105049

Appendix 8-1

GEOLOGIC SITE INVESTIGATIONS

FOR

CONCEPTUAL EVALUATION OF

SURFACE WASTE CLEANUP

WELLINGTON - ORO MINE COMPLEX

BRECKENRIDGE, COLORADO

UNITED STATES BUREAU OF RECLAMATION
TECHNICAL SERVICE CENTER
DENVER, COLORADO

JULY 1997

CONCURRENCE

CONCEPTUAL EVALUATION OF
SURFACE WASTE CLEANUP

WELLINGTON - ORO MINE COMPLEX

Peer Reviewed by

Prepared by

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The Wellington-Oro mill processed ore onsite from 1908 to the 1950's. An estimated 55,000 yd^3 of mill tailings and 43,000 yd^3 of roaster fines are present on the site. These materials are exposed at the ground surface and were placed both on the north side of the valley above the water table and placed in the water table in French Creek. Approximately 20,000 yd^3 of the mill tailings are saturated and 17,000 yd^3 of the roaster fines are saturated. An unknown quantity of mine waste rock also remains on site above the groundwater table and an unknown quantity of dredge tailings remain in the valley floor within French Creek. Mine waste occurs as distinct, separate piles of mill tailings, roaster fines, and mine waste rock. For locations of mill tailings, roaster fines, and mine waste rock, refer to figure 1 in appendix 2.

III. SITE GEOLOGY

The geology of the Wellington-Oro mine and surrounding area was described by T. S. Lovering in the U.S. Geological Survey Professional Paper 176 (1934). The report incorporates a geologic map of the Breckenridge Mining District, as well as numerous geologic cross sections and maps of underground workings of the Wellington, Oro, and other nearby mines. Data on the mines came from files of mining companies operating during the late 1920's, or from Lovering's personal observation of underground workings. Most of these data are no longer available, as adits and shafts are flooded, caved, and no longer accessible. Mining company files may still be in existence which would provide data on the mine.

The workings penetrate a section of Jurassic-age (136 to 190 million years old) and Cretaceous-age (65 to 135 million years old) igneous rocks. The mines traverse about equal percentages of sedimentary and igneous intrusive rocks (monzonite porphyry). The sedimentary formations penetrated by the workings include, in ascending order, the Morrison Formation, Dakota Sandstone, Benton Shale, Niobrara Formation, and Pierre Shale.

The sedimentary strata and igneous intrusions are cut by a series of north-northeast trending faults. Three of these faults, the Bullhide, Great Northern, and 11-10 faults, occur in the study area.

Groundwater movement is essentially restricted to fractures in the rock and along tunnels, adits, and mine stopes and within the alluvium in French Creek.

IV. SITE INVESTIGATIONS

A. General Description

Field investigations were primarily conducted between October 8 and 24, 1996. The field work included:

- Ten hollow stem auger drill holes ranging up to 31.3 feet deep.
- Ten backhoe excavated test pits ranging from 8.2 to 11.0 feet deep.
- Four in-place density tests in four test pits.

- One hundred and thirty samples collected from 61 surface and near-surface sample sites ranging from 0 to 1.5 feet deep.

For locations of these investigations, refer to table 1. Locations of explorations are also shown in plan view in appendix 2 on figure 1, Sampling Location Map.

At least one auger hole was drilled at each mill tailing and roaster fines site to determine thickness of contaminated material, depth to ground water, depth to underlying natural material, and to collect samples suitable for laboratory testing. All auger holes were advanced to rock or refusal with a 3-inch-diameter hollow stem flight auger with samples collected continuously using 2.5- and 5.0-foot-long split-tube inner barrels. Photographs of sampling activities are included in appendix 1. Geologic logs of auger holes are included in appendix 3.

Ten test pits were excavated ranging from 8.2 to 11.0 feet deep (the limit of the equipment). Representative disturbed samples were obtained for use in laboratory testing including standard engineering properties and chemistry for heavy metals. In-place density tests were performed in four test pits. Geologic logs of test pits are included in appendix 3.

One hundred and thirty samples were collected from 61 surface and near-surface sample sites for use in laboratory testing for heavy metals to provide area and background concentrations across the Wellington-Oro Mine site. Originally, the surface samples were to be collected by others. Upon request by the EPA, Reclamation performed the sample collection activity. Results of these laboratory tests are presented in appendix 6.

The auger holes and surface and near surface samples were drilled, collected, and logged by drill crew, materials lab, and geologists from Reclamation's Technical Service Center. Test pits were excavated by personnel from Reclamation's Loveland Area Office; sampling, in-place testing density, and logging were performed by the Technical Service Center.

TABLE 1

EXPLORATION	LOCATION OF EXPLORATION
10 Auger Holes:	
2	Below Extenuate pile in dead tree area (completed as observation wells)
2	South tailings pond (south of French Gulch Road) (one hole was completed as an observation well)
4	North tailings pond (north of French Gulch Road) (two holes finished as observation wells)
2	Roaster fines, large pile (both holes completed as observation wells)
10 Test Pits:	
1	On top of Extenuate pile
1	Below Extenuate pile
1	South (lower) tailings pond
1	South tailings pond, west end
1	North (upper) tailings pond - west area
1	South French Gulch Road, west of Country Boy mine road
1	South French Gulch Road, east of Country Boy mine road
1	Upper tailings pile, northeast of Roaster fines
1	Upper tailings pile, near Oro shaft
1	Small Roaster fines pile
61 Surface/ Near Surface Sample Sites:	
17	Extenuate area
13	Upper tailings pile, northeast of Roaster fines pile
4	Shower site, east of Wellington mine, north of French Gulch Road
4	East of Extenuate area, north of French Gulch Road
2	Above School Bus site, east of Wellington mine
8	Union Mill, west of Wellington mine
2	Above Country Boy mine
2	Above old dredge on French Gulch Road, east of Wellington mine
6	In dredge deposit area in channel, downstream of Wellington mine
3	Wellington mine site, northeast of Roaster fines.

All surface and subsurface sampling sites, auger holes, and test pit locations were recorded in the field using GPS (Global Position System) technology, and field located

on existing topography. Rockwell Type HNV-560B radio receivers recorded northing, easting, and elevations in UTM (Universal Transverse Mercator) grid coordinates. Accesible drill hole locations were subsequently field located using conventional surveying techniques. GPS Position were adjusted based on the more accurative conventional surveys. Locations of explorations are shown on figure 1 in appendix 2.

B. Testing and Sampling

Materials testing of samples included the determination of soil gradation, natural moisture content, specific gravity, and consistency limits (Atterberg limits) for selected auger hole samples and for disturbed samples taken in test pits. Testing (ICP Scan) was performed to determine concentrations of heavy metals on 19 selected samples from the drill hole and test pit samples. For the geotechnical field explorations all materials and metals testing was performed by Reclamation's Technical Service Center. Results of all materials laboratory testing for standard engineering properties and chemistry laboratory testing are presented in appendices 4 and 5, respectively.

Material testing data in appendix 4 includes only gradations performed in accordance with Reclamation's USBR 5335-89 procedure. Materials data do not present soil consistency (Atterberg) limits of minus 200 sieve-size materials. Laboratory technicians experienced difficulty in performing satisfactory hydrometer tests on minus 200 materials from several samples collected from auger holes (B-WTU01DHAT-01 from 0 to 2.5 feet-, BWR02DHAT-01 from 9.2 to 11.7 feet-, BWR01DHAT-01 from 9.5 to 12.0 feet-, BEX01DH-01 from 13.2 to 13.6 feet- BWTL01DHST-01 from 2.5 to 4.4 feet-, and BWR02DHAT-01 from 4.3 to 6.7 feet-depths). The samples represent both mill tailings and roaster fines. While attempting to perform hydrometer tests, anomalous readings were recorded and a grey scum formed on the surface of the testing medium (sodium hexametaphosphate) that indicated a mineral or chemical in the samples formed a suspension. This sample behavior invalidated the hydrometer test results. Additional hydrometer tests were performed using distilled water as the testing medium.

SUMMARY

The field investigation program accomplished program goals. Subsurface samples of mill tailings, roaster fines, and mine waste rock were collected utilizing a hollow stem auger and backhoe-excavated test pits. Geotechnical data provided from these explorations includes standard engineering index properties of mill tailings, roaster fines, and natural in-place materials, moisture content, and thickness of materials. The geotechnical data provide more accurate estimation of waste quantity and estimated cleanup cost.

Metals analysis of surface and near-surface samples collected during the investigation provide both area background and site specific levels of heavy metals contamination at various locations in the project area. These data provide and indication of areal extent and level of existing contamination.

TABLE 2
SAMPLE INDEX

Locations of samples collected from drill holes and test pits.

SAMPLE IDENTIFIERS Materials	Chemistry	LOCATION	DEPTH (Feet)	DRILL HOLE OR TEST PIT
70C-1	J-8522	Upper Tailings Area	0.0 - 2.5	B-WTU01DHAT-01-961009
70C-2	-----		2.5 - 4.9	
70C-3	J-8523		4.9 - 7.4	
70C-4	-----		7.4 - 9.9	
70C-5	J-8524		9.9 -12.4	
70C-6	-----		12.4 - 13.5	
		Upper Tailings Area		B-WTU02DHAT-01-961009
70C-7	-----	Upper Tailings Area	0.0 - 2.5	B-WTU03DHAT-01-961009
70C-8	-----		No Depth	
70C-9	-----	Upper Tailings Area	0.0 - 2.5	B-WTU04DHAT-01-961009
70C-10	-----		2.5 - 4.5	
70C-11	-----	Roaster Fines Area	0.0 - 2.5	B-WR02DHAT-01-961010
70C-12	-----		2.5 - 4.3	
70C-13	J-8525		4.3 - 6.7	
70C-14	-----		6.7 - 9.2	
70C-15	J-8526		9.2 - 11.7	
70C-16	-----		11.7 - 14.2	
70C-17	-----		14.2 - 16.6	
70C-18	-----	Roaster Fines Area	0.0 - 2.5	B-WR01DHAT-01-961010
70C-19	J-8527		2.5 - 4.6	
70C-20	-----		4.6 - 7.0	
70C-21	-----		7.0 - 9.5	
70C-22	J-8528		9.5 - 12.0	
70C-23	-----		12.0 - 14.5	
70C-24	J-8529		14.5 - 16.7	
---------	-----		16.7 - 18.1	

SAMPLE IDENTIFIERS Materials	Chemistry	LOCATION	DEPTH (Feet)	DRILL HOLE OR TEST PIT
70C-25	-----	Extenuate Area	0.0 - 2. 4	B-EX01DHST-01- 961007
70C-26	J-8530		2.4 -4.7	
70C-27	-----		5.1 - 7.2	
70C-28	-----		7.2 - 9.7	
70C-29	J-8531		9.2 - 9.7	
70C-30	-----		9.7 - 10.6	
70C-31	-----		10.6 - 12.2	
70C-32	-----		12.2 - 13.2	
70C-33	J-8532		13.2 - 13.6	
70C-34	-----	Extenuate Area	0.0 - 2.4	B-EX02DHST-01- 961008
70C-35	-----		2.4 - 3.6	
70C-36	-----		3.6 - 4.7	
70C-37	-----		4.7 - 7.2	
70C-38	-----		7.2 - 9.7	
70C-39	-----		9.7 - 10.2	
70C-40	-----	Lower Tailings Area	0.0 - 2.5	B-WTL01DHST-01-961008
70C-41	J-8533		2.5 - 4.4	
70C-42	-----		4.4 - 7.3	
70C-43	-----		7.3 - 9.8	
70C-44	J-8534		9.8 - 12.3	
70C-45	-----		12.3 - 14.8	
70C-46	-----		14.8 17.3	
70C-47	-----		17.3 - 19.5	
70C-48	-----		19.5 - 19.8	
70C-49	J-8535		19.8 - 21.8	
70C-50	-----		21.8 - 22.3	
70C-51	-----		22.3 - 24.8	
70C-52	J-8536		27.3 - 29.8	
70C-53	-----		29.8 - 31.4	
70C-55	-----	Lower Tailings Area	17.0 - 19.0	B-WTL02DHST-01-961008
70C-56	-----		19.0 - 19.5	

SAMPLE IDENTIFIERS Materials	Chemistry	LOCATION	DEPTH (Feet)	DRILL HOLE OR TEST PIT
70C-57	-----	Near Oro Shaft, Above Roaster Fines Area	0.0 - 9.0	BWTU04TP01- 961010
70C-58 70C-59 70C-60	----- ----- J-8649 #1 of 5, J-8650 #4 of 5	Roaster Fines Area	5.5 .5 Various depths	BWTU10TP01- 961011
70C-61	-----	Near Oro Shaft, Above Roaster Fines Area	0.0 - 9.0	BWTU05TP01- 961010
70C-62 70C-63	J-8651 -----	Mill Tailings Area	0.0 - 2.0 2.0 - 4.5	BWTL09TP01- 961011
70C-64	-----	Mill Tailings Area	0.0 - 5.0	BWTL08TP01- 961010
70C-65 70C066	----- -----	Mill Tailings Area	0.0 - 3.5 3.5 - 11.0	BWTL07TP01- 961010
70C-67	-----	Above Roaster Fines Area	0.0 - 4.5	BWTL04TP01- 961010
70C-68 70C-69 70C-70 70C-71	----- ----- ----- -----	Mill Tailings Area	0.5 0.5 0.0 - 2.0 2.0 - 5.0	BWTL03TP01- 961010
70C-72 70C-73	----- J-8652	Mill Tailings Area	5.0 5.0	BWTL02TP01- 961009
70C-74	-----	Extenuate Area	0.0 - 9.0	BEX06TP01- 961010
70C-75 70C-76	----- -----	Extenuate Area	5.4 5.4	BEX01TP01- 961009

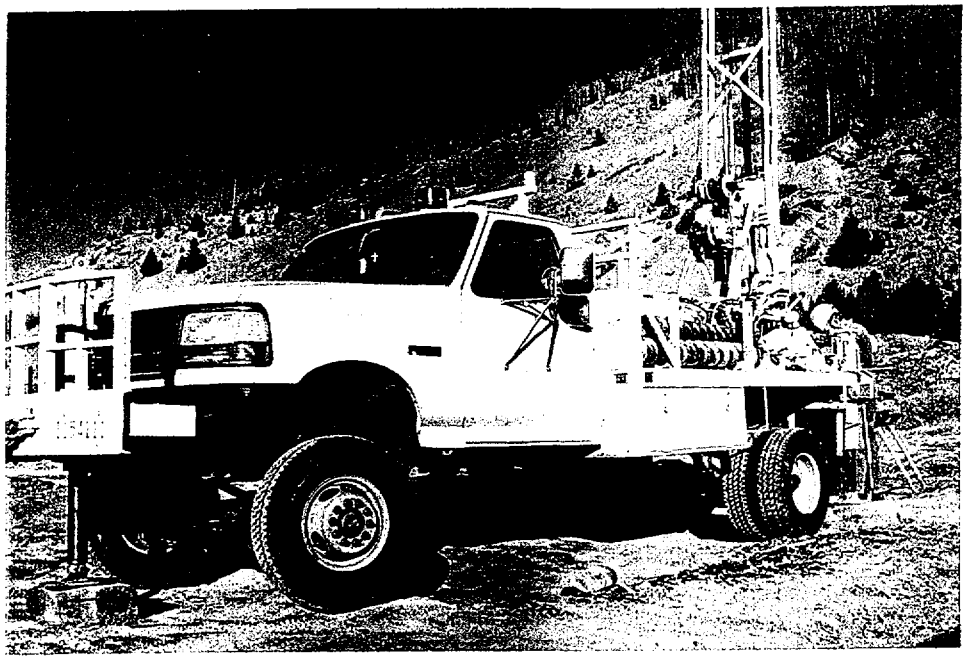
REFERENCES

[1] Lovering, T. S., 1934, Geology and Ore Deposits of the Breckenridge Mining District, Colorado, U.S. Geological Survey Professional Paper 176, 64 p.

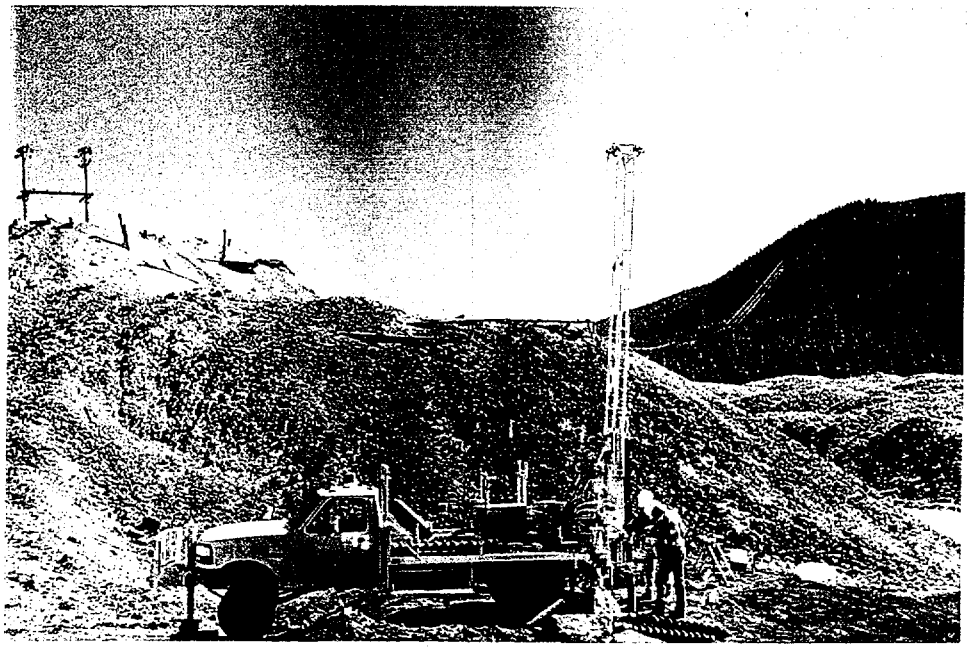
[2] Morrissey, Arthur M., April 1995 Groundwater Hydrology Characterization, French Gulch Mine Pool, Breckenridge, Colorado, 85 p.

[3] Stover, B., 1994 French Gulch Mine Encapsulation Project, Unpublished Internal Report, Colorado Division of Minerals and Geology.

APPENDIX 1 - PHOTOGRAPHS

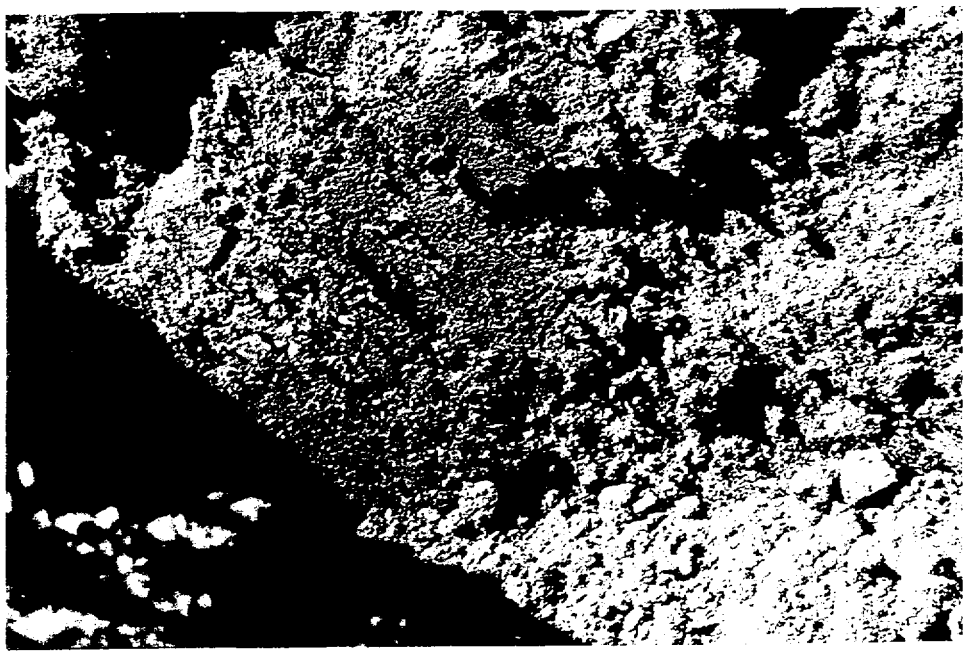


Photograph 1. CME 45 drill working at north tailings pond, Wellington-Oro Project.

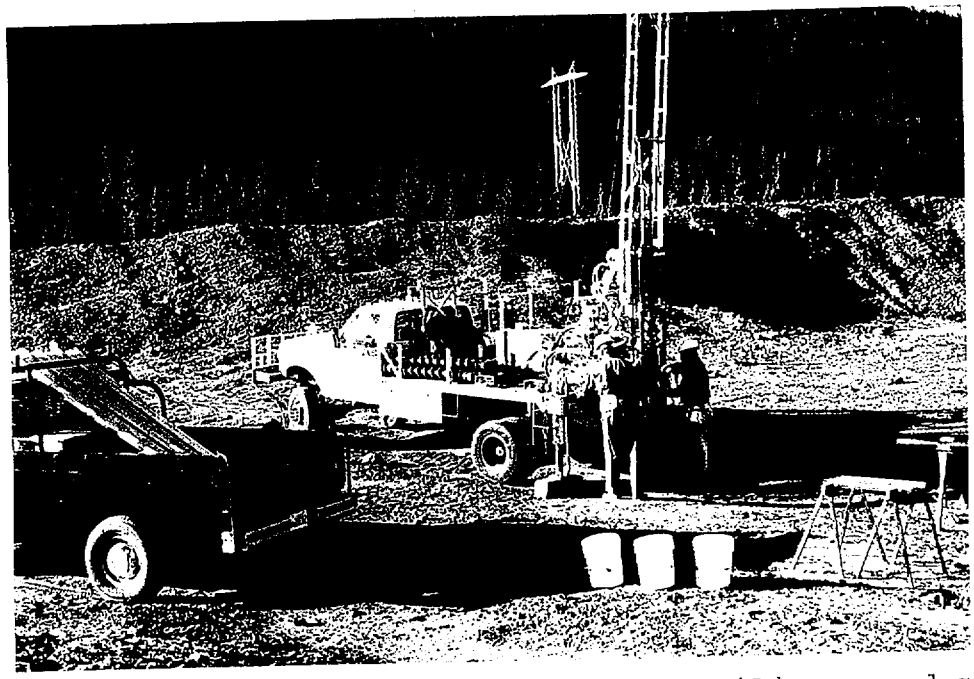


Photograph 2. Drilling on the large roaster fines pile at Wellington Mine.

Photograph 3. Backhoe opening small roaster fines pile, Wellington Mine site.

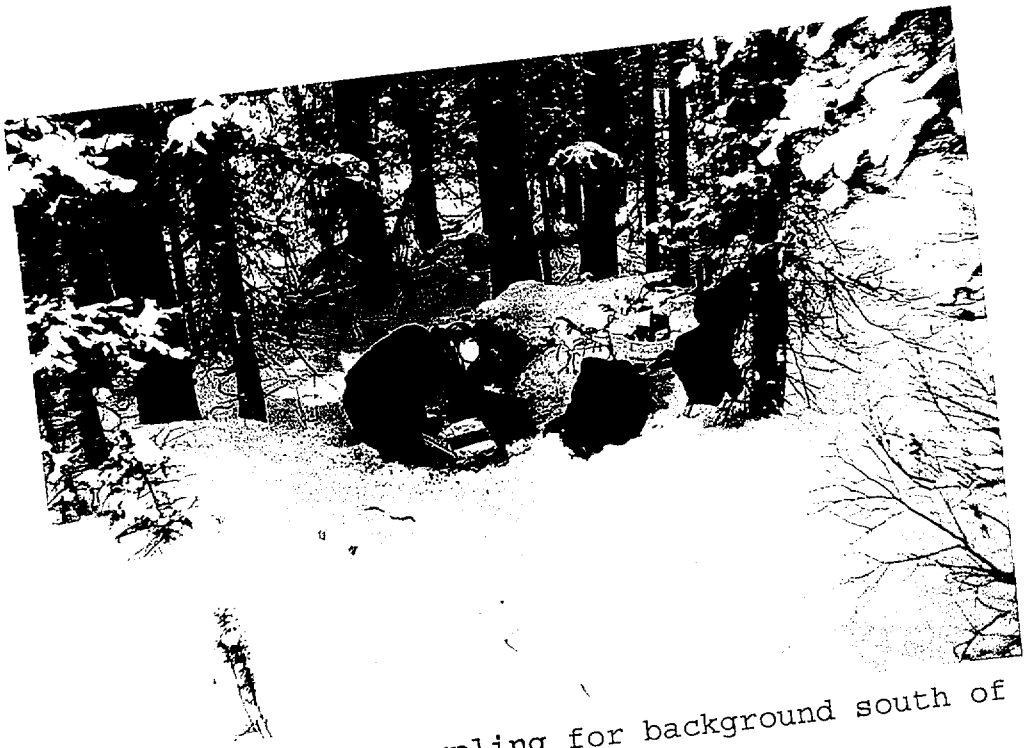


Photograph 4. Looking into excavation on small roaster fines pile.



Photograph 5. Drilling operation on south tailings pond south of Wellington Mine.

Photograph 6. Surface sampling below extenuate pile, west of Wellington Mine



Photograph 7. Surface sampling for background south of Wellington Mine site.

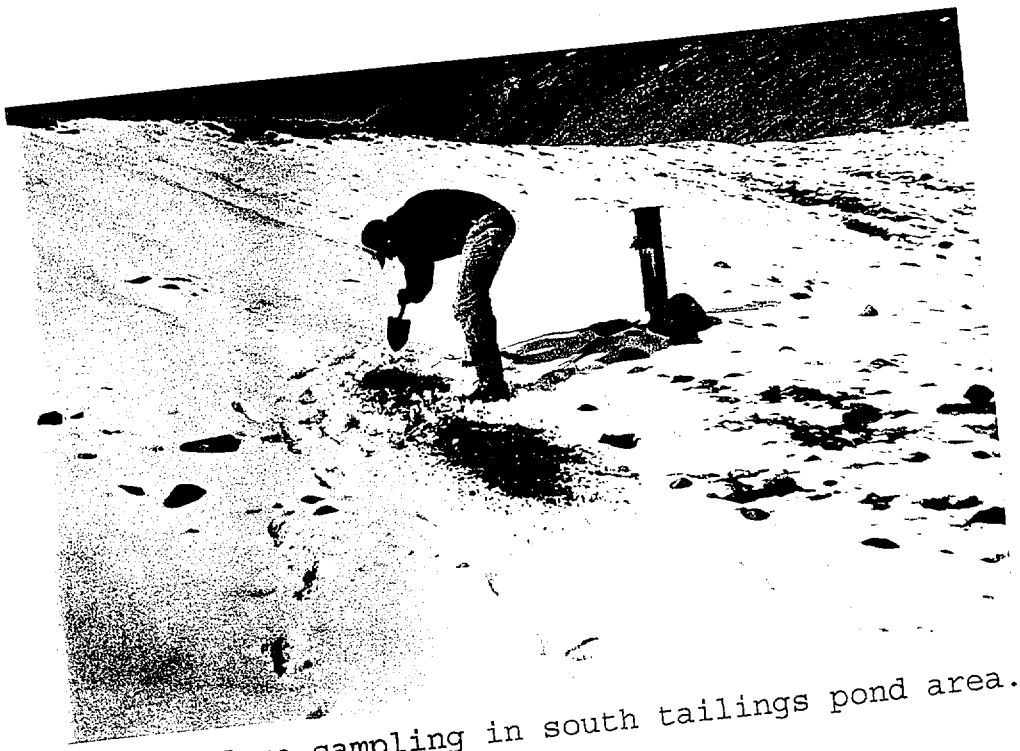


Figure 8. Surface sampling in south tailings pond area.

APPENDIX 2 - FIGURE 1

EPA REGION VIII
SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOC ID # 105049
PAGE #

IMAGERY COVER SHEET
UNSCANNABLE ITEM

Contact the Superfund Records Center to view this document.

SITE NAME French Gulch

OPERABLE UNIT

REPORT OR DOCUMENT TITLE Final Hydrogeologic Report Wellington-Ore Mine

DATE OF DOCUMENT May 1, 1999

DESCRIPTION OF IMAGERY Large Map

NUMBER AND TYPE OF IMAGERY ITEM(S) 1

APPENDIX 3 - GEOLOGIC LOGS

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 2 HOLE NO. B-EX01DH

FEATURE: Surface Waste Cleanup
AREA DESIGNATION: DEAD TREE AREA EXTENUATE SHAFT
COORDINATES: N 1601886 E 2856309
APPROXIMATE DIMENSIONS:
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: Wellington-Oro Mine
GROUND ELEVATION: 9945
METHOD OF EXPLORATION: CME 45 AUGER
LOGGED BY: LAUREL ROOD
DATE(S) LOGGED: 10-07-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
MH 2.4 ft.	0.0 - - 2.4 ft. GRAVELLY SILT WITH SAND: About 50% non-plastic fines with low toughness, no dry strength; about 30% fine; hard, subangular to angular gravel; about 20% fine sand. No reaction to HCL. In-place Condition: Moist, tan with some organic material present at surface. No obvious odor. Geological Interpretation: Mine waste.			
ML 5.1 ft.	2.4 - 5.1 ft. SILT WITH SAND: About 65% non-plastic fines with no dry strength, low toughness; about 20% coarse sand to 1/4 ", medium hardness, sub-angular; about 15% weathered subangular gravel. In-place Condition: Trace of cobbles (rock fragments); material is moist, reddish tan in color, no reaction to HCL and no odor. Geological Interpretation: Mine waste.			
ML 6.8 ft.	5.1 - 6.8 ft. SANDY SILT: About 65% non-plastic fines, no dilatancy, low toughness, low dry strength; about 35% subangular to angular, medium to coarse sand; no reaction to HCL, trace of gravel (rock fragments). In-place Condition: Reddish-brown, moist with no noticeable odor. Geological Interpretation: Mine waste.			
MH 7.2 ft.	6.8 - 7.2 ft. SILT: About 90% low plasticity fines, no dilatancy, medium toughness; about 10% fine to medium sand. No reaction to HCL. In-place Condition: Reddish tan, moist, no odor. Some small clay lenses were noted. Geological Interpretation: Mine waste.			
SM	7.2 - 9.2 ft. SILTY SAND WITH GRAVEL: About 50% fine to coarse sand to 1/4 inch, predominably subangular; about 30% non-plastic fines, no dry strength, low toughness; about 20% subangular fine gravel to maximum size 1/4". No reaction to HCL.			

REMARKS: Auger hole B-EX01DHST-01-961007

Hole completed as observation well; 2" ID PVC;

Depth to top of sand = 6.8'
Depth to top of screen = 7.8'

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 2 OF 2 HOLE NO. 8-EX01DH

FEATURE: Surface Waste Cleanup
AREA DESIGNATION: DEAD TREE AREA EXTENUATE SHAFT
COORDINATES: N 1601886 E 2856309
APPROXIMATE DIMENSIONS:
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: Wellington-Oro Mine
GROUND ELEVATION: 9945
METHOD OF EXPLORATION: CME 45 AUGER
LOGGED BY: LAUREL ROOD
DATE(S) LOGGED: 10-07-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
9.2 ft.	In-place Condition: Moist, with no odor. Geological Interpretation: Mine waste.			
MH 10.6 ft.	9.2 - 10.6 ft. SILT: About 90% non-plastic to low plasticity fines, none to low dry strength, low toughness; about 10% medium sand with some fine sand; no gravel. In-place Condition: Reddish in color, no odor. Geological Interpretation: Mine waste.			
MH 13.2 ft.	10.6 - 13.2 ft. SILT WITH SAND: About 80% non-plastic fines; no dry strength, low toughness, no dilatancy; about 20% fine sand; trace of fine gravel. No reaction to HCL. In-place Condition: Moist with no odor. Geological Interpretation: Mine waste.			
MH-CL 13.6 ft.	13.2 - 13.6 ft. SILT/LEAN CLAY: About 90% medium plasticity fines, medium dry strength, medium toughness, no dilatancy; about 10% very fine sand. No reaction to HCL. No gravel present. No reaction to HCL. In-place Condition: Moist, no odor, tan-brown in color. Geological Interpretation: Mine waste.			

REMARKS: Depth to bottom of screen = 12.8'

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 2 HOLE NO. B-EX02DH

FEATURE: Surface Waste Cleanup
PROJECT: Wellington-Oro Mine
AREA DESIGNATION: DEAD TREE AREA EXTENUATE SHAFT
GROUND ELEVATION: 9940
COORDINATES: N 1601757 E 2856172
METHOD OF EXPLORATION: CME 45 AUGER
APPROXIMATE DIMENSIONS:
LOGGED BY: LAUREL ROOD
DEPTH WATER ENCOUNTERED 1/: DATE:
DATE(S) LOGGED: 10-08-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
MH 2.4 ft.	0.0 - 2.4 ft. SILT: About 95% medium plasticity fines, low dry strength, slow dilatancy, medium toughness, contains same organics; about 5% hard, fine; subangular to angular sand; trace of gravel. In-place Condition: Moist, dark brown, slight organic odor. Geologic Interpretation: Mine waste.			
MH 3.6 ft.	2.4 - 3.6 ft. SANDY SILT: About 95% low plasticity fines; medium dry strength, no dilatancy, low toughness; about 5% fine to coarse sand, hard and subangular; trace of coarse gravel. In-place Condition: Color is ochre (tan), material is moist with no obvious odor, some small pockets of clayey material. Geologic Interpretation: Mine waste.			
CL 7.2 ft.	3.6 - 7.2 ft. SANDY LEAN CLAY: About 55% medium plasticity fines, low dry strength, no dilatancy, low toughness; about 35% fine to coarse sand, angular with medium hardness; about 10% medium hardness coarse gravel. In-place Condition: Ochre (tan) color, no odor, moist. Geologic Interpretation: Mine waste.			
ML 9.7 ft.	7.2 - 9.7 ft. SILT WITH SAND: About 80% medium plasticity fines, low dry strength, medium toughness and no dilatancy; about 20% medium to coarse hard sand; trace of gravel of 3/4" maximum. In-place Condition: Light brown, moist, no odor. Two small clay seams. Geologic Interpretation: Mine waste.			
CL	9.7 - 10.2 ft. SANDY LEAN CLAY: About 55% medium plasticity fines; medium dry strength, slow dilatancy; about 40% fine, medium, and coarse sand, subangular; about 5% subangular, coarse (to 1") gravel. In-place Condition: Moist, dark-brown, with no odor. Refusal, possibly at			

REMARKS: Auger hole B-EX02DHST-01-961008

Hole completed as observation well; 2" ID PVC;
Depth to top of sand = 3.7'
Depth to top of screen = 4.7'
Depth to bottom of screen = 9.7'

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 2 OF 2 HOLE NO. B-EX02DH

FEATURE: Surface Waste Cleanup
PROJECT: Wellington-Oro Mine
AREA DESIGNATION: DEAD TREE AREA EXTENUATE SHAFT
GROUND ELEVATION: 9940
COORDINATES: N 1601757 E 2856172
METHOD OF EXPLORATION: CME 45 AUGER
APPROXIMATE DIMENSIONS:
LOGGED BY: LAUREL ROOD
DEPTH WATER ENCOUNTERED 1/: DATE:
DATE(S) LOGGED: 10-08-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
10.2 ft.	bedrock. Medium-soft black shale fragments. Geologic Interpretation: Mine waste.			

REMARKS: Ground elevation estimated from Hole B-EX01DH1

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 2 HOLE NO. B-WR01DH

FEATURE: Surface Waste Cleanup
AREA DESIGNATION: N OF RD FROM COUNTRY BOY MINE
COORDINATES: N 1601173 E 2854667
APPROXIMATE DIMENSIONS:
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: Wellington-Oro Mine
GROUND ELEVATION: 9896.22
METHOD OF EXPLORATION: CME 45 AUGER
LOGGED BY: LAUREL ROOD
DATE(S) LOGGED: 10-10-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
SM 1.2 ft.	0.0 - 1.2 ft. SAND: About 100% fine to medium sand to approximately .08 in., medium hardness; traces of fines; no dry strength, low toughness, and no plastic. None to weak reaction to HCL. In-place Condition: Light brown in color, dry with strong processing odor. Geological Interpretations: Roaster fines (tailings).			
SM 2.5 ft.	1.2 - 2.5 ft. SAND: About 95% fine sand to .003 in.; trace to 5% nonplastic fines, with no dry strength, low toughness. Weak reaction to HCL. In-place Condition: Dry to somewhat moist with depth, dark brown with strong odor. Yellow fines bonded but can be powdered. Geological Interpretations: Roaster fines.			
SM 3.7 ft.	2.5 - 3.7 ft. SAND: About 95% fine to medium sand to .08 in. Trace to 5% nonplastic fines, with no dry strength in dilatancy and low toughness. No reaction to HCL. In-place Condition: Color grades with depth from light brown to darker. Material is moist with a strong odor. Some appearance of crystals in material. Geological Interpretations: Roaster fines.			
SM 12.0 ft.	3.7 - 12.0 ft. SAND: About 95% fine sand to .003 inc., about 5% nonplastic fines with no dry strength or dilatancy and low toughness. No reaction to HCL. In-place Condition: Black with strong sulphur ? odor. Geologic Interpretations: Roaster fines.			
CH	12.0 - 14.5 ft. FAT CLAY: About 90% fines with high plasticity and toughness, no dilatancy and very high dry strength; about 10% fine sand. No reaction to HCL.			

REMARKS: Auger hole B-WR01DHAT-01-961010

Hole completed as observation well; 2" ID PVC;
Depth to top of sand = 14.0'
Depth to top of screen = 14.1'
Depth to bottom of screen = 18.1'

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 2 OF 2 HOLE NO. B-WR01DH

FEATURE: Surface Waste Cleanup
AREA DESIGNATION: N OF RD FROM COUNTRY BOY MINE
COORDINATES: N 1601173 E 2854667
APPROXIMATE DIMENSIONS:
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: Wellington-Oro Mine
GROUND ELEVATION: 9896.22
METHOD OF EXPLORATION: CME 45 AUGER
LOGGED BY: LAUREL ROOD
DATE(S) LOGGED: 10-10-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
14.5 ft.	In-place Condition: Material is wet with strong, processing odor. Organics are evident, may be near natural ground. Geological Interpretations: Roaster fines.			
SC 16.7 ft.	14.5 - 16.7 ft. CLAYED SAND WITH GRAVEL: About 50% fine, medium, coarse sand to .19 in., hard, subangular to angular; about 30% fine, hard, subangular to angular gravel; about 20% medium to high plasticity; medium toughness, no dilatancy fines with high dry strength. No reaction to HCL. In-place Condition: Light brown with strong processing odor. Geological Interpretation: May be natural ground.			
Bedrock 18.1 ft.	16.7 - 18.1 ft. Bedrock: Recovered as rock chips, angular gravel to coarse sand. In-place Condition: medium to dark gray. Geological Interpretation: Bedrock			

REMARKS:

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 2 HOLE NO. B-WR02DH

FEATURE: Surface Waste Cleanup
AREA DESIGNATION: N OF RD FROM COUNTRY BOY MINE
COORDINATES: N 1601176 E 2854667
APPROXIMATE DIMENSIONS:
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: Wellington-Oro Mine
GROUND ELEVATION: 9896.08
METHOD OF EXPLORATION: CME 45 AUGER
LOGGED BY: LAUREL ROOD
DATE(S) LOGGED: 10-10-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
SM 4.3 ft.	0.0 - 4.3 ft. SAND: About 95% fine to medium sand to .08 in., about 5% nonplastic fines with no dilatancy or dry strength and low toughness. In-place Condition: Brown, moist with strong processing odor. Geological Interpretation: Roaster fines.			
SM 11.7 ft.	4.3 - 11.7 ft. SAND: About 95% fine sand to .003 in., about 5% nonplastic fines with no dilatancy and low toughness. In-place Condition: Dry to moist with depth, black with strong processing odor. Geological Interpretation: Roaster fines.			
MH 12.5 ft.	11.7 - 12.5 ft. SILTY SAND WITH GRAVEL: About 55% fine sand to about .19 in. in size; about 25% low to medium plasticty fines, low dry strength, medium toughness and no dilatancy; about 20% hard, fine subangular gravels. In-place Condition: Material wet, black, with strong processing odor. Geological Interpretation: Roaster fines.			
SW 14.2 ft.	12.5 - 14.2 ft. WELL GRADED SAND WITH GRAVEL: About 80% fine, medium and coarse sand to .19 in., about 20% hard, fine gravel; trace of nonplastic fines with none to slow dilatancy, no dry strength, and low toughness. No reaction to HCL. In-place Condition: Brown with strong processing odor. Geological Interpretation: Roaster fines.			
CH	14.2 0 16.6 ft. FAT CLAY: About 95% medium plasticity, fines, with high dry strength, no dilatancy, and medium toughness, about 5% fine sand to .003 in. . In-place Condition: Wet, brown in color with strong odor.			

REMARKS: Auger hole B-WR02DHAT-01-961010

Hole completed as observation well: 2" ID PVC:
Depth to top of sand = 6.1'
Depth to top of screen = 6.7'
Depth to bottom of screen = 11.7'

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 2 OF 2 HOLE NO. B-WR02DH

FEATURE: Surface Waste Cleanup
AREA DESIGNATION: N OF RD FROM COUNTRY BOY MINE
COORDINATES: N 1601176 E 2854667
APPROXIMATE DIMENSIONS:
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: Wellington-Oro Mine
GROUND ELEVATION: 9896.08
METHOD OF EXPLORATION: CME 45 AUGER
LOGGED BY: LAUREL ROOD
DATE(S) LOGGED: 10-10-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
16.6 ft.	Geological Interpretation: May be natural ground.			

REMARKS:

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 3 HOLE NO. B-WTL01DH

FEATURE: Surface Waste Cleanup
AREA DESIGNATION: 10' West of DWG DH #2
COORDINATES: N 1600885 E 2854465
APPROXIMATE DIMENSIONS:
DEPTH WATER ENCOUNTERED 1/: 13.1 DATE:

PROJECT: Wellington Oro Mine
GROUND ELEVATION: 9865
METHOD OF EXPLORATION: CME 45 AUGER
LOGGED BY: LAUREL ROOD
DATE(S) LOGGED: 10-08-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
SM 2.5 ft.	0.0 - 2.5 ft. SILTY SAND (TAILINGS): About 95% hard, subangular to angular medium sand; about 0-5% fines, with no plasticity, low toughness and rapid dilatancy; no reaction to HCL. In-place condition: Pale orange-brown, moist, with processing odor. Consistency soft with weak cementation. Abundant sand size pyrite particles. Geological Interpretation: Tailings.			
SM 4.0 ft.	2.5 - 4.4 ft. SILTY SAND: About 90% hard to moderately hard, subangular to angular medium sand; 10% nonplastic fines with no dry strength rapid dilatancy, and low toughness. No reaction to HCL. In-place Condition: Pale orange-brown in color, moist, with processing odor, upper portion from 1.2' contains some cemented lenses to 1.5" thick. Geological Interpretation: Tailings			
SM 19.5 ft.	4.4 - 19.5 ft. SILTY SAND: About 90% predominably medium with some coarse sand, subangular to angular, with some flat and elongated particles; about 10% non-plastic fines, with no dry strength, rapid dilatancy and low toughness. No reaction to HCL. In-place Condition: Water at about 12.1'. Finely disseminated pyrite particles evident to about 12.3'. Some small areas cemented. Material predominantly black, moist with processing odor. Water @13.1'. Geological Interpretation: Tailings.			
CL	19.5 - 19.8 ft. CLAY: About 90% medium to high plasticity fines, no dry strength, slow dilatancy, with medium toughness. About 10% fine to medium sand to 2 mm maximum size; trace of hard, fine to coarse subrounded to subangular gravels. No reaction to HCL. In-place Condition: Material wet, black in color with processing odor. Geological Interpretation: Tailings.			

REMARKS: Auger hole B-WTL01DHST-01-961008

Hole backfilled with native material

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 2 OF 3 HOLE NO. B-WTL01DH

FEATURE: Surface Waste Cleanup
AREA DESIGNATION: 10' West of DWG DH #2
COORDINATES: N 1600885 E 2854465
APPROXIMATE DIMENSIONS:
DEPTH WATER ENCOUNTERED 1/: 13.1 DATE:

PROJECT: Wellington Oro Mine
GROUND ELEVATION: 9865
METHOD OF EXPLORATION: CME 45 AUGER
LOGGED BY: LAUREL ROOD
DATE(S) LOGGED: 10-08-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
19.8 ft.				
SM 21.8 ft.	19.8 - 21.8 ft. SILTY SAND: About 95% fine to coarse sand to .4 inches, hard, with particles ranging from rounded to angular, with some flat and elongated; trace to 5% fines, non-plastic; with no dry strength, no dilatancy and low toughness. No reaction to HCL. In-place Condition: Material black, very wet with processing odor. Some organics mixed in with material. Geological Interpretation: Tailings.			
ML-CL 22.3 ft.	21.8 - 22.3 ft. CLAY: About 95% fines with low plasticity, low toughness, and none to slow dilatancy; about 5% hard, subangular mostly medium to coarse sand to "" with some fine sand; trace of hard, fine subangular to angular gravel. In-place Condition: Wet, black with processing odor, some organic material found. Geological Interpretation: Tailings.			
SP 24.8 ft.	22.3 - 24.8 ft. POORLY GRADED SAND: About 95% hard, subrounded to subangular sand, ranging from fine to coarse, to maximum size of 1/4", with no dry strength or dilatancy, medium toughness; about 5% predominately fine; subangular to angular gravel. No reaction to HCL. In-place Condition: Overall color gray, consisting of black, yellow (ochre), white particles; wet with processing odor. Geological Interpretations: Tailings.			
No Recovery 27.3 ft.	24.8 - 27.3 ft. NO RECOVERY			
SP	27.3 - 29.8 ft. POORLY GRADED SAND: About 95% fine, medium, through coarse sand to a maximum of 1/4", hard, subrounded to subangular, material is nonplastic, with medium toughness, no dry strength and no dilatancy; about 5% fine, hard, subangular to angular fine gravel. No reaction to HCL.			

REMARKS:

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 3 OF 3 HOLE NO. B-WTL01DH

FEATURE: Surface Waste Cleanup
AREA DESIGNATION: 10' West of DWG DH #2
COORDINATES: N 1600885 E 2854465
APPROXIMATE DIMENSIONS:
DEPTH WATER ENCOUNTERED 1/: 13.1 DATE:

PROJECT: Wellington Oro Mine
GROUND ELEVATION: 9865
METHOD OF EXPLORATION: CME 45 AUGER
LOGGED BY: LAUREL ROOD
DATE(S) LOGGED: 10-08-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
29.8 ft.	In-place Condition: Material grades from fine to medium sand with small gravel seam to coarse sand. Material wet, gray with black, yellow, white particles, and processing odor. Geological Interpretations: Tailings.			
GP 31.3 ft.	29.8 - 31.3 ft. POORLY GRADED GRAVEL WITH SAND: About 100% hard, surrounded to subangular, medium to coarse sand to 1/4", with some fine sand; trace of fines, material is nonplastic, with no dry strength, or dilatancy and low toughness. No reaction to HCL. In-place Condition: Particles are black, yellow, white, and wet. Bottom .4 is a poorly graded hard, angular to subangular gravel with some flat and elongated pieces. Geological Interpretations: Tailings.			

REMARKS:

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. B-WTL02DH

FEATURE: Surface Waste Cleanup
PROJECT: Wellington Oro Mine
AREA DESIGNATION: LOWER TAILINGS POND - 2ND HOLE
GROUND ELEVATION: 9865.6
COORDINATES: N 1600897 E 2854436
METHOD OF EXPLORATION: CME 45 AUGER
APPROXIMATE DIMENSIONS:
LOGGED BY: LAUREL ROOD
DEPTH WATER ENCOUNTERED 1/: DATE:
DATE(S) LOGGED: 10-07-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
No Sample 17.0 ft.	0.0 to 17.0 ft. NOT LOGGED (not sampled)			
SP 19.0 ft.	17.00 - 19.0 ft. POORLY GRADED SAND: About 100% fine sand with some medium sand to maximum of 2 mm, subrounded to subangular. In-place Condition: Material is wet with black, white particles, processing odor evident. Geological Interpretations: Tailings.			
CL 19.5 ft.	19.0 - 19.5 ft. LEAN CLAY: About 90% medium plasticity fines with medium dry, strength, no dilatancy, and low to medium toughness; about 5-10% fine sand. No reaction to HCL. In-place Condition: Material black in color and wet, processing order evident. Geological Interpretation: Tailings.			

REMARKS: Auger hole B-WTL02DHST-01-961008

Hole completed as observation well:
Depth to top of screen = 14.1'
Depth to bottom of screen = 19.1'
Depth to top of sand = 8.1'

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 2 HOLE NO. B-WTU01DH

FEATURE: Surface Waste Cleanup
AREA DESIGNATION: UPPER TAILINGS POND
COORDINATES: N 1601041 E 2854155
APPROXIMATE DIMENSIONS:
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: Wellington Oro Mine
GROUND ELEVATION: 9871.28
METHOD OF EXPLORATION: CME 45 AUGER
LOGGED BY: LAUREL ROOD
DATE (S) LOGGED: 10-09-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
ML 1.3 ft.	Top - 1.3 ft. SILT (TAILINGS): About 100% to low plasticity silt, with slow to rapid dilatancy, low dry strength and toughness; trace of fine sand. Weak to strong reaction to HCL. In-place Condition: Color gray, no detectable odor, material is dry. Geological Interpretation: Tailings.			
CL 2.5 ft.	Bottom - 2.5 ft. SANDY LEAN CLAY (TAILINGS): About 80% low plasticity day with medium dry strength, no dilatancy and medium toughness; about 20% extremely fine sand. No reaction to HCL. In-place Condition: Yellow (ochre) color with some black particles; weak processing odor, sandy fines and clay material mixed for testing. Pyrite particles present. Geological Interpretations: Tailings.			
ML 3.3 ft.	Top - 3.3 ft. SANDY SILT: About 100% nonplastic sandy silt with no dry strength, slow dilatancy and low toughness; trace of fine sand. No reaction to HCL. In-place Condition: Color is tan and material is moist with processing odor. Consistency is soft with no cementation. Geological Interpretations: Tailings.			
MH 7.4 ft.	3.3 - 7.4 ft. ELASTIC SILT (TAILINGS, SLIMES): About 100% medium plasticity elastic silt, with low toughness, slow dilatancy and low to medium dry strength. In-place Condition: Wet, dark gray with processing odor. Some pyrite evident. Same material appears as "slimes" due to water content. Consistency is soft. Geological Interpretations: Tailings.			
No Sample	7.4 to 8.7 ft. NO SAMPLE RECOVERED			

REMARKS: Auger hole B-WTU01DHAT-01-961009

Hole completed as observation well; 2" ID PVC;
Depth to top of sand = 9.5'
Depth to top of screen = 10.5'
Depth to bottom of screen = 13.5'

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 2 OF 2 HOLE NO. B-WTU01DH

FEATURE: Surface Waste Cleanup
AREA DESIGNATION: UPPER TAILINGS POND
COORDINATES: N 1601041 E 2854155
APPROXIMATE DIMENSIONS:
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: Wellington Oro Mine
GROUND ELEVATION: 9871.28
METHOD OF EXPLORATION: CME 45 AUGER
LOGGED BY: LAUREL ROOD
DATE(S) LOGGED: 10-09-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
8.7 ft.				
SW 9.9 ft.	8.7 - 9.9 ft. WELL GRADED SAND: About 95% hard subrounded to subangular fine, medium to coarse sand; about trace to 5% hard fine gravel, subrounded to subangular. No reaction to HCL. In-place Condition: Wet, tan, black, and beize particles, no obvious odor. Consistency is hard and cementation is lacking. Geological Interpretations: Tailings.			
MH 12.9 ft.	9.9 - 12.9 ft. ELASTIC SILT: About 100% low plasticity, no dilatancy and medium toughness; trace of fine sand. No reaction to HCL. In-place condition: Wet material, tan to light brown in color. Geological Interpretations: Tailings.			
SM 13.5 ft.	12.9 - 13.5 ft. SILTY SAND: About 60% hard subrounded to subangular fine, medium, and coarse sand; about 40% nonplastic fines with no dry strength, no dilatancy, low toughness. No reaction to HCL. In-place Condition: Overall color brown with individual grains of tan, black and gray; material wet. Geological Interpretations: Tailings.			

REMARKS:

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BWTU02DH

FEATURE: WELLINGTON-ORR MILL
PROJECT: EPA-BRECKENRIDGE
AREA DESIGNATION: UPPER TAILINGS POND
GROUND ELEVATION: 9871.2
COORDINATES: N 1601048 E 2854155
METHOD OF EXPLORATION: CME 45 Auger
APPROXIMATE DIMENSIONS:
LOGGED BY: L. ROOD
DEPTH WATER ENCOUNTERED 1/: DATE:
DATE(S) LOGGED: 10-09-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
ML 7.0 ft.	0.0 to 7.0 ft. SANDY SILT: About 100% nonplastic sandy silt with no dry strength, slow dilatancy and low toughness; trace of fine sand. No reaction to HCl. In-place condition: Color is tan and material is moist with processing odor. Consistency is soft. Geologic Interpretation: Tailings			
ML 8.0 ft.	7.0 to 8.0 ft. ROCK: Recovered as rock chips, angular to subangular gravel to coarse sand. In-place condition: Color medium to dark gray. Geologic Interpretation: Large Boulder			

REMARKS: Auger Hole 8-WTU02DHAT-01-961009

Hole completed as observation well: 2" ID PVC:
Backfill with bentonite to 7.0 ft. depth.
Placed 5 feet of screen and 3 feet of solid PVC.
1.0 foot stickup.

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BWTU03DH

FEATURE: WELLINGTON-ORR MILL
PROJECT: EPA-BRECKENRIDGE
AREA DESIGNATION: UPPER TAILINGS POND
GROUND ELEVATION: 9881
COORDINATES: N 1601070 E 2854223
METHOD OF EXPLORATION: CME 45 Auger
APPROXIMATE DIMENSIONS:
LOGGED BY: L. ROOD
DEPTH WATER ENCOUNTERED 1/: DATE:
DATE(S) LOGGED: 10-09-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
ML 2.5 ft.	0.0 to 2.5 ft. SILT: About 100% low plasticity fines, with slow dilatancy and low toughness. No reaction to HCl. In-place condition: Color is tan to rusty red, weak processing odor, material is dry. Geologic Interpretation: Tailings			
Rock 3.5 ft.	2.5 to 3.5 ft. ROCK: Auger met refusal with recovery as rock chips, angular to subangular gravel to coarse sand. In-place condition: Color medium gray. Geologic Interpretation: Large Boulder			

REMARKS: Auger Hole B-WTU03DHAT-01-961009

Hole backfilled with native material.

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BWTU04DH

FEATURE: WELLINGTON-ORR MILL
PROJECT: EPA-BRECKENRIDGE
AREA DESIGNATION: UPPER TAILINGS POND
GROUND ELEVATION: 9875
COORDINATES: N 1601053 E 2854190
METHOD OF EXPLORATION: CME 45 Auger
APPROXIMATE DIMENSIONS:
LOGGED BY: L. ROOD
DEPTH WATER ENCOUNTERED 1/: DATE:
DATE (S) LOGGED: 10-09-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
ML 2.5 ft.	0.0 to 2.5 ft. SILT: About 100% low plasticity fines, with slow dilatancy and low toughness. No reaction to HCl. In-place condition: Color tan to rusty red, weak processing odor, material is dry. Geologic Interpretation: Tailings			
ML 4.5 ft.	2.5 to 4.5 ft. SILT: About 100% low plasticity fines, with slow dilatancy and low toughness. No reaction to HCl. In-place condition: Color rusty red, weak processing odor, material is moist, consistency is soft with no cementation. Geologic Interpretation: Tailings			
Cobbles and boulders 4.6 ft.	4.5 to 4.6 ft. ROCK: Auger met refusal with recovery as a cobble wedged in the shoe. Geologic Interpretation: Cobbles and boulders			

REMARKS: Auger Hole B-WTU04DHAT-01-961009

Hole backfilled with native material.

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BEX01TP

FEATURE: WELLINGTON-ORR MILL
AREA DESIGNATION: EXTENUATE SHAFT
COORDINATES: N 1601787 E 2856267
APPROXIMATE DIMENSIONS: 5.0 x 5.0 X 8.2
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: EPA-BRECKENRIDGE
GROUND ELEVATION: 9985.0
METHOD OF EXPLORATION: BACKHOE
LOGGED BY: T. STRICKLAND
DATE(S) LOGGED: 10-09-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
ML One bag sample (1 lb.) 1.8 ft.	0.0 to 1.8 ft. SILT: About 90% nonplastic fines with no dilatancy, low dry strength; about 10% fine, subangular, sand;; trace of rock fragments; maximum size, 1-inch; moist, black.			
CL One bag sample @ 5.5 ft. One sack sample @ 5.5 ft. (2 lbs.) 8.2 ft.	1.8 to 8.2 ft. LEAN CLAY: About 90% slightly plastic fines with slow dilatancy, low dry strength; about 10% fine angular sand trace of fine rock fragments; maximum size, 1 inch; reddish-tan, moist, no reaction with HCl.			
Cobbles and Boulders 8.2 ft.	8.2 ft. COBBLES AND BOULDERS: Rounded, hard, tan with red iron staining, moist.			

REMARKS: Discontinued excavation at 8.2 ft. due to hard digging and caving.

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BEX06TP

FEATURE: WELLINGTON-ORR MILL
AREA DESIGNATION: EXTENUATE SHAFT
COORDINATES: N 1602112 E 2856245
APPROXIMATE DIMENSIONS: 5.0 x 5.0 X 9.0
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: EPA-BRECKENRIDGE
GROUND ELEVATION: 10000
METHOD OF EXPLORATION: BACKHOE
LOGGED BY: T. STRICKLAND
DATE(S) LOGGED: 10-10-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
Rock Fragments One 50 lb. sack sample 9.0 ft	0.0 to 9.0 ft. ROCK FRAGMENTS: About 40% larger than 3 inch; about 30% range from sand to gravel; about 20% sand size material; about 10% slightly plastic fines, angular; yellow, moist; no odor. Test pit encountered mine timbers, rails, nails, etc.			

REMARKS: Discontinued excavation at 9.0 ft. due to caving.

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BWTL02TP

FEATURE: WELLINGTON-ORR MILL
AREA DESIGNATION: WELLINGTON TAILINGS-LOWER
COORDINATES: N 1600910 E 2854437
APPROXIMATE DIMENSIONS: 5.0 x 5.0 X 11.0
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: EPA-BRECKENRIDGE
GROUND ELEVATION:
METHOD OF EXPLORATION: BACKHOE
LOGGED BY: T. STRICKLAND
DATE (S) LOGGED: 10-09-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
s (ML) One bag sample (1 lb.) 2.0 ft.	0.0 to 2.0 ft. SANDY SILT: About 60% nonplastic fines with slow dilatancy, no dry strength; about 40% fine, subangular, sand; maximum size, medium sand; dry, yellowish-orange; no odor; no reaction with HCl.			
SM One bag sample. (1 lb.) 2.7 ft.	2.0 to 2.7 ft. SILTY SAND: About 85% fine subangular sand; about 15% nonplastic, well cemented fines; red, moist, no odor; no reaction with HCl.			
SM One bag sample (1 lb.) 3.5 ft.	2.7 to 3.5 ft. SILTY SAND: About 75% medium to fine subangular sand; about 25% nonplastic, well cemented fines; yellowish-tan, moist, no odor; no reaction with HCl.			
SM One bag sample 3.5 to 5 ft. 11.0 ft.	3.5 to 11.0 ft. SILTY SAND: About 85% coarse to fine, subangular sand; about 15% nonplastic fines with rapid dilatancy, no dry strength; trace of rock fragments; black, wet.			

REMARKS: Test pit located in tailings area near settling pond south of French Creek Road, west of Country Boy Mine.

Discontinued excavation at 11.0 ft. at limit of backhoe.

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BWTL03TP

FEATURE: WELLINGTON-ORR MILL
PROJECT: EPA-BRECKENRIDGE
AREA DESIGNATION: WELLINGTON WEST SETTLING POND
GROUND ELEVATION: 9886
COORDINATES: N 1601050 E 2854174
METHOD OF EXPLORATION: BACKHOE
APPROXIMATE DIMENSIONS: 5.0 x 5.0 X 9.0
LOGGED BY: T. STRICKLAND
DEPTH WATER ENCOUNTERED 1/: DATE:
DATE(S) LOGGED: 10-10-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
ML One bag sample (2 lbs.) 2.0 ft.	0.0 to 2.0 ft. SILT: About 90% nonplastic fines with no dilatancy, no dry strength; about 10% fine, sand; maximum size, medium sand; dry, reddish-tan, moist; no odor.			
ML One bag sample. (2 lbs.) 7.0 ft.	2.0 to 7.0 ft. SILT: About 90% nonplastic fines; about 10% fine subangular sand; gray, wet, no odor; no reaction with HCl.			
Rock Fragments 9.0 ft	7.0 to 9.0 ft. ROCK FRAGMENTS: Coarse, angular, iron stained; maximum size, 18 inches. GEOLOGIC INTERPRETATION: Talus Deposit			

REMARKS: Discontinued excavation at 9.0 ft. in hard material.

Too wet @ 5.0 feet to dig inplace density - moved 23 feet east - dug down with shovel and performed test - 1 sack sample @ 5.0 feet.

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BWTL07TP

FEATURE: WELLINGTON-ORR MILL
AREA DESIGNATION: LOWER TAILINGS AREA
COORDINATES: N 1600948 E 2854624
APPROXIMATE DIMENSIONS: 5.0 x 5.0 X 11.0
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: EPA-BRECKENRIDGE
GROUND ELEVATION: 9849
METHOD OF EXPLORATION: BACKHOE
LOGGED BY: T. STRICKLAND
DATE(S) LOGGED: 10-10-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
SM One bag sample (2 lbs.) 3.5 ft.	0.0 to 3.5 ft. SILTY SAND: About 75% fine, subangular sand; about 25% nonplastic fines with slow dilatancy, no dry strength; brown, moist; no odor, no reaction with HCl.			
(GP) scb One bag sample. (2 lbs.) 11.0 ft.	3.5 to 11.0 ft. POORLY GRADED GRAVEL WITH SAND, COBBLES AND BOULDERS: About 80% subrounded, hard gravel; about 15% fine, subrounded sand; about 5% nonplastic fines; tan, moist; maximum size, 24 inches.			

REMARKS: Discontinued excavation at 11.0 ft. in cobbles and boulders.

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BWTL08TP

FEATURE: WELLINGTON-ORR MILL
AREA DESIGNATION: LOWER TAILINGS AREA
COORDINATES: N 1601010 E 2854706
APPROXIMATE DIMENSIONS: 5.0 x 5.0 X 5.0
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: EPA-BRECKENRIDGE
GROUND ELEVATION: 9849
METHOD OF EXPLORATION: BACKHOE
LOGGED BY: L. SHEHORN
DATE(S) LOGGED: 10-11-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
SP-SM 2.0 ft.	0.0 to 2.0 ft. POORLY GRADED SAND WITH SILT: About 90% sand; about 10% fines; brown with red and yellow layers, material breaks up with handling; moist.			
SP-SM 3.0 ft.	2.0 to 3.0 ft. POORLY GRADED SAND WITH SILT: About 90% sand; about 10% fines; black; well cemented.			
	3.0 to 5.0 ft. POORLY GRADED SAND WITH SILT: About 90% sand; about 10% fines; black; poorly cemented.			
Cobbles and Boulders 5.0 ft.	5.0 ft COBBLES AND BOULDERS: Rounded, hard; maximum size, 12 inches.			

REMARKS: Discontinued excavation at 5.0 ft. in cobbles and boulders.

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BWTL09TP

FEATURE: WELLINGTON-ORR MILL
PROJECT: EPA-BRECKENRIDGE
AREA DESIGNATION: LOWER TAILINGS AREA
GROUND ELEVATION:
COORDINATES: N 1600860 E 2854233
METHOD OF EXPLORATION: BACKHOE
APPROXIMATE DIMENSIONS: 5.0 x 5.0 X 4.5
LOGGED BY: L. SHEHORN
DEPTH WATER ENCOUNTERED 1/: DATE:
DATE(S) LOGGED: 10-11-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
SP-SM 2.0 ft.	0.0 to 2.0 ft. POORLY GRADED SAND WITH SILT: About 80% sand; about 10% fines; about 10% gravel; light brown with red and yellow layers, moist; material is interbedded in 0.5 to 0.75 inch layers, breaks up with handling.			
Cobbles and sand 5.0 ft.	2.0 to 5.0 ft COBBLES AND SAND: About 65% rounded, hard, cobbles; about 30% sand; about 5% fines.			

REMARKS: Discontinued excavation at 4.5 ft. in cobbles.

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BWTL10TP

FEATURE: WELLINGTON-ORR MILL
AREA DESIGNATION: UPPER TAILINGS AREA
COORDINATES: N 1601185 E 2854510
APPROXIMATE DIMENSIONS: 5.0 x 5.0 X 7.0
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: EPA-BRECKENRIDGE
GROUND ELEVATION:
METHOD OF EXPLORATION: BACKHOE
LOGGED BY: L. SHEHORN
DATE(S) LOGGED: 10-11-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
(SP-SM) g 3.6 ft.	0.0 to 3.6 ft. POORLY GRADED SAND WITH SILT AND GRAVEL: About 50% sand; about 40% gravel; about 5% fines; about 5% rounded cobbles; light brown, moist. Maximum size: 4 inch.			
SP-SM 4.6 ft.	3.6 to 4.6 ft POORLY GRADED SAND WITH SILT: About 90% sand; about 10% fines; red.			
(SP-SM) g 7.0 ft.	4.6 to 7.0 ft. POORLY GRADED SAND WITH SILT AND GRAVEL: About 70% sand; about 20% rounded gravel; about 10% fines; brown with red and yellow, moist.			

REMARKS: Discontinued excavation at 7.0 ft. in cobbles.

NE = Not Encountered.

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BWTU04TP

FEATURE: WELLINGTON-ORR MILL
PROJECT: EPA-BRECKENRIDGE
AREA DESIGNATION: UPPER TAILINGS PILE
GROUND ELEVATION: 9970
COORDINATES: N 1601274 E 2854852
METHOD OF EXPLORATION: BACKHOE
APPROXIMATE DIMENSIONS:
LOGGED BY: T. STRICKLAND
DEPTH WATER ENCOUNTERED 1/: DATE:
DATE(S) LOGGED: 10-10-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
1 sack sample (50 lbs) 7.0 ft.	0.0 to 7.0 ft. ROCK FRAGMENTS: Angular, about 50% larger than 3", 30% rock fragments 3" to #4, 15% rock fragments to #200, 5% nonplastic fines (rock flour) maximum size 12", gray, moist.			
1 sack sample (50 lbs) 9.0 ft.	7.0 to 9.0 ft. ROCK FRAGMENTS: About 40% 12" to 3" angular, about 25% angular 3" to #4 rock fragments, 25% #4 to #200 rock fragments, 10% nonplastic fines (rock flour), yellow-orange, moist, no odor.			

REMARKS: Discontinued excavation at 9.0 ft. due to caving.

1/ Report to nearest 0.1 foot

7-1336-A (1-86) Bureau of Reclamation	LOG OF TEST PIT OR AUGER HOLE	SHEET 1 OF 1 HOLE NO. BWTU05TP

FEATURE: WELLINGTON-ORR MILL
AREA DESIGNATION: UPPER TAILINGS PILE
COORDINATES: N 1601380 E 2854996
APPROXIMATE DIMENSIONS: 5.0 x 5.0 X 9.0
DEPTH WATER ENCOUNTERED 1/: DATE:

PROJECT: EPA-BRECKENRIDGE
GROUND ELEVATION: 9970
METHOD OF EXPLORATION: BACKHOE
LOGGED BY: T. STRICKLAND
DATE(S) LOGGED: 10-10-96

CLASSIFICATION GROUP SYMBOL (describe sample taken)	CLASSIFICATION AND DESCRIPTION OF MATERIAL SEE USBR 5000, 5005	% PLUS 3 in (BY VOLUME) 3-5 in	5-12 in	PLUS 12 in
Rock Fragments 9.0 ft	0.0 to 9.0 ft. ROCK FRAGMENTS: About 65% larger than 3 inch; about 20% range from sand to gravel; about 10% sand size material; about 5% rock flour, angular, iron stained; maximum size, 24 inches; tan, moist.			

REMARKS: Discontinued excavation at 9.0 ft. due to caving.

1/ Report to nearest 0.1 foot

APPENDIX 4 - MATERIALS DATA

D-5[illegible]
(Twin[illegible])

United States Department of the Interior

BUREAU OF RECLAMATION
Reclamation Service Center
P.O. Box 25007
Building 67, Denver Federal Center
Denver, Colorado 80225-0007

IN REPLY REFER TO
D-8340
RES-3.40

JAN 31 1997

MEMORANDUM

To: Manager, Geotechnical Engineering Group 3
Attention: Tom Brown D-8313

From: Jeffrey A. Farrar
Civil Engineer, Earth Sciences and Research Laboratory Group

Subject: Results of Physical Properties Soils Tests and Test Pit Logging - Wellington Oro Mines - EPA Region VIII - Breckenridge, Colorado

Earth Sciences and Research Laboratory Referral Number: 8340-97-02

INTRODUCTION

This Memorandum reports the results of investigations and soil testing performed for characterization of mine waste and tailings piles at the Wellington Oro mines complex at Breckenridge, Colorado. Field investigations were performed from October 7 to 11, 1996. Personnel from our laboratory assisted with tube density measurements and test pit operations. The Denver laboratory performed physical properties tests, consisting of grain size analysis, Atterberg (consistency) limits, and specific gravity testing.

See the text of the geologic site investigation report for information on the scope and conduct of the investigation. That report contains drill hole logging and exploration locations. Explorations were performed in several areas, Roaster Fines Pile, Upper and Lower Tailings piles, and the dead tree area below the Extenuate Waste Pile.

Field explorations were performed in accordance with Bureau of Reclamation Earth Manual, and Engineering Geology Field Manual. Specific citations will be given in the discussion. Soil samples received in the Earth Sciences and Research Laboratory were assigned index numbers for each sample. The sample index numbers were 70C - 1 through 76 as summarized in table 1. Not all of the samples were tested. The samples will be retained for later testing if required.

DISCUSSION

PHYSICAL PROPERTIES TESTS

Physical properties test results are shown on figures 1 through 34 and are summarized in table 2. Particle size analysis was performed in accordance with Earth Manual test procedures USBR 5330 and USBR 5325 if gravel was present. For tube samples the top and bottom ends of the tubes were analyzed if the material appeared different in appearance. Specific gravity tests were performed by the flask method, USBR 5320. Testing of these mine waste soils which contain heavy metals and sulfates required special precautions. Most of the tube and bag samples were oven dried prior to testing, but sack samples from test pits were air dried. Instead of splitting soil samples, we used quartering and grab sampling to avoid worker exposure from dust generation. Sack samples of coarse materials were quartered and then hand sieved through the gravel screen sizes. The material passing the gravel sieves was grabbed to avoid splitting.

The chemical composition of some of the samples caused interferences in hydrometer testing. Samples 70C-1,-13,-15,-19,-22-64,-73, and -74 exhibited abnormal behavior in the hydrometer test. These samples must have contained excessive metals and sulfates which invalidated the hydrometer tests. Our hydrometers are calibrated for either sodium hexametaphosphate dispersing solutions or distilled water. For the samples exhibiting abnormal behavior, the hydrometer was buoyed by dissolved metallic sulfates in solution, resulting in unreliable readings. If these erratic readings were observed, the test was halted and the material was wet sieved through the number 200 sieve to perform gradations in accordance with USBR 5335. For this case, the gradation plots will show no hydrometer data and the wet sieving procedure will be noted. The soils exhibiting these behaviors are primarily from the roaster fines or tailings areas.

The chemical composition of some soils also interfered with the specific gravity (Gs) test. Typical specific gravities of soils range from 2.5 to 2.8. For the mine waste materials containing large amounts of heavy pyrite minerals, we would expect high specific gravities. However, with some soils we obtained Gs of 4 and 5 which are considered to be unreasonable. The flask method was used to perform the tests. The basis of the flask method is to place soil in a flask of control volume and fill the flask with distilled water. The flasks are calibrated in distilled water. If metallic sulphate compounds dissolve in the water, the calibration would be invalidated. We measured pH in some flasks as low as 2. In some samples, a gray scum formed and floated at the top of the sample. This scum is probably lead sulphate precipitate. In general the samples with very high specific gravities had a pH of less than 3. On the summary table, we have marked the Gs data of over 3.0 as being unreliable - due to uncertainty of the chemical effects.

DENSITY MEASUREMENTS ON AUGER SAMPLES

Tube density data are presented in table 1. The purpose of the tube density measurements was to estimate mass hauling requirements for the roaster fines and tailings piles. Tube density measurements were performed in accordance with USBR 7105. USBR 7105 describes taking

undisturbed samples using a double tube auger. On this investigation, a CME 3.25 inch hollowstem auger was used for sampling. The inner tube assembly was equipped with two 2.5 ft long 2.25 inch ID (Inside Diameter) acrylic liners. The liners were measured with micrometers and weighed. We found the liners to be very consistent in dimensions and weight. We developed a weight per length factor for the liners such that the samples could be cut, weighed and their mass could be determined by measurement of liner length. The diameter of the core was controlled by the cutting shoe, which was only 2.00 inch diameter. The over cutting of core made it difficult to evaluate core expansion. Some cores were obviously disturbed and were not measured. The density measurement is an average tube density, and local variations could be present in the core. Normally we prefer to perform these measurements with larger diameter core samples, but we believe some the data measured in this should be within 5 to 10 lb/ft^3. One way to evaluate inplace density measurements is to plot dry density and moisture content on a moisture density graph. This graph is shown on figure 35. Accurate data for saturated soils will lie on the zero air voids line which can be calculated with knowledge of Gs. Any data plotting above the zero air voids line indicates an error made in the measurement. Soils which are partially saturated can lie below the line. Figure 35 shows the tube density data in table 1. Most of the data lie close to or slightly above the zero air voids line for Gs of 2.85. These data appear reasonable because 1.) The specific gravity may be higher than 2.85, and 2.) Most of the soil samples below 2 to 4 ft appeared to be saturated. The dry density and moisture data for 70C-3 and 70C-19 are unreliable.

TEST PIT OPERATIONS

Test Pit logs are shown on figures 36 to 46. Test pit logging was performed in accordance with Reclamation's Training Manual No. 6, "Soil Classification handbook - Unified Soil Classification," with the exception of a few logs which do not contain full detailed descriptions of soils. Laboratory data from some of the sack samples are shown on the logs in accordance with training manual procedures.

Sand Cone Density tests were performed in a few test pits. The tests were performed in accordance with USBR 7205. This data is summarized on the test pit logs and in table 2. Typically sand cone density data is considered to be the most reliable measure of inplace density. Sand cone test data are plotted on figure 35 for comparison to tube density data. The few data points available agree well with some of the tube data.

Attachments

cc: D-8340 (files), D-8340 (Farrar), D-8322 (Turlington)
(w/att to each)

Table 1. Summary of Samples Index Numbers, Location, Feature and sample Type

JAF 1/31/97

Sample Index Number	Location	Feature	Depth Range ft.	Sample Types
70C-1 through 6	Upper Tailings	WTU01DHAT	0.0 to 13.5	2.25 in Tubes, Bags
70C-7 through 8	Upper Tailings	WTU03DHAT	0.0 to 3.5	2.25 in Tubes & Bags
70C-9 through 10	Upper Tailings	WTU04DHAT	0.0 to 4.5	2.25 in Tubes & Bags
70C-11 through 17	Roaster Fines	WR02DHAT	0.0 to 15.0	2.25 in Tubes & Bags
70C-18 through 24	Roaster Fines	WR01DHAT	0.0 to 16.7	2.25 in Tubes &Bags
70C-25 through 33	Extenuate Area - (below pile)	EX01DHST	0.0 to 13.6	Bag Samples
70C-34 through 39	Extenuate Area - (below pile)	EX02DHST	0.0 to 10.2	Bag Samples
70C-40 through 56	Lower Tailings	WTL01DHST	0.0 to 32.2	Bag Samples
70C-57A and B, -67	Upper Tailings - (near Oro shaft)	WTU04TP01	0.0 to 9.0	Sack Samples
70C-58, -59, -60	Roaster Fines Area	WTU10TP01	0.0 to 7.0	Sack, bucket, bag samples
70C-61	Upper Tailings - (near Oro shaft)	WTU05TP01	0.0 to 9.0	Sack
70C-62,-63	Lower Tailings	WTL09TP01	0.0 to 4.5	Sacks
70C-64	Lower mill tailings area	WTL08TP01	0.0 to 5.0	Sacks
70C-65,-66	Lower Tailings	BWTL07TP01	0.0 to 11.0	Sacks
70C-68, through 71	Upper Tailings	BWTL03TP01	0.0 to 7.0	Sacks, grab bag, density bucket
70C-72,- 73	Lower Tailings	BWTL02TP01	0.0 to 5.0	Sack and Density Bucket
70C-74	Extenuate Area - (Top of Pile)	BEX06TP01	0.0 to 9.0	Sack
70C-75,-76	Extenuate Area - (below pile)	BEX01TP01	5.4	Sack and Density Bucket

Summary Table of Physical Properties Test Results

Breckenridge - Wellington Oro - Field Investigation

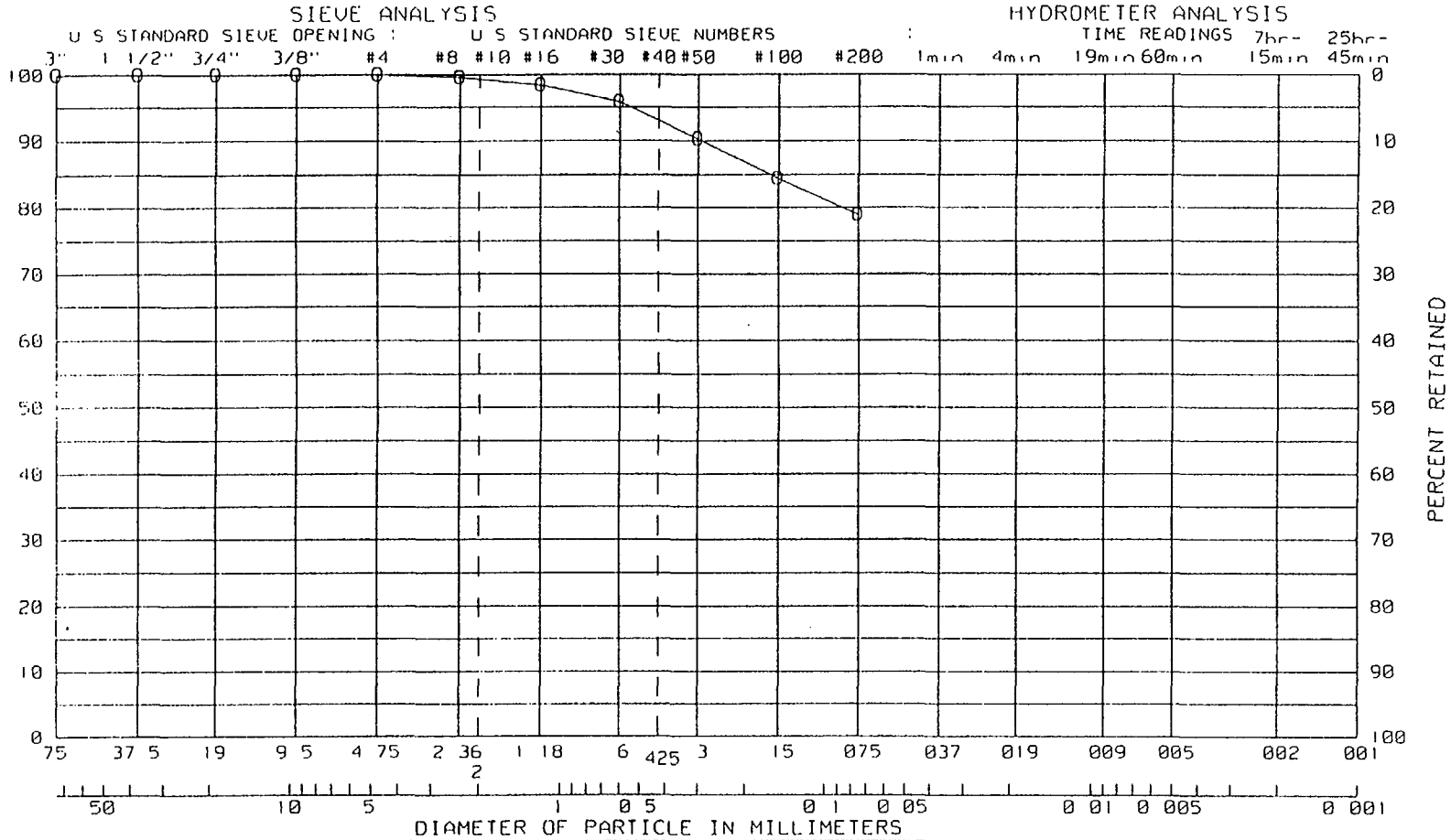
JAF 1/31/97 RB 1/31/97

Sample Description					Atterberg Limits		Gradation Analysis			Moisture Content			Inplace Density		
Sample No. 70C-	Test Pit or Drill Hole Number	Interval (feet)	Location	Classification	Liquid Limit (%)	Plastic Index (%)	Gravel (%)	Sand (%)	Fines (%)	Moisture Content Top - %	Moisture Content Bottom - %	Average Moisture Content - %	Specific Gravity	Wet Density (lbf/ft³)	Dry Density (lbf/ft³)
52	B-WTL01DHST-01	27.3-29.8	Bag	SW-SM, Well Graded Sand with Silt		NP	7	84	9			22.6	2.76		
57A	B-WTU04TP01	0.0-7.0	Sack	GP, Poorly Graded Gravel		NP	84	11	5			NT	2.79		
57B	B-WTU04TP01	7.0-9.0	Sack	GM, Silty Gravel with Sand		NP	53	32	15			NT	2.83		
58,59	B-WTU10TP01	3.6	Bucket	No Test yet - waiting Chem Analysis - Red Goo								33.2			
61	B-WTU05TP01	0.0-9.0	Sack	GC, Clayey Gravel with Sand	30	9	51	33	16				2.74		
64	BWTL08TP01	0.0-5.0	Sack	SM, Silty Sand		NP	1	75	24			NT	3.15*		
65	BWTL07TP01	0.0-3.5	Sack	SM, Silty Sand		NP	1	74	25				2.82		
66	BWTL07TP01	3.5-11.0	Sack	GP, Poorly Graded Gravel		NP	88	7	5				2.77		
69	BWTL03TP01	0.5	Bucket									24.4		106.5	85.6
73	BWTL02TP01	5	Bucket	SM, Silty Sand		NP	1	85	14			12.5	3.84*	120.5	107.1
74	BEX06TP01	0.0-9.0	Sack	GC, Clayey Gravel with Sand	38	14	50	31	19				2.77		
75	BEX01TP01	5.4	Sack - Extra												
76	BEX01TP01	5.4	Bucket	CL, Sandy Lean Clay	32	12	6	43	51			23.7	2.67	101.9	82.3

* Specific Gravity of over 3.0 is quetionable due to possible chemical interferences.

