Impacted Soil	Soil from As-Hg Imapcted Soil			0.20	
8	10--13	As-Hg Impacted Soil	From Fuel Tanks, north		0.043	0.30	
9	10--14	As-Hg Impacted Soil	Soil, down gradient sample		<0.01	0.30	
10	10--15	Pb-Impacted Building Debris	Soil debris pile along road to retort			0.30	
11	10--16	Pb-Impacted Soil	Soil midway from retort ops and settling pond			0.30	
12	10--17	Pb-Impacted Soil	Soil near old chemical storage bldg.	**10.6**	<0.01	0.00	**Fail-As**
13	10--18	Pb-Impacted Soil	Soil, center of sedimention pond	**4.0**	<0.01	0.60	
14	10--19	Warehouse	Soil, for Warehouse, west side	**5.5**	0.03	0.70	**Fail-As**
15	10--20	As-Hg Impacted Soil	Soil, near shop debris and shaft	<0.5	<0.01	0.00	
16	10--21	Pb-Impacted Soil	Soil, Pb impacted between old chemical /powerhouse bldgs.	<0.5	<0.01	0.00	
17	10--22	Retort Building Debris	Soil, slag and dump area, downgradient (PCB's?)	4.5	0.03	0.00	
18	10--23	As-Hg Impacted Soil	Soil, downgradient SE of pond	4.5	0.06	0.60	
19	10--24	Retort Building Debris	Soil, under fines old retort furnace	**32.0**	0.02	0.60	**Fail-As**
20	10--25	Mess Hall Bunkhouse	Soil, downgradient messhall/bunk	**10.0**	0.01	0.60	**Fail-As**
21	10--26	Houses	Soil, downgraident form House # 3	4.0	<0.01	0.50	
22	10--27	Houses	Soil, incl. Roof/floor debris betw. Houses # 5, 1	1.0	<0.01	0.50	
23	10--28	Refractory Bricks	Stored Brick from retort bldg. foundation	<0.5		0.10	
24	10--29	Refractory Bricks	Furnace brick from pile under chemical bldg., green	<0.5		0.06	
25	10--30	Refractory Bricks	Furnace brick downgradinet of retort	**48.8**	2.19	0.07	**Fail-As/Hg**
Ore	10--31	Ore	Ore sample, orange from bank above retort /silo	2.0	0.015	0.09	
			AVERAGES	**9.9**	**0.7**	**0.3**	

Notes:
(1.) This is the sample number that Paul DeWitt placed on the samples as he collected them on site
(2.) This is sample number assigned to the sample in the MT2 laboratory.
(3.) These assays are AA determinations of the TCLP filtrates. Values in bold fail the RCRA hazardous waste criteria which is (ppm): As 5; Pb 5; Hg 0.2.

E 6

Red Devil Lab Characterization Information

–Sort of As Data–

MT2 Site Sample No.(1)	MT2 Lab Sample No.(2)	Waste Type	Sample Description	Natural pH (3)	Totals Assay (Niton),ppm (4)						TCLP Assays, ppm			
					As	Hg	Pb	Fe	Other(6)	Other(6)	As	Hg	Pb	Pass/Fail
19	10–24	Retort Building Debris	Soil, under fines old retort furnace	6.23	82200	250.5	<DL	29.5K	Mn - 2450		32.0	0.02	0.60	Fail-As
25	10–30	Refractory Bricks	Furnace brick downgradinet of retort	3.8	44300	1785	<DL	15.9K	Sr - 399	Mn - 2400	48.8	2.19	0.07	Fail-As/Hg
Ore	10–31	Ore	Ore sample, orange from bank above retort /silo	6.25	14400	264.5	<DL	11.3K	Mn - 965		2.0	0.015	0.09	
2	10–7	Retort Building Debris	Soil from under retort bldg. Foundation+Debris north of foundation	6.32	8270	970.5	<DL	15.0K	Ni - 1220	Zn - 379	14.6	0.26	0.30	Fail-As/Hg
1A	10–6	Retort Furnace Slag	Soil- like slag sample.NE end of retort. URS RDSlag-01	4.76	7530	1955	<DL	25.2K	Cr - 6380	Ni - 3210	10.8	6.09	0.00	Fail-As/Hg
12	10–17	Pb-Impacted Soil	Soil near old chemical storage bldg.	7.09	4570	74.85	<DL	20.9K	Zn - 293	Sr - 198	10.6	<0.01	0.00	Fail-As
20	10–25	Mess Hall Bunkhouse	Soil, downgradient messhall/bunk	6.17	3815	204.5	449	12.6K	Mn - 554		10.0	0.01	0.60	Fail-As
13	10–18	Pb-Impacted Soil	Soil, center of sedimention pond	6.33	3435	241	<DL	20.5K	Mn - 1700		4.0	<0.01	0.60	
18	10–23	As-Hg Impacted Soil	Soil, downgradient SE of pond	7.02	2690	502.5	<DL	18.0K	Mn - 1780		4.5	0.06	0.60	
3	10–8	As-Hg Impacted Soil	Material from hillside, HgS ore & slag	6.59	2605	1248	120	15.4K	Mn - 9.8K		<0.5	0.015	0.00	
21	10–26	Houses	Soil, downgraident form House # 3	6.06	2560	128.5	34	17.0K			4.0	<0.01	0.50	
17	10–22	Retort Building Debris	Soil, slag and dump area, downgradient (PCB's?)	6.52	2505	426	173	17.7K	Mn - 1300		4.5	0.03	0.00	
5	10–10	Retort Building Debris	Wood, middle of debris pile	5.8	2435	82.6	199	21.0K	Zn - 132		3.0	0.17	1.10	
14	10–19	Warehouse	Soil, for Warehouse, west side	6.55	2270	135.5	325	17.3K	Mn - 1098		5.5	0.03	0.70	Fail-As
24	10–29	Refractory Bricks	Furnace brick from pile under chemical bldg., green	7.49	1904	64.9	59.5	7700	Sr - 510	Cu - 382	<0.5		0.06	
15	10–20	As-Hg Impacted Soil	Soil, near shop debris and shaft	7.11	1625	68.65	33	17.1K	Mn - 1815		<0.5	<0.01	0.00	
6	10–11	Retort Furnace Slag	Slag, purple color	6.68	1610	111.5	50.5	12.2K	Sr - 245	Zn - 62	1.5	0.02	0.70	
16	10–21	Pb-Impacted Soil	Soil, Pb impacted between old chemical /powerhouse bldgs.	7.19	1560	63.1	<DL	18.5K	Mn - 645		<0.5	<0.01	0.00	
4	10–9	Pb-Impacted Building Debris	Scrapings from inside of cast iron piping in debris pile	6.16	1008.5	109.4	111	24.0K	Zr - 166	Sr - 105.8	2.0	0.15	0.50	
9	10–14	As-Hg Impacted Soil	Soil, down gradient sample	5.4	503	63.55	41.1	16.1K	Mn - 751			<0.01	0.30	
8	10–13	As-Hg Impacted Soil	From Fuel Tanks, north	6.3	487.5	60.5	35.5	14.6K	Mn - 1045			0.043	0.30	
7	10–12	As-Hg Impacted Soil	Soil from As-Hg Imapcted Soil	6.2	413.5	27.2	29.4	16.5K	Mn - 1069	Zr - 111			0.20	
11	10–16	Pb-Impacted Soil	Soil midway from retort ops and settling pond	4.75	319.5	23	22.6	17.4K	Zr - 147				0.30	
10	10–15	Pb-Impacted Building Debris	Soil debris pile along road to retort	5.09	197.5	<DL	21	12.1K	Mn - 759				0.30	
22	10–27	Houses	Soil, incl. Roof/floor debris betw. Houses # 5, 1	6.87	196.5	68.35	31.2	5305	Mn - 502	Zn - 73	1.0	<0.01	0.50	
23	10–28	Refractory Bricks	Stored Brick from retort bldg. foundation	6.22	84.8	<DL	30	9.4K	Cu - 666	Sr - 79.7	<0.5		0.10	
1	10–5	Retort Bldg. Foundation	Drilling dust from Foundation-Retort.Drilling by URS	11.82	76.1	24.55	<DL	12.5K	Sr - 152				0.20	