NT = Not Tested

GRADATION TEST



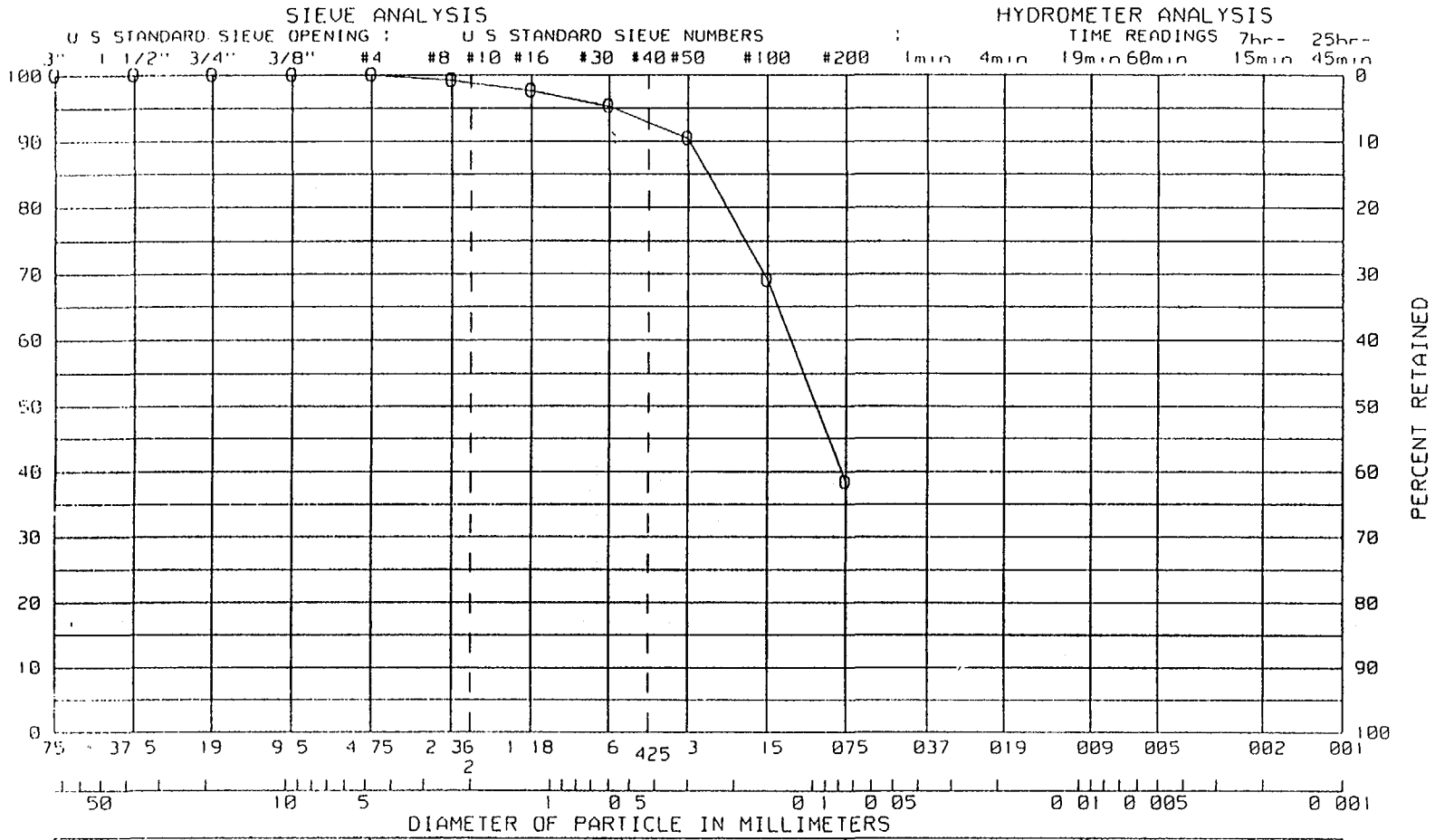
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 0 0-2 5 feet
SAMPLE NUMBER 70C-1T
NOTES B-WTU01DHAT-01 UPPER TAILINGS-WET SIEVE-PH OF 7
UNIFIED SOIL CLASSIFICATION Group Symbol CH Group Name Fat Clay with Sand
ATTERBERG LIMITS Liquid Limit(/) 51 0 Plasticity Index(/) 23 0 Shrinkage Limit(/)
SPECIFIC GRAVITY Minus No 4 2 84
GRADATION Percent Gravel 0 0 Percent Sand 21 1 Percent Fines 78 9

PREPARED BY [signature] CHECKED BY [signature] 12/6/86 FIGURE

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

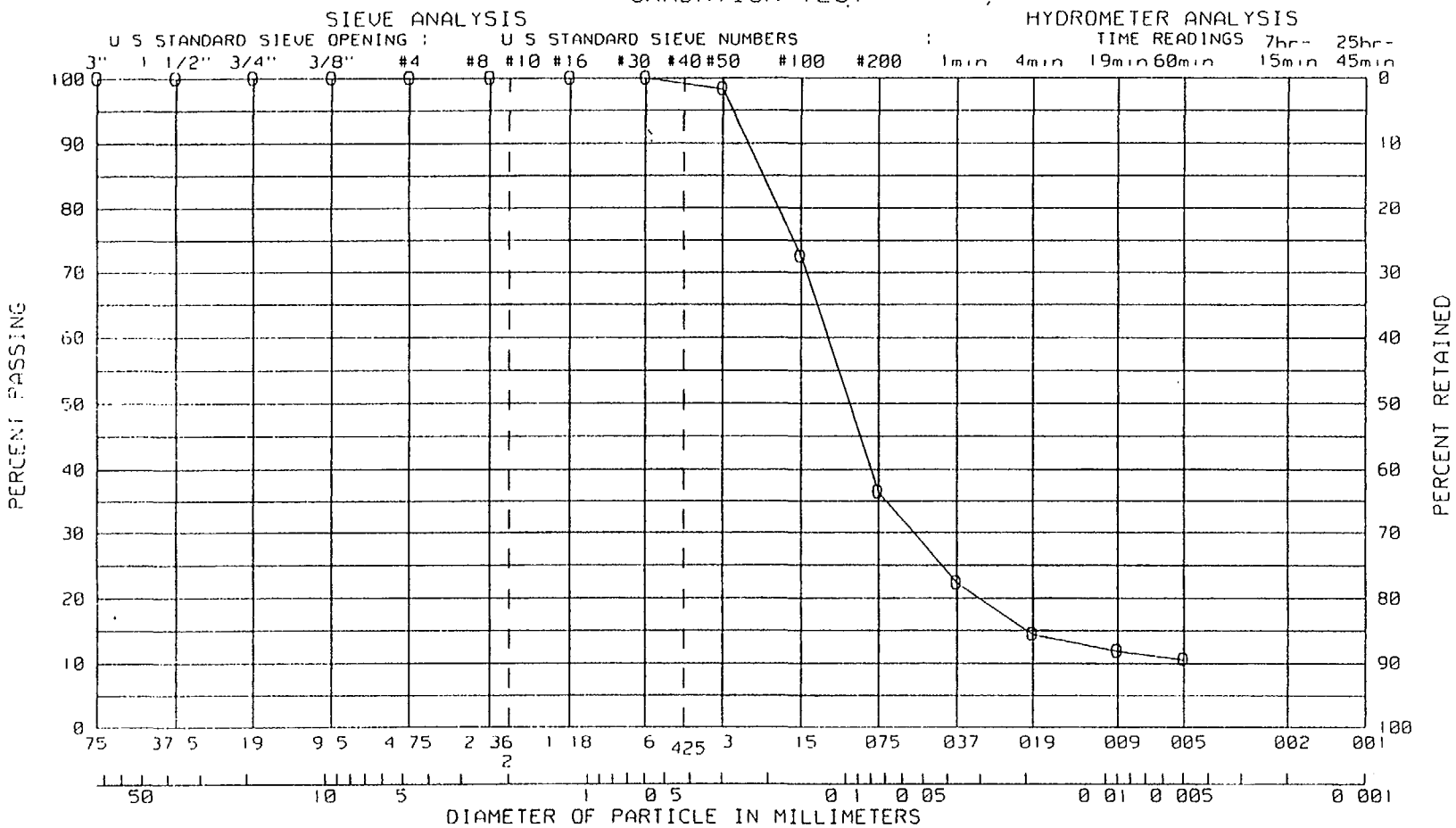
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 0 0-2 5 feet
SAMPLE NUMBER 70C-1B
NOTES B-WTU01DHAT-01 UPPER TAILINGS-WET SIEVE-PH OF 7
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 2 93
GRADATION Percent Gravel 0 0 Percent Sand 61 7 Percent Fines 38 3

PREPARED BY [illegible] CHECKED BY [illegible] 12/13/96

FIGURE 2

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

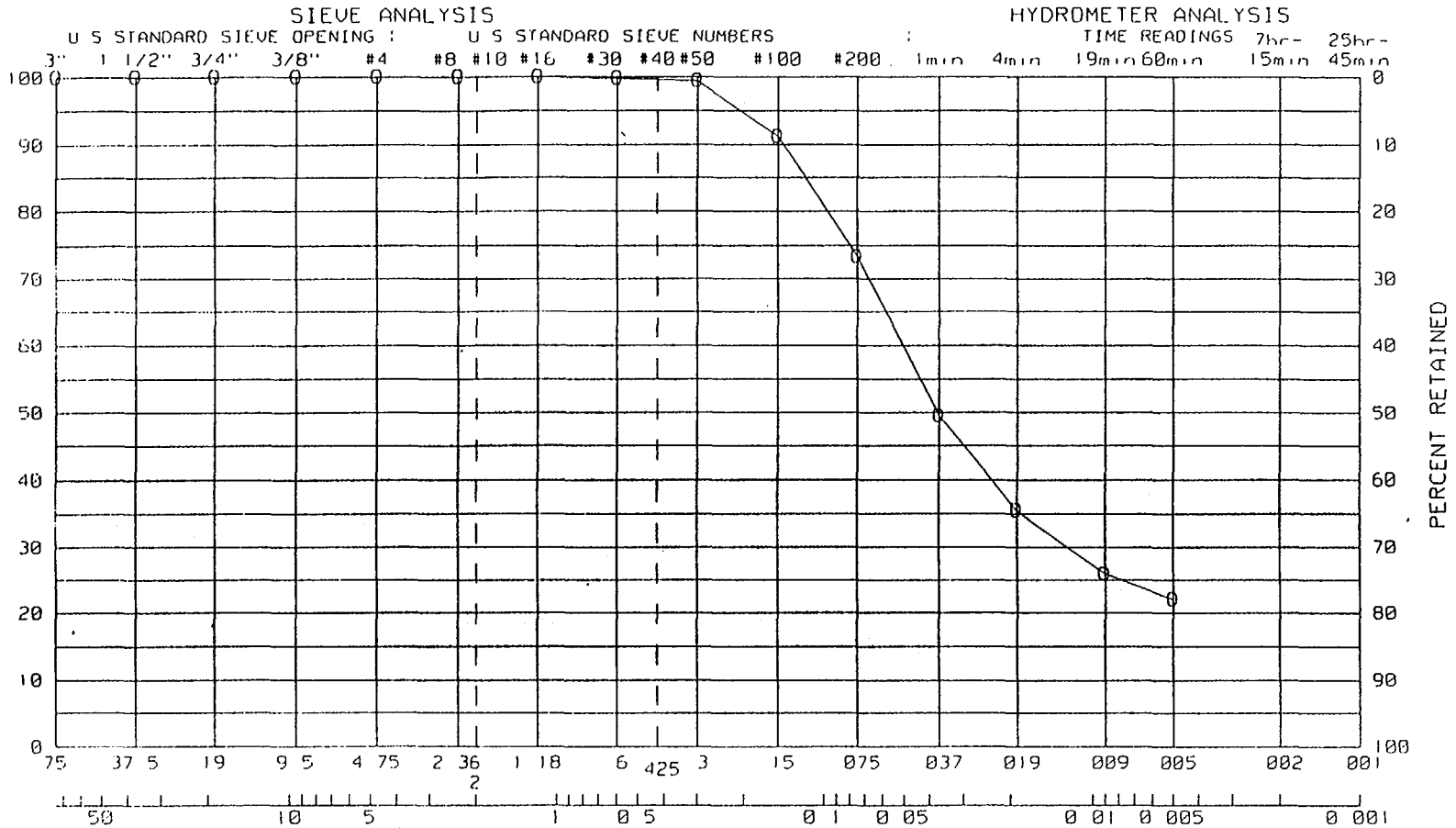
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 4 9-7 4 feet
SAMPLE NUMBER 70C-3T
NOTES B-WTU01DHAT-01 UPPER TAILINGS AREA
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 2 94
GRADATION Percent Gravel 0 0 Percent Sand 63 6 Percent Fines 36 4

PREPARED BY [illegible] CHECKED BY [illegible] 12/13/96

FIGURE

GRADATION TEST



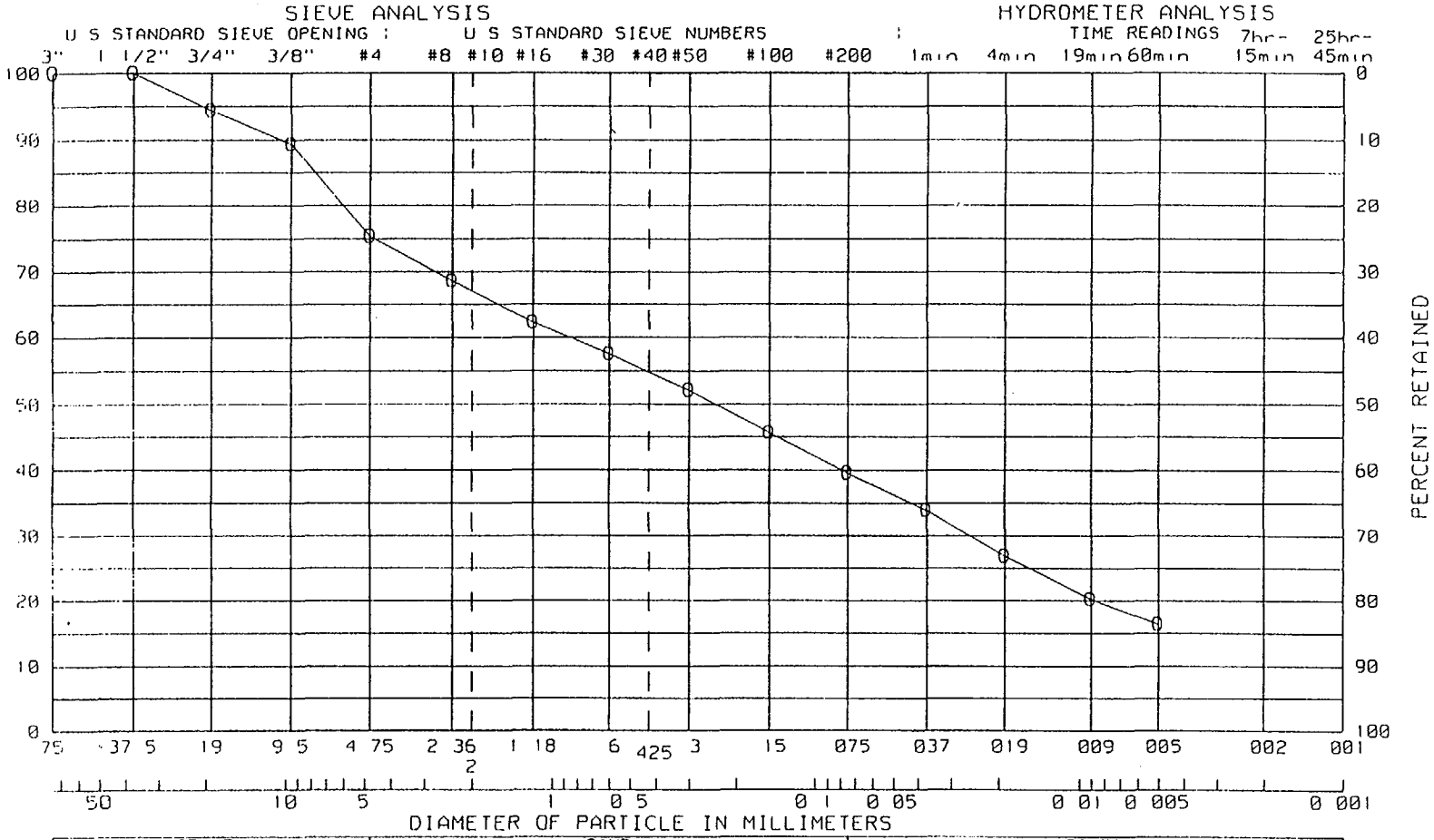
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 4 9-7 4 feet
SAMPLE NUMBER 70C-3B
NOTES B-WTU01DHAT-01 UPPER TAILINGS AREA
UNIFIED SOIL CLASSIFICATION Group Symbol CL-ML Group Name Silty Clay with Sand
ATTERBERG LIMITS Liquid Limit(/) 21 0 Plasticity Index(/) 5 0 Shrinkage Limit(/)
SPECIFIC GRAVITY Minus No 4 2 96
GRADATION Percent Gravel 0 0 Percent Sand 26 7 Percent Fines 73 3

PREPARED BY [signature] CHECKED BY JAF 12/13/96 FIGURE 4

GRADATION TEST



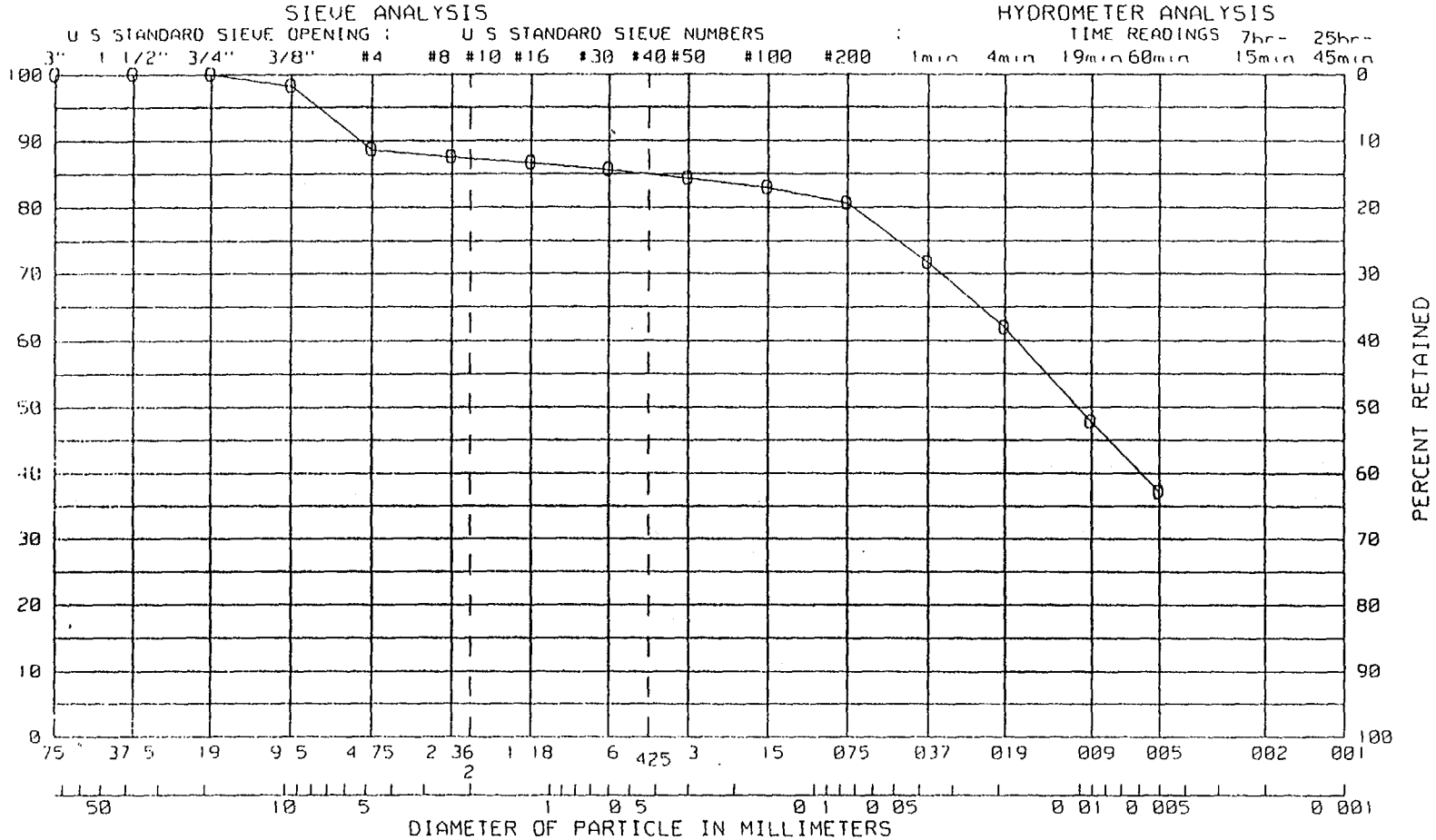
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE
DRILL HOLE SEE NOTES
SAMPLE NUMBER 70C-5T
NOTES B-WTU01DHAT-01 UPPER TAILINGS AREA
UNIFIED SOIL CLASSIFICATION Group Symbol SC Group Name Clayey Sand with Gravel
ATTERBERG LIMITS Liquid Limit(/) 36 0 Plasticity Index(/) 16 0 Shrinkage Limit(/)
SPECIFIC GRAVITY Minus No 4 2 68
GRADATION Percent Gravel 24 7 Percent Sand 35 8 Percent Fines 39 5

PROJECT EPA - REGION 8
DEPTH 9 9-12 4 feet

PREPARED BY Burnham CHECKED BY JAK 2/13/96 FIGURE 5

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

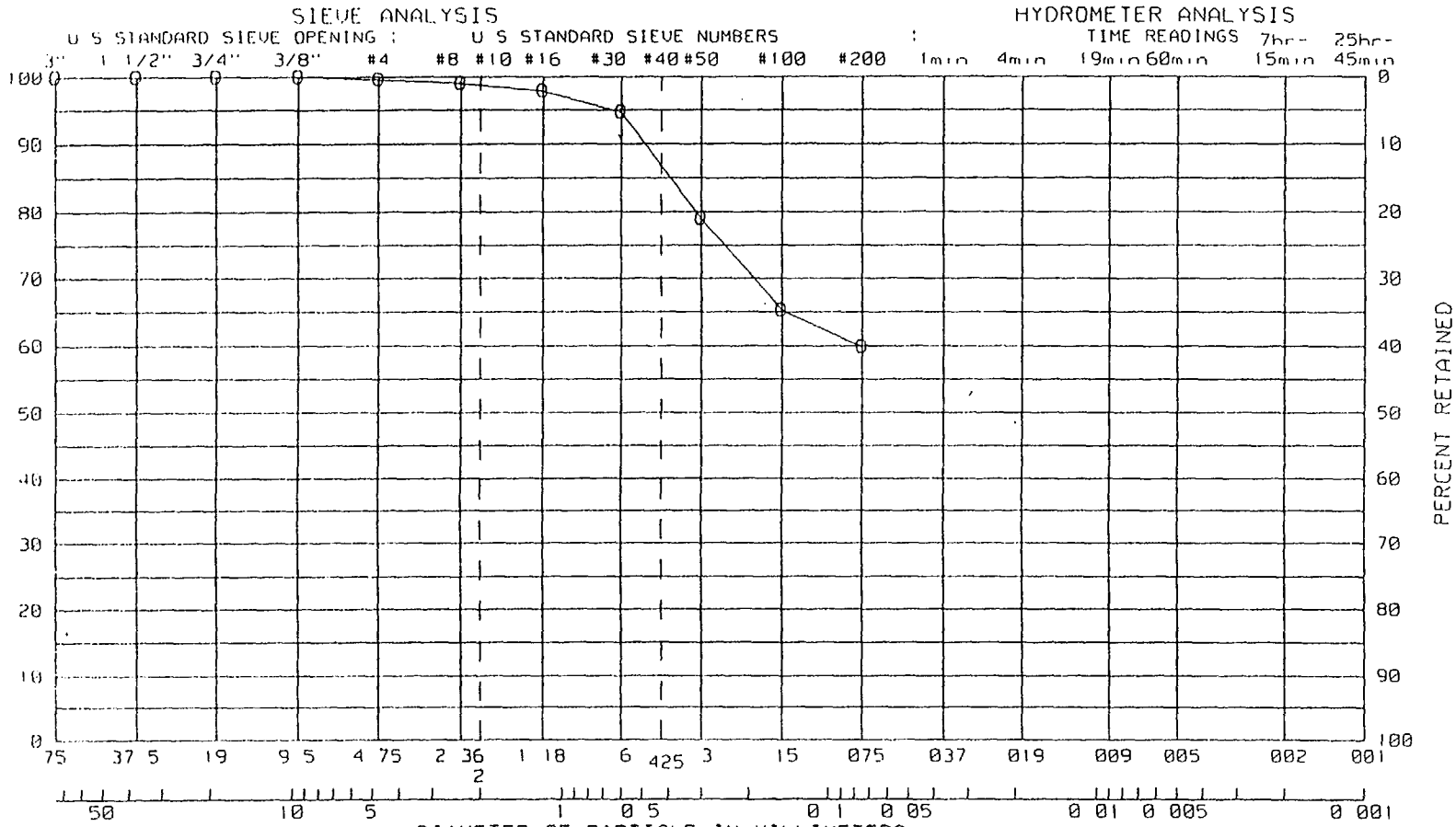
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 9 9-12 4 feet
SAMPLE NUMBER 70C-58
NOTES B-WTU01DHAT-01 UPPER TAILINGS AREA
UNIFIED SOIL CLASSIFICATION Group Symbol CL Group Name Lean Clay with Gravel
ATTERBERG LIMITS Liquid Limit(/) 27 0 Plasticity Index(/) 10 0 Shrinkage Limit(/)
SPECIFIC GRAVITY Minus No 4 2 65
GRADATION Percent Gravel 11 4 Percent Sand 8 0 Percent Fines 80 6

PREPARED BY Benham CHECKED BY JAE 12/3/90

FIGURE 6

GRADATION TEST



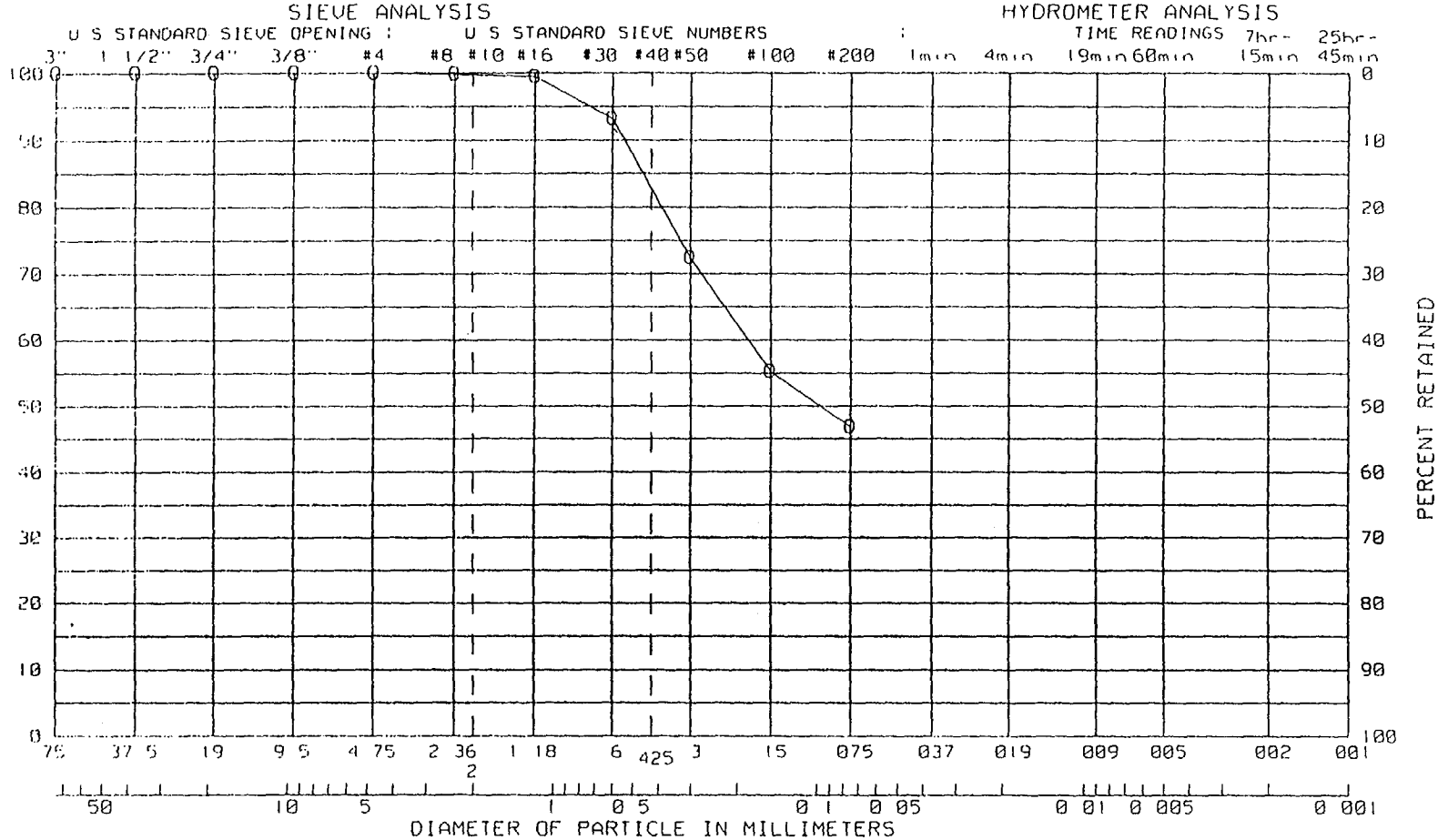
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 4 3-6 7 feet
SAMPLE NUMBER 70C-13T
NOTES B-WR02DHAT-01-ROASTER FINES-WET SIEVE- SpG 4 95 and 5 07 PH OF 2
UNIFIED SOIL CLASSIFICATION Group Symbol ML Group Name Sandy Silt
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 5 01
GRADATION Percent Gravel 4 Percent Sand 39 8 Percent Fines 59 8

PREPARED BY Burnhard CHECKED BY JAF 12/13/96 FIGURE 7

GRADATION TEST



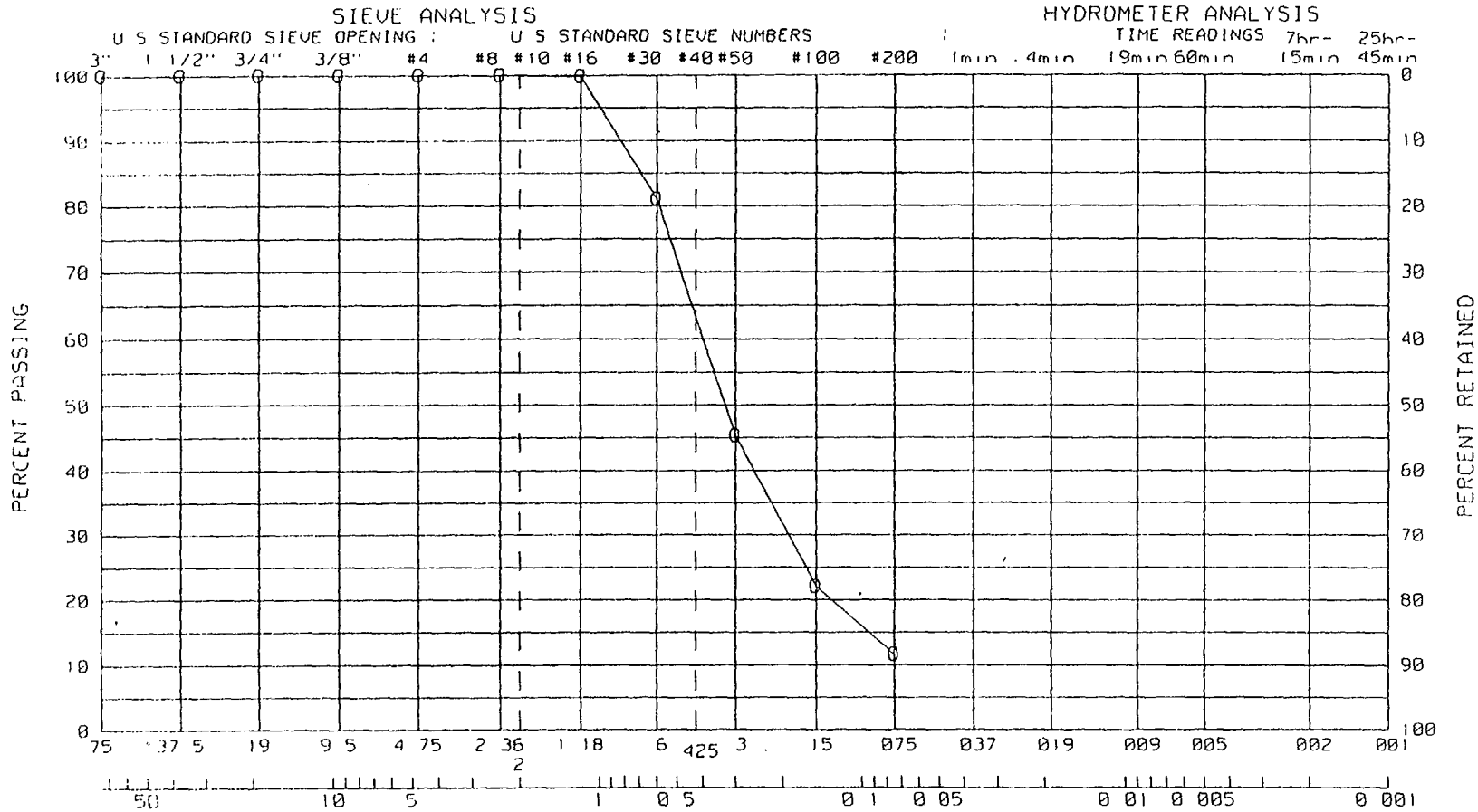
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 4 3-6 7 feet
SAMPLE NUMBER 70C-13B
NOTES B-WR02DHAT-01-ROASTER FINES-WET SIEVE-SpG 5 52 and 5 44 PH OF 3
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 5 48
GRADATION Percent Gravel 0 0 Percent Sand 53 2 Percent Fines 46 8

PREPARED BY Burkard CHECKED BY JAF 12/13/96 FIGURE C

GRADATION TEST



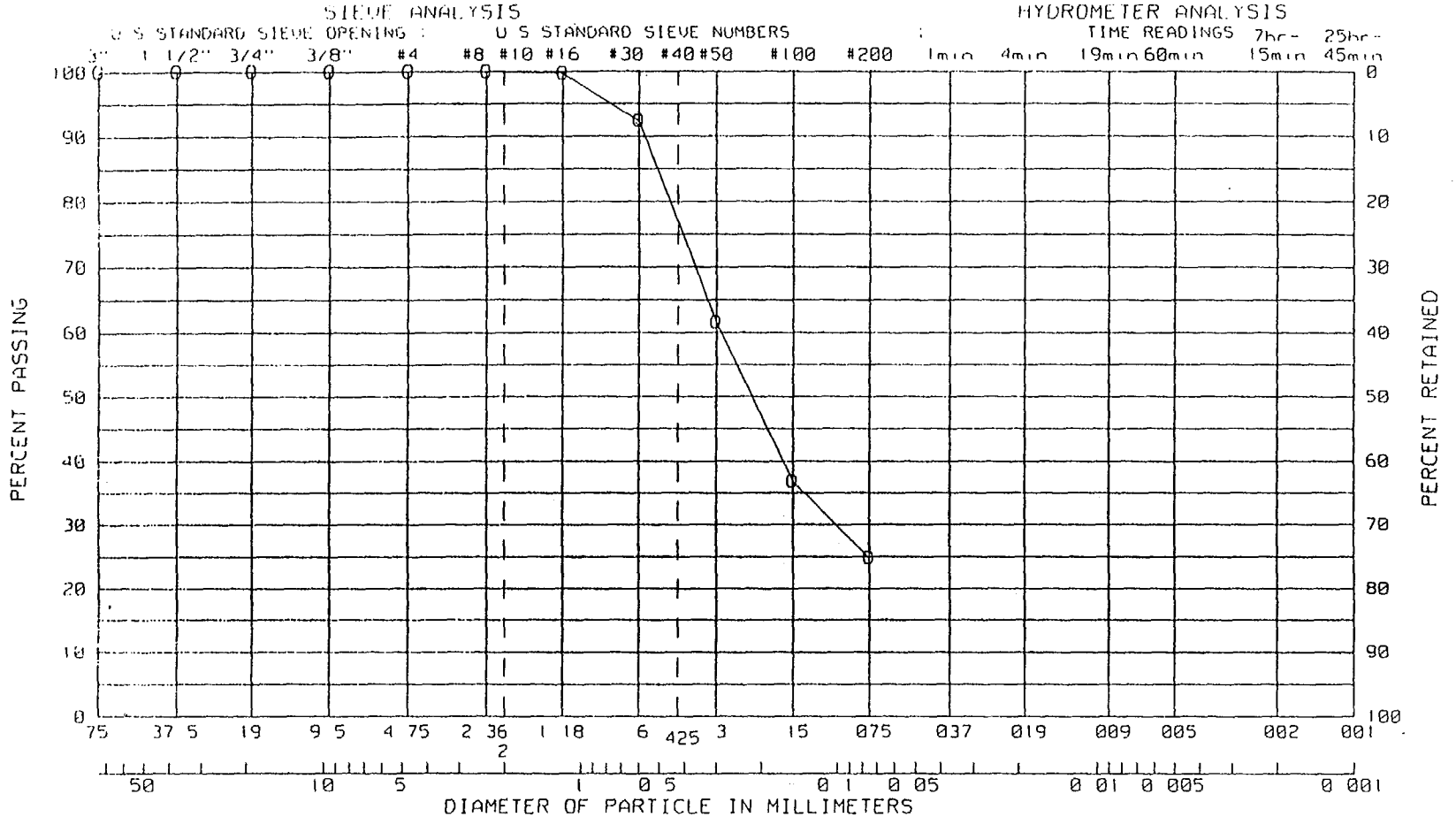
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 9 2-11 7 feet
SAMPLE NUMBER 70C-15T
NOTES B-WR02DHAT-01 ROASTER FINES-GRADATION USBR5335-89 WET SIEVE
UNIFIED SOIL CLASSIFICATION Group Symbol SP-SM Group Name Poorly Graded Sand with Silt
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 4 61
GRADATION Percent Gravel 0 0 Percent Sand 88 4 Percent Fines 11 6

PREPARED BY [signature] CHECKED BY [signature] 12/13/96 FIGURE 9

GRADATION TEST



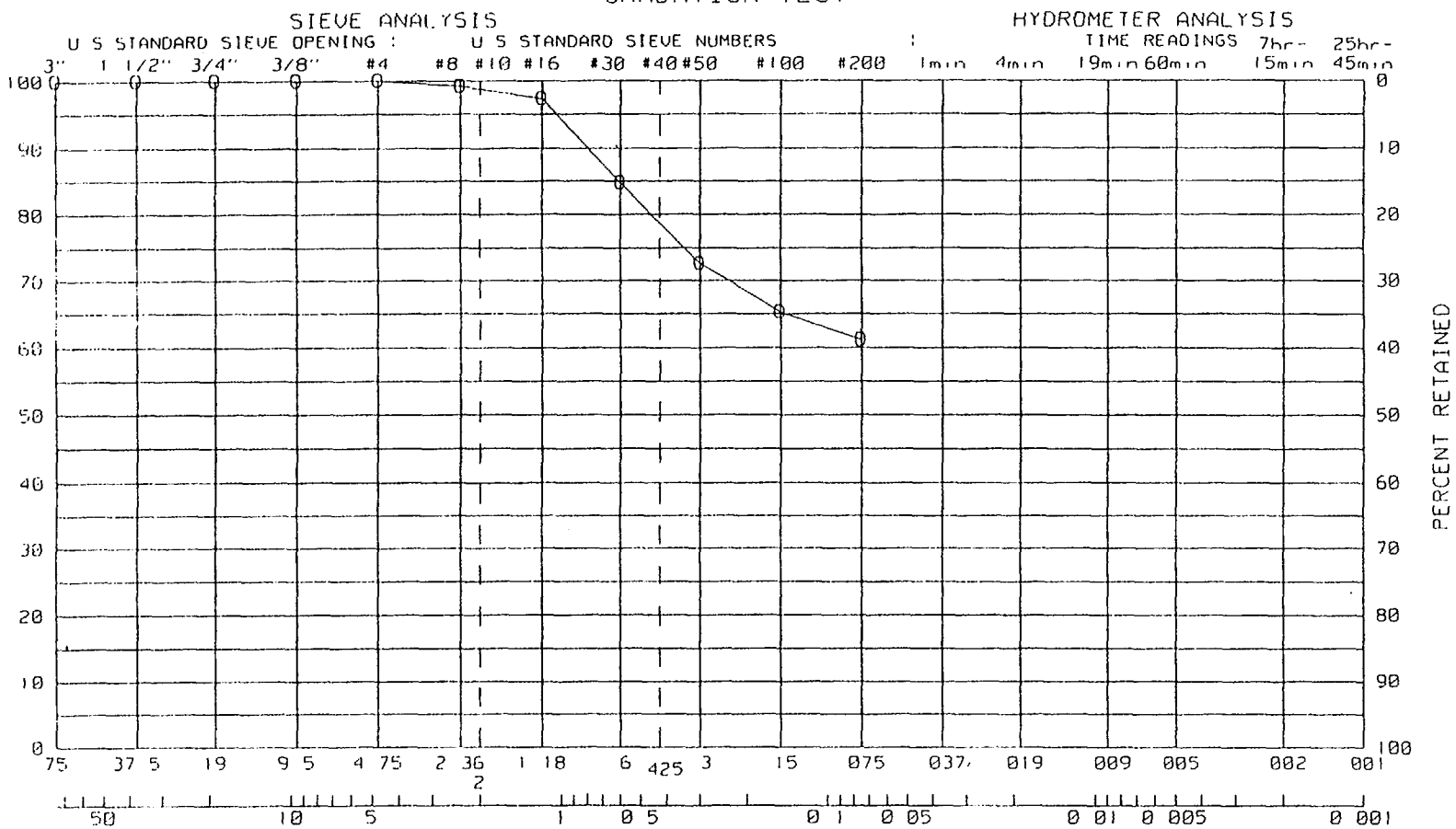
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 9 2-11 7 feet
SAMPLE NUMBER 70C-15B
NOTES B-WR020HAT-01 ROASTER FINES-GRADATION USBR 5335-89 WET SIEVE
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 4 55
GRADATION Percent Gravel 0 0 Percent Sand 75 3 Percent Fines 24 7

PREPARED BY Burkhardt CHECKED BY JAE 12/13/96 FIGURE 10

GRADATION TEST



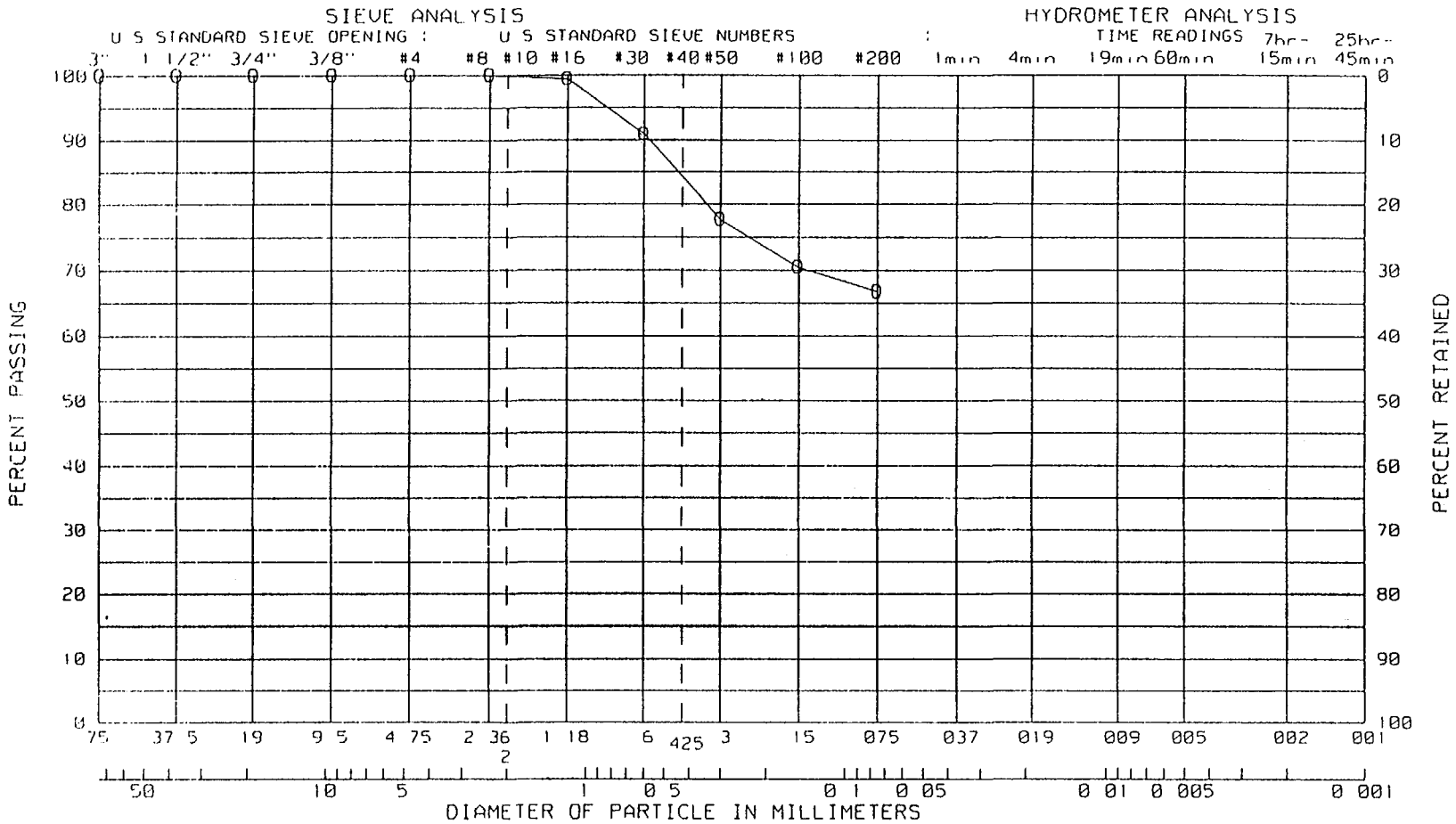
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 2 5-4 6 feet
SAMPLE NUMBER 70C-19T
NOTES B-WR01DHAT-01 ROASTER FINES-WET SIEVE-SpG 4 38 and 4 48-PH OF 3
UNIFIED SOIL CLASSIFICATION Group Symbol ML Group Name Sandy Silt
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 4 43
GRADATION Percent Gravel 0 0 Percent Sand 38 9 Percent Fines 61 1

PREPARED BY Burnham CHECKED BY JAC 12/13/96 FIGURE 11

GRADATION TEST



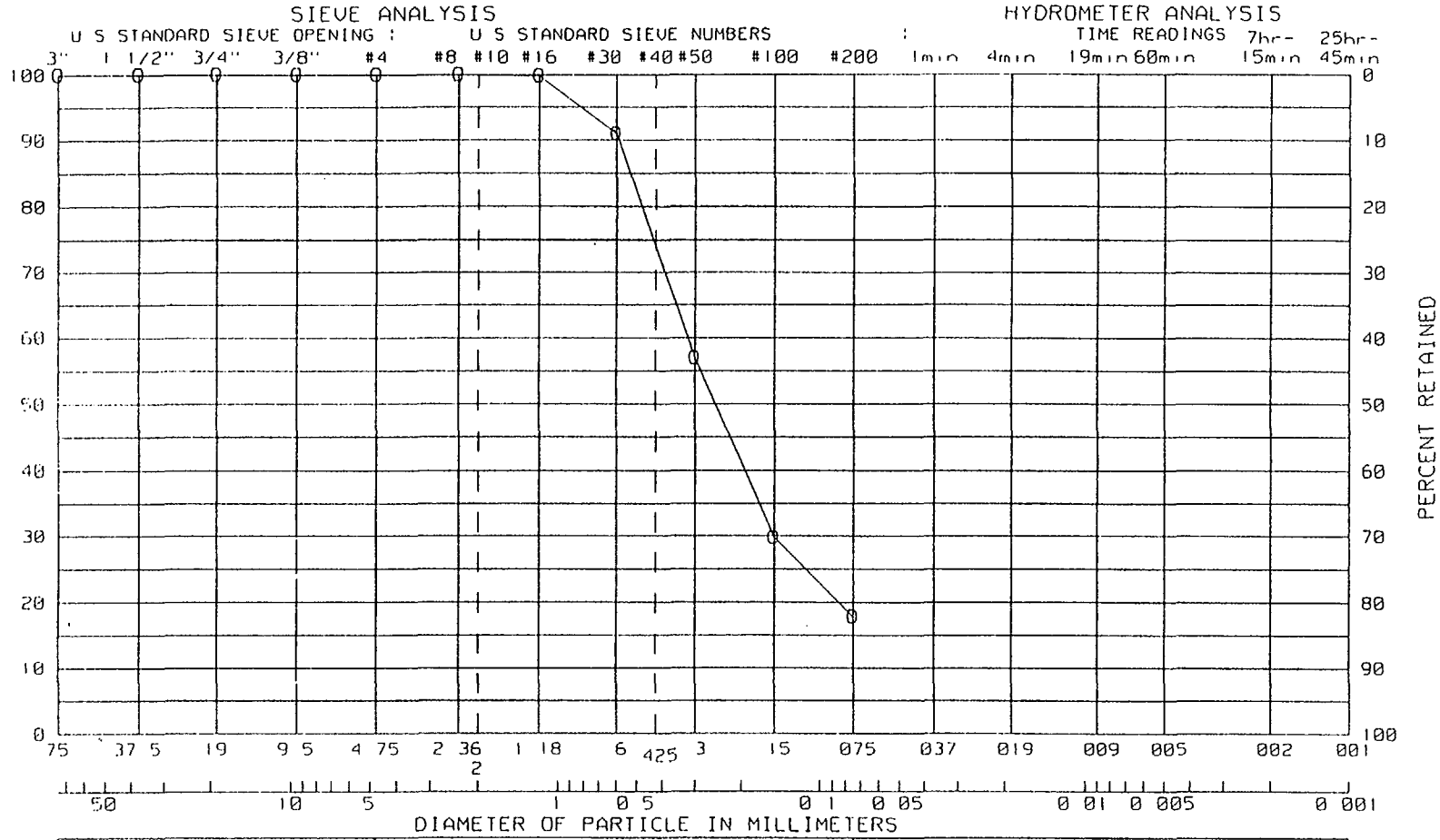
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 2 5-4 6 feet
SAMPLE NUMBER 70C-19B
NOTES B-WR01DHAT-01 ROASTER FINES-WET SIEVE-SpG 4 38 and 4 48-PH OF 3
UNIFIED SOIL CLASSIFICATION Group Symbol ML Group Name Sandy Silt
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 4 43
GRADATION Percent Gravel 0 0 Percent Sand 33 3 Percent Fines 66 7

PREPARED BY Burnham CHECKED BY JAE 12/13/96 FIGURE 12

GRADATION TEST



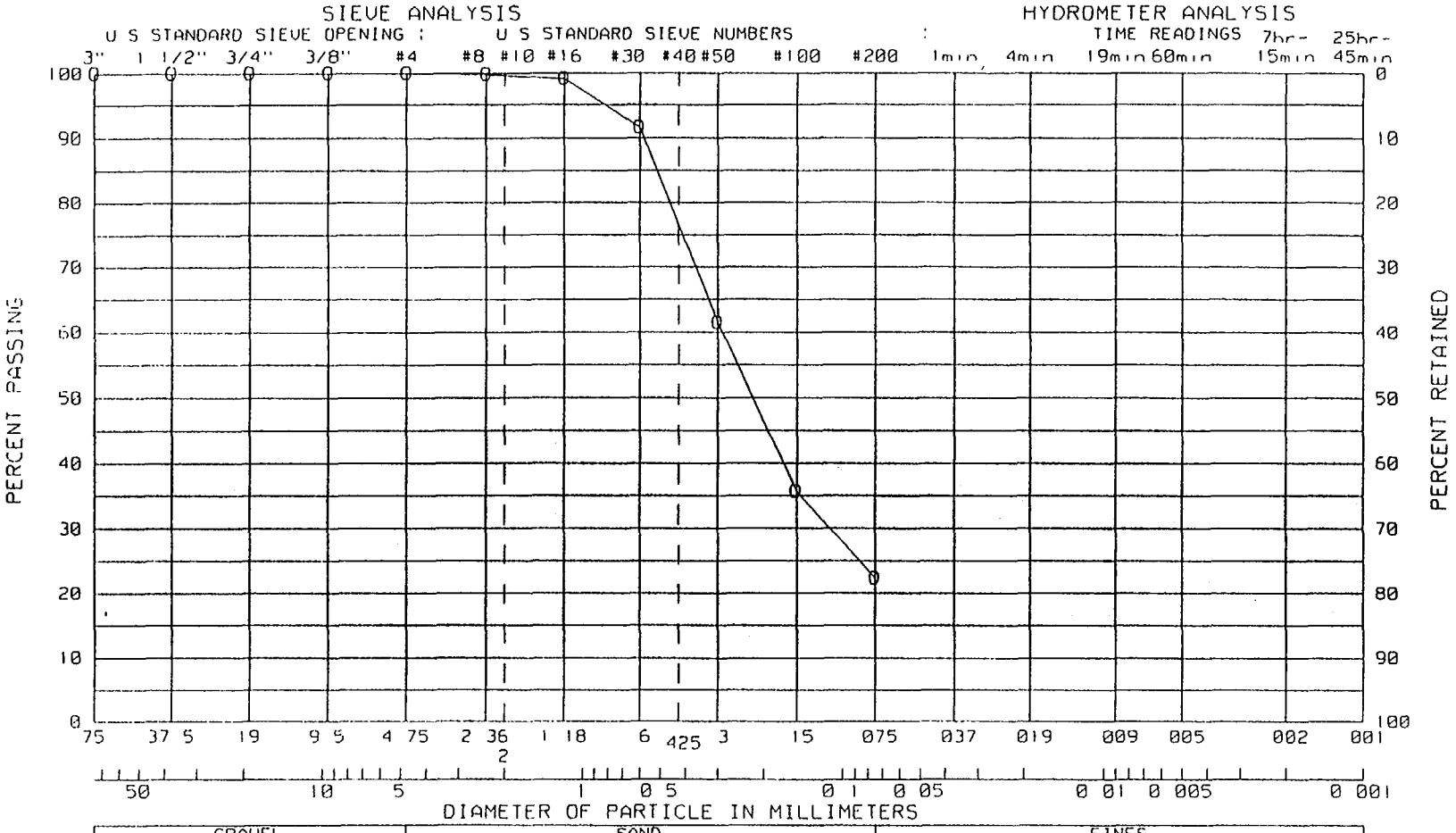
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 9 5-12 0 feet
SAMPLE NUMBER 70C-22T
NOTES B-WR01DHAT-01 ROASTER FINES-GRADATION USBR 5335-89 WET SIEVE
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 4 50
GRADATION Percent Gravel 0 0 Percent Sand 82 2 Percent Fines 17 8

PREPARED BY Burnham CHECKED BY JAR 02/13/96 FIGURE 13

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

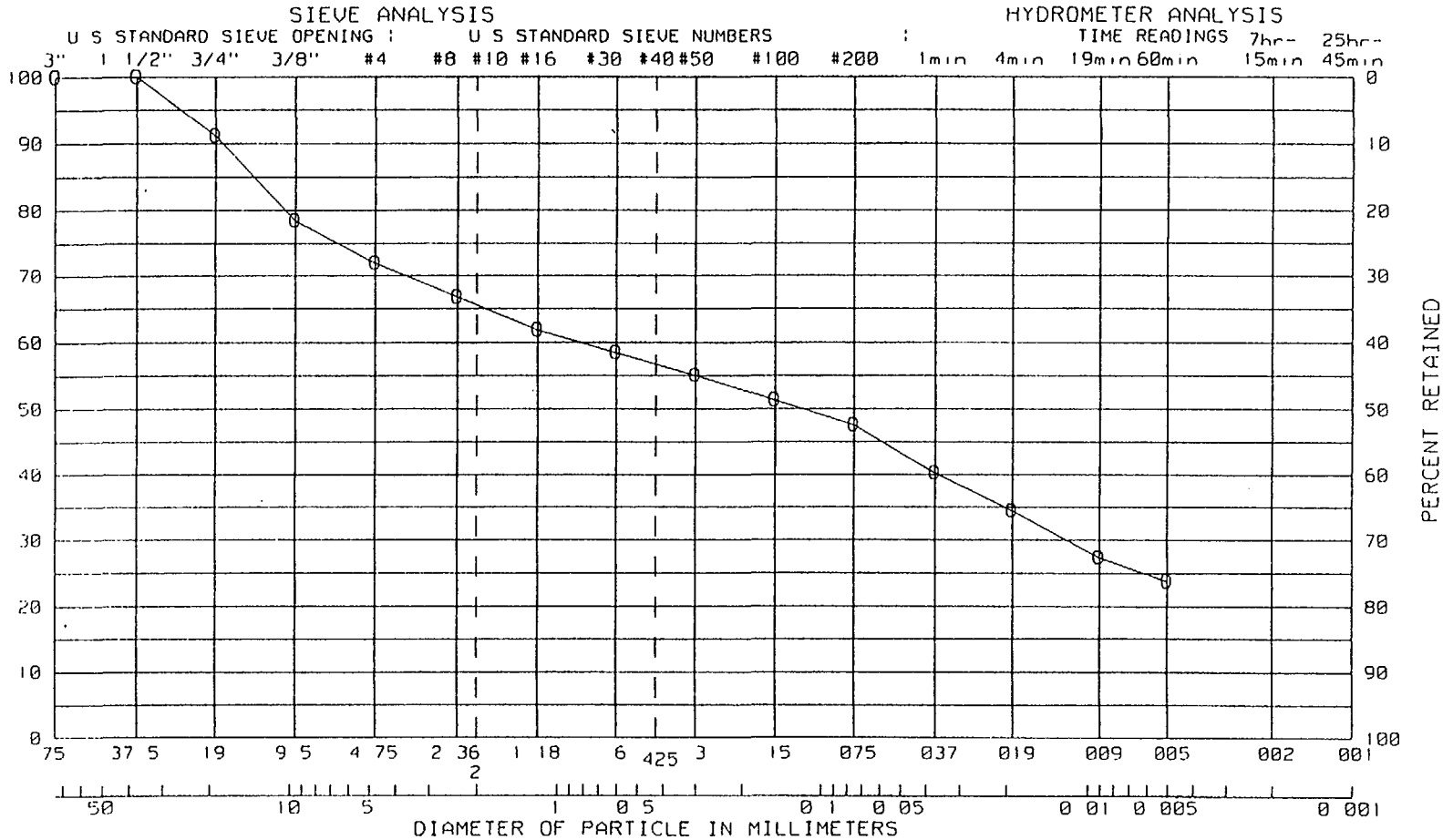
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 9 5-12 0 feet
SAMPLE NUMBER 70C-22B
NOTES B-WR01DHAT-01 ROASTER FINES-GRADATION USBR 5335-89 WET SIEVE
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 4 50
GRADATION Percent Gravel 0 0 Percent Sand 77 7 Percent Fines 22 3

PREPARED BY Bunham CHECKED BY JAF 12/13/96

FIGURE

GRADATION TEST



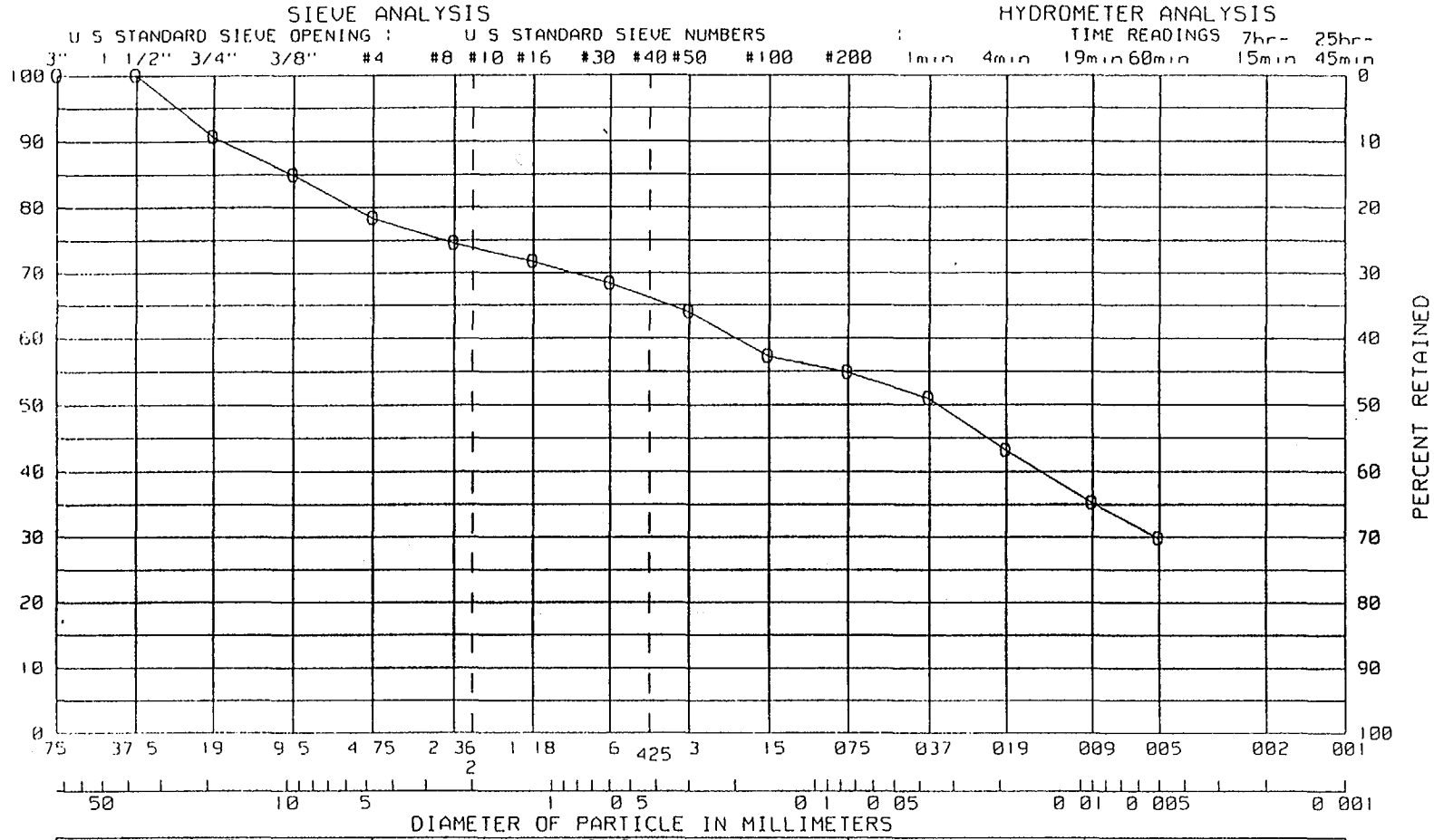
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 14 5-16 7 feet
SAMPLE NUMBER 70C-24T
NOTES B-WR01DHAT-01 ROASTER FINES
UNIFIED SOIL CLASSIFICATION Group Symbol GM Group Name Silty Gravel with Sand
ATTERBERG LIMITS Liquid Limit(/) 49 0 Plasticity Index(/) 21 0 Shrinkage Limit(/)
SPECIFIC GRAVITY Minus No 4 2 62
GRADATION Percent Gravel 28 1 Percent Sand 24 3 Percent Fines 47 6

PREPARED BY [signature] CHECKED BY JAK 12/17/96 FIGURE 15

GRADATION TEST



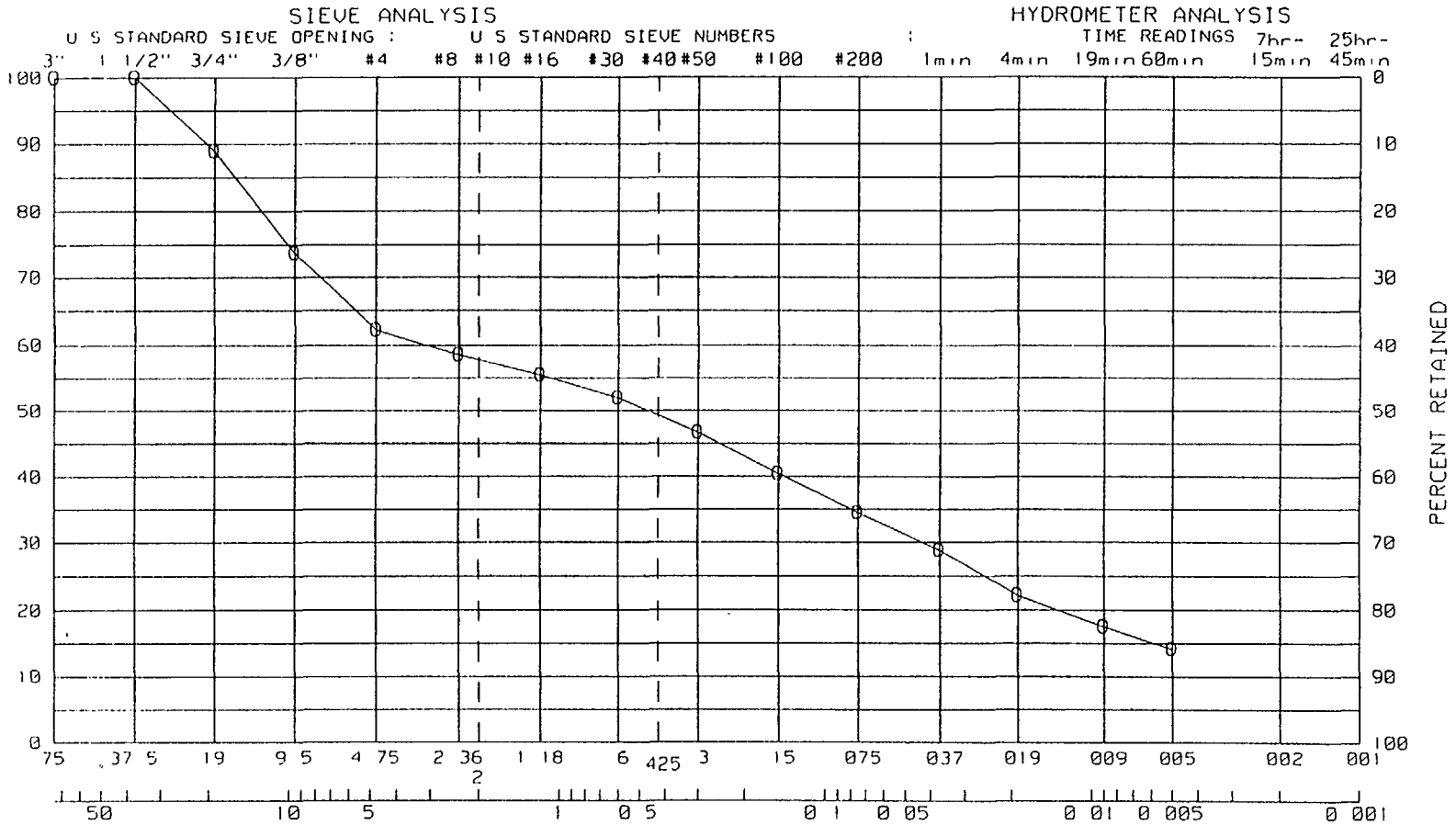
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 14 5-16 7 feet
SAMPLE NUMBER 70C-24B
NOTES B-WR01DHAT-01 ROASTER FINES
UNIFIED SOIL CLASSIFICATION Group Symbol CL Group Name Sandy Lean Clay with Gravel
ATTERBERG LIMITS Liquid Limit(/) 39 0 Plasticity Index(/) 19 0 Shrinkage Limit(/)
SPECIFIC GRAVITY Minus No 4 2 68
GRADATION Percent Gravel 21 7 Percent Sand 23 5 Percent Fines 54 8

PREPARED BY Burhart CHECKED BY JAF 12/13/96 FIGURE 12

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

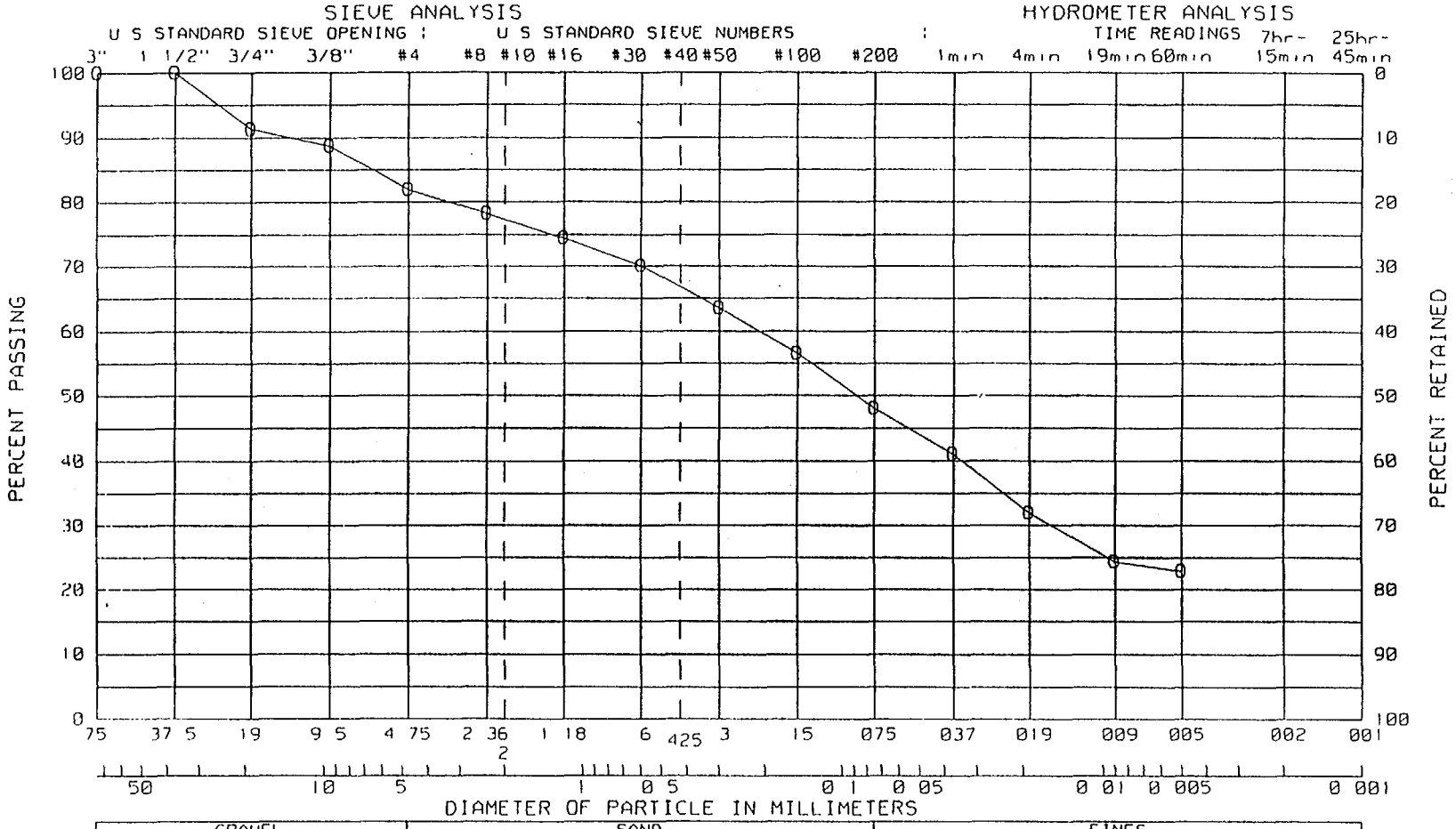
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE — PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES — DEPTH 2 4-4 7 feet
SAMPLE NUMBER 70C-26
NOTES B-EX01DH-01 EXTENUATE AREA
UNIFIED SOIL CLASSIFICATION Group Symbol GC Group Name Clayey Gravel with Sand
ATTERBERG LIMITS Liquid Limit(%) 31 0 Plasticity Index(%) 19 0 Shrinkage Limit(%)
SPECIFIC GRAVITY Minus No 4 2 70
GRADATION Percent Gravel 37 8 Percent Sand 27 7 Percent Fines 34 5

PREPARED BY [illegible] CHECKED BY JAF 12/13/96

FIGURE 17

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

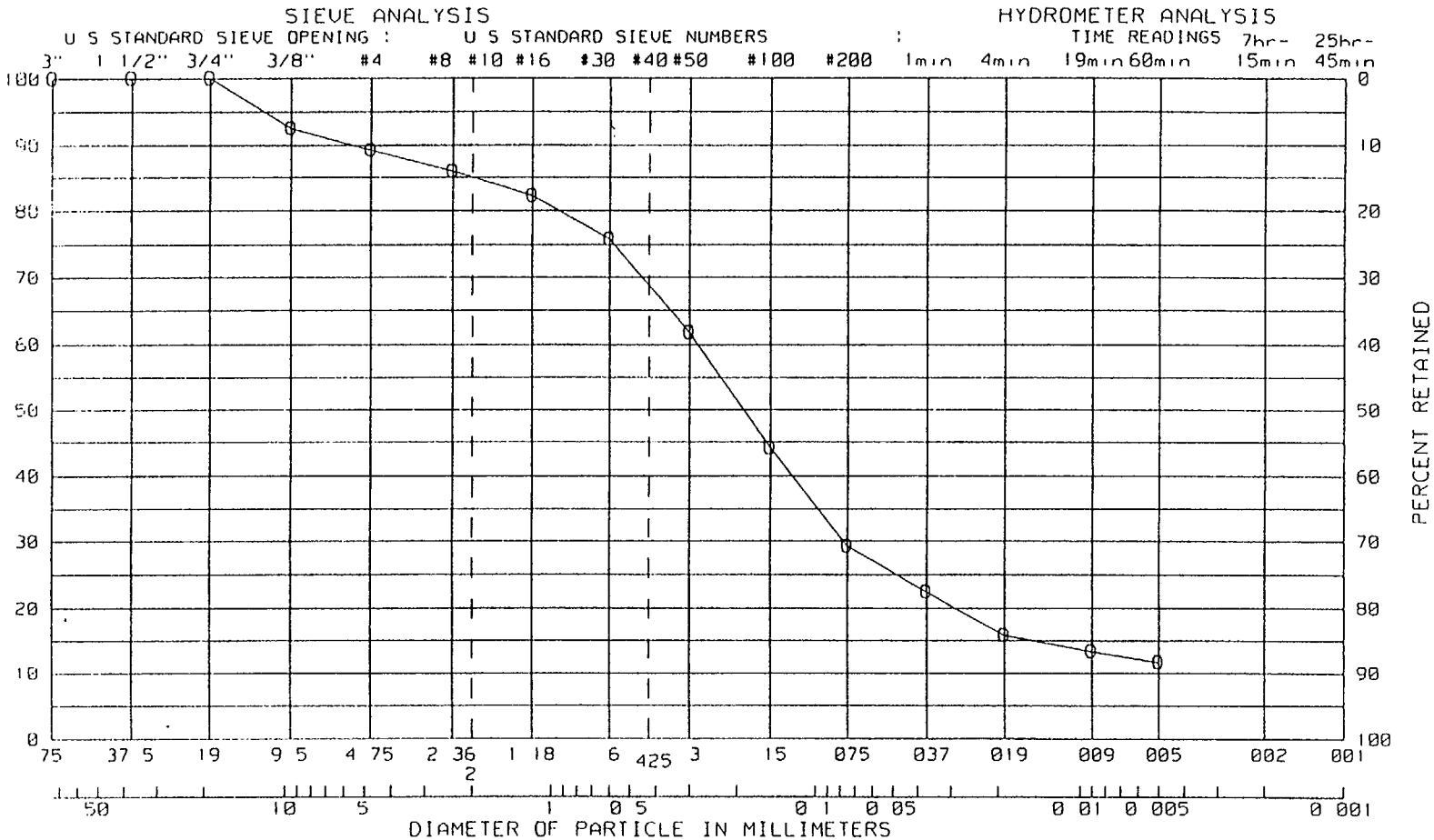
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE — PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES — DEPTH 9 2-9 7 feet
SAMPLE NUMBER 70C-29
NOTES 8-EX01DH-01 EXTENUATE AREA
UNIFIED SOIL CLASSIFICATION Group Symbol SC Group Name Clayey Sand with Gravel
ATTERBERG LIMITS Liquid Limit(/) 32 0 Plasticity Index(/) 14 0 Shrinkage Limit(/)
SPECIFIC GRAVITY Minus No 4 2 67
GRADATION Percent Gravel 18 1 Percent Sand 33 9 Percent Fines 48 0

PREPARED BY [illegible] CHECKED BY [illegible] 12/13/95

FIGURE 12

GRADATION TEST



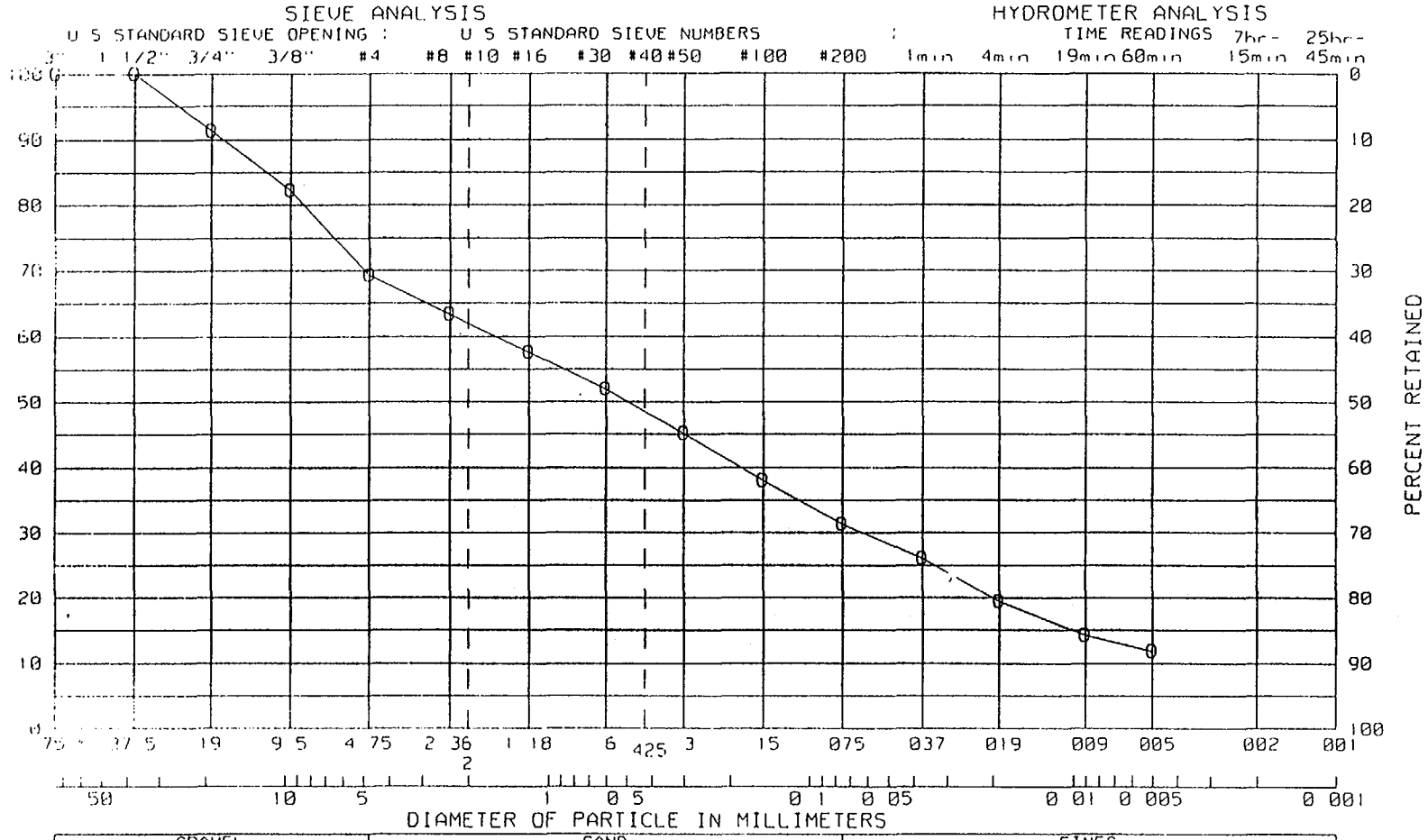
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE
PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES
DEPTH 13 2-13 6 feet
SAMPLE NUMBER 70C-33
NOTES B-EX01DH-01 EXTENUATE AREA
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 2 70
GRADATION Percent Gravel 10 8 Percent Sand 60 0 Percent Fines 29 2

PREPARED BY [signature] CHECKED BY [signature] 12/19/96 FIGURE 19

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

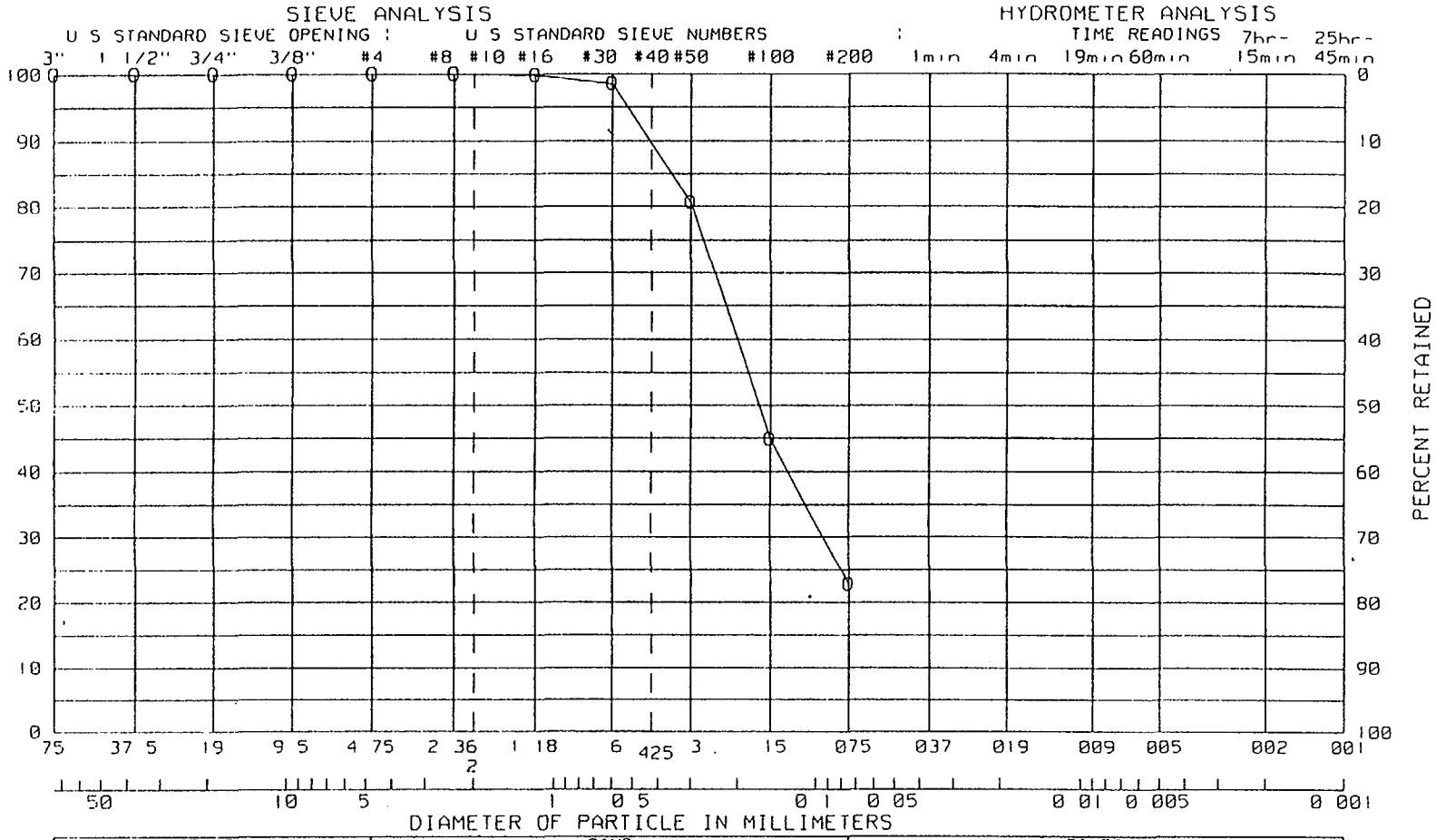
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE — PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES — DEPTH 4 7-7 2 feet
SAMPLE NUMBER 70C-37
NOTES B-EX02DHST-01 EXTENUATE AREA
UNIFIED SOIL CLASSIFICATION Group Symbol SC Group Name Clayey Sand with Gravel
ATTERBERG LIMITS Liquid Limit(/) 30 0 Plasticity Index(/) 8 0 Shrinkage Limit(/)
SPECIFIC GRAVITY NO TEST PERFORMED
GRADATION Percent Gravel 30 8 Percent Sand 37 9 Percent Fines 31 3

PREPARED BY [signature] CHECKED BY [signature] 12/16/96

FIGURE 2-2

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

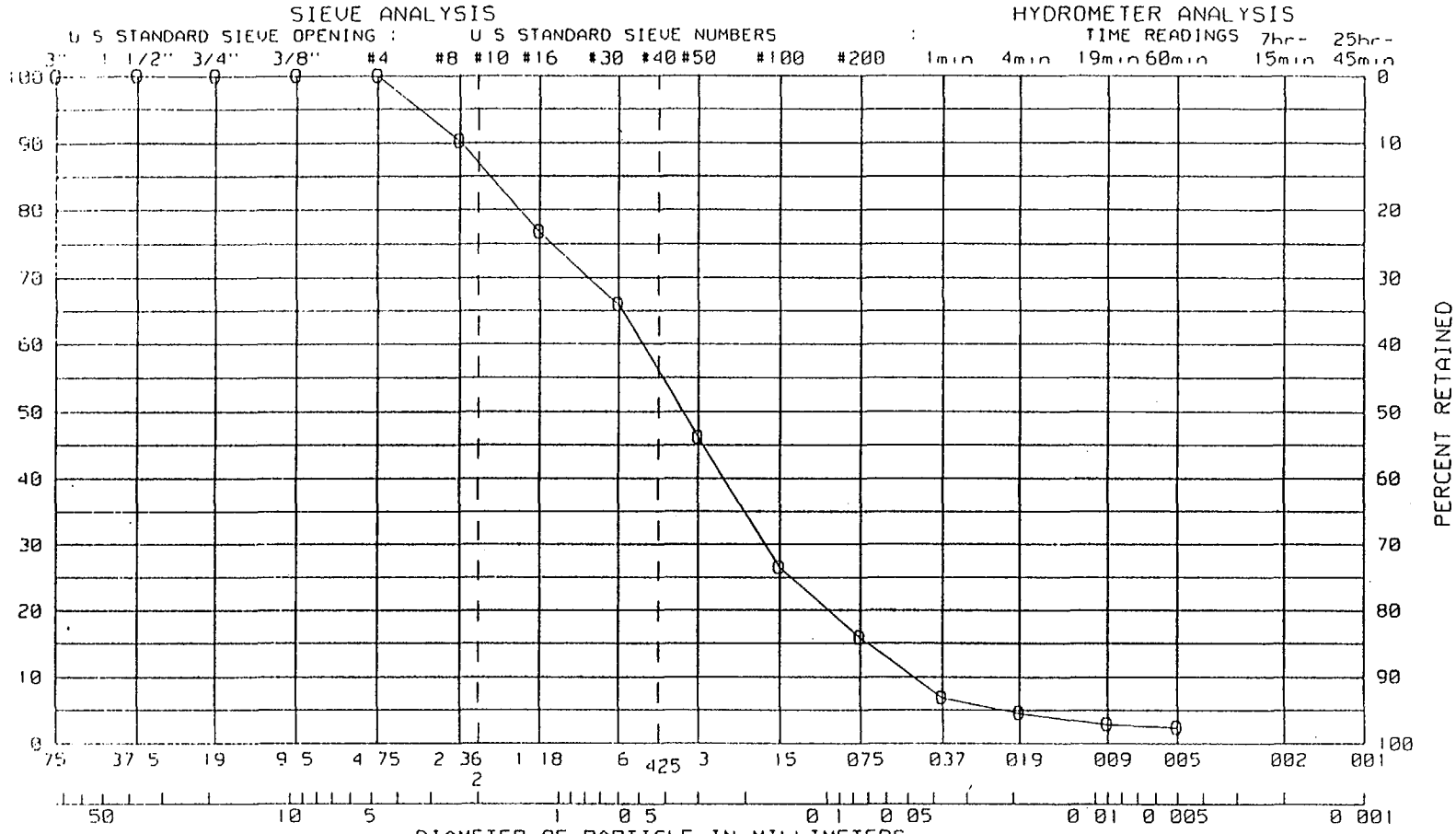
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE — PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES — DEPTH 2.5-4 4 feet
SAMPLE NUMBER 70C-41
NOTES B-WTL01DHST-01 LOWER TAILING AREA - USBR 5335-89 WET SIEVE
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 2 87
GRADATION Percent Gravel 0 0 Percent Sand 77 3 Percent Fines 22 7