Notes:
(1.) This is the sample number that the MT2 site rep., Paul DeWitt, placed on the samples as he collected them on site
(2.) This is sample number assigned to the sample in the MT2 laboratory.
(3.) The natural pH is measured by slurrying 5 gms. of the sample in 96 mls. of water and measureing the pH. This is the US EPA SW-846 TCLP procedure.
(4.) These assays are total metal concentrations in the sample as measure by a portable x-ray instrument (Niton, Series 700); they are the average of at least two measurements taken through the plastic sample bag.
Soil samples were blended in the bag and any lumps broken up before the measurement.
The ore sample (MT2 10–31) was crushed in the bag to minus 3/8 inch in the bag
Slices of the brick samples (MT2 10–28,-29,-30) were taken from the middle of the brick and crushed to minus 3/8 inch in a plastic bag.
The wood sample (MT2 10–10) was reduced minus 3/8 inch pieces with a saw and chisel.
(5.) These assays are AA determinations of the TCLP filtrates. Values in bold fail the RCRA hazardous waste criteria which is (ppm): As 5; Pb 5; Hg 0.2.
(6.) The "Other" columns contain Niton assay data for the highest and next highest total metals concentrations in the sample.

Conclusions:
(1.) A reasonable correlation exists between the tota As and the TCLP /as concentration, except for the ore which may contain the mineral AsFeS2 which wouldn't leach in the TCLP.
(2.) The highest As level (8.2%) is in the fines under the old retort furance.
(3.) Seven of the 27 samples failed the TCLP As criteria. Five are in the vicinity of the retort area, one near the chemical buiding, and one near the mess hall/bunk house.
(4.) A total As level greater than 0.38% will generate a TCLP concentration > 5 ppm.
(5.) On average only 2.5 % of the total As present in the feed samples leached in the TCLP. The high iron level or the presence of the mineral arsenopyrite would account for this.