PREPARED BY [illegible] CHECKED BY [illegible] 12/15/92

FIGURE

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

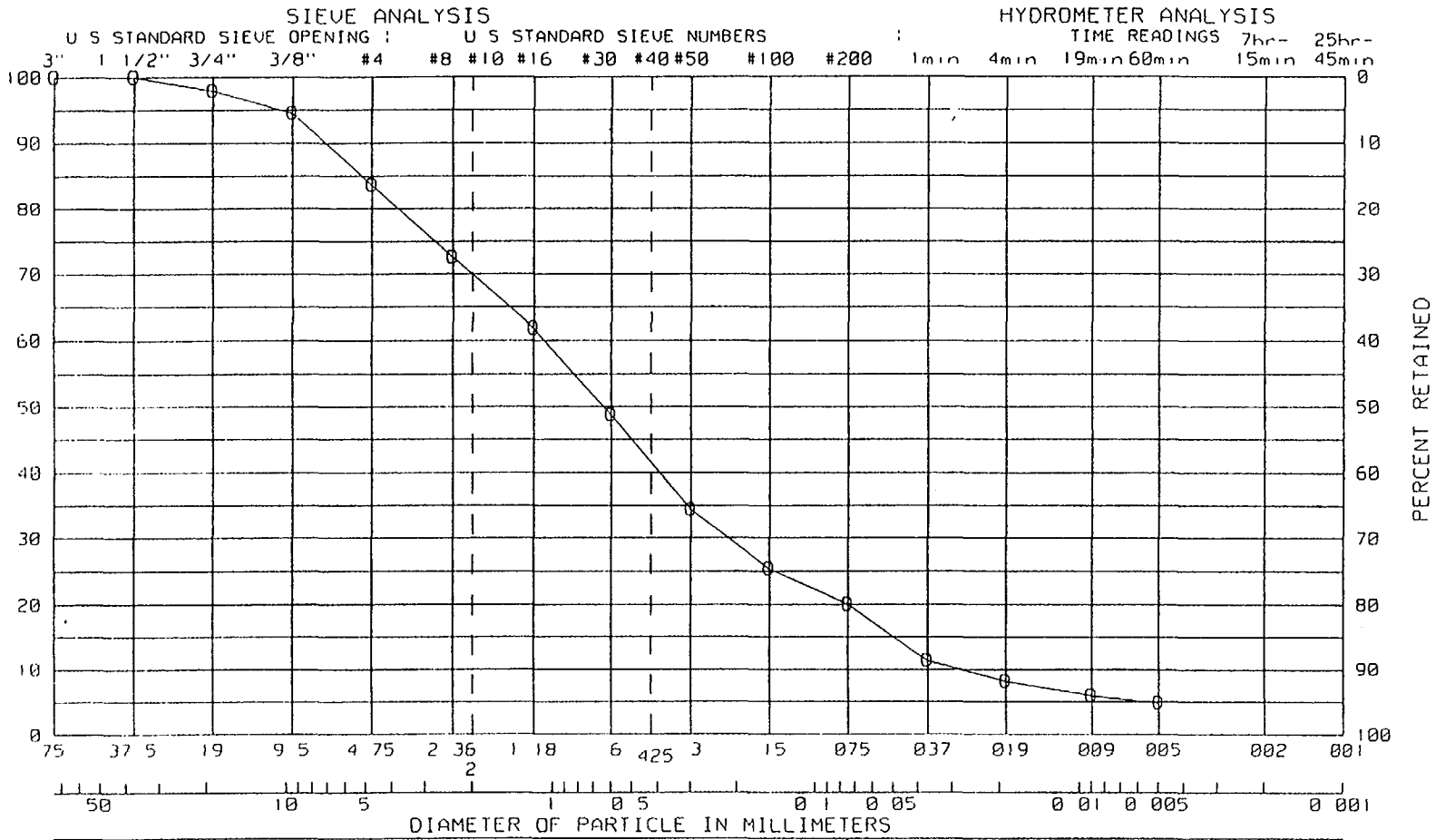
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE — PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES — DEPTH 9 8-12 3 feet
SAMPLE NUMBER 70C-44
NOTES 8-WTL01DHST-01 LOWER TAILINGS AREA
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 3 57
GRADATION Percent Gravel 0 0 Percent Sand 84 2 Percent Fines 15 8
D60 (mm) 488 D50 (mm) 344 D30 170 D10 (mm) 048
Coefficient of Curvature Cc 1 25 Coefficient of Uniformity Cu 10 26

PREPARED BY [signature] CHECKED BY [signature] 12/16/96

FIGURE 4

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

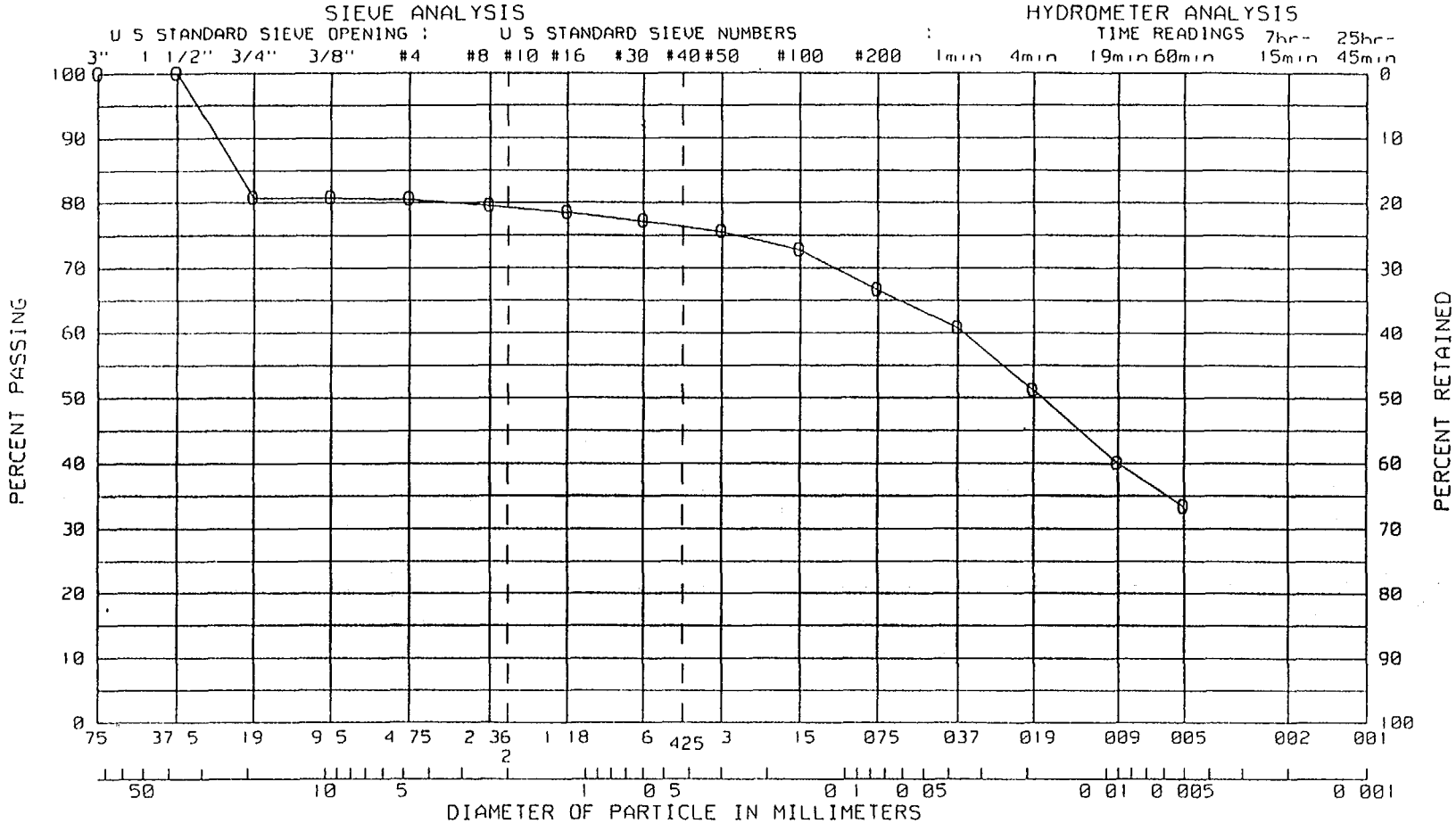
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE — PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES — DEPTH 19 8-21 8 feet
SAMPLE NUMBER 70C-49
NOTES B-WTL01DHST-01 LOWER TAILINGS AREA
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand with Gravel
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 3 26
GRADATION Percent Gravel 16 4 Percent Sand 63 6 Percent Fines 20 0
D60 (mm) 1 080 D50 (mm) 642 D30 215 D10 (mm) 028
Coefficient of Curvature Cc 1 52 Coefficient of Uniformity Cu 38 27

PREPARED BY Buchanan CHECKED BY JAE 12/13/96

FIGURE

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

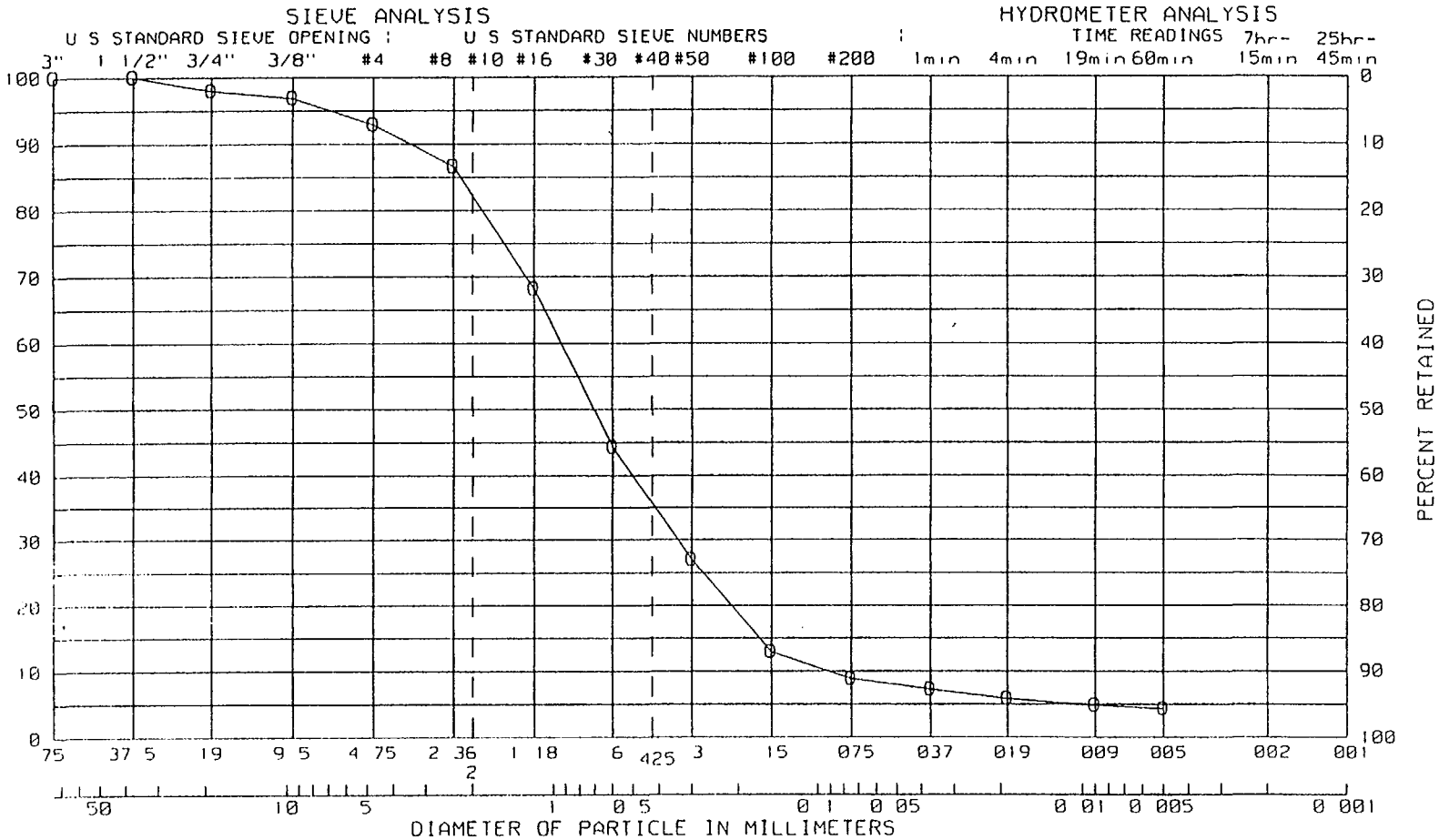
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 21 8-22 3 feet
SAMPLE NUMBER 70C-50
NOTES B-WTL01DHST-01 LOWER TAILINGS AREA
UNIFIED SOIL CLASSIFICATION Group Symbol ML Group Name Gravelly Silt
ATTERBERG LIMITS Liquid Limit(/) 44 0 Plasticity Index(/) 12 0 Shrinkage Limit(/)
SPECIFIC GRAVITY NO TEST PERFORMED
GRADATION Percent Gravel 19 5 Percent Sand 13 9 Percent Fines 66 6

PREPARED BY [illegible] CHECKED BY JAF 12/13/95

FIGURE [illegible]

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE
DRILL HOLE SEE NOTES
SAMPLE NUMBER 70C-52
NOTES B-WTL01DHST-01 LOWER TAILINGS AREA
UNIFIED SOIL CLASSIFICATION Group Symbol SW-SM Group Name Well-Graded Sand with Silt
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 2 76
GRADATION

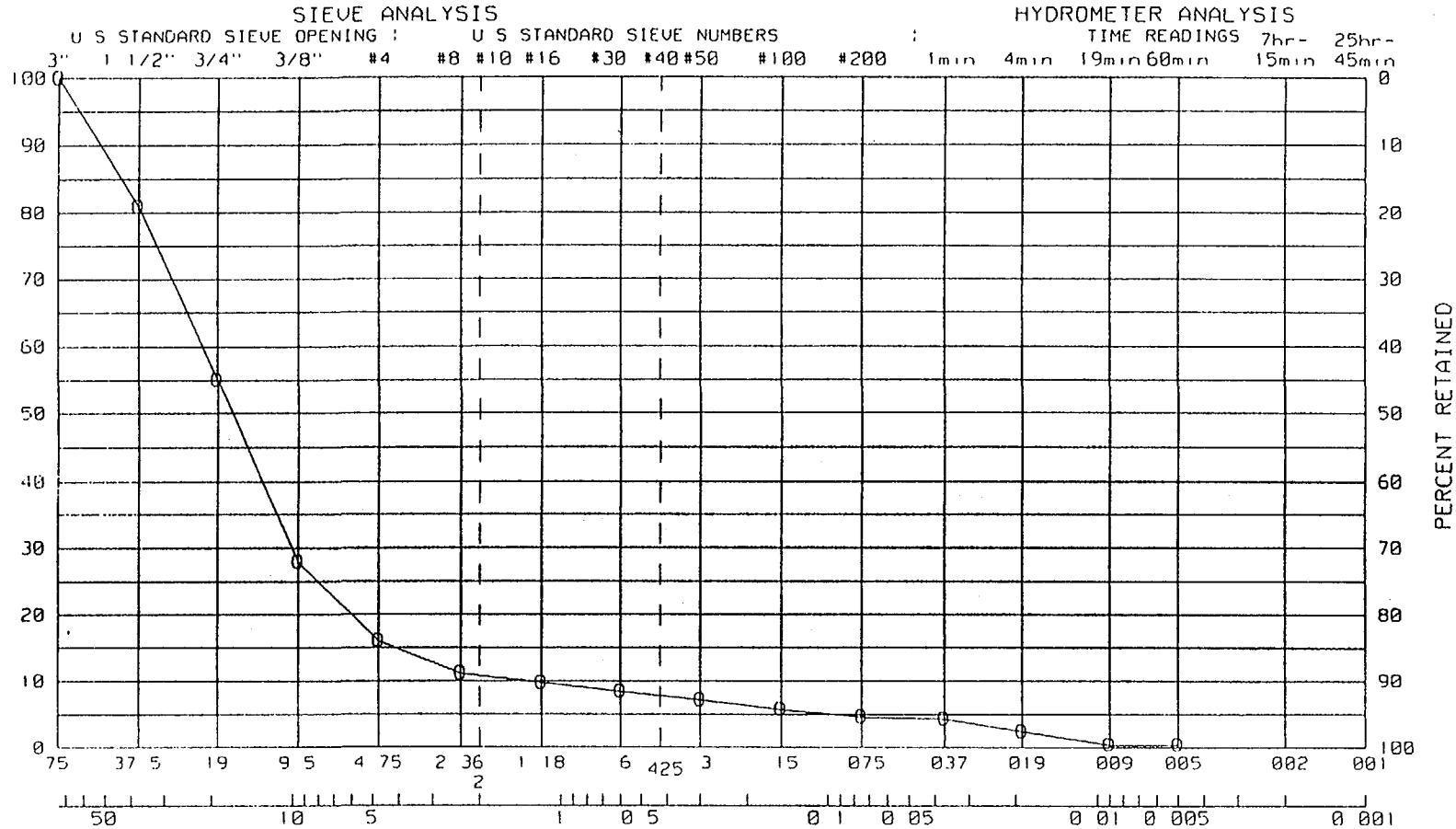
PROJECT EPA - REGION 8
DEPTH 27 3-29 8 feet

Percent Gravel 7 1 Percent Sand 84 1 Percent Fines 8 8
D60 (mm) 937 D50 (mm) 706 D30 338 D10 (mm) 092
Coefficient of Curvature Cc 1 33 Coefficient of Uniformity Cu 10 20

PREPARED BY [signature] CHECKED BY [signature] 12/12/75

FIGURE 25

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

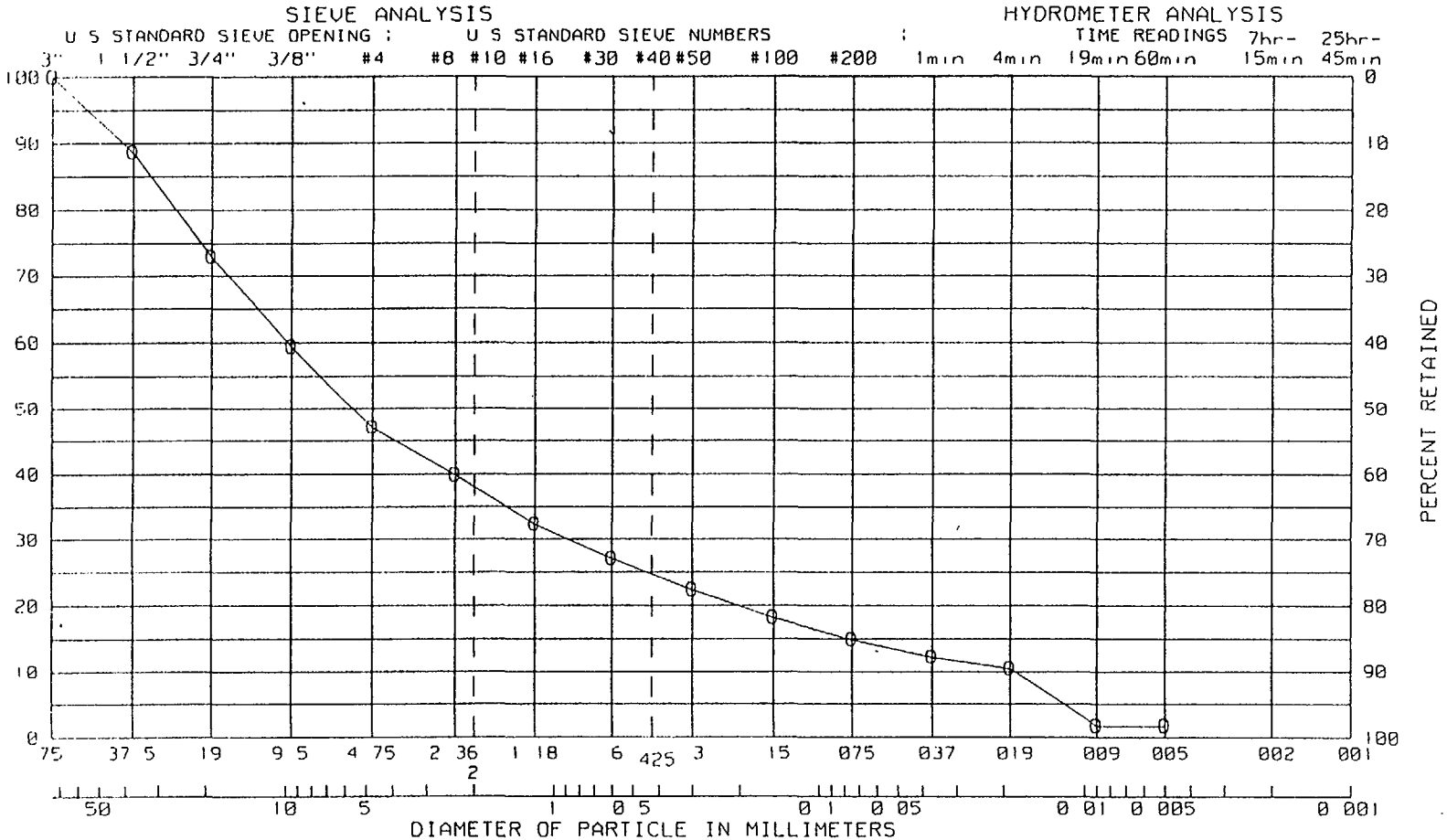
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 0 0-7 0 feet
SAMPLE NUMBER 70C-57A
NOTES B-WTU04TP01 UPPER TAILINGS-TESTS RUN ON AIR DRIED MATERIAL-TAN COLOR
UNIFIED SOIL CLASSIFICATION Group Symbol GP Group Name Poorly Graded Gravel
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 2 79
GRADATION Percent Gravel 84 0 Percent Sand 11 4 Percent Fines 4 6
D60 (mm) 21 665 D50 (mm) 16 719 D30 10 024 D10 (mm) 1 369
Coefficient of Curvature Cc 3 39 Coefficient of Uniformity Cu 15 83

PREPARED BY [illegible] CHECKED BY [illegible] 12/13/96

FIGURE [illegible]

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

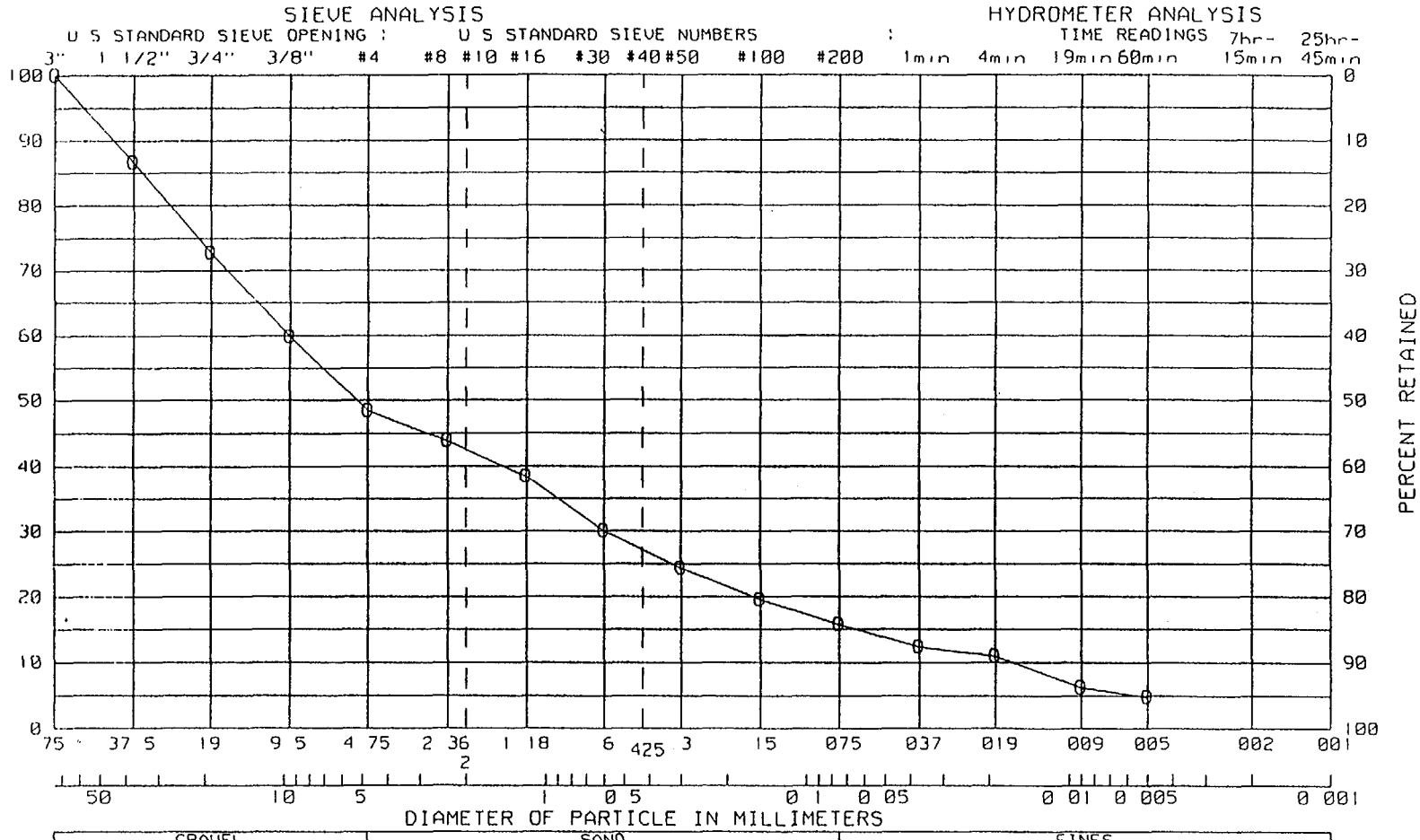
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 7 0-9 0 feet
SAMPLE NUMBER 70C-57B
NOTES BWTU04T901-UPPER TAILINGS-TESTS RUN ON AIR DRIED MATERIAL-ORANGE COLOR
UNIFIED SOIL CLASSIFICATION Group Symbol GM Group Name Silty Gravel with Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 2 83
GRADATION Percent Gravel 53 0 Percent Sand 32 1 Percent Fines 14 9
D60 (mm) 9 848 D50 (mm) 5 625 D30 880 D10 (mm) 018
Coefficient of Curvature Cc 4 28 Coefficient of Uniformity Cu 536 41

PREPARED BY [signature] CHECKED BY JAF 12/13/96

FIGURE 2.7

GRADATION TEST



PHYSICAL PROPERTIES SUMMARY

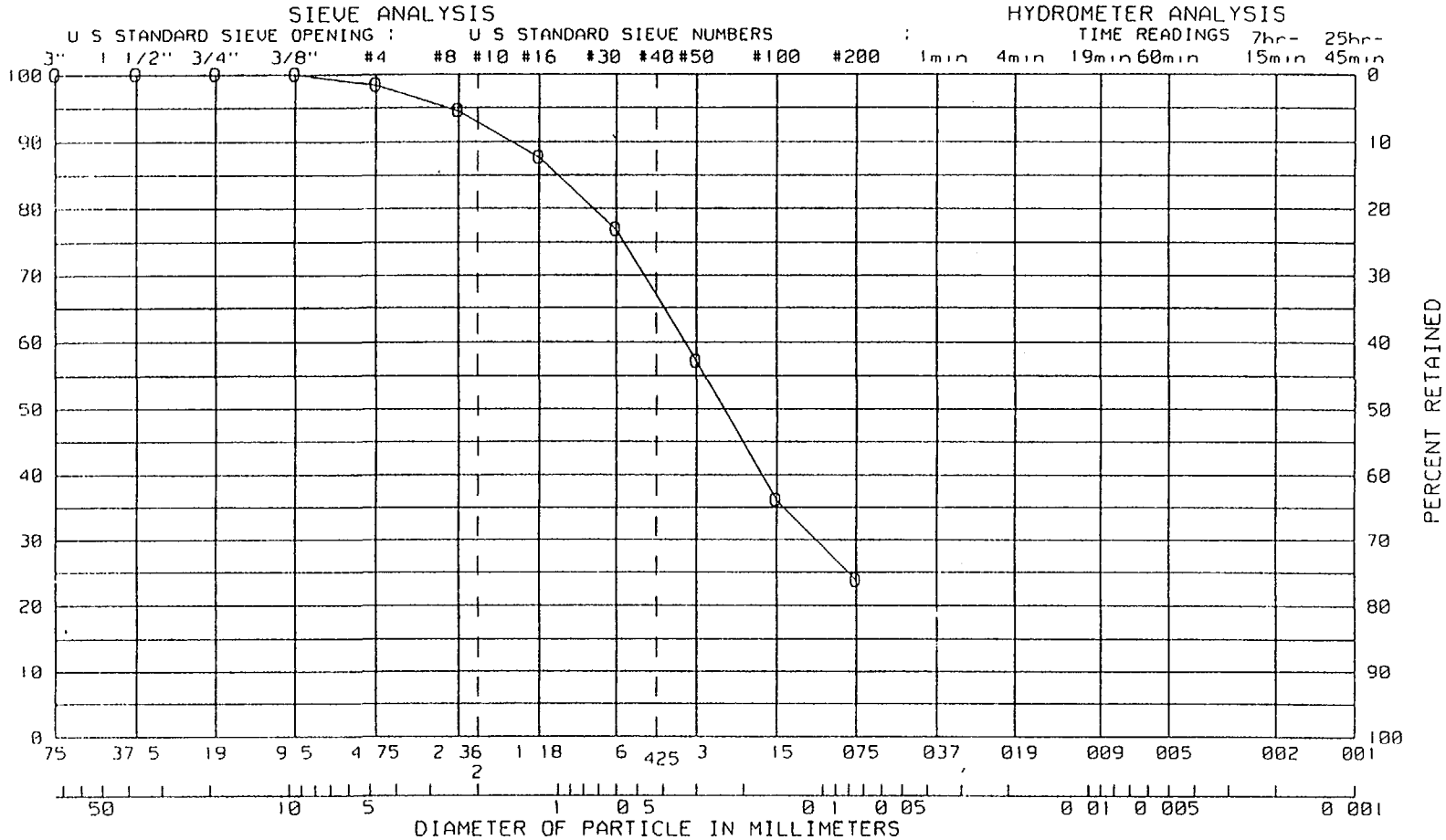
FEATURE BRECKENRIDGE
PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES
DEPTH 0 0-9 0 feet
SAMPLE NUMBER 70C-61
NOTES B-WTU05TP01 UPPER TAILINGS-TESTS RUN ON AIR DRIED MATERIAL
UNIFIED SOIL CLASSIFICATION Group Symbol GC Group Name Clayey Gravel with Sand
ATTERBERG LIMITS Liquid Limit(/) 30 0 Plasticity Index(/) 9 0 Shrinkage Limit(/)
SPECIFIC GRAVITY Minus No 4 2 74
GRADATION Percent Gravel 51 6 Percent Sand 32 7 Percent Fines 15 7
D60 (mm) 9 603 D50 (mm) 5 235 D30 600 D10 (mm) 016
Coefficient of Curvature Cc 2 28 Coefficient of Uniformity Cu 583 15

* MINE DEBRIS - WOOD & NAILS

PREPARED BY [illegible] CHECKED BY [illegible] 12/3/95

FIGURE [illegible]

GRADATION TEST



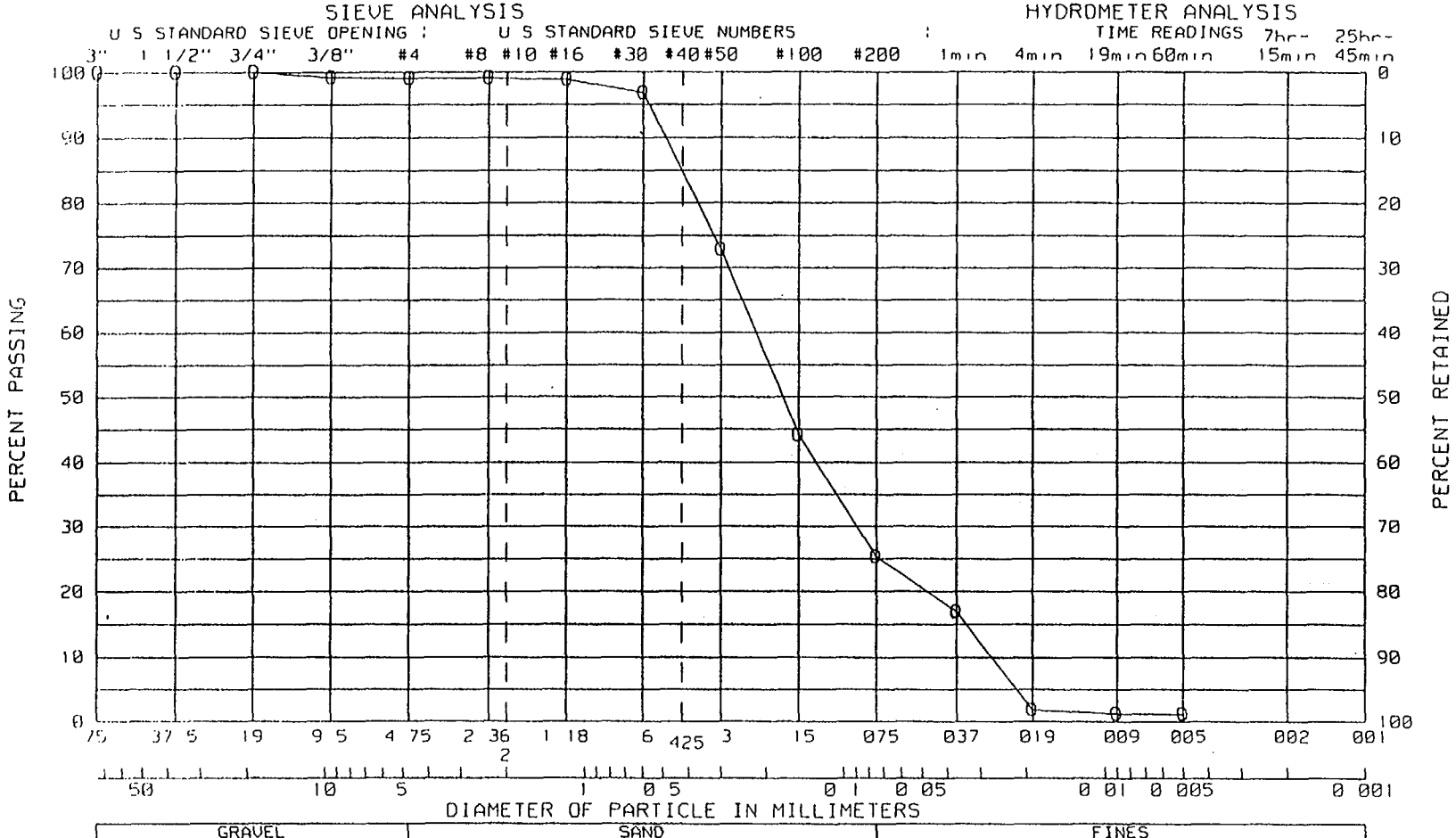
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 0 0-5 0 feet
SAMPLE NUMBER 70C-64
NOTES B-WTL08TP01 LOWER TAILINGS-TESTS RUN ON AIR DRIED MATERIAL-WET SIEVE
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 3 15
GRADATION Percent Gravel 1 6 Percent Sand 74 7 Percent Fines 23 7
D60 (mm) 332 D50 (mm) 237 D30 107 D10 (mm) 016
Coefficient of Curvature Cc 2 08 Coefficient of Uniformity Cu 20 18

PREPARED BY [signature] CHECKED BY [signature] 12/16/96 FIGURE 2[illegible]

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

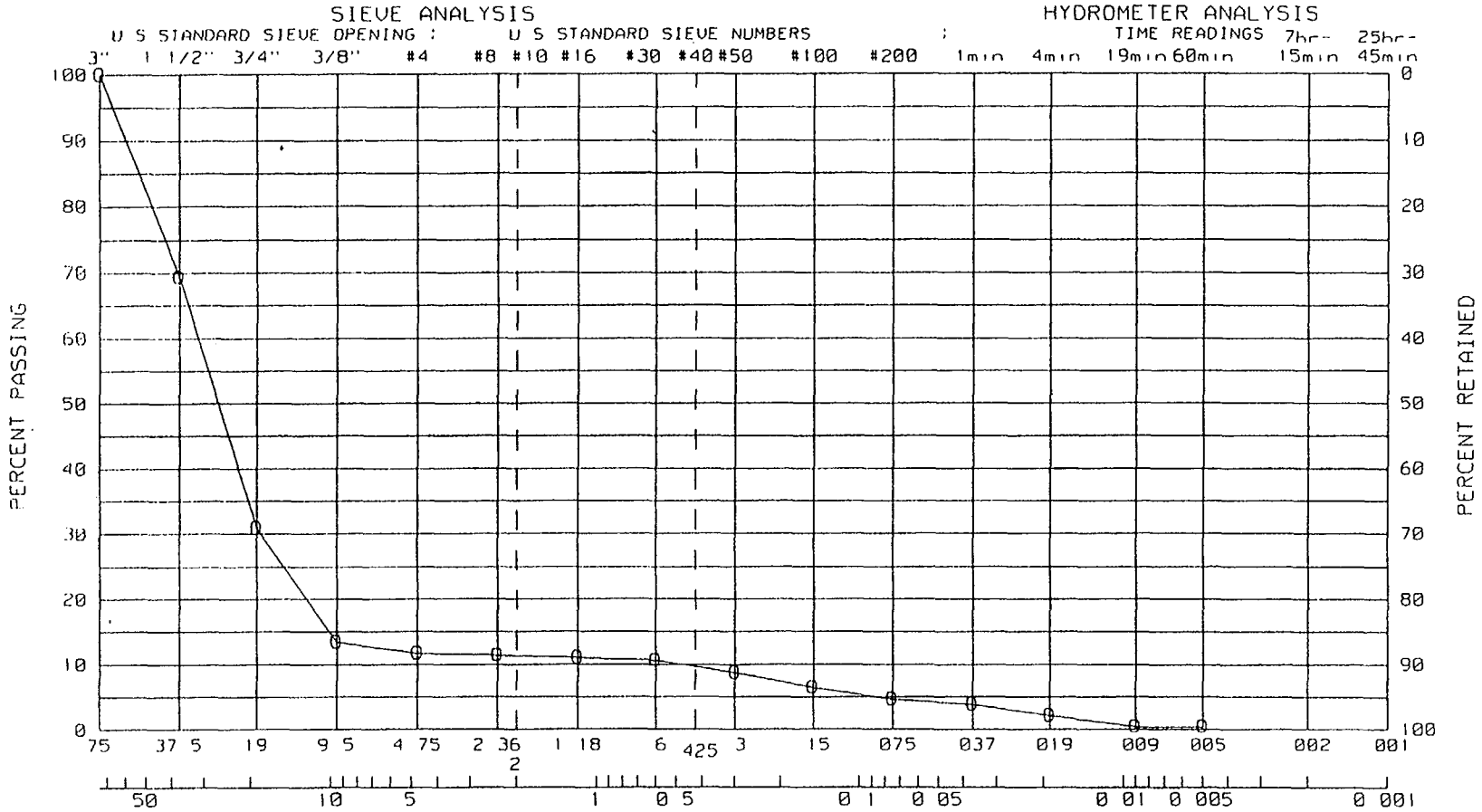
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 0 0-3 5 feet
SAMPLE NUMBER· 70C-65
NOTES 8-WTL07TP01 LOWER TAILINGS-TESTS RUN ON AIR DRIED MATERIAL
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 2 82
GRADATION Percent Gravel 9 Percent Sand 73 8 Percent Fines 25 3
D60 (mm) 220 D50 (mm) 173 D30 089 D10 (mm) 027
Coefficient of Curvature Cc 1 32 Coefficient of Uniformity Cu 8 07

PREPARED BY [illegible] CHECKED BY JAF 12/19/96

FIGURE 30

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

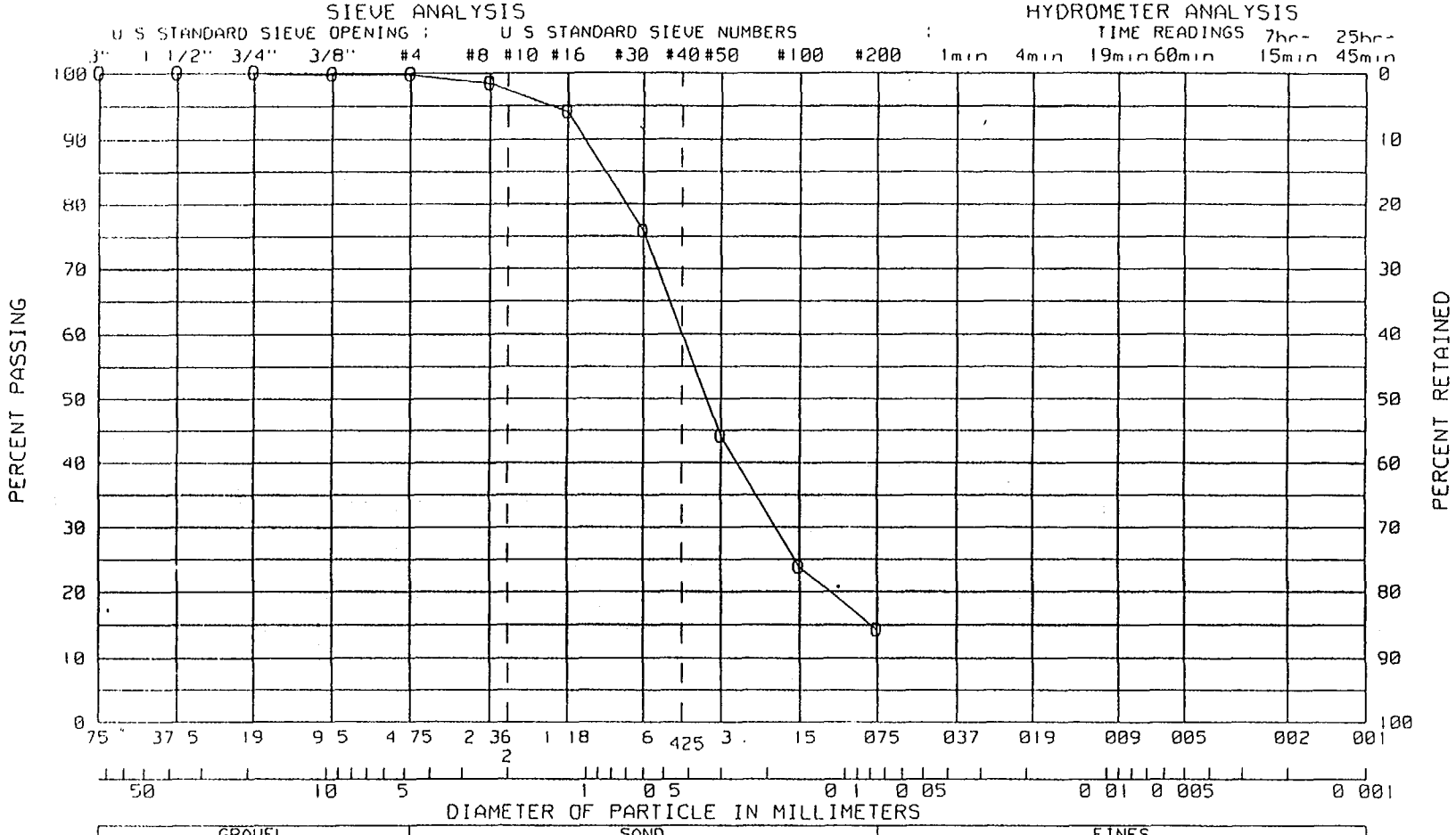
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE — PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES — DEPTH 3 5-11 0 feet
SAMPLE NUMBER 70C-66
NOTES B-WTL07TP01 LOWER TAILINGS-TESTS RUN ON AIR DRIED MATERIAL
UNIFIED SOIL CLASSIFICATION Group Symbol GP Group Name Poorly Graded Gravel
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 2 77
GRADATION Percent Gravel 88 3 Percent Sand 7 1 Percent Fines 4 6
D60 (mm) 31 820 D50 (mm) 26 669 D30 18 404 D10 (mm) 482
Coefficient of Curvature Cc 22 08 Coefficient of Uniformity Cu 66 01

PREPARED BY [illegible] CHECKED BY JAF 12/16/96

FIGURE 21

GRADATION TEST



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

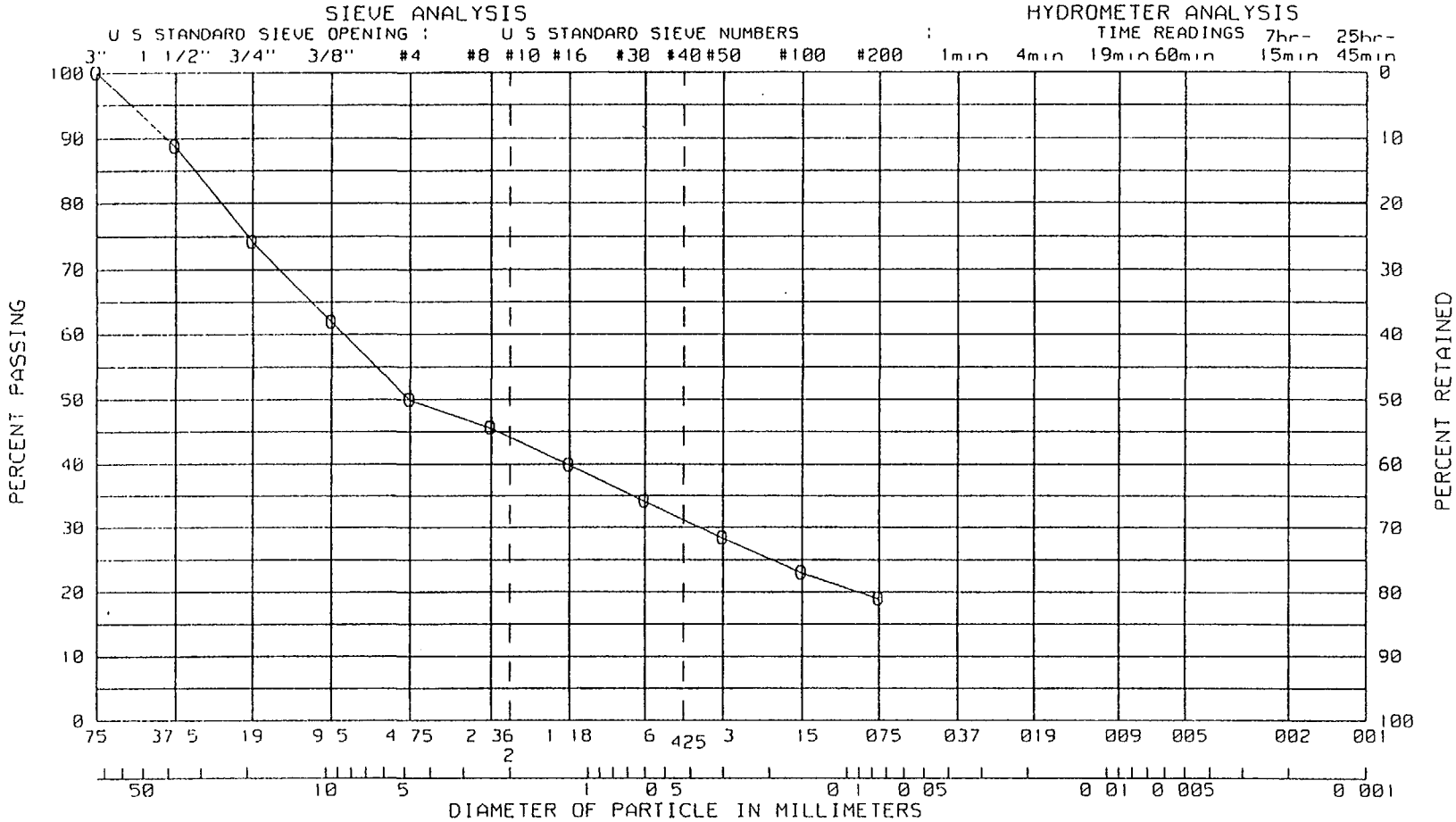
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 5 0 feet
SAMPLE NUMBER 70C-73
NOTES B-WTL02TP01 LOWER TAILINGS-TESTS RUN ON AIR DRIED MATERIAL-WET SIEVE
UNIFIED SOIL CLASSIFICATION Group Symbol SM Group Name Silty Sand
ATTERBERG LIMITS Non-Plastic
SPECIFIC GRAVITY Minus No 4 3 84
GRADATION Percent Gravel 3 Percent Sand 85 5 Percent Fines 14 2
D60 (mm) 426 D50 (mm) 342 D30 186 D10 (mm) 482
Coefficient of Curvature Cc 17 Coefficient of Uniformity Cu 88

PREPARED BY [illegible] CHECKED BY [illegible] 12/10/86

FIGURE 22

GRADATION TEST



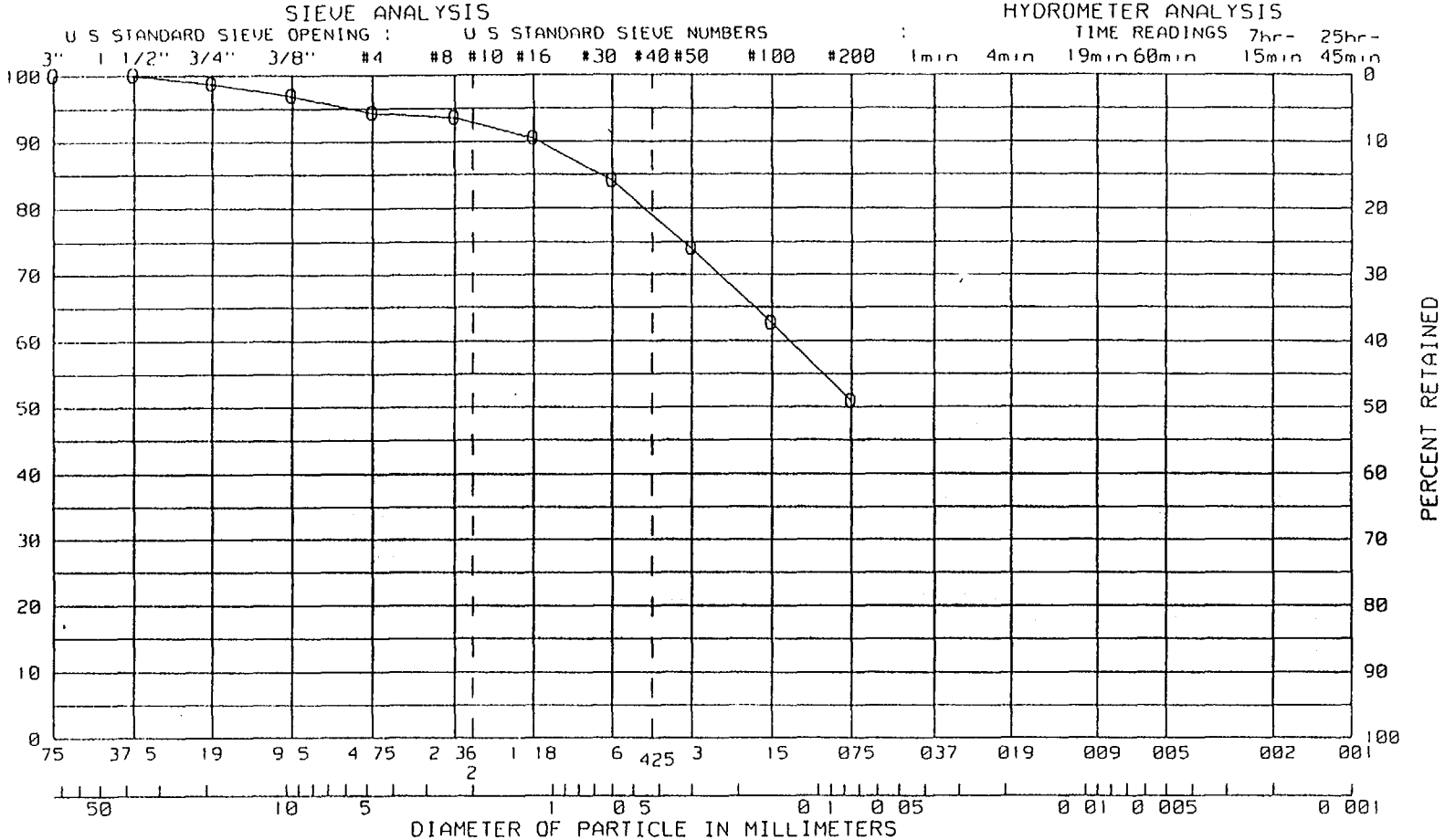
PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 0 0-9 0 feet
SAMPLE NUMBER 70C-74
NOTES 8-EX06TP01-EXTENUATE AREA- TESTS RUN ON AIR DRIED MATERIAL-WET SIEVE
UNIFIED SOIL CLASSIFICATION Group Symbol GC Group Name Clayey Gravel with Sand
ATTERBERG LIMITS Liquid Limit(/) 38 0 Plasticity Index(/) 14 0 Shrinkage Limit(/)
SPECIFIC GRAVITY Minus No 4 2 77
GRADATION Percent Gravel 50 1 Percent Sand 31 0 Percent Fines 18 9
D60 (mm) 8 554 D50 (mm) 4 778 D30 368 D10 (mm) 482
Coefficient of Curvature Cc 03 Coefficient of Uniformity Cu 17 75

PREPARED BY [illegible] CHECKED BY [illegible] 12/16/96

FIGURE 2-2

GRADATION TEST



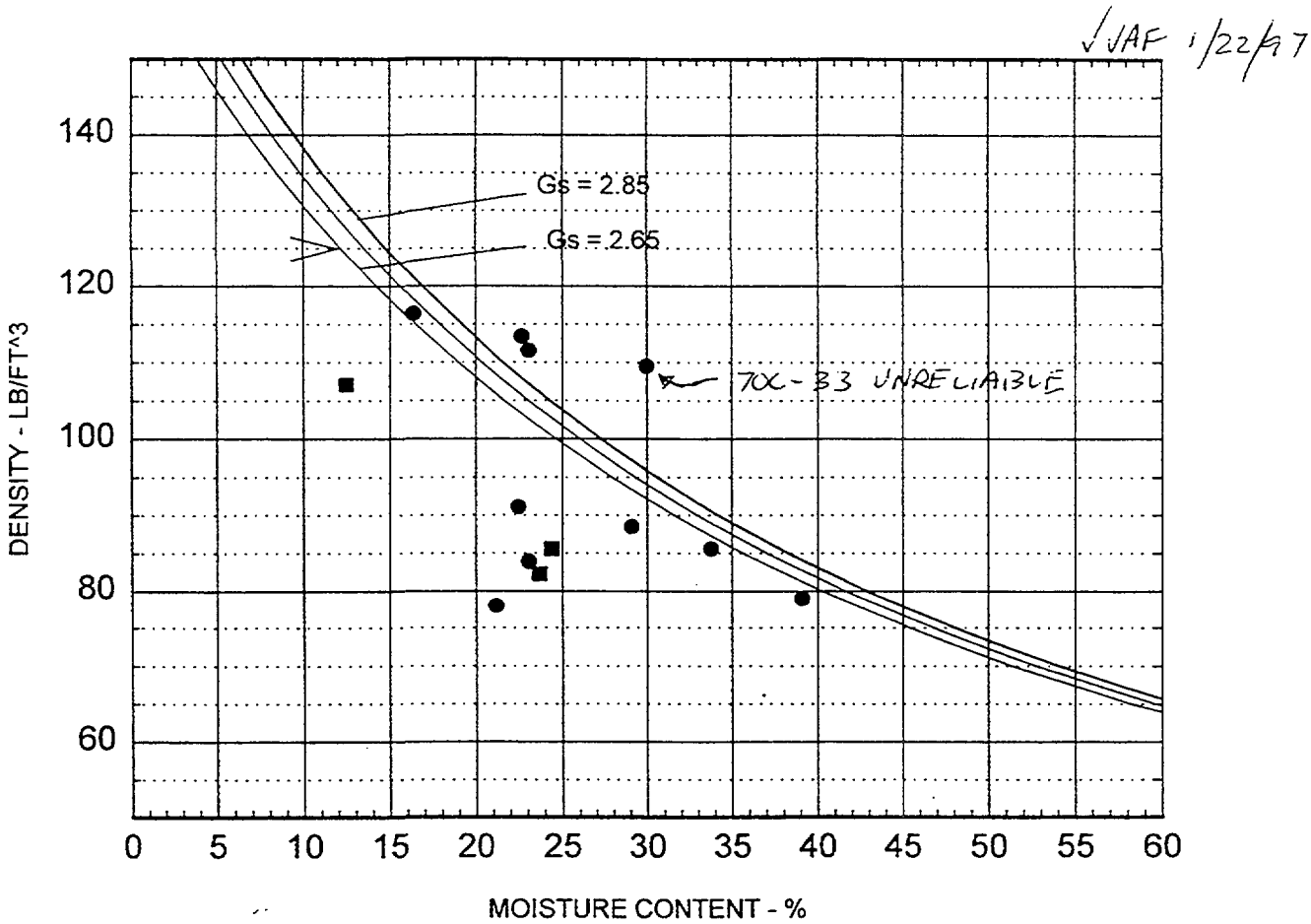
GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	

PHYSICAL PROPERTIES SUMMARY

FEATURE BRECKENRIDGE PROJECT EPA - REGION 8
DRILL HOLE SEE NOTES DEPTH 5 4 feet
SAMPLE NUMBER 70C-76
NOTES B-EX01TP01-EXTENUATE AREA- TESTS RUN ON AIR DRIED MATERIAL-WET SIEVE
UNIFIED SOIL CLASSIFICATION Group Symbol CL Group Name Sandy Lean Clay
ATTERBERG LIMITS Liquid Limit(/) 32 0 Plasticity Index(/) 12 0 Shrinkage Limit(/)
SPECIFIC GRAVITY Minus No 4 2 67
GRADATION Percent Gravel 5 7 Percent Sand 43 5 Percent Fines 50 8

PREPARED BY [signature] CHECKED BY JAF 12/10/96 FIGURE 34

MOISTURE DENSITY RELATIONSHIPS



—— DRY DENSITY VS. MOISTURE CONTENT AT 100% SATURATION FOR Gs RANGE 2.65 TO 2.85

● DRY DENSITY DATA FROM WELLINGTON- ORO TUBE SAMPLES

■ DRY DENSITY DATA FROM TEST PITS

FIGURE 35 - MOISTURE DENSITY RELATIONSHIPS FOR SOIL

APPENDIX 5 - SUBSURFACE METALS DATA

United States Department of the Interior

BUREAU OF RECLAMATION
Reclamation Service Center
P.O. Box 25007
Building 67, Denver Federal Center
Denver, Colorado 80225-0007

IN REPLY REFER TO:

D-8240
RES-1.10

NOV 27 1996

MEMORANDUM

To: Manager, Geotechnical Engineering Group 3
Attention: D-8313 (T. Brown)

From: Michael Simonavice, Client Representative
Technical Service Center
Environmental Research Chemistry Laboratory Group

Subject: ICP Scan of Wellington-Oro samples (Reference Number D8240961127-2)

Attached are the final results for the 19 samples sent into our lab for analysis on November 4, 1996. These samples were digested by EPA Method 3051. The digested samples were then analyzed by ICP Scan using EPA Method 200.7. There was no other preparation involved in the samples, besides the microwave digestion. All samples were received in good condition.

All holding times were met and all internal QC criteria were met. The acceptance limits for the certified reference material (CRM) digested with these samples is based on Method 3050 digestion. Since the samples were more rigorously digested, the following elements for the CRM were biased slightly high: Ba/Co/K/Ni/Pb/V. All other data meets our laboratory Quality Assurance Plan (QAP 2.1).

If you have questions regarding this report, please contact me, your Client Representative at (303) 236-4290 extension 224, Group Manager, Margaret Lake at extension 256, or Quality Control Officer, Doug Craft at extension 255.

Michael Simonavice

Attachments

****

SAMPLE IDENTIFIERS
USBR CHEMISTRY LABORATORY
DENVER COLORADO

****

ID data file..... UC8522
BATCH NUMBER..... 63
Type of samples..... soil
Sampling date..... 11/04/1996
Date logged in..... 11/04/1996
Date due..... 12/02/1996
Priority..... High
Recall number..... ER638
Project..... BRECKENRIDGE - EPA REGION 8
Feature..... SOIL

Requested analyses (or codes).:. ICAP SCAN

SAMPLE IDENTIFIERS

J- 8522	70C-1
J- 8523	70C-3
J- 8524	70C-5
J- 8525	70C-13
J- 8526	70C-15
J- 8527	70C-19
J- 8528	70C-22
J- 8529	70C-24
J- 8530	70C-26
J- 8531	70C-29
J- 8532	70C-33
J- 8533	70C-41
J- 8534	70C-44
J- 8535	70C-49
J- 8536	70C-52

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****

SAMPLE LOG-IN SUMMARY
USBR CHEMISTRY LABORATORY
DENVER, COLORADO

****

BATCH NUMBER..... 71
DATA disk file name....UC8649

==========

Type of samples.....soil
Submitted by.....TOM BROWN, D-8313
Number of samples.....4
Chem lab numbers.....J- 8649 to 8652
Sampling date.....11/07/1996
Requested analyses.....ICAP SCAN
Region of origin.....UC
Project.....BRECKENRIDGE - EPA REGION 8
Feature.....SOIL

==========

Recall number.....ER638
DUE DATE.....12/02/1996
PRIORITY.....High

==========

SAMPLE IDENTIFIERS

SAMPLE 1 J-8649 70C-60 #1 OF 5
SAMPLE 2 J-8650 70C-60 #4 OF 5
SAMPLE 3 J-8651 70C-62 0-2'
SAMPLE 4 J-8652 70C-73

==========

LABORATORY ANALYSIS SUMMARY REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Trace Elements By ICP/~~GFAA~~

Date Printed: *15-Nov-96*

Analyst Initial:

	Method	272.2	200.7	206.2	200.7	200.7	200.7	200.7	213.2	200.7	200.7	200.7	200.7	200.7	200.7
	Units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
	ICP-MDL	0.8	6	14	2	0.8	0.8	6	0.8	0.6	2	1	0.8	200	6
	GFAA-MDL	0.1		0.2					0.02						
	Report Limit	0.4	20	0.6	2	0.8	0.8	13.4	0.1	0.6	2	3.4	14	660	6.6
Lab#	StationID	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	Mg
J8522		12	1300	212	ND	67	0.32	30400	9.71	ND	2.8	380	66400	1800	1320
J8523		7.63	1550	102	ND	35.3	0.591	16300	23.1	6.32	3.62	1060	58400	1230	7860
J8524		1.06	13400	ND	ND	158	1	1720	5.79	9.95	16.8	135	22200	1790	4950
J8529		1.22	14700	18.4	ND	126	0.978	1690	8.61	3.62	15.9	134	23400	2100	3500
J8530		2.01	13200	15.3	ND	171	0.663	1060	3.79	5.29	15.4	46.4	34800	1620	4700
J8531		2.17	19300	19.9	ND	129	0.963	2480	6.09	11	17.3	62.5	35100	2810	5880
J8532		2.41	13700	23.7	ND	138	0.906	2760	7.52	15.8	14.2	70.8	30500	2070	4960

LABORATORY ANALYSIS SUMMARY REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Trace Elements By ICP/GFAA

Date Printed: *15-Nov-96*

Analyst Initial:

	Method	200.7	200.7	200.7	200.7	239.2	200.7	200.7	200.7	200.7	200.7	200.7				
	Units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg				
	ICP-MDL	0.8	2	6	2	6	4	6	4		0.8	0.8				
	GFAA-MDL					0.278										
	Report Limit	3.4	2	20	2	0.6	4	6	14		0.8	3.4				
Lab#	StationID	Mn	Mo	Na	Ni	Pb	Sb	Se	Si	Sr	V	Zn				
J8522		1000	5.07	72.5	2.95	3500	4.93	ND	403	35.6	14.2	3170				
J8523		5960	ND	19.1	11.2	3650	ND	ND	495	24.6	11	7880				
J8524		963	ND	45.8	16	204	5.7	ND	2270	17.7	25.1	1100				
J8529		183	ND	60.9	9.97	722	ND	ND	1400	16.5	33.4	2560				
J8530		412	ND	63	8.59	454	ND	ND	1330	17.6	36.9	1100				
J8531		558	ND	98.1	9.45	552	4.45	ND	1330	21.1	49	1580				
J8532		1810	ND	64.9	10.9	512	ND	ND	1390	22	37.1	1290				

LABORATORY ANALYSIS SUMMARY REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Trace Elements By ICP/GFAA

Date Printed: *15-Nov-96*

Analyst Initial: BJ

	Method	272.2	200.7	206.2	200.7	200.7	200.7	200.7	213.2	200.7	200.7	200.7	200.7	200.7	200.7			
	Units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg			
	ICP-MDL	0.8	6	14	2	0.8	0.8	6	0.8	0.6	2	1	0.8	200	6			
	GFAA-MDL	0.1		0.2					0.02									
	Report Limit	0.4	20	0.6	2	0.8	0.8	13.4	0.1	0.6	2	3.4	14	660	6.6			
Lab#	StationID	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	Mg			
J8533		8.76	1280	126	ND	13	0.82	15800	47.8	2.33	7.07	355	84000	890	3810			
J8536		5.17	6940	52.8	ND	26.7	0.706	3780	41.7	7.89	11.3	150	36800	1090	3740			
J8651		82.5	1130	64.9	ND	680	0.291	8580	5.97	ND	4.73	411	42100	1530	405			

LABORATORY ANALYSIS SUMMARY REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Trace Elements By ICP/GFAA

Date Printed: *15-Nov-96*

Analyst Initial: BL

	Method	200.7	200.7	200.7	200.7	239.2	200.7	200.7	200.7	200.7	200.7	200.7				
	Units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg				
	ICP-MDL	0.8	2	6	2	6	4	6	4		0.8	0.8				
	GFAA-MDL					0.278										
	Report Limit	3.4	2	20	2	0.6	4	6	14		0.8	3.4				
Lab#	StationID	Mn	Mo	Na	Ni	Pb	Sb	Se	Si	Sr	V	Zn				
J8533		2540	5.99	15.3	7.51	1790	5.11	ND	344	29	34.9	9060				
J8536		549	3.89	140	18.4	1330	4.73	ND	785	17.4	28	7590				
J8651		668	34.8	36.1	ND	4880	5.03	ND	293	36.2	22.9	1600				

LABORATORY ANALYSIS SUMMARY REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Trace Elements By ICP/GFAA

Date Printed: *15-Nov-96*

Analyst Initial:

	Method	272.2	200.7	206.2	200.7	200.7	200.7	200.7	213.2	200.7	200.7	200.7	200.7	200.7	200.7	
	Units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	
	ICP-MDL	0.8	6	14	2	0.8	0.8	6	0.8	0.6	2	1	0.8	200	6	
	GFAA-MDL	0.1		0.2					0.02							
	Report Limit	0.4	20	0.6	2	0.8	0.8	13.4	0.1	0.6	2	3.4	14	660	6.6	
Lab#	StationID	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	
J8525		69.5	254	ND	ND	ND	ND	21.3	323	25.3	ND	834	196000	208	25.1	
J8526		117	377	75.7	ND	ND	0.226	140	182	33.3	ND	972	489000	1660	87.6	
J8527		64.3	160	62.4	ND	ND	ND	23.6	47.2	43.8	ND	1500	231000	1020	13.3	
J8528		118	326	ND	ND	ND	ND	122	185	31.2	ND	1040	448000	1540	88.6	
J8534		70.7	1240	30.3	ND	ND	0.325	15800	194	21.5	2.34	752	265000	590	8830	
J8535		70	4020	45.1	ND	7.1	0.555	21000	156	19.9	4.65	638	200000	817	8060	
J8649		222	1500	231	ND	34.1	0.325	6000	8.04	ND	ND	103	228000	1230	597	
J8650		154	773	145	ND	ND	ND	1180	10.5	15.7	ND	612	317000	2580	637	
J8652		116	809	ND	ND	ND	0.226	7710	350	47.5	ND	1540	270000	2310	4460	

LABORATORY ANALYSIS SUMMARY REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Trace Elements By ICP/GFAA

Date Printed: *15-Nov-96*

Analyst Initial: BJ

	Method	200.7	200.7	200.7	200.7	239.2	200.7	200.7	200.7	200.7	200.7	200.7				
	Units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg				
	ICP-MDL	0.8	2	6	2	6	4	6	4		0.8	0.8				
	GFAA-MDL					0.278										
	Report Limit	3.4	2	20	2	0.6	4	6	14		0.8	3.4				
Lab#	StationID	Mn	Mo	Na	Ni	Pb	Sb	Se	Si	Sr	V	Zn				
J8525		191	ND	ND	2.71	13200	15.3	ND	255	ND	ND	29400				
J8526		630	2.64	101	11.4	18400	38.4	ND	474	ND	ND	42200				
J8527		52.7	5.61	222	3.12	12600	26.9	64.8	299	ND	ND	10700				
J8528		648	2.37	110	9.82	15500	50.3	14.2	403	ND	ND	42600				
J8534		5210	ND	11.3	8.95	3240	16.1	ND	442	54.3	ND	37900				
J8535		3340	2.39	107	16.8	7200	6.19	ND	739	46.6	ND	29200				
J8649		1530	2.28	63.8	2.41	6390	16.4	ND	439	16.9	ND	1970				
J8650		1270	8.05	143	7.58	3510	11.8	54.7	476	6.66	ND	1990				
J8652		3950	ND	47.3	64.9	8510	41.6	11.2	452	15.8	ND	70300				

APPENDIX 6 - SURFACE SAMPLING DATA

DATE	PEER REVIEWER(S)	CODE
1/9/97	Margaret A Lake Signature Printed Name	D 8240
	Signature Printed Name	
Author initials	PEER REVIEW NOT REQUIRED	

Official File Copy
File Code
Project
Folder I.D.

D-8240
RES-1.10

JAN 09 1997

MEMORANDUM

To: Manager, Geotechnical Engineering Group 3
Attention: D-8250 (T. Brown)

From: Michael Simonavice, Client Representative
Technical Service Center
Environmental Research Chemistry Laboratory Group

Subject: ICP Scan of Oro-Wellington Samples (Reference Number D8240970109-1)

Please find attached the final results of our ICP elemental scan of 130 grab soil samples and five rinsate samples. Although most of these data were pre-released to you earlier under separate reports, this is a complete compilation of analytical data from all samples sent to our laboratory from your project at the Oro-Wellington Superfund site. The sample numbers for the grab samples are: K2829-K2958. The sample numbers for the rinsate samples are: J8679-J8683. These samples were digested by EPA Microwave Method 3051 before ICP analysis by EPA Method 200.7.

All samples were received in good condition. All holding times were met and all internal QC criteria were met. All of the data meets our laboratory Quality Assurance Plan (QAP 2.1).

If you have questions regarding this report, please contact me, your Client Representative at (303) 236-4290 extension 224, Group Manager Margaret Lake at extension 256, or Quality Control Officer, Doug Craft at extension 255. Thank you for this opportunity to serve you.

Michael A. Simonavice

Attachments

bc: D-8240 (Simonavice, Petrie, files)
(w/att to each)

WBR:MSimonavice:ddw:01/09/97:236-4290 X224
(WP:B:970109-1)

SA... LE LC ... SU...ARY

USBOR ENVIRONMENTAL RESEARCH CHEMISTRY LAB

DENVER, CO

Name Initial:_____

Lab#	Login Date	COC#	No of Cont.	StationID	Matrix	Sampled Date	Sampled Time	Analyses Required	Comment
K2829	11/20/96	8-25482	1	B-EX01-ASS01--961015	ASS	10/15/96	12:45	ICP Scan	
K2830	11/20/96	8-25482	1	B-EX02-ASS01--961015	ASS	10/15/96	12:45	ICP Scan	
K2831	11/20/96	8-25482	1	B-EX01-BSS01--961015	BSS	10/15/96	12:45	ICP Scan	
K2832	11/20/96	8-25482	1	B-EX02-BSS01--961015	BSS	10/15/96	12:45	ICP Scan	
K2833	11/20/96	8-25482	1	B-EX03-ASS01--961015	ASS	10/15/96	12:45	ICP Scan	
K2834	11/20/96	8-25482	1	B-EX03-BSS01--961015	BSS	10/15/96	12:45	ICP Scan	
K2835	11/20/96	8-25482	1	B-EX04-ASS01--961015	ASS	10/15/96	12:45	ICP Scan	
K2836	11/20/96	8-25482	1	B-EX04-BSS01--961015	BSS	10/15/96	12:45	ICP Scan	
K2837	11/20/96	8-25482	1	B-EX05-ASS01--961015	ASS	10/15/96	12:45	ICP Scan	
K2838	11/20/96	8-25482	1	B-EX05-BSS01--961015	BSS	10/15/96	12:45	ICP Scan	
K2839	11/20/96	8-25482	1	B-EX18-ASS01--961015	ASS	10/15/96	12:45	ICP Scan	
K2840	11/20/96	8-25482	1	B-EX18-BSS01--961015	BSS	10/15/96	12:45	ICP Scan	
K2841	11/20/96	8-25482	1	B-EX19-ASS01--961015	ASS	10/15/96	12:45	ICP Scan	
K2842	11/20/96	8-25482	1	B-EX19-BSS01--961015	BSS	10/15/96	12:45	ICP Scan	
K2843	11/20/96	8-25482	1	B-EX20-ASS01--961015	ASS	10/15/96	12:45	ICP Scan	
K2844	11/20/96	8-25483	1	B-EX20-BSS01--961015	BSS	10/15/96	12:45	ICP Scan	
K2845	11/20/96	8-25483	1	B-LC01-ASS01--961015	ASS	10/15/96	15:45	ICP Scan	
K2846	11/20/96	8-25483	1	B-LC01-BSS01--961015	BSS	10/15/96	15:45	ICP Scan	
K2847	11/20/96	8-25483	1	B-LC02-ASS01--961015	ASS	10/15/96	15:45	ICP Scan	
K2848	11/20/96	8-25483	1	B-LC02-BSS01--961015	BSS	10/15/96	15:45	ICP Scan	
K2849	11/20/96	8-25483	1	B-LC03-ASS01--961015	ASS	10/15/96	15:45	ICP Scan	
K2850	11/20/96	8-25483	1	B-LC03-BSS01--961015	BSS	10/15/96	15:45	ICP Scan	
K2851	11/20/96	8-25483	1	B-LC04-ASS01--961015	ASS	10/15/96	15:45	ICP Scan	
K2852	11/20/96	8-25483	1	B-LC04-BSS01--961015	BSS	10/15/96	15:45	ICP Scan	
K2853	11/20/96	8-25483	1	B-LC04-ADSS02--96101	ADSS	10/15/96	15:45	ICP Scan	
K2854	11/20/96	8-25483	1	B-LC04-BDSS02--96101	BDSS	10/15/96	15:45	ICP Scan	
K2855	11/20/96	8-25483	1	B-S01-ASS01--961015	ASS	10/15/96	14:15	ICP Scan	
K2856	11/20/96	8-25483	1	B-S01-BSS01--961015	BSS	10/15/96	14:15	ICP Scan	
K2857	11/20/96	8-25483	1	B-S02-ASS01--961015	ASS	10/15/96	14:15	ICP Scan	
K2858	11/20/96	8-25483	1	B-S02-BSS01--961015	BSS	10/15/96	14:15	ICP Scan	
K2859	11/20/96	8-25484	1	B-S03-ASS01--961015	ASS	10/15/96	14:15	ICP Scan	
K2860	11/20/96	8-25484	1	B-S03-BSS01--961015	BSS	10/15/96	14:15	ICP Scan	
K2861	11/20/96	8-25484	1	B-S04-ASS01--961015	ASS	10/15/96	14:15	ICP Scan	
K2862	11/20/96	8-25484	1	B-S04-BSS01--961015	BSS	10/15/96	14:15	ICP Scan	
K2863	11/20/96	8-25484	1	B-USB01-ASS01--96101	ASS	10/15/96	17:05	ICP Scan	
K2864	11/20/96	8-25484	1	B-USB01-BSS01--96101	BSS	10/15/96	17:05	ICP Scan	

SAMPLE LC N SUMMARY

USBOR ENVIRONMENTAL RESEARCH CHEMISTRY LAB

DENVER, CO

Name Initial:_____

Lab#	Login Date	COC#	No of Cont.	StationID	Matrix	Sampled Date	Sampled Time	Analyses Required	Comment
K2865	11/20/96	8-25484	1	B-USB02-ASS01--96101	ASS	10/15/96	17:05	ICP Scan	
K2866	11/20/96	8-25484	1	B-USB02-BSS01--96101	BSS	10/15/96	17:05	ICP Scan	
K2867	11/20/96	8-25485	1	B-WU01-ASS01--96101	ASS	10/16/96	9:10	ICP Scan	
K2868	11/20/96	8-25485	1	B-WU01-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2869	11/20/96	8-25485	1	B-WU02-ASS01--96101	ASS	10/16/96	9:10	ICP Scan	
K2870	11/20/96	8-25485	1	B-WU02-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2871	11/20/96	8-25485	1	B-WU03-ASS01--96101	ASS	10/16/96	9:10	ICP Scan	
K2872	11/20/96	8-25485	1	B-WU03-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2873	11/20/96	8-25485	1	B-WU04-ASS01--96101	ASS	10/16/96	9:10	ICP Scan	
K2874	11/20/96	8-25485	1	B-WU04-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2875	11/20/96	8-25485	1	B-WU05-ASS01--96101	ASS	10/16/96	9:10	ICP Scan	
K2876	11/20/96	8-25485	1	B-WU05-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2877	11/20/96	8-25485	1	B-WU06-ASS01--96101	ASS	10/16/96	9:10	ICP Scan	
K2878	11/20/96	8-25485	1	B-WU06-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2879	11/20/96	8-25485	1	B-WU07-ASS01--96101	ASS	10/16/96	9:10	ICP Scan	
K2880	11/20/96	8-25485	1	B-WU07-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2881	11/20/96	8-25485	1	B-WU08-ASS01--96101	ASS	10/16/96	9:10	ICP Scan	
K2882	11/20/96	8-25486	1	B-WU08-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2883	11/20/96	8-25486	1	B-WU09-ASS01--96101	ASS	10/16/96	9:10	ICP Scan	
K2884	11/20/96	8-25486	1	B-WU09-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2885	11/20/96	8-25486	1	B-WU10-ASS01--96101	ASS	10/16/96	23:59	ICP Scan	
K2886	11/20/96	8-25486	1	B-WU10-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2887	11/20/96	8-25486	1	B-WU11-ASS01--96101	ASS	10/16/96	9:10	ICP Scan	
K2888	11/20/96	8-25486	1	B-WU11-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2889	11/20/96	8-25486	1	B-WU12-ASS01--96101	ASS	10/16/96	9:10	ICP Scan	
K2890	11/20/96	8-25486	1	B-WU12-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2891	11/20/96	8-25486	1	B-WU13-ASS01--96101	ASS	10/16/96	9:10	ICP Scan	
K2892	11/20/96	8-25486	1	B-WU13-BSS01--96101	BSS	10/16/96	9:10	ICP Scan	
K2893	11/20/96	8-25486	1	B-EX07-ASS01--961016	ASS	10/16/96	14:00	ICP Scan	
K2894	11/20/96	8-25486	1	B-EX07-BSS01--961016	BSS	10/16/96	14:00	ICP Scan	
K2895	11/20/96	8-25486	1	B-EX08-ASS01--961016	ASS	10/16/96	14:00	ICP Scan	
K2896	11/20/96	8-25486	1	B-EX08-BSS01--961016	BSS	10/16/96	14:00	ICP Scan	
K2897	11/20/96	8-25487	1	B-EX09-ASS01--961016	ASS	10/16/96	14:00	ICP Scan	
K2898	11/20/96	8-25487	1	B-EX09-BSS01--961016	BSS	10/16/96	14:00	ICP Scan	
K2899	11/20/96	8-25487	1	B-EX10-ASS01--961016	ASS	10/16/96	14:00	ICP Scan	
K2900	11/20/96	8-25487	1	B-EX10-BSS01--961016	BSS	10/16/96	14:00	ICP Scan	

SA[illegible] LC[illegible] SU[illegible]RY

USBOR ENVIRONMENTAL RESEARCH CHEMISTRY LAB

DENVER, CO

Name Initial:_____

Lab#	Login Date	COC#	No of Cont.	StationID	Matrix	Sampled Date	Sampled Time	Analyses Required	Comment
K2901	11/20/96	8-25487	1	B-EX11-ASS01--961016	ASS	10/16/96	14:00	ICP Scan	
K2902	11/20/96	8-25487	1	B-EX11-BSS01--961016	BSS	10/16/96	14:00	ICP Scan	
K2903	11/20/96	8-25487	1	B-EX13-ASS01--961016	ASS	10/16/96	14:00	ICP Scan	
K2904	11/20/96	8-25487	1	B-EX13-BSS01--961016	BSS	10/16/96	14:00	ICP Scan	
K2905	11/20/96	8-25487	1	B-EX13-ADSS02--96101	ADSS	10/16/96	14:00	ICP Scan	
K2906	11/20/96	8-25487	1	B-EX13-BDSS02--96101	BDSS	10/16/96	14:00	ICP Scan	
K2907	11/20/96	8-33275	1	B-UM01-ASS01--961008	ASS	10/8/96	14:00	ICP Scan	
K2908	11/20/96	8-33275	1	B-UM01-BSS01--961008	BSS	10/8/96	14:00	ICP Scan	
K2909	11/20/96	8-33275	1	B-UM02-ASS01--961008	ASS	10/8/96	14:00	ICP Scan	
K2910	11/20/96	8-33275	1	B-UM02-BSS01--961008	BSS	10/8/96	14:00	ICP Scan	
K2911	11/20/96	8-33275	1	B-UM03-ASS01--961008	ASS	10/8/96	14:00	ICP Scan	
K2912	11/20/96	8-33275	1	B-UM03-BSS01--961008	BSS	10/8/96	14:00	ICP Scan	
K2913	11/20/96	8-33275	1	B-UM04-ASS01--961008	ASS	10/8/96	14:00	ICP Scan	
K2914	11/20/96	8-33275	1	B-UM04-BSS01--961008	BSS	10/8/96	14:00	ICP Scan	
K2915	11/20/96	8-33275	1	B-UM05-ASS01--961008	ASS	10/8/96	14:00	ICP Scan	
K2916	11/20/96	8-33275	1	B-UM05-BSS01--961008	BSS	10/8/96	14:00	ICP Scan	
K2917	11/20/96	8-33275	1	B-UM06-ASS01--961008	ASS	10/8/96	14:00	ICP Scan	
K2918	11/20/96	8-33275	1	B-UM06-BSS01--961008	BSS	10/8/96	14:00	ICP Scan	
K2919	11/20/96	8-33275	1	B-UM07-ASS01--961008	ASS	10/8/96	14:00	ICP Scan	
K2920	11/20/96	8-33275	1	B-UM07-BSS01--961008	BSS	10/8/96	14:00	ICP Scan	
K2921	11/20/96	8-33275	1	B-UM08-ASS01--961008	ASS	10/8/96	14:00	ICP Scan	
K2922	11/20/96	8-33276	1	B-UM08-BSS01--961008	BSS	10/8/96	14:00	ICP Scan	
K2923	11/20/96	8-33277	1	B-DD10-ASS01--961008	ASS	10/8/96	14:00	ICP Scan	
K2924	11/20/96	8-33278	1	B-DD10-BSS01--961008	BSS	10/8/96	14:00	ICP Scan	
K2925	11/20/96	8-33279	1	B-DD10-ADSS02--96100	ADSS	10/8/96	14:00	ICP Scan	
K2926	11/20/96	8-33280	1	B-DD10-BDSS01--96100	BDSS	10/8/96	14:00	ICP Scan	
K2927	11/20/96	8-33281	1	B-DD11-ASS01--961008	ASS	10/8/96	14:00	ICP Scan	
K2928	11/20/96	8-33282	1	B-DD11-BSS01--961008	BSS	10/8/96	14:00	ICP Scan	
K2929	11/20/96	8-25488	0	B-EX-6-ASS01--961023	ASS	10/23/96	13:00	ICP Scan	
K2930	11/20/96	8-25488	0	B-EX-6-BSS01--961023	BSS	10/23/96	13:00	ICP Scan	
K2931	11/20/96	8-25488	0	B-EX-14-ASS01--961023	ASS	10/23/96	13:30	ICP Scan	
K2932	11/20/96	8-25488	0	B-EX-14-BSS01--961023	BSS	10/23/96	13:30	ICP Scan	
K2933	11/20/96	8-25488	0	B-EX-21-ASS01--961023	ASS	10/23/96	14:15	ICP Scan	
K2934	11/20/96	8-25488	0	B-EX-21-BSS01--961023	BSS	10/23/96	14:15	ICP Scan	
K2935	11/20/96	8-25488	0	B-BKG-1-ASS01--96102	ASS	10/23/96	11:00	ICP Scan	
K2936	11/20/96	8-25488	0	B-BKG-1-BSS01--96102	BSS	10/23/96	11:00	ICP Scan	

SAMPLE LC N SUMMARY

USBOR ENVIRONMENTAL RESEARCH CHEMISTRY LAB

DENVER, CO

Name Initial:_____.

Lab#	Login Date	COC#	No of Cont.	StationID	Matrix	Sampled Date	Sampled Time	Analyses Required	Comment
K2937	11/20/96	8-25488	0	B-BKG-2-ASS01--96102	ASS	10/23/96	11:30	ICP Scan	
K2938	11/20/96	8-25488	0	B-BKG-2-BSS01--96102	BSS	10/23/96	11:30	ICP Scan	
K2939	11/20/96	8-25488	0	B-BKG-3-ASS01--96102	ASS	10/23/96	15:15	ICP Scan	
K2940	11/20/96	8-25488	0	B-BKG-3-BSS01--96102	BSS	10/23/96	15:15	ICP Scan	
K2941	11/20/96	8-25488	0	B-BKG-4-ASS01--96102	ASS	10/23/96	16:15	ICP Scan	
K2942	11/20/96	8-25488	0	B-BKG-4-BSS01--96102	BSS	10/23/96	16:15	ICP Scan	
K2943	11/20/96	8-25491	0	B-DD03-ASS01--961023	ASS	10/23/96	17:00	ICP Scan	
K2944	11/20/96	8-25491	0	B-DD06-ASS01--961023	ASS	10/23/96	13:30	ICP Scan	
K2945	11/20/96	8-25491	0	B-DD06-ADSS02--96102	ADSS	10/24/96	13:30	ICP Scan	
K2946	11/20/96	8-25491	0	B-DD06-BSS01--961113	BSS	11/13/96	13:00	ICP Scan	
K2947	11/20/96	8-25491	0	B-DD06-BDSS01--96102	BDSS	10/24/96	13:30	ICP Scan	
K2948	11/20/96	8-25491	0	B-DD14-ASS01--961024	ASS	10/24/96	11:45	ICP Scan	
K2949	11/20/96	8-25491	0	B-DD14-BSS01--961024	BSS	10/24/96	11:45	ICP Scan	
K2950	11/20/96	8-25491	0	B-DD15-ASS01--961023	ASS	10/23/96	12:30	ICP Scan	
K2951	11/20/96	8-25491	0	B-DD15-BSS01--961024	BSS	10/24/96	10:24	ICP Scan	
K2952	11/20/96	8-25491	0	B-WTL05-ASS01--96102	ASS	10/24/96	10:30	ICP Scan	
K2953	11/20/96	8-25491	0	B-WTL05-BSS01--96102	BSS	10/24/96	10:30	ICP Scan	
K2954	11/20/96	8-25491	0	B-WTL06-ASS01--96102	ASS	10/24/96	9:30	ICP Scan	
K2955	11/20/96	8-25491	0	B-WTL06-BSS01--96102	BSS	10/24/96	9:30	ICP Scan	
K2956	11/20/96	8-25491	0	B-WTL07-ASS01--96102	ASS	10/24/96	8:30	ICP Scan	
K2957	11/20/96	8-25489	0	B-WTL07-BSS01--96102	BSS	10/24/96	8:30	ICP Scan	
K2958	11/20/96	8-25491	0	B-DD-3-BSS01--961023	BSS	10/23/96	23:59	ICP Scan	
			1	B-UM-SS04--961008	SS	10/8/96	17:00	ICP Scan	
			0	B-DD06R-DH01--961024	DH	10/24/96	14:30	ICP Scan	

LABORATORY ANALYSIS SUMMARY REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Trace Elements By ICP/GFAA

Date Printed: *10-Dec-96*

Analyst Initial: BL

	Method	272.2	200.7	206.2	200.7	200.7	200.7	200.7	213.2	200.7	200.7	200.7	200.7	200.7	200.7
	Units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
	ICP-MDL	0.8	6	14	2	0.8	0.8	6	0.8	0.6	2	1	0.8	200	6
	GFAA-MDL	0.1		0.2					0.02						
	Report Limit	0.4	20	0.6	2	0.8	0.8	13.4	0.1	0.6	2	3.4	14	660	6.6
Lab#	StationID	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	Mg
K2847		21.3	2370	363	ND	244	0.558	805	31	14.3	7.14	222	62900	1660	92.6
K2848		14.3	2590	333	ND	216	0.675	1810	58.8	8.16	5.43	385	68200	1260	116
K2849		54.8	1580	298	ND	152	0.53	5920	120	10.8	2.81	198	48100	1220	1880
K2850		43.4	4270	261	ND	158	1.58	2260	60.1	6.36	3.18	501	50100	1310	394
K2891		5.88	15900	44.5	ND	95.2	1.05	2360	21.4	13.6	11.1	331	32400	3120	3290
K2893		51.2	3780	118	ND	75.7	0.258	618	6.29	ND	5	290	50900	3260	868
K2899		16.5	3090	183	ND	34	0.37	446	9.93	ND	5.44	176	72800	2730	291
K2905		8.33	2760	135	ND	30.8	0.342	21300	3.98	0.898	7.95	47.2	70700	2660	457

LABORATORY ANALYSIS SUMMARY REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Trace Elements By ICP/GFAA

Date Printed: *10-Dec-96*

Analyst Initial: RB

	Method	200.7	200.7	200.7	200.7	239.2	200.7	200.7	200.7	200.7	200.7	200.7				
	Units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg				
	ICP-MDL	0.8	2	6	2	6	4	6	4		0.8	0.8				
	GFAA-MDL					0.278										
	Report Limit	3.4	2	20	2	0.6	4	6	14		0.8	3.4				
Lab#	**StationID**	**Mn**	**Mo**	**Na**	**Ni**	**Pb**	**Sb**	**Se**	**Si**	**Sr**	**V**	**Zn**				
K2847		5030	9.98	28.2	3.23	14500	6.74	6.6	825	29.5	1.01	5050				
K2848		3690	4.19	14.8	2.96	9380	4.67	15.7	821	14.6	7.29	5930				
K2849		5190	3.59	20.8	5.16	30700	4.53	87.9	846	42.8	4.81	21700				
K2850		3670	ND	28.1	3.49	14900	ND	85.4	1110	23.4	2.23	15800				
K2891		1610	ND	56.6	6.9	7010	ND	ND	1210	20.8	32.3	2030				
K2893		79.4	2.27	77	ND	55700	ND	10	635	115	18.1	1040				
K2899		658	ND	92	ND	10800	4.65	ND	1010	23	23.3	2200				
K2905		249	ND	73.6	ND	1430	4	ND	678	40.7	22.3	758				

LABORATORY ANALYSIS SUMMARY REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Trace Elements By ICP/GFAA Rerun table

Date Printed: *10-Dec-96*

Analyst Initial: B

	Method	200.7	200.7	200.7	200.7	239.2	200.7	200.7	200.7	200.7	200.7	200.7				
	Units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg				
	ICP-MDL	0.8	2	6	2	6	4	6	4		0.8	0.8				
	GFAA-MDL					0.278										
	Report Limit	3.4	2	20	2	0.6	4	6	14		0.8	3.4				
Lab#	**StationID**	**Mn**	**Mo**	**Na**	**Ni**	**Pb**	**Sb**	**Se**	**Si**	**Sr**	**V**	**Zn**				
K2857		19200	3.4	307000	11.3	125000	12.9	16.7	1830	47.2	ND	98700				
K2861		22800	16	17.3	11.7	53100	18.9	27.4	2620	32.2	14.8	28000				
K2869		151	9.36	92.1	2.21	20100	6.44	9.18	1210	19.2	ND	1830				
K2897		131	ND	40.9	2.06	3370	ND	8.76	470	31.8	ND	1640				
K2898		466	ND	40.3	2.2	6200	12.7	11.1	473	50.8	ND	21300				
K2906		361	ND	95.2	5.81	2270	9.9	ND	1070	101	27.1	2770				
K2927		2310	ND	26.8	6.4	15600	15.9	ND	516	44.3	ND	27800				
K2928		279	ND	68.9	2.78	9120	9.44	17.7	363	30	ND	4180				
K2944		402	2.4	236	2.58	1850	12.7	ND	623	20.4	9.72	1300				

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: J8679
Station ID: B-WTU01DHAT-04
Additional ID: 1
Chain-Of-Custody:
Matrix: WATER

Sampled Date: 10/9/96
Login Date: 11/15/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag		U	µg/L	4	12/30/96	1
Al	30.1		µg/L	30	12/30/96	1
As		U	µg/L	70	12/30/96	1
B		U	µg/L	10	12/30/96	1
Ba		U	µg/L	4	12/30/96	1
Be		U	µg/L	0.5	12/30/96	1
Ca	0.104		mg/L	0.03	12/30/96	1
Cd		U	µg/L	4	12/30/96	1
Co		U	µg/L	3	12/30/96	1
Cr		U	µg/L	10	12/30/96	1
Cu	5.01		µg/L	5	12/30/96	1
Fe	34.7		µg/L	4	12/30/96	1
K	1.03		mg/L	1	12/30/96	1
Li		U	µg/L	6	12/30/96	1
Mg		U	mg/L	0.03	12/30/96	1
Mn		U	µg/L	4	12/30/96	1
Mo		U	µg/L	10	12/30/96	1
Na	0.134		mg/L	0.03	12/30/96	1
Ni		U	µg/L	10	12/30/96	1
Pb		U	µg/L	30	12/30/96	1
Sb		U	µg/L	20	12/30/96	1
Se		U	µg/L	30	12/30/96	1
Si	63.4		µg/L	20	12/30/96	1
Sr		U	µg/L	10	12/30/96	1
V		U	µg/L	4	12/30/96	1
Zn	19		µg/L	4	12/30/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: J8680
Station ID: B-WR02DHAT-04
Additional ID: 1
Chain-Of-Custody:
Matrix: WATER

Sampled Date: 10/10/96
Login Date: 11/15/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	5.28		µg/L	4	12/30/96	1
Al		U	µg/L	30	12/30/96	1
As		U	µg/L	70	12/30/96	1
B		U	µg/L	10	12/30/96	1
Ba		U	µg/L	4	12/30/96	1
Be		U	µg/L	0.5	12/30/96	1
Ca		U	mg/L	0.03	12/30/96	1
Cd		U	µg/L	4	12/30/96	1
Co		U	µg/L	3	12/30/96	1
Cr		U	µg/L	10	12/30/96	1
Cu		U	µg/L	5	12/30/96	1
Fe	27.2		µg/L	4	12/30/96	1
K	1.23		mg/L	1	12/30/96	1
Li		U	µg/L	6	12/30/96	1
Mg		U	mg/L	0.03	12/30/96	1
Mn		U	µg/L	4	12/30/96	1
Mo		U	µg/L	10	12/30/96	1
Na	0.0424		mg/L	0.03	12/30/96	1
Ni		U	µg/L	10	12/30/96	1
Pb		U	µg/L	30	12/30/96	1
Sb		U	µg/L	20	12/30/96	1
Se		U	µg/L	30	12/30/96	1
Si		U	µg/L	20	12/30/96	1
Sr		U	µg/L	10	12/30/96	1
V		U	µg/L	4	12/30/96	1
Zn	5.76		µg/L	4	12/30/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

E ·onmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: J8681
Station ID: B-WTU04DHAT-04
Additional ID: 1
Chain-Of-Custody:
Matrix: WATER

Sampled Date: 10/9/96
Login Date: 11/15/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	4.92		µg/L	4	12/30/96	1
Al	223		µg/L	30	12/30/96	1
As		U	µg/L	70	12/30/96	1
B		U	µg/L	10	12/30/96	1
Ba	4.23		µg/L	4	12/30/96	1
Be		U	µg/L	0.5	12/30/96	1
Ca	0.547		mg/L	0.03	12/30/96	1
Cd		U	µg/L	4	12/30/96	1
Co		U	µg/L	3	12/30/96	1
Cr		U	µg/L	10	12/30/96	1
Cu	11.4		µg/L	5	12/30/96	1
Fe	2320		µg/L	4	12/30/96	1
K	1.24		mg/L	1	12/30/96	1
Li		U	µg/L	6	12/30/96	1
Mg	0.155		mg/L	0.03	12/30/96	1
Mn	183		µg/L	4	12/30/96	1
Mo		U	µg/L	10	12/30/96	1
Na	0.108		mg/L	0.03	12/30/96	1
Ni		U	µg/L	10	12/30/96	1
Pb	32		µg/L	30	12/30/96	1
Sb		U	µg/L	20	12/30/96	1
Se		U	µg/L	30	12/30/96	1
Si	324		µg/L	20	12/30/96	1
Sr		U	µg/L	10	12/30/96	1
V	4.1		µg/L	4	12/30/96	1
Zn	147		µg/L	4	12/30/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: J8682
Station ID: B-WT202DHST-04
Additional ID: 1
Chain-Of-Custody:
Matrix: WATER

Sampled Date: 10/8/96
Login Date: 11/15/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	4.32		µg/L	4	12/30/96	1
Al		U	µg/L	30	12/30/96	1
As		U	µg/L	70	12/30/96	1
B		U	µg/L	10	12/30/96	1
Ba		U	µg/L	4	12/30/96	1
Be		U	µg/L	0.5	12/30/96	1
Ca	0.286		mg/L	0.03	12/30/96	1
Cd		U	µg/L	4	12/30/96	1
Co	3.03		µg/L	3	12/30/96	1
Cr		U	µg/L	10	12/30/96	1
Cu	5.51		µg/L	5	12/30/96	1
Fe	81.6		µg/L	4	12/30/96	1
K		U	mg/L	1	12/30/96	1
Li		U	µg/L	6	12/30/96	1
Mg	0.0511		mg/L	0.03	12/30/96	1
Mn	9.97		µg/L	4	12/30/96	1
Mo		U	µg/L	10	12/30/96	1
Na	0.221		mg/L	0.03	12/30/96	1
Ni		U	µg/L	10	12/30/96	1
Pb	32.2		µg/L	30	12/30/96	1
Sb		U	µg/L	20	12/30/96	1
Se		U	µg/L	30	12/30/96	1
Si	31		µg/L	20	12/30/96	1
Sr		U	µg/L	10	12/30/96	1
V		U	µg/L	4	12/30/96	1
Zn	118		µg/L	4	12/30/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: J8683
Station ID: B-WTL01TP04
Additional ID: 1
Chain-Of-Custody:
Matrix: WATER

Sampled Date: 10/9/96
Login Date: 11/15/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	5.64		µg/L	4	12/30/96	1
Al		U	µg/L	30	12/30/96	1
As		U	µg/L	70	12/30/96	1
B		U	µg/L	10	12/30/96	1
Ba		U	µg/L	4	12/30/96	1
Be		U	µg/L	0.5	12/30/96	1
Ca	0.44		mg/L	0.03	12/30/96	1
Cd		U	µg/L	4	12/30/96	1
Co	4.81		µg/L	3	12/30/96	1
Cr		U	µg/L	10	12/30/96	1
Cu	7.62		µg/L	5	12/30/96	1
Fe		U	µg/L	4	12/30/96	1
K	2.42		mg/L	1	12/30/96	1
Li		U	µg/L	6	12/30/96	1
Mg	0.0666		mg/L	0.03	12/30/96	1
Mn	14.8		µg/L	4	12/30/96	1
Mo		U	µg/L	10	12/30/96	1
Na	1.26		mg/L	0.03	12/30/96	1
Ni		U	µg/L	10	12/30/96	1
Pb		U	µg/L	30	12/30/96	1
Sb		U	µg/L	20	12/30/96	1
Se		U	µg/L	30	12/30/96	1
Si		U	µg/L	20	12/30/96	1
Sr		U	µg/L	10	12/30/96	1
V		U	µg/L	4	12/30/96	1
Zn	133		µg/L	4	12/30/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2829
Station ID: B-EX01-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	64		mg/Kg	0.8	12/11/96	1
Al	2870		mg/Kg	6	12/11/96	1
As	526		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	42.1		mg/Kg	0.8	12/11/96	1
Be	0.158		mg/Kg	0.1	12/11/96	1
Ca	27.7		mg/Kg	6	12/11/96	1
Cd	10.3		mg/Kg	0.8	12/11/96	1
Co		U	mg/Kg	0.6	12/11/96	1
Cr		U	mg/Kg	2	12/11/96	1
Cu	1210		mg/Kg	1	12/11/96	1
Fe	56400		mg/Kg	0.8	12/11/96	1
K	2580		mg/Kg	200	12/11/96	1
Li		U	mg/Kg	1.2	12/11/96	1
Mg	69.5		mg/Kg	6	12/11/96	1
Mn	9.39		mg/Kg	0.8	12/11/96	1
Mo	3.15		mg/Kg	2	12/11/96	1
Na	72.9		mg/Kg	6	12/11/96	1
Ni	3.04		mg/Kg	2	12/11/96	1
Pb	60200		mg/Kg	6	12/11/96	1
Sb	10.7		mg/Kg	4	12/11/96	1
Se	13		mg/Kg	6	12/11/96	1
Si	648		mg/Kg	4	12/11/96	1
Sr	11.6		mg/Kg	2	12/11/96	1
V	10.5		mg/Kg	0.8	12/11/96	1
Zn	274		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2830
Station ID: B-EX02-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	91.5		mg/Kg	2.4	12/18/96	3
Al	1970		mg/Kg	18	12/18/96	3
As	617		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	13.7		mg/Kg	2.4	12/18/96	3
Be		U	mg/Kg	0.3	12/18/96	3
Ca	52.2		mg/Kg	18	12/18/96	3
Cd	27.4		mg/Kg	2.4	12/18/96	3
Co		U	mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	194		mg/Kg	3	12/18/96	3
Fe	224000		mg/Kg	2.4	12/18/96	3
K	1840		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	83.4		mg/Kg	18	12/18/96	3
Mn	63.1		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	60.3		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	33800		mg/Kg	18	12/18/96	3
Sb	13.4		mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	922		mg/Kg	12	12/18/96	3
Sr	11.8		mg/Kg	6	12/18/96	3
V		U	mg/Kg	2.4	12/18/96	3
Zn	3590		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2831
Station ID: B-EX01-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	98.6		mg/Kg	2.4	12/18/96	3
Al	4360		mg/Kg	18	12/18/96	3
As	604		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	24.8		mg/Kg	2.4	12/18/96	3
Be	0.333		mg/Kg	0.3	12/18/96	3
Ca		U	mg/Kg	18	12/18/96	3
Cd	11		mg/Kg	2.4	12/18/96	3
Co		U	mg/Kg	1.8	12/18/96	3
Cr	7.52		mg/Kg	6	12/18/96	3
Cu	2170		mg/Kg	3	12/18/96	3
Fe	128000		mg/Kg	2.4	12/18/96	3
K	2060		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	160		mg/Kg	18	12/18/96	3
Mn	250		mg/Kg	2.4	12/18/96	3
Mo	14		mg/Kg	6	12/18/96	3
Na	42.7		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	33700		mg/Kg	18	12/18/96	3
Sb	16		mg/Kg	12	12/18/96	3
Se	33.6		mg/Kg	18	12/18/96	3
Si	2900		mg/Kg	12	12/18/96	3
Sr		U	mg/Kg	6	12/18/96	3
V	10.8		mg/Kg	2.4	12/18/96	3
Zn	1520		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2832
Station ID: B-EX02-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	73		mg/Kg	2.4	12/18/96	3
Al	3300		mg/Kg	18	12/18/96	3
As	481		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	80.6		mg/Kg	2.4	12/18/96	3
Be	0.52		mg/Kg	0.3	12/18/96	3
Ca	336		mg/Kg	18	12/18/96	3
Cd	10.8		mg/Kg	2.4	12/18/96	3
Co		U	mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	576		mg/Kg	3	12/18/96	3
Fe	109000		mg/Kg	2.4	12/18/96	3
K	3030		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	874		mg/Kg	18	12/18/96	3
Mn	157		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	114		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	41400		mg/Kg	18	12/18/96	3
Sb	14.2		mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	2790		mg/Kg	12	12/18/96	3
Sr	21.1		mg/Kg	6	12/18/96	3
V	35.3		mg/Kg	2.4	12/18/96	3
Zn	3210		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2833
Station ID: B-EX03-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	41.7		mg/Kg	0.8	12/18/96	1
Al	2790		mg/Kg	6	12/18/96	1
As	104		mg/Kg	14	12/18/96	1
B		U	mg/Kg	2	12/18/96	1
Ba	99.8		mg/Kg	0.8	12/18/96	1
Be	0.24		mg/Kg	0.1	12/18/96	1
Ca	1030		mg/Kg	6	12/18/96	1
Cd	9.46		mg/Kg	0.8	12/18/96	1
Co	0.883		mg/Kg	0.6	12/18/96	1
Cr	2.01		mg/Kg	2	12/18/96	1
Cu	597		mg/Kg	1	12/18/96	1
Fe	32400		mg/Kg	0.8	12/18/96	1
K	4250		mg/Kg	200	12/18/96	1
Li	1.86		mg/Kg	1.2	12/18/96	1
Mg	272		mg/Kg	6	12/18/96	1
Mn	162		mg/Kg	0.8	12/18/96	1
Mo		U	mg/Kg	2	12/18/96	1
Na	43.6		mg/Kg	6	12/18/96	1
Ni		U	mg/Kg	2	12/18/96	1
Pb	13800		mg/Kg	6	12/18/96	1
Sb		U	mg/Kg	4	12/18/96	1
Se		U	mg/Kg	6	12/18/96	1
Si	1090		mg/Kg	4	12/18/96	1
Sr	13.3		mg/Kg	2	12/18/96	1
V	3.47		mg/Kg	0.8	12/18/96	1
Zn	1360		mg/Kg	0.8	12/18/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2834
Station ID: B-EX03-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	8.72		mg/Kg	0.8	12/11/96	1
Al	13100		mg/Kg	6	12/11/96	1
As	90.3		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	404		mg/Kg	0.8	12/11/96	1
Be	0.973		mg/Kg	0.1	12/11/96	1
Ca	5570		mg/Kg	6	12/11/96	1
Cd	13.4		mg/Kg	0.8	12/11/96	1
Co	16.2		mg/Kg	0.6	12/11/96	1
Cr	44.8		mg/Kg	2	12/11/96	1
Cu	218		mg/Kg	1	12/11/96	1
Fe	47600		mg/Kg	0.8	12/11/96	1
K	3450		mg/Kg	200	12/11/96	1
Li	8.74		mg/Kg	1.2	12/11/96	1
Mg	10600		mg/Kg	6	12/11/96	1
Mn	1080		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	81.9		mg/Kg	6	12/11/96	1
Ni	13.1		mg/Kg	2	12/11/96	1
Pb	2400		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	13.8		mg/Kg	6	12/11/96	1
Si	3380		mg/Kg	4	12/11/96	1
Sr	33.9		mg/Kg	2	12/11/96	1
V	51.9		mg/Kg	0.8	12/11/96	1
Zn	3290		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Environmental Research Chemistry Laboratory
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2835
Station ID: B-EX04-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	5.53		mg/Kg	0.8	12/11/96	1
Al	17500		mg/Kg	6	12/11/96	1
As	54.9		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	196		mg/Kg	0.8	12/11/96	1
Be	1.16		mg/Kg	0.1	12/11/96	1
Ca	1610		mg/Kg	6	12/11/96	1
Cd	4.54		mg/Kg	0.8	12/11/96	1
Co	13.6		mg/Kg	0.6	12/11/96	1
Cr	16.6		mg/Kg	2	12/11/96	1
Cu	76.1		mg/Kg	1	12/11/96	1
Fe	49300		mg/Kg	0.8	12/11/96	1
K	3260		mg/Kg	200	12/11/96	1
Li	10.6		mg/Kg	1.2	12/11/96	1
Mg	5420		mg/Kg	6	12/11/96	1
Mn	1190		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	88.5		mg/Kg	6	12/11/96	1
Ni	13.5		mg/Kg	2	12/11/96	1
Pb	1290		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	10.5		mg/Kg	6	12/11/96	1
Si	3500		mg/Kg	4	12/11/96	1
Sr	17.2		mg/Kg	2	12/11/96	1
V	47.9		mg/Kg	0.8	12/11/96	1
Zn	1920		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2836
Station ID: B-EX04-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	14.8		mg/Kg	0.8	12/11/96	1
Al	2160		mg/Kg	6	12/11/96	1
As	63.8		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	135		mg/Kg	0.8	12/11/96	1
Be	0.189		mg/Kg	0.1	12/11/96	1
Ca	363		mg/Kg	6	12/11/96	1
Cd	2.31		mg/Kg	0.8	12/11/96	1
Co		U	mg/Kg	0.6	12/11/96	1
Cr		U	mg/Kg	2	12/11/96	1
Cu	70.1		mg/Kg	1	12/11/96	1
Fe	32000		mg/Kg	0.8	12/11/96	1
K	3670		mg/Kg	200	12/11/96	1
Li	1.41		mg/Kg	1.2	12/11/96	1
Mg	302		mg/Kg	6	12/11/96	1
Mn	38		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	82		mg/Kg	6	12/11/96	1
Ni		U	mg/Kg	2	12/11/96	1
Pb	10500		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se		U	mg/Kg	6	12/11/96	1
Si	531		mg/Kg	4	12/11/96	1
Sr	29.5		mg/Kg	2	12/11/96	1
V	3.85		mg/Kg	0.8	12/11/96	1
Zn	613		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2837
Station ID: B-EX05-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	11.8		mg/Kg	0.8	12/11/96	1
Al	10300		mg/Kg	6	12/11/96	1
As	111		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	199		mg/Kg	0.8	12/11/96	1
Be	0.482		mg/Kg	0.1	12/11/96	1
Ca	983		mg/Kg	6	12/11/96	1
Cd	3.02		mg/Kg	0.8	12/11/96	1
Co	5.21		mg/Kg	0.6	12/11/96	1
Cr	9.88		mg/Kg	2	12/11/96	1
Cu	122		mg/Kg	1	12/11/96	1
Fe	47700		mg/Kg	0.8	12/11/96	1
K	3530		mg/Kg	200	12/11/96	1
Li	6.46		mg/Kg	1.2	12/11/96	1
Mg	4080		mg/Kg	6	12/11/96	1
Mn	287		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	232		mg/Kg	6	12/11/96	1
Ni	6.99		mg/Kg	2	12/11/96	1
Pb	4610		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	10.8		mg/Kg	6	12/11/96	1
Si	1150		mg/Kg	4	12/11/96	1
Sr	22.9		mg/Kg	2	12/11/96	1
V	31.2		mg/Kg	0.8	12/11/96	1
Zn	721		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Environmental Research Chemistry Laboratory
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2838
Station ID: B-EX05-BSS01--961015
Sampled Date: 10/15/96
Additional ID: 1
Login Date: 11/20/96
Chain-Of-Custody: 8-25482
Analyses Required: ICP Scan
Matrix: Soil
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	13.6		mg/Kg	0.8	12/11/96	1
Al	2150		mg/Kg	6	12/11/96	1
As	260		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	221		mg/Kg	0.8	12/11/96	1
Be	0.324		mg/Kg	0.1	12/11/96	1
Ca	45.5		mg/Kg	6	12/11/96	1
Cd	6.09		mg/Kg	0.8	12/11/96	1
Co		U	mg/Kg	0.6	12/11/96	1
Cr		U	mg/Kg	2	12/11/96	1
Cu	210		mg/Kg	1	12/11/96	1
Fe	66200		mg/Kg	0.8	12/11/96	1
K	3640		mg/Kg	200	12/11/96	1
Li		U	mg/Kg	1.2	12/11/96	1
Mg	90.7		mg/Kg	6	12/11/96	1
Mn	113		mg/Kg	0.8	12/11/96	1
Mo	3.42		mg/Kg	2	12/11/96	1
Na	56.9		mg/Kg	6	12/11/96	1
Ni		U	mg/Kg	2	12/11/96	1
Pb	6410		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se		U	mg/Kg	6	12/11/96	1
Si	592		mg/Kg	4	12/11/96	1
Sr	13.9		mg/Kg	2	12/11/96	1
V		U	mg/Kg	0.8	12/11/96	1
Zn	1160		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2839
Station ID: B-EX18-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	37.6		mg/Kg	0.8	12/11/96	1
Al	7650		mg/Kg	6	12/11/96	1
As	348		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	70.6		mg/Kg	0.8	12/11/96	1
Be	0.541		mg/Kg	0.1	12/11/96	1
Ca	368		mg/Kg	6	12/11/96	1
Cd	9.89		mg/Kg	0.8	12/11/96	1
Co		U	mg/Kg	0.6	12/11/96	1
Cr	8.38		mg/Kg	2	12/11/96	1
Cu	422		mg/Kg	1	12/11/96	1
Fe	89500		mg/Kg	0.8	12/11/96	1
K	3380		mg/Kg	200	12/11/96	1
Li	2.9		mg/Kg	1.2	12/11/96	1
Mg	590		mg/Kg	6	12/11/96	1
Mn	137		mg/Kg	0.8	12/11/96	1
Mo	8.4		mg/Kg	2	12/11/96	1
Na	99.6		mg/Kg	6	12/11/96	1
Ni		U	mg/Kg	2	12/11/96	1
Pb	51000		mg/Kg	6	12/11/96	1
Sb	12.4		mg/Kg	4	12/11/96	1
Se	18.1		mg/Kg	6	12/11/96	1
Si	954		mg/Kg	4	12/11/96	1
Sr	14.4		mg/Kg	2	12/11/96	1
V	22.3		mg/Kg	0.8	12/11/96	1
Zn	799		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2840
Station ID: B-EX18-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	15.8		mg/Kg	0.8	12/11/96	1
Al	6170		mg/Kg	6	12/11/96	1
As	115		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	167		mg/Kg	0.8	12/11/96	1
Be	0.541		mg/Kg	0.1	12/11/96	1
Ca	157		mg/Kg	6	12/11/96	1
Cd	3.87		mg/Kg	0.8	12/11/96	1
Co		U	mg/Kg	0.6	12/11/96	1
Cr	4.63		mg/Kg	2	12/11/96	1
Cu	96.7		mg/Kg	1	12/11/96	1
Fe	28600		mg/Kg	0.8	12/11/96	1
K	2320		mg/Kg	200	12/11/96	1
Li	1.73		mg/Kg	1.2	12/11/96	1
Mg	184		mg/Kg	6	12/11/96	1
Mn	41.1		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	30.3		mg/Kg	6	12/11/96	1
Ni		U	mg/Kg	2	12/11/96	1
Pb	10700		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	10.8		mg/Kg	6	12/11/96	1
Si	780		mg/Kg	4	12/11/96	1
Sr	36.5		mg/Kg	2	12/11/96	1
V	18.9		mg/Kg	0.8	12/11/96	1
Zn	214		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2841
Station ID: B-EX19-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	102		mg/Kg	0.8	12/11/96	1
Al	6520		mg/Kg	6	12/11/96	1
As	608		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	29.5		mg/Kg	0.8	12/11/96	1
Be	0.324		mg/Kg	0.1	12/11/96	1
Ca	80.7		mg/Kg	6	12/11/96	1
Cd	12.5		mg/Kg	0.8	12/11/96	1
Co		U	mg/Kg	0.6	12/11/96	1
Cr	4.32		mg/Kg	2	12/11/96	1
Cu	956		mg/Kg	1	12/11/96	1
Fe	70500		mg/Kg	0.8	12/11/96	1
K	2440		mg/Kg	200	12/11/96	1
Li	2.38		mg/Kg	1.2	12/11/96	1
Mg	229		mg/Kg	6	12/11/96	1
Mn	352		mg/Kg	0.8	12/11/96	1
Mo	2.44		mg/Kg	2	12/11/96	1
Na	81.5		mg/Kg	6	12/11/96	1
Ni		U	mg/Kg	2	12/11/96	1
Pb	82700		mg/Kg	6	12/11/96	1
Sb	14.1		mg/Kg	4	12/11/96	1
Se	23.5		mg/Kg	6	12/11/96	1
Si	989		mg/Kg	4	12/11/96	1
Sr	15.4		mg/Kg	2	12/11/96	1
V	7.91		mg/Kg	0.8	12/11/96	1
Zn	713		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2842
Station ID: B-EX19-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	19.5		mg/Kg	0.8	12/11/96	1
Al	6530		mg/Kg	6	12/11/96	1
As	145		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	79.3		mg/Kg	0.8	12/11/96	1
Be	0.432		mg/Kg	0.1	12/11/96	1
Ca	74.9		mg/Kg	6	12/11/96	1
Cd	4.18		mg/Kg	0.8	12/11/96	1
Co	3.11		mg/Kg	0.6	12/11/96	1
Cr	8.45		mg/Kg	2	12/11/96	1
Cu	613		mg/Kg	1	12/11/96	1
Fe	38600		mg/Kg	0.8	12/11/96	1
K	3700		mg/Kg	200	12/11/96	1
Li	1.83		mg/Kg	1.2	12/11/96	1
Mg	905		mg/Kg	6	12/11/96	1
Mn	307		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	69.8		mg/Kg	6	12/11/96	1
Ni	2.13		mg/Kg	2	12/11/96	1
Pb	28900		mg/Kg	6	12/11/96	1
Sb	6.75		mg/Kg	4	12/11/96	1
Se	10.7		mg/Kg	6	12/11/96	1
Si	987		mg/Kg	4	12/11/96	1
Sr	10.7		mg/Kg	2	12/11/96	1
V	46.4		mg/Kg	0.8	12/11/96	1
Zn	646		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2843
Station ID: B-EX20-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25482
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	57.1		mg/Kg	0.8	12/11/96	1
Al	6400		mg/Kg	6	12/11/96	1
As	157		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	49.8		mg/Kg	0.8	12/11/96	1
Be	0.487		mg/Kg	0.1	12/11/96	1
Ca	69.1		mg/Kg	6	12/11/96	1
Cd	5.09		mg/Kg	0.8	12/11/96	1
Co		U	mg/Kg	0.6	12/11/96	1
Cr	5		mg/Kg	2	12/11/96	1
Cu	2450		mg/Kg	1	12/11/96	1
Fe	51100		mg/Kg	0.8	12/11/96	1
K	5100		mg/Kg	200	12/11/96	1
Li	3.32		mg/Kg	1.2	12/11/96	1
Mg	150		mg/Kg	6	12/11/96	1
Mn	9.49		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	372		mg/Kg	6	12/11/96	1
Ni		U	mg/Kg	2	12/11/96	1
Pb	34700		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	9.92		mg/Kg	6	12/11/96	1
Si	781		mg/Kg	4	12/11/96	1
Sr	25		mg/Kg	2	12/11/96	1
V	55.9		mg/Kg	0.8	12/11/96	1
Zn	766		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2844
Station ID: B-EX20-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	8.78		mg/Kg	2.4	12/18/96	3
Al	4960		mg/Kg	18	12/18/96	3
As	248		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	133		mg/Kg	2.4	12/18/96	3
Be	0.493		mg/Kg	0.3	12/18/96	3
Ca	1870		mg/Kg	18	12/18/96	3
Cd	5.25		mg/Kg	2.4	12/18/96	3
Co	2.85		mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	1060		mg/Kg	3	12/18/96	3
Fe	90800		mg/Kg	2.4	12/18/96	3
K	3670		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	1930		mg/Kg	18	12/18/96	3
Mn	141		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	139		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	5730		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	2070		mg/Kg	12	12/18/96	3
Sr	18.8		mg/Kg	6	12/18/96	3
V	34.4		mg/Kg	2.4	12/18/96	3
Zn	1120		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2845
Station ID: B-LC01-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	20.2		mg/Kg	0.8	12/18/96	1
Al	4950		mg/Kg	6	12/18/96	1
As	293		mg/Kg	14	12/18/96	1
B		U	mg/Kg	2	12/18/96	1
Ba	1190		mg/Kg	0.8	12/18/96	1
Be	0.457		mg/Kg	0.1	12/18/96	1
Ca	674		mg/Kg	6	12/18/96	1
Cd	12.3		mg/Kg	0.8	12/18/96	1
Co	2.99		mg/Kg	0.6	12/18/96	1
Cr	4.72		mg/Kg	2	12/18/96	1
Cu	323		mg/Kg	1	12/18/96	1
Fe	31700		mg/Kg	0.8	12/18/96	1
K	2110		mg/Kg	200	12/18/96	1
Li	1.93		mg/Kg	1.2	12/18/96	1
Mg	502		mg/Kg	6	12/18/96	1
Mn	699		mg/Kg	0.8	12/18/96	1
Mo	4.49		mg/Kg	2	12/18/96	1
Na	53.9		mg/Kg	6	12/18/96	1
Ni	3.28		mg/Kg	2	12/18/96	1
Pb	27300		mg/Kg	6	12/18/96	1
Sb		U	mg/Kg	4	12/18/96	1
Se	146		mg/Kg	6	12/18/96	1
Si	1500		mg/Kg	4	12/18/96	1
Sr	36		mg/Kg	2	12/18/96	1
V	14.4		mg/Kg	0.8	12/18/96	1
Zn	1770		mg/Kg	0.8	12/18/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2846
Station ID: B-LC01-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	37.1		mg/Kg	2.4	12/18/96	3
Al	2490		mg/Kg	18	12/18/96	3
As	412		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	2350		mg/Kg	2.4	12/18/96	3
Be	0.826		mg/Kg	0.3	12/18/96	3
Ca	689		mg/Kg	18	12/18/96	3
Cd	91.5		mg/Kg	2.4	12/18/96	3
Co	32.9		mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	689		mg/Kg	3	12/18/96	3
Fe	87100		mg/Kg	2.4	12/18/96	3
K	1710		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	213		mg/Kg	18	12/18/96	3
Mn	19600		mg/Kg	2.4	12/18/96	3
Mo	38.4		mg/Kg	6	12/18/96	3
Na	32.3		mg/Kg	18	12/18/96	3
Ni	17.7		mg/Kg	6	12/18/96	3
Pb	21900		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se	92.4		mg/Kg	18	12/18/96	3
Si	2650		mg/Kg	12	12/18/96	3
Sr	23.6		mg/Kg	6	12/18/96	3
V	8		mg/Kg	2.4	12/18/96	3
Zn	8860		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2847
Station ID: B-LC02-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	21.3		mg/Kg	0.8	12/3/96	1
Al	2370		mg/Kg	6	12/3/96	1
As	363		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	244		mg/Kg	0.8	12/3/96	1
Be	0.558		mg/Kg	0.1	12/3/96	1
Ca	805		mg/Kg	6	12/3/96	1
Cd	31		mg/Kg	0.8	12/3/96	1
Co	14.3		mg/Kg	0.6	12/3/96	1
Cr	7.14		mg/Kg	2	12/3/96	1
Cu	222		mg/Kg	1	12/3/96	1
Fe	62900		mg/Kg	0.8	12/3/96	1
K	1660		mg/Kg	200	12/3/96	1
Li		U	mg/Kg	1.2	12/3/96	1
Mg	92.6		mg/Kg	6	12/3/96	1
Mn	5030		mg/Kg	0.8	12/3/96	1
Mo	9.98		mg/Kg	2	12/3/96	1
Na	28.2		mg/Kg	6	12/3/96	1
Ni	3.23		mg/Kg	2	12/3/96	1
Pb	14500		mg/Kg	6	12/3/96	1
Sb	6.74		mg/Kg	4	12/3/96	1
Se	6.6		mg/Kg	6	12/3/96	1
Si	825		mg/Kg	4	12/3/96	1
Sr	29.5		mg/Kg	2	12/3/96	1
V	1.01		mg/Kg	0.8	12/3/96	1
Zn	5050		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Environmental Research Chemistry Laboratory
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2848
Station ID: B-LC02-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	14.3		mg/Kg	0.8	12/3/96	1
Al	2590		mg/Kg	6	12/3/96	1
As	333		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	216		mg/Kg	0.8	12/3/96	1
Be	0.675		mg/Kg	0.1	12/3/96	1
Ca	1810		mg/Kg	6	12/3/96	1
Cd	58.8		mg/Kg	0.8	12/3/96	1
Co	8.16		mg/Kg	0.6	12/3/96	1
Cr	5.43		mg/Kg	2	12/3/96	1
Cu	385		mg/Kg	1	12/3/96	1
Fe	68200		mg/Kg	0.8	12/3/96	1
K	1260		mg/Kg	200	12/3/96	1
Li		U	mg/Kg	1.2	12/3/96	1
Mg	116		mg/Kg	6	12/3/96	1
Mn	3690		mg/Kg	0.8	12/3/96	1
Mo	4.19		mg/Kg	2	12/3/96	1
Na	14.8		mg/Kg	6	12/3/96	1
Ni	2.96		mg/Kg	2	12/3/96	1
Pb	9380		mg/Kg	6	12/3/96	1
Sb	4.67		mg/Kg	4	12/3/96	1
Se	15.7		mg/Kg	6	12/3/96	1
Si	821		mg/Kg	4	12/3/96	1
Sr	14.6		mg/Kg	2	12/3/96	1
V	7.29		mg/Kg	0.8	12/3/96	1
Zn	5930		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2849
Station ID: B-LC03-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	54.8		mg/Kg	0.8	12/3/96	1
Al	1580		mg/Kg	6	12/3/96	1
As	298		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	152		mg/Kg	0.8	12/3/96	1
Be	0.53		mg/Kg	0.1	12/3/96	1
Ca	5920		mg/Kg	6	12/3/96	1
Cd	120		mg/Kg	0.8	12/3/96	1
Co	10.8		mg/Kg	0.6	12/3/96	1
Cr	2.81		mg/Kg	2	12/3/96	1
Cu	198		mg/Kg	1	12/3/96	1
Fe	48100		mg/Kg	0.8	12/3/96	1
K	1220		mg/Kg	200	12/3/96	1
Li		U	mg/Kg	1.2	12/3/96	1
Mg	1880		mg/Kg	6	12/3/96	1
Mn	5190		mg/Kg	0.8	12/3/96	1
Mo	3.59		mg/Kg	2	12/3/96	1
Na	20.8		mg/Kg	6	12/3/96	1
Ni	5.16		mg/Kg	2	12/3/96	1
Pb	30700		mg/Kg	6	12/3/96	1
Sb	4.53		mg/Kg	4	12/3/96	1
Se	87.9		mg/Kg	6	12/3/96	1
Si	846		mg/Kg	4	12/3/96	1
Sr	42.8		mg/Kg	2	12/3/96	1
V	4.81		mg/Kg	0.8	12/3/96	1
Zn	21700		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2850
Station ID: B-LC03-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	43.4		mg/Kg	0.8	12/3/96	1
Al	4270		mg/Kg	6	12/3/96	1
As	261		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	158		mg/Kg	0.8	12/3/96	1
Be	1.58		mg/Kg	0.1	12/3/96	1
Ca	2260		mg/Kg	6	12/3/96	1
Cd	60.1		mg/Kg	0.8	12/3/96	1
Co	6.36		mg/Kg	0.6	12/3/96	1
Cr	3.18		mg/Kg	2	12/3/96	1
Cu	501		mg/Kg	1	12/3/96	1
Fe	50100		mg/Kg	0.8	12/3/96	1
K	1310		mg/Kg	200	12/3/96	1
Li		U	mg/Kg	1.2	12/3/96	1
Mg	394		mg/Kg	6	12/3/96	1
Mn	3670		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	28.1		mg/Kg	6	12/3/96	1
Ni	3.49		mg/Kg	2	12/3/96	1
Pb	14900		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se	85.4		mg/Kg	6	12/3/96	1
Si	1110		mg/Kg	4	12/3/96	1
Sr	23.4		mg/Kg	2	12/3/96	1
V	2.23		mg/Kg	0.8	12/3/96	1
Zn	15800		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2851
Station ID: B-LC04-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	51.7		mg/Kg	0.8	12/18/96	1
Al	2530		mg/Kg	6	12/18/96	1
As	275		mg/Kg	14	12/18/96	1
B		U	mg/Kg	2	12/18/96	1
Ba	1730		mg/Kg	0.8	12/18/96	1
Be	0.671		mg/Kg	0.1	12/18/96	1
Ca	2430		mg/Kg	6	12/18/96	1
Cd	267		mg/Kg	0.8	12/18/96	1
Co	13.1		mg/Kg	0.6	12/18/96	1
Cr	2.65		mg/Kg	2	12/18/96	1
Cu	1040		mg/Kg	1	12/18/96	1
Fe	69900		mg/Kg	0.8	12/18/96	1
K	1970		mg/Kg	200	12/18/96	1
Li		U	mg/Kg	1.2	12/18/96	1
Mg	802		mg/Kg	6	12/18/96	1
Mn	11900		mg/Kg	0.8	12/18/96	1
Mo	72.6		mg/Kg	2	12/18/96	1
Na	98100		mg/Kg	6	12/18/96	1
Ni	4.67		mg/Kg	2	12/18/96	1
Pb	38700		mg/Kg	6	12/18/96	1
Sb	8.65		mg/Kg	4	12/18/96	1
Se	70.9		mg/Kg	6	12/18/96	1
Si	1590		mg/Kg	4	12/18/96	1
Sr	35.2		mg/Kg	2	12/18/96	1
V	1.39		mg/Kg	0.8	12/18/96	1
Zn	44500		mg/Kg	0.8	12/18/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2852
Station ID: B-LC04-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	13.9		mg/Kg	0.8	12/11/96	1
Al	2150		mg/Kg	6	12/11/96	1
As	159		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	136		mg/Kg	0.8	12/11/96	1
Be	0.649		mg/Kg	0.1	12/11/96	1
Ca	27000		mg/Kg	6	12/11/96	1
Cd	105		mg/Kg	0.8	12/11/96	1
Co	9.61		mg/Kg	0.6	12/11/96	1
Cr		U	mg/Kg	2	12/11/96	1
Cu	222		mg/Kg	1	12/11/96	1
Fe	47900		mg/Kg	0.8	12/11/96	1
K	1970		mg/Kg	200	12/11/96	1
Li		U	mg/Kg	1.2	12/11/96	1
Mg	7800		mg/Kg	6	12/11/96	1
Mn	5600		mg/Kg	0.8	12/11/96	1
Mo	2.34		mg/Kg	2	12/11/96	1
Na	22.3		mg/Kg	6	12/11/96	1
Ni	6.25		mg/Kg	2	12/11/96	1
Pb	12200		mg/Kg	6	12/11/96	1
Sb	4.45		mg/Kg	4	12/11/96	1
Se	20.4		mg/Kg	6	12/11/96	1
Si	610		mg/Kg	4	12/11/96	1
Sr	114		mg/Kg	2	12/11/96	1
V	1.54		mg/Kg	0.8	12/11/96	1
Zn	18600		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2853
Station ID: B-LC04-ADSS02--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	60.2		mg/Kg	2.4	12/18/96	3
Al	2010		mg/Kg	18	12/18/96	3
As	344		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	1390		mg/Kg	2.4	12/18/96	3
Be	0.68		mg/Kg	0.3	12/18/96	3
Ca	4980		mg/Kg	18	12/18/96	3
Cd	338		mg/Kg	2.4	12/18/96	3
Co	10.5		mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	1120		mg/Kg	3	12/18/96	3
Fe	85500		mg/Kg	2.4	12/18/96	3
K	2030		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	1990		mg/Kg	18	12/18/96	3
Mn	8520		mg/Kg	2.4	12/18/96	3
Mo	56.8		mg/Kg	6	12/18/96	3
Na	25.6		mg/Kg	18	12/18/96	3
Ni	6.32		mg/Kg	6	12/18/96	3
Pb	41200		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se	97.9		mg/Kg	18	12/18/96	3
Si	2090		mg/Kg	12	12/18/96	3
Sr	58.3		mg/Kg	6	12/18/96	3
V		U	mg/Kg	2.4	12/18/96	3
Zn	57800		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2854
Station ID: B-LC04-BDSS02--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	18.8		mg/Kg	0.8	12/11/96	1
Al	2430		mg/Kg	6	12/11/96	1
As	174		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	218		mg/Kg	0.8	12/11/96	1
Be	0.739		mg/Kg	0.1	12/11/96	1
Ca	20900		mg/Kg	6	12/11/96	1
Cd	186		mg/Kg	0.8	12/11/96	1
Co	10.4		mg/Kg	0.6	12/11/96	1
Cr	3.34		mg/Kg	2	12/11/96	1
Cu	278		mg/Kg	1	12/11/96	1
Fe	61100		mg/Kg	0.8	12/11/96	1
K	1740		mg/Kg	200	12/11/96	1
Li	1.26		mg/Kg	1.2	12/11/96	1
Mg	4410		mg/Kg	6	12/11/96	1
Mn	7110		mg/Kg	0.8	12/11/96	1
Mo	3.38		mg/Kg	2	12/11/96	1
Na	91200		mg/Kg	6	12/11/96	1
Ni	5.95		mg/Kg	2	12/11/96	1
Pb	14800		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	20.9		mg/Kg	6	12/11/96	1
Si	676		mg/Kg	4	12/11/96	1
Sr	65.4		mg/Kg	2	12/11/96	1
V	3.86		mg/Kg	0.8	12/11/96	1
Zn	32400		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2855
Station ID: B-S01-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	114		mg/Kg	2.4	12/18/96	3
Al	6670		mg/Kg	18	12/18/96	3
As	358		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	81.4		mg/Kg	2.4	12/18/96	3
Be	1.44		mg/Kg	0.3	12/18/96	3
Ca	1150		mg/Kg	18	12/18/96	3
Cd	113		mg/Kg	2.4	12/18/96	3
Co	19.4		mg/Kg	1.8	12/18/96	3
Cr	10.7		mg/Kg	6	12/18/96	3
Cu	1780		mg/Kg	3	12/18/96	3
Fe	195000		mg/Kg	2.4	12/18/96	3
K	1590		mg/Kg	600	12/18/96	3
Li	7.12		mg/Kg	3.6	12/18/96	3
Mg	871		mg/Kg	18	12/18/96	3
Mn	7740		mg/Kg	2.4	12/18/96	3
Mo	19.3		mg/Kg	6	12/18/96	3
Na	23.7		mg/Kg	18	12/18/96	3
Ni	7.76		mg/Kg	6	12/18/96	3
Pb	126000		mg/Kg	18	12/18/96	3
Sb	36.6		mg/Kg	12	12/18/96	3
Se	74.6		mg/Kg	18	12/18/96	3
Si	4340		mg/Kg	12	12/18/96	3
Sr	10.9		mg/Kg	6	12/18/96	3
V	103		mg/Kg	2.4	12/18/96	3
Zn	37100		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2856
Station ID: B-S01-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	46		mg/Kg	2.4	12/18/96	3
Al	6120		mg/Kg	18	12/18/96	3
As	391		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	30.1		mg/Kg	2.4	12/18/96	3
Be	1.08		mg/Kg	0.3	12/18/96	3
Ca	1270		mg/Kg	18	12/18/96	3
Cd	70.1		mg/Kg	2.4	12/18/96	3
Co	28.8		mg/Kg	1.8	12/18/96	3
Cr	6.14		mg/Kg	6	12/18/96	3
Cu	1690		mg/Kg	3	12/18/96	3
Fe	163000		mg/Kg	2.4	12/18/96	3
K	1980		mg/Kg	600	12/18/96	3
Li	6.63		mg/Kg	3.6	12/18/96	3
Mg	481		mg/Kg	18	12/18/96	3
Mn	4130		mg/Kg	2.4	12/18/96	3
Mo	9.63		mg/Kg	6	12/18/96	3
Na	25.5		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	33400		mg/Kg	18	12/18/96	3
Sb	18.8		mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	3180		mg/Kg	12	12/18/96	3
Sr	9.69		mg/Kg	6	12/18/96	3
V	49.5		mg/Kg	2.4	12/18/96	3
Zn	18600		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2857
Station ID: B-S02-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	97.7		mg/Kg	2.4	12/3/96	3
Al	3090		mg/Kg	18	12/3/96	3
As	49.7		mg/Kg	42	12/3/96	3
B		U	mg/Kg	6	12/3/96	3
Ba	347		mg/Kg	2.4	12/3/96	3
Be	1.27		mg/Kg	0.3	12/3/96	3
Ca	2970		mg/Kg	18	12/3/96	3
Cd	440		mg/Kg	2.4	12/3/96	3
Co	11		mg/Kg	1.8	12/3/96	3
Cr		U	mg/Kg	6	12/3/96	3
Cu	273		mg/Kg	3	12/3/96	3
Fe	147000		mg/Kg	2.4	12/3/96	3
K	795		mg/Kg	600	12/3/96	3
Li		U	mg/Kg	3.6	12/3/96	3
Mg	1050		mg/Kg	18	12/3/96	3
Mn	19200		mg/Kg	2.4	12/3/96	3
Mo		U	mg/Kg	6	12/3/96	3
Na	307000		mg/Kg	18	12/3/96	3
Ni	11.3		mg/Kg	6	12/3/96	3
Pb	125000		mg/Kg	18	12/3/96	3
Sb	12.9		mg/Kg	12	12/3/96	3
Se		U	mg/Kg	18	12/3/96	3
Si	1830		mg/Kg	12	12/3/96	3
Sr	47.2		mg/Kg	6	12/3/96	3
V		U	mg/Kg	2.4	12/3/96	3
Zn	98700		mg/Kg	2.4	12/3/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2858
Station ID: B-S02-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25483
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	20.3		mg/Kg	0.8	12/18/96	1
Al	8260		mg/Kg	6	12/18/96	1
As	33.6		mg/Kg	14	12/18/96	1
B		U	mg/Kg	2	12/18/96	1
Ba	312		mg/Kg	0.8	12/18/96	1
Be	1.07		mg/Kg	0.1	12/18/96	1
Ca	2970		mg/Kg	6	12/18/96	1
Cd	70.6		mg/Kg	0.8	12/18/96	1
Co	10.9		mg/Kg	0.6	12/18/96	1
Cr	8.29		mg/Kg	2	12/18/96	1
Cu	114		mg/Kg	1	12/18/96	1
Fe	59200		mg/Kg	0.8	12/18/96	1
K	985		mg/Kg	200	12/18/96	1
Li	5.19		mg/Kg	1.2	12/18/96	1
Mg	2780		mg/Kg	6	12/18/96	1
Mn	7140		mg/Kg	0.8	12/18/96	1
Mo	26.5		mg/Kg	2	12/18/96	1
Na	26.6		mg/Kg	6	12/18/96	1
Ni	8.85		mg/Kg	2	12/18/96	1
Pb	28500		mg/Kg	6	12/18/96	1
Sb	6.84		mg/Kg	4	12/18/96	1
Se		U	mg/Kg	6	12/18/96	1
Si	4340		mg/Kg	4	12/18/96	1
Sr	19.4		mg/Kg	2	12/18/96	1
V	19.7		mg/Kg	0.8	12/18/96	1
Zn	17300		mg/Kg	0.8	12/18/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2859
Station ID: B-S03-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25484
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	23.1		mg/Kg	0.8	12/11/96	1
Al	6610		mg/Kg	6	12/11/96	1
As	50		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	939		mg/Kg	0.8	12/11/96	1
Be	0.865		mg/Kg	0.1	12/11/96	1
Ca	4950		mg/Kg	6	12/11/96	1
Cd	61.5		mg/Kg	0.8	12/11/96	1
Co	12.7		mg/Kg	0.6	12/11/96	1
Cr	8.78		mg/Kg	2	12/11/96	1
Cu	63.6		mg/Kg	1	12/11/96	1
Fe	76100		mg/Kg	0.8	12/11/96	1
K	1530		mg/Kg	200	12/11/96	1
Li	6.22		mg/Kg	1.2	12/11/96	1
Mg	1560		mg/Kg	6	12/11/96	1
Mn	12000		mg/Kg	0.8	12/11/96	1
Mo	6.39		mg/Kg	2	12/11/96	1
Na	31.7		mg/Kg	6	12/11/96	1
Ni	9.54		mg/Kg	2	12/11/96	1
Pb	32500		mg/Kg	6	12/11/96	1
Sb	5.19		mg/Kg	4	12/11/96	1
Se	15.1		mg/Kg	6	12/11/96	1
Si	1040		mg/Kg	4	12/11/96	1
Sr	20.4		mg/Kg	2	12/11/96	1
V	14.1		mg/Kg	0.8	12/11/96	1
Zn	13600		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2860
Station ID: B-S03-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25484
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	21.7		mg/Kg	2.4	12/18/96	3
Al	3790		mg/Kg	18	12/18/96	3
As	147		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	1370		mg/Kg	2.4	12/18/96	3
Be	1.07		mg/Kg	0.3	12/18/96	3
Ca	4380		mg/Kg	18	12/18/96	3
Cd	113		mg/Kg	2.4	12/18/96	3
Co	12.9		mg/Kg	1.8	12/18/96	3
Cr	6.59		mg/Kg	6	12/18/96	3
Cu	192		mg/Kg	3	12/18/96	3
Fe	133000		mg/Kg	2.4	12/18/96	3
K	1590		mg/Kg	600	12/18/96	3
Li	7.37		mg/Kg	3.6	12/18/96	3
Mg	594		mg/Kg	18	12/18/96	3
Mn	20200		mg/Kg	2.4	12/18/96	3
Mo	13.2		mg/Kg	6	12/18/96	3
Na	21.2		mg/Kg	18	12/18/96	3
Ni	11.8		mg/Kg	6	12/18/96	3
Pb	34800		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	3130		mg/Kg	12	12/18/96	3
Sr	34.3		mg/Kg	6	12/18/96	3
V	7.08		mg/Kg	2.4	12/18/96	3
Zn	29400		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
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P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2861
Station ID: B-S04-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25484
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	39.7		mg/Kg	2.4	12/3/96	3
Al	3790		mg/Kg	18	12/3/96	3
As	122		mg/Kg	42	12/3/96	3
B		U	mg/Kg	6	12/3/96	3
Ba	1120		mg/Kg	2.4	12/3/96	3
Be	1.35		mg/Kg	0.3	12/3/96	3
Ca	1860		mg/Kg	18	12/3/96	3
Cd	70.6		mg/Kg	2.4	12/3/96	3
Co	13.9		mg/Kg	1.8	12/3/96	3
Cr	11.4		mg/Kg	6	12/3/96	3
Cu	313		mg/Kg	3	12/3/96	3
Fe	132000		mg/Kg	2.4	12/3/96	3
K	1140		mg/Kg	600	12/3/96	3
Li		U	mg/Kg	3.6	12/3/96	3
Mg	447		mg/Kg	18	12/3/96	3
Mn	22800		mg/Kg	2.4	12/3/96	3
Mo	16		mg/Kg	6	12/3/96	3
Na		U	mg/Kg	18	12/3/96	3
Ni	11.7		mg/Kg	6	12/3/96	3
Pb	53100		mg/Kg	18	12/3/96	3
Sb	18.9		mg/Kg	12	12/3/96	3
Se	27.4		mg/Kg	18	12/3/96	3
Si	2620		mg/Kg	12	12/3/96	3
Sr	32.2		mg/Kg	6	12/3/96	3
V	14.8		mg/Kg	2.4	12/3/96	3
Zn	28000		mg/Kg	2.4	12/3/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2862
Station ID: B-S04-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25484
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	13.7		mg/Kg	2.4	12/18/96	3
Al	5540		mg/Kg	18	12/18/96	3
As	47.4		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	803		mg/Kg	2.4	12/18/96	3
Be	1.16		mg/Kg	0.3	12/18/96	3
Ca	3130		mg/Kg	18	12/18/96	3
Cd	47.4		mg/Kg	2.4	12/18/96	3
Co	13.8		mg/Kg	1.8	12/18/96	3
Cr	8.01		mg/Kg	6	12/18/96	3
Cu	128		mg/Kg	3	12/18/96	3
Fe	89300		mg/Kg	2.4	12/18/96	3
K	1280		mg/Kg	600	12/18/96	3
Li	3.75		mg/Kg	3.6	12/18/96	3
Mg	1800		mg/Kg	18	12/18/96	3
Mn	15300		mg/Kg	2.4	12/18/96	3
Mo	10.6		mg/Kg	6	12/18/96	3
Na	23.2		mg/Kg	18	12/18/96	3
Ni	13.7		mg/Kg	6	12/18/96	3
Pb	15500		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	4490		mg/Kg	12	12/18/96	3
Sr	20.6		mg/Kg	6	12/18/96	3
V	16.6		mg/Kg	2.4	12/18/96	3
Zn	16700		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2863
Station ID: B-USB01-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25484
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	26.6		mg/Kg	0.8	12/11/96	1
Al	1960		mg/Kg	6	12/11/96	1
As	212		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	306		mg/Kg	0.8	12/11/96	1
Be	0.275		mg/Kg	0.1	12/11/96	1
Ca	2240		mg/Kg	6	12/11/96	1
Cd	7.2		mg/Kg	0.8	12/11/96	1
Co		U	mg/Kg	0.6	12/11/96	1
Cr		U	mg/Kg	2	12/11/96	1
Cu	96.1		mg/Kg	1	12/11/96	1
Fe	44000		mg/Kg	0.8	12/11/96	1
K	3970		mg/Kg	200	12/11/96	1
Li		U	mg/Kg	1.2	12/11/96	1
Mg	77.6		mg/Kg	6	12/11/96	1
Mn	39.6		mg/Kg	0.8	12/11/96	1
Mo	2.34		mg/Kg	2	12/11/96	1
Na	49.6		mg/Kg	6	12/11/96	1
Ni		U	mg/Kg	2	12/11/96	1
Pb	12400		mg/Kg	6	12/11/96	1
Sb	4.92		mg/Kg	4	12/11/96	1
Se	49.9		mg/Kg	6	12/11/96	1
Si	420		mg/Kg	4	12/11/96	1
Sr	11.6		mg/Kg	2	12/11/96	1
V	5.83		mg/Kg	0.8	12/11/96	1
Zn	1150		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Er ronmental Research Chemistry Laboratory
B au of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2864
Station ID: B-USB01-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25484
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	15.8		mg/Kg	0.8	12/11/96	1
Al	1520		mg/Kg	6	12/11/96	1
As	304		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	69.5		mg/Kg	0.8	12/11/96	1
Be	0.284		mg/Kg	0.1	12/11/96	1
Ca	2580		mg/Kg	6	12/11/96	1
Cd	8.36		mg/Kg	0.8	12/11/96	1
Co	0.977		mg/Kg	0.6	12/11/96	1
Cr		U	mg/Kg	2	12/11/96	1
Cu	76.2		mg/Kg	1	12/11/96	1
Fe	41700		mg/Kg	0.8	12/11/96	1
K	4450		mg/Kg	200	12/11/96	1
Li		U	mg/Kg	1.2	12/11/96	1
Mg	52.3		mg/Kg	6	12/11/96	1
Mn	27.9		mg/Kg	0.8	12/11/96	1
Mo	2.73		mg/Kg	2	12/11/96	1
Na	102		mg/Kg	6	12/11/96	1
Ni		U	mg/Kg	2	12/11/96	1
Pb	6830		mg/Kg	6	12/11/96	1
Sb	7.31		mg/Kg	4	12/11/96	1
Se	61.6		mg/Kg	6	12/11/96	1
Si	373		mg/Kg	4	12/11/96	1
Sr	15.4		mg/Kg	2	12/11/96	1
V	9.98		mg/Kg	0.8	12/11/96	1
Zn	1170		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2865
Station ID: B-USB02-ASS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25484
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	36.5		mg/Kg	2.4	12/18/96	3
Al	2010		mg/Kg	18	12/18/96	3
As	486		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	402		mg/Kg	2.4	12/18/96	3
Be		U	mg/Kg	0.3	12/18/96	3
Ca	23.2		mg/Kg	18	12/18/96	3
Cd	9.49		mg/Kg	2.4	12/18/96	3
Co		U	mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	429		mg/Kg	3	12/18/96	3
Fe	113000		mg/Kg	2.4	12/18/96	3
K	3580		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	56.2		mg/Kg	18	12/18/96	3
Mn	613		mg/Kg	2.4	12/18/96	3
Mo	11.5		mg/Kg	6	12/18/96	3
Na	79.1		mg/Kg	18	12/18/96	3
Ni	6.43		mg/Kg	6	12/18/96	3
Pb	25700		mg/Kg	18	12/18/96	3
Sb	14.2		mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	1150		mg/Kg	12	12/18/96	3
Sr	16.6		mg/Kg	6	12/18/96	3
V	2.6		mg/Kg	2.4	12/18/96	3
Zn	2530		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2866
Station ID: B-USB02-BSS01--961015
Additional ID: 1
Chain-Of-Custody: 8-25484
Matrix: Soil

Sampled Date: 10/15/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	82.7		mg/Kg	0.8	12/18/96	1
Al	1980		mg/Kg	6	12/18/96	1
As	114		mg/Kg	14	12/18/96	1
B		U	mg/Kg	2	12/18/96	1
Ba	147		mg/Kg	0.8	12/18/96	1
Be	0.142		mg/Kg	0.1	12/18/96	1
Ca	25.3		mg/Kg	6	12/18/96	1
Cd	5.6		mg/Kg	0.8	12/18/96	1
Co		U	mg/Kg	0.6	12/18/96	1
Cr		U	mg/Kg	2	12/18/96	1
Cu	82.1		mg/Kg	1	12/18/96	1
Fe	34600		mg/Kg	0.8	12/18/96	1
K	3030		mg/Kg	200	12/18/96	1
Li	1.57		mg/Kg	1.2	12/18/96	1
Mg	50.3		mg/Kg	6	12/18/96	1
Mn	247		mg/Kg	0.8	12/18/96	1
Mo		U	mg/Kg	2	12/18/96	1
Na	32.6		mg/Kg	6	12/18/96	1
Ni		U	mg/Kg	2	12/18/96	1
Pb	72800		mg/Kg	6	12/18/96	1
Sb	7.07		mg/Kg	4	12/18/96	1
Se	20.1		mg/Kg	6	12/18/96	1
Si	756		mg/Kg	4	12/18/96	1
Sr	18.1		mg/Kg	2	12/18/96	1
V		U	mg/Kg	0.8	12/18/96	1
Zn	821		mg/Kg	0.8	12/18/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2867
Station ID: B-WU01-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	71.7		mg/Kg	0.8	12/3/96	1
Al	10200		mg/Kg	6	12/3/96	1
As	187		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	82.2		mg/Kg	0.8	12/3/96	1
Be	0.53		mg/Kg	0.1	12/3/96	1
Ca	122		mg/Kg	6	12/3/96	1
Cd	3.4		mg/Kg	0.8	12/3/96	1
Co	0.613		mg/Kg	0.6	12/3/96	1
Cr	7.93		mg/Kg	2	12/3/96	1
Cu	685		mg/Kg	1	12/3/96	1
Fe	44500		mg/Kg	0.8	12/3/96	1
K	2680		mg/Kg	200	12/3/96	1
Li	3.63		mg/Kg	1.2	12/3/96	1
Mg	773		mg/Kg	6	12/3/96	1
Mn	49.8		mg/Kg	0.8	12/3/96	1
Mo	2		mg/Kg	2	12/3/96	1
Na	127		mg/Kg	6	12/3/96	1
Ni		U	mg/Kg	2	12/3/96	1
Pb	54500		mg/Kg	6	12/3/96	1
Sb	4.18		mg/Kg	4	12/3/96	1
Se	19.9		mg/Kg	6	12/3/96	1
Si	1000		mg/Kg	4	12/3/96	1
Sr	17.1		mg/Kg	2	12/3/96	1
V	16.9		mg/Kg	0.8	12/3/96	1
Zn	699		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2868
Station ID: B-WU01-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	12.6		mg/Kg	0.8	12/3/96	1
Al	5610		mg/Kg	6	12/3/96	1
As	66.3		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	159		mg/Kg	0.8	12/3/96	1
Be	0.886		mg/Kg	0.1	12/3/96	1
Ca	498		mg/Kg	6	12/3/96	1
Cd	9.48		mg/Kg	0.8	12/3/96	1
Co	30.2		mg/Kg	0.6	12/3/96	1
Cr	4.58		mg/Kg	2	12/3/96	1
Cu	446		mg/Kg	1	12/3/96	1
Fe	47300		mg/Kg	0.8	12/3/96	1
K	1500		mg/Kg	200	12/3/96	1
Li	2.01		mg/Kg	1.2	12/3/96	1
Mg	857		mg/Kg	6	12/3/96	1
Mn	3050		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	59.4		mg/Kg	6	12/3/96	1
Ni	2.08		mg/Kg	2	12/3/96	1
Pb	6880		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se	6.37		mg/Kg	6	12/3/96	1
Si	980		mg/Kg	4	12/3/96	1
Sr	9.21		mg/Kg	2	12/3/96	1
V	15.2		mg/Kg	0.8	12/3/96	1
Zn	1130		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Environmental Research Chemistry Laboratory
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2869
Station ID: B-WU02-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	63.9		mg/Kg	2.4	12/3/96	3
Al	6820		mg/Kg	18	12/3/96	3
As	379		mg/Kg	42	12/3/96	3
B		U	mg/Kg	6	12/3/96	3
Ba	49.1		mg/Kg	2.4	12/3/96	3
Be	0.591		mg/Kg	0.3	12/3/96	3
Ca	520		mg/Kg	18	12/3/96	3
Cd	14.6		mg/Kg	2.4	12/3/96	3
Co		U	mg/Kg	1.8	12/3/96	3
Cr		U	mg/Kg	6	12/3/96	3
Cu	648		mg/Kg	3	12/3/96	3
Fe	126000		mg/Kg	2.4	12/3/96	3
K	2050		mg/Kg	600	12/3/96	3
Li		U	mg/Kg	3.6	12/3/96	3
Mg	313		mg/Kg	18	12/3/96	3
Mn	151		mg/Kg	2.4	12/3/96	3
Mo	9.36		mg/Kg	6	12/3/96	3
Na	92.1		mg/Kg	18	12/3/96	3
Ni		U	mg/Kg	6	12/3/96	3
Pb	20100		mg/Kg	18	12/3/96	3
Sb		U	mg/Kg	12	12/3/96	3
Se		U	mg/Kg	18	12/3/96	3
Si	1210		mg/Kg	12	12/3/96	3
Sr	19.2		mg/Kg	6	12/3/96	3
V		U	mg/Kg	2.4	12/3/96	3
Zn	1830		mg/Kg	2.4	12/3/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2870
Station ID: B-WU02-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	31.1		mg/Kg	0.8	12/11/96	1
Al	6300		mg/Kg	6	12/11/96	1
As	429		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	47.6		mg/Kg	0.8	12/11/96	1
Be	0.369		mg/Kg	0.1	12/11/96	1
Ca	867		mg/Kg	6	12/11/96	1
Cd	9.07		mg/Kg	0.8	12/11/96	1
Co		U	mg/Kg	0.6	12/11/96	1
Cr	3.79		mg/Kg	2	12/11/96	1
Cu	244		mg/Kg	1	12/11/96	1
Fe	64400		mg/Kg	0.8	12/11/96	1
K	3550		mg/Kg	200	12/11/96	1
Li	2.39		mg/Kg	1.2	12/11/96	1
Mg	512		mg/Kg	6	12/11/96	1
Mn	46.4		mg/Kg	0.8	12/11/96	1
Mo	5.91		mg/Kg	2	12/11/96	1
Na	99.3		mg/Kg	6	12/11/96	1
Ni	2.57		mg/Kg	2	12/11/96	1
Pb	49300		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	31.7		mg/Kg	6	12/11/96	1
Si	1260		mg/Kg	4	12/11/96	1
Sr	22.9		mg/Kg	2	12/11/96	1
V	2.58		mg/Kg	0.8	12/11/96	1
Zn	675		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2871
Station ID: B-WU03-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	6.08		mg/Kg	0.8	12/11/96	1
Al	16500		mg/Kg	6	12/11/96	1
As	52.9		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	201		mg/Kg	0.8	12/11/96	1
Be	1.05		mg/Kg	0.1	12/11/96	1
Ca	1760		mg/Kg	6	12/11/96	1
Cd	8.26		mg/Kg	0.8	12/11/96	1
Co	13.3		mg/Kg	0.6	12/11/96	1
Cr	14.6		mg/Kg	2	12/11/96	1
Cu	76.6		mg/Kg	1	12/11/96	1
Fe	33000		mg/Kg	0.8	12/11/96	1
K	3220		mg/Kg	200	12/11/96	1
Li	12.1		mg/Kg	1.2	12/11/96	1
Mg	3760		mg/Kg	6	12/11/96	1
Mn	1130		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	86.9		mg/Kg	6	12/11/96	1
Ni	11.9		mg/Kg	2	12/11/96	1
Pb	2080		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	16.2		mg/Kg	6	12/11/96	1
Si	1190		mg/Kg	4	12/11/96	1
Sr	21.7		mg/Kg	2	12/11/96	1
V	37.1		mg/Kg	0.8	12/11/96	1
Zn	1140		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2872
Station ID: B-WU03-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	4.4		mg/Kg	0.8	12/11/96	1
Al	11600		mg/Kg	6	12/11/96	1
As	38.7		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	120		mg/Kg	0.8	12/11/96	1
Be	0.955		mg/Kg	0.1	12/11/96	1
Ca	2850		mg/Kg	6	12/11/96	1
Cd	6.15		mg/Kg	0.8	12/11/96	1
Co	8.38		mg/Kg	0.6	12/11/96	1
Cr	11		mg/Kg	2	12/11/96	1
Cu	120		mg/Kg	1	12/11/96	1
Fe	32500		mg/Kg	0.8	12/11/96	1
K	2760		mg/Kg	200	12/11/96	1
Li	7.26		mg/Kg	1.2	12/11/96	1
Mg	4120		mg/Kg	6	12/11/96	1
Mn	409		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	78.2		mg/Kg	6	12/11/96	1
Ni	10		mg/Kg	2	12/11/96	1
Pb	2800		mg/Kg	6	12/11/96	1
Sb	4.02		mg/Kg	4	12/11/96	1
Se	14.3		mg/Kg	6	12/11/96	1
Si	1140		mg/Kg	4	12/11/96	1
Sr	31.3		mg/Kg	2	12/11/96	1
V	32.3		mg/Kg	0.8	12/11/96	1
Zn	812		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2873
Station ID: B-WU04-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	22.2		mg/Kg	0.8	12/11/96	1
Al	7490		mg/Kg	6	12/11/96	1
As	634		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	71		mg/Kg	0.8	12/11/96	1
Be	0.824		mg/Kg	0.1	12/11/96	1
Ca	814		mg/Kg	6	12/11/96	1
Cd	20		mg/Kg	0.8	12/11/96	1
Co	6.15		mg/Kg	0.6	12/11/96	1
Cr	6.67		mg/Kg	2	12/11/96	1
Cu	275		mg/Kg	1	12/11/96	1
Fe	63000		mg/Kg	0.8	12/11/96	1
K	3040		mg/Kg	200	12/11/96	1
Li	4.25		mg/Kg	1.2	12/11/96	1
Mg	1220		mg/Kg	6	12/11/96	1
Mn	853		mg/Kg	0.8	12/11/96	1
Mo	2.71		mg/Kg	2	12/11/96	1
Na	70.5		mg/Kg	6	12/11/96	1
Ni	5.46		mg/Kg	2	12/11/96	1
Pb	14700		mg/Kg	6	12/11/96	1
Sb	10.8		mg/Kg	4	12/11/96	1
Se	17.9		mg/Kg	6	12/11/96	1
Si	684		mg/Kg	4	12/11/96	1
Sr	20.8		mg/Kg	2	12/11/96	1
V	22.4		mg/Kg	0.8	12/11/96	1
Zn	1520		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2874
Station ID: B-WU04-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	4.92		mg/Kg	0.8	12/11/96	1
Al	12000		mg/Kg	6	12/11/96	1
As	110		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	166		mg/Kg	0.8	12/11/96	1
Be	1.23		mg/Kg	0.1	12/11/96	1
Ca	2210		mg/Kg	6	12/11/96	1
Cd	14.7		mg/Kg	0.8	12/11/96	1
Co	7.63		mg/Kg	0.6	12/11/96	1
Cr	12.7		mg/Kg	2	12/11/96	1
Cu	167		mg/Kg	1	12/11/96	1
Fe	44700		mg/Kg	0.8	12/11/96	1
K	2620		mg/Kg	200	12/11/96	1
Li	8.01		mg/Kg	1.2	12/11/96	1
Mg	2380		mg/Kg	6	12/11/96	1
Mn	485		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	70.4		mg/Kg	6	12/11/96	1
Ni	9.13		mg/Kg	2	12/11/96	1
Pb	1090		mg/Kg	6	12/11/96	1
Sb	5.05		mg/Kg	4	12/11/96	1
Se	10.7		mg/Kg	6	12/11/96	1
Si	1220		mg/Kg	4	12/11/96	1
Sr	30		mg/Kg	2	12/11/96	1
V	36.5		mg/Kg	0.8	12/11/96	1
Zn	1320		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2875
Station ID: B-WU05-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	56.1		mg/Kg	8	12/19/96	10
Al	5050		mg/Kg	60	12/19/96	10
As	1840		mg/Kg	140	12/19/96	10
B		U	mg/Kg	20	12/19/96	10
Ba	78		mg/Kg	8	12/19/96	10
Be	2.98		mg/Kg	1	12/19/96	10
Ca	274		mg/Kg	60	12/19/96	10
Cd	63.2		mg/Kg	8	12/19/96	10
Co	29		mg/Kg	6	12/19/96	10
Cr		U	mg/Kg	20	12/19/96	10
Cu	811		mg/Kg	10	12/19/96	10
Fe	306000		mg/Kg	8	12/19/96	10
K	6900		mg/Kg	2000	12/19/96	10
Li	13.2		mg/Kg	12	12/19/96	10
Mg	172		mg/Kg	60	12/19/96	10
Mn	4380		mg/Kg	8	12/19/96	10
Mo		U	mg/Kg	20	12/19/96	10
Na	232		mg/Kg	60	12/19/96	10
Ni	32		mg/Kg	20	12/19/96	10
Pb	6400		mg/Kg	60	12/19/96	10
Sb		U	mg/Kg	40	12/19/96	10
Se	60.2		mg/Kg	60	12/19/96	10
Si	3980		mg/Kg	40	12/19/96	10
Sr		U	mg/Kg	20	12/19/96	10
V	14.3		mg/Kg	8	12/19/96	10
Zn	8300		mg/Kg	8	12/19/96	10