TABLE 7
Red Devil Lab Characterization Information
--Samples Sorted by Hg--

MT2 Site Sample No.(1)	MT2 Lab Sample No.(2)	Waste Type	Sample Description	Natural pH (3)	Totals Assay (Niton),ppm (4)						TCLP Assays, ppm			
					As	Hg	Pb	Fe	Other(6)	Other(6)	As	Hg	Pb	Pass/Fail
1A	10--6	Retort Furnace Slag	Soil- like slag sample.NE end of retort. URS RDSlag-01	4.76	7530	1955	<DL	25.2K	Cr - 6380	Ni - 3210	10.8	6.09	0.00	Fail-As/Hg
25	10--30	Refractory Bricks	Furnace brick downgradinet of retort	3.8	44.3K	1785	<DL	15.9K	Sr - 399	Mn - 2400	48.8	2.19	0.07	Fail-As/Hg
3	10--8	As-Hg Impacted Soil	Material from hillside, HgS ore & slag	6.59	2605	1248	120	15.4K	Mn - 9.8K		<0.5	0.015	0.00	
2	10--7	Retort Building Debris	Soil from under retort bldg. Foundation+Debris north of foundation	6.32	8270	970.5	<DL	15.0K	Ni - 1220	Zn - 379	14.6	0.26	0.30	Fail-As/Hg
18	10--23	As-Hg Impacted Soil	Soil, downgradient SE of pond	7.02	2690	502.5	<DL	18.0K	Mn - 1780		4.5	0.06	0.60	
17	10--22	Retort Building Debris	Soil, slag and dump area, downgradient (PCB's?)	6.52	2505	426	173	17.7K	Mn - 1300		4.5	0.03	0.00	
Ore	10--31	Ore	Ore sample, orange from bank above retort /silo	6.25	14.4K	264.5	<DL	11.3K	Mn - 965		2.0	0.015	0.09	
19	10--24	Retort Building Debris	Soil, under fines old retort furnace	6.23	82.2K	250.5	<DL	29.5K	Mn - 2450		32.0	0.02	0.60	Fail-As
13	10--18	Pb-Impacted Soil	Soil, center of sedimention pond	6.33	3435	241	<DL	20.5K	Mn - 1700		4.0	<0.01	0.60	
20	10--25	Mess Hall Bunkhouse	Soil, downgradient messhall/bunk	6.17	3815	204.5	449	12.6K	Mn - 554		10.0	0.01	0.60	Fail-As
14	10--19	Warehouse	Soil, for Warehouse, west side	6.55	2270	135.5	325	17.3K	Mn - 1098		5.5	0.03	0.70	Fail-As
21	10--26	Houses	Soil, downgraident form House # 3	6.06	2560	128.5	34	17.0K			4.0	<0.01	0.50	
6	10--11	Retort Furnace Slag	Slag, purple color	6.68	1610	111.5	50.5	12.2K	Sr - 245	Zn - 62	1.5	0.02	0.70	
4	10--9	Pb-Impacted Building Debris	Scrapings from inside of cast iron piping in debris pile	6.16	1008.5	109.4	111	24.0K	Zr - 166	Sr - 105.8	2.0	0.15	0.50	
5	10--10	Retort Building Debris	Wood, middle of debris pile	5.8	2435	82.6	199	21.0K	Zn - 132		3.0	0.17	1.10	
12	10--17	Pb-Impacted Soil	Soil near old chemical storage bldg.	7.09	4570	74.85	<DL	20.9K	Zn - 293	Sr - 198	10.6	<0.01	0.00	Fail-As
15	10--20	As-Hg Impacted Soil	Soil, near shop debris and shaft	7.11	1625	68.65	33	17.1K	Mn - 1815		<0.5	<0.01	0.00	
22	10--27	Houses	Soil, incl. Roof/floor debris betw. Houses # 5, 1	6.87	196.5	68.35	31.2	5305	Mn - 502	Zn - 73	1.0	<0.01	0.50	
24	10--29	Refractory Bricks	Furnace brick from pile under chemical bldg., green	7.49	1904	64.9	59.5	7700	Sr - 510	Cu - 382	<0.5		0.06	
9	10--14	As-Hg Impacted Soil	Soil, down gradient sample	5.4	503	63.55	41.1	16.1K	Mn - 751			<0.01	0.30	
16	10--21	Pb-Impacted Soil	Soil, Pb impacted between old chemical /powerhouse bldgs.	7.19	1560	63.1	<DL	18.5K	Mn - 645		<0.5	0.01	0.00	
8	10--13	As-Hg Impacted Soil	From Fuel Tanks, north	6.3	487.5	60.5	35.5	14.6K	Mn - 1045			0.043	0.30	
7	10--12	As-Hg Impacted Soil	Soil from As-Hg Imapcted Soil	6.2	413.5	27.2	29.4	16.5K	Mn - 1069	Zr - 111			0.20	
1	10--5	Retort Bldg. Foundation	Drilling dust from Foundation-Retort.Drilling by URS	11.82	76.1	24.55	<DL	12.5K	Sr - 152				0.20	
11	10--16	Pb-Impacted Soil	Soil midway from retort ops and settling pond	4.75	319.5	23	22.6	17.4K	Zr - 147				0.30	
10	10--15	Pb-Impacted Building Debris	Soil debris pile along road to retort	5.09	197.5	<DL	21	12.1K	Mn - 759				0.30	
23	10--28	Refractory Bricks	Stored Brick from retort bldg. foundation	6.22	84.8	<DL	30	9.4K	Cu - 666	Sr - 79.7	<0.5		0.10	

Notes:
(1.) This is the sample number that Paul DeWitt placed on the samples as he collected them on site
(2.) This is sample number assigned to the sample in the MT2 laboratory.
(3.) The natural pH is measured by slurrying 5 gms. of the sample in 96 mls. of water and measureing the pH. This is the US EPA SW-846 TCLP procedure.
(4.) These assays are total metal concentrations in the sample as measure by a portable x-ray instrument (Niton, Series 700); they are the average of at least two measurements taken through the plastic sample bag.
Soil samples were blended in the bag and any lumps broken up before the measurement.
The ore sample (MT2 10--31) was crushed in the bag to minus 3/8 inch in the bag
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The wood sample (MT2 10--10) was reduced minus 3/8 inch pieces with a saw and chisel.
(5.) These assays are AA determinations of the TCLP filtrates. Values in bold fail the RCRA hazardous waste criteria which is (ppm): As 5; Pb 5; Hg 0.2.
(6.) The "Other" columns contain Niton assay data for the highest and next highest total metals concentrations in the sample.

Conclusions:
(1.) The highest total Hg levels are found retort area, slag, bricks from the retort area, and As-Hg impacted soils (hillside, pond).
(2.) Seven samples are above 260 ppm Hg total including the ore sample
(3.) Three samples were TCLP hazardous (>0.2 ppm) for Hg. They are soil from the retort area and from a brick down-gradient of the retort.
(4.) The highest totals are the highest TCLP, except for one sample (MT# 8, Hillside ore and slag).