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2876
Station ID: B-WU05-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	10.7		mg/Kg	2.4	12/3/96	3
Al	3160		mg/Kg	18	12/3/96	3
As	507		mg/Kg	42	12/3/96	3
B		U	mg/Kg	6	12/3/96	3
Ba	264		mg/Kg	2.4	12/3/96	3
Be	1.01		mg/Kg	0.3	12/3/96	3
Ca	474		mg/Kg	18	12/3/96	3
Cd	42.8		mg/Kg	2.4	12/3/96	3
Co	24.1		mg/Kg	1.8	12/3/96	3
Cr		U	mg/Kg	6	12/3/96	3
Cu	337		mg/Kg	3	12/3/96	3
Fe	109000		mg/Kg	2.4	12/3/96	3
K	2570		mg/Kg	600	12/3/96	3
Li		U	mg/Kg	3.6	12/3/96	3
Mg	218		mg/Kg	18	12/3/96	3
Mn	8530		mg/Kg	2.4	12/3/96	3
Mo		U	mg/Kg	6	12/3/96	3
Na	39.4		mg/Kg	18	12/3/96	3
Ni	11.3		mg/Kg	6	12/3/96	3
Pb	2330		mg/Kg	18	12/3/96	3
Sb	13.8		mg/Kg	12	12/3/96	3
Se		U	mg/Kg	18	12/3/96	3
Si	895		mg/Kg	12	12/3/96	3
Sr	46.7		mg/Kg	6	12/3/96	3
V		U	mg/Kg	2.4	12/3/96	3
Zn	5180		mg/Kg	2.4	12/3/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2877
Station ID: B-WU06-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	254		mg/Kg	2.4	12/18/96	3
Al	4470		mg/Kg	18	12/18/96	3
As	320		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	73		mg/Kg	2.4	12/18/96	3
Be		U	mg/Kg	0.3	12/18/96	3
Ca	61.4		mg/Kg	18	12/18/96	3
Cd	6.54		mg/Kg	2.4	12/18/96	3
Co		U	mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	1540		mg/Kg	3	12/18/96	3
Fe	128000		mg/Kg	2.4	12/18/96	3
K	2420		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	263		mg/Kg	18	12/18/96	3
Mn	31.7		mg/Kg	2.4	12/18/96	3
Mo	6.56		mg/Kg	6	12/18/96	3
Na	142		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	126000		mg/Kg	18	12/18/96	3
Sb	26.9		mg/Kg	12	12/18/96	3
Se	19.2		mg/Kg	18	12/18/96	3
Si	1960		mg/Kg	12	12/18/96	3
Sr	16.5		mg/Kg	6	12/18/96	3
V	15.1		mg/Kg	2.4	12/18/96	3
Zn	1200		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2878
Station ID: B-WU06-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	13.8		mg/Kg	0.8	12/3/96	1
Al	9460		mg/Kg	6	12/3/96	1
As	39.3		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	177		mg/Kg	0.8	12/3/96	1
Be	0.586		mg/Kg	0.1	12/3/96	1
Ca	61.2		mg/Kg	6	12/3/96	1
Cd	1.72		mg/Kg	0.8	12/3/96	1
Co	1.51		mg/Kg	0.6	12/3/96	1
Cr	6.85		mg/Kg	2	12/3/96	1
Cu	259		mg/Kg	1	12/3/96	1
Fe	60300		mg/Kg	0.8	12/3/96	1
K	5640		mg/Kg	200	12/3/96	1
Li	3.91		mg/Kg	1.2	12/3/96	1
Mg	2240		mg/Kg	6	12/3/96	1
Mn	59.3		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	295		mg/Kg	6	12/3/96	1
Ni		U	mg/Kg	2	12/3/96	1
Pb	5940		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	1320		mg/Kg	4	12/3/96	1
Sr	17.3		mg/Kg	2	12/3/96	1
V	33.2		mg/Kg	0.8	12/3/96	1
Zn	652		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2879
Station ID: B-WU07-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	43.8		mg/Kg	0.8	12/18/96	1
Al	2550		mg/Kg	6	12/18/96	1
As	293		mg/Kg	14	12/18/96	1
B		U	mg/Kg	2	12/18/96	1
Ba	59.4		mg/Kg	0.8	12/18/96	1
Be	0.266		mg/Kg	0.1	12/18/96	1
Ca	332		mg/Kg	6	12/18/96	1
Cd	8.27		mg/Kg	0.8	12/18/96	1
Co		U	mg/Kg	0.6	12/18/96	1
Cr		U	mg/Kg	2	12/18/96	1
Cu	522		mg/Kg	1	12/18/96	1
Fe	67800		mg/Kg	0.8	12/18/96	1
K	5020		mg/Kg	200	12/18/96	1
Li	1.26		mg/Kg	1.2	12/18/96	1
Mg	96.7		mg/Kg	6	12/18/96	1
Mn	41.8		mg/Kg	0.8	12/18/96	1
Mo	2.37		mg/Kg	2	12/18/96	1
Na	72		mg/Kg	6	12/18/96	1
Ni		U	mg/Kg	2	12/18/96	1
Pb	26700		mg/Kg	6	12/18/96	1
Sb	5.82		mg/Kg	4	12/18/96	1
Se		U	mg/Kg	6	12/18/96	1
Si	1340		mg/Kg	4	12/18/96	1
Sr	10.9		mg/Kg	2	12/18/96	1
V	12.4		mg/Kg	0.8	12/18/96	1
Zn	1900		mg/Kg	0.8	12/18/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2880
Station ID: B-WU07-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	36.1		mg/Kg	0.8	12/11/96	1
Al	1850		mg/Kg	6	12/11/96	1
As	215		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	23.3		mg/Kg	0.8	12/11/96	1
Be	0.41		mg/Kg	0.1	12/11/96	1
Ca	5960		mg/Kg	6	12/11/96	1
Cd	10.6		mg/Kg	0.8	12/11/96	1
Co	0.989		mg/Kg	0.6	12/11/96	1
Cr		U	mg/Kg	2	12/11/96	1
Cu	364		mg/Kg	1	12/11/96	1
Fe	62700		mg/Kg	0.8	12/11/96	1
K	2760		mg/Kg	200	12/11/96	1
Li	1.32		mg/Kg	1.2	12/11/96	1
Mg	130		mg/Kg	6	12/11/96	1
Mn	68.1		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	60.8		mg/Kg	6	12/11/96	1
Ni		U	mg/Kg	2	12/11/96	1
Pb	14100		mg/Kg	6	12/11/96	1
Sb	8.68		mg/Kg	4	12/11/96	1
Se	11.3		mg/Kg	6	12/11/96	1
Si	417		mg/Kg	4	12/11/96	1
Sr	14.1		mg/Kg	2	12/11/96	1
V	12.6		mg/Kg	0.8	12/11/96	1
Zn	2670		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2881
Station ID: B-WU08-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25485
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	5.52		mg/Kg	0.8	12/11/96	1
Al	2580		mg/Kg	6	12/11/96	1
As	146		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	168		mg/Kg	0.8	12/11/96	1
Be	0.378		mg/Kg	0.1	12/11/96	1
Ca	64.1		mg/Kg	6	12/11/96	1
Cd	3.55		mg/Kg	0.8	12/11/96	1
Co	0.96		mg/Kg	0.6	12/11/96	1
Cr	2.1		mg/Kg	2	12/11/96	1
Cu	54.2		mg/Kg	1	12/11/96	1
Fe	45600		mg/Kg	0.8	12/11/96	1
K	5150		mg/Kg	200	12/11/96	1
Li	1.56		mg/Kg	1.2	12/11/96	1
Mg	210		mg/Kg	6	12/11/96	1
Mn	29.8		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	220		mg/Kg	6	12/11/96	1
Ni	2.69		mg/Kg	2	12/11/96	1
Pb	4990		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	15.7		mg/Kg	6	12/11/96	1
Si	674		mg/Kg	4	12/11/96	1
Sr	26.8		mg/Kg	2	12/11/96	1
V	11.5		mg/Kg	0.8	12/11/96	1
Zn	374		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2882
Station ID: B-WU08-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	19.2		mg/Kg	0.8	12/11/96	1
Al	2500		mg/Kg	6	12/11/96	1
As	152		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	31		mg/Kg	0.8	12/11/96	1
Be	0.617		mg/Kg	0.1	12/11/96	1
Ca	473		mg/Kg	6	12/11/96	1
Cd	4.52		mg/Kg	0.8	12/11/96	1
Co	0.698		mg/Kg	0.6	12/11/96	1
Cr	6.71		mg/Kg	2	12/11/96	1
Cu	362		mg/Kg	1	12/11/96	1
Fe	51400		mg/Kg	0.8	12/11/96	1
K	2340		mg/Kg	200	12/11/96	1
Li	1.7		mg/Kg	1.2	12/11/96	1
Mg	70.9		mg/Kg	6	12/11/96	1
Mn	46.7		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	52.2		mg/Kg	6	12/11/96	1
Ni		U	mg/Kg	2	12/11/96	1
Pb	9980		mg/Kg	6	12/11/96	1
Sb	4.77		mg/Kg	4	12/11/96	1
Se	10.9		mg/Kg	6	12/11/96	1
Si	431		mg/Kg	4	12/11/96	1
Sr	13.2		mg/Kg	2	12/11/96	1
V	18.3		mg/Kg	0.8	12/11/96	1
Zn	1240		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2883
Station ID: B-WU09-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	57.9		mg/Kg	2.4	12/18/96	3
Al	1980		mg/Kg	18	12/18/96	3
As	579		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	24		mg/Kg	2.4	12/18/96	3
Be		U	mg/Kg	0.3	12/18/96	3
Ca	54.4		mg/Kg	18	12/18/96	3
Cd	11.8		mg/Kg	2.4	12/18/96	3
Co		U	mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	533		mg/Kg	3	12/18/96	3
Fe	96700		mg/Kg	2.4	12/18/96	3
K	3010		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	62.1		mg/Kg	18	12/18/96	3
Mn	29.3		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	79.4		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	35400		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	1140		mg/Kg	12	12/18/96	3
Sr		U	mg/Kg	6	12/18/96	3
V	8.75		mg/Kg	2.4	12/18/96	3
Zn	2040		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2884
Station ID: B-WU09-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	132		mg/Kg	0.8	12/18/96	1
Al	1470		mg/Kg	6	12/18/96	1
As	560		mg/Kg	14	12/18/96	1
B		U	mg/Kg	2	12/18/96	1
Ba	7.59		mg/Kg	0.8	12/18/96	1
Be	0.218		mg/Kg	0.1	12/18/96	1
Ca	33.5		mg/Kg	6	12/18/96	1
Cd	10.1		mg/Kg	0.8	12/18/96	1
Co		U	mg/Kg	0.6	12/18/96	1
Cr		U	mg/Kg	2	12/18/96	1
Cu	581		mg/Kg	1	12/18/96	1
Fe	83100		mg/Kg	0.8	12/18/96	1
K	2170		mg/Kg	200	12/18/96	1
Li		U	mg/Kg	1.2	12/18/96	1
Mg	39		mg/Kg	6	12/18/96	1
Mn	20.3		mg/Kg	0.8	12/18/96	1
Mo	2.19		mg/Kg	2	12/18/96	1
Na	37.1		mg/Kg	6	12/18/96	1
Ni		U	mg/Kg	2	12/18/96	1
Pb	51900		mg/Kg	6	12/18/96	1
Sb	14.7		mg/Kg	4	12/18/96	1
Se		U	mg/Kg	6	12/18/96	1
Si	870		mg/Kg	4	12/18/96	1
Sr	7.59		mg/Kg	2	12/18/96	1
V		U	mg/Kg	0.8	12/18/96	1
Zn	1640		mg/Kg	0.8	12/18/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2885
Station ID: B-WU10-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	7.52		mg/Kg	0.8	12/11/96	1
Al	7450		mg/Kg	6	12/11/96	1
As	48.9		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	123		mg/Kg	0.8	12/11/96	1
Be	0.991		mg/Kg	0.1	12/11/96	1
Ca	1210		mg/Kg	6	12/11/96	1
Cd	11.4		mg/Kg	0.8	12/11/96	1
Co	11.6		mg/Kg	0.6	12/11/96	1
Cr	7.11		mg/Kg	2	12/11/96	1
Cu	175		mg/Kg	1	12/11/96	1
Fe	42400		mg/Kg	0.8	12/11/96	1
K	1850		mg/Kg	200	12/11/96	1
Li	5.05		mg/Kg	1.2	12/11/96	1
Mg	1910		mg/Kg	6	12/11/96	1
Mn	1180		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	52		mg/Kg	6	12/11/96	1
Ni	7.46		mg/Kg	2	12/11/96	1
Pb	3800		mg/Kg	6	12/11/96	1
Sb	4.23		mg/Kg	4	12/11/96	1
Se	13.8		mg/Kg	6	12/11/96	1
Si	1120		mg/Kg	4	12/11/96	1
Sr	15.8		mg/Kg	2	12/11/96	1
V	22.1		mg/Kg	0.8	12/11/96	1
Zn	1570		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2886
Station ID: B-WU10-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	14.6		mg/Kg	0.8	12/11/96	1
Al	6380		mg/Kg	6	12/11/96	1
As	101		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	73.4		mg/Kg	0.8	12/11/96	1
Be	0.599		mg/Kg	0.1	12/11/96	1
Ca	818		mg/Kg	6	12/11/96	1
Cd	6.67		mg/Kg	0.8	12/11/96	1
Co	6.22		mg/Kg	0.6	12/11/96	1
Cr	4.4		mg/Kg	2	12/11/96	1
Cu	240		mg/Kg	1	12/11/96	1
Fe	47100		mg/Kg	0.8	12/11/96	1
K	2790		mg/Kg	200	12/11/96	1
Li	2.84		mg/Kg	1.2	12/11/96	1
Mg	1130		mg/Kg	6	12/11/96	1
Mn	1090		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	49.6		mg/Kg	6	12/11/96	1
Ni	4.41		mg/Kg	2	12/11/96	1
Pb	10400		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	16.6		mg/Kg	6	12/11/96	1
Si	796		mg/Kg	4	12/11/96	1
Sr	23.2		mg/Kg	2	12/11/96	1
V	12.3		mg/Kg	0.8	12/11/96	1
Zn	1330		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2887
Station ID: B-WU11-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	8.7		mg/Kg	0.8	12/11/96	1
Al	11500		mg/Kg	6	12/11/96	1
As	129		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	95.8		mg/Kg	0.8	12/11/96	1
Be	1.04		mg/Kg	0.1	12/11/96	1
Ca	2100		mg/Kg	6	12/11/96	1
Cd	15.1		mg/Kg	0.8	12/11/96	1
Co	6.35		mg/Kg	0.6	12/11/96	1
Cr	11.4		mg/Kg	2	12/11/96	1
Cu	194		mg/Kg	1	12/11/96	1
Fe	55200		mg/Kg	0.8	12/11/96	1
K	3570		mg/Kg	200	12/11/96	1
Li	7.29		mg/Kg	1.2	12/11/96	1
Mg	3870		mg/Kg	6	12/11/96	1
Mn	320		mg/Kg	0.8	12/11/96	1
Mo	4.19		mg/Kg	2	12/11/96	1
Na	79.6		mg/Kg	6	12/11/96	1
Ni	8.46		mg/Kg	2	12/11/96	1
Pb	7750		mg/Kg	6	12/11/96	1
Sb	4.56		mg/Kg	4	12/11/96	1
Se	20.9		mg/Kg	6	12/11/96	1
Si	984		mg/Kg	4	12/11/96	1
Sr	19.5		mg/Kg	2	12/11/96	1
V	36.4		mg/Kg	0.8	12/11/96	1
Zn	2270		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Environmental Research Chemistry Laboratory
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2888
Station ID: B-WU11-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	8.32		mg/Kg	0.8	12/11/96	1
Al	8700		mg/Kg	6	12/11/96	1
As	61.4		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	118		mg/Kg	0.8	12/11/96	1
Be	0.955		mg/Kg	0.1	12/11/96	1
Ca	1610		mg/Kg	6	12/11/96	1
Cd	8.91		mg/Kg	0.8	12/11/96	1
Co	9.24		mg/Kg	0.6	12/11/96	1
Cr	8.41		mg/Kg	2	12/11/96	1
Cu	196		mg/Kg	1	12/11/96	1
Fe	44100		mg/Kg	0.8	12/11/96	1
K	2650		mg/Kg	200	12/11/96	1
Li	5.5		mg/Kg	1.2	12/11/96	1
Mg	2260		mg/Kg	6	12/11/96	1
Mn	1110		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	63.2		mg/Kg	6	12/11/96	1
Ni	7.58		mg/Kg	2	12/11/96	1
Pb	4010		mg/Kg	6	12/11/96	1
Sb	4.2		mg/Kg	4	12/11/96	1
Se	15.9		mg/Kg	6	12/11/96	1
Si	778		mg/Kg	4	12/11/96	1
Sr	19.2		mg/Kg	2	12/11/96	1
V	26.8		mg/Kg	0.8	12/11/96	1
Zn	1440		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2889
Station ID: B-WU12-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	3.89		mg/Kg	0.8	12/11/96	1
Al	2620		mg/Kg	6	12/11/96	1
As	83		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	231		mg/Kg	0.8	12/11/96	1
Be	0.68		mg/Kg	0.1	12/11/96	1
Ca	9480		mg/Kg	6	12/11/96	1
Cd	4.7		mg/Kg	0.8	12/11/96	1
Co	4.31		mg/Kg	0.6	12/11/96	1
Cr	5.2		mg/Kg	2	12/11/96	1
Cu	62.1		mg/Kg	1	12/11/96	1
Fe	49500		mg/Kg	0.8	12/11/96	1
K	2610		mg/Kg	200	12/11/96	1
Li	2.56		mg/Kg	1.2	12/11/96	1
Mg	309		mg/Kg	6	12/11/96	1
Mn	275		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	74.3		mg/Kg	6	12/11/96	1
Ni	5.41		mg/Kg	2	12/11/96	1
Pb	571		mg/Kg	6	12/11/96	1
Sb	5.3		mg/Kg	4	12/11/96	1
Se	17.2		mg/Kg	6	12/11/96	1
Si	561		mg/Kg	4	12/11/96	1
Sr	24		mg/Kg	2	12/11/96	1
V	17.3		mg/Kg	0.8	12/11/96	1
Zn	881		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
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P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2890
Station ID: B-WU12-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	25.2		mg/Kg	0.8	12/11/96	1
Al	3640		mg/Kg	6	12/11/96	1
As	121		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	28.1		mg/Kg	0.8	12/11/96	1
Be	0.649		mg/Kg	0.1	12/11/96	1
Ca	2390		mg/Kg	6	12/11/96	1
Cd	19.8		mg/Kg	0.8	12/11/96	1
Co	4.3		mg/Kg	0.6	12/11/96	1
Cr	2.9		mg/Kg	2	12/11/96	1
Cu	525		mg/Kg	1	12/11/96	1
Fe	57400		mg/Kg	0.8	12/11/96	1
K	3700		mg/Kg	200	12/11/96	1
Li	2.08		mg/Kg	1.2	12/11/96	1
Mg	1050		mg/Kg	6	12/11/96	1
Mn	468		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	78.7		mg/Kg	6	12/11/96	1
Ni	5.59		mg/Kg	2	12/11/96	1
Pb	19900		mg/Kg	6	12/11/96	1
Sb	6.43		mg/Kg	4	12/11/96	1
Se	15.8		mg/Kg	6	12/11/96	1
Si	472		mg/Kg	4	12/11/96	1
Sr	14		mg/Kg	2	12/11/96	1
V	8.89		mg/Kg	0.8	12/11/96	1
Zn	3750		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2891
Station ID: B-WU13-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	5.88		mg/Kg	0.8	12/3/96	1
Al	15900		mg/Kg	6	12/3/96	1
As	44.5		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	95.2		mg/Kg	0.8	12/3/96	1
Be	1.05		mg/Kg	0.1	12/3/96	1
Ca	2360		mg/Kg	6	12/3/96	1
Cd	21.4		mg/Kg	0.8	12/3/96	1
Co	13.6		mg/Kg	0.6	12/3/96	1
Cr	11.1		mg/Kg	2	12/3/96	1
Cu	331		mg/Kg	1	12/3/96	1
Fe	32400		mg/Kg	0.8	12/3/96	1
K	3120		mg/Kg	200	12/3/96	1
Li	6.8		mg/Kg	1.2	12/3/96	1
Mg	3290		mg/Kg	6	12/3/96	1
Mn	1610		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	56.6		mg/Kg	6	12/3/96	1
Ni	6.9		mg/Kg	2	12/3/96	1
Pb	7010		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	1210		mg/Kg	4	12/3/96	1
Sr	20.8		mg/Kg	2	12/3/96	1
V	32.3		mg/Kg	0.8	12/3/96	1
Zn	2030		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2892
Station ID: B-WU13-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	6.44		mg/Kg	0.8	12/11/96	1
Al	7590		mg/Kg	6	12/11/96	1
As	23.2		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	64.8		mg/Kg	0.8	12/11/96	1
Be	1.09		mg/Kg	0.1	12/11/96	1
Ca	2510		mg/Kg	6	12/11/96	1
Cd	25.8		mg/Kg	0.8	12/11/96	1
Co	22.2		mg/Kg	0.6	12/11/96	1
Cr	6.46		mg/Kg	2	12/11/96	1
Cu	539		mg/Kg	1	12/11/96	1
Fe	42600		mg/Kg	0.8	12/11/96	1
K	1920		mg/Kg	200	12/11/96	1
Li	3.92		mg/Kg	1.2	12/11/96	1
Mg	1920		mg/Kg	6	12/11/96	1
Mn	1300		mg/Kg	0.8	12/11/96	1
Mo	2.29		mg/Kg	2	12/11/96	1
Na	40.9		mg/Kg	6	12/11/96	1
Ni	6.7		mg/Kg	2	12/11/96	1
Pb	1700		mg/Kg	6	12/11/96	1
Sb	6.51		mg/Kg	4	12/11/96	1
Se	16.9		mg/Kg	6	12/11/96	1
Si	867		mg/Kg	4	12/11/96	1
Sr	19.2		mg/Kg	2	12/11/96	1
V	29.1		mg/Kg	0.8	12/11/96	1
Zn	1050		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2893
Station ID: B-EX07-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	51.2		mg/Kg	0.8	12/3/96	1
Al	3780		mg/Kg	6	12/3/96	1
As	118		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	75.7		mg/Kg	0.8	12/3/96	1
Be	0.258		mg/Kg	0.1	12/3/96	1
Ca	618		mg/Kg	6	12/3/96	1
Cd	6.29		mg/Kg	0.8	12/3/96	1
Co		U	mg/Kg	0.6	12/3/96	1
Cr	5		mg/Kg	2	12/3/96	1
Cu	290		mg/Kg	1	12/3/96	1
Fe	50900		mg/Kg	0.8	12/3/96	1
K	3260		mg/Kg	200	12/3/96	1
Li	2.7		mg/Kg	1.2	12/3/96	1
Mg	868		mg/Kg	6	12/3/96	1
Mn	79.4		mg/Kg	0.8	12/3/96	1
Mo	2.27		mg/Kg	2	12/3/96	1
Na	77		mg/Kg	6	12/3/96	1
Ni		U	mg/Kg	2	12/3/96	1
Pb	55700		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se	10		mg/Kg	6	12/3/96	1
Si	635		mg/Kg	4	12/3/96	1
Sr	115		mg/Kg	2	12/3/96	1
V	18.1		mg/Kg	0.8	12/3/96	1
Zn	1040		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2894
Station ID: B-EX07-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	26.2		mg/Kg	0.8	12/11/96	1
Al	4330		mg/Kg	6	12/11/96	1
As	84.4		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	75.2		mg/Kg	0.8	12/11/96	1
Be	0.473		mg/Kg	0.1	12/11/96	1
Ca	13800		mg/Kg	6	12/11/96	1
Cd	5.77		mg/Kg	0.8	12/11/96	1
Co	2.47		mg/Kg	0.6	12/11/96	1
Cr	5.97		mg/Kg	2	12/11/96	1
Cu	78		mg/Kg	1	12/11/96	1
Fe	40500		mg/Kg	0.8	12/11/96	1
K	2700		mg/Kg	200	12/11/96	1
Li	4.25		mg/Kg	1.2	12/11/96	1
Mg	1230		mg/Kg	6	12/11/96	1
Mn	48		mg/Kg	0.8	12/11/96	1
Mo	3.91		mg/Kg	2	12/11/96	1
Na	98.7		mg/Kg	6	12/11/96	1
Ni	3.13		mg/Kg	2	12/11/96	1
Pb	2750		mg/Kg	6	12/11/96	1
Sb	5.21		mg/Kg	4	12/11/96	1
Se	12.2		mg/Kg	6	12/11/96	1
Si	712		mg/Kg	4	12/11/96	1
Sr	49.5		mg/Kg	2	12/11/96	1
V	23.8		mg/Kg	0.8	12/11/96	1
Zn	800		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2895
Station ID: B-EX08-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	76.8		mg/Kg	0.8	12/11/96	1
Al	3830		mg/Kg	6	12/11/96	1
As	138		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	31.4		mg/Kg	0.8	12/11/96	1
Be	0.541		mg/Kg	0.1	12/11/96	1
Ca	1140		mg/Kg	6	12/11/96	1
Cd	29.1		mg/Kg	0.8	12/11/96	1
Co	1.5		mg/Kg	0.6	12/11/96	1
Cr	6.44		mg/Kg	2	12/11/96	1
Cu	226		mg/Kg	1	12/11/96	1
Fe	77600		mg/Kg	0.8	12/11/96	1
K	2320		mg/Kg	200	12/11/96	1
Li	5.83		mg/Kg	1.2	12/11/96	1
Mg	650		mg/Kg	6	12/11/96	1
Mn	355		mg/Kg	0.8	12/11/96	1
Mo	4.88		mg/Kg	2	12/11/96	1
Na	134		mg/Kg	6	12/11/96	1
Ni	2.71		mg/Kg	2	12/11/96	1
Pb	2920		mg/Kg	6	12/11/96	1
Sb	7.1		mg/Kg	4	12/11/96	1
Se	11.7		mg/Kg	6	12/11/96	1
Si	651		mg/Kg	4	12/11/96	1
Sr	16.1		mg/Kg	2	12/11/96	1
V	27.5		mg/Kg	0.8	12/11/96	1
Zn	4530		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2896
Station ID: B-EX08-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25486
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	60.6		mg/Kg	0.8	12/11/96	1
Al	3000		mg/Kg	6	12/11/96	1
As	98.8		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	56.3		mg/Kg	0.8	12/11/96	1
Be	0.581		mg/Kg	0.1	12/11/96	1
Ca	17800		mg/Kg	6	12/11/96	1
Cd	11		mg/Kg	0.8	12/11/96	1
Co	0.827		mg/Kg	0.6	12/11/96	1
Cr	5.41		mg/Kg	2	12/11/96	1
Cu	298		mg/Kg	1	12/11/96	1
Fe	89200		mg/Kg	0.8	12/11/96	1
K	2020		mg/Kg	200	12/11/96	1
Li	2.45		mg/Kg	1.2	12/11/96	1
Mg	1060		mg/Kg	6	12/11/96	1
Mn	223		mg/Kg	0.8	12/11/96	1
Mo	2.34		mg/Kg	2	12/11/96	1
Na	138		mg/Kg	6	12/11/96	1
Ni	2.74		mg/Kg	2	12/11/96	1
Pb	2840		mg/Kg	6	12/11/96	1
Sb	7.32		mg/Kg	4	12/11/96	1
Se	6.15		mg/Kg	6	12/11/96	1
Si	569		mg/Kg	4	12/11/96	1
Sr	42.3		mg/Kg	2	12/11/96	1
V	20		mg/Kg	0.8	12/11/96	1
Zn	2150		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Environmental Research Chemistry Laboratory
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2897
Station ID: B-EX09-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25487
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	152		mg/Kg	2.4	12/3/96	3
Al	2280		mg/Kg	18	12/3/96	3
As	362		mg/Kg	42	12/3/96	3
B		U	mg/Kg	6	12/3/96	3
Ba		U	mg/Kg	2.4	12/3/96	3
Be	0.309		mg/Kg	0.3	12/3/96	3
Ca	10500		mg/Kg	18	12/3/96	3
Cd	15.6		mg/Kg	2.4	12/3/96	3
Co	13.1		mg/Kg	1.8	12/3/96	3
Cr		U	mg/Kg	6	12/3/96	3
Cu	116		mg/Kg	3	12/3/96	3
Fe	131000		mg/Kg	2.4	12/3/96	3
K	3670		mg/Kg	600	12/3/96	3
Li		U	mg/Kg	3.6	12/3/96	3
Mg	173		mg/Kg	18	12/3/96	3
Mn	131		mg/Kg	2.4	12/3/96	3
Mo		U	mg/Kg	6	12/3/96	3
Na	40.9		mg/Kg	18	12/3/96	3
Ni		U	mg/Kg	6	12/3/96	3
Pb	3370		mg/Kg	18	12/3/96	3
Sb		U	mg/Kg	12	12/3/96	3
Se		U	mg/Kg	18	12/3/96	3
Si	470		mg/Kg	12	12/3/96	3
Sr	31.8		mg/Kg	6	12/3/96	3
V		U	mg/Kg	2.4	12/3/96	3
Zn	1640		mg/Kg	2.4	12/3/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Environmental Research Chemistry Laboratory
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2898
Station ID: B-EX09-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25487
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	149		mg/Kg	2.4	12/3/96	3
Al	2010		mg/Kg	18	12/3/96	3
As	310		mg/Kg	42	12/3/96	3
B		U	mg/Kg	6	12/3/96	3
Ba		U	mg/Kg	2.4	12/3/96	3
Be	0.338		mg/Kg	0.3	12/3/96	3
Ca	23300		mg/Kg	18	12/3/96	3
Cd	126		mg/Kg	2.4	12/3/96	3
Co		U	mg/Kg	1.8	12/3/96	3
Cr		U	mg/Kg	6	12/3/96	3
Cu	867		mg/Kg	3	12/3/96	3
Fe	120000		mg/Kg	2.4	12/3/96	3
K	1790		mg/Kg	600	12/3/96	3
Li		U	mg/Kg	3.6	12/3/96	3
Mg	830		mg/Kg	18	12/3/96	3
Mn	466		mg/Kg	2.4	12/3/96	3
Mo		U	mg/Kg	6	12/3/96	3
Na	40.3		mg/Kg	18	12/3/96	3
Ni		U	mg/Kg	6	12/3/96	3
Pb	6200		mg/Kg	18	12/3/96	3
Sb	12.7		mg/Kg	12	12/3/96	3
Se		U	mg/Kg	18	12/3/96	3
Si	473		mg/Kg	12	12/3/96	3
Sr	50.8		mg/Kg	6	12/3/96	3
V		U	mg/Kg	2.4	12/3/96	3
Zn	21300		mg/Kg	2.4	12/3/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2899
Station ID: B-EX10-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25487
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	16.5		mg/Kg	0.8	12/3/96	1
Al	3090		mg/Kg	6	12/3/96	1
As	183		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	34		mg/Kg	0.8	12/3/96	1
Be	0.37		mg/Kg	0.1	12/3/96	1
Ca	446		mg/Kg	6	12/3/96	1
Cd	9.93		mg/Kg	0.8	12/3/96	1
Co		U	mg/Kg	0.6	12/3/96	1
Cr	5.44		mg/Kg	2	12/3/96	1
Cu	176		mg/Kg	1	12/3/96	1
Fe	72800		mg/Kg	0.8	12/3/96	1
K	2730		mg/Kg	200	12/3/96	1
Li	3.74		mg/Kg	1.2	12/3/96	1
Mg	291		mg/Kg	6	12/3/96	1
Mn	658		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	92		mg/Kg	6	12/3/96	1
Ni		U	mg/Kg	2	12/3/96	1
Pb	10800		mg/Kg	6	12/3/96	1
Sb	4.65		mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	1010		mg/Kg	4	12/3/96	1
Sr	23		mg/Kg	2	12/3/96	1
V	23.3		mg/Kg	0.8	12/3/96	1
Zn	2200		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2900
Station ID: B-EX10-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25487
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	15.3		mg/Kg	0.8	12/11/96	1
Al	5540		mg/Kg	6	12/11/96	1
As	43.3		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	28.6		mg/Kg	0.8	12/11/96	1
Be	1.13		mg/Kg	0.1	12/11/96	1
Ca	31000		mg/Kg	6	12/11/96	1
Cd	148		mg/Kg	0.8	12/11/96	1
Co	13.6		mg/Kg	0.6	12/11/96	1
Cr	6.5		mg/Kg	2	12/11/96	1
Cu	252		mg/Kg	1	12/11/96	1
Fe	50300		mg/Kg	0.8	12/11/96	1
K	1550		mg/Kg	200	12/11/96	1
Li	5.15		mg/Kg	1.2	12/11/96	1
Mg	7060		mg/Kg	6	12/11/96	1
Mn	3460		mg/Kg	0.8	12/11/96	1
Mo	2.75		mg/Kg	2	12/11/96	1
Na	48.9		mg/Kg	6	12/11/96	1
Ni	17.8		mg/Kg	2	12/11/96	1
Pb	6140		mg/Kg	6	12/11/96	1
Sb	4.19		mg/Kg	4	12/11/96	1
Se	20.9		mg/Kg	6	12/11/96	1
Si	957		mg/Kg	4	12/11/96	1
Sr	65.8		mg/Kg	2	12/11/96	1
V	24.2		mg/Kg	0.8	12/11/96	1
Zn	25300		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2901
Station ID: B-EX11-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25487
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	8.95		mg/Kg	0.8	12/11/96	1
Al	12800		mg/Kg	6	12/11/96	1
As	27.9		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	102		mg/Kg	0.8	12/11/96	1
Be	2.23		mg/Kg	0.1	12/11/96	1
Ca	12000		mg/Kg	6	12/11/96	1
Cd	34.7		mg/Kg	0.8	12/11/96	1
Co	13.4		mg/Kg	0.6	12/11/96	1
Cr	6.7		mg/Kg	2	12/11/96	1
Cu	332		mg/Kg	1	12/11/96	1
Fe	40900		mg/Kg	0.8	12/11/96	1
K	2460		mg/Kg	200	12/11/96	1
Li	11.9		mg/Kg	1.2	12/11/96	1
Mg	7030		mg/Kg	6	12/11/96	1
Mn	1930		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	85.5		mg/Kg	6	12/11/96	1
Ni	11.5		mg/Kg	2	12/11/96	1
Pb	4280		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	17		mg/Kg	6	12/11/96	1
Si	2070		mg/Kg	4	12/11/96	1
Sr	24.1		mg/Kg	2	12/11/96	1
V	31.8		mg/Kg	0.8	12/11/96	1
Zn	12500		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
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P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2902
Station ID: B-EX11-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25487
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	27.1		mg/Kg	0.8	12/11/96	1
Al	2930		mg/Kg	6	12/11/96	1
As	179		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	17.2		mg/Kg	0.8	12/11/96	1
Be	0.64		mg/Kg	0.1	12/11/96	1
Ca	34900		mg/Kg	6	12/11/96	1
Cd	60.3		mg/Kg	0.8	12/11/96	1
Co	2.49		mg/Kg	0.6	12/11/96	1
Cr	4.78		mg/Kg	2	12/11/96	1
Cu	296		mg/Kg	1	12/11/96	1
Fe	73400		mg/Kg	0.8	12/11/96	1
K	1750		mg/Kg	200	12/11/96	1
Li	3.53		mg/Kg	1.2	12/11/96	1
Mg	1170		mg/Kg	6	12/11/96	1
Mn	756		mg/Kg	0.8	12/11/96	1
Mo	2.41		mg/Kg	2	12/11/96	1
Na	147		mg/Kg	6	12/11/96	1
Ni	7.87		mg/Kg	2	12/11/96	1
Pb	7620		mg/Kg	6	12/11/96	1
Sb	5.07		mg/Kg	4	12/11/96	1
Se	13		mg/Kg	6	12/11/96	1
Si	661		mg/Kg	4	12/11/96	1
Sr	47.4		mg/Kg	2	12/11/96	1
V	25.3		mg/Kg	0.8	12/11/96	1
Zn	11000		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2903
Station ID: B-EX13-ASS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25487
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	15.3		mg/Kg	2.4	12/18/96	3
Al	6210		mg/Kg	18	12/18/96	3
As	113		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	91		mg/Kg	2.4	12/18/96	3
Be	0.453		mg/Kg	0.3	12/18/96	3
Ca	11800		mg/Kg	18	12/18/96	3
Cd	7.18		mg/Kg	2.4	12/18/96	3
Co		U	mg/Kg	1.8	12/18/96	3
Cr	19.2		mg/Kg	6	12/18/96	3
Cu	63.7		mg/Kg	3	12/18/96	3
Fe	93400		mg/Kg	2.4	12/18/96	3
K	3160		mg/Kg	600	12/18/96	3
Li	6.75		mg/Kg	3.6	12/18/96	3
Mg	1220		mg/Kg	18	12/18/96	3
Mn	156		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	127		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	5840		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	2080		mg/Kg	12	12/18/96	3
Sr	44		mg/Kg	6	12/18/96	3
V	34.4		mg/Kg	2.4	12/18/96	3
Zn	1070		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2904
Station ID: B-EX13-BSS01--961016
Additional ID: 1
Chain-Of-Custody: 8-25487
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	58.3		mg/Kg	2.4	12/18/96	3
Al	2620		mg/Kg	18	12/18/96	3
As	383		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	58.2		mg/Kg	2.4	12/18/96	3
Be	0.44		mg/Kg	0.3	12/18/96	3
Ca	30200		mg/Kg	18	12/18/96	3
Cd	17.4		mg/Kg	2.4	12/18/96	3
Co	4.5		mg/Kg	1.8	12/18/96	3
Cr	8.71		mg/Kg	6	12/18/96	3
Cu	105		mg/Kg	3	12/18/96	3
Fe	188000		mg/Kg	2.4	12/18/96	3
K	1770		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	995		mg/Kg	18	12/18/96	3
Mn	522		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	58.3		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	2210		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	2110		mg/Kg	12	12/18/96	3
Sr	61		mg/Kg	6	12/18/96	3
V	10.7		mg/Kg	2.4	12/18/96	3
Zn	3040		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2905
Station ID: B-EX13-ADSS02--961016
Additional ID: 1
Chain-Of-Custody: 8-25487
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	8.33		mg/Kg	0.8	12/3/96	1
Al	2760		mg/Kg	6	12/3/96	1
As	135		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	30.8		mg/Kg	0.8	12/3/96	1
Be	0.342		mg/Kg	0.1	12/3/96	1
Ca	21300		mg/Kg	6	12/3/96	1
Cd	3.98		mg/Kg	0.8	12/3/96	1
Co	0.858		mg/Kg	0.6	12/3/96	1
Cr	7.95		mg/Kg	2	12/3/96	1
Cu	47.2		mg/Kg	1	12/3/96	1
Fe	70700		mg/Kg	0.8	12/3/96	1
K	2660		mg/Kg	200	12/3/96	1
Li	1.9		mg/Kg	1.2	12/3/96	1
Mg	457		mg/Kg	6	12/3/96	1
Mn	249		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	73.6		mg/Kg	6	12/3/96	1
Ni		U	mg/Kg	2	12/3/96	1
Pb	1430		mg/Kg	6	12/3/96	1
Sb	4		mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	678		mg/Kg	4	12/3/96	1
Sr	40.7		mg/Kg	2	12/3/96	1
V	22.3		mg/Kg	0.8	12/3/96	1
Zn	758		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake; Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2906
Station ID: B-EX13-BDSS02--961016
Additional ID: 1
Chain-Of-Custody: 8-25487
Matrix: Soil

Sampled Date: 10/16/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	18.3		mg/Kg	2.4	12/3/96	3
Al	4790		mg/Kg	18	12/3/96	3
As	160		mg/Kg	42	12/3/96	3
B		U	mg/Kg	6	12/3/96	3
Ba	136		mg/Kg	2.4	12/3/96	3
Be	0.619		mg/Kg	0.3	12/3/96	3
Ca	32700		mg/Kg	18	12/3/96	3
Cd	14.1		mg/Kg	2.4	12/3/96	3
Co	1.96		mg/Kg	1.8	12/3/96	3
Cr	23.2		mg/Kg	6	12/3/96	3
Cu	113		mg/Kg	3	12/3/96	3
Fe	114000		mg/Kg	2.4	12/3/96	3
K	2990		mg/Kg	600	12/3/96	3
Li		U	mg/Kg	3.6	12/3/96	3
Mg	1950		mg/Kg	18	12/3/96	3
Mn	361		mg/Kg	2.4	12/3/96	3
Mo		U	mg/Kg	6	12/3/96	3
Na	95.2		mg/Kg	18	12/3/96	3
Ni		U	mg/Kg	6	12/3/96	3
Pb	2270		mg/Kg	18	12/3/96	3
Sb		U	mg/Kg	12	12/3/96	3
Se		U	mg/Kg	18	12/3/96	3
Si	1070		mg/Kg	12	12/3/96	3
Sr	101		mg/Kg	6	12/3/96	3
V	27.1		mg/Kg	2.4	12/3/96	3
Zn	2770		mg/Kg	2.4	12/3/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2907
Station ID: B-UM01-ASS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	10.5		mg/Kg	0.8	12/18/96	1
Al	6430		mg/Kg	6	12/18/96	1
As	34.7		mg/Kg	14	12/18/96	1
B		U	mg/Kg	2	12/18/96	1
Ba	115		mg/Kg	0.8	12/18/96	1
Be	0.333		mg/Kg	0.1	12/18/96	1
Ca	3600		mg/Kg	6	12/18/96	1
Cd	0.825		mg/Kg	0.8	12/18/96	1
Co	0.959		mg/Kg	0.6	12/18/96	1
Cr	7.69		mg/Kg	2	12/18/96	1
Cu	212		mg/Kg	1	12/18/96	1
Fe	33100		mg/Kg	0.8	12/18/96	1
K	1790		mg/Kg	200	12/18/96	1
Li	5.51		mg/Kg	1.2	12/18/96	1
Mg	2040		mg/Kg	6	12/18/96	1
Mn	92.5		mg/Kg	0.8	12/18/96	1
Mo	2.67		mg/Kg	2	12/18/96	1
Na	309		mg/Kg	6	12/18/96	1
Ni	3.25		mg/Kg	2	12/18/96	1
Pb	1950		mg/Kg	6	12/18/96	1
Sb		U	mg/Kg	4	12/18/96	1
Se		U	mg/Kg	6	12/18/96	1
Si	2360		mg/Kg	4	12/18/96	1
Sr	29.8		mg/Kg	2	12/18/96	1
V	21.2		mg/Kg	0.8	12/18/96	1
Zn	217		mg/Kg	0.8	12/18/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2908
Station ID: B-UM01-BSS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	5.45		mg/Kg	0.8	12/11/96	1
Al	4720		mg/Kg	6	12/11/96	1
As	16.8		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	50.9		mg/Kg	0.8	12/11/96	1
Be	0.396		mg/Kg	0.1	12/11/96	1
Ca	6460		mg/Kg	6	12/11/96	1
Cd	1.73		mg/Kg	0.8	12/11/96	1
Co	3.32		mg/Kg	0.6	12/11/96	1
Cr	7.2		mg/Kg	2	12/11/96	1
Cu	117		mg/Kg	1	12/11/96	1
Fe	21800		mg/Kg	0.8	12/11/96	1
K	899		mg/Kg	200	12/11/96	1
Li	4.15		mg/Kg	1.2	12/11/96	1
Mg	2550		mg/Kg	6	12/11/96	1
Mn	95.1		mg/Kg	0.8	12/11/96	1
Mo		U	mg/Kg	2	12/11/96	1
Na	175		mg/Kg	6	12/11/96	1
Ni	5.4		mg/Kg	2	12/11/96	1
Pb	517		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	15.7		mg/Kg	6	12/11/96	1
Si	1190		mg/Kg	4	12/11/96	1
Sr	21.1		mg/Kg	2	12/11/96	1
V	20.8		mg/Kg	0.8	12/11/96	1
Zn	305		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2909
Station ID: B-UM02-ASS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	82.3		mg/Kg	2.4	12/18/96	3
Al	3420		mg/Kg	18	12/18/96	3
As	156		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	56.5		mg/Kg	2.4	12/18/96	3
Be	0.4		mg/Kg	0.3	12/18/96	3
Ca	794		mg/Kg	18	12/18/96	3
Cd	3.03		mg/Kg	2.4	12/18/96	3
Co		U	mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	1580		mg/Kg	3	12/18/96	3
Fe	88700		mg/Kg	2.4	12/18/96	3
K	2610		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	258		mg/Kg	18	12/18/96	3
Mn	128		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	106		mg/Kg	18	12/18/96	3
Ni	6.55		mg/Kg	6	12/18/96	3
Pb	8260		mg/Kg	18	12/18/96	3
Sb	14.9		mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	1570		mg/Kg	12	12/18/96	3
Sr	23.8		mg/Kg	6	12/18/96	3
V	7.28		mg/Kg	2.4	12/18/96	3
Zn	645		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2910
Station ID: B-UM02-BSS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	12.5		mg/Kg	0.8	12/18/96	1
Al	4240		mg/Kg	6	12/18/96	1
As	57.7		mg/Kg	14	12/18/96	1
B		U	mg/Kg	2	12/18/96	1
Ba	57.7		mg/Kg	0.8	12/18/96	1
Be	0.24		mg/Kg	0.1	12/18/96	1
Ca	3190		mg/Kg	6	12/18/96	1
Cd	1.42		mg/Kg	0.8	12/18/96	1
Co	0.699		mg/Kg	0.6	12/18/96	1
Cr	4		mg/Kg	2	12/18/96	1
Cu	344		mg/Kg	1	12/18/96	1
Fe	40000		mg/Kg	0.8	12/18/96	1
K	1560		mg/Kg	200	12/18/96	1
Li	3.73		mg/Kg	1.2	12/18/96	1
Mg	1640		mg/Kg	6	12/18/96	1
Mn	85.9		mg/Kg	0.8	12/18/96	1
Mo		U	mg/Kg	2	12/18/96	1
Na	320		mg/Kg	6	12/18/96	1
Ni	3.66		mg/Kg	2	12/18/96	1
Pb	1890		mg/Kg	6	12/18/96	1
Sb		U	mg/Kg	4	12/18/96	1
Se		U	mg/Kg	6	12/18/96	1
Si	2340		mg/Kg	4	12/18/96	1
Sr	21.3		mg/Kg	2	12/18/96	1
V	12.9		mg/Kg	0.8	12/18/96	1
Zn	228		mg/Kg	0.8	12/18/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2911
Station ID: B-UM03-ASS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	36.6		mg/Kg	0.8	12/11/96	1
Al	5820		mg/Kg	6	12/11/96	1
As	75.9		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	79.1		mg/Kg	0.8	12/11/96	1
Be	0.649		mg/Kg	0.1	12/11/96	1
Ca	5810		mg/Kg	6	12/11/96	1
Cd	3.26		mg/Kg	0.8	12/11/96	1
Co	1.68		mg/Kg	0.6	12/11/96	1
Cr	7.37		mg/Kg	2	12/11/96	1
Cu	739		mg/Kg	1	12/11/96	1
Fe	65100		mg/Kg	0.8	12/11/96	1
K	2010		mg/Kg	200	12/11/96	1
Li	4.06		mg/Kg	1.2	12/11/96	1
Mg	1300		mg/Kg	6	12/11/96	1
Mn	322		mg/Kg	0.8	12/11/96	1
Mo	2.76		mg/Kg	2	12/11/96	1
Na	88.7		mg/Kg	6	12/11/96	1
Ni	4.86		mg/Kg	2	12/11/96	1
Pb	5460		mg/Kg	6	12/11/96	1
Sb	5.06		mg/Kg	4	12/11/96	1
Se	19.9		mg/Kg	6	12/11/96	1
Si	845		mg/Kg	4	12/11/96	1
Sr	9.53		mg/Kg	2	12/11/96	1
V	14.4		mg/Kg	0.8	12/11/96	1
Zn	681		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2912
Station ID: B-UM03-BSS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	55.6		mg/Kg	0.8	12/11/96	1
Al	1220		mg/Kg	6	12/11/96	1
As	74.9		mg/Kg	14	12/11/96	1
B		U	mg/Kg	2	12/11/96	1
Ba	52.8		mg/Kg	0.8	12/11/96	1
Be	0.387		mg/Kg	0.1	12/11/96	1
Ca	217		mg/Kg	6	12/11/96	1
Cd	3.37		mg/Kg	0.8	12/11/96	1
Co	3.08		mg/Kg	0.6	12/11/96	1
Cr		U	mg/Kg	2	12/11/96	1
Cu	181		mg/Kg	1	12/11/96	1
Fe	13300		mg/Kg	0.8	12/11/96	1
K	1160		mg/Kg	200	12/11/96	1
Li		U	mg/Kg	1.2	12/11/96	1
Mg	148		mg/Kg	6	12/11/96	1
Mn	1160		mg/Kg	0.8	12/11/96	1
Mo	4.83		mg/Kg	2	12/11/96	1
Na	28.8		mg/Kg	6	12/11/96	1
Ni	2.45		mg/Kg	2	12/11/96	1
Pb	8170		mg/Kg	6	12/11/96	1
Sb		U	mg/Kg	4	12/11/96	1
Se	19.4		mg/Kg	6	12/11/96	1
Si	846		mg/Kg	4	12/11/96	1
Sr	11.2		mg/Kg	2	12/11/96	1
V	3.49		mg/Kg	0.8	12/11/96	1
Zn	255		mg/Kg	0.8	12/11/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2913
Station ID: B-UM04-ASS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	111		mg/Kg	0.8	12/17/96	1
Al	1930		mg/Kg	6	12/17/96	1
As	19.2		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	168		mg/Kg	0.8	12/17/96	1
Be	0.103		mg/Kg	0.1	12/17/96	1
Ca	459		mg/Kg	6	12/17/96	1
Cd	1.84		mg/Kg	0.8	12/17/96	1
Co		U	mg/Kg	0.6	12/17/96	1
Cr		U	mg/Kg	2	12/17/96	1
Cu	140		mg/Kg	1	12/17/96	1
Fe	10900		mg/Kg	0.8	12/17/96	1
K	1020		mg/Kg	200	12/17/96	1
Li		U	mg/Kg	1.2	12/17/96	1
Mg	107		mg/Kg	6	12/17/96	1
Mn	13.1		mg/Kg	0.8	12/17/96	1
Mo		U	mg/Kg	2	12/17/96	1
Na	37.6		mg/Kg	6	12/17/96	1
Ni		U	mg/Kg	2	12/17/96	1
Pb	71100		mg/Kg	6	12/17/96	1
Sb	5.98		mg/Kg	4	12/17/96	1
Se	14.6		mg/Kg	6	12/17/96	1
Si	801		mg/Kg	4	12/17/96	1
Sr	16.3		mg/Kg	2	12/17/96	1
V		U	mg/Kg	0.8	12/17/96	1
Zn	384		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2914
Station ID: B-UM04-BSS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	157		mg/Kg	0.8	12/17/96	1
Al	1360		mg/Kg	6	12/17/96	1
As	88.4		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	31.9		mg/Kg	0.8	12/17/96	1
Be	0.103		mg/Kg	0.1	12/17/96	1
Ca	50.4		mg/Kg	6	12/17/96	1
Cd	4.01		mg/Kg	0.8	12/17/96	1
Co		U	mg/Kg	0.6	12/17/96	1
Cr		U	mg/Kg	2	12/17/96	1
Cu	408		mg/Kg	1	12/17/96	1
Fe	31500		mg/Kg	0.8	12/17/96	1
K	1260		mg/Kg	200	12/17/96	1
Li		U	mg/Kg	1.2	12/17/96	1
Mg	76		mg/Kg	6	12/17/96	1
Mn	15.2		mg/Kg	0.8	12/17/96	1
Mo	2.37		mg/Kg	2	12/17/96	1
Na	38.3		mg/Kg	6	12/17/96	1
Ni		U	mg/Kg	2	12/17/96	1
Pb	88200		mg/Kg	6	12/17/96	1
Sb	5.01		mg/Kg	4	12/17/96	1
Se	21.1		mg/Kg	6	12/17/96	1
Si	640		mg/Kg	4	12/17/96	1
Sr	9.41		mg/Kg	2	12/17/96	1
V		U	mg/Kg	0.8	12/17/96	1
Zn	1000		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2915
Station ID: B-UM05-ASS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	25.8		mg/Kg	0.8	12/17/96	1
Al	4600		mg/Kg	6	12/17/96	1
As	43.5		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	103		mg/Kg	0.8	12/17/96	1
Be	0.697		mg/Kg	0.1	12/17/96	1
Ca	8050		mg/Kg	6	12/17/96	1
Cd	4.05		mg/Kg	0.8	12/17/96	1
Co	7.28		mg/Kg	0.6	12/17/96	1
Cr	3.83		mg/Kg	2	12/17/96	1
Cu	380		mg/Kg	1	12/17/96	1
Fe	53000		mg/Kg	0.8	12/17/96	1
K	1340		mg/Kg	200	12/17/96	1
Li	2.29		mg/Kg	1.2	12/17/96	1
Mg	1290		mg/Kg	6	12/17/96	1
Mn	2170		mg/Kg	0.8	12/17/96	1
Mo	3.44		mg/Kg	2	12/17/96	1
Na	245		mg/Kg	6	12/17/96	1
Ni	7.71		mg/Kg	2	12/17/96	1
Pb	7490		mg/Kg	6	12/17/96	1
Sb		U	mg/Kg	4	12/17/96	1
Se	7.24		mg/Kg	6	12/17/96	1
Si	3010		mg/Kg	4	12/17/96	1
Sr	26.7		mg/Kg	2	12/17/96	1
V	2.81		mg/Kg	0.8	12/17/96	1
Zn	1150		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2916
Station ID: B-UM05-BSS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	17.5		mg/Kg	0.8	12/17/96	1
Al	4630		mg/Kg	6	12/17/96	1
As	36.7		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	87.9		mg/Kg	0.8	12/17/96	1
Be	0.693		mg/Kg	0.1	12/17/96	1
Ca	8830		mg/Kg	6	12/17/96	1
Cd	3.41		mg/Kg	0.8	12/17/96	1
Co	7.48		mg/Kg	0.6	12/17/96	1
Cr	3.95		mg/Kg	2	12/17/96	1
Cu	292		mg/Kg	1	12/17/96	1
Fe	50800		mg/Kg	0.8	12/17/96	1
K	1260		mg/Kg	200	12/17/96	1
Li	2.87		mg/Kg	1.2	12/17/96	1
Mg	1320		mg/Kg	6	12/17/96	1
Mn	1660		mg/Kg	0.8	12/17/96	1
Mo	2.08		mg/Kg	2	12/17/96	1
Na	182		mg/Kg	6	12/17/96	1
Ni	7.67		mg/Kg	2	12/17/96	1
Pb	2740		mg/Kg	6	12/17/96	1
Sb	4.03		mg/Kg	4	12/17/96	1
Se		U	mg/Kg	6	12/17/96	1
Si	2270		mg/Kg	4	12/17/96	1
Sr	19.9		mg/Kg	2	12/17/96	1
V	2.84		mg/Kg	0.8	12/17/96	1
Zn	976		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2917
Station ID: B-UM06-ASS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	36.5		mg/Kg	0.8	12/3/96	1
Al	4970		mg/Kg	6	12/3/96	1
As	108		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	31.1		mg/Kg	0.8	12/3/96	1
Be	0.37		mg/Kg	0.1	12/3/96	1
Ca	4910		mg/Kg	6	12/3/96	1
Cd	2.06		mg/Kg	0.8	12/3/96	1
Co		U	mg/Kg	0.6	12/3/96	1
Cr	4.79		mg/Kg	2	12/3/96	1
Cu	646		mg/Kg	1	12/3/96	1
Fe	64600		mg/Kg	0.8	12/3/96	1
K	1780		mg/Kg	200	12/3/96	1
Li	3		mg/Kg	1.2	12/3/96	1
Mg	361		mg/Kg	6	12/3/96	1
Mn	200		mg/Kg	0.8	12/3/96	1
Mo	2.2		mg/Kg	2	12/3/96	1
Na	56.4		mg/Kg	6	12/3/96	1
Ni		U	mg/Kg	2	12/3/96	1
Pb	9410		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	700		mg/Kg	4	12/3/96	1
Sr	10.7		mg/Kg	2	12/3/96	1
V	10.9		mg/Kg	0.8	12/3/96	1
Zn	679		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2918
Station ID: B-UM06-BSS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	33.8		mg/Kg	0.8	12/3/96	1
Al	3290		mg/Kg	6	12/3/96	1
As	58.9		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	27.2		mg/Kg	0.8	12/3/96	1
Be	0.258		mg/Kg	0.1	12/3/96	1
Ca	8250		mg/Kg	6	12/3/96	1
Cd	3.48		mg/Kg	0.8	12/3/96	1
Co		U	mg/Kg	0.6	12/3/96	1
Cr	5.54		mg/Kg	2	12/3/96	1
Cu	589		mg/Kg	1	12/3/96	1
Fe	55900		mg/Kg	0.8	12/3/96	1
K	1050		mg/Kg	200	12/3/96	1
Li	1.89		mg/Kg	1.2	12/3/96	1
Mg	577		mg/Kg	6	12/3/96	1
Mn	250		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	107		mg/Kg	6	12/3/96	1
Ni		U	mg/Kg	2	12/3/96	1
Pb	5780		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	767		mg/Kg	4	12/3/96	1
Sr	13.5		mg/Kg	2	12/3/96	1
V	10.1		mg/Kg	0.8	12/3/96	1
Zn	898		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2919
Station ID: B-UM07-ASS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	158		mg/Kg	2.4	12/18/96	3
Al	1330		mg/Kg	18	12/18/96	3
As	83.6		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	35.5		mg/Kg	2.4	12/18/96	3
Be		U	mg/Kg	0.3	12/18/96	3
Ca	47.9		mg/Kg	18	12/18/96	3
Cd	3.63		mg/Kg	2.4	12/18/96	3
Co		U	mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	402		mg/Kg	3	12/18/96	3
Fe	31100		mg/Kg	2.4	12/18/96	3
K	1760		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	73.7		mg/Kg	18	12/18/96	3
Mn	15.3		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	54.5		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	89600		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	696		mg/Kg	12	12/18/96	3
Sr	9.78		mg/Kg	6	12/18/96	3
V		U	mg/Kg	2.4	12/18/96	3
Zn	995		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2920
Station ID: B-UM07-BSS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	44.2		mg/Kg	0.8	12/17/96	1
Al	2890		mg/Kg	6	12/17/96	1
As	71.2		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	343		mg/Kg	0.8	12/17/96	1
Be	0.43		mg/Kg	0.1	12/17/96	1
Ca	14700		mg/Kg	6	12/17/96	1
Cd	5.52		mg/Kg	0.8	12/17/96	1
Co	3.34		mg/Kg	0.6	12/17/96	1
Cr	4.22		mg/Kg	2	12/17/96	1
Cu	673		mg/Kg	1	12/17/96	1
Fe	64200		mg/Kg	0.8	12/17/96	1
K	542		mg/Kg	200	12/17/96	1
Li		U	mg/Kg	1.2	12/17/96	1
Mg	123		mg/Kg	6	12/17/96	1
Mn	982		mg/Kg	0.8	12/17/96	1
Mo	3.55		mg/Kg	2	12/17/96	1
Na	49.4		mg/Kg	6	12/17/96	1
Ni		U	mg/Kg	2	12/17/96	1
Pb	2830		mg/Kg	6	12/17/96	1
Sb	14.2		mg/Kg	4	12/17/96	1
Se		U	mg/Kg	6	12/17/96	1
Si	1480		mg/Kg	4	12/17/96	1
Sr	10.5		mg/Kg	2	12/17/96	1
V	5.48		mg/Kg	0.8	12/17/96	1
Zn	896		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2921
Station ID: B-UM08-ASS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33275
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	6.48		mg/Kg	0.8	12/17/96	1
Al	10200		mg/Kg	6	12/17/96	1
As	37.1		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	107		mg/Kg	0.8	12/17/96	1
Be	0.68		mg/Kg	0.1	12/17/96	1
Ca	1300		mg/Kg	6	12/17/96	1
Cd	2.39		mg/Kg	0.8	12/17/96	1
Co	6.18		mg/Kg	0.6	12/17/96	1
Cr	15.4		mg/Kg	2	12/17/96	1
Cu	147		mg/Kg	1	12/17/96	1
Fe	41000		mg/Kg	0.8	12/17/96	1
K	1420		mg/Kg	200	12/17/96	1
Li	8.73		mg/Kg	1.2	12/17/96	1
Mg	2550		mg/Kg	6	12/17/96	1
Mn	510		mg/Kg	0.8	12/17/96	1
Mo	2.06		mg/Kg	2	12/17/96	1
Na	142		mg/Kg	6	12/17/96	1
Ni	10		mg/Kg	2	12/17/96	1
Pb	2440		mg/Kg	6	12/17/96	1
Sb		U	mg/Kg	4	12/17/96	1
Se		U	mg/Kg	6	12/17/96	1
Si	1950		mg/Kg	4	12/17/96	1
Sr	14.7		mg/Kg	2	12/17/96	1
V	31.1		mg/Kg	0.8	12/17/96	1
Zn	493		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2922
Station ID: B-UM08-BSS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33276
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	2.76		mg/Kg	0.8	12/17/96	1
Al	20200		mg/Kg	6	12/17/96	1
As		U	mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	130		mg/Kg	0.8	12/17/96	1
Be	1.03		mg/Kg	0.1	12/17/96	1
Ca	2550		mg/Kg	6	12/17/96	1
Cd	1.58		mg/Kg	0.8	12/17/96	1
Co	10.7		mg/Kg	0.6	12/17/96	1
Cr	25.8		mg/Kg	2	12/17/96	1
Cu	123		mg/Kg	1	12/17/96	1
Fe	26000		mg/Kg	0.8	12/17/96	1
K	2030		mg/Kg	200	12/17/96	1
Li	13.9		mg/Kg	1.2	12/17/96	1
Mg	6260		mg/Kg	6	12/17/96	1
Mn	849		mg/Kg	0.8	12/17/96	1
Mo		U	mg/Kg	2	12/17/96	1
Na	375		mg/Kg	6	12/17/96	1
Ni	16.9		mg/Kg	2	12/17/96	1
Pb	768		mg/Kg	6	12/17/96	1
Sb		U	mg/Kg	4	12/17/96	1
Se		U	mg/Kg	6	12/17/96	1
Si	3240		mg/Kg	4	12/17/96	1
Sr	22.5		mg/Kg	2	12/17/96	1
V	58.1		mg/Kg	0.8	12/17/96	1
Zn	307		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J: Estimated.

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2923
Station ID: B-DD10-ASS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33277
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	8.35		mg/Kg	2.4	12/18/96	3
Al	4790		mg/Kg	18	12/18/96	3
As		U	mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	29.5		mg/Kg	2.4	12/18/96	3
Be	0.466		mg/Kg	0.3	12/18/96	3
Ca	1510		mg/Kg	18	12/18/96	3
Cd	2.48		mg/Kg	2.4	12/18/96	3
Co		U	mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	64.3		mg/Kg	3	12/18/96	3
Fe	237000		mg/Kg	2.4	12/18/96	3
K	1660		mg/Kg	600	12/18/96	3
Li	5.57		mg/Kg	3.6	12/18/96	3
Mg	1490		mg/Kg	18	12/18/96	3
Mn	251		mg/Kg	2.4	12/18/96	3
Mo	6.14		mg/Kg	6	12/18/96	3
Na	104		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	1140		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	1500		mg/Kg	12	12/18/96	3
Sr	13.1		mg/Kg	6	12/18/96	3
V		U	mg/Kg	2.4	12/18/96	3
Zn	3440		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2924
Station ID: B-DD10-BSS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33278
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	23.6		mg/Kg	2.4	12/18/96	3
Al	7340		mg/Kg	18	12/18/96	3
As	105		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	83.5		mg/Kg	2.4	12/18/96	3
Be	0.506		mg/Kg	0.3	12/18/96	3
Ca	2110		mg/Kg	18	12/18/96	3
Cd	32.3		mg/Kg	2.4	12/18/96	3
Co	29.8		mg/Kg	1.8	12/18/96	3
Cr	10.3		mg/Kg	6	12/18/96	3
Cu	178		mg/Kg	3	12/18/96	3
Fe	88200		mg/Kg	2.4	12/18/96	3
K	1770		mg/Kg	600	12/18/96	3
Li	8.07		mg/Kg	3.6	12/18/96	3
Mg	2820		mg/Kg	18	12/18/96	3
Mn	5180		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	145		mg/Kg	18	12/18/96	3
Ni	10.5		mg/Kg	6	12/18/96	3
Pb	3010		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	1610		mg/Kg	12	12/18/96	3
Sr	20.9		mg/Kg	6	12/18/96	3
V	23.8		mg/Kg	2.4	12/18/96	3
Zn	6990		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2925
Station ID: B-DD10-ADSS02--961008
Additional ID: 1
Chain-Of-Custody: 8-33279
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	9.96		mg/kg	2.4	12/18/96	3
Al	4340		mg/kg	18	12/18/96	3
As		U	mg/kg	42	12/18/96	3
B		U	mg/kg	6	12/18/96	3
Ba	37.6		mg/kg	2.4	12/18/96	3
Be	0.506		mg/kg	0.3	12/18/96	3
Ca		U	mg/kg	18	12/18/96	3
Cd	4.12		mg/kg	2.4	12/18/96	3
Co		U	mg/kg	1.8	12/18/96	3
Cr		U	mg/kg	6	12/18/96	3
Cu	96.4		mg/kg	3	12/18/96	3
Fe	216000		mg/kg	2.4	12/18/96	3
K		U	mg/kg	600	12/18/96	3
Li	4.98		mg/kg	3.6	12/18/96	3
Mg		U	mg/kg	18	12/18/96	3
Mn	250		mg/kg	2.4	12/18/96	3
Mo	6.14		mg/kg	6	12/18/96	3
Na		U	mg/kg	18	12/18/96	3
Ni		U	mg/kg	6	12/18/96	3
Pb	1210		mg/kg	18	12/18/96	3
Sb		U	mg/kg	12	12/18/96	3
Se		U	mg/kg	18	12/18/96	3
Si	1540		mg/kg	12	12/18/96	3
Sr	9.72		mg/kg	6	12/18/96	3
V		U	mg/kg	2.4	12/18/96	3
Zn	3980		mg/kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2926
Station ID: B-DD10-BDSS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33280
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	35.8		mg/Kg	2.4	12/18/96	3
Al	7640		mg/Kg	18	12/18/96	3
As	86		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	157		mg/Kg	2.4	12/18/96	3
Be	0.68		mg/Kg	0.3	12/18/96	3
Ca	1900		mg/Kg	18	12/18/96	3
Cd	41.4		mg/Kg	2.4	12/18/96	3
Co	18.2		mg/Kg	1.8	12/18/96	3
Cr	9.45		mg/Kg	6	12/18/96	3
Cu	189		mg/Kg	3	12/18/96	3
Fe	96000		mg/Kg	2.4	12/18/96	3
K	1880		mg/Kg	600	12/18/96	3
Li	7.98		mg/Kg	3.6	12/18/96	3
Mg	2900		mg/Kg	18	12/18/96	3
Mn	3070		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	85.7		mg/Kg	18	12/18/96	3
Ni	11		mg/Kg	6	12/18/96	3
Pb	3190		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	1720		mg/Kg	12	12/18/96	3
Sr	18.7		mg/Kg	6	12/18/96	3
V	24.2		mg/Kg	2.4	12/18/96	3
Zn	8650		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2927
Station ID: B-DD11-ASS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33281
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	44.4		mg/Kg	2.4	12/3/96	3
Al	2320		mg/Kg	18	12/3/96	3
As	164		mg/Kg	42	12/3/96	3
B		U	mg/Kg	6	12/3/96	3
Ba	9.42		mg/Kg	2.4	12/3/96	3
Be	0.675		mg/Kg	0.3	12/3/96	3
Ca	5610		mg/Kg	18	12/3/96	3
Cd	139		mg/Kg	2.4	12/3/96	3
Co	6.28		mg/Kg	1.8	12/3/96	3
Cr		U	mg/Kg	6	12/3/96	3
Cu	791		mg/Kg	3	12/3/96	3
Fe	136000		mg/Kg	2.4	12/3/96	3
K	1320		mg/Kg	600	12/3/96	3
Li		U	mg/Kg	3.6	12/3/96	3
Mg	2210		mg/Kg	18	12/3/96	3
Mn	2310		mg/Kg	2.4	12/3/96	3
Mo		U	mg/Kg	6	12/3/96	3
Na	26.8		mg/Kg	18	12/3/96	3
Ni	6.4		mg/Kg	6	12/3/96	3
Pb	15600		mg/Kg	18	12/3/96	3
Sb	15.9		mg/Kg	12	12/3/96	3
Se		U	mg/Kg	18	12/3/96	3
Si	516		mg/Kg	12	12/3/96	3
Sr	44.3		mg/Kg	6	12/3/96	3
V		U	mg/Kg	2.4	12/3/96	3
Zn	27800		mg/Kg	2.4	12/3/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2928
Station ID: B-DD11-BSS01--961008
Additional ID: 1
Chain-Of-Custody: 8-33282
Matrix: Soil

Sampled Date: 10/8/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	41.8		mg/Kg	2.4	12/3/96	3
Al	1120		mg/Kg	18	12/3/96	3
As	127		mg/Kg	42	12/3/96	3
B		U	mg/Kg	6	12/3/96	3
Ba	9.64		mg/Kg	2.4	12/3/96	3
Be	0.338		mg/Kg	0.3	12/3/96	3
Ca	9090		mg/Kg	18	12/3/96	3
Cd	8.58		mg/Kg	2.4	12/3/96	3
Co		U	mg/Kg	1.8	12/3/96	3
Cr		U	mg/Kg	6	12/3/96	3
Cu	501		mg/Kg	3	12/3/96	3
Fe	159000		mg/Kg	2.4	12/3/96	3
K	1450		mg/Kg	600	12/3/96	3
Li		U	mg/Kg	3.6	12/3/96	3
Mg	163		mg/Kg	18	12/3/96	3
Mn	279		mg/Kg	2.4	12/3/96	3
Mo		U	mg/Kg	6	12/3/96	3
Na	68.9		mg/Kg	18	12/3/96	3
Ni		U	mg/Kg	6	12/3/96	3
Pb	9120		mg/Kg	18	12/3/96	3
Sb		U	mg/Kg	12	12/3/96	3
Se		U	mg/Kg	18	12/3/96	3
Si	363		mg/Kg	12	12/3/96	3
Sr	30		mg/Kg	6	12/3/96	3
V		U	mg/Kg	2.4	12/3/96	3
Zn	4180		mg/Kg	2.4	12/3/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2929
Station ID: B-EX-6-ASS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25488
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	32.8		mg/Kg	0.8	12/3/96	1
Al	1820		mg/Kg	6	12/3/96	1
As	441		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	86.3		mg/Kg	0.8	12/3/96	1
Be	0.258		mg/Kg	0.1	12/3/96	1
Ca	204		mg/Kg	6	12/3/96	1
Cd	6.32		mg/Kg	0.8	12/3/96	1
Co		U	mg/Kg	0.6	12/3/96	1
Cr	2.73		mg/Kg	2	12/3/96	1
Cu	698		mg/Kg	1	12/3/96	1
Fe	74500		mg/Kg	0.8	12/3/96	1
K	3400		mg/Kg	200	12/3/96	1
Li		U	mg/Kg	1.2	12/3/96	1
Mg	78.8		mg/Kg	6	12/3/96	1
Mn	39.8		mg/Kg	0.8	12/3/96	1
Mo	2.12		mg/Kg	2	12/3/96	1
Na	167		mg/Kg	6	12/3/96	1
Ni		U	mg/Kg	2	12/3/96	1
Pb	16800		mg/Kg	6	12/3/96	1
Sb	4.06		mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	1110		mg/Kg	4	12/3/96	1
Sr	22		mg/Kg	2	12/3/96	1
V	10.6		mg/Kg	0.8	12/3/96	1
Zn	1180		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2930
Station ID: B-EX-6-BSS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25488
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	5.89		mg/Kg	0.8	12/3/96	1
Al	5640		mg/Kg	6	12/3/96	1
As	81.9		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	163		mg/Kg	0.8	12/3/96	1
Be	0.483		mg/Kg	0.1	12/3/96	1
Ca	4260		mg/Kg	6	12/3/96	1
Cd	3.01		mg/Kg	0.8	12/3/96	1
Co	0.601		mg/Kg	0.6	12/3/96	1
Cr	3.63		mg/Kg	2	12/3/96	1
Cu	184		mg/Kg	1	12/3/96	1
Fe	50100		mg/Kg	0.8	12/3/96	1
K	3800		mg/Kg	200	12/3/96	1
Li	2.5		mg/Kg	1.2	12/3/96	1
Mg	908		mg/Kg	6	12/3/96	1
Mn	91		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	243		mg/Kg	6	12/3/96	1
Ni		U	mg/Kg	2	12/3/96	1
Pb	4070		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	827		mg/Kg	4	12/3/96	1
Sr	47.1		mg/Kg	2	12/3/96	1
V	26.2		mg/Kg	0.8	12/3/96	1
Zn	1110		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2931
Station ID: B-EX-14-ASS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25488
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	14		mg/Kg	0.8	12/3/96	1
Al	2880		mg/Kg	6	12/3/96	1
As	91.5		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	73.1		mg/Kg	0.8	12/3/96	1
Be	0.464		mg/Kg	0.1	12/3/96	1
Ca	11100		mg/Kg	6	12/3/96	1
Cd	41.8		mg/Kg	0.8	12/3/96	1
Co	3.64		mg/Kg	0.6	12/3/96	1
Cr	2.22		mg/Kg	2	12/3/96	1
Cu	90		mg/Kg	1	12/3/96	1
Fe	50800		mg/Kg	0.8	12/3/96	1
K	2190		mg/Kg	200	12/3/96	1
Li	1.29		mg/Kg	1.2	12/3/96	1
Mg	1600		mg/Kg	6	12/3/96	1
Mn	2010		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	54.5		mg/Kg	6	12/3/96	1
Ni	2.99		mg/Kg	2	12/3/96	1
Pb	3130		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	1160		mg/Kg	4	12/3/96	1
Sr	26.5		mg/Kg	2	12/3/96	1
V	9.55		mg/Kg	0.8	12/3/96	1
Zn	9510		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2932
Station ID: B-EX-14-BSS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25488
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	12.6		mg/Kg	0.8	12/3/96	1
Al	1580		mg/Kg	6	12/3/96	1
As	103		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	25.7		mg/Kg	0.8	12/3/96	1
Be	0.502		mg/Kg	0.1	12/3/96	1
Ca	20600		mg/Kg	6	12/3/96	1
Cd	197		mg/Kg	0.8	12/3/96	1
Co	8.34		mg/Kg	0.6	12/3/96	1
Cr		U	mg/Kg	2	12/3/96	1
Cu	159		mg/Kg	1	12/3/96	1
Fe	74400		mg/Kg	0.8	12/3/96	1
K	1290		mg/Kg	200	12/3/96	1
Li		U	mg/Kg	1.2	12/3/96	1
Mg	4440		mg/Kg	6	12/3/96	1
Mn	2450		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	30.6		mg/Kg	6	12/3/96	1
Ni	3.91		mg/Kg	2	12/3/96	1
Pb	1290		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	609		mg/Kg	4	12/3/96	1
Sr	56.1		mg/Kg	2	12/3/96	1
V	15		mg/Kg	0.8	12/3/96	1
Zn	33300		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2933
Station ID: B-EX-21-ASS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25488
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	3.3		mg/Kg	0.8	12/3/96	1
Al	10100		mg/Kg	6	12/3/96	1
As	129		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	193		mg/Kg	0.8	12/3/96	1
Be	0.567		mg/Kg	0.1	12/3/96	1
Ca	635		mg/Kg	6	12/3/96	1
Cd	8.41		mg/Kg	0.8	12/3/96	1
Co	4.39		mg/Kg	0.6	12/3/96	1
Cr	10.6		mg/Kg	2	12/3/96	1
Cu	112		mg/Kg	1	12/3/96	1
Fe	57600		mg/Kg	0.8	12/3/96	1
K	1630		mg/Kg	200	12/3/96	1
Li	6.99		mg/Kg	1.2	12/3/96	1
Mg	2340		mg/Kg	6	12/3/96	1
Mn	284		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	74.1		mg/Kg	6	12/3/96	1
Ni	4.86		mg/Kg	2	12/3/96	1
Pb	624		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	1250		mg/Kg	4	12/3/96	1
Sr	16.8		mg/Kg	2	12/3/96	1
V	27.9		mg/Kg	0.8	12/3/96	1
Zn	688		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2934
Station ID: B-EX-21-BSS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25488
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	2.8		mg/Kg	0.8	12/3/96	1
Al	12000		mg/Kg	6	12/3/96	1
As		U	mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	184		mg/Kg	0.8	12/3/96	1
Be	0.708		mg/Kg	0.1	12/3/96	1
Ca	1060		mg/Kg	6	12/3/96	1
Cd	6.34		mg/Kg	0.8	12/3/96	1
Co	6.86		mg/Kg	0.6	12/3/96	1
Cr	12		mg/Kg	2	12/3/96	1
Cu	123		mg/Kg	1	12/3/96	1
Fe	30200		mg/Kg	0.8	12/3/96	1
K	1580		mg/Kg	200	12/3/96	1
Li	8.45		mg/Kg	1.2	12/3/96	1
Mg	3620		mg/Kg	6	12/3/96	1
Mn	832		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	56.7		mg/Kg	6	12/3/96	1
Ni	5.36		mg/Kg	2	12/3/96	1
Pb	534		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se	9.13		mg/Kg	6	12/3/96	1
Si	1700		mg/Kg	4	12/3/96	1
Sr	16.7		mg/Kg	2	12/3/96	1
V	28.9		mg/Kg	0.8	12/3/96	1
Zn	1120		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

ɔn' ntal Research Chemistry Laboratory
Reclamation - Technical Service Center
). (25007, D-8240, Denver, CO 80025-0007
arr et Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2935
Station ID: B-BKG-1-ASS01--961023
Sampled Date: 10/23/96
Additional ID: 1
Login Date: 11/20/96
Chain-Of-Custody: 8-25488
Analyses Required: ICP Scan
Matrix: Soil
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	1.61		mg/Kg	0.8	12/3/96	1
Al	6010		mg/Kg	6	12/3/96	1
As		U	mg/Kg	14	12/3/96	1
B	2.32		mg/Kg	2	12/3/96	1
Ba	259		mg/Kg	0.8	12/3/96	1
Be	0.37		mg/Kg	0.1	12/3/96	1
Ca	4650		mg/Kg	6	12/3/96	1
Cd	8.89		mg/Kg	0.8	12/3/96	1
Co	3.9		mg/Kg	0.6	12/3/96	1
Cr	5.88		mg/Kg	2	12/3/96	1
Cu	21.7		mg/Kg	1	12/3/96	1
Fe	7210		mg/Kg	0.8	12/3/96	1
K	945		mg/Kg	200	12/3/96	1
Li	4.95		mg/Kg	1.2	12/3/96	1
Mg	1290		mg/Kg	6	12/3/96	1
Mn	2640		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	34.5		mg/Kg	6	12/3/96	1
Ni	3.8		mg/Kg	2	12/3/96	1
Pb	315		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se	6.6		mg/Kg	6	12/3/96	1
Si	469		mg/Kg	4	12/3/96	1
Sr	26.6		mg/Kg	2	12/3/96	1
V	10.5		mg/Kg	0.8	12/3/96	1
Zn	636		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2936
Station ID: B-BKG-1-BSS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25488
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	1.83		mg/Kg	0.8	12/18/96	1
Al	9840		mg/Kg	6	12/18/96	1
As		U	mg/Kg	14	12/18/96	1
B		U	mg/Kg	2	12/18/96	1
Ba	157		mg/Kg	0.8	12/18/96	1
Be	0.64		mg/Kg	0.1	12/18/96	1
Ca	2060		mg/Kg	6	12/18/96	1
Cd	2.05		mg/Kg	0.8	12/18/96	1
Co	10.3		mg/Kg	0.6	12/18/96	1
Cr	8.44		mg/Kg	2	12/18/96	1
Cu	9.01		mg/Kg	1	12/18/96	1
Fe	19600		mg/Kg	0.8	12/18/96	1
K	1220		mg/Kg	200	12/18/96	1
Li	7.82		mg/Kg	1.2	12/18/96	1
Mg	3160		mg/Kg	6	12/18/96	1
Mn	2040		mg/Kg	0.8	12/18/96	1
Mo		U	mg/Kg	2	12/18/96	1
Na	49.8		mg/Kg	6	12/18/96	1
Ni	8.1		mg/Kg	2	12/18/96	1
Pb	92.7		mg/Kg	6	12/18/96	1
Sb		U	mg/Kg	4	12/18/96	1
Se		U	mg/Kg	6	12/18/96	1
Si	1730		mg/Kg	4	12/18/96	1
Sr	17		mg/Kg	2	12/18/96	1
V	25		mg/Kg	0.8	12/18/96	1
Zn	400		mg/Kg	0.8	12/18/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2937
Station ID: B-BKG-2-ASS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25488
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	1.78		mg/Kg	0.8	12/3/96	1
Al	6480		mg/Kg	6	12/3/96	1
As		U	mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	68.8		mg/Kg	0.8	12/3/96	1
Be	0.37		mg/Kg	0.1	12/3/96	1
Ca	2420		mg/Kg	6	12/3/96	1
Cd	4.78		mg/Kg	0.8	12/3/96	1
Co	3.01		mg/Kg	0.6	12/3/96	1
Cr	7.91		mg/Kg	2	12/3/96	1
Cu	22.1		mg/Kg	1	12/3/96	1
Fe	8240		mg/Kg	0.8	12/3/96	1
K	1020		mg/Kg	200	12/3/96	1
Li	5.46		mg/Kg	1.2	12/3/96	1
Mg	1700		mg/Kg	6	12/3/96	1
Mn	925		mg/Kg	0.8	12/3/96	1
Mo	4.13		mg/Kg	2	12/3/96	1
Na	37.9		mg/Kg	6	12/3/96	1
Ni	5.26		mg/Kg	2	12/3/96	1
Pb	345		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	530		mg/Kg	4	12/3/96	1
Sr	13.6		mg/Kg	2	12/3/96	1
V	13.9		mg/Kg	0.8	12/3/96	1
Zn	483		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2938
Station ID: B-BKG-2-BSS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25488
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	1.28		mg/Kg	0.8	12/17/96	1
Al	27700		mg/Kg	6	12/17/96	1
As	14		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	129		mg/Kg	0.8	12/17/96	1
Be	1.48		mg/Kg	0.1	12/17/96	1
Ca	2560		mg/Kg	6	12/17/96	1
Cd	1.24		mg/Kg	0.8	12/17/96	1
Co	9.43		mg/Kg	0.6	12/17/96	1
Cr	30		mg/Kg	2	12/17/96	1
Cu	33		mg/Kg	1	12/17/96	1
Fe	23400		mg/Kg	0.8	12/17/96	1
K	1980		mg/Kg	200	12/17/96	1
Li	15.8		mg/Kg	1.2	12/17/96	1
Mg	7830		mg/Kg	6	12/17/96	1
Mn	402		mg/Kg	0.8	12/17/96	1
Mo		U	mg/Kg	2	12/17/96	1
Na	142		mg/Kg	6	12/17/96	1
Ni	19.7		mg/Kg	2	12/17/96	1
Pb	78.5		mg/Kg	6	12/17/96	1
Sb		U	mg/Kg	4	12/17/96	1
Se	11.2		mg/Kg	6	12/17/96	1
Si	3100		mg/Kg	4	12/17/96	1
Sr	18.9		mg/Kg	2	12/17/96	1
V	70.9		mg/Kg	0.8	12/17/96	1
Zn	281		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

ne ı Research Chemistry Laboratory
:clamation - Technical Service Center
;o, ;007, D-8240, Denver, CO 80025-0007
ar(.ake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2939
Station ID: B-BKG-3-ASS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25488
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	2.4		mg/Kg	0.8	12/3/96	1
Al	6670		mg/Kg	6	12/3/96	1
As		U	mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	172		mg/Kg	0.8	12/3/96	1
Be	0.37		mg/Kg	0.1	12/3/96	1
Ca	7820		mg/Kg	6	12/3/96	1
Cd	11.1		mg/Kg	0.8	12/3/96	1
Co	4.51		mg/Kg	0.6	12/3/96	1
Cr	6.34		mg/Kg	2	12/3/96	1
Cu	41.4		mg/Kg	1	12/3/96	1
Fe	9640		mg/Kg	0.8	12/3/96	1
K	1130		mg/Kg	200	12/3/96	1
Li	5.89		mg/Kg	1.2	12/3/96	1
Mg	1500		mg/Kg	6	12/3/96	1
Mn	1960		mg/Kg	0.8	12/3/96	1
Mo	2.52		mg/Kg	2	12/3/96	1
Na	67.3		mg/Kg	6	12/3/96	1
Ni	3.8		mg/Kg	2	12/3/96	1
Pb	497		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se	6.9		mg/Kg	6	12/3/96	1
Si	485		mg/Kg	4	12/3/96	1
Sr	30.9		mg/Kg	2	12/3/96	1
V	11.9		mg/Kg	0.8	12/3/96	1
Zn	1400		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2940
Station ID: B-BKG-3-BSS01--961023
Sampled Date: 10/23/96
Additional ID: 1
Login Date: 11/20/96
Chain-Of-Custody: 8-25488
Analyses Required: ICP Scan
Matrix: Soil
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	1.85		mg/Kg	0.8	12/17/96	1
Al	11000		mg/Kg	6	12/17/96	1
As		U	mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	123		mg/Kg	0.8	12/17/96	1
Be	1.03		mg/Kg	0.1	12/17/96	1
Ca	1570		mg/Kg	6	12/17/96	1
Cd	2.86		mg/Kg	0.8	12/17/96	1
Co	10.1		mg/Kg	0.6	12/17/96	1
Cr	8.81		mg/Kg	2	12/17/96	1
Cu	21.9		mg/Kg	1	12/17/96	1
Fe	30600		mg/Kg	0.8	12/17/96	1
K	1220		mg/Kg	200	12/17/96	1
Li	8.25		mg/Kg	1.2	12/17/96	1
Mg	2580		mg/Kg	6	12/17/96	1
Mn	1780		mg/Kg	0.8	12/17/96	1
Mo		U	mg/Kg	2	12/17/96	1
Na	35.1		mg/Kg	6	12/17/96	1
Ni	5.22		mg/Kg	2	12/17/96	1
Pb	617		mg/Kg	6	12/17/96	1
Sb		U	mg/Kg	4	12/17/96	1
Se	10.4		mg/Kg	6	12/17/96	1
Si	1590		mg/Kg	4	12/17/96	1
Sr	13.9		mg/Kg	2	12/17/96	1
V	28.9		mg/Kg	0.8	12/17/96	1
Zn	1010		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

ıvi .mental Research Chemistry Laboratory
.u of Reclamation - Technical Service Center
P Box 25007, D-8240, Denver, CO 80025-0007
.rgaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2941
Station ID: B-BKG-4-ASS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25488
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	2.19		mg/Kg	0.8	12/3/96	1
Al	3370		mg/Kg	6	12/3/96	1
As	22.8		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	80.1		mg/Kg	0.8	12/3/96	1
Be	0.145		mg/Kg	0.1	12/3/96	1
Ca	2210		mg/Kg	6	12/3/96	1
Cd	5.01		mg/Kg	0.8	12/3/96	1
Co	1.99		mg/Kg	0.6	12/3/96	1
Cr	2.94		mg/Kg	2	12/3/96	1
Cu	59.7		mg/Kg	1	12/3/96	1
Fe	6410		mg/Kg	0.8	12/3/96	1
K	691		mg/Kg	200	12/3/96	1
Li	2.61		mg/Kg	1.2	12/3/96	1
Mg	819		mg/Kg	6	12/3/96	1
Mn	668		mg/Kg	0.8	12/3/96	1
Mo		U	mg/Kg	2	12/3/96	1
Na	23.8		mg/Kg	6	12/3/96	1
Ni		U	mg/Kg	2	12/3/96	1
Pb	863		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	360		mg/Kg	4	12/3/96	1
Sr	16.9		mg/Kg	2	12/3/96	1
V	4.99		mg/Kg	0.8	12/3/96	1
Zn	877		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2942
Station ID: B-BKG-4-BSS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25488
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	1.08		mg/Kg	0.8	12/17/96	1
Al	19200		mg/Kg	6	12/17/96	1
As		U	mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	83.6		mg/Kg	0.8	12/17/96	1
Be	0.723		mg/Kg	0.1	12/17/96	1
Ca	4130		mg/Kg	6	12/17/96	1
Cd	1.21		mg/Kg	0.8	12/17/96	1
Co	9.27		mg/Kg	0.6	12/17/96	1
Cr	14.1		mg/Kg	2	12/17/96	1
Cu	14		mg/Kg	1	12/17/96	1
Fe	27000		mg/Kg	0.8	12/17/96	1
K	1890		mg/Kg	200	12/17/96	1
Li	24.8		mg/Kg	1.2	12/17/96	1
Mg	6960		mg/Kg	6	12/17/96	1
Mn	401		mg/Kg	0.8	12/17/96	1
Mo		U	mg/Kg	2	12/17/96	1
Na	82.8		mg/Kg	6	12/17/96	1
Ni	9		mg/Kg	2	12/17/96	1
Pb	58.1		mg/Kg	6	12/17/96	1
Sb		U	mg/Kg	4	12/17/96	1
Se	9.1		mg/Kg	6	12/17/96	1
Si	2880		mg/Kg	4	12/17/96	1
Sr	26.1		mg/Kg	2	12/17/96	1
V	43.6		mg/Kg	0.8	12/17/96	1
Zn	219		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2943
Station ID: B-DD03-ASS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25491
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	35.7		mg/Kg	0.8	12/3/96	1
Al	6960		mg/Kg	6	12/3/96	1
As	76.3		mg/Kg	14	12/3/96	1
B		U	mg/Kg	2	12/3/96	1
Ba	458		mg/Kg	0.8	12/3/96	1
Be	1.24		mg/Kg	0.1	12/3/96	1
Ca	5430		mg/Kg	6	12/3/96	1
Cd	37.4		mg/Kg	0.8	12/3/96	1
Co	5.54		mg/Kg	0.6	12/3/96	1
Cr	17.3		mg/Kg	2	12/3/96	1
Cu	337		mg/Kg	1	12/3/96	1
Fe	54600		mg/Kg	0.8	12/3/96	1
K	3980		mg/Kg	200	12/3/96	1
Li	5.73		mg/Kg	1.2	12/3/96	1
Mg	3510		mg/Kg	6	12/3/96	1
Mn	5130		mg/Kg	0.8	12/3/96	1
Mo	2.27		mg/Kg	2	12/3/96	1
Na	99.3		mg/Kg	6	12/3/96	1
Ni	13.4		mg/Kg	2	12/3/96	1
Pb	3850		mg/Kg	6	12/3/96	1
Sb		U	mg/Kg	4	12/3/96	1
Se		U	mg/Kg	6	12/3/96	1
Si	638		mg/Kg	4	12/3/96	1
Sr	30.7		mg/Kg	2	12/3/96	1
V	22.7		mg/Kg	0.8	12/3/96	1
Zn	7190		mg/Kg	0.8	12/3/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2944
Station ID: B-DD06-ASS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25491
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	40		mg/Kg	2.4	12/3/96	3
Al	3540		mg/Kg	18	12/3/96	3
As	62		mg/Kg	42	12/3/96	3
B		U	mg/Kg	6	12/3/96	3
Ba	55.9		mg/Kg	2.4	12/3/96	3
Be	0.338		mg/Kg	0.3	12/3/96	3
Ca	452		mg/Kg	18	12/3/96	3
Cd	3.95		mg/Kg	2.4	12/3/96	3
Co		U	mg/Kg	1.8	12/3/96	3
Cr		U	mg/Kg	6	12/3/96	3
Cu	204		mg/Kg	3	12/3/96	3
Fe	120000		mg/Kg	2.4	12/3/96	3
K	1850		mg/Kg	600	12/3/96	3
Li	4.4		mg/Kg	3.6	12/3/96	3
Mg	542		mg/Kg	18	12/3/96	3
Mn	402		mg/Kg	2.4	12/3/96	3
Mo		U	mg/Kg	6	12/3/96	3
Na	236		mg/Kg	18	12/3/96	3
Ni		U	mg/Kg	6	12/3/96	3
Pb	1850		mg/Kg	18	12/3/96	3
Sb	12.7		mg/Kg	12	12/3/96	3
Se		U	mg/Kg	18	12/3/96	3
Si	623		mg/Kg	12	12/3/96	3
Sr	20.4		mg/Kg	6	12/3/96	3
V	9.72		mg/Kg	2.4	12/3/96	3
Zn	1300		mg/Kg	2.4	12/3/96	3

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

ıvi' mental Research Chemistry Laboratory
ı of Reclamation - Technical Service Center
P Box 25007, D-8240, Denver, CO 80025-0007
' rgaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2945
Station ID: B-DD06-ADSS02--961024
Additional ID: 1
Chain-Of-Custody: 8-25491
Matrix: Soil

Sampled Date: 10/24/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	40.9		mg/Kg	2.4	12/18/96	3
Al	2770		mg/Kg	18	12/18/96	3
As	80.4		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	93.2		mg/Kg	2.4	12/18/96	3
Be	0.426		mg/Kg	0.3	12/18/96	3
Ca	477		mg/Kg	18	12/18/96	3
Cd	2.87		mg/Kg	2.4	12/18/96	3
Co	3.97		mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	215		mg/Kg	3	12/18/96	3
Fe	139000		mg/Kg	2.4	12/18/96	3
K	2330		mg/Kg	600	12/18/96	3
Li	4.07		mg/Kg	3.6	12/18/96	3
Mg	380		mg/Kg	18	12/18/96	3
Mn	415		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	313		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	1930		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	1090		mg/Kg	12	12/18/96	3
Sr	26.6		mg/Kg	6	12/18/96	3
V	19.1		mg/Kg	2.4	12/18/96	3
Zn	1380		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2946
Station ID: B-DD06-BSS01--961113
Additional ID: 1
Chain-Of-Custody: 8-25491
Matrix: Soil

Sampled Date: 10/24/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	88		mg/Kg	2.4	12/18/96	3
Al	1110		mg/Kg	18	12/18/96	3
As	164		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	14.1		mg/Kg	2.4	12/18/96	3
Be	0.4		mg/Kg	0.3	12/18/96	3
Ca	14900		mg/Kg	18	12/18/96	3
Cd	4.66		mg/Kg	2.4	12/18/96	3
Co		U	mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	232		mg/Kg	3	12/18/96	3
Fe	211000		mg/Kg	2.4	12/18/96	3
K	1530		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	118		mg/Kg	18	12/18/96	3
Mn	573		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	60		mg/Kg	18	12/18/96	3
Ni		U	mg/Kg	6	12/18/96	3
Pb	3630		mg/Kg	18	12/18/96	3
Sb		U	mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	535		mg/Kg	12	12/18/96	3
Sr	23.6		mg/Kg	6	12/18/96	3
V		U	mg/Kg	2.4	12/18/96	3
Zn	2520		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2947
Station ID: B-DD06-BDSS01--961024
Additional ID: 1
Chain-Of-Custody: 8-25491
Matrix: Soil