Information:
(1.) If the total Hg is < 260 ppm, the waste is classified as " low level" waste and must be stabilized before disposing in a landfill.
(1.) If the total Hg is > 260 ppm, the waste is classified as " high level" waste and must be retorted before disposing in a landfill.

T[illegible]8

Red Devil Sample Characterization-Lab Data

--Pb Sort--

MT2 Site Sample No.(1)	MT2 Lab Sample No.(2)	Waste Type	Sample Description	Natural pH (3)	Totals Assay (Niton),ppm (4)						TCLP Assays, ppm			
					As	Hg	Pb	Fe	Other(6)	Other(6)	As	Hg	Pb	Pass/Fail
20	10--25	Mess Hall Bunkhouse	Soil, downgradient messhall/bunk	6.17	3815	204.5	449	12.6K	Mn - 554		10.0	0.01	0.60	Fail-As
14	10--19	Warehouse	Soil, for Warehouse, west side	6.55	2270	135.5	325	17.3K	Mn - 1098		5.5	0.03	0.70	Fail-As
5	10--10	Retort Building Debris	Wood, middle of debris pile	5.8	2435	82.6	199	21.0K	Zn - 132		3.0	0.17	1.10	
17	10--22	Retort Building Debris	Soil, slag and dump area, downgradient (PCB's?)	6.52	2505	426	173	17.7K	Mn - 1300		4.5	0.03	0.00	
3	10--8	As-Hg Impacted Soil	Material from hillside, HgS ore & slag	6.59	2605	1248	120	15.4K	Mn - 9.8K		<0.5	0.015	0.00	
4	10--9	Pb-Impacted Building Debris	Scrapings from inside of cast iron piping in debris pile	6.16	1008.5	109.4	111	24.0K	Zr - 166	Sr - 105.8	2.0	0.15	0.50	
24	10--29	Refractory Bricks	Furnace brick from pile under chemical bldg., green	7.49	1904	64.9	59.5	7700	Sr - 510	Cu - 382	<0.5		0.06	
6	10--11	Retort Furnace Slag	Slag, purple color	6.68	1610	111.5	50.5	12.2K	Sr - 245	Zn - 62	1.5	0.02	0.70	
9	10--14	As-Hg Impacted Soil	Soil, down gradient sample	5.4	503	63.55	41.1	16.1K	Mn - 751			<0.01	0.30	
8	10--13	As-Hg Impacted Soil	From Fuel Tanks, north	6.3	487.5	60.5	35.5	14.6K	Mn - 1045			0.043	0.30	
21	10--26	Houses	Soil, downgraident form House # 3	6.06	2560	128.5	34	17.0K			4.0	<0.01	0.50	
15	10--20	As-Hg Impacted Soil	Soil, near shop debris and shaft	7.11	1625	68.65	33	17.1K	Mn - 1815		<0.5	<0.01	0.00	
22	10--27	Houses	Soil, incl. Roof/floor debris betw. Houses # 5, 1	6.87	196.5	68.35	31.2	5305	Mn - 502	Zn - 73	1.0	<0.01	0.50	
23	10--28	Refractory Bricks	Stored Brick from retort bldg. foundation	6.22	84.8	<DL	30	9.4K	Cu - 666	Sr - 79.7	<0.5		0.10	
7	10--12	As-Hg Impacted Soil	Soil from As-Hg Imapcted Soil	6.2	413.5	27.2	29.4	16.5K	Mn - 1069	Zr - 111			0.20	
11	10--16	Pb-Impacted Soil	Soil midway from retort ops and settling pond	4.75	319.5	23	22.6	17.4K	Zr - 147				0.30	
10	10--15	Pb-Impacted Building Debris	Soil debris pile along road to retort	5.09	197.5	<DL	21	12.1K	Mn - 759				0.30	
1	10--5	Retort Bldg. Foundation	Drilling dust from Foundation-Retort.Drilling by URS	11.82	76.1	24.55	<DL	12.5K	Sr - 152				0.20	
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13	10--18	Pb-Impacted Soil	Soil, center of sedimention pond	6.33	3435	241	<DL	20.5K	Mn - 1700		4.0	<0.01	0.60	
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18	10--23	As-Hg Impacted Soil	Soil, downgradient SE of pond	7.02	2690	502.5	<DL	18.0K	Mn - 1780		4.5	0.06	0.60	
19	10--24	Retort Building Debris	Soil, under fines old retort furnace	6.23	82.2K	250.5	<DL	29.5K	Mn - 2450		32.0	0.02	0.60	Fail-As
25	10--30	Refractory Bricks	Furnace brick downgradinet of retort	3.8	44.3K	1785	<DL	15.9K	Sr - 399	Mn - 2400	48.8	2.19	0.07	Fail-As/Hg
Ore	10--31	Ore	Ore sample, orange from bank above retort /silo	6.25	14.4K	264.5	<DL	11.3K	Mn - 965		2.0	0.015	0.09	

Notes:
(1.) This is the sample number that Paul DeWitt placed on the samples as he collected them on site
(2.) This is sample number assigned to the sample in the MT2 laboratory.
(3.) The natural pH is measured by slurrying 5 gms. of the sample in 96 mls. of water and measureing the pH. This is the US EPA SW-846 TCLP procedure.
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The wood sample (MT2 10--10) was reduced minus 3/8 inch pieces with a saw and chisel.
(5.) These assays are AA determinations of the TCLP filtrates. Values in bold fail the RCRA hazardous waste criteria which is (ppm): As 5; Pb 5; Hg 0.2.
(6.) The "Other" columns contain Niton assay data for the highest and next highest total metals concentrations in the sample.

Conclusions:
(1.) No samples are RCRA TCLP hazardous of the 27 samples run. None are even close to the 5.0 ppm criteria.
(2.) The highest totals Pb samples are found in the messhall/bunk house, warehouse, scrapings from inside the pipe, the dump area, and the hillside.

APPENDIX A

Red Devil, Niton Readings, Brick and Wood Surface Samples

MT2 Sample No. Sample Section	Total Metals Analyses, Niton, ppm									
	Not Scraped					Scraped				
Top	As	Hg	Pb	Fe	Other	As	Hg	Pb	Fe	Other
10--10	869	108	44	7320	Ni-254	128	35	25	1630	Zn-148
10--28	809	82	91	7560	Sr-365	2370	106	0	9130	Sr-347
10--29	422	66	0	9570	Cu-136K	88	0	47	8930	Cu-5690
10--30	69300	5190	0	18500	Ni-35.2K	10700	358	0	12200	Zn-338
Bottom	As	Hg	Pb	Fe	Other	As	Hg	Pb	Fe	Other
10--10	1080	192	77	9500	Zn-153	97	32	0	900	Cu-68.4
10--28	1360	163	0	6940	Zr-504	135	71	123	5530	Mn-761
10--29	354	0	0	10900	Cu-82K	58	0	91	10.1K	Cu-16.1K
10--30	20200	4180	0	15800	Ni-49.1K	55.6K	2970	0	12.9K	Sr-357
Side-1	As	Hg	Pb	Fe	Other	As	Hg	Pb	Fe	Other
10--10	1040	182	63	8450	Zn-291	283	42	0	639	Zn-311
10--28	474	48	82	14300	Sr-504	358	65	103	12.2K	Mn-2290
10--29	142	0	0	9320	Cu-8200	0	0	0	9110	Cu-2440
10--30	50300	3080	0	14300	Sr-456	43.1K	2450	0	12.1K	Sr-376
Side-2	As	Hg	Pb	Fe	Other	As	Hg	Pb	Fe	Other
10--10	229	37	0	1380	Zn-80.5	99	28	0	355	Zn-60.2
10--28	3300	5560	0	8980	Sr-364	3950	1600	0	7210	Mn-3390
10--29	375	0	0	8770	Cu-42.7K	197	258	0	12.9K	Cu-21.6K
10--30	60500	7720	0	20500	Sr-624	114K	2570	0	14.7K	Sr-565
End-1	As	Hg	Pb	Fe	Other	As	Hg	Pb	Fe	Other
10--10	135	35	0	745	Zn-100	191	33	29	969	Zn-114
10--28	1280	219	147	6010	Zr-1060	210	86	114	7510	Sr-413
10--29	0	37	66	10400	Cu-25K	0	172	0	11.9K	Cu-16.5K
10--30	83000	6690	0	16600	Ni-26.1K	38.1K	1700	0	8270	Sr-404
End On(Exposed)	As	Hg	Pb	Fe	Other					
10--10	481	0	0	4100	N/A					
10--28	179	29	89	5320	Mn-699					
10--29	0	0	0	8200	Cu-933					
10--30	12500	0	0	5350	Sr-281					
Averages,sides	As	Hg	Pb	Fe	Other	As	Hg	Pb	Fe	Other
10--10	671	111	37	5479		159	34	11	899	
10--28	1445	1214	64	8758		1405	386	68	7345	
10--29	259	21	13	9792		69	86	28	9020	
10--30	56660	5372	0	17140		10700	2010	0	10235	