Sampled Date: 10/24/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	71.6		mg/Kg	2.4	12/18/96	3
Al	1130		mg/Kg	18	12/18/96	3
As	135		mg/Kg	42	12/18/96	3
B		U	mg/Kg	6	12/18/96	3
Ba	4.42		mg/Kg	2.4	12/18/96	3
Be	0.346		mg/Kg	0.3	12/18/96	3
Ca	60300		mg/Kg	18	12/18/96	3
Cd	11.9		mg/Kg	2.4	12/18/96	3
Co	3.63		mg/Kg	1.8	12/18/96	3
Cr		U	mg/Kg	6	12/18/96	3
Cu	289		mg/Kg	3	12/18/96	3
Fe	163000		mg/Kg	2.4	12/18/96	3
K	1520		mg/Kg	600	12/18/96	3
Li		U	mg/Kg	3.6	12/18/96	3
Mg	394		mg/Kg	18	12/18/96	3
Mn	520		mg/Kg	2.4	12/18/96	3
Mo		U	mg/Kg	6	12/18/96	3
Na	54.6		mg/Kg	18	12/18/96	3
Ni	6.05		mg/Kg	6	12/18/96	3
Pb	2520		mg/Kg	18	12/18/96	3
Sb	12.4		mg/Kg	12	12/18/96	3
Se		U	mg/Kg	18	12/18/96	3
Si	549		mg/Kg	12	12/18/96	3
Sr	49.9		mg/Kg	6	12/18/96	3
V		U	mg/Kg	2.4	12/18/96	3
Zn	3320		mg/Kg	2.4	12/18/96	3

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2948
Station ID: B-DD14-ASS01--961024
Additional ID: 1
Chain-Of-Custody: 8-25491
Matrix: Soil

Sampled Date: 10/24/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	32		mg/Kg	0.8	12/18/96	1
Al	2520		mg/Kg	6	12/18/96	1
As	176		mg/Kg	14	12/18/96	1
B		U	mg/Kg	2	12/18/96	1
Ba	317		mg/Kg	0.8	12/18/96	1
Be	0.431		mg/Kg	0.1	12/18/96	1
Ca	1280		mg/Kg	6	12/18/96	1
Cd	6.54		mg/Kg	0.8	12/18/96	1
Co	2.04		mg/Kg	0.6	12/18/96	1
Cr	9.44		mg/Kg	2	12/18/96	1
Cu	197		mg/Kg	1	12/18/96	1
Fe	78900		mg/Kg	0.8	12/18/96	1
K	3120		mg/Kg	200	12/18/96	1
Li	1.81		mg/Kg	1.2	12/18/96	1
Mg	759		mg/Kg	6	12/18/96	1
Mn	879		mg/Kg	0.8	12/18/96	1
Mo	2.77		mg/Kg	2	12/18/96	1
Na	50.3		mg/Kg	6	12/18/96	1
Ni	6		mg/Kg	2	12/18/96	1
Pb	3050		mg/Kg	6	12/18/96	1
Sb	4.35		mg/Kg	4	12/18/96	1
Se		U	mg/Kg	6	12/18/96	1
Si	927		mg/Kg	4	12/18/96	1
Sr	16.2		mg/Kg	2	12/18/96	1
V	16.6		mg/Kg	0.8	12/18/96	1
Zn	2060		mg/Kg	0.8	12/18/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2949
Station ID: B-DD14-BSS01--961024
Additional ID: 1
Chain-Of-Custody: 8-25491
Matrix: Soil

Sampled Date: 10/24/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	14.4		mg/Kg	0.8	12/17/96	1
Al	6150		mg/Kg	6	12/17/96	1
As	107		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	184		mg/Kg	0.8	12/17/96	1
Be	1.08		mg/Kg	0.1	12/17/96	1
Ca	16300		mg/Kg	6	12/17/96	1
Cd	53.8		mg/Kg	0.8	12/17/96	1
Co	8.82		mg/Kg	0.6	12/17/96	1
Cr	11.5		mg/Kg	2	12/17/96	1
Cu	278		mg/Kg	1	12/17/96	1
Fe	72100		mg/Kg	0.8	12/17/96	1
K	1590		mg/Kg	200	12/17/96	1
Li	4.55		mg/Kg	1.2	12/17/96	1
Mg	4010		mg/Kg	6	12/17/96	1
Mn	5630		mg/Kg	0.8	12/17/96	1
Mo		U	mg/Kg	2	12/17/96	1
Na	81.2		mg/Kg	6	12/17/96	1
Ni	10.8		mg/Kg	2	12/17/96	1
Pb	2330		mg/Kg	6	12/17/96	1
Sb	4.9		mg/Kg	4	12/17/96	1
Se		U	mg/Kg	6	12/17/96	1
Si	1150		mg/Kg	4	12/17/96	1
Sr	25		mg/Kg	2	12/17/96	1
V	25.6		mg/Kg	0.8	12/17/96	1
Zn	10500		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2950
Station ID: B-DD15-ASS01--961023
Sampled Date: 10/24/96
Additional ID: 1
Login Date: 11/20/96
Chain-Of-Custody: 8-25491
Analyses Required: ICP Scan
Matrix: Soil
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	21		mg/Kg	0.8	12/17/96	1
Al	2650		mg/Kg	6	12/17/96	1
As	113		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	276		mg/Kg	0.8	12/17/96	1
Be	0.826		mg/Kg	0.1	12/17/96	1
Ca	3570		mg/Kg	6	12/17/96	1
Cd	22.7		mg/Kg	0.8	12/17/96	1
Co	5.51		mg/Kg	0.6	12/17/96	1
Cr	6.07		mg/Kg	2	12/17/96	1
Cu	402		mg/Kg	1	12/17/96	1
Fe	61200		mg/Kg	0.8	12/17/96	1
K	1180		mg/Kg	200	12/17/96	1
Li	1.73		mg/Kg	1.2	12/17/96	1
Mg	1620		mg/Kg	6	12/17/96	1
Mn	2580		mg/Kg	0.8	12/17/96	1
Mo	7.38		mg/Kg	2	12/17/96	1
Na	26.6		mg/Kg	6	12/17/96	1
Ni	10.2		mg/Kg	2	12/17/96	1
Pb	2490		mg/Kg	6	12/17/96	1
Sb	5.77		mg/Kg	4	12/17/96	1
Se	7.39		mg/Kg	6	12/17/96	1
Si	1010		mg/Kg	4	12/17/96	1
Sr	19.2		mg/Kg	2	12/17/96	1
V	17.7		mg/Kg	0.8	12/17/96	1
Zn	5350		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2951
Station ID: B-DD15-BSS01--961024
Additional ID: 1
Chain-Of-Custody: 8-25491
Matrix: Soil

Sampled Date: 10/24/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	10.1		mg/Kg	0.8	12/17/96	1
Al	5940		mg/Kg	6	12/17/96	1
As	72.9		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	73.1		mg/Kg	0.8	12/17/96	1
Be	0.813		mg/Kg	0.1	12/17/96	1
Ca	11600		mg/Kg	6	12/17/96	1
Cd	58.6		mg/Kg	0.8	12/17/96	1
Co	3.65		mg/Kg	0.6	12/17/96	1
Cr	8.51		mg/Kg	2	12/17/96	1
Cu	1060		mg/Kg	1	12/17/96	1
Fe	46100		mg/Kg	0.8	12/17/96	1
K	2420		mg/Kg	200	12/17/96	1
Li	6.39		mg/Kg	1.2	12/17/96	1
Mg	5880		mg/Kg	6	12/17/96	1
Mn	4160		mg/Kg	0.8	12/17/96	1
Mo	4.01		mg/Kg	2	12/17/96	1
Na	30.7		mg/Kg	6	12/17/96	1
Ni	11.9		mg/Kg	2	12/17/96	1
Pb	2650		mg/Kg	6	12/17/96	1
Sb		U	mg/Kg	4	12/17/96	1
Se	9.39		mg/Kg	6	12/17/96	1
Si	989		mg/Kg	4	12/17/96	1
Sr	21.8		mg/Kg	2	12/17/96	1
V	42.2		mg/Kg	0.8	12/17/96	1
Zn	13500		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2954
Station ID: B-WTL06-ASS01--961024
Sampled Date: 10/24/96
Additional ID: 1
Login Date: 11/20/96
Chain-Of-Custody: 8-25491
Analyses Required: ICP Scan
Matrix: Soil
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	8.04		mg/Kg	0.8	12/17/96	1
Al	7470		mg/Kg	6	12/17/96	1
As	48.5		mg/Kg	14	12/17/96	1
B	.	U	mg/Kg	2	12/17/96	1
Ba	143		mg/Kg	0.8	12/17/96	1
Be	0.714		mg/Kg	0.1	12/17/96	1
Ca	5580		mg/Kg	6	12/17/96	1
Cd	30.7		mg/Kg	0.8	12/17/96	1
Co	11.3		mg/Kg	0.6	12/17/96	1
Cr	7.48		mg/Kg	2	12/17/96	1
Cu	225		mg/Kg	1	12/17/96	1
Fe	34000		mg/Kg	0.8	12/17/96	1
K	2070		mg/Kg	200	12/17/96	1
Li	4.61		mg/Kg	1.2	12/17/96	1
Mg	3270		mg/Kg	6	12/17/96	1
Mn	2080		mg/Kg	0.8	12/17/96	1
Mo		U	mg/Kg	2	12/17/96	1
Na	57.3		mg/Kg	6	12/17/96	1
Ni	12.4		mg/Kg	2	12/17/96	1
Pb	4050		mg/Kg	6	12/17/96	1
Sb		U	mg/Kg	4	12/17/96	1
Se	12.1		mg/Kg	6	12/17/96	1
Si	1280		mg/Kg	4	12/17/96	1
Sr	18		mg/Kg	2	12/17/96	1
V	20.3		mg/Kg	0.8	12/17/96	1
Zn	7470		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

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ıre ake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2955
Station ID: B-WTL06-BSS01--961024
Sampled Date: 10/24/96
Additional ID: 1
Login Date: 11/20/96
Chain-Of-Custody: 8-25491
Analyses Required: ICP Scan
Matrix: Soil
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	1.81		mg/Kg	0.8	12/17/96	1
Al	8680		mg/Kg	6	12/17/96	1
As	14.6		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	104		mg/Kg	0.8	12/17/96	1
Be	0.826		mg/Kg	0.1	12/17/96	1
Ca	2600		mg/Kg	6	12/17/96	1
Cd	5.71		mg/Kg	0.8	12/17/96	1
Co	7.08		mg/Kg	0.6	12/17/96	1
Cr	8.3		mg/Kg	2	12/17/96	1
Cu	88.1		mg/Kg	1	12/17/96	1
Fe	30600		mg/Kg	0.8	12/17/96	1
K	2500		mg/Kg	200	12/17/96	1
Li	6.83		mg/Kg	1.2	12/17/96	1
Mg	3740		mg/Kg	6	12/17/96	1
Mn	494		mg/Kg	0.8	12/17/96	1
Mo		U	mg/Kg	2	12/17/96	1
Na	57.8		mg/Kg	6	12/17/96	1
Ni	7.47		mg/Kg	2	12/17/96	1
Pb	490		mg/Kg	6	12/17/96	1
Sb		U	mg/Kg	4	12/17/96	1
Se	8		mg/Kg	6	12/17/96	1
Si	2060		mg/Kg	4	12/17/96	1
Sr	20.6		mg/Kg	2	12/17/96	1
V	26.6		mg/Kg	0.8	12/17/96	1
Zn	1150		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
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Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2956
Station ID: B-WTL07-ASS01--961024
Additional ID: 1
Chain-Of-Custody: 8-25491
Matrix: Soil

Sampled Date: 10/24/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	10.3		mg/Kg	0.8	12/17/96	1
Al	6460		mg/Kg	6	12/17/96	1
As	35.4		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	198		mg/Kg	0.8	12/17/96	1
Be	0.783		mg/Kg	0.1	12/17/96	1
Ca	3550		mg/Kg	6	12/17/96	1
Cd	59.5		mg/Kg	0.8	12/17/96	1
Co	8		mg/Kg	0.6	12/17/96	1
Cr	8.1		mg/Kg	2	12/17/96	1
Cu	218		mg/Kg	1	12/17/96	1
Fe	37200		mg/Kg	0.8	12/17/96	1
K	1940		mg/Kg	200	12/17/96	1
Li	4.62		mg/Kg	1.2	12/17/96	1
Mg	2870		mg/Kg	6	12/17/96	1
Mn	2360		mg/Kg	0.8	12/17/96	1
Mo		U	mg/Kg	2	12/17/96	1
Na	54.9		mg/Kg	6	12/17/96	1
Ni	6.97		mg/Kg	2	12/17/96	1
Pb	4690		mg/Kg	6	12/17/96	1
Sb		U	mg/Kg	4	12/17/96	1
Se	7.47		mg/Kg	6	12/17/96	1
Si	1360		mg/Kg	4	12/17/96	1
Sr	18.7		mg/Kg	2	12/17/96	1
V	19.9		mg/Kg	0.8	12/17/96	1
Zn	10200		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2957
Station ID: B-WTL07-BSS01--961024
Additional ID: 1
Chain-Of-Custody: 8-25489
Matrix: Soil

Sampled Date: 10/24/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	3.74		mg/Kg	0.8	12/17/96	1
Al	9730		mg/Kg	6	12/17/96	1
As	133		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	132		mg/Kg	0.8	12/17/96	1
Be	0.723		mg/Kg	0.1	12/17/96	1
Ca	2230		mg/Kg	6	12/17/96	1
Cd	8.14		mg/Kg	0.8	12/17/96	1
Co	6.56		mg/Kg	0.6	12/17/96	1
Cr	9.13		mg/Kg	2	12/17/96	1
Cu	141		mg/Kg	1	12/17/96	1
Fe	27300		mg/Kg	0.8	12/17/96	1
K	2420		mg/Kg	200	12/17/96	1
Li	6.39		mg/Kg	1.2	12/17/96	1
Mg	3390		mg/Kg	6	12/17/96	1
Mn	467		mg/Kg	0.8	12/17/96	1
Mo		U	mg/Kg	2	12/17/96	1
Na	70.8		mg/Kg	6	12/17/96	1
Ni	6.83		mg/Kg	2	12/17/96	1
Pb	1260		mg/Kg	6	12/17/96	1
Sb		U	mg/Kg	4	12/17/96	1
Se	10		mg/Kg	6	12/17/96	1
Si	1920		mg/Kg	4	12/17/96	1
Sr	23.2		mg/Kg	2	12/17/96	1
V	28.1		mg/Kg	0.8	12/17/96	1
Zn	1020		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

LABORATORY ANALYSIS DATA REPORT

Environmental Research Chemistry Laboratory
Bureau of Reclamation - Technical Service Center
P.O. Box 25007, D-8240, Denver, CO 80025-0007
Margaret Lake, Laboratory Manager, 303-236-4290 Ext. 256

Feature: ICP Scan
Project: Oro-Wellington

Chem Lab#: K2958
Station ID: B-DD-3-BSS01--961023
Additional ID: 1
Chain-Of-Custody: 8-25491
Matrix: Soil

Sampled Date: 10/23/96
Login Date: 11/20/96
Analyses Required: ICP Scan
Comment:

Analyte	Result	Qualifier	Units	MDL	Date Analyzed	Dilution
Ag	25		mg/Kg	0.8	12/17/96	1
Al	3140		mg/Kg	6	12/17/96	1
As	110		mg/Kg	14	12/17/96	1
B		U	mg/Kg	2	12/17/96	1
Ba	472		mg/Kg	0.8	12/17/96	1
Be	0.761		mg/Kg	0.1	12/17/96	1
Ca	15300		mg/Kg	6	12/17/96	1
Cd	135		mg/Kg	0.8	12/17/96	1
Co	7.21		mg/Kg	0.6	12/17/96	1
Cr	9.57		mg/Kg	2	12/17/96	1
Cu	602		mg/Kg	1	12/17/96	1
Fe	65000		mg/Kg	0.8	12/17/96	1
K	1910		mg/Kg	200	12/17/96	1
Li	2.49		mg/Kg	1.2	12/17/96	1
Mg	7240		mg/Kg	6	12/17/96	1
Mn	7960		mg/Kg	0.8	12/17/96	1
Mo	4.08		mg/Kg	2	12/17/96	1
Na	31.3		mg/Kg	6	12/17/96	1
Ni	14.8		mg/Kg	2	12/17/96	1
Pb	4490		mg/Kg	6	12/17/96	1
Sb	4.24		mg/Kg	4	12/17/96	1
Se	11.7		mg/Kg	6	12/17/96	1
Si	764		mg/Kg	4	12/17/96	1
Sr	34.4		mg/Kg	2	12/17/96	1
V	15.7		mg/Kg	0.8	12/17/96	1
Zn	22000		mg/Kg	0.8	12/17/96	1

U: Not Detected at Listed MDL.
J : Estimated .

Appendix 8-2

TECHNICAL SERVICE CENTER
Denver, Colorado

WELLINGTON-ORO MINE COMPLEX
Near Breckenridge, Colorado

CONCEPTUAL DESIGN COST REPORT FOR SURFACE WASTE CLEANUP

Submitted to:

U.S. Environmental Protection Agency, Region VIII
Superfund Prevention Assessment and
Emergency Response Program
Denver, Colorado

Prepared by:

U.S. Bureau of Reclamation
Technical Service Center
Denver Federal Center
Denver, Colorado 80225

July 24, 1997

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I. BACKGROUND

1.1 Purpose of Report

The purpose of this report is to document conceptual field cost estimates related to cleaning up surface waste at the Wellington-Oro Mine site. The data and assumptions used in the development of the conceptual design cost estimates are also presented. The decision as to which option(s) are chosen will be based on whether the cleanup action is cost effective and contributes to meeting the overall remediation goals established by the French Gulch Remediation Opportunities Group (FROG).

1.2 Scope of Work

The Bureau of Reclamation (Reclamation) was requested by the Environmental Protection Agency (EPA) to provide conceptual design field cost estimates for addressing cleanup of surface waste in the immediate vicinity of the Wellington-Oro Mine complex (W-O). The costs estimated in this report do not include the engineering and data acquisition costs which would be incurred in implementing the work. The field costs include a 15 percent allowance for unlisted items and 25 percent for contingencies. The surface waste addressed herein includes:

1) Roaster fines, mill tailings and mine waste rock at the W-O mill site (see figure 1).

2) Waste rock at the Extenuate area which is approximately 1/4 mile east of the W-O mill site (see figure 2).

Options and associated costs for cleanup of the identified surface waste are as follows:

Option A - On-site Repository of Existing Mill Tailings and Roaster Fines

Option B - On-site Repository of Stabilized and/or Solidified Mill Tailings and Roaster Fines

Option C - Re-Processing of Roaster Fines and Mill Tailings

Option D - Removal and Off-site Disposal of Roaster Fines and Mill Tailings

Option F - Encapsulation of Roaster Fines and Mill Tailings inside Mine Workings

Option G - In-place Mine Waste Rock Reclamation

Option H - In-Place Shaping and Covering of Roaster Fines and Mill Tailings

The above options, except for Option H, were identified in the report "Evaluation of Surface Waste Cleanup," dated August 16, 1996 [1]. Using available data, these options were developed taking into consideration the physical and chemical characteristics of the waste materials. Option E, Realignment of Additional Segments of French Creek, was not evaluated because present information indicates that French Creek is not a significant source of flow into the W-O Mine. Option H was added at the request of the EPA upon review of the draft costs for the other options, and recent information on the probable relative metal loading contributions of the surface waste and W-O Mine. Option H is different from the other options because Option H would not isolate the waste from groundwater or surface water infiltration.

1.3 Site Location and History

The Wellington-Oro Mine Complex is located in French Gulch, 2 miles northeast of the Town of Breckenridge, Colorado, just east of the French Creek/Blue River confluence. French Gulch is located in the southeast 1/4 of Section 32, Township 6 South, Range 77 West. The site geographical coordinates are latitude 39°29'00" and longitude 106°00'52".

Extensive mining in the French Gulch watershed continued intermittently from the 1880's into the 1960's. Lode mining occurred on the steep valley slopes of the glaciated high-mountain valley. Within this interval, large scale floating dredge boats worked their way upstream along the valley floor, placering for gold in the glacial outwash and stream gravels of French Creek. The valley floor of French Gulch has been completely disrupted by historic placer dredging; resulting in much of French Creek flowing beneath the windrows of cobbles left by the dredges.

Several abandoned mine sites exist in the French Gulch water shed. The largest and considered to be the single greatest contributor of heavy metals loading to French Creek is the Wellington-Oro (W-O) Mine. The Wellington and Oro Mines were once distinct facilities, but later were combined into

one. An extensive underground network of tunnels and adits exists at the Wellington-Oro complex on the north side of French Gulch. Approximately six levels of these tunnels and adits are below the elevation of French Creek and the groundwater table.

In 1908 a mill was constructed as part of the Wellington-Oro mine operations. The mill used various processing methods to treat lead, copper, and zinc ores. Mined ore was removed from the underground works at two primary locations: at the mill site through the Oro Shaft and 1/4 mile upstream from the mill site through the X.10.U.8 portal (Extenuate). Roaster fines, mill tailings, and waste rock piles exist at the W-O mill site (See figure 1). The south mill tailings remain in the French Creek alluvial channel immediately downstream of the mill site, although surface water has been rerouted in this area so that it no longer flows through the south mill tailings. A large waste rock pile exists at the Extenuate site (See figure 2). For purposes of this document, the term Wellington-Oro (W-O) Complex will be used to refer to the main W-O mill site and the Extenuate Shaft area.

The Union Mill site located downstream from the W-O mill was not evaluated in this study.

Specific information regarding the history of the W-O complex, the Union Mill and surrounding areas and existing water quality conditions, is included within several investigation reports which have been prepared for the French Gulch area [2], [3], [4].

1.4 Waste Descriptions

The roaster fines, mill tailings and waste rock surface waste vary in their total metals content, particle size and mineralogy; all of which affect their metal leaching potential. In addition, some of these waste materials are saturated or partially saturated during certain times of the year, further contributing to their metal leachability. Material volumes estimated for the W-O site are: 43,000 yd^3 of roaster fines, 13,000 yd^3 of north mill tailings and 42,000 yd^3 of south mill tailings. Waste volumes were estimated using data from explorations performed by the State of Colorado, Division of Minerals and Geology (DMG), and Reclamation. Volumes were calculated by estimating the areal extent of the waste piles using surface exposure and subsurface explorations, and assigning depths to sections of

the waste piles based on subsurface exploration. Plan views and sections depicting the approximate limits of the roaster fines and mill tailings waste materials are shown in figures 3 through 8. Volumes calculated are greater than previous estimates by DMG [6]. The basis for previous estimates is unknown. The increase in estimated volumes could be due to using a different methodology to calculate the volumes, or additional data on the extent of the waste. Cut and fill volumes estimated for the waste rock shaping option are 30,000 yd^3 at the W-O site and 21,000 yd^3 at the Extenuate site. Plan and sections showing limits of the cut and fill for the waste rock shaping option are shown in figures 13 through 16.

II. DEWATERING AND EXCAVATION MODULES

Except for the in-place waste reclamation options, all options include items for excavation of the roaster fines and/or mill tailings. A specific determination of the requirements for isolation of the wastes from French Creek during removal is beyond the scope of this report, so two general approaches were included in the cost estimates. In one, the material would be isolated from the stream and excavated in the "dry." In the second, the material would be excavated in the "wet" while in connection with the stream. For these conceptual cost estimates it was assumed that all of the wastes would be excavated. No allowance was made for removal of contaminated natural material under or around the wastes. Therefore, to keep the cost estimate sheets concise, six cost estimate "modules" have been prepared containing only the items and costs for dewatering, "dry" excavation, and "wet" excavation of the roaster fines and mill tailings. The cost estimate module sheets are as follows:

Module NO. 1 - SOUTH MILL TAILINGS DEWATERING

Module No. 2 - ROASTER FINES DEWATERING

Module NO. 3 - "DRY" EXCAVATION OF MILL TAILINGS

Module NO. 4 - "DRY" EXCAVATION OF ROASTER FINES

Module NO. 5 - "WET" EXCAVATION OF MILL TAILINGS

Module NO. 6 - "WET" EXCAVATION OF ROASTER FINES

Modules No. 1 and 2 involve dewatering of the roaster fines and south mill tailings waste piles prior to excavation taking place.

It is assumed that dewatering of the north mill tailings pile will not be required, and therefore, excavation would be by dry methods only. Dewatering of the south mill tailings pond, module No. 1, entails: diverting French Creek flows using a 48-inch corrugated metal pipe, constructing a sheet pile cutoff wall system around a portion of the south mill tailings (See figure 9), drilling wells and installing submersible pumps for drawing the water down. Dewatering of the roaster fines, module No. 2, involves drilled wells and installing submersible pumps. Both dewatering modules include costs for water treatment to remove 90 percent of the metals content from dewatering system effluent. See section 3 of this report for discussion of water treatment during construction dewatering.

Modules No. 3 and 4 are for dry excavation of the roaster fines and/or mill tailings after the areas have been dewatered as discussed above. "Dry" excavation of the roaster fines and north mill tailings would be by conventional methods. "Dry" excavation of the south mill tailings, module No. 3, would involve a 4-step process. First, the inner footprint (mill tailings not interspersed with dredge cobble) would be excavated to the groundwater surface; second, the difference of material between the south mill tailings inner and outer footprint (assumed outer extent of mill tailings interspersed with dredge cobble) would be excavated and screened, where sand size material and smaller would be assumed contaminated; third, the larger than sand size material from the screening process would be disposed of without special handling requirements; and fourth, the mill tailings below the water table would be excavated during and after the dewatering process as described in module No. 1.

Modules 5 and 6 are for "wet" excavation conditions, without dewatering taking place. "Wet" excavation of the roaster fines, module No. 6, would involve excavating the material by conventional methods to the water table, excavating the saturated materials below the water table, and then hauling the materials to a centrifuge for drying. It is assumed that the centrifuge would reduce the moisture content from approximately 45 percent to 20 percent. "Wet" excavation of the south mill tailings, module No. 5, would involve the same process as that described above for module No. 3 with the exception that dewatering would not be required. The wet material below the water table would then be excavated, hauled to a centrifuge and dried. Both "wet" excavation modules include costs for treatment of water from the centrifuge to remove 90 percent of the metals content. See section 3 of this report for discussion of water treatment during construction dewatering.

Modules 3 through 6 also contain an item for "reshaping" of the Mill Tailings and/or "filling" of the Roaster Fines disturbed areas following construction activities. This item assumes that materials from the surrounding areas such as waste rock and river rock can be used to fill and shape the excavations.

When excavating and removing the roaster fines and mill tailings, typical construction requirements such as grading haul roads into and around the work areas, working around the dewatering system, dust abatement, and traffic control would be required. The costs for such activities are included in each of the applicable cost estimates.

Each conceptual design option that includes items for dewatering and/or excavation of the roaster fines and/or mill tailings, refers to a corresponding cost estimate module. Five of the seven options evaluated in this report include an item for excavation, and would have associated costs for either the dry or wet methods. The five options that require excavation are options A, B, C, D, and F. Cost estimates for both excavation methods are only provided for option A. Excavation costs for the other four options are the same as option A, therefore, only the "dry" method of excavation is included in their associated cost estimate sheets. The difference in estimated costs for the "wet" method of excavation would be of a similar magnitude for the other options.

3. WATER TREATMENT DURING CONSTRUCTION DEWATERING

The Water Treatment system for cleanup actions is for dewatering activities during excavation of the roaster fines and the mill tailings. It is estimated that the mill tailings area would require treatment support for dewatering at a rate of 175 gallons per minute (GPM) for 20 days. It is estimated that the roaster fines would require treatment support for dewatering at a rate of 175 GPM for 7 days. In addition, a 32 GPM recharge from bedrock is factored into both dewatering rates.

The water treatment system is conceptually designed for a treatment rate of 250 GPM. This is a treatment rate of 360,000 gallons per day (GPD) or approximately 10 million gallons in a 4 week period. The annual requirement for the water treatment system is 90 percent removal of total metals including lead, aluminum, iron, zinc, copper, cadmium and manganese. The base level metal loadings were assumed to be represented by the metal loadings in existing wells near the roaster fines and mill tailings waste piles.

The conceptual water treatment design is a lined pond system. The pond would be partitioned into three stages using two overflow baffles. Construction dewatering flow would be pH adjusted to a pH of 8.0 using hydrated lime or sodium hydroxide. The untreated water would then be pumped into one end of the pond and flow through the pond to an overflow point at the other end. Sludge is collected at each of the baffles and pumped out using a suction truck. The sludge is then stabilized using stabilization process equipment (for any of the processing options) or by mixing with waste and disposed of on site with the roaster fines and mill tailings.

4. OPTION A, ON-SITE REPOSITORY OF MILL TAILINGS AND ROASTER FINES

This option consists of adding a small amount of calcium carbonate to the roaster fines and mill tailings and then confining the material. The material would be placed within an on-site repository or cell, designed to reduce infiltration, runon and runoff. The repository cell would be above the water table and outside of the floodplain.

A final location for the repository was not determined. The costs developed are considered representative of potential repository sites in the vicinity of the north mill tailings mine waste pile (Refer to Figure 1), or below the Extenuate area just north of the French Gulch Road (Refer to Figure 2).

Under this option, the roaster fines and/or mill tailings would be confined within an above ground mine-waste repository and covered/capped. The repository would be approximately 20 feet in height and have 3H:1V side slopes. Two repository alternatives were evaluated for costs. The alternatives represent a range of approaches, from providing a simple cap, to complete encapsulation. The surface cover/cap of the repository would consist of geosynthetic and native materials. Sand was assumed available from a nearby processing plant, rock and/or gravel and cobbles, were assumed to be acquired locally from within French Gulch.

Conceptual costs were developed for two variations of the repository option, a confined cell with a multiple defense cover/cap and a cell with a simple cover/cap. From the two variations, 12 possible combinations or modules have been derived. The first six of the 12 different combinations are as listed below:

1) OPTION NO. A1: MILL TAILINGS AND ROASTER FINES - MULTIPLE DEFENSE CAP AND LINER, "DRY" EXCAVATION

2) OPTION NO. A2: MILL TAILINGS AND ROASTER FINES - SIMPLE CAP, "DRY" EXCAVATION

3) OPTION NO. A3: ROASTER FINES - MULTIPLE DEFENSE CAP AND LINER, "DRY" EXCAVATION

4) OPTION NO. A4: MILL TAILINGS - MULTIPLE DEFENSE CAP AND LINER, "DRY" EXCAVATION

5) OPTION NO. A5: ROASTER FINES - SIMPLE CAP, "DRY" EXCAVATION

6) OPTION NO. A6: MILL TAILINGS - SIMPLE CAP, "DRY" EXCAVATION

The remaining six combinations of this option are identical to the above six, except that their method of excavation is by the "wet" method of excavation rather than the "dry" method. See Appendix A for cost estimates associated with these combinations.

In each of the repository options, the roaster fines and/or mill tailings were assumed to be excavated and hauled to the repository location. The waste materials would be placed in an in-situ condition, with the exception of mixing and drying to reduce the moisture content if required; after which 0.5 percent by dry weight of calcium carbonate would be added and mixed into the material.

For the multiple defense cap repository, the foundation pad would require excavation of approximately 2 feet for construction of a multi-layer geotechnical liner (See figure 10). The cover/cap of the cell would consist of multiple layers of both geotechnical and geosynthetic materials (See figure 11). For the simple cap repository, the waste material would be placed directly upon the ground surface after foundation stripping, grading, and compactive efforts. The cell would be covered/capped with both native and geosynthetic materials (See figure 12). Clearing and grubbing of the repository area would be required of all variations of the repository option.

Because the roaster fines and mill tailings have always been considered to represent a greater pollution threat than the mine waste rock, confinement of the roaster fines and mill tailings in combination with capped mine waste rock was not included as an alternative within the scope of this work. However, if all

surface wastes were to be treated, and if a simple cap is considered an appropriate alternative for the roaster fines and mill tailings, then combined placement and capping of the mill tailings and roaster fines with the mine waste rock would provide an opportunity for cost savings.

5. OPTION B, ON-SITE REPOSITORY OF STABILIZED MILL TAILINGS AND ROASTER FINES

This conceptual option evaluates an on-site repository of treated roaster fines and mill tailings. Treatment benefits of mixing the contaminated materials with alkaline amendments such as cement kiln dust, fly ash, and cement/pozzolan mixtures is to reduce acid generation potential and mobility of the metals. Costs presented here are considered representative of a repository location similar to the unstabilized waste repository option.

This option assumes that the waste material requiring stabilization would be excavated, hauled and stockpiled adjacent to the repository site. The stabilization equipment would then be installed next to the repository. Waste material would be fed to the stabilization system with a front end loader. After treatment, the stabilized waste would be conveyed to the repository and deposited there.

Two conceptual approaches were pursued for the stabilization of the waste material. The first approach is stabilization of using a mixture of an alkaline amendment (cement kiln dust) and a pozzolonic material (fly ash). In general, the solidified waste from CKD/fly ash amendment are not considered durable and have a tendency to weather and sometimes disintegrate. The second approach was the use of a portland cement/pozzolan (fly ash) mixture. The resulting product sets similar to concrete and can have exceptional strength and durability. A variety of emulsifiers are available in the market and can be used to improve the formation of a solid matrix and reduce the leachability of metals from the solid matrix. This second approach has the potential of being used without the need for an impermeable cover/cap on the repository, and was priced out.

In this option, Portland Cement was assumed to be used as the binding agent for the waste material. Pozzolonic material such as fly ash was also assumed to be added to the waste mix to improve the strength and chemical resistance of the final product.

Bench scale testing would be needed to verify if the sulfates present in the mineral structure would require special grades of cement. It would also verify if the buffering produced by the fly ash in the mixture design is sufficient to buffer acid generation which could have a deleterious effect on the stabilized material.

The cost estimates included in Appendix A are for the "dry" method of excavation. The "wet" method of excavation would change the cost of this option an amount similar to the difference between "dry" and "wet" excavation for option A.

6. OPTION C, REPROCESSING OF ROASTER FINES AND MILL TAILINGS

This alternative involves removal of the roaster fines and mill tailings by excavation, processing for metals recovery, and disposal of the residue. Only processing of the roaster fines was considered. Processing of the mill tailings was not evaluated because of the apparent lack of viability.

Two variations of the option for reprocessing the roaster fines were considered, on-site and off-site. Off-site processing is only feasible if a processing facility can be identified within a reasonable distance from the site. However, the off-site processing facilities contacted indicated that the level of metal content in the feed stock is not sufficient to effectively process or that their facilities would have to be adapted to process the material. Therefore, only on-site processing is discussed. Final disposition of processing the waste material is dependent upon the nature of the waste residue and location of the process. Existing commercial facilities use either smelting, or flotation and hydrometallurgical processes for recovery of base metals. These processes are discussed below for an on-site facility:

Smelting

An evaluation of a specialty smelter for on-site processing indicated that the metals could be recovered; however, the value of the metals is not quantifiable at this time. Also, the degree of resource recovery is not quantifiable with the present level of data. The effectiveness of this process is currently uncertain since there is not sufficient assay data to make an initial evaluation.

Flotation

The processing options for flotation are undefined or not quantifiable. Additional assay testing for the collection of data and detailed design needs to be performed in order to determine the implementability or effectiveness of this option. The feasibility of the process can only be determined after further sampling and characterization, bench scale testing, and preliminary process design. This option, however, was conceptually developed based on the existing data and standard processing requirements. The alternative consists of an on-site processing plant which can mill the roaster fines and a flotation circuit. Value of resource recovery is not quantifiable at present.

The plant capacity was assumed to be 100 tons/day for a design basis. A much larger plant would reduce processing times but higher capitalization costs and greater personnel requirements would result in approximately similar total cost.

Hydrometallurgical Processing

Hydrometallurgical processing involves the dissolution of metals into solution and the subsequent recovery by precipitation or plating. This technology requires much more data to be evaluated for implementability and effectiveness. It is not feasible within the scope of the present study and data to estimate its costs for application at this site.

Cost estimates for the reprocessing alternative were not developed because, based on information that is available, the cost for this option is expected to be comparatively high in relation to the other options. If treated by flotation or hydrometallurgy, capital cost would include a treatability study, plant design, site evaluation and preparation, construction of buildings, support equipment, and final disposal of material. The O&M for flotation or hydrometallurgy are high due to the long processing times. There may be an approximate equal tradeoff between operation and maintenance and capitalization for flotation and hydrometallurgy processing. Approximately doubling the plant size will decreases the O&M by 50 percent, but the capital costs will increase by approximately the decrease in the O&M costs.

If chosen, a smelter would produce a disposable slag. Operation and maintenance costs are high with respect to the other options.

This is due to the sophistication of the management, operation and support personnel needed for a smelter.

If a larger plant is constructed to decrease the processing times and, therefore, lower the cost of O&M, the capitalization costs higher.

7. OPTION D, REMOVAL AND OFF-SITE DISPOSAL OF ROASTER FINES AND MILL TAILINGS

This option consists of removal, transportation, and disposal of the roaster fines and/or mill tailings at an off-site landfill facility. Because of the high metals content and Toxicity Characteristic Leaching Procedure (TCLP) data, it was determined that the waste would have to be disposed of at a hazardous waste landfill. A confirmed landfill was not determined, however, several different sites were evaluated. The landfill site assumed for cost estimates is Envirocare of Utah.

Requirements for excavation, dewatering, and water treatment for this option are the same as with other options involving excavation. The roaster fines and/or mill tailings would be excavated and then dried before hauling to the hazardous waste landfill. Landfills impose moisture content before acceptance of waste material. Therefore, after excavation and surface drying, an amendment such as fly ash would be used to dry the waste to an acceptable level and so that the waste would not give up free moisture during hauling. Approximately 40 percent of fly ash by dry weight of the waste was assumed needed to dry the material to an acceptable level before transporting it to a waste facility. The fly ash could be mixed with the waste in a pugmill and or by other means.

The waste material would be taken to a selected landfill facility by means of trucking it to a rail head and then transporting the material by use of a rail system. After the roaster fines and mill tailings were removed from the site, all disturbed/excavated areas would require backfilling and reshaping, as with other options involving excavation.

The cost estimates included in Appendix A are for the "dry" method of excavation. The "wet" method of excavation would change the cost of this option an amount similar to the difference between "dry" and "wet" excavation for option A.

8. OPTION F, ENCAPSULATION OF ROASTER FINES AND MILL TAILINGS

This option involves excavating, amending, and then placing the roaster fines and mill tailings back into the mine workings. Three methods of placing the mine waste back into the mine workings were considered:

1) drilling and pumping the roaster fines and mill tailings in slurry form below the mine's water table

2) opening up the abandoned Extenuate adit, and pumping the roaster fines and mill tailings in slurry form into the mine workings above the water table

3) transporting the mine waste in dry form into the mine workings and placing it above the water table.

Method No. 1 consists of pumping the mine waste through drilled holes into existing slopes. This method would require a drilling program to locate the mine stopes. Methods No. 2 and 3 include costs to reopen the Extenuate adit and perform underground operations in accordance with current standards. The cost estimate for method No. 3 assumes transporting the waste into the mine workings using a rail car system.

Both the first and second method of this option involve converting the roaster fines and mill tailings into a slurry consistency and pumping the waste material inside the existing mine workings. Before pumping the waste material, it would be amended with an alkaline additive and stabilized using portland cement. This process is defined as paste technology. The waste material is converted into a paste which is approximately 80 percent solids and 20 percent moisture by weight. Typical amendments that can be used are cement, cement/fly ash, and a proprietary binder.

The processing rate for this method would be approximately 1000 tons/day on a 24 hour operation. A treatability testing regime would be required to determine mixing ratios of amendments, materials and moisture prior to design of a treatment plant.

The third method involves stabilizing the roaster fines and mill tailings with a binding agent such as fly ash or cement dust, and disposing the material into abandoned mine openings accessible above the water table. The waste material would be conveyed to the point of deposition using conventional earthwork materials handling equipment.

The three methods of the encapsulation option include the following:

(1) moving the waste materials to a central processing area

(2) construction of a treatment plant and silos for storage of the mill tailings, roaster fines, and amendments

(3) piping, positive displacement pumps, and a mixer for the first and second methods

(4) rail system and mixer for the third method

(5) rehabilitation of the mine workings to deliver the encapsulated material for the second and third method.

The cost estimates included in Appendix A are for the "dry" method of excavation. The "wet" method of excavation would change the cost of this option an amount similar to the difference between "dry" and "wet" excavation for option A.

9. OPTION G, IN-PLACE MINE WASTE ROCK RECLAMATION

The mine waste rock piles being considered are within the boundaries of the Wellington-Oro Mine site and the Extenuate site. There are two variations of this option, in-place reclamation of the waste rock using 3H:1V side slopes and in-place reclamation using 2H:1V side slopes (See figures 13 through 16). Both variations involve shaping, some cut and fill of the waste rock, and surface water control. Both variations also include a simple geomembrane and natural material surface cover/cap for the top portion of the waste rock piles (see figure 12, with the exception of there being a 10-inch sand layer instead of the 6-inch sand layer shown). Slope of the top portion of the waste rock piles would be maintained at about 5 percent.

The 3H:1V side slope version entails a simple geomembrane and natural material surface cover/cap for both the top and side slopes of the mine waste rock piles.

The 2H:1V side slope version includes a simple geomembrane and natural material surface cover/cap for the top of the mine waste rock piles and stabilizing the 2H:1V side slopes using an amendment such as cement with fly ash or a proprietary mixture. The benefit of treating the slope material by mixing it with an amendment is to stabilize the slope and reduce infiltration

potential, therefore reducing the acid generation potential and mobility of metals within the waste rock.

Shaping of the piles would help to limit surface water infiltration, reduce erosion, and provide a suitable subgrade for the surface cover materials. The cover/cap materials would consist of a sand layer, and a gravel/cobble layer or the more inert mine waste rock if available. Surface water control would include drainage ditches for diverting water around and away from the waste rock piles.

In development of quantities for the cost estimates, the mine waste rock piles were reshaped to balance cut and fill, and reflect the current configurations of the piles. The toe of the W-O waste rock pile was assumed to be moved 20 feet back from the French Gulch road. The shape around the Wellington mill foundation was retained to reflect the current appearance.

10. OPTION H, IN-PLACE SHAPING AND COVERING OF ROASTER FINES AND MILL TAILINGS

This option entails covering the roaster fines and mill tailings piles in their existing state using a simple cover design. This option is fundamentally different from the other options in that this option does not isolate the wastes from the surface and ground water. Included in this design is shaping and drainage control. Ditches would be constructed to divert surface water away from the piles. Included at the toe of the roaster fines pile is an 8-foot-wide runoff ditch for conveying road ditch flows past the roaster fines pile. This option also does not reduce the infiltration of surface water from rain and snowmelt which falls directly onto the roaster fines and mill tailings piles.

Some excavation and moving of materials would be required. The smaller roaster fines pile just west of the main roaster fines pile would be excavated to natural ground and added onto the main roaster fines pile, which would then be shaped. The north mill tailings would require some filling and minor shaping. Existing materials surrounding the north mill tailings could be used for this. The south mill tailings area would require some moving and concentration of waste materials before filling and final grading. The small amount of mill tailings on both sides of the Country Boy Mine Road would be excavated and moved to the main portion of the south mill tailings area, approximately 300 feet west of the Country Boy Mine Road. Before placing the simple cover on top of the roaster fines and mill tailings, the

piles would be filled in and then shaped to obtain a maximum of 2H:1V side slopes.

After shaping of the mine waste piles has been completed, the cover material would be placed. The roaster fines and north mill tailings would be covered by a simple cover consisting of a 6-inch sand layer and a 1-1/2-foot gravel and cobble layer. The south mill tailings would be brought to designed final grade using the gravel and cobble material in the immediate area, having a minimum of 1-1/2 feet of cover material.

REFERENCES

[1] "Wellington-Oro Mine, French Gulch, Proposed Evaluation of Surface Waste Cleanup," Prepared for the U.S. Environmental Protection Agency, Region VIII Superfund Prevention Assessment and Emergency Response Program Denver, Colorado, Prepared by U.S. Bureau of Reclamation Technical Service Center, August 16, 1996.

[2] "Preliminary Assessment, Wellington-Oro Mine Site, Summit County, Colorado, TDD #T08-9507-504, CERCLIS ID #CO0001093392," Prepared for the U.S. Environmental Protection Agency, Region VIII, Denver, Colorado, Pat Smith, Site Assessment Manager, Prepared by Ecology and Environment, Inc., Technical Assistance Team, Sabrina Forrest, Project Manager, August 1, 1995.

[3] "Ground-Water Hydrology Characterization, French Gulch Mine Pool, Breckenridge, Colorado," Prepared for the U.S. Environmental Protection Agency, Region VIII, Prepared by Arthur M. Morrissey, Consulting Geologist, 721 S. Moline St., Aurora, Colorado, April, 1995.

[4] "French Gulch Nonpoint Source Project Case History, Final Draft, Contract No. 68-W2-0026, Work Assignment No. 15-II, SAIC Project No. 0-0857-07-1599-001," Prepared for the U.S. Environmental Protection Agency, Region VIII, Mining Waste Section, Prepared by Science Applications International Corporation, 999 18th Street, Suite 855, Denver, Colorado 80202, April, 1995.

[5] "Geologic Site Investigations for Surface Waste Cleanup, Wellington-Oro Mine," Breckenridge, Colorado, Bureau of Reclamation, December, 1996 (Draft).

[6] "Characterization of Heavy Metals Pollution Sources Associated with the Inactive Wellington-Oro Mine Complex, Summit County Colorado," B.K. Stevens, September 19, 1994.

Prepared by _____ 7/30/97

Peer Reviewed by _____ 7/28/97

FIGURES

FIGURE 1: WELLINGTON-ORO MILL SITE

FIGURE 2: EXTENUATE SITE

FIGURE 3: ROASTER FINES - PLAN VIEW

FIGURE 4: ROASTER FINES - SECTIONS

FIGURE 5: NORTH MILL TAILINGS - PLAN VIEW

FIGURE 6: NORTH MILL TAILINGS - SECTION

FIGURE 7: SOUTH MILL TAILINGS - PLAN VIEW

FIGURE 8: SOUTH MILL TAILINGS - PROFILE AND SECTIONS

FIGURE 9: SOUTH MILL TAILINGS - SHEET PILE CUTOFF WALL

FIGURE 10: MULTIPLE DEFENSE REPOSITORY LINER

FIGURE 11: MULTIPLE DEFENSE REPOSITORY CAP

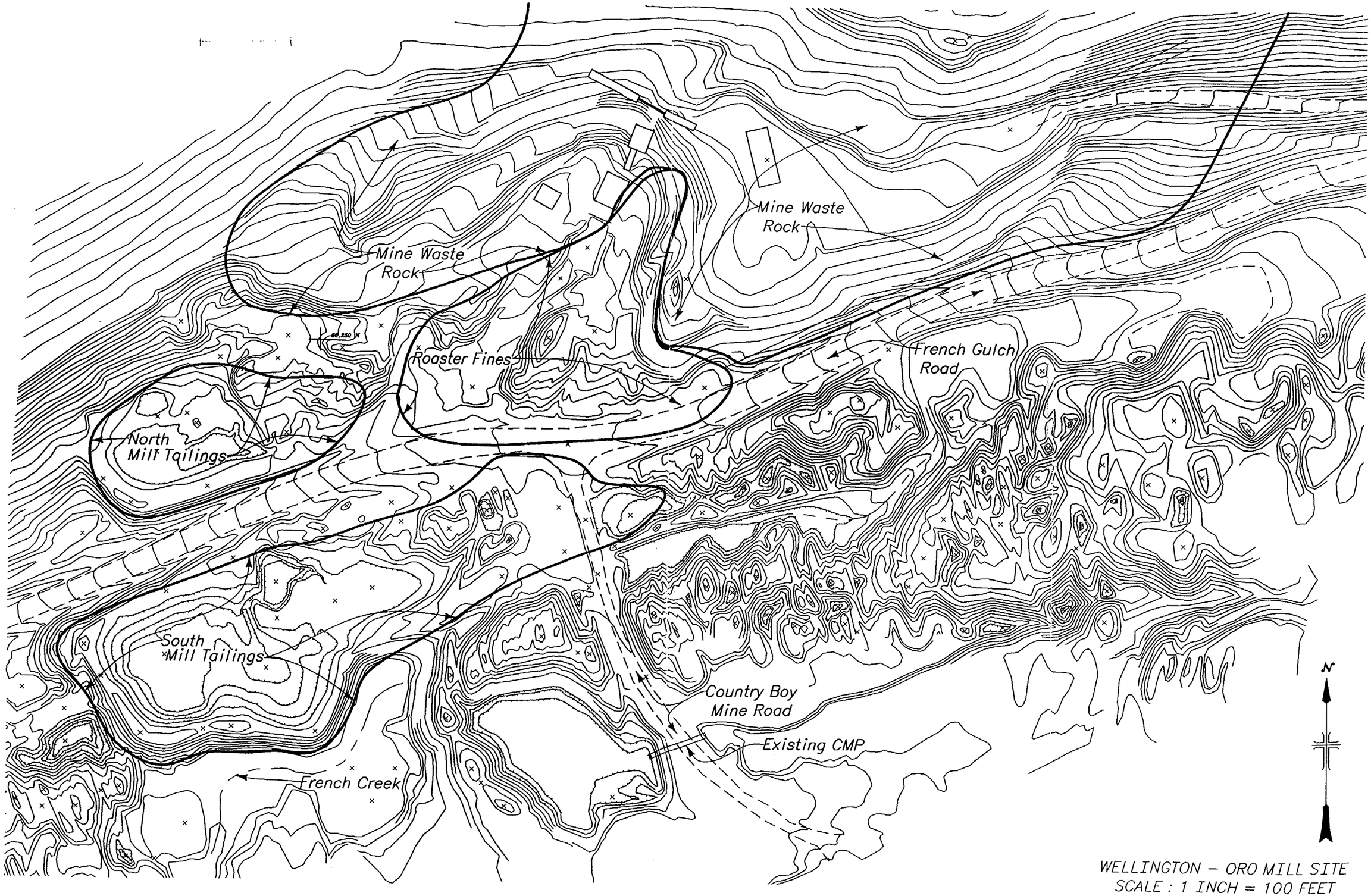
FIGURE 12: SIMPLE CAP REPOSITORY

FIGURE 13: EXTENUATE SITE - WASTE ROCK RECLAMATION

FIGURE 14: EXTENUATE SITE - WASTE ROCK RECLAMATION SECTIONS

FIGURE 15: WELLINGTON-ORO SITE - WASTE ROCK RECLAMATION

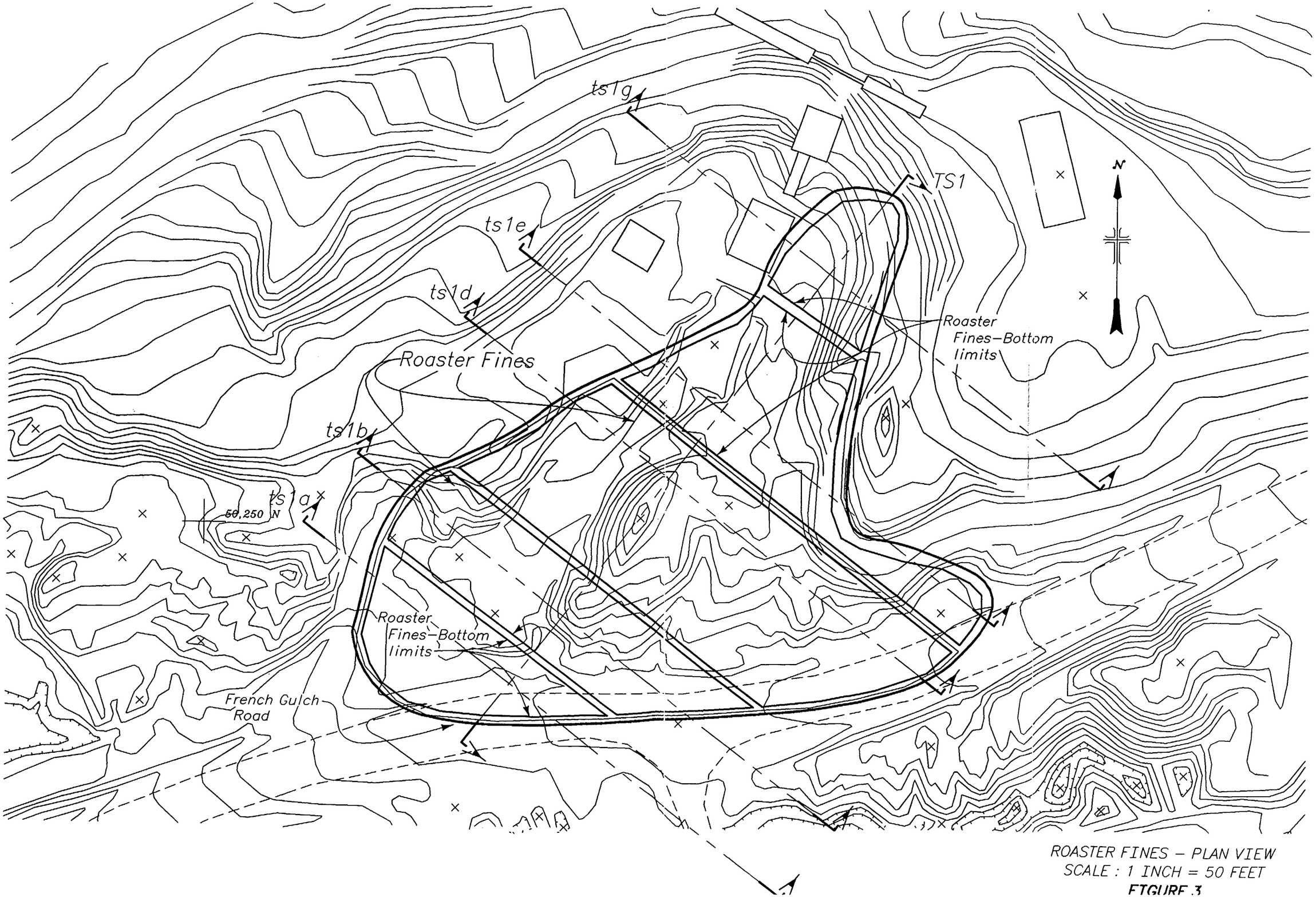
FIGURE 16: WELLINGTON-ORO SITE - WASTE ROCK RECLAMATION SECTIONS



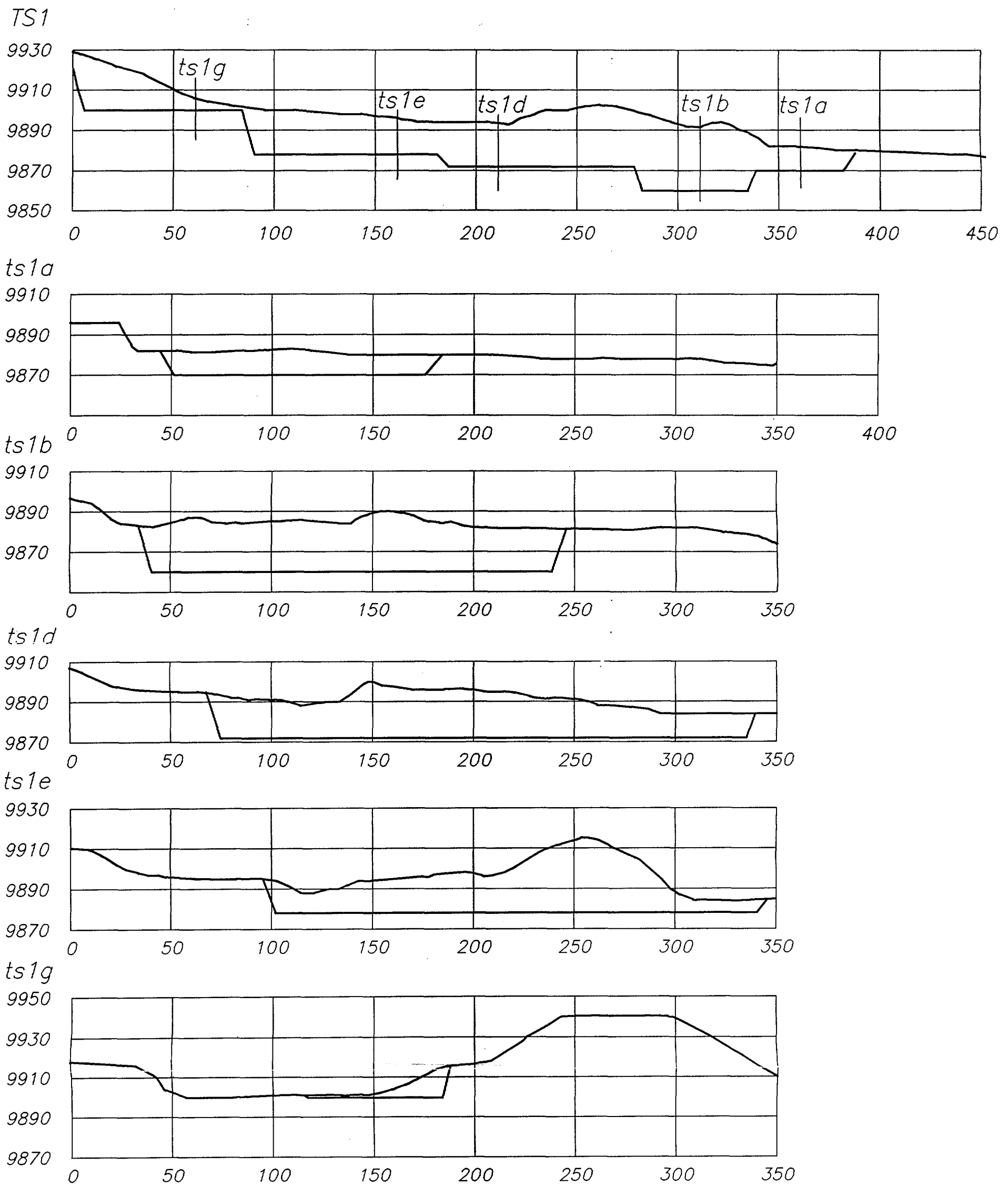
WELLINGTON – ORO MILL SITE
SCALE : 1 INCH = 100 FEET
FIGURE 1

EXTENUATE SITE
SCALE : 1 INCH = 100 FEET

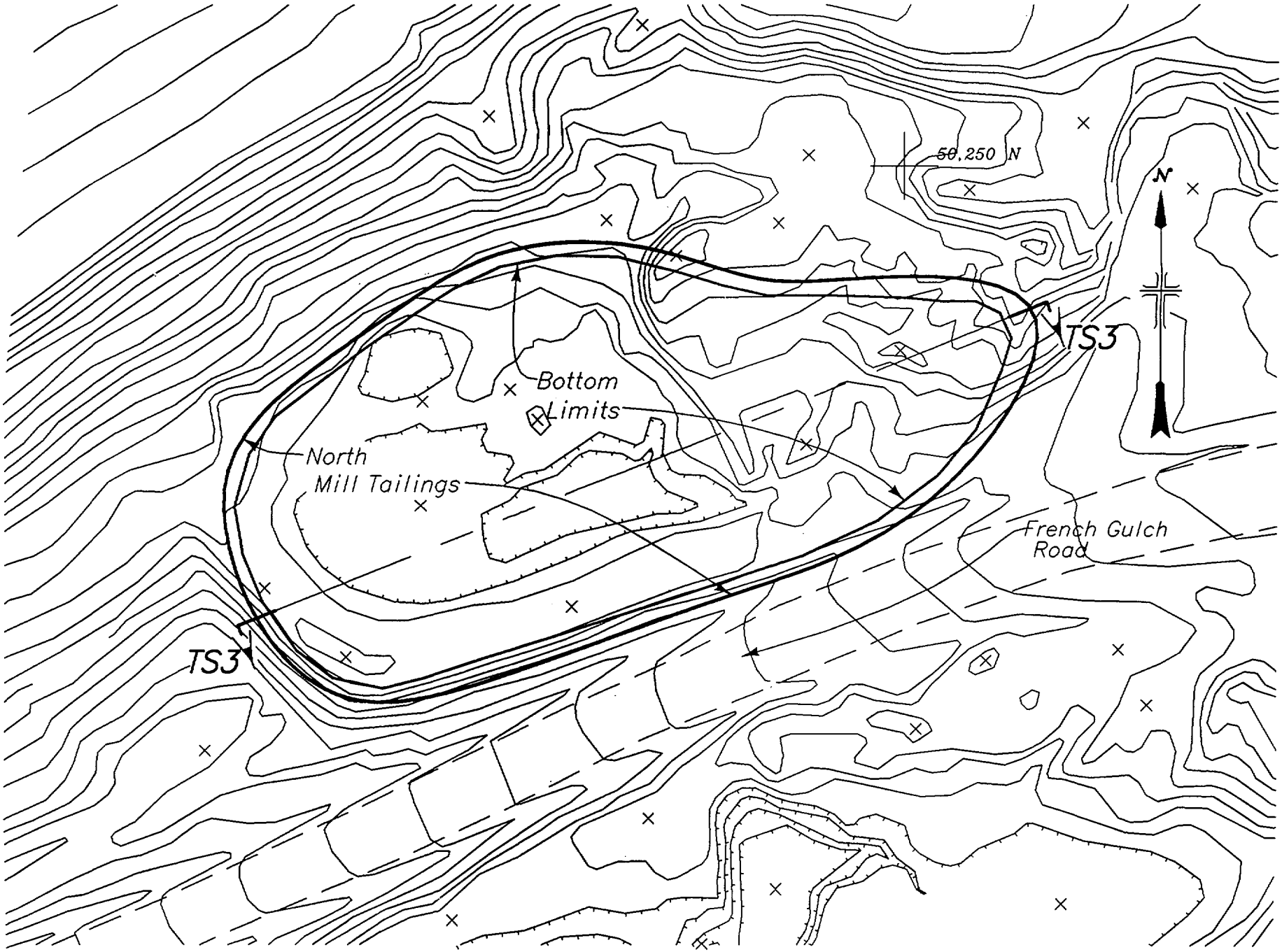
FIGURE 2



ROASTER FINES – PLAN VIEW
SCALE : 1 INCH = 50 FEET
FIGURE 3

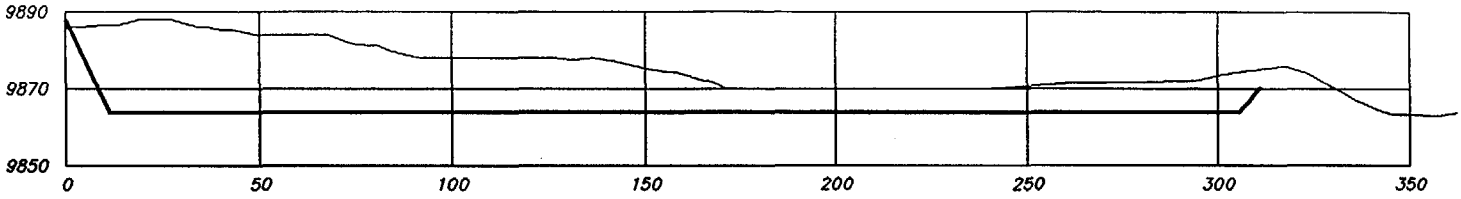


ROASTER FINES – SECTIONS
SCALE 1 INCH = 50 FEET
FIGURE 4



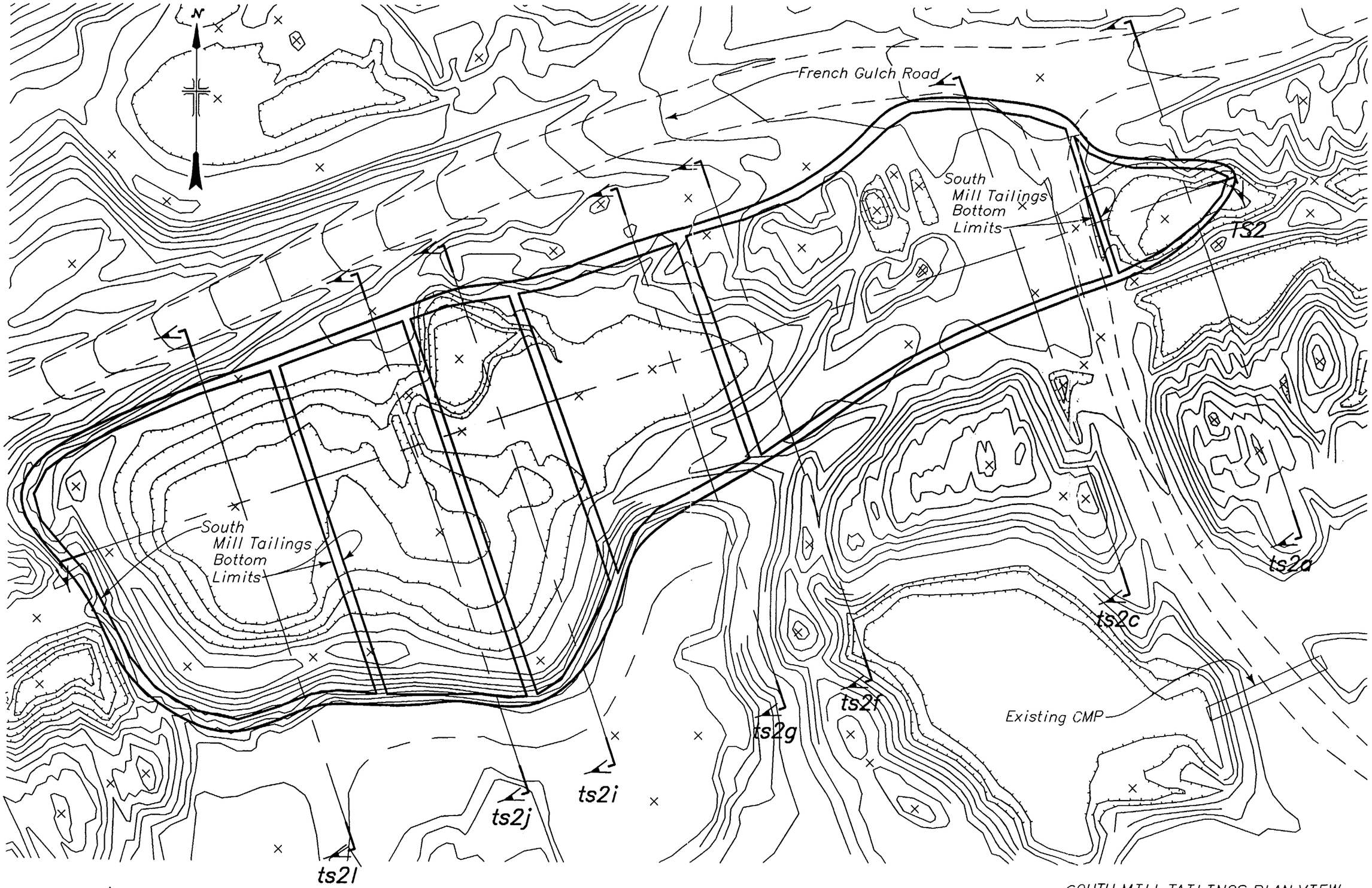
NORTH MILL TAILINGS – PLAN VIEW
SCALE: 1 INCH = 50 FEET

FIGURE 5



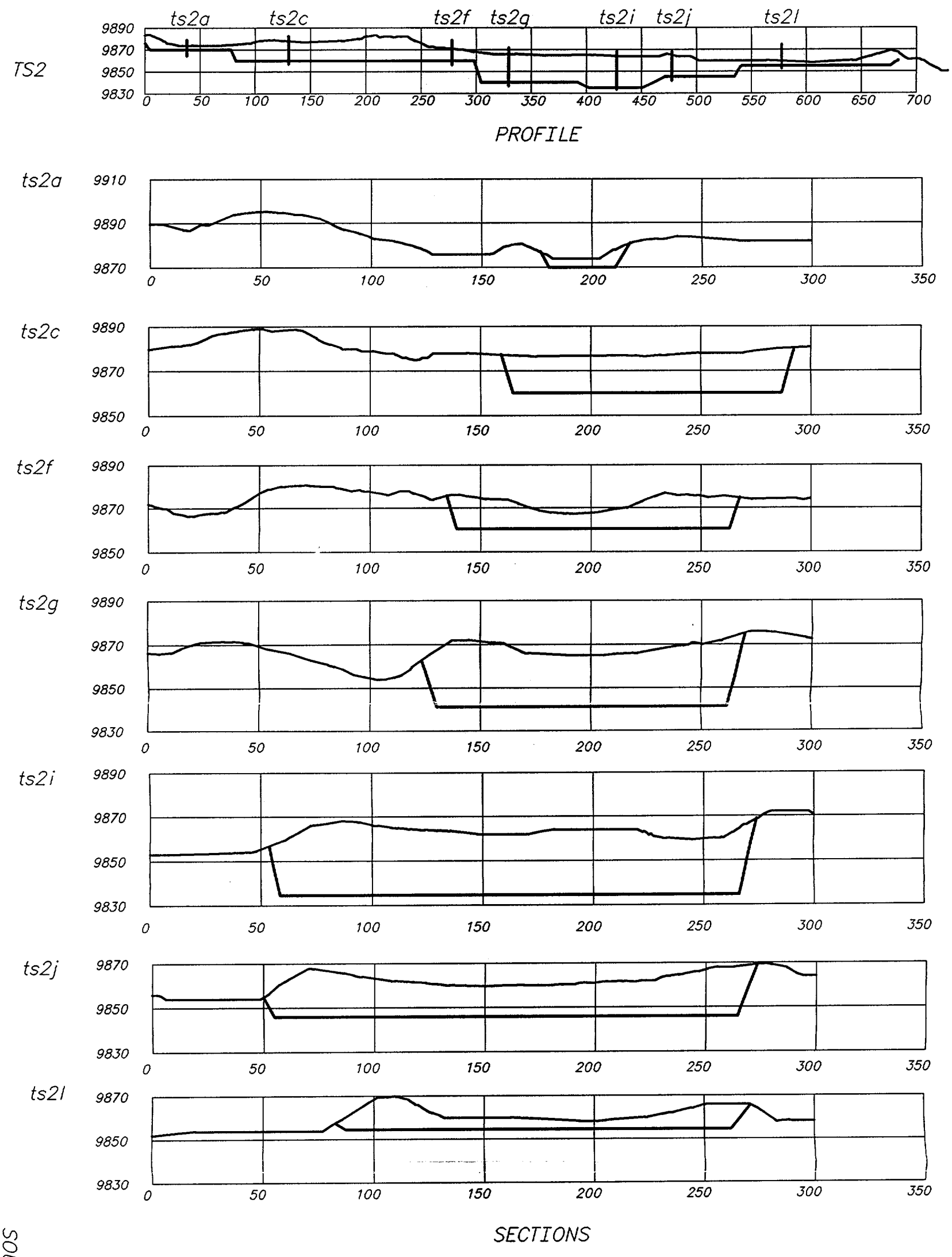
NORTH MILL TAILINGS – SECTION
SCALE : 1 INCH = 50 FEET

FIGURE 6



SOUTH MILL TAILINGS PLAN VIEW
SCALE : 1 INCH = 50 FEET

FIGURE 7

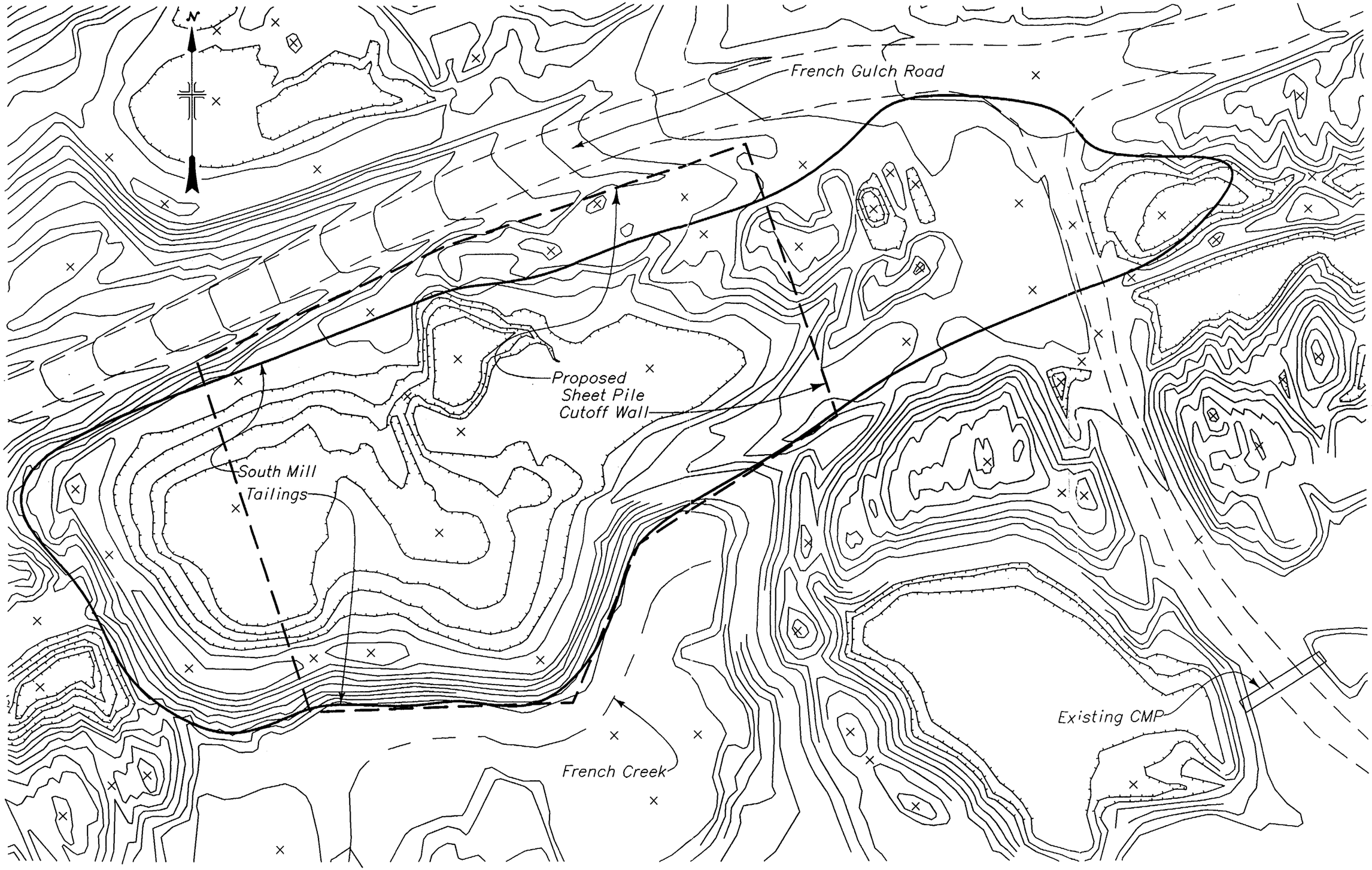


SOUTH MILL TAILINGS

SCALE : 1 INCH = 100 FEET = PROFILE

SCALE : 1 INCH = 50 FEET = SECTIONS

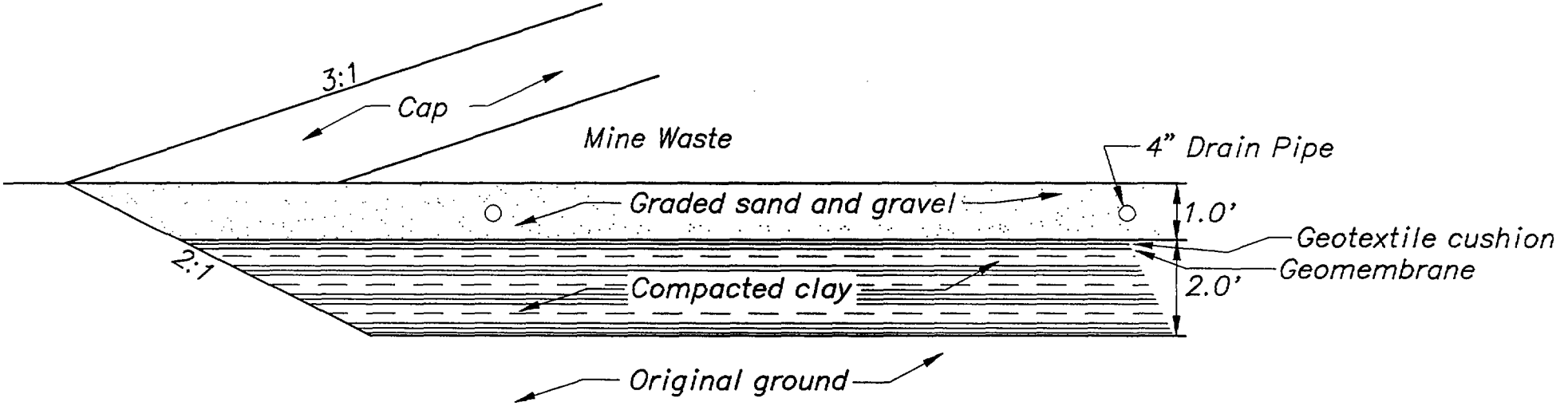
FIGURE 8



SOUTH MILL TAILINGS – SHEET PILE CUTOFF WALL
SCALE : 1 INCH = 50 FEET

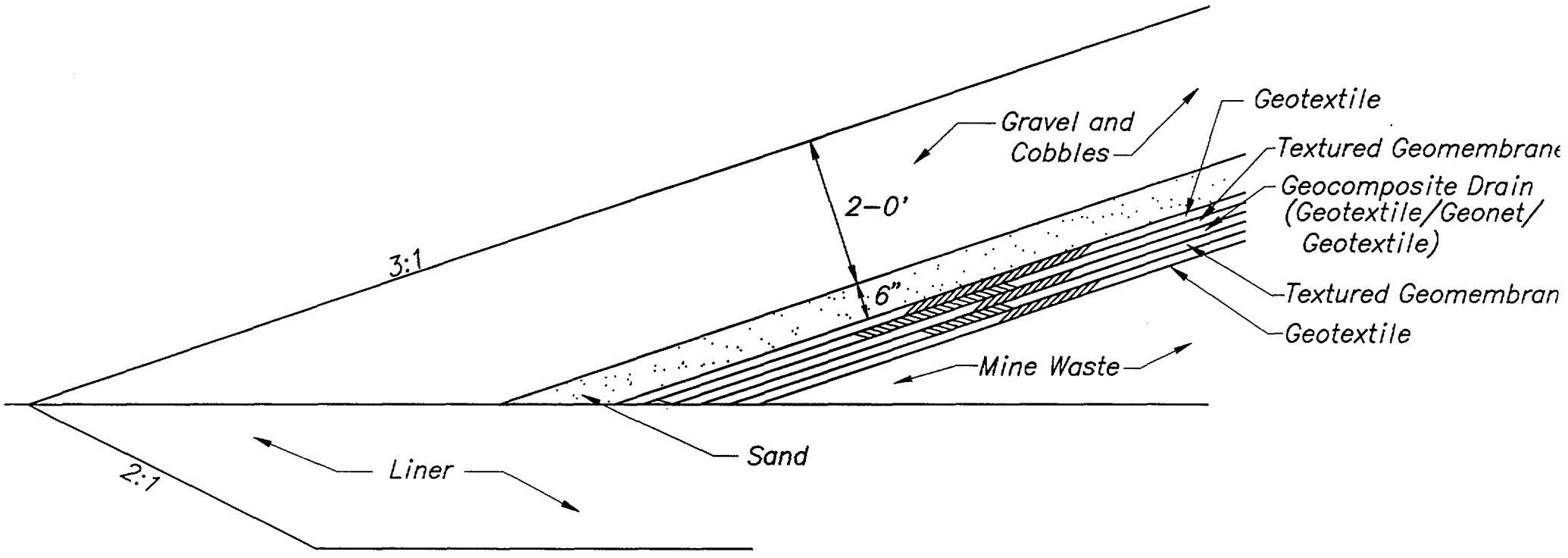
FIGURE 9

Note: Graded sand and gravel drainage blanket to include 4" perforated pipe on 10-foot-on-center grid pattern