APPENDIX B

US EPA
Toxicity Characteristics Leaching Procedure (TCLP)

1.0 Background

MT^2 follows EPA's SW-846 Method No. 1311 "Toxicity Characteristic Leaching Procedure" (TCLP) exactly but since the MT2 test program only deals with inorganics, only a portion of the EPA TCLP method is utilized and so an abbreviated version is presented below which is easier to follow.

2.0 Safety

Wear safety glasses and lab coats.

3.0 Assumptions

All MT2 samples are assumed to contain no free liquids, are less than 3/8 inches in size, and only will be assayed for metals.

4.0 Apparatus, Equipment, and Reagents

Because only metals are considered, all TCLP leaches can be conducted in 1.0 liter plastic wide-mouth bottles.
The TCLP bottles are rotated in a 5-gal. bucket on rollers which are normally used to complete gold ore leaching tests.
The filtration device is the method 1311 recommended glass device with a glass frit.
The filter paper as recommended in the method (Table 5) is a glass fiber filter having a pore size of 0.7 microns.
Reagent grade acetic acid and sodium hydroxide pellets are used. Both solution # 1 and # 2 are prepared. Solution # 1 is prepared by adding 22.8 mls of glacial acetic acid to about 2 liters of DI water, adding 257 mls. of 1 M NaOH (ie., 40 g/l NaOH), mixing, and bringing the volume to 4.0 liters with DI water, mixing, and measuring the pH. The pH should be 4.93 +- 0.05. Solution # 2 is prepared by adding 22.8 mls. of glacial acetic acid to about 2 liter of DI water, mixing, and bringing the volume to 4.0 liter with DI water. The pH should be 2.88_- 0.05.

5.0 Procedure

5.1 Acid Test: Before the TCLP can be run the "acid test" must be run on the feed material in order to determine which leach solution (# 1 or # 2) must be used. Weigh 5.0 gms of feed into a beaker, add about 96 mls. of DI water, stir vigorously with a magnetic stir bar for at least 3 minutes and measure the pH. If the pH is less than 5.0 then TCLP solution # 1 is used. If the pH is greater than 5.0, then add 3.5 mls. of 1M HCl solution to the slurry, mix at least 3 minutes and measure the pH. If the pH is less than about 4.0 then use solution # 1. If greater than 4.0 heat the slurry to

50 C, mix at least 3 minutes, cool to room temperature and re-measure the pH. If less than 5 use solution #1, if greater than 5 use solution # 2.

5.2 TCLP Extraction: Transfer 40.0 gms (Note 6) of the blended sample to a 1.0 liter wide-mouth plastic bottle (Note 7). Add 0.80 liters of the appropriate leaching solution (# 1 or # 2) as determined by the "acid test". Place the tightly capped bottles into a 5-gal pail perpendicular to the long axis so the bottles rotate end over end. Fill the pail (Note 8) with plastic bottles. Place on the rolls, start the rolls and roll for 18 hrs. (overnight). Remove the sample bottles, allow the solids to settle, and pour a portion of the supernatant (say 100 mls.) into the vacuum filter apparatus containing the 7-micron glass fiber filter paper. Measure the pH and perhaps the EMF and note the filtrate color. Add 1:1 HNO3 to the filtrate to a pH of 2.0+-0.3 and assay for the desired analytes.

Appendix C
Red Devil TCLP Lab Data

No.	MT2 Test Number	Feed ID		pH Data			TCLPLeach Info			TCLP Filtrate Data					
		Client Description	MT2 Sample Number	Natural pH of Sample	HCl, 1M RT	HCl, 1M Heat/RT	Sample Wt.Gms.	Solution Vol.	TCLP Leach Solution No.	Filtrate pH	Filtrate EMF mv(2)	Filtrate Color	Metals Conc.(1) Pb ppm	Metals Conc.(1) As ppm	Metals Conc.(1) Hg ppm
1	4-78-1	1	10-5	11.82	9.98	3.23	40.00	0.80	1	11.85	149	n/a	0.20		
2	4-78-2	1A	10-6	4.76			40.00	0.80	1	4.93	505	n/a	0.00	10.8	6.09
3	4-78-3	2	10-7	6.32	1.62		20.00	0.40	1	5.25	315	n/a	0.30	14.6	0.26
4	4-78-4	3	10-8	6.59	1.59		40.00	0.80	1	4.95	247	n/a	0.00	<0.5	0.02
5	4-78-5	4	10-9	6.16	1.50		40.00	0.80	1	5.01	482	n/a	0.50	2	0.15
6	4-78-6	5	10-10	5.8	1.44		29.00	0.58	1	4.94	455	n/a	1.10	3	0.17
7	4-78-7	6	10-11	6.68	1.55		40.00	0.80	1	4.94	450	n/a	0.70	1.5	0.02
8	4-78-8	7	10-12	6.2	1.25		40.00	0.80	1	4.88	374	n/a	0.20		
9	4-78-9	8	10-13	6.3	1.14		40.00	0.80	1	4.86	451	n/a	0.30		0.04
10	4-78-10	9	10-14	5.4	1.34		40.00	0.80	1	4.91	510	n/a	0.30		<0.01
11	4-78-11	10	10-15	5.09	1.29		40.00	0.80	1	4.89	546	n/a	0.30		
12	4-78-12	11	10-16	4.75			40.00	0.80	1	4.89	542	n/a	0.30		
13	4-78-13	12	10-17	7.09	1.61		40.00	0.80	1	5.15	456	n/a	0.00	10.6	<0.01
14	4-78-14	13	10-18	6.33	1.39		40.00	0.80	1	5.02	442	n/a	0.60	4	<0.01
15	4-78-15	14	10-19	6.55	1.29		40.00	0.80	1	5.00	440	n/a	0.70	5.5	0.03
16	4-78-16	15	10-20	7.11	1.58		40.00	0.80	1	5.10	445	n/a	0.00	<0.5	<0.01
17	4-78-17	16	10-21	7.19	1.50		40.00	0.80	1	5.02	484	n/a	0.00	<0.5	<0.01
18	4-78-18	17	10-22	6.52	1.30		40.00	0.80	1	4.97	460	n/a	0.00	4.5	0.03
19	4-78-19	18	10-23	7.02	1.47		40.00	0.80	1	5.33	459	n/a	0.60	4.5	0.06
20	4-78-20	19	10-24	6.23	2.52		40.00	0.80	1	4.94	458	n/a	0.60	32	0.02
21	4-78-21	20	10-25	6.17	1.38		40.00	0.80	1	4.99	457	n/a	0.60	10	0.01
22	4-78-22	21	10-26	6.06	1.33		40.00	0.80	1	4.99	453	n/a	0.50	4	<0.01
23	4-78-23	22	10-27	6.87	4.83		40.00	0.80	1	6.57	419	n/a	0.50	1	<0.01
24	4-78-24	23	10-28	6.22	1.79		40.00	0.80	1	4.91	302	n/a	0.10	<0.5	
25	4-78-25	24	10-29	7.49	1.21		40.00	0.80	1	4.94	462	n/a	0.06	<0.5	
26	4-78-26	25	10-30	3.8			40.00	0.80	1	4.83	422	n/a	0.07	48.8	2.19
27	4-78-27	26	10-31	6.25	1.34		40.00	0.80	1	4.85	322	n/a	0.09	2	0.02

Note: (1.) Lab Assays completed by: Pb MT2(AA); As CTE (AA); Hg Hazen(cold vapor)
(2.) EMF measurements are taken vs. a Ag/AgCl reference electrode.

Sample Preparation:

MT2 #10--10: Saw off several boards 1/4 inch pieces. Reduce in size with a chisle to smaller pieces and add to the TCLP vessel.
MT2 #10--28: Scored and then broke off a slice of the brick (1/2 inch) from the middle broken section of the brick. Cruched this section to - 3/8 inch with a hammer in a plastic bag.
MT2# 10--29: Same as above.
MT2 #10--30: Same as above.
MT2 #10--31: This ore sample was crushed to -3/8 inch in a plastic bag with a hammer.