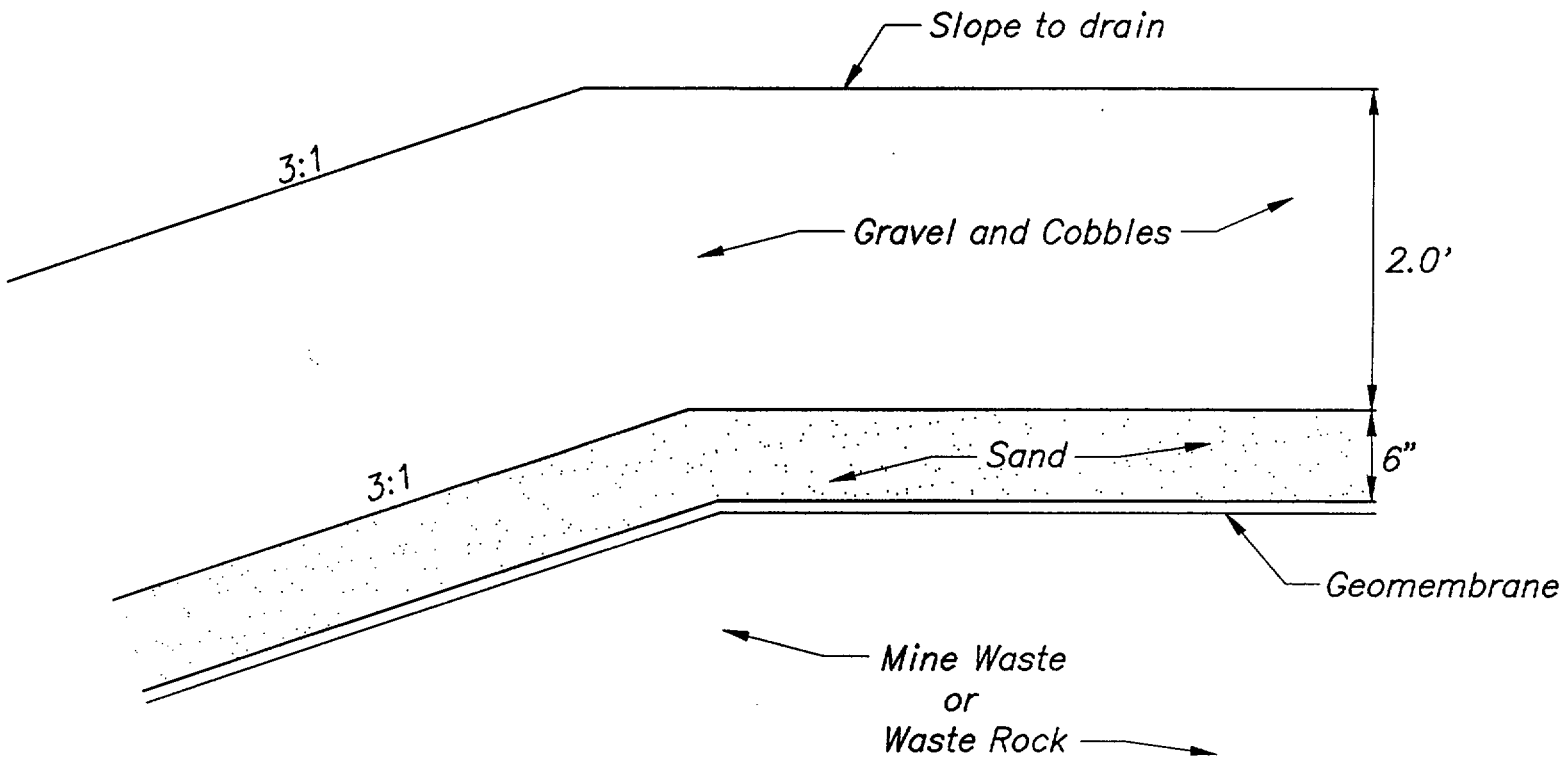


MULTIPLE DEFENSE REPOSITORY LINER

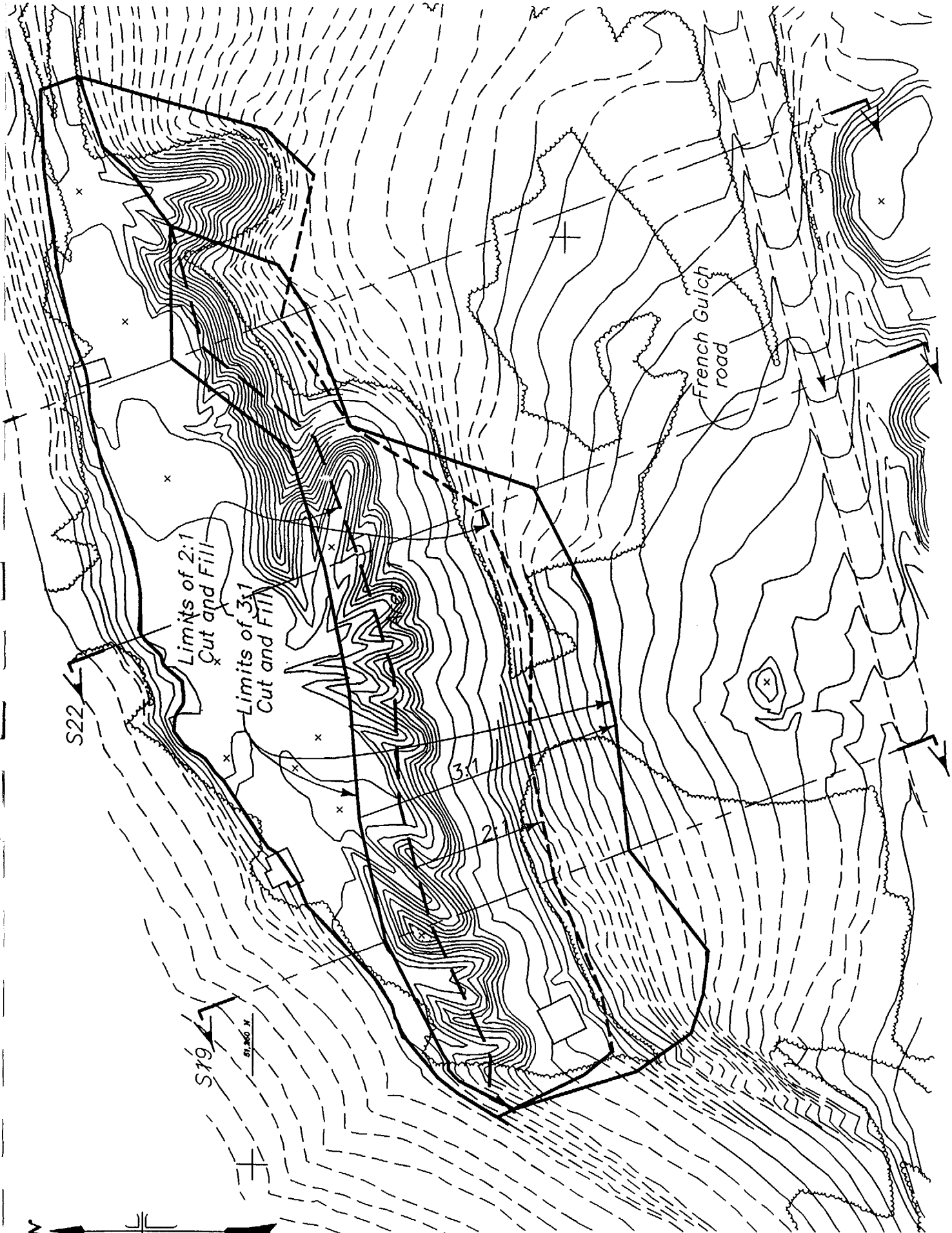
FIGURE 10



MULTIPLE DEFENSE
REPOSITORY CAP
FIGURE 11

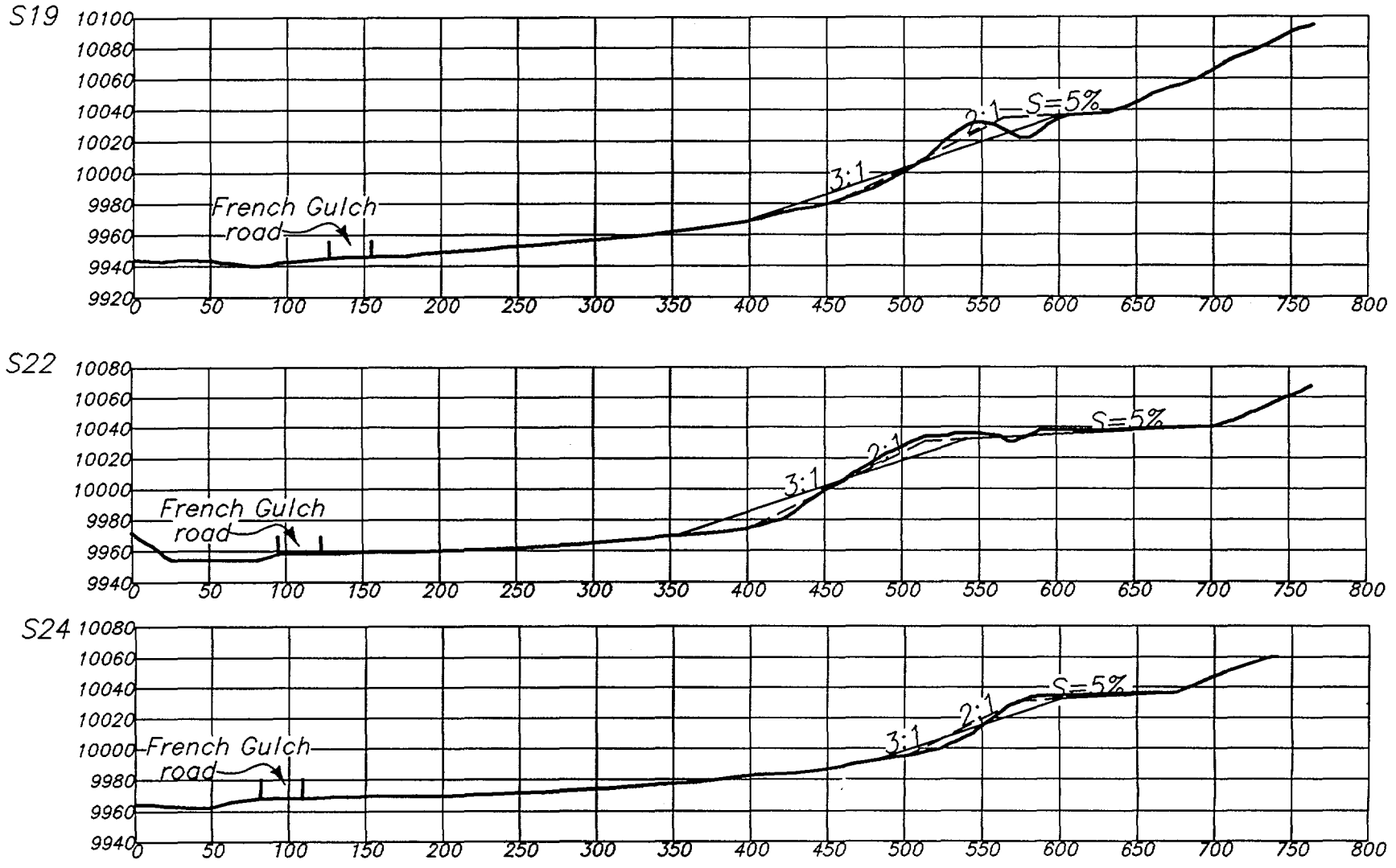


SIMPLE CAP
REPOSITORY
FIGURE 12



EXTENUATE SITE – WASTE ROCK RECLAMATION
SCALE : 1 INCH = 100 FEET

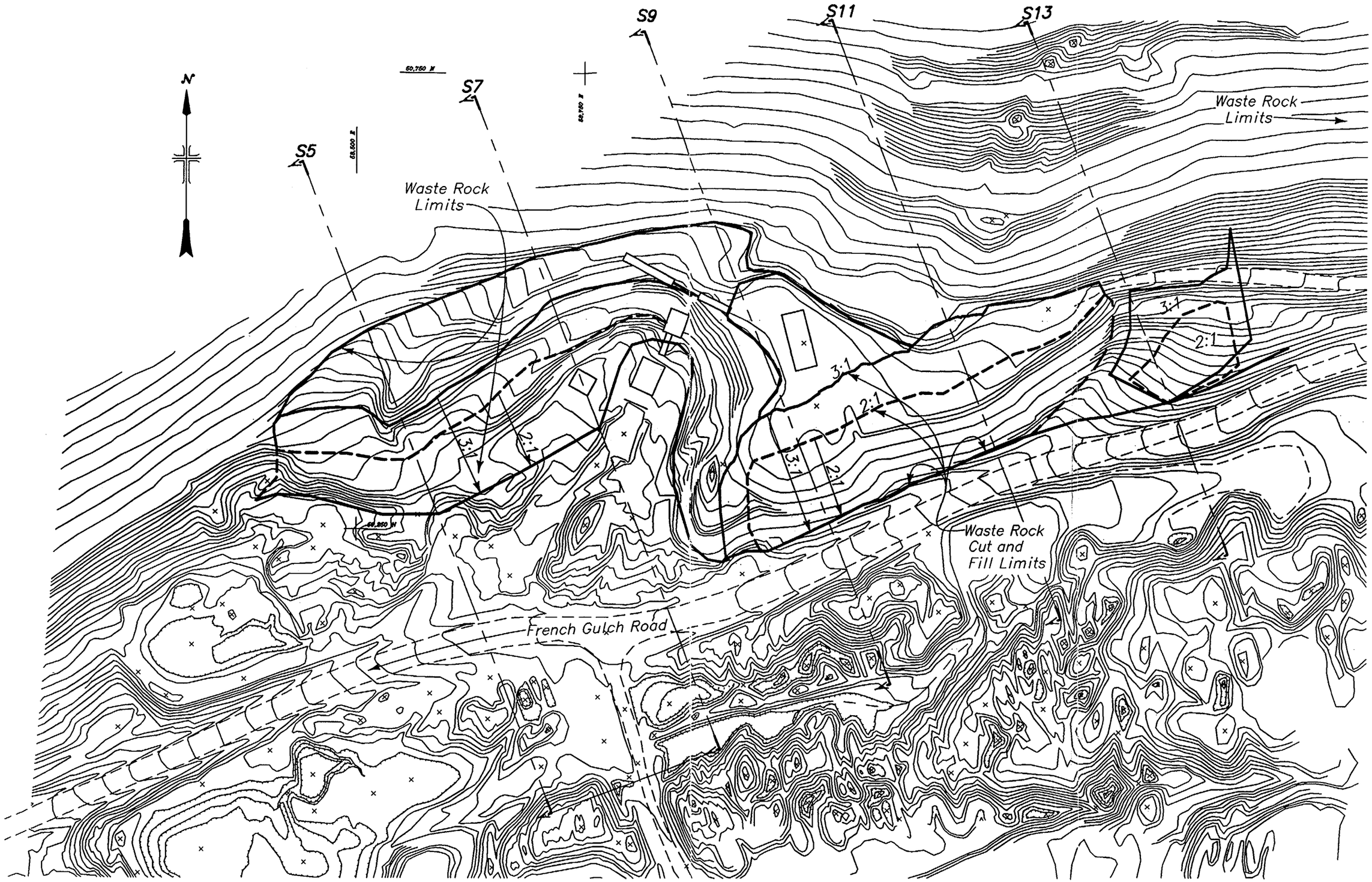
FIGURE 13



EXTENUATE SITE – WASTE ROCK RECLAMATION SECTIONS

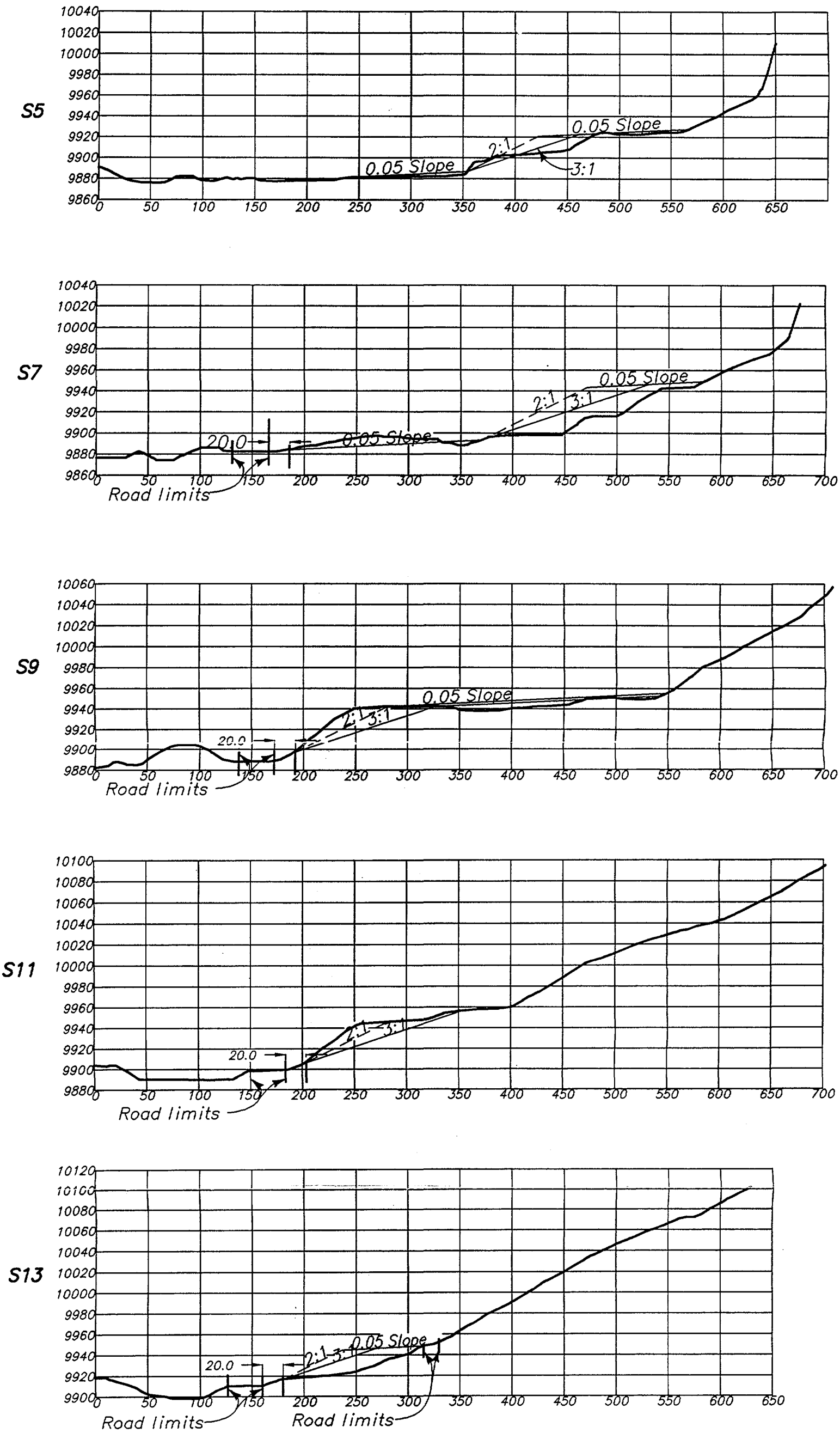
SCALE : 1 INCH = 100 FEET

FIGURE 14



WELLINGTON ORO SITE – WASTE ROCK RECLAMATION
SCALE : 1 INCH = 100 FEET

FIGURE 15



WELLINGTON ORO SITE
WASTE ROCK RECLAMATION SECTIONS
SCALE : 1 INCH = 100 FEET

FIGURE 16

SUMMARY TABLES OF FIELD COSTS

TABLE 1: Module Costs

TABLE 2: Repository Option Costs

TABLE 3: Stabilized Repository Option Costs

TABLE 4: Off-Site Disposal Option Costs

TABLE 5: Encapsulation in Mine Workings Option Costs

TABLE 6: In-Place Waste Rock Reclamation Option Costs

TABLE 7: In-Place Shaping and Covering of Roaster Fines and Mill Tailings Costs

SUMMARY TABLES OF FIELD COSTS

Table 1

Module Costs

MODULE	COST
MODULE 1 - SOUTH MILL TAILINGS DEWATERING	$1,501,700
MODULE 2 - ROASTER FINES DEWATERING	$56,600
MODULE 3 - "DRY" EXCAVATION OF MILL TAILINGS	$504,000
MODULE 4 - "DRY" EXCAVATION OF ROASTER FINES	$315,000
MODULE 5 - "WET" EXCAVATION OF MILL TAILINGS	$694,000
MODULE 6 - "WET" EXCAVATION OF ROASTER FINES	$510,500

Table 2

Repository Option Costs

OPTION	TOTAL FIELD COST
OPTION A1 - ON-SITE REPOSITORY OF MILL TAILINGS AND ROASTER FINES - MULTIPLE DEFENCE CAP AND LINER - DRY EXCAVATION	$5,600,000
OPTION A2 - ON-SITE REPOSITORY OF MILL TAILINGS AND ROASTER FINES - SIMPLE CAP - DRY EXCAVATION	$4,600,000
OPTION A3 - ON-SITE REPOSITORY OF ROASTER FINES - MULTIPLE DEFENCE CAP AND LINER - DRY EXCAVATION	$1,550,000
OPTION A4 - ON-SITE REPOSITORY OF MILL TAILINGS - MULTIPLE DEFENCE CAP AND LINER - DRY EXCAVATION	$4,300,000
OPTION A5 - ON-SITE REPOSITORY OF ROASTER FINES - SIMPLE CAP - DRY EXCAVATION	$1,050,000
OPTION A6 - ON-SITE REPOSITORY OF MILL TAILINGS - SIMPLE CAP - DRY EXCAVATION	$3,700,000
OPTION A7 - ON-SITE REPOSITORY OF MILL TAILINGS AND ROASTER FINES - MULTIPLE DEFENCE CAP AND LINER - WET EXCAVATION	$3,800,000
OPTION A8 - ON-SITE REPOSITORY OF MILL TAILINGS AND ROASTER FINES - SIMPLE CAP - WET EXCAVATION	$2,800,000

OPTION	TOTAL FIELD COST
OPTION A9 - ON-SITE REPOSITORY OF ROASTER FINES - MULTIPLE DEFENCE CAP AND LINER - WET EXCAVATION	$1,800,000
OPTION A10 - ON-SITE REPOSITORY OF MILL TAILINGS - MULTIPLE DEFENCE CAP AND LINER - WET EXCAVATION	$2,300,000
OPTION A11 - ON-SITE REPOSITORY OF ROASTER FINES - SIMPLE CAP - WET EXCAVATION	$1,250,000
OPTION A12 - ON-SITE REPOSITORY OF MILL TAILINGS - SIMPLE CAP - WET EXCAVATION	$1,700,000

Table 3

Stabilized Repository Option Costs

OPTION	TOTAL FIELD COST
OPTION B1 - ON-SITE REPOSITORY OF STABILIZED MILL TAILINGS AND ROASTER FINES	$7,600,000
OPTION B2 - ON-SITE REPOSITORY OF STABILIZED ROASTER FINES	$2,400,000
OPTION B3 - ON-SITE REPOSITORY OF STABILIZED MILL TAILINGS	$5,400,000

Table 4

Off-Site Disposal Option Costs

OPTION	TOTAL FIELD COST
OPTION D1 - REMOVAL AND OFF-SITE DISPOSAL OF ROASTER FINES AND MILL TAILINGS	$44,000,000
OPTION D2 - REMOVAL AND OFF-SITE DISPOSAL OF ROASTER FINES	$18,500,000
OPTION D3 - REMOVAL AND OFF-SITE DISPOSAL OF MILL TAILINGS	$26,000,000

Table 5

Encapsulation in Mine Workings Option Costs

OPTION	TOTAL FIELD COST
OPTION F1A - ENCAPSULATION OF ROASTER FINES AND MILL TAILINGS IN MINE WORKINGS, DRY FORM - ABOVE WATER TABLE OF EXTENUATE SITE	$9,500,000
OPTION F1B - ENCAPSULATION OF ROASTER FINES AND MILL TAILINGS IN MINE WORKINGS, SLURRY FORM - ABOVE WATER TABLE OF EXTENUATE SITE	$10,000,000
OPTION F2 - ENCAPSULATION OF ROASTER FINES AND MILL TAILINGS IN MINE WORKINGS, SLURRY FORM - BELOW WATER TABLE OF WELLINGTON-ORO SITE	$10,000,000

Table 6

In-Place Waste Rock Reclamation Option Costs

OPTION	TOTAL FIELD COST
OPTION G1 - IN-PLACE WASTE ROCK RECLAMATION, PARTIAL CAP AND 2:1 SLOPES FOR EXTENUATE SITE	$550,000
OPTION G2 - IN-PLACE WASTE ROCK RECLAMATION, 3:1 SLOPES FOR EXTENUATE SITE	$810,000
OPTION G3 - IN-PLACE WASTE ROCK RECLAMATION, PARTIAL CAP AND 2:1 SLOPES FOR WELLINGTON-ORO SITE	$480,000
OPTION G4 - IN-PLACE WASTE ROCK RECLAMATION, 3:1 SLOPES FOR WELLINGTON-ORO SITE	$690,000

Table 7

In-Place Shaping and Covering of Roaster Fines and Mill Tailings

OPTION	TOTAL FIELD COST
OPTION H1 - IN-PLACE ROASTER FINES, SHAPING AND COVERINGS	$78,000
OPTION H2 - IN-PLACE SOUTH MILL TAILINGS, SHAPING AND COVERING	$110,000
OPTION H3 - IN-PLACE NORTH MILL TAILINGS, SHAPING AND COVERING	$66,000

APPENDIX A

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

South Mill Tailings Dewatering Module No. 1

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: J:\123R31\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Clearing and grubbing for stream diversion		0.75	ACRE	$4,000.00	$3,000
	2	Excavate and shape diversion pipe alignment		1,800	YD3	$8.00	$14,400
	3	Furnish and install 48-inch CMP diversion pipe		750	LF	$60.00	$45,000
	4	Furnish and install sheet pile wall around portion of Mill Tailings to be dewatered (1,070-foot long wall, 35-foot long piles, PZ27 piles)		506	TONS	$2,500.00	$1,265,000
	5	Furnish and install 10-inch diameter wells with 6-inch diameter well screen, including gravel pack and surface casing (10 to 35 feet deep wells)		350	FT	$180.00	$63,000
	6	Furnish and install submersible pumps (100 gpm capacity with 50-foot head)		10	EA	$1,500.00	$15,000
	7	Furnish and install 3-inch diameter PVC pipe to connect wells to manifold		1,500	FT	$12.00	$18,000
	8	Furnish and install 10-inch diameter PVC manifold and discharge line		350	FT	$18.00	$6,300
	9	Furnish and install 10-inch electronic flowmeter		1	EA	$2,000.00	$2,000
	10	Water treatment - remove 90% of metals, minimum 400 gpm capacity plant		7,000,000	GAL	$0.01	$70,000
		TOTAL (Module No. 1):					$1,501,700

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Roaster Fines Dewatering Module No. 2

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: J:\123R31\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Furnish and install 10-inch diameter wells with 6-inch diameter well screen, including gravel pack and surface casing (4 wells - 30 feet deep)		120	FT	$180.00	$21,600
	2	Furnish and install submersible pumps (100 gpm capacity with 50-foot head)		4	EA	$1,500.00	$6,000
	3	Furnish and install 3-inch diameter PVC pipe to connect wells to manifold		200	FT	$12.00	$2,400
	4	Furnish and install 8-inch diameter PVC manifold and discharge line		300	FT	$16.00	$4,800
	5	Furnish and install 8-inch diameter PVC electronic flowmeter		1	EA	$1,800.00	$1,800
	6	Water treatement - remove 90% of metals, minimum 200 gpm capacity plant (Treatment cost from RH&A)		2,000,000	GAL	$0.01	$20,000
		TOTAL (Module No. 2):					$56,600

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

"Dry" Excavation Of Mill Tailings
Module No. 3

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: J:\123R31\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Excavate North Mill Tailings		13,000	YD3	$5.00	$65,000
		(Assume 1/4-mile haul to "processing" area)					
	2	Excavate contaminated South Mill Tailings - to groundwater surface		18,000	YD3	$5.00	$90,000
		(Assume 1/4-mile haul to "processing" area)					
	3	Screen South Mill Tailings from dredger cobble - one screen size - sand size and below contaminated		26,000	YD3	$4.50	$117,000
	4	Dispose of oversize from screening at local disposal - No special handling; 15% (4,000 yd3 contaminated) to Mill Tailings disposal		22,000	YD3	$3.00	$66,000
	5	Mill Tailings disposed		4,000	YD3	$4.00	$16,000
	6	Excavate South Mill Tailings below previous groundwater table after construction at sheet pile cutoff wall and dewatering		20,000	YD3	$7.00	$140,000
		(Assume 1/4-mile haul to "processing" area)					
	7	Reshape Mill Tailings excavation area - No special requirements, will leave "bowl", material from immediate area		5,000	YD3	$2.00	$10,000
		Note: Net volume of Mill Tailings = 55,000 yd3					
		TOTAL (Module No. 3):					$504,000

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

"Dry" Excavation Of Roaster Fines
Module No. 4

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: J:\123R31\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Excavate Roaster Fines		43,000	YD3	$5.00	$215,000
		(Assume 1/4-mile haul to "processing" area)					
		Note: Assume that dewatering wells would be installed concurrently with or before excavation of upper portion of Roaster Fines - excavation of entire pile can be performed in one operation					
	2	Refill Roaster Fines excavation		25,000	YD3	$4.00	$100,000
		(Assume dredge tailings or other local material within 1/2-mile haul)					
		Note: *Varing estimate - backfill only to "average" ground surface					
		TOTAL (Module No. 4):					$315,000

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

"Wet" Excavation Of Mill Tailings - Module No. 5

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: J:\123R31\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Excavate North Mill Tailings		13,000	YD3	$5.00	$65,000
	2	Excavate contaminated South Mill Tailings to groundwater surface		18,000	YD3	$5.00	$90,000
	3	Screen South Mill Tailings from dredger cobble - one screen size - sand size and below considered contaminated		26,000	YD3	$4.50	$117,000
	4	Dispose of oversize from screening at local disposal - No special handling; 15% (4,000 yd3 contaminated) to Mill Tailings disposal		22,000	YD3	$3.00	$66,000
	5	Mill Tailings disposed		4,000	YD3	$4.00	$16,000
	6	Excavate South Mill Tailings below groundwater table. Transport saturated material 1/4-mile to centrifuge		20,000	YD3	$9.00	$180,000
	7	Centrifuge saturated material. "Dryed" material to Mill Tailings disposal		20,000	YD3	$7.00	$140,000
	8	Reshape Mill Tailings excavation area - No special requirements, will leave "bowl", material from immediate area)		5,000	YD3	$2.00	$10,000
	9	Treatment of water from centrifuge (Assume reductions from 45% water by volume to 20% water by volume)		1,000,000	GAL	$0.01	$10,000
		Note: Net volume of Mill Tailings = 55,000 yd3					
		TOTAL (Module No. 5)					$694,000

QUANTITIES		PRICES	
BY D Curran, D-8313 JRC	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

"Wet" Excavation of Roaster Fines
Module No. 6

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: J:\123R31\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Excavate Roaster Fines above water table -		26,000	YD3	$5.00	$130,000
		(Assume 1/4-mile haul to "processing" area)					
	2	Excavate saturated Roaster Fines		17,000	YD3	$9.00	$153,000
		(Assume 1/4-mile haul to centrifuge)					
	3	Centrifuge saturated material; "dryed" material		17,000	YD3	$7.00	$119,000
		to Roaster Fines disposal					
	4	Treatment of water from centrifuge		850,000	GAL	$0.01	$8,500
		(Assume reduction from 45% to 20% water by					
		volume)					
	5	Refill Roaster Fines excavation		25,000	YD3	$4.00	$100,000
		(Assume dredge tailings or other local material					
		within 1/2-mile haul)					
		TOTAL (Module No. 6):					$510,500

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A1
On-Site Repository of Mill Tailings And Roaster Fines - Multiple Defense Cap and Liner - Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$185,000.00	$185,000
	2	Stream diversion and dewatering of South Mill Tailings (See Module No. 1)		1	LS	$1,501,700.00	$1,501,700
	3	Dewatering of Roaster Fines (See Module No. 2)		1	LS	$56,600.00	$56,600
	4	Excavation of Mill Tailings (See Module No. 3)		1	LS	$504,000.00	$504,000
	5	Excavation of Roaster Fines (See Module No. 4)		1	LS	$315,000.00	$315,000
	6	Furnish calcium carbonate, 0.5% by dry weight (Assume 1 yd3 = 1.5 tons)		735	TONS	$70.00	$51,450
	7	Apply calcium carbonate to repository surface		20,000	SY	$0.35	$7,000
	8	Clearing and grubbing repository area		4.3	ACRE	$5,000.00	$21,500
	9	Excavate repository pad area 2 feet deep		13,000	YD3	$4.00	$52,000
	10	Construct liner (Assume all material impervious soil processed from excavation or source within 1 mile of site, granular material from commercial source within 4 miles of site)		175,000	FT2		
		Clay and Sand		19,500	SY	$12.00	$234,000
		Liner		19,500	SY	$7.50	$146,250
	11	Place Roaster Fines and Mill Tailings in repository - 3-foot lifts, 4 passes of a specified roller (Assume 10% shrinkage)		88,000	YD3	$3.00	$264,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TMB	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A1
On-Site Repository of Mill Tailings And Roaster Fines - Multiple Defense Cap and Liner - Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	12	Construct cap (Assume sand from commercial		180,000	FT2		
		source within 4 miles, cobble obtained within					
		1 mile)					
		F/P gravel		13,400	YD3	$4.50	$60,300
		F/P sand		3,400	YD3	$13.00	$44,200
		F/P 5 geosynthetic layers		20,000	SY	$15.70	$314,000
	13	Road and traffic control during construction		1	LS	$71,000.00	$71,000
		(Assume 3 months)					
	14	Removal of French Creek diversion pipeline and		750	FT	$50.00	$37,500
		restoration of stream channel					
		Subtotal					$3,865,500
		Unlisted Items (15%)					$534,500
		Contract Cost					$4,400,000
		Contingencies (25%)					$1,200,000
		Field Cost					$5,600,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TAD	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A2
On-Site Repository Of Mill Tailings And Roaster Fines - Simple Cap
Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$150,000.00	$150,000
	2	Stream diversion and dewatering of South Mill Tailings (See Module No. 1)		1	LS	$1,501,700.00	$1,501,700
	3	Dewatering of Roaster Fines (See Module No. 2)		1	LS	$56,600.00	$56,600
	4	Excavation of Mill Tailings (See Module No. 3)		1	LS	$504,000.00	$504,000
	5	Excavation of Roaster Fines (See Module No. 4)		1	LS	$315,000.00	$315,000
	6	Furnish calcium carbonate, 0.5% by dry weight		735	TONS	$70.00	$51,450
	7	Apply calcium carbonate to repository surface		20,000	SY	$0.35	$7,000
	8	Clearing and grubbing repository area		4.3	ACRE	$5,000.00	$21,500
	9	Place Roaster Fines and Mill Tailings in repository - 3-foot lifts, 4 passes of a specified roller (Assume 10% shrinkage)		88,000	YD3	$3.00	$264,000
	10	Construct cap (Assume sand from commercial source within 4 miles, cobble obtained within 1 mile)		180,000	FT2		
		F/P gravel		13,400	YD3	$4.50	$60,300
		F/P sand		3,400	YD3	$13.00	$44,200
		F/P geomembrane		20,000	SY	$4.50	$90,000
	11	Road and traffic control during construction		1	LS	$71,000.00	$71,000
	12	Removal of French Creek diversion pipeline and restoration of stream channel		750	FT	$50.00	$37,500

QUANTITIES		PRICES	
BY D Curran, D-8313 TW	CHECKED	BY	CHECKED DLn 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A2
On-Site Repository Of Roaster Fines - Multiple Defense Cap And Liner
Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal					$3,174,250
		Unlisted Items (15%)					$525,750
		Contract Cost					$3,700,000
		Contingencies (25%)					$900,000
		Field Cost					$4,600,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TBD	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A3
On-Site Repository Of Roaster Fines - Multiple Defense Cap And Liner
Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$53,000.00	$52,000
	2	Dewatering of Roaster Fines		1	LS	$56,600.00	$56,600
		(See Module No. 2)					
		Note: Complete cost of water treatment plant					
		mobilization has to be assigned to Roaster Fines					
		under this option					
	3	Excavate Roaster Fines		1	LS	$315,000.00	$315,000
		(See Module No. 4)					
	4	Furnish calcium carbonate, 0.5% by dry weight		330	TONS	$70.00	$23,100
		(Assume 1 yd3 = 1.5 tons)					
	5	Apply calcium carbonate to repository surface		9,300	SY	$0.35	$3,255
	6	Clearing and grubbing repository area		2.2	ACRE	$5,000.00	$11,000
	7	Excavate repository pad area 2 feet deep		6,600	YD3	$4.00	$26,400
	8	Construct liner (Assume all material impervious		90,000	FT2	$2.20	$198,000
		soil processed from excavation or source within					
		1 mile of site, granular material from commercial					
		source within 4 miles of site)					
	9	Place Roaster Fines		39,000	YD3	$3.00	$117,000
		(Assumes 10% shrinkage)					
	10	Construct cap (Assume sand from commercial		93,000	FT2	$2.35	$218,550
		source within 4 miles, cobbler obtained within					
		1 mile)					
	11	Road and traffic control during construction		1	LS	$71,000.00	$71,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TAD	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A3
On-Site Repository Of Roaster Fines - Multiple Defense Cap And Liner
Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal					$1,091,905
		Unlisted Items (15%)					$158,095
		Contract Cost					$1,250,000
		Contingencies (25%)					$300,000
		Field Cost					$1,550,000

QUANTITIES		PRICES	
BY D Curran, D-8313 DMB	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A4
On-Site Repository Of Mill Tailings - Multiple Defense Cap And Liner
Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$145,000.00	$140,000
	2	Stream diversion and dewatering of South Mill Tailings (See Module No. 1)		1	LS	$1,501,700.00	$1,501,700
	3	Excavation of Mill Tailings (See Module No. 3)		1	LS	$504,000.00	$504,000
	4	Furnish calcium carbonate, 0.5% by dry weight (Assume 1 yd3 = 1.5 tons)		413	TONS	$70.00	$28,910
	5	Apply calcium carbonate to repository surface		11,100	SY	$0.35	$3,885
	6	Clearing and grubbing respository area		2.6	ACRE	$5,000.00	$13,000
	7	Excavate repository pad 2 feet deep		8,000	YD3	$4.00	$32,000
	8	Construct liner (Assume all material impervious soil processed from excavation or source within 1 mile of site, granular material from commercial source within 4 miles of site)		107,500	FT2	$2.20	$236,500
	9	Place Mill Tailings in repository (Assumes 10% shrinkage)		50,000	YD3	$3.00	$150,000
	10	Construct cap (Assume sand from commercial source within 4 miles, cobble obtained within 1 mile)		111,000	FT2	$2.35	$260,850
	11	Road and traffic control during construction		1	LS	$71,000.00	$71,000
	12	Removal of French Creek diversion pipeline and restoration of stream channel		750	FT	$50.00	$37,500

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A4
On-Site Repository Of Mill Tailings - Multiple Defense Cap And Liner
Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal					$2,979,345
		Unlisted Items (15%)					$420,655
		Contract Cost					$3,400,000
		Contingencies (25%)					$900,000
		Field Cost					$4,300,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TRD	CHECKED	BY	CHECKED DLA 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A5
On-Site Repository Of Roaster Fines - Single Cap
Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$37,000.00	$35,000
	2	Dewatering Roaster Fines		1	LS	$56,600.00	$56,600
		(See Module No. 2)					
	3	Excavate Roaster Fines		1	LS	$315,000.00	$315,000
		(See Module No. 4)					
	4	Furnish calcium carbonate, 0.5% by dry weight		330	TONS	$70.00	$23,100
		(Assume 1 yd3 = 1.5 tons)					
	5	Apply calcium carbonate to repository surface		9,300	SY	$0.35	$3,255
	6	Clearing and grubbing respository area		2.2	ACRE	$5,000.00	$11,000
	7	Place Roaster Fines in repository		39,000	YD3	$3.00	$117,000
		(Assumes 10% shrinkage)					
	8	Construct cap (Assume sand from commercial		93,000	FT2	$1.10	$102,300
		source within 4 miles, cobble obtained within					
		1 mile)					
	9	Road and traffic control during construction		1	LS	$73,000.00	$73,000
		Subtotal					$736,255
		Unlisted Items (15%)					$113,745
		Contract Cost					$850,000
		Contingencies (25%)					$200,000
		Field Cost					$1,050,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TBS	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A6
On-Site Repository Of Mill Tailings - Simple Cap
Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$125,000.00	$120,000
	2	Stream diversion and dewatering of South Mill Tailings (See Module No. 1)		1	LS	$1,501,700.00	$1,501,700
	3	Excavation of Mill Tailings (See Module No. 3)		1	LS	$504,000.00	$504,000
	4	Furnish calcium carbonate, 0.5% by dry weight (Assume 1 yd3 = 1.5 tons)		413	TONS	$70.00	$28,910
	5	Apply calcium carbonate to repository surface		11,100	SY	$0.35	$3,885
	6	Clearing and grubbing respository area		2.6	ACRE	$5,000.00	$13,000
	5	Place Mill Tailings in repository (Assumes 10% shrinkage)		50,000	YD3	$3.00	$150,000
	6	Construct cap (Assume sand from commercial source within 4 miles, cobble obtained within 1 mile)		111,000	FT2	$1.10	$122,100
	7	Road and traffic control during construction		1	LS	$71,000.00	$71,000
	8	Removal of French Creek diversion pipeline and restoration of stream channel		750	FT	$50.00	$37,500
		Subtotal					$2,552,095
		Unlisted Items (15%)					$347,905
		Contract Cost					$2,900,000
		Contingencies (25%)					$800,000
		Field Cost					$3,700,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TMD	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A7
On-Site Repository of Mill Tailings And Roaster Fines - Multiple Defense Cap and Liner - Wet Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$125,000.00	$125,000
	2	Excavation of Mill Tailings		1	LS	$694,000.00	$694,000
		(See Module No. 5)					
	3	Excavation of Roaster Fines		1	LS	$510,500.00	$510,500
		(See Module No. 6)					
	4	Furnish calcium carbonate, 0.5% by dry weight		735	TONS	$70.00	$51,450
		(Assume 1 yd3 = 1.5 tons)					
	5	Apply calcium carbonate to repository surface		20,000	SY	$0.35	$7,000
	6	Clearing and grubbing repository area		4.3	ACRE	$5,000.00	$21,500
	7	Excavate repository pad area 2 feet deep		13,000	YD3	$4.00	$52,000
	8	Construct liner (Assume all material impervious		175,000	FT2		
		soil processed from excavation or source within					
		1 mile of site, granular material from					
		commercial source within 4 miles of site)					
		Clay and Sand		19,500	YD3	$12.00	$234,000
		Liner		19,500	YD3	$7.50	$146,250
	9	Place Roaster Fines and Mill Tailings in repository -		88,000	YD3	$3.00	$264,000
		3-foot lifts, 4 passes of a specified roller (Assume					
		10% shrinkage)					

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A7
On-Site Repository of Mill Tailings And Roaster Fines - Multiple Defense Cap and Liner - Wet Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	10	Construct cap (Assume sand from commercial		180,000	FT2		
		source within 4 miles, cobble obtained within					
		1 mile)					
		F/P gravel		13,400	YD3	$4.50	$60,300
		F/P sand		3,400	YD3	$13.00	$44,200
		F/P 5 geosynthetic layers		20,000	SY	$15.70	$314,000
	11	Road and traffic control during construction		1	LS	$71,000.00	$71,000
		(Assume 3 months)					
	12	Removal of French Creek diversion pipeline and		750	FT	$50.00	$37,500
		restoration of stream channel					
		Subtotal					$2,632,700
		Unlisted Items (15%)					$367,300
		Contract Cost					$3,000,000
		Contingencies (25%)					$800,000
		Field Cost					$3,800,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TWB	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A8
On-Site Repository Of Mill Tailings And Roaster Fines - Simple Cap
Wet Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$93,000.00	$93,000
	2	Excavation of Mill Tailings		1	LS	$694,000.00	$694,000
		(See Module No. 5)					
	3	Excavation of Roaster Fines		1	LS	$510,500.00	$510,500
		(See Module No. 6)					
	4	Furnish calcium carbonate, 0.5% by dry weight		735	TONS	$70.00	$51,450
		(Assume 1 yd3 = 1.5 tons)					
	5	Apply calcium carbonate to repository surface		20,000	SY	$0.35	$7,000
	6	Clearing and grubbing repository area		4.3	ACRE	$5,000.00	$21,500
	7	Place Roaster Fines and Mill Tailings in repository -		88,000	YD3	$3.00	$264,000
		3-foot lifts, 4 passes of a specified roller (Assume					
		10% shrinkage)					
	8	Construct cap (Assume sand from commercial		180,000	FT2		
		source within 4 miles, cobble obtained within					
		1 mile)					
		F/P gravel		13,400	YD3	$4.50	$60,300
		F/P sand		3,400	YD3	$13.00	$44,200
		F/P geomembrane		20,000	SY	$4.50	$90,000
	9	Road and traffic control during construction		1	LS	$71,000.00	$71,000
	10	Removal of French Creek diversion pipeline and		750	FT	$50.00	$37,500
		restoration of stream channel					

QUANTITIES		PRICES	
BY D Curran, D-8313 TMS	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A8
On-Site Repository Of Roaster Fines - Multiple Defense Cap And Liner
Wet Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal					$1,944,450
		Unlisted Items (15%)					$255,550
		Contract Cost					$2,200,000
		Contingencies (25%)					$600,000
		Field Cost					$2,800,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TMB	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A9
On-Site Repository Of Roaster Fines - Multiple Defense Cap And Liner
Wet Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$60,000.00	$59,000
	2	Excavate Roaster Fines (See Module No. 6)		1	LS	$510,500.00	$510,500
	3	Furnish calcium carbonate, 0.5% by dry weight (Assume 1 yd3 = 1.5 tons)		330	TONS	$70.00	$23,100
	4	Apply calcium carbonate to repository surface		9,300	SY	$0.35	$3,255
	5	Clearing and grubbing repository area		2.2	ACRE	$5,000.00	$11,000
	6	Excavate repository pad area 2 feet deep		6,600	YD3	$4.00	$26,400
	7	Construct liner (Assume all material impervious soil processed from excavation or source within 1 mile of site, granular material from commercial source within 4 miles of site)		90,000	FT2	$2.20	$198,000
	8	Place Roaster Fines in repository (Assumes 10% shrinkage)		39,000	YD3	$3.00	$117,000
	9	Construct cap (Assume sand from commercial source within 4 miles, cobbler obtained within 1 mile)		93,000	FT2	$2.35	$218,550
	10	Road and traffic control during construction		1	LS	$71,000.00	$71,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TMS	CHECKED	BY	CHECKED DCm 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A9
On-Site Repository Of Roaster Fines - Multiple Defense Cap And Liner
Wet Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal					$1,237,805
		Unlisted Items (15%)					$162,195
		Contract Cost					$1,400,000
		Contingencies (25%)					$400,000
		Field Cost					$1,800,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TBB	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A10
On-Site Repository Of Mill Tailings - Multiple Defense Cap And Liner
Wet Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$78,000.00	$76,000
	2	Excavation of Mill Tailings		1	LS	$694,000.00	$694,000
		(See Module No. 5)					
	3	Furnish calcium carbonate, 0.5% by dry weight		413	TONS	$70.00	$28,910
		(Assume 1 yd3 = 1.5 tons)					
	4	Apply calcium carbonate to repository surface		11,100	SY	$0.35	$3,885
	5	Clearing and grubbing respository area		2.6	ACRE	$5,000.00	$13,000
	6	Excavate repository pad 2 feet deep		8,000	YD3	$4.00	$32,000
	7	Construct liner (Assume all material impervious		107,500	FT2	$2.20	$236,500
		soil processed from excavation or source within					
		1 mile of site, granular material from commercial					
		source within 4 miles of site)					
	8	Place Mill Tailings in repository		50,000	YD3	$3.00	$150,000
		(Assumes 10% shrinkage)					
	9	Construct cap (Assume sand from commercial		111,000	FT2	$2.35	$260,850
		source within 4 miles, cobble obtained within					
		1 mile)					
	10	Road and traffic control during construction		1	LS	$71,000.00	$71,000
	11	Removal of French Creek diversion pipeline and		750	FT	$50.00	$37,500
		restoration of stream channel					

QUANTITIES		PRICES	
BY D Curran, D-8313 TBB	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A10
On-Site Repository Of Mill Tailings - Multiple Defense Cap And Liner
Wet Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal					$1,603,645
		Unlisted Items (15%)					$246,355
		Contract Cost					$1,850,000
		Contingencies (25%)					$450,000
		Field Cost					$2,300,000

QUANTITIES		PRICES	
BY D Curran, D-8313 THD	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A11
On-Site Repository Of Roaster Fines
Simple Cap
Wet Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$43,000.00	$42,000
	2	Excavate Roaster Fines		1	LS	$510,500.00	$510,500
		(See Module No. 6)					
	3	Furnish calcium carbonate, 0.5% by dry weight		330	TONS	$70.00	$23,100
		(Assume 1 yd3 = 1.5 tons)					
	4	Apply calcium carbonate to repository surface		9,300	SY	$0.35	$3,255
	5	Clearing and grubbing respository area		2.2	ACRE	$5,000.00	$11,000
	6	Place Roaster Fines in repository		39,000	YD3	$3.00	$117,000
		(Assumes 10% shrinkage)					
	7	Construct cap (Assume sand from commercial		93,000	FT2	$1.10	$102,300
		source within 4 miles, cobble obtained within					
		1 mile)					
	8	Road and traffic control during construction		1	LS	$73,000.00	$73,000
		Subtotal					$882,155
		Unlisted Items (15%)					$117,845
		Contract Cost					$1,000,000
		Contingencies (25%)					$250,000
		Field Cost					$1,250,000

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. A12
On-Site Repository Of Mill Tailings - Simple Cap
Wet Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$58,000.00	$56,000
	2	Excavation of Mill Tailings		1	LS	$694,000.00	$694,000
		(See Module No. 5)					
	3	Furnish calcium carbonate, 0.5% by dry weight		413	TONS	$70.00	$28,910
		(Assume 1 yd3 = 1.5 tons)					
	4	Apply calcium carbonate to repository surface		11,100	SY	$0.35	$3,885
	5	Clearing and grubbing respository area		2.6	ACRE	$5,000.00	$13,000
	6	Place Mill Tailings in repository		50,000	YD3	$3.00	$150,000
		(Assumes 10% shrinkage)					
	7	Construct cap (Assume sand from commercial		111,000	FT2	$1.10	$122,100
		source within 4 miles, cobble obtained within					
		1 mile)					
	8	Road and traffic control during construction		1	LS	$71,000.00	$71,000
	9	Removal of French Creek diversion pipeline and		750	FT	$50.00	$37,500
		restoration of stream channel					
		Subtotal					$1,176,395
		Unlisted Items (15%)					$173,605
		Contract Cost					$1,350,000
		Contingencies (25%)					$350,000
		Field Cost					$1,700,000

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. B1
On-Site Repository Of Stabilized Mill Tailings And Roaster Fines - Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$250,000.00	$250,000
	2	Stream diversion and dewatering of South Mill Tailings (See Module No. 1)		1	LS	$1,501,700.00	$1,501,700
	3	Dewatering of Roaster Fines (See Module No. 2)		1	LS	$56,600.00	$56,600
	4	Excavation of Mill Tailings (See Module No. 3)		1	LS	$504,000.00	$504,000
	5	Excavation of Roaster Fines (See Module No. 4)		1	LS	$315,000.00	$315,000
	6	Clearing and grubbing respository area		4.3	ACRE	$5,000.00	$21,500
	7	Furnish cement amendment		13,230	TONS	$80.00	$1,058,400
	8	Furnish fly ash amendment		13,230	TONS	$30.00	$396,900
	9	Mix waste and amendments (Assume pugmill mixing)		102,000	YD3	$7.00	$714,000
	10	Place amended Roaster Fines and Mill Tailings in repository, 3-foot lifts, 4 passes of a specified roller (Assume 15% volume increase due to amendment, 10% volume decrease due to compaction)		102,000	YD3	$3.00	$306,000
	11	Cover amended material - 2 ft thick cobble local source		219,000	FT2	$0.35	$76,650
	12	Road and traffic control during construction		1	LS	$71,000.00	$71,000
	13	Removal of French Creek diversion pipeline and restoration of stream channel		750	FT	$50.00	$37,500

QUANTITIES		PRICES	
BY D Curran, D-8313 TKD	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. B1
On-Site Repository Of Stabilized Mill Tailings And Roaster Fines - Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal					$5,309,250
		Unlisted Items (15%)					$790,750
		Contract Cost					$6,100,000
		Contingencies (25%)					$1,500,000
		Field Cost					$7,600,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TAP	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. B2
On-Site Repository Of Stabilized Roaster Fines - Dry Excavation

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$81,000.00	$79,000
	2	Dewatering of Roaster Fines		1	LS	$56,600.00	$56,600
		(See Module No. 2)					
	3	Excavation of Roaster Fines		1	LS	$315,000.00	$315,000
		(See Module No. 4)					
	4	Clearing and grubbing respository area		2.5	ACRE	$5,000.00	$12,500
	5	Furnish cement amendment		5,805	TONS	$80.00	$464,400
		(10% dry weight at 10% moisture content)					
	6	Furnish fly ash amendment		5,805	TONS	$30.00	$174,150
		(10% dry weight at 10% moisture content)					
	7	Mix waste and amendments		44,500	YD3	$7.00	$311,500
	8	Place amended Roaster Fines in repository,		44,500	YD3	$3.00	$133,500
		3-foot lifts, 4 passes of a specified					
		roller (Assume 15% volume increase due to					
		amendments, 10% volume decrease due to					
		compaction)					
	9	Cover amended waste - 2 ft thick		107,000	FT2	$0.35	$37,450
		cobble cover from local source					
	10	Road and traffic control during construction		1	LS	$71,000.00	$71,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TMB	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. B2
On-Site Repository Of Stabilized Roaster Fines - Dry Excavation

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal					$1,655,100
		Unlisted Items (15%)					($1,465,100)
		Contract Cost					$190,000
		Contingencies (25%)					$2,210,000
		Field Cost					$2,400,000

QUANTITIES		PRICES	
BY D Curran, D-8313 THB	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. B3
On-Site Repository Of Stabilized Mill Tailings - Dry Excavation

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$180,000.00	$180,000
	2	Stream diversion and dewatering of South Mill Tailings (See Module No. 1)		1	LS	$1,501,700.00	$1,501,700
	3	Excavation of Mill Tailings (See Module No. 3)		1	LS	$504,000.00	$504,000
	4	Clearing and grubbing respository area		2.7	ACRE	$5,000.00	$13,500
	5	Furnish cement amendment (10% dry weight at 10% moisture content)		7,425	TONS	$80.00	$594,000
	6	Furnish fly ash amendment (10% dry weight at 10% moisture content)		7,425	TONS	$30.00	$222,750
	7	Mix waste and amendments		55,000	YD3	$7.00	$385,000
	8	Place amended Mill Tailings in repository, 3-foot lifts, 4 passes of a specified roller (Assume 15% volume increase due to amendment, 10% volume decrease due to compaction)		58,000	YD3	$3.00	$174,000
	9	Cover amended waste - 2 ft thick cobble cover from local source		114,000	FT2	$0.70	$79,800
	10	Road and traffic control during construction		1	LS	$71,000.00	$71,000
	11	Removal of French Creek diversion pipeline and restoration of stream channel		750	FT	$50.00	$37,500

QUANTITIES		PRICES	
BY D Curran, D-8313 TDC	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. B3
On-Site Repository Of Stabilized Mill Tailings - Dry Excavation

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal					$3,763,250
		Unlisted Items (15%)					$536,750
		Contract Cost					$4,300,000
		Contingencies (25%)					$1,100,000
		Field Cost					$5,400,000

QUANTITIES		PRICES	
BY D Curran, D-8313 JDC	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. D1
Removal And Off-Site Disposal Of Roaster Fines And Mill Tailings - Dry Excavaton
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$1,450,000.00	$1,450,000
	2	Stream diversion and dewatering of South Mill Tailings (See Module No. 1)		1	LS	$1,501,700.00	$1,501,700
	3	Dewatering of Roaster Fines (See Module No. 2)		1	LS	$56,600.00	$56,600
	4	Excavation of Mill Tailings (See Module No. 3)		1	LS	$504,000.00	$504,000
	5	Excavation of Roaster Fines (See Module No. 4)		1	LS	$315,000.00	$315,000
	6	Furnish fly ash (40% by dry weight)		52,900	TONS	$30.00	$1,587,000
	7	Mix fly ash and waste (Assume pugmill)		122,500	YD3	$7.00	$857,500
	8	Load and haul Mill Tailings and Roaster Fines to an off-site RCRA landfill facility (Assume 25% volume increase)		122,500	YD3	$80.00	$9,800,000
	9	Disposal cost of Mill Tailings and Roaster Fines at off-site landfill		122,500	YD3	$120.00	$14,700,000
	10	Road and traffic control during construction		1	LS	$71,000.00	$71,000
	11	Removal of French Creek diversion pipeline and restoration of stream channel		750	LF	$50.00	$37,500

QUANTITIES		PRICES	
BY D Curran, D-8313 TBB	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. D1
Removal And Off-Site Disposal Of Roaster Fines And Mill Tailings - Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal					$30,880,300
		Unlisted Items (15%)					$5,119,700
		Contract Cost					$36,000,000
		Contingencies (25%)					$8,000,000
		Field Cost					$44,000,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TDB	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. D2
Removal And Off-Site Disposal Of Roaster Fines - Dry Excavation

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$620,000.00	$610,000
	2	Dewatering of Roaster Fines		1	LS	$56,600.00	$56,600
		(See Module No. 2)					
	3	Excavation of Roaster Fines		1	LS	$315,000.00	$315,000
		(See Module No. 4)					
	4	Furnish fly ash		23,200	TONS	$30.00	$696,000
		(40% by dry weight)					
	5	Mix fly ash and waste		53,750	YD3	$7.00	$376,250
		(Assume pugmill)					
	6	Load and haul Roaster Fines to on off-site RCRA		53,750	YD3	$80.00	$4,300,000
		landfill facility (Assume 25 % volume increase)					
	7	Disposal cost for Roaster Fines at off-site landfill		53,750	YD3	$120.00	$6,450,000
	8	Road and traffic control during construction		1	LS	$71,000.00	$71,000
		Subtotal					$12,874,850
		Unlisted Items (15%)					$2,125,150
		Contract Cost					$15,000,000
		Contingencies (25%)					$3,500,000
		Field Cost					$18,500,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TAB	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. D3
Removal And Off-Site Disposal
Of Mill Tailings - Dry Excavation

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$860,000.00	$860,000
	2	Dewatering of Roaster Fines (See Module No. 1)		1	LS	$1,501,700.00	$1,501,700
	3	Excavation of Roaster Fines (See Module No. 3)		1	LS	$504,000.00	$504,000
	4	Furnish fly ash (40% by dry weight)		29,700	TONS	$30.00	$891,000
	5	Mix fly ash and waste (Assume pugmill)		68,750	YD3	$7.00	$481,250
	6	Load and haul Roaster Fines to on off-site RCRA landfill facility (Assume 25 % volume increase)		68,750	YD3	$80.00	$5,500,000
	7	Disposal cost for Roaster Fines at off-site landfill		68,750	YD3	$120.00	$8,250,000
	8	Road and traffic control during construction		1	LS	$71,000.00	$71,000
	9	Removal of French Creek diversion pipeline and restoration of stream channel		750	LF	$50.00	$37,500
		Subtotal					$18,096,450
		Unlisted Items (15%)					$2,903,550
		Contract Cost					$21,000,000
		Contingencies (25%)					$5,000,000
		Field Cost					$26,000,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TM	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. F1-a
Encapsulation Of Roaster Fines And Mill Tailings In Mine Workings, Dry Form - Above Water Table Of Extenuate Site - Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION: -

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$320,000.00	$320,000
	2	Stream diversion and dewatering of South Mill Tailings (See Module No. 1)		1	LS	$1,501,700.00	$1,501,700
	3	Dewatering of Roaster Fines (See Module No. 2)		1	LS	$56,600.00	$56,600
	4	Excavation of Mill Tailings (See Module No. 3)		1	LS	$504,000.00	$504,000
	5	Excavation of Roaster Fines (See Module No. 4)		1	LS	$315,000.00	$315,000
	6	Widen access road for hauling amended mine waste from excavation to extenuate portal area		600	LF	$10.00	$6,000
	7	Haul waste to extenuate portal for mixing (Assume 1/4-mile haul distance)		98,000	YD3	$1.00	$98,000
	8	Furnish cement amendment		13,230	TONS	$80.00	$1,058,400
	9	Furnish fly ash		13,230	TONS	$30.00	$396,900
	10	Mix amendments with waste material (Assume pugmill for mixing)		98,000	YD3	$7.00	$686,000
	11	Reestablish and stabilize mine portal (Assume 5,000 yd3 excavation)		1	LS	$100,000.00	$100,000
	12	Rehabilitate extenuate tunnel (includes ventilation, lighting, power, etc.)		2,250	LF	$300.00	$675,000
	13	Resupport tunnel with steel sets on 4-foot centers for structural support of tunnel crown)		560	LF	$500.00	$280,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TDM	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. F1-a
Encapsulation Of Roaster Fines And Mill Tailings In Mine Workings, Dry Form - Above Water Table Of Extenuate Site - Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION: -

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	14	Construct rail system for hauling amended mine waste into extenuate tunnel		2,250	LF	$100.00	$225,000
	15	Transport amended material underground and place into openings		113,000	YD3	$3.00	$339,000
	16	Close access to tunnel		1	LS	$10,000.00	$10,000
	17	Removal of French Creek diversion pipeline and restoration of stream channel		750	LF	$25.00	$18,750
	18	Road and traffic control during construction		1	LS	$30,000.00	$30,000
		Subtotal					$6,620,350
		Unlisted Items (15%)					$979,650
		Contract Cost					$7,600,000
		Contingencies (25%)					$1,900,000
		Field Cost					$9,500,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TM	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. F1-b
Encapsulation Of Roaster Fines And Mill Tailings In Mine Workings, Slurry Form - Above Water Table In Extenuate Site - Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$340,000.00	$340,000
	2	Stream diversion and dewatering of South Mill Tailings (See Module No. 1)		1	LS	$1,501,700.00	$1,501,700
	3	Dewatering of Roaster Fines (See Module No. 2)		1	LS	$56,600.00	$56,600
	4	Excavation of Mill Tailings (See Module No. 3)		1	LS	$504,000.00	$504,000
	5	Excavation of Roaster Fines (See Module No. 4)		1	LS	$315,000.00	$315,000
	6	Widen access road for hauling amended mine waste from excavation to extenuate portal area		600	LF	$10.00	$6,000
	7	Reestablish mine portal (Assume 5,000 yd3 excavation)		1	LS	$100,000.00	$100,000
	8	Reestablish existing extenuate tunnel; lighting, ventilation, power, etc.		2,250	LF	$300.00	$675,000
	9	Provide supports in extenuate tunnel, steel sets on 4-foot centers Field Cost		560	LF	$500.00	$280,000
	10	Furnish cement amendment		13,230	TONS	$80.00	$1,058,400
	11	Furnish fly ash amendment		13,230	TONS	$30.00	$396,900
	12	Furnish and install slurry equipment Note: Includes following - F/E silos/nozzler F/E mixer F/E pump F/E dewatering equipment & piping		1	LS	$500,000.00	$500,000

QUANTITIES		PRICES	
BY D Curran, D-8313 THB	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. F1-b
Encapsulation Of Roaster Fines And Mill Tailings In Mine Workings, Slurry Form - Above Water Table In Extenuate Site Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	13	Mixing slurry and pump to extenuate portal		113,000	YD3	$5.00	$565,000
	14	Furnish and install equipment to pump slurry into mine. Includes in-line pump and 2,250 ft of 6-inch pipe		1	LS	$125,000.00	$125,000
	15	Pump slurry to deposit location inside of mine		113,000	YD3	$5.00	$565,000
	16	Close access to extenuate tunnel		1	LS	$10,000.00	$10,000
	17	Road and traffic control during construction		1	LS	$30,000.00	$30,000
	18	Removal of French Creek diversion pipeline and restoration of stream channel		750	LF	$25.00	$18,750
		Subtotal					$7,047,350
		Unlisted Items (15%)					$1,052,650
		Contract Cost					$8,100,000
		Contingencies (25%)					$1,900,000
		Field Cost					$10,000,000

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. F2
Encapsulation Of Roaster Fines And Mill Tailings In Mine Workings, Slurry Form - Below Water Table Of Wellington Oro Site - Dry Excavation
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$330,000.00	$330,000
	2	Stream diversion and dewatering of South Mill Tailings (See Module No. 1)		1	LS	$1,501,700.00	$1,501,700
	3	Dewatering of Roaster Fines (See Module No. 2)		1	LS	$56,600.00	$56,600
	4	Excavation of Mill Tailings (See Module No. 3)		1	LS	$504,000.00	$504,000
	5	Excavation of Roaster Fines (See Module No. 4)		1	LS	$315,000.00	$315,000
	6	Furnish and install slurry equipment		1	LS	$500,000.00	$500,000
		Note: Includes following. -					
		F/E silos/nozzles					
		F/E mixer					
		F/E pump					
		F/E dewatering equipment					
		F/E piping					
	7	Furnish cement amendment		13,230	TONS	$80.00	$1,058,400
	8	Furnish fly ash amendment		13,230	TONS	$30.00	$396,900
	9	Bore drill holes for injection of slurry (Assume 10-inch bore holes)		12,500	LF	$50.00	$625,000
	10	Mix and pump slurry to injection locations (Assume 750 ft to injection locations)		113,000	YD3	$5.00	$565,000
	11	Furnish and install injection equipment (Includes 6-inch in-line pump and 9,000 feet of 6-inch steel trimie pipe)		1	LS	$460,000.00	$460,000
	12	Inject slurry into voids through drill holes		113,000	YD3	$5.00	$565,000

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. F2
Encapsulation Of Roaster Fines And Mill Tailings In Mine Workings, Slurry Form - Below Water Table Of Wellington Oro Site
WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	13	Removal of French Creek diversion pipeline and restoration of stream channel		750	LF	$25.00	$18,750
	14	Road and traffic control during construction		1	LS	$30,000.00	$30,000
		Subtotal					$6,926,350
		Unlisted Items (15%)					$1,073,650
		Contract Cost					$8,000,000
		Contingencies (25%)					$2,000,000
		Field Cost					$10,000,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TM	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. G1
In-Place Waste Rock Reclamation, Partial Cap And 2:1 Slopes For Extenuate Site

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$18,000.00	$18,000
	2	Cut and fill - Recontour extenuate site waste rock piles. Achieve 5% slope across top and 2:1 side slopes. Cut in drainage channels, top , side, and toe for run-on and run-off		12,500	YD3	$3.00	$37,500
	3	Furnish amendments for 2:1 slope		500	TONS	$110.00	$55,000
	4	Apply stabilization amendment to 2:1 side slopes (Apply 10% to soil by dry weight, mixing 1 foot into slope material and then light compacting)		100,000	SF	$0.35	$35,000
	5	Construct partial cap for 5% top of mine waste rock pile (Assume sand from commercial source, cobbles and gravel obained within 1 mile)		100,000	SF	$1.60	$160,000
	6	Construct run-on and run-off drainage ditches on top, side, and toe of piles		1,200	LF	$3.50	$4,200
	7	Road and traffic control during construction		1	LS	$71,000.00	$71,000
		Subtotal					$380,700
		Unlisted Items (15%)					$59,300
		Contract Cost					$440,000
		Contingencies (25%)					$110,000
		Field Cost					$550,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TDP	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. G2
In-Place Waste Rock Reclamation,
3:1 Slopes For Extenuate Site

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$27,000.00	$27,000
	2	Cut and fill - Recontour extenuate site waste rock piles. Achieve 5% slope across top and 3:1 side slopes. Cut drainage channels, at top, side, and toe for run-on and run-off		21,000	YD3	$3.00	$63,000
	3	Construct cap for 5% top and 3:1 side slopes of mine waste rock pile. (Assume sand from commercial source, cobbles and gravel obtained within 1 mile		250,000	SF	$1.60	$400,000
	4	Constract run-on and run-off drainage ditches at top, side, and toe of pile. (The cross section of ditches is similar to cap, except for an additional 12-inch of cobble and material for armoring).		1,200	LF	$3.50	$4,200
	5	Road and traffic control during construction		1	LS	$71,000.00	$71,000
		Subtotal					$565,200
		Unlisted Items (15%)					$84,800
		Contract Cost					$650,000
		Contingencies (25%)					$160,000
		Field Cost					$810,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TW	CHECKED	BY	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. G3
In-Place Waste Rock Reclamation, Partial Cap And 2:1 Slopes For Wellington Oro Site

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$16,000.00	$16,000
	2	Cut and fill - Recontour Wellington Oro Mine site waste rock piles. Achieve 5% slope across top and 2:1 side slopes. Cut drainage channels, at top, side, and toe for run-on and run-off		14,000	YD3	$3.00	$42,000
	3	Furnish amendments for 2:1 slope		330	TONS	$110.00	$36,300
	4	Apply stabilization amendment to 2:1 side slopes. (Apply at 10% to soil by dry weight, mixing 1 foot into slope material and then light compacting)		65,000	FT2	$0.35	$22,750
	5	Construct partial cap for 5% top of mine waste rock pile (Assume sand from commercial source, cobbles and gravel obtained within 1 mile)		90,000	SF	$1.60	$144,000
	6	Construct run-on and run-off drainage ditches on top, side, and toe of piles		1,300	LF	$3.50	$4,550
	7	Road and traffic control during construction		1	LS	$71,000.00	$71,000
		Subtotal					$336,600
		Unlisted Items (15%)					$53,400
		Contract Cost					$390,000
		Contingencies (25%)					$90,000
		Field Cost					$480,000

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY	CHECKED DCM 7/28/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. G4
In-Place Waste Rock Reclamation,
3:1 Slopes For Wellington Oro Site

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$23,000.00	$23,000
	2	Cut and fill - Recontour extenuate site waste rock piles. Achieve 5% slope across top and 3:1 side slopes. Cut drainage channels, at top, side, and toe for run-on and run-off		30,000	YD3	$3.00	$90,000
	3	Construct cap for 5% top and 3:1 side slopes of mine waste rock pile. (Assume sand from commercial source, cobbles and gravel obtained within 1 mile		181,000	SF	$1.60	$289,600
	4	Construct run-on and run-off drainage ditches at top, side, and toe of pile. (The cross section of ditches is similar as cap, except for an additional 12-inch of cobble and material for armoring).		1,300	LF	$3.50	$4,550
	5	Road and traffic control during construction		1	LS	$71,000.00	$71,000
		Subtotal					$478,150
		Unlisted Items (15%)					$71,850
		Contract Cost					$550,000
		Contingencies (25%)					$140,000
		Field Cost					$690,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TDS	CHECKED	BY	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. H1
In-Place Roaster Fines, Shaping and Covering

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$2,600.00	$2,600
	2	Cut and fill - Place all exposed Roaster Fines into pile & shape and recontour to achieve 2:1 slopes		4,000	YD3	$3.00	$12,000
	3	Furnish and place 6-inch layer of sand over top and side slopes of roaster fines pile. (Assume about a 4 mile haul for processed sand source)		1,200	YD3	$13.00	$15,600
	4	Furnish and place 18-inch layer of gravel & cobbles over top & side slopes of pile (Assume 2 mi. source)		3,500	YD3	$5.00	$17,500
	5	Excavation for drainage ditch		150	YD3	$5.00	$750
		Construct 300' x 8' wide "V" shaped run-on drainage ditch. Section to be same as cover with 6" sand and 18" gravel and cobbles					
	6	Furnish and place 6" sand for drainage ditch		40	YD3	$13.00	$520
	7	Furnish and place 18" gravel and cobbles for drainage ditch		120	YD3	$5.00	$600
	8	Excavation for toe ditch		250	YD3	$5.00	$1,250
	9	Furnish and place 6" sand for toe ditch		50	YD3	$13.00	$650
	10	Furnish and place 30 mil LDPE geomembrane for toe ditch		350	YD2	$4.50	$1,575
	11	Furnish and place 6 " sand for toe ditch		50	YD3	$13.00	$650
	12	Furnish and place 18" gravel and cobbles for toe ditch		120	YD3	$5.00	$600

QUANTITIES		PRICES	
BY D Curran, D-8313 TDC	CHECKED	BY D Donaldson, D-8170	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. H1
In-Place Roaster Fines,
Shaping and Covering

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal					$54,295
		Unlisted Items (15%)					$7,705
		Contract Cost					$62,000
		Contingencies (25%)					$16,000
		Field Cost					$78,000

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY D Donaldson, D-8170	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. H2
In-Place South Mill Tailings,
Shaping and Covering

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$3,600.00	$3,600
	2	Cut and fill - Move mill tailings from east side of Country Boy Road to west side and shape and recontour mill tailings pile to form mound with 2:1 slopes		20,000	YD3	$3.00	$60,000
	3	Furnish and place minimum 24" gravel cobble cover over top of mill tailings pond. (Assume cover material within 1/4 mile upstream from French Creek). (Quantity assumes 50% of fill material is cap material as well)		3,000	YD3	$4.00	$12,000
		Subtotal					$75,600
		Unlisted Items (15%)					$11,400
		Contract Cost					$87,000
		Contingencies (25%)					$23,000
		Field Cost					$110,000

QUANTITIES		PRICES	
BY D Curran, D-8313 TRD	CHECKED	BY D Donaldson, D-8170	CHECKED DCM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Jul-97

Option No. H3
In-Place North Mill Tailings,
Shaping and Covering

WOID: ER650

PROJECT: Wellington Oro Mine - EPA

DIVISION:

FILE: B:\MODULES.WK3

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Mobilization (5%)		1	LS	$2,200.00	$2,200
	2	Cut and fill - Shape and recontour into mound shape w/ 2:1 slopes		2,000	YD3	$3.00	$6,000
	3	Furnish and place 6-inch layer of sand over top and side-slopes of mill tailings pile (Assume about 4 mile haul to processed material).		650	YD3	$13.00	$8,450
	4	Furnish and place 18-inch layer of gravel and cobbles over top and side slopes of pile (Assume 2 mile source).		2,000	YD3	$5.00	$10,000
	5	Excavation for drainage ditch		170	YD3	$5.00	$850
		Construct 330' x 6' wide "V" shaped run-on drainage ditch. Section to be same as cap w/6" sand and 18" gravel and cobbles					
	6	Furnish and place 6" sand for drainage ditch		45	YD3	$13.00	$585
	7	Furnish and place 18" gravel and cobbles for drainage ditch		3,500	YD3	$5.00	$17,500
		Subtotal					$45,585
		Unlisted Items (15%)					$6,415
		Contract Cost					$52,000
		Contingencies (25%)					$14,000
		Field Cost					$66,000

QUANTITIES		PRICES	
BY D Curran, D-8313	CHECKED	BY D Donaldson, D-8170	CHECKED DLM 7/29/97
DATE PREPARED	APPROVED	DATE 07/30/97	PRICE LEVEL

Appendix 8-3

START

Superfund Technical Assessment and Response Team - Region VIII

United States
Environmental Protection Agency

Contract No. 68-W5-0031

SAMPLING ACTIVITIES REPORT

WELLINGTON/ORO MINE
Summit County, Colorado

TDD No. 9604-0011

FEBRUARY 12, 1996

URS
OPERATING SERVICES, INC.

URS OPERATING SERVICES

1099 18TH STREET
SUITE 710
DENVER, COLORADO 80202-1908
TEL: (303) 291-8300
FAX: (303) 291-8296

February 12, 1997

Ms. Johanna Miller
On-Scene Coordinator
U.S. Environmental Protection Agency
Region VIII, Mail Code: 8EPR-ER
999 18th Street, Suite 500
Denver, Colorado 80202-2405

SUBJECT: START, EPA Region VIII, Contract No. 68-W5-0031, TDD No. 9604-0011
Sampling Activities Report, Wellington/Oro Mine, Summit County, Colorado

Dear Johanna:

Attached is a copy of the final Sampling Activities Report for the Wellington/Oro Mine, Summit County, Colorado. This document is submitted for your review and approval.

If you have any questions, please call me at 291-8319.

Very truly yours,

URS OPERATING SERVICES, INC.

for T. F. Staible

Mike Sullivan
Geological Engineer

attachment

cc: T. F. Staible/UOS without attachment
File/UOS

75-60411.00
\START\Oro\Final.SAR\Transmit.Ltr:bas

SAMPLING ACTIVITIES REPORT

ORO/WELLINGTON MINE
Summit County, Colorado

EPA Contract No. 68-W5-0031
TDD No. 9604-0011

Prepared By:
Mike Sullivan
Geological Engineer

URS Operating Services, Inc.
1099 18th Street, Suite 710
Denver, CO 80202-1908

Approved: _____ Date: 13 Feb 97
T. F. Staible, START Team Leader, UOS

Approved: _____ Date: 02/12/97
Mike Sullivan, Geological Engineer, UOS

Approved: _____ Date: 2/18/97
Johanna Miller, OSC, EPA, Region VIII

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U.S. ENVIRONMENTAL PROTECTION AGENCY

Johanna Miller	OSC, EPA Region VIII

URS OPERATING SERVICES, INC.

Mike Sullivan	Geological Engineer, START, EPA Region VIII
File (2 copies)	START, EPA Region VIII

SAMPLING ACTIVITIES REPORT
Wellington Oro Mine
Summit County, Colorado

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1.0 INTRODUCTION

Under Technical Direction Document (TDD) 9604-0011, the U.S. Environmental Protection Agency - Emergency Response Branch (EPA) tasked the URS Operating Services (UOS) Superfund Technical Assessment and Response Team (START) with providing support to the assessment of removal options at the Wellington Oro Mine complex.

Specific tasks included collection of samples from the waste piles for X-ray Fluorescence (XRF) analysis, technical evaluation of the data supplied by other agencies as the data relates to the development of removal options, and assistance in the development of the scope of work for solidification/stabilization plans. Contamination of groundwater sources is suspected from both water from the mine workings; and from inundation and leaching of mine waste rock, mill tailings, and roaster fines. An extensive network of monitoring wells has been established on site by the Colorado Division of Mining and Geology (DMG). The thrust of the START sampling effort was to delineate the potential for leaching of metals from the waste rock, roaster fines, and mill tailings scattered about the site.

2.0 BACKGROUND

The Wellington Oro Mine complex was a lead/zinc/copper metal mine operated from the early 1880s to the 1930s. The mine had a mill located on the site. Ore from the mine was roasted to remove sulfur, milled at the mill site, and tailings from the mill were deposited in tailings ponds adjacent to and in French Creek. Waste rock from mining operations was stockpiled around the perimeter of the mine site. Upstream of the main mine/mill site is the location of the Extenuate Mine adit. This adit was also used to convey ore and waste rock from the underground workings of the Wellington Oro Mine. Downstream of the main Wellington Oro Mine is the Union City Mill site. This mill also placed mill tailings adjacent to French Creek. It is unknown how long the Union City Mill operated or the scale of the operation, so determination of the potential extent of the tailings from the operation is not possible without further field investigation.

Concurrent with, or subsequent to, the operation of the mine/mill, placer dredging was also performed in the French Creek floodplain (Photo 1). The placer operation may have mined through some of the tailings ponds; however, it is more likely that the tailings ponds were skirted, as much as possible, by the dredging operations. Cobble spoils from the dredging operation may be capping portions of the mill tailings.

Water elevations in the spring in French Creek rise and are inundating the mill tailings located under and adjacent to the placer spoil piles. The inundation results in leaching of metals and discharge of these metals to French Creek. In 1993, to alleviate some of the inundation, the DMG dredged a channel in "clean" areas lowering the water table in the vicinity of the tailings and reducing some of the saturation.

Groundwater and surface water from the surrounding hillsides still pass through a portion of the tailings causing leaching of metals and loading to French Creek.

Additionally, the underground workings of the Wellington Oro Mine complex are flooded during the spring runoff. This flooding results in the leaching and washing of metals into the groundwater and eventually into French Creek. DMG has grouted off the main shaft of the mine in an attempt to control Acid Mine Drainage (AMD) discharges to the alluvial aquifer; however, this action has not resulted in the expected pooling of water in the mine. Flooding of the mine can result in reducing the metals loading, by preventing oxidation of metals, if the workings are kept flooded and there is little water passing through the mine. It is likely that mine workings are connected to the alluvium through other areas than the main adit and shaft as grouting of the shaft has not resulted in raising of the mine pool. A fracture system (the 10-11 fault) may be a conduit for water through the mine and into the alluvial aquifer.

3.0 SITE ACTIVITIES

START's Alexander and Sullivan responded to the site with On-Scene Coordinator (OSC) Miller on July 30, 1996, to sample the mill tailings and the waste rock dumps for XRF analysis. The XRF was set up in the field. START and the OSC took samples from the waste rock piles, the roaster fines, and from the tailings ponds on site. Some of the locations were established by the U.S. Bureau of Reclamation (BOR) sample team the previous week. Opportunity samples were also taken at selected locations to fill in areas of interest. Sample locations are plotted on Figures 1 through 10 and are listed in Table 1. The samples were processed and analyzed in the field using the Spectrace 9000 XRF. The data results for elements of interest are presented in Table 2A. Additional samples were submitted to the EPA by the DMG. START analyzed these samples with the XRF and the results are presented in Table 2B.

Additionally, with the rainy weather, it was possible to take field pH measurements, with pH test paper, of runoff water from the waste rock and mine tailings piles. Generally, drainage from the mine tailings exhibited depressed pH values. The sample locations, for both tailings and pH measurements are

presented on the attached Figures 1 through 10. Photographs of the sampling locations are presented in Appendix A.

4.0 ANALYTICAL PROCEDURES

The samples taken from the waste rock, tailings, and roaster fines piles were taken with dedicated disposable scoops and placed in plastic bags. The samples were homogenized in the bag. When necessary the samples were dried in the field using a portable drier. The samples were placed in XRF sample cups and analyzed on the Spectrace 9000 XRF. Known standards were run in concert with the field samples to determine error and method detection limits.

Ten of the samples were also analyzed for total metals and Total Characteristic Leaching Procedure (TCLP) at a commercial laboratory, and for X-ray Diffraction (XRD) through the BOR. The results of laboratory analysis are presented in Table 3 (TCLP) and Table 4 (total metals).

5.0 QA/QC

A comparison of the laboratory data and the XRF data has been done for the eight samples submitted for both laboratory and XRF. Samples from the sample bags were submitted to Galson Laboratories for analysis. At the same time sample cups were prepared from the sample bag for XRF analysis. The initial XRF analysis was done using the XRF SOILS application. This application is intended for normal soils with elevated metals content. Comparison of the XRF SOILS data with the laboratory analytical data did not have good correlation. The XRF was submitted for repair to the manufacturer. After return the samples were again analyzed with the soils application. Again the correlation with the laboratory data was poor with almost one-half of the detected analytes having Relative Percent Differences (RPDs) exceeding 35 percent.

Validation of the laboratory analytical results was performed by START subcontractor TechLaw, Inc., and is presented in Appendix B. In general the data from the laboratory are acceptable with qualifications.

Due to the extremely high metals content of most of the samples the manufacturer provided START with a software program intended to compensate for the elevated metals content of the material. START again

ran the eight samples using the XRF TAILINGS application. Correlation with the laboratory data was better than before, with approximately one-third of the analytes detected exceeding a RPD of 35 percent.

Comparing the XRF results (SOILS and TAILINGS applications) with the laboratory data, better correlation was noted with the SOILS application when the sum total of Manganese and Zinc was less than approximately 14,000 parts per million (ppm). Using the XRF SOILS application for samples WO-OP-10A and WO-OP-8 (where Manganese and Zinc are relatively low) and the XRF TAILINGS application for the remainder of the samples, the RPD for the set of detected metals is approximately 25 percent exceeding the RPD of 35 percent. Based on this result, any samples from the START set and from the DMG set with sum total zinc and manganese exceeding 14,000 ppm were analyzed with the XRF TAILINGS application. Table 2A is a summary of the START samples and Table 2B is a summary of the DMG samples using the XRF SOILS or the XRF TAILINGS application as appropriate. Table 5 is a summary of the RPDs for the laboratory and XRF data.

To determine if there was any error in the laboratory data, START submitted the samples to an independent laboratory for confirmation. Comparing the two sets of laboratory data, approximately 22 percent of the analytes exceeded the RPD of 35 percent. This difference in the sets of laboratory data may be due to inhomogeneity of the samples. Review and comparison of the XRF data with the new laboratory data had worse correlation than the original laboratory data. Using the criteria for SOILS and TAILINGS application (Manganese and Zinc totals) the RPD for the sample set with the new laboratory data, approximately 40 percent of the analytes had RPDs exceeding 35 percent. Based on this START is using the original laboratory data for confirmation of the XRF results.

START notes that the TAILINGS application tends to over-report manganese with a MEAN RPD of 35 percent. Other metals of interest are reported both above and below the laboratory data with the following MEAN RPDs: copper at 16 percent; iron at 27 percent; zinc at 17 percent; and lead at 25 percent. Overall these MEANs are in line with RPDs for the two laboratory data sets so confidence in the XRF data is characterized as good.

6.0 RESULTS OF ANALYSIS

The results of the XRF analysis indicate that the "roaster fines," samples WR-01 through WR-04, are chiefly composed of iron with percentage levels of lead and zinc in the one thousand ppm range.

Opportunity samples, which are also possibly roaster fines, were collected in the "roaster fines" area. These samples, OP-04 through OP-06, also exhibited elevated high iron, lead, and zinc levels in the one thousand to ten thousand ppm range. All of these materials were located adjacent to the road and at the Wellington Oro Mine complex. In the borrow ditch adjacent to the roaster fines, yellow and blue precipitate had formed. Samples of this material indicated up to 20 percent iron and up to 2 percent zinc.

Waste rock piles were sampled at various areas around the site. Generally the analysis of the samples indicated elevated levels of zinc and lead. One sample OP-8, located due west of the mill site contained up to two percent lead.

Samples of tailings material exhibited iron levels of up to 14 percent, lead levels of up to 2 percent, and zinc levels in the thousands of ppm.

Thirty-four samples were prepared for XRF analysis (Table 2A). Ten of these samples were also submitted to a commercial lab for total metals and TCLP analysis (Tables 3 and 4). Splits from these same samples were submitted to the BOR for XRD screening (Table 6). This suite of analysis was intended to cross check the accuracy of the XRF (XRF vs. Total Metals), determine if a relationship exists between the total metals contained, the leachability of those metals, and the form those metals were in (XRD). Additionally, 36 subsurface samples received from the DMG were analyzed on the XRF. The XRF results are presented in Table 2B. The BOR's full report on the XRD is attached in Appendix C.

The subsurface samples received from the DMG were analyzed on the XRF. Review of the analytical data indicates that the samples contain the same range and concentration of metals as the samples collected by START. There was no laboratory total metals analysis run for these DMG samples. DMG did have saturation paste extracts run on the samples. The saturation paste extract analysis is essentially a 24-hour leach test using water instead of acid as in the TCLP analysis. The saturation paste extract data (Appendix D) indicates that the materials are highly leachable with lead levels as high as 0.72 milligrams per liter (mg/l) and cadmium as high as 2.75 mg/l.

Samples submitted for TCLP analysis were compared to regulatory standards for TCLP (Table 7). Of the samples submitted for TCLP analysis, all but one exceeded the TCLP standard for lead. The one that did not exceed the standard was from shale waste rock (Table 7). The levels of lead in the leachate ranged from 53.2 ppm to 4.08 ppm. Leachable zinc in the samples was also extremely high ranging from 1,560

ppm to 9.25 ppm. A comparison of the laboratory total metals data and the TCLP data was made for lead and zinc (Table 8). The lowest ratio of total lead and zinc to TCLP, indicating greater leaching potential, was from the tailings pond sample WO-DD-03. The roaster fines had a low ratio for total zinc to TCLP but a high ratio for total lead to TCLP. For lead the waste rock was more leachable than the roaster fines, grey waste, and tailings sample WO-DD-03. Zinc, however, was more leachable from the processed materials than from the waste rock. Sample WO-DD-03 exhibits very leachable lead and zinc. This sample was taken from an area where water ponds in the old tailings ponds and may reflect the deposition of leachable metals as the water dries out.

The XRD data has been received from the BOR (Table 6). The data, when compared to the sampling locations indicate that the milling/roasting process has altered the lead and zinc sulfide minerals into sulfate minerals, notably Jarosite, Angelsite (lead sulfate minerals), and ZnSO4. In hydrometallurgy, converting ZnS to ZnSO4 is desirable as ZnSO4 is more easily leached for production purposes. Jarosite and Angelsite are less leachable forms of lead minerals; however, they are more suitable for smelting. These observations are noted in the Total/TCLP chart where zinc is more leachable in the roaster fines, milled material, and tailings than in the waste rock (Table 8). The lead minerals are less leachable in the roaster fines, milled material, and tailings than in the waste rock and gangue material from mining (unprocessed rock).

7.0 CONCLUSIONS

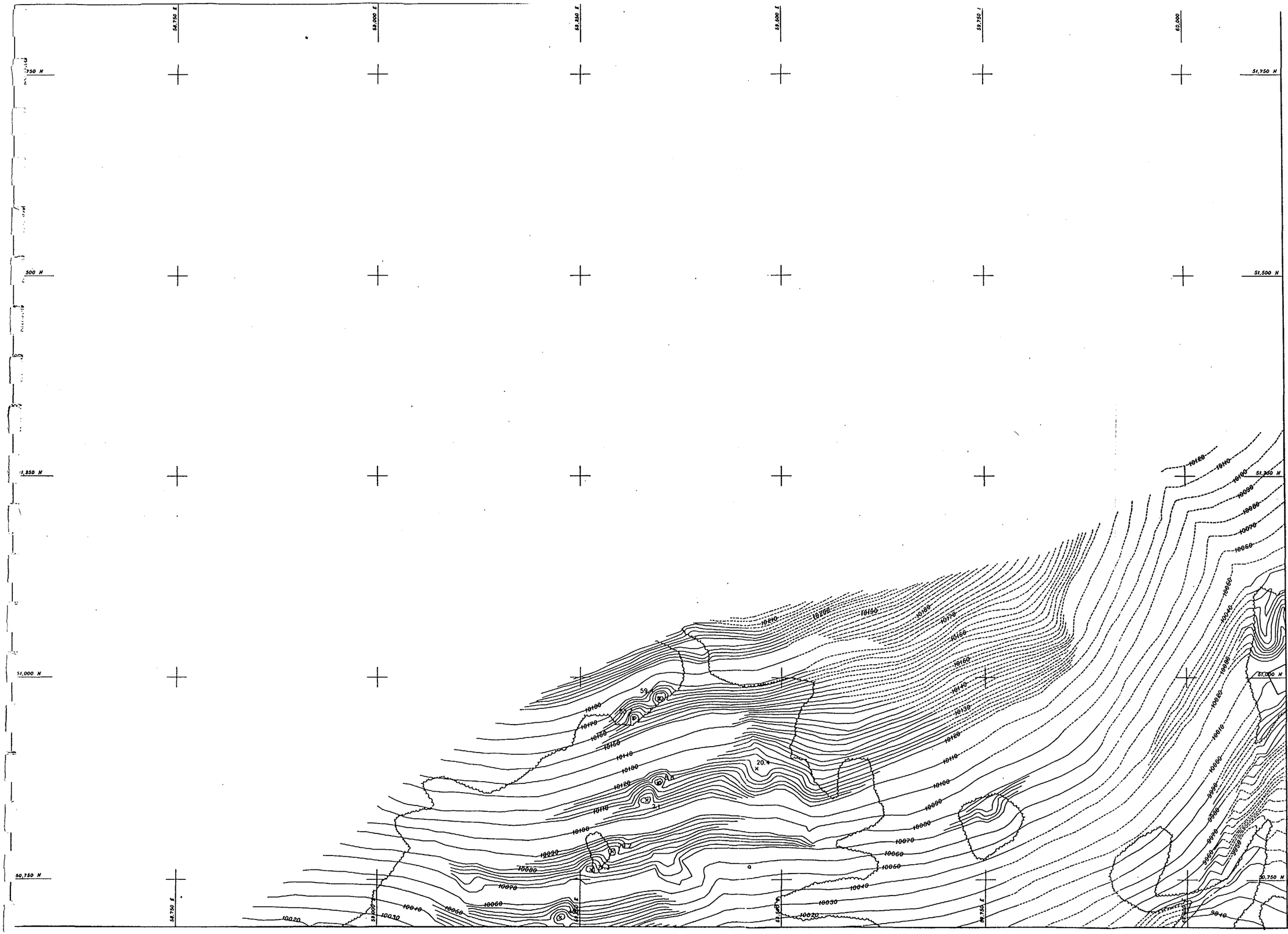
Tailings, roaster fines, and waste rock at the Wellington Oro Mine complex all have elevated levels of lead, zinc, and other metals and all possibly contribute to the metals contamination in French Creek. Given the relatively high levels of zinc and lead in all of the waste rock samples indicates that the mine was extracting the higher grade material and was discarding the "low level" rock as mine waste rock. The tailings and roaster fines have been ground to a small size allowing more surface area for oxidation and a higher leaching potential. Roaster fines were subjected to heat under oxidizing conditions to reduce the sulfur content of the ore making smelting easier. Part of the sulfur in the mineral assemblages is driven off as SO_2 during the roasting process leaving raw metals and oxide and sulfide mineral assemblages. The roaster material tends to leach zinc materials faster than the waste rock, possibly due to the zinc being in a sulfate form. Conversely, the lead in the roaster and tailings materials are not as leachable as in the waste rock. Again, this may be due to the roasted lead having been converted to less soluble sulfate forms (Jarosite and Angelsite) than is present in the ore and waste rock sources.

8.0 RECOMMENDATIONS

It is recommended that the highly leachable material in the roaster fines and in some of the waste rock piles near the main mine site be consolidated and capped to prevent infiltration and leaching of metals into the alluvial system. Some of the tailings in the valley bottom also exhibit leaching potential. Further delineation of the extent of the tailings material is necessary to determine feasibility of removing or stabilizing the material.

The TCLP test used is an aggressive leaching test and may give leaching results higher than would be noted on site. It may be useful to run some static (acid base accounting) and kinetic tests (column, humidity cell, etc.) to determine the actual rates of leaching for various materials on site. This information could assist in determining the real "bad actors" on the site. This information may also be useful if stabilization is an investigated option. The Saturated Paste Extract test run by the DMG indicates that the metals are all leachable even with water. However, this test is a short duration test (24 hours), which may only reflect a flush of oxidized material out of the sample. Longer term tests will allow for geochemical processes to stabilize giving a better picture of the long term leaching potential. The kinetic tests will give this type of information.

When the major contributor source piles are identified if may be useful to do acid-base accounting to determine the suitability of the material for stabilization or neutralization.



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FRENCH GULCH AREA

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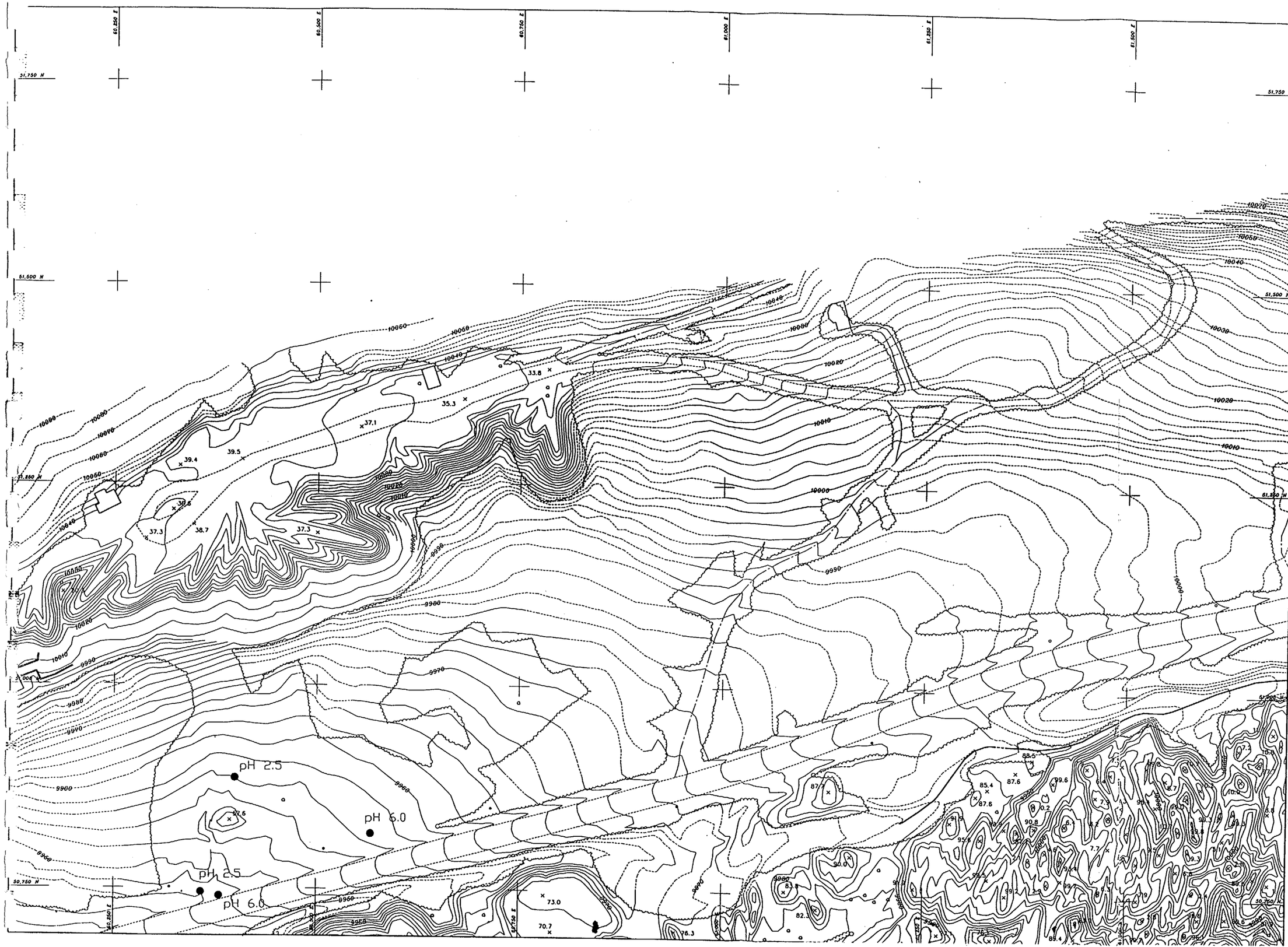

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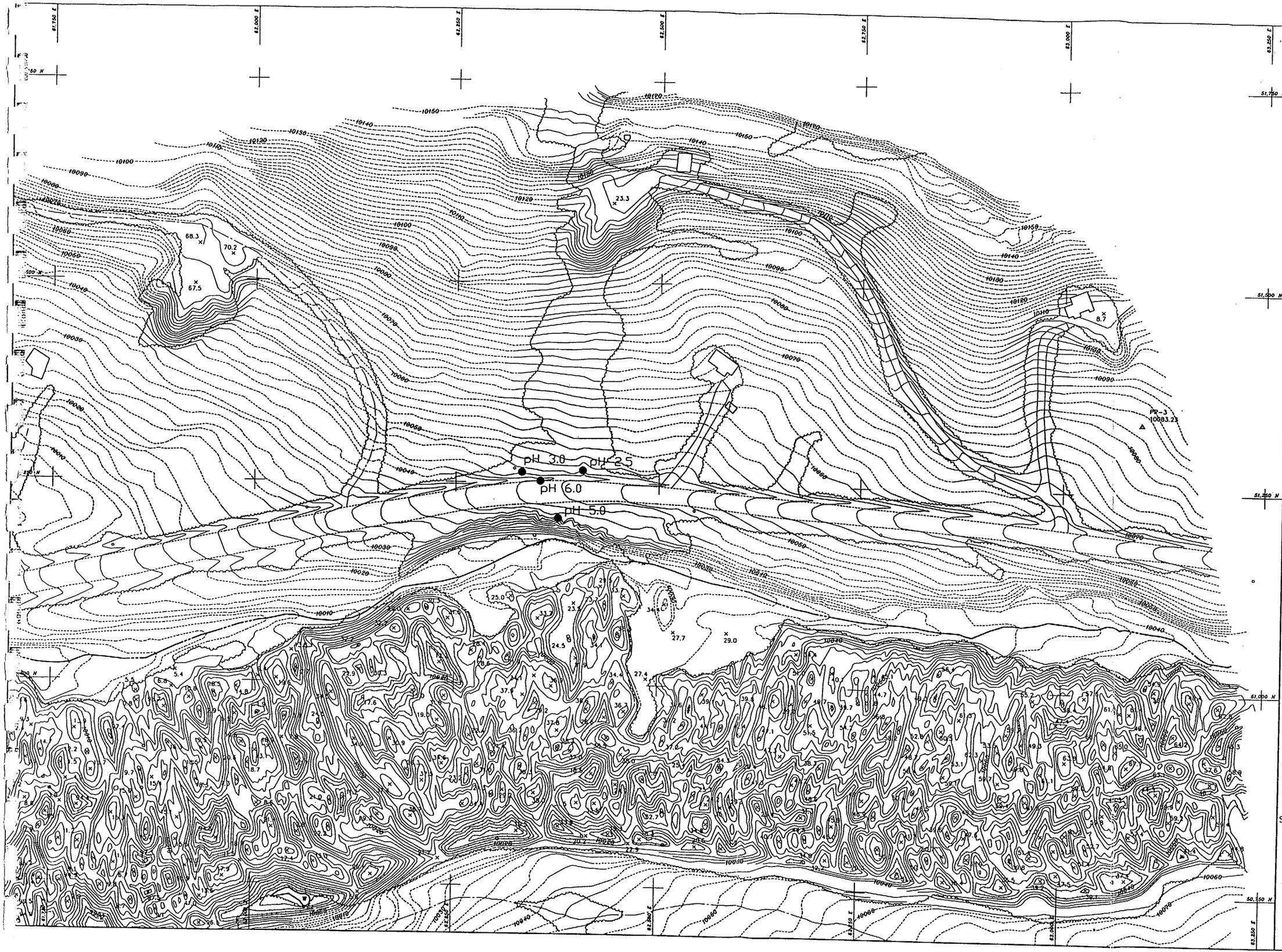

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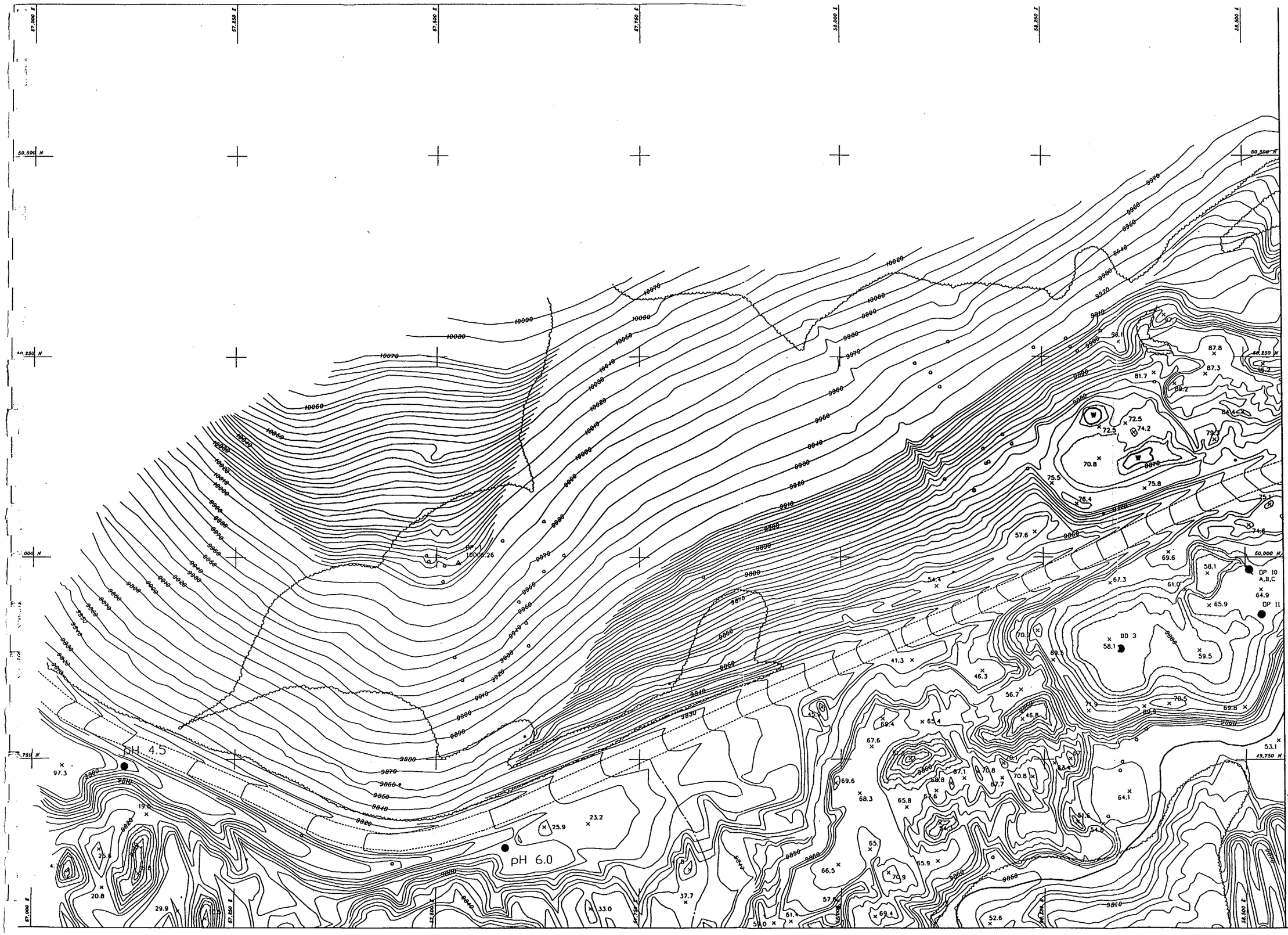

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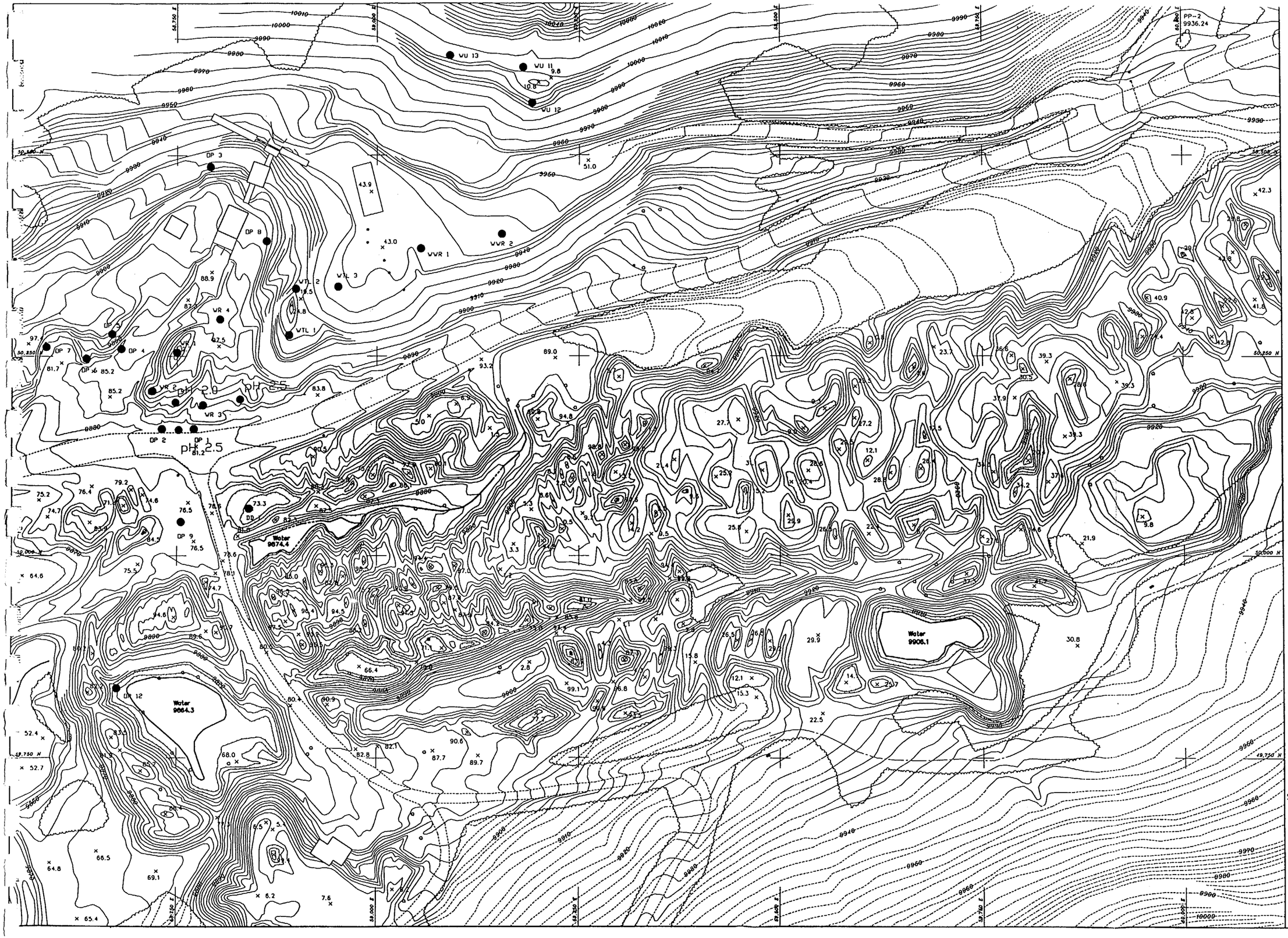

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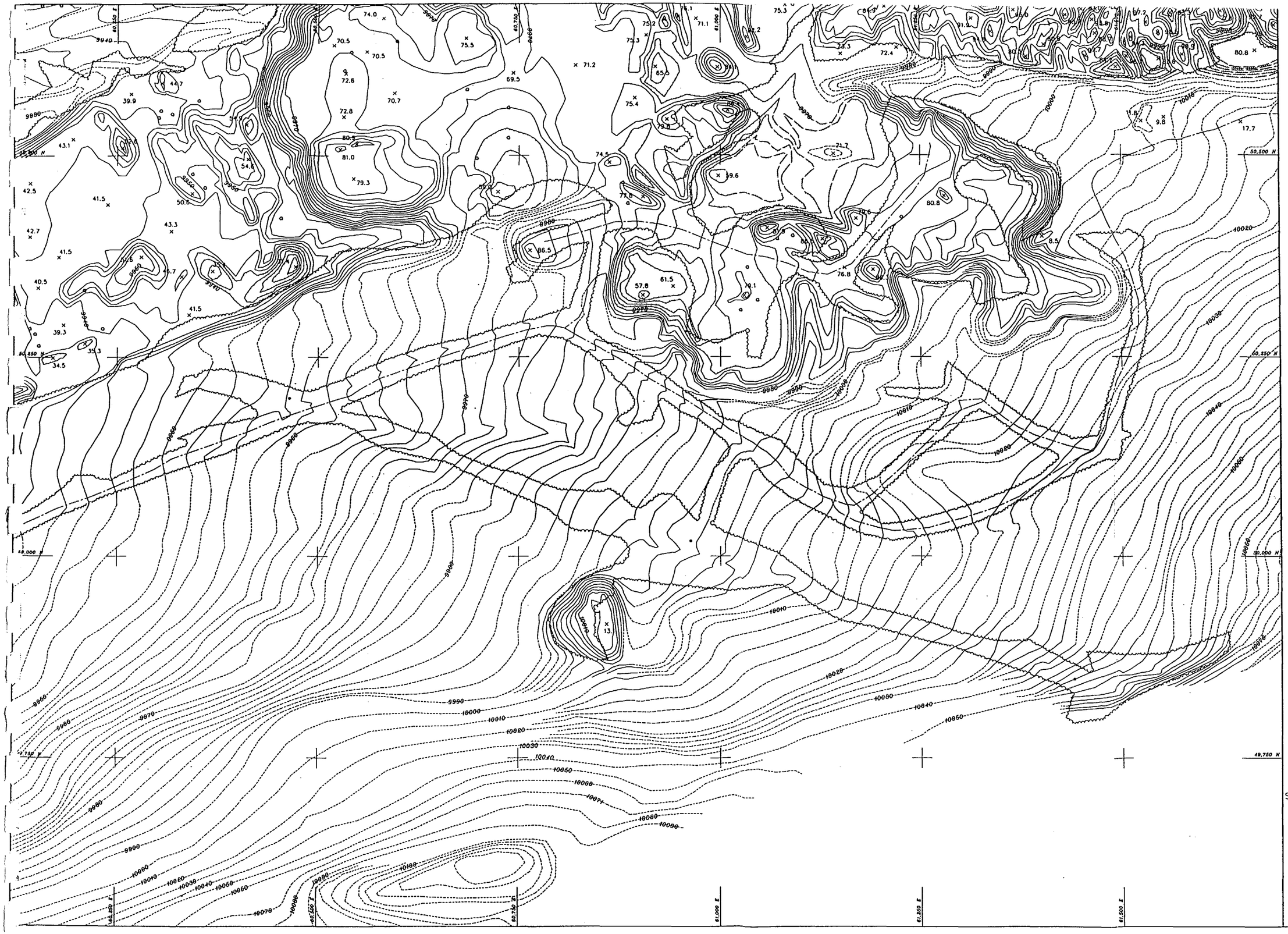

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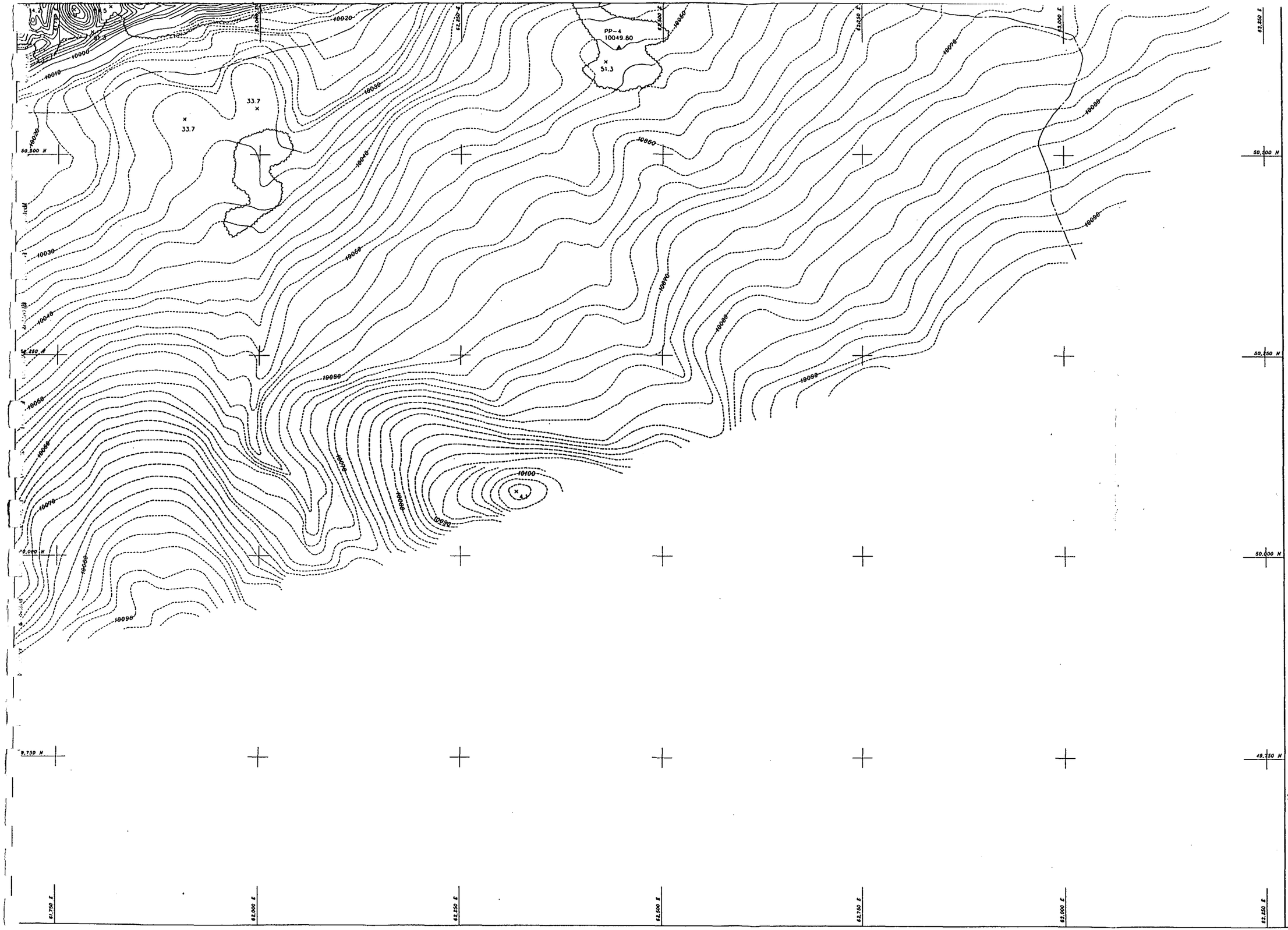

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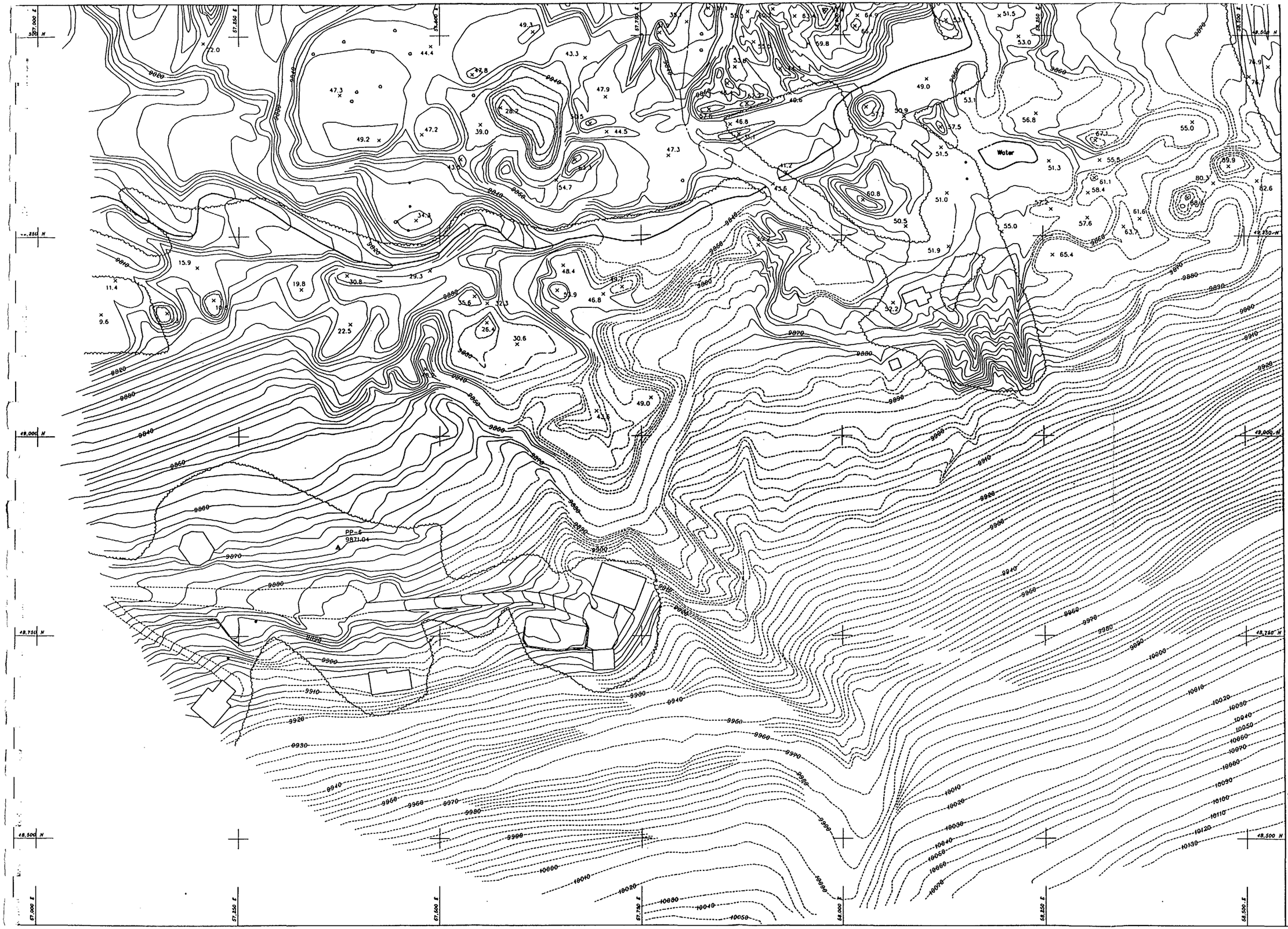

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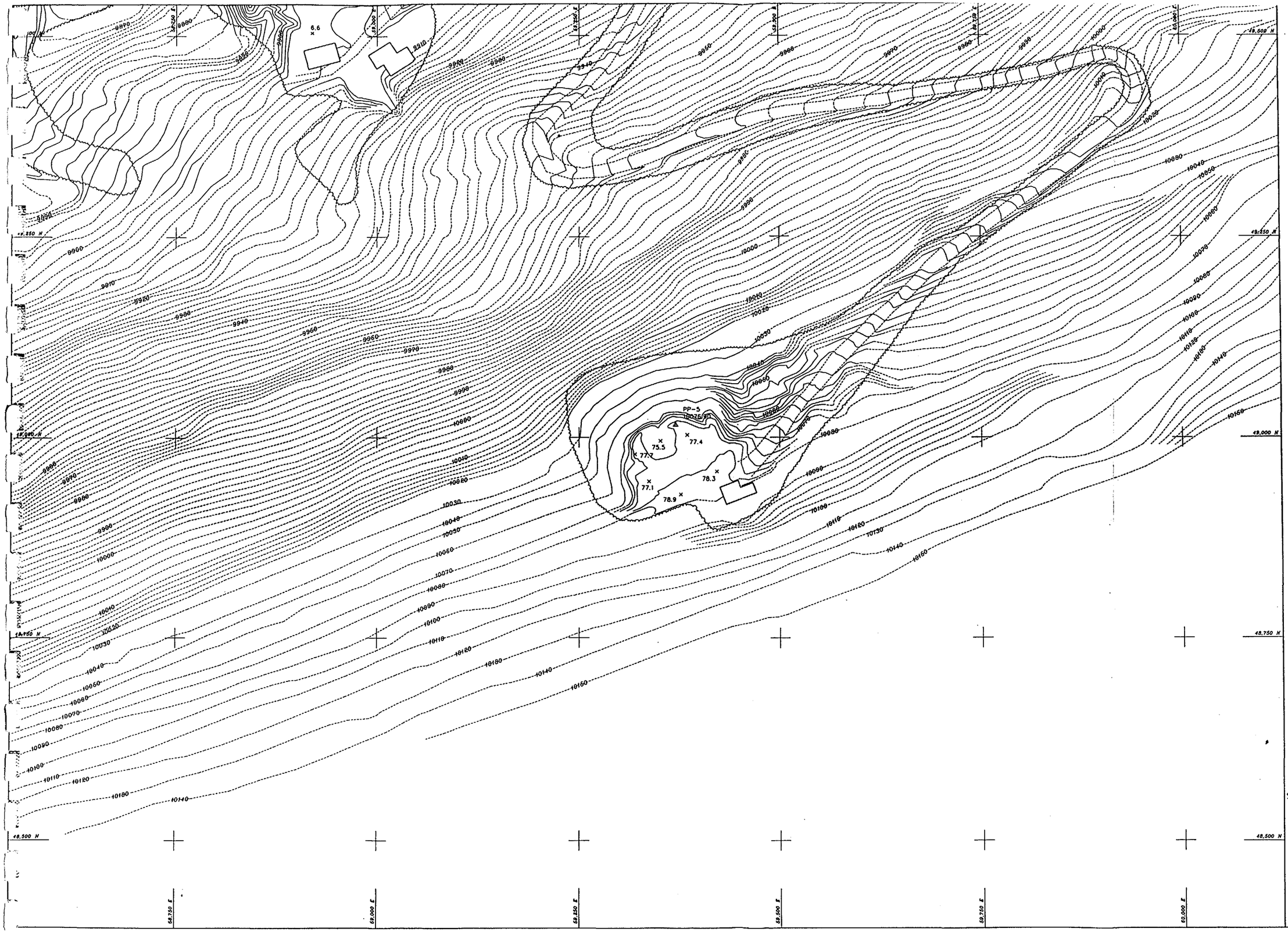

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AERIAL MAPPING PROFESSIONALS
3600 Jet Drive * PO Box 3134
Rapid City, SD 57709-3134 * (605)343-0280

HORIZONS FILE 2-1121

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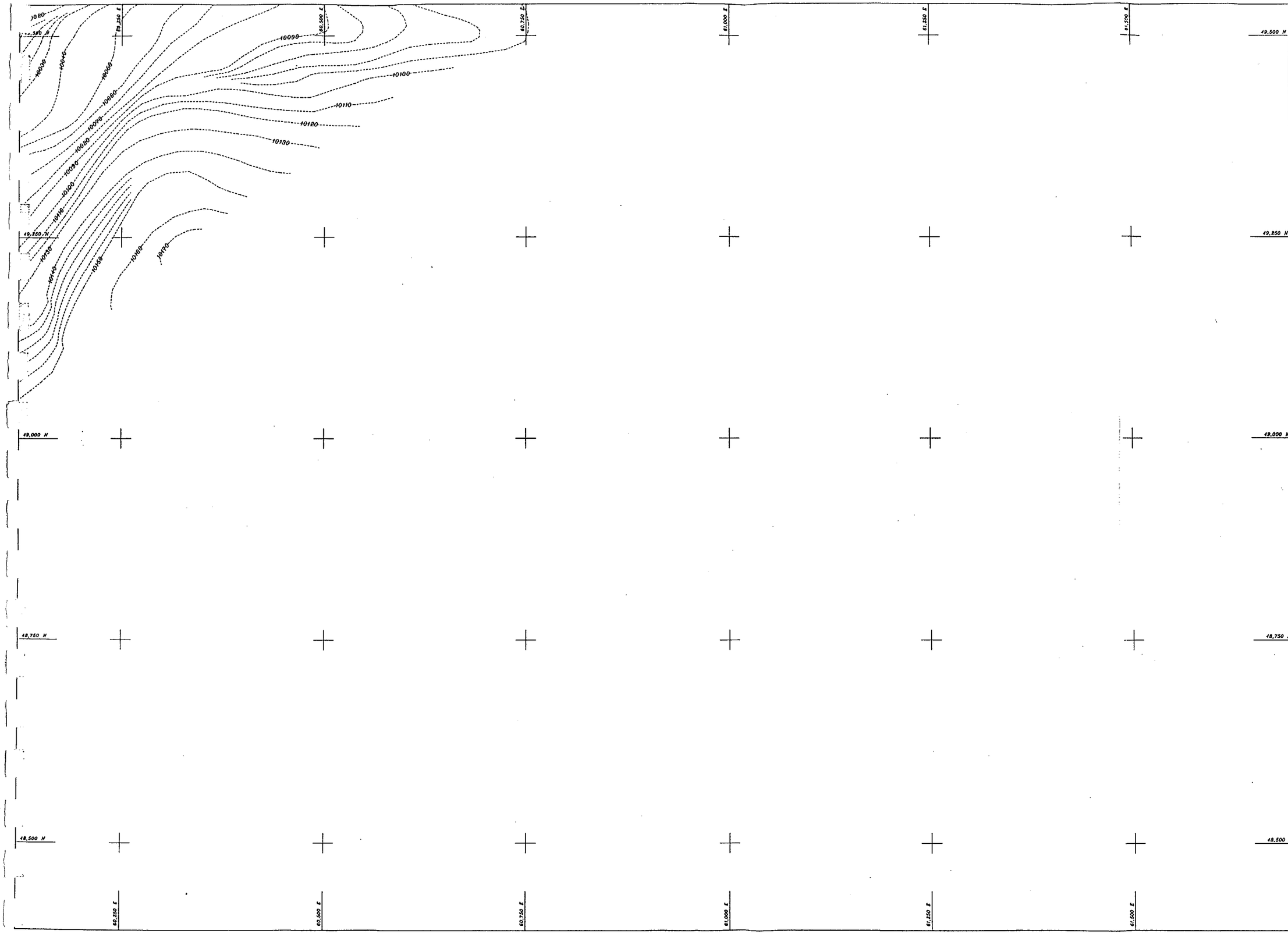

Wellington/Oro Mine - SAR
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Date: 02/1997
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LEGEND

- PAVED ROAD
- GRAVEL ROAD
- TRAIL
- DRIVEWAY
- FENCE
- WALL
- CULVERT
- POND/LAKE
- DRAINAGE LINE
- TREE
- TREE COVER
- BUILDING
- BUILDING FOUNDATION
- CONCRETE SLAB
- LOCATED OBJECT
- POLE
- ELECTRICAL POLE
- GROUND CONTROL
- 9800 INDEX CONTOUR
- INTERMEDIATE CONTOUR
- OBSCURED CONTOUR
- DEPRESSION CONTOUR
- × 9889.3 SPOT ELEVATION

SHEET INDEX

1	2	3
4	5	6	7
8	9	

Scale in Feet
50 0 50 100

Contour Interval = 2'

FRENCH GULCH AREA
NEAR
BRECKENRIDGE, COLORADO
FOR
SUMMIT COUNTY GOVERNMENT
COLORADO

Date of Photography: 7-27-92

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TABLE 1
Wellington \Oro Sample Location Data

Sample Nu;mber	Date	Time	Location	Latitude	Longitude	Comments
WO-WR-3	7/29/96	1150	Roaster fines	39 28.99	106 00.91	Reddish Sandy roaster fines
WO-WR-2	7/29/96	1155	Roaster fines	39 28.98	106 00.92	Reddish sandy roaster fines including white crust
WO-WR-1	7/29/96	1200	Roaster fines	39 28.99	106 00.90	Brown sandy material with waste rock
WR-WO-4A	7/29/96	1204	Roaster fines	39 28.96	106 00.91	6"-12" depth, grey sandy material with some clay
WO-WR-4B	7/29/96	1206	Roaster fines	39 28.96	106 00.91	0"-6" depth, reddish brown sandy material mixed with waste rock
WO-OP-01	7/29/96	1220	Near Roaster Fines	39 28.99	106 00.98	Yellow Precipitate in road ditch near the Roaster fines
WO-OP-02	7/29/96	1225	Near Roaster fines	39 28.94	106 00.91	Blue Precipitate in road ditch near the Roaster fines
WO-WWR-02	7/29/96	1252	Waste Rock	39 28.98	106 00.87	Black, broken-up shale rock
WO-WWR-01	7/29/96	1258	Waste Rock	39 29.02	106 00.87	Tan sandy material with waste rock mixed in
WO-WTL-03	7/29/96	1302	Tailings	39 28.98	106 00.86	Light tan and reddish brown sandy material mixed with waste rock
WO-WTL-04	7/29/96	1310	Tailings	39 28.99	106 00.87	Orange-brown sandy material mixed with waste rock
WO-WU-12	7/29/96	1323	Upper tailings	39 29.00	106 00.80	Orange-yellow tailings
WO-WU-11	7/29/96	1334	Upper tailings	39 29.03	106 00.83	Tan, fine grained sandy clay mixed with waste rock
WO-WU-13	7/29/96	1337	Upper tailings	39 29.00	106 00.82	Tan, fine grained sandy clay mixed with waste rock
WO-WTL-02	7/29/96	1430	Tailings	39 28.99	106 00.87	Light tan waste rock
WO-WTL-01	7/29/96	1433	Tailings	39 28.98	106 00.89	orange-yellow sandy oxidized material mixed with waste rock
WO-OP-03	7/29/96	1441	Tailings at adit	39 29.00	106 00.91	Fine grained yellow material (turns orange-brown when wet)
WO-OP-04	7/29/96	1455	West of roaster fines	39 28.97	106 00.94	Black coures sandy material located near flag pole
WO-OP-05	7/29/96	1458	West of roaster fines	39 28.97	106 00.94	Dark purple fine sandy material
WO-OP-06	7/29/96	1502	West of roaster fines	39 28.96	106 00.94	Light grey, very fine, greenish-gray material
WO-OP-07	7/29/96	1512	West of roaster fines	39 28.95	106 00.95	Yellowish-tan sandy material
WO-OP-08	7/29/96	1530	North-east of roaster fines	39 29.02	106 00.85	Green-brown, fine sand mixed with waste rock
WO-DD-01	7/29/96	1544	Tailings south-east of road	39 28.93	106 00.89	Orange, sandy tailings (more clay at depth)
WO-OP-09	7/29/96	1610	Tailings south-west of road	39 28.94	106 00.93	Orange sandy tailings (0"-6")
WO-OP-10A	7/29/96	1625	Gully cut in tailings pond	39 28.94	106 00.99	Dark orange tailings (0"-6")
WO-OP-10B	7/29/96	1622	Gully cut in tailings pond	39 28.94	106 00.99	Gray clay (6"-12")
WO-OP-10C	7/29/96	1620	Gully cut in tailings pond	39 28.94	106 00.99	Yellow sand (12"-24")
WO-OP-11	7/29/96	1630	Near tailings pond road	39 28.91	106 00.97	Tan sand
WO-DD-03	7/29/96	1635	Adj to MW-03	39 28.91	106 01.01	Orange-brown sandy tailings
WO-OP-12	7/29/96	1642	Seep @ Country Boy mine road	---	---	Orange sediment

TABLE 2A
WELLINGTON ORO SPECTRACE 9000 XRF START SAMPLE DATA (ppm)

ID	APP.	TIME	DATE	Mn	Fe	Cu	Zn	As	Pb	Cd	Ag
WO-DD-01	S	917	10/29/96	730 U	82000	150 J	550	200 U	2000	230 U	110 J
WO-DD-03	T	1421	12/26/96	13000	75000	310 J	13000	440 U	4400	NA	NA
WO-OP-01	T	656	2/10/97	6200	265000	110 U	19000	220 U	6600	NA	NA
WO-OP-01D	T	743	2/10/97	4300	270000	110 U	20000	220 U	7000	NA	NA
WO-OP-02	T	659	2/10/97	2800	388000	110 U	34000	220 U	220 U	NA	NA
WO-OP-03	S	1701	10/28/96	1880 U	54000	210 J	2100	480 U	4800	240 U	140 U
WO-OP-03D	S	1623	10/28/96	1880 U	54000	220 J	2000	510 U	5100	240 U	140 U
WO-OP-04	S	949	10/29/96	3000	342000	420	2700	350 U	3500	240 J	180 J
WO-OP-05	S	1029	10/29/96	1500 J	329000	200 J	1300	360 U	3600	230 U	210 J
WO-OP-06	T	1425	12/26/96	8000	81000	17000	340000	9400 U	94000	NA	NA
WO-OP-07	S	1646	10/28/96	2200 J	77000	290 J	2100	590 U	5900	240 U	170 J
WO-OP-08	S	1530	10/28/96	1880 U	114000	430 J	2000	2000 U	20000	240 U	200 J
WO-OP-08D	S	1025	10/29/96	880 J	115000	580	1900	2000 U	20000	270 J	210 J
WO-OP-09	S	1545	10/28/96	1100 U	95000	230 J	1200	160 U	1600	240 U	140 U
WO-OP-10A	S	1641	10/28/96	1800 U	128000	690	4700	2000 U	20000	240 U	320 J
WO-OP-10B	T	703	2/10/97	15000	57000	110 U	6700	220 U	3300	NA	NA
WO-OP-10C	S	1636	10/28/96	1880 U	23000	140 U	5000	360 U	3600	240 U	160 J
WO-OP-11	T	714	2/10/97	20000	57000	110 U	2000	220 U	1600	NA	NA
WO-OP-12	S	1609	10/28/96	1900 J	146000	350 J	4600	500 U	5000	240 U	140 U
WO-WR-01	S	922	10/29/96	770 J	70000	190 J	1200	570 U	5700	230 U	180 J
WO-WR-02	S	958	10/29/96	730 U	287000	120 J	3200	1300 U	13000	370 J	280 J
WO-WR-03	S	1551	10/28/96	1880 U	294000	140 U	1200	730 U	7300	240 U	280 J
WO-WR-04A	S	1535	10/28/96	1880 U	89000	340 J	1100	3300 U	33000	240 U	210 J
WO-WR-04B	S	1011	10/29/96	730 U	278000	220 J	2800	1600 U	16000	230 U	300 J
WO-WTL-01	S	912	10/29/96	730 U	48000	110 U	250 J	370	770	230 U	140 J
WO-WTL-02	T	1410	12/26/96	4900	41000	180 U	15000	500 U	5000	NA	NA
WO-WTL-03	S	1016	10/29/96	5500	48000	110 U	3800	56 U	400	230 U	100 U
WO-WTL-04	T	1417	12/26/96	4900	120000	280 J	11000	1700 U	17000	NA	NA
WO-WU-11	S	1604	10/28/96	1880 U	48000	180 J	1800	470 U	4700	240 U	140 J
WO-WU-12	S	944	10/29/96	730 U	59000	110 U	870	150	120 J	230 U	140 J
WO-WU-13	S	1034	10/29/96	2100 J	47000	280 J	2200	400 U	4000	230 U	170 J
WO-WWR-01	T	1402	12/26/96	6300	56000	400 J	26000	950 U	9500	NA	NA
WO-WWR-02	T	1406	12/26/96	8000	47000	180 U	13000	270 U	2700	NA	NA

J – The associated numerical value is an estimated quantity between 3 and 10 times the standard deviation of a control sample.
S – The soils application was used.
T – The tailings application was used.
U – The analyte was not detected above the reported concentration which is 3 times the standard deviation of a control sample.

TABLE 2B
WELLINGTON ORO SPECTRACE 9000 XRF DMG SAMPLE DATA (ppm)

ID	APP.	TIME	DATE	Mn	Fe	Cu	Zn	As	Pb	Cd	Ag
WO-DP-2-1	T	717	2/10/97	2100	367000	890	17000	220 U	8100	NA	NA
WO-DP-2-2	T	721	2/10/97	7100	452000	1600	76000	220 U	7100	NA	NA
WO-FG-1-4	S	1026	09/27/96	410 J	36000	70 U	1900	210 U	130 U	110 U	100 U
WO-HS-1-1	S	1417	09/25/96	2500	71000	150 J	2400	160 U	1100	160 U	120 U
WO-HS-1-2	S	1401	09/25/96	1900	70000	120 U	1300	160 U	330 J	160 U	120 U
WO-HS-1-3	S	1206	09/25/96	1200	50000	120 U	1100	160 U	240 J	160 U	120 U
WO-HS-1-4	S	1320	09/25/96	1800	65000	120 U	2000	160 U	1200	160 U	120 U
WO-HS-1-5	S	1200	09/27/96	3300	55000	70 U	2500	210 U	550	110 U	100 U
WO-HS-1-6	S	1524	09/25/96	2000	45000	120 U	1500	160 U	210 J	160 U	120 U
WO-MW-1-2	S	945	09/27/96	3000	222000	280	1900	210 U	13000	220 J	140 J
WO-MW-2-1	S	1123	09/27/96	980 J	73000	250	1200	210 U	5100	110 U	100 U
WO-MW-2-1D	S	1131	09/27/96	1000 J	72000	250	1200	210 U	5100	110 U	100 U
WO-MW-2-3	S	1344	09/25/96	1100	52000	120 U	990	160 U	930	160 U	120 U
WO-MW-3-1	S	1409	09/25/96	1500	66000	240 J	1200	160 U	2200	160 U	120 U
WO-MW-5-1	S	1148	09/25/96	840 J	39000	120 U	1600	160 U	840	160 U	120 U
WO-MW-5-1D	S	1157	09/25/96	920 J	41000	120 U	1600	160 U	910	160 U	120 U
WO-MW-5-2	S	1336	09/25/96	1000	46000	120 U	930	160 U	840	160 U	120 U
WO-MW-5-3	S	1050	09/27/96	1100 J	42000	97 J	940	210 U	730	110 U	100 U
WO-MW-5-4	S	1010	09/27/96	1000 J	45000	70 U	900	210 U	860	110 U	100 U
WO-QW-1-1	S	1214	09/25/96	960 J	55000	120 U	700	160 U	290 J	160 U	120 U
WO-QW-1-2	S	1239	09/25/96	1500	40000	140 J	1100	160 U	800	160 U	120 U
WO-QW-1-3	S	1451	09/25/96	940 J	43000	120 U	400	160 U	410	160 U	120 U
WO-QW-1-4	S	1139	09/25/96	530 J	43000	120 U	540	160 U	940	160 U	120 U
WO-QW-1-5	S	1516	09/25/96	1100	45000	120 U	520	160 U	1500	160 U	120 U
WO-QW-2-1	S	1255	09/25/96	2000	54000	120 U	1100	160 U	360	160 U	120 U
WO-QW-2-2	S	1042	09/27/96	890 J	48000	70 U	550	210 U	170 J	110 U	100 U
WO-QW-2-3	S	953	09/27/96	1700	43000	140 J	600	210 U	130 U	110 U	100 U
WO-QW-2-4	S	1311	09/25/96	1700	46000	120 U	630	160 U	110 U	160 U	120 U
WO-QW-2-5	S	1222	09/25/96	1900	53000	120 U	530	160 U	110 U	160 U	120 U
WO-QW-2-6	S	1443	09/25/96	1800	45000	120 U	500	160 U	110 U	160 U	120 U
WO-QW-3-1	T	725	2/10/97	48000	45000	270 J	9300	220 U	1800	NA	NA
WO-QW-3-2	S	1059	09/27/96	3300	44000	170 J	2100	210 U	880	110 U	100 U
WO-QW-3-3	S	1459	09/25/96	2000	49000	190 J	1700	160 U	660	160 U	120 U
WO-QW-3-4	S	1303	09/25/96	1300	50000	120 U	1700	160 U	680	160 U	120 U
WO-QW-4-1	S	1115	09/27/96	780 J	40000	160 J	1400	210 U	1600	110 U	100 U
WO-QW-4-2	S	1352	09/25/96	1100	46000	120 U	950	160 U	880	160 U	120 U
WO-RF-1-4	T	735	2/10/97	1400 J	308000	1400	48000	220 U	19000	NA	NA
WO-RF-2-1	T	739	2/10/97	480 U	651000	1000	19000	220 U	35000	NA	NA

J – The associated numerical value is an estimated quantity between 3 and 10 times the standard deviation of a control sample.
S – The soils application was used.
T – The tailings application was used.
U – The analyte was not detected above the reported concentration which is 3 times the standard deviation of a control sample.

TABLE 3
WELLINGTON/ORO WASTE ROCK AND TAILINGS SAMPLES : TCLP
TDD# 9604-0011

Sample	Description	Arsenic (ppm)	Barium (ppm)	Cadmium (ppm)	Chromium (ppm)	Lead (ppm)	Nickel (ppm)	Selenium (ppm)	Silver (ppm)	Zinc (ppm)
WOWR01	Roaster fines	U	.707B	0.82	0.0129	11.40	.0242 B	.006 B	U	16.60
WOOP10A	Tailings	U	1.150B	0.29	U	21.30	0.04	0.02	U	45.10
WOOP06	Grey Waste	U	1.140B	7.41	U	43.30	0.19	.0205 B	U	1560.00
WOOP08	Green Waste	U	1.170B	0.07	0.004	25.60	.0173B	.0064B	U	9.25
WODD03	Tailings	U	1.580B	1.02	U	29.50	.0847B	.0247B	U	128.00
WOWTL02	Waste Rock	0.0076	1.590B	0.39	U	32.10	0.19	.0252B	U	59.20
WOWTL04	Waste Rock	U	1.090B	0.48	U	42.70	0.19	.0207B	U	83.90
WOWWR01	Sand Waste	U	1.540B	0.81	U	53.20	0.06	.0138B	U	145.00
WOWWR03	Shale	U	1.350B	0.29	U	4.08	0.23	.0254B	U	26.70

TABLE #4
WELLINGTON ORO LABORATORY DATA (ppm)

ID	Mn	Fe	Cu	Zn	As	Pb	Cd	Ag
WO-DD-03	8970	72200	436	12500	124	3360	70.6	22.5
WO-OP-06	5990	90400	17000	304000	30.7	72700	1470	135
WO-OP-08	108	91700	504	1760	292	24100	3.1	45.6
WO-OP-10A	954	135000	955	5520	386	25000	11.5	94.7
WO-WTL-02	4540	47500	216	14700	392	7230	78	10.3
WO-WTL-04	3920	67100	261	17600	162	10900	85.5	17.3
WO-WWR-01	3830	70500	630	34300	131	10600	187	27.8
WO-WWR-02	3930	29200	96.1	14300	81.3	2930	79	5.9

TABLE #5
WELLINGTON ORO DATA (ppm) and RPDs

ID	Mn		RPD	Fe	RPD	Cu		RPD	Zn	RPD	Pb	RPD
WO-DD-03												
LAB	8970			72200		436			12500		3360	
XRF-SOIL	15000		0.503	63000	(0.136)	330	J	(0.277)	9000	(0.326)	2600	(0.255)
XRF-TAIL	13000		0.367	75000	0.038	310	J	(0.338)	13000	0.039	4400	0.268
WO-OP-06												
LAB	5990			90400		17000			304000		72700	
LAB - SVL	5410		(0.102)	103000	0.130	16700		(0.018)	318000	0.045	82400	0.125
XRF-TAIL	8000		0.287	81000	(0.110)	17000		0.000	340000	0.112	94000	0.256
WO-OP-08												
LAB	108			91700		504			1760		24100	
XRF-SOIL	1880	U	N/A	114000	0.217	430	J	(0.158)	2000	0.128	20000	(0.186)
XRF-TAIL	570	J	1.363	180000	0.650	960		0.623	3800	0.734	44000	0.584
WO-OP-10A												
LAB	954			135000		955			5520		25000	
XRF-SOIL	1800	U	N/A	128000	(0.053)	690		(0.322)	4700	(0.160)	20000	(0.222)
XRF-TAIL	900	J	(0.058)	170000	0.230	1300		0.306	7100	0.250	37000	0.387
WO-WTL-02												
LAB	4540			47500		216			14700		7230	
XRF-SOIL	4900		0.076	36000	(0.275)	180	J	(0.182)	9200	(0.460)	2600	(0.942)
XRF-TAIL	4900		0.076	41000	(0.147)	180	U	N/A	15000	0.020	5000	(0.365)
WO-WTL-04												
LAB	3920			67100		261			17600		10900	
XRF-SOIL	5400		0.318	90000	0.292	270	J	0.034	6700	(0.897)	8500	(0.247)
XRF-TAIL	4900		0.222	120000	0.565	280	J	0.070	11000	(0.462)	17000	0.437
WO-WWR-01												
LAB	3830			70500		630			34300		10600	
XRF-SOIL	6300		0.488	47000	(0.400)	360	J	(0.545)	18000	(0.623)	4800	(0.753)
XRF-TAIL	6300		0.488	56000	(0.229)	400.000	J	(0.447)	26000	(0.275)	9500	(0.109)
WO-WWR-02												
LAB	3930			29200		96.1			14300		2930	
XRF-SOIL	8200		0.704	41000	0.336	160	J	0.499	10000	(0.354)	1400	(0.707)
XRF-TAIL	8000		0.682	47000	0.467	180	U	N/A	13000	(0.095)	2700	(0.082)

J - The associated numerical value is an estimated quantity between 3 and 10 times the standard deviation of a control sample.
NA - Not Applicable
U - The analyte was not detected above the reported concentration which is 3 times the standard deviation of a control sample.

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Table 6
BOR XRD Results

Sample No.	Quartz	Feldspar	Smectite	Illite/mica	Kaolinite	Ankerite	Siderite	Gypsum	Angelsite	Jasonite	Alunites	Geothite	Hematite	Pyrite\sphalerite	Other
WOWR01	Major	X		X	X			major		major	?	X		?	
WOOP10A	Major	?		X	X			Major		Major	?	?			?
WOOP06	X			X			?	X	Major				X	Major	?
WOOP08	X			X	X			Major		Major	?	?			
WODD03	Major	?	?	Major	X	X	X							X	
WOWTL02	Major	?		Major	Major	X	?	?						?	
WOWTL04	Major	X		Major	Major			X		Major		?			
WOWWR01	Major	?		Major	Major	?	?	?						X	
WOWWR03	Major			X	X	Major								Major	X

"Major" indicates a significant portion of the mineral is present in the sample evidenced by multiple diffraction peaks with relatively strong intensity.
"X" indicates the mineral is present in the sample evidenced by multiple diffraction peaks.
"?" indicates the mineral is probably present evidenced by only one diffraction peak.
A blank space indicates no diffraction peaks were identified.

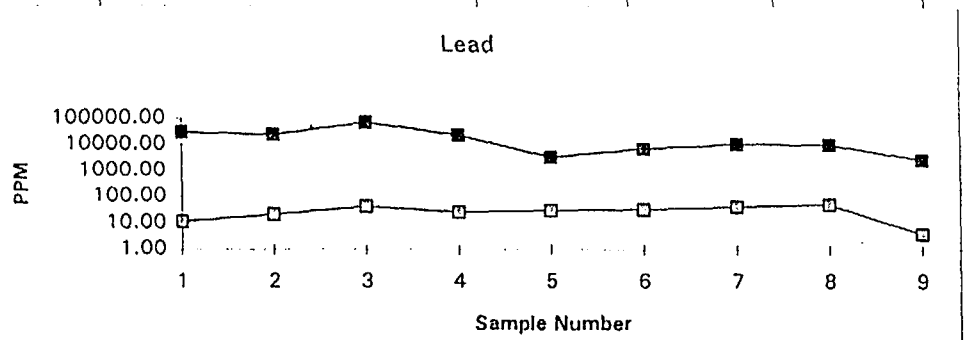
TABLE 7
WELLINGTON/ORO WASTE ROCK AND TAILINGS SAMPLES : TOTAL METALS VS TCLP
TDD# 9604-0011

Sample	Description	Arsenic		Cadmium		Chromium		Lead		Zinc	
		Total (ppm)	TCLP (ppm)	Total (ppm)	TCLP (ppm)	Total (ppm)	TCLP (ppm)	Total (ppm)	TCLP (ppm)	Total (ppm)	TCLP (ppm)
WOWR01	Roaster fines	169.00	U	3.70	0.82	2.90	0.0129	30500.00	11.40	2070.00	16.60
WOOP10A	Tailings	386.00	U	11.50	0.29	6.50	U	25000.00	21.30	5520.00	45.10
WOOP06	Grey Waste	30.70	U	1470.00	7.41	20.50	U	72700.00	43.30	304000.00	1560.00
WOOP08	Green Waste	292.00	U	3.10	0.07	3.70	0.004	24100.00	25.60	1760.00	9.25
WODD03	Tailings	124.00	U	70.60	1.02	5.90	U	3360.00	29.50	12500.00	128.00
WOWTL02	Waste Rock	392.00	0.0076	78.00	0.39	7.40	U	7230.00	32.10	14700.00	59.20
WOWTL04	Waste Rock	162.00	U	85.50	0.48	6.90	U	10900.00	42.70	17600.00	83.90
WOWWR01	Sand Waste	131.00	U	187.00	0.81	4.90	U	10600.00	53.20	34300.00	145.00
WOWWR03	Shale	81.30	U	79.00	0.29	5.30	U	2930.00	4.08	14300.00	26.70

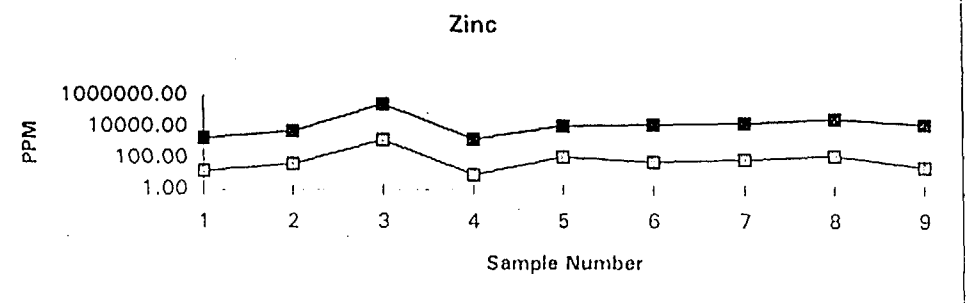
Exceeds TCLP Standards 40 CFR 261.24

TABLE 8
WELLINGTON ORO TCLP vs. TOTAL METALS
TDD# 9604-0011

		Lead		
		Total/TC	Total Lead	TCLP
WOWR01	Roaster fi	2675.4	30500.00	11.40
WOOP10A	Tailings	1173.7	25000.00	21.30
WOOP06	Grey Was	1679	72700.00	43.30
WOOP08	Green Wa	941.41	24100.00	25.60
WODD03	Tailings	113.9	3360.00	29.50
WOWTL02	Waste Ro	225.23	7230.00	32.10
WOWTL04	Waste Ro	255.27	10900.00	42.70
WOWWR01	Sand Wa	199.25	10600.00	53.20
WOWWR03	Shale	718.14	2930.00	4.08



		Zinc		
		Total/TC	Total (ppm)	TCLP (ppm)
WOWR01	Roaster fi	124.7	2070.00	16.60
WOOP10A	Tailings	122.39	5520.00	45.10
WOOP06	Grey Was	194.87	304000.00	1560.00
WOOP08	Green Wa	190.27	1760.00	9.25
WODD03	Tailings	97.656	12500.00	128.00
WOWTL02	Waste Ro	248.31	14700.00	59.20
WOWTL04	Waste Ro	209.77	17600.00	83.90
WOWWR01	Sand Wa	236.55	34300.00	145.00
WOWWR03	Shale	535.58	14300.00	26.70



APPENDIX A

Photolog

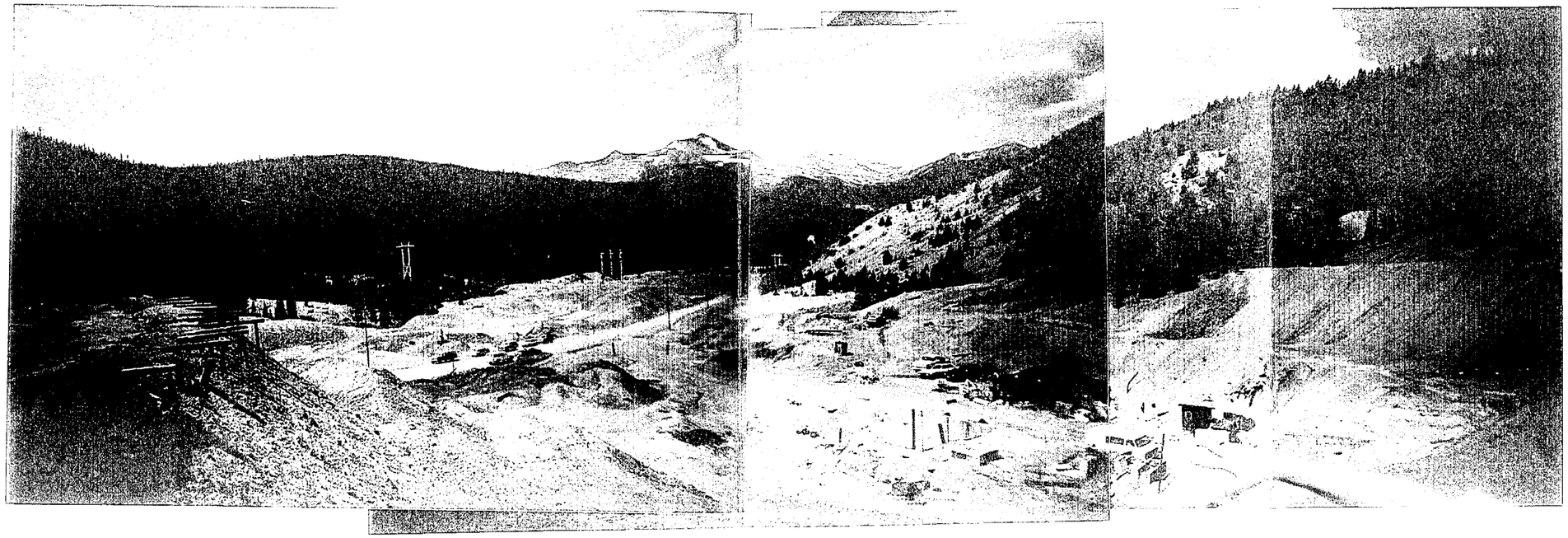


PHOTO 1
Panorama of Wellington/Oro site.

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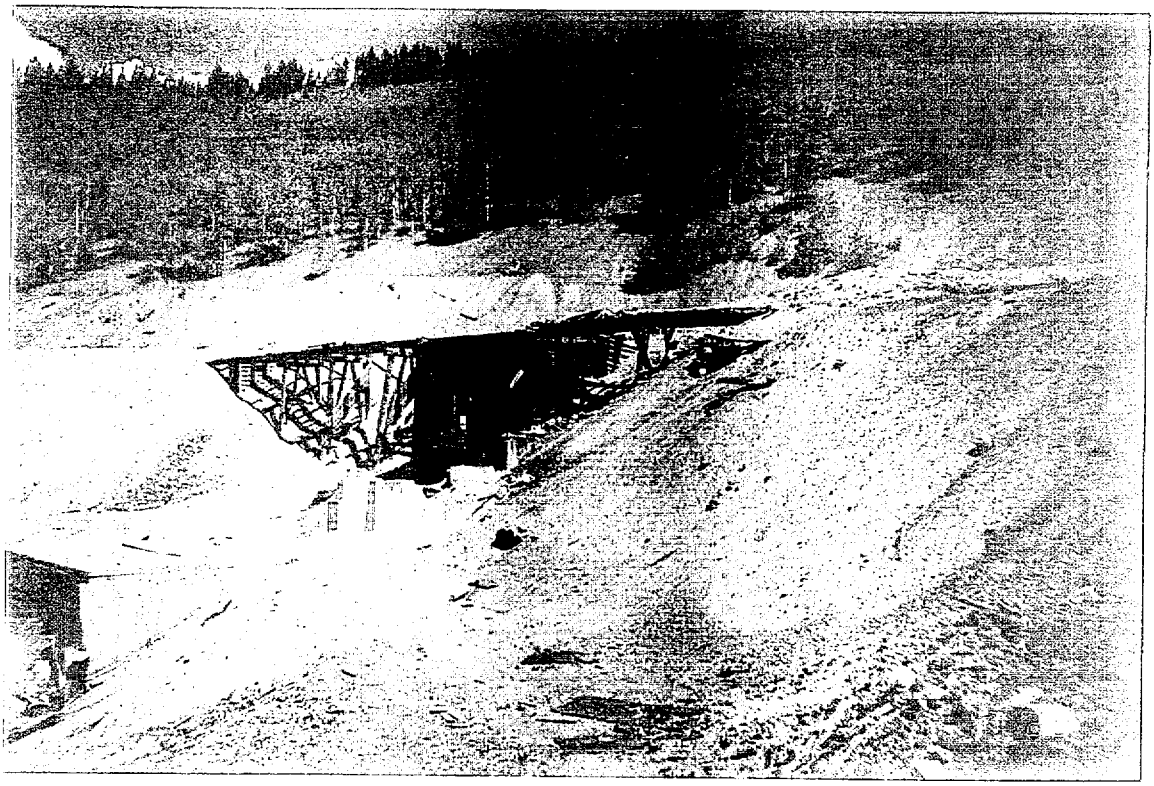

PHOTO 2
Storage bin leading into old mill site.

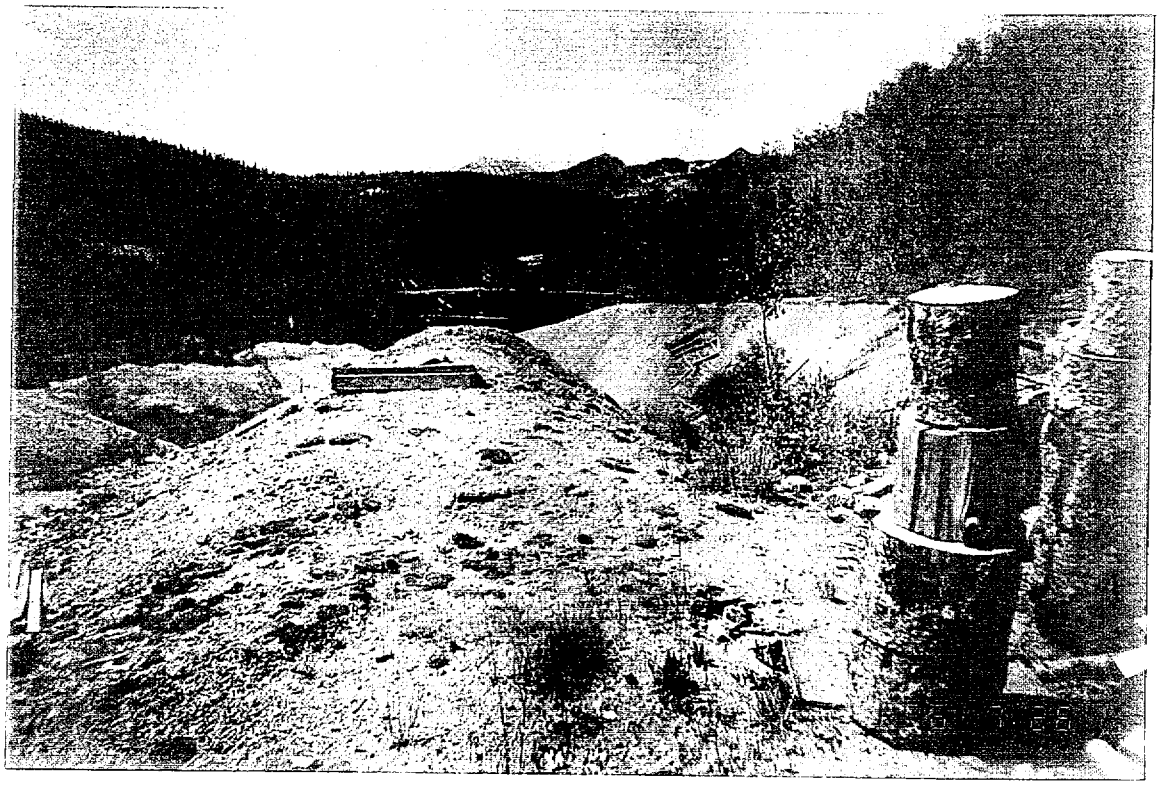

PHOTO 3
Looking at the Extenuate Adit.

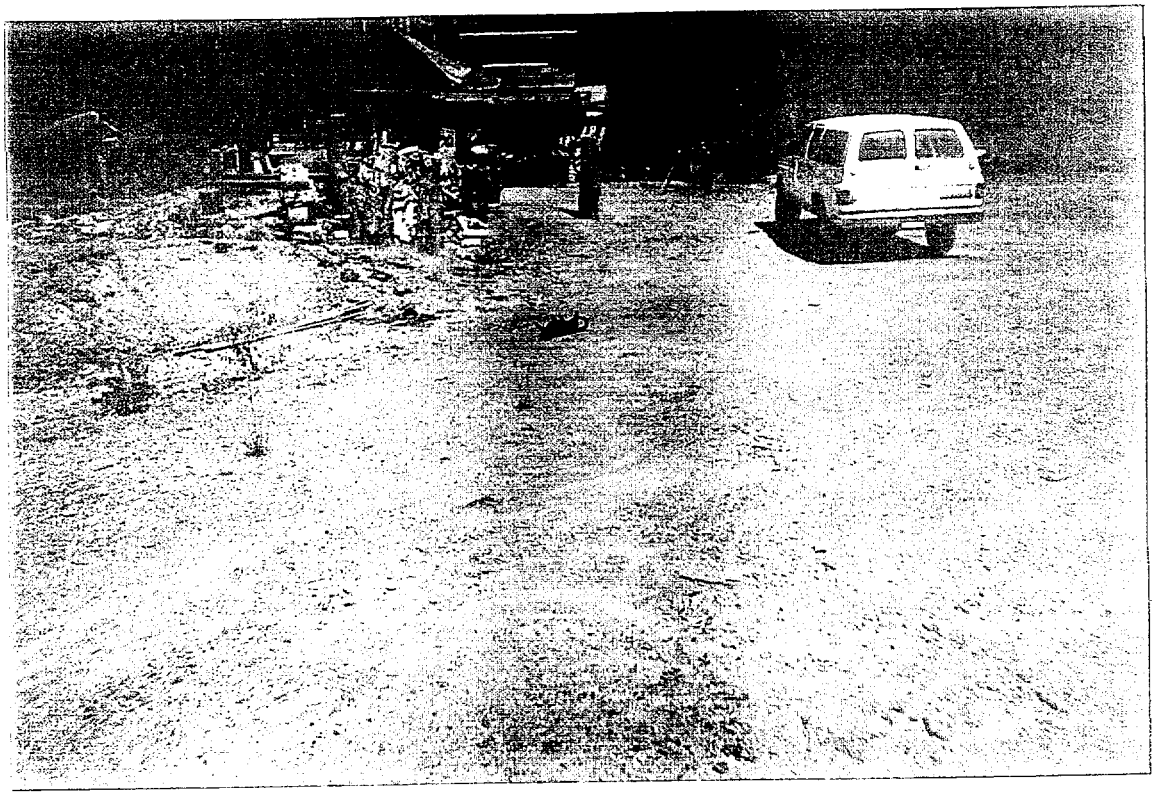

PHOTO 4
Cat rolling in mine tailings.

PHOTO 5
View from waste rock dump east of adit.

PHOTO 6
View of mill/adit site from waste rock dump.

PHOTO 7
Old foundations at Wellington/Oro Mine site.

PHOTO 8
XRF set up in the field.

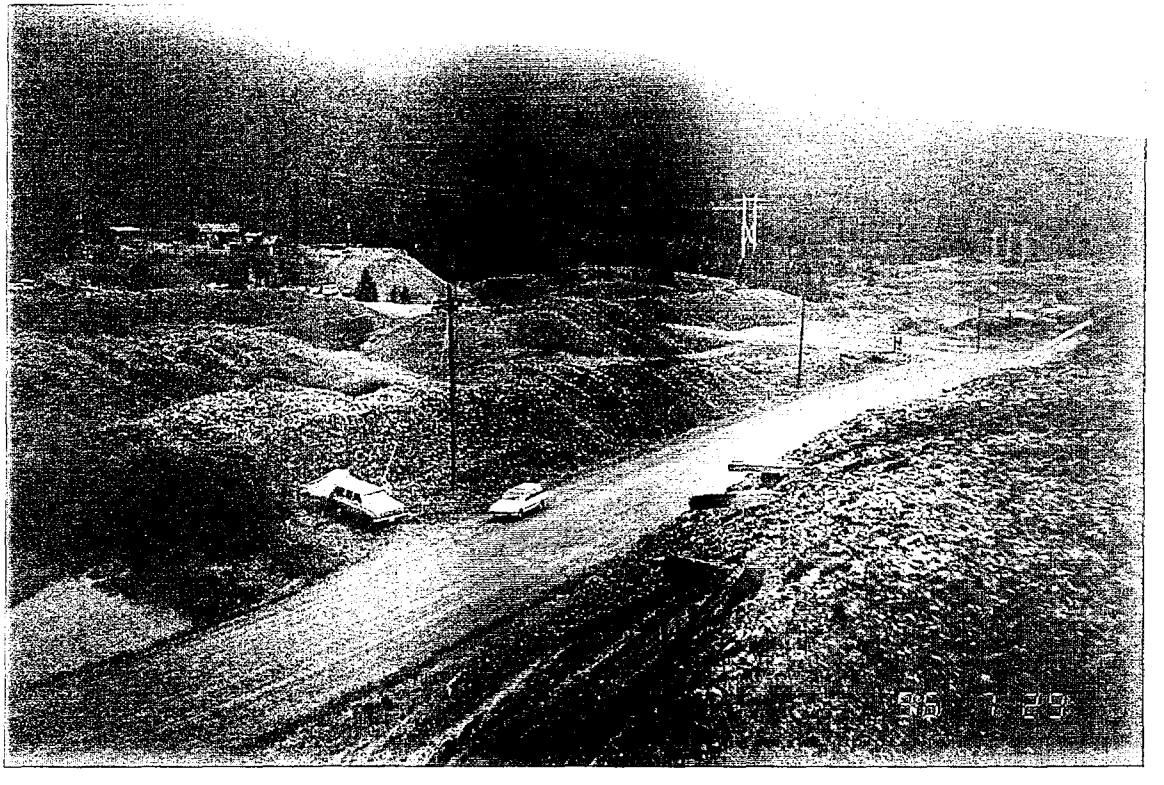

PHOTO 9
Placer/dredge spoils in French Creek.

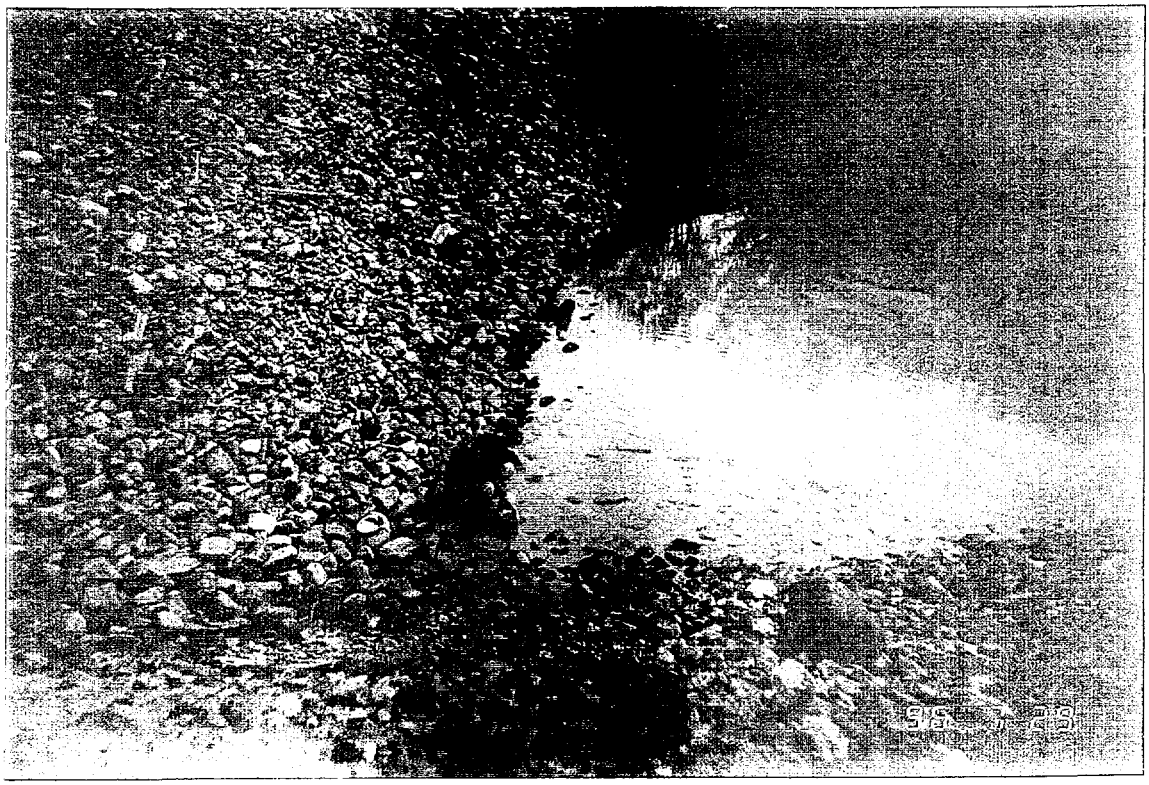

PHOTO 10
Sampling sludge at seep into French Creek.

PHOTO 11
Collecting Sample WO-OP-03.

PHOTO 12
Sampling at the roaster fines.

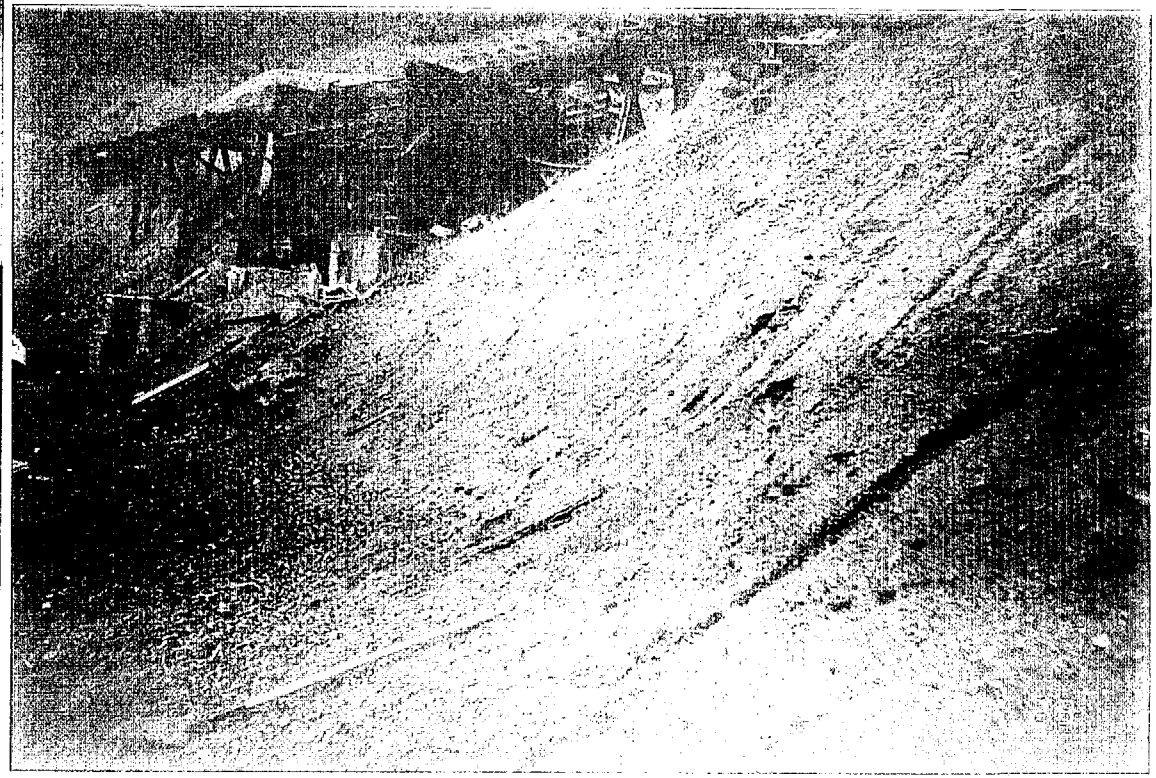

PHOTO 13
Collecting Sample WO-OP-08.

PHOTO 14
Collecting Samples WO-OP-10A, WO-OP-10B, and WO-OP-10C at tailings pond.

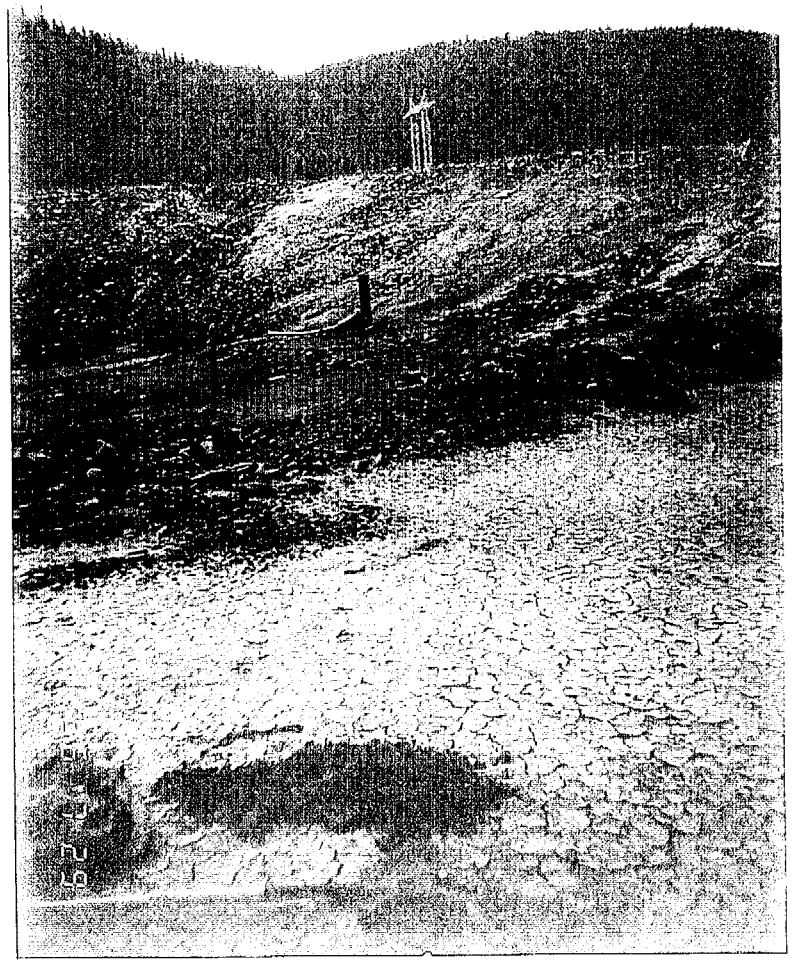

PHOTO 15
Collecting Sample WO-OD-03 at the tailings pond.

PHOTO 16
Iron staining from seepage out of tailings.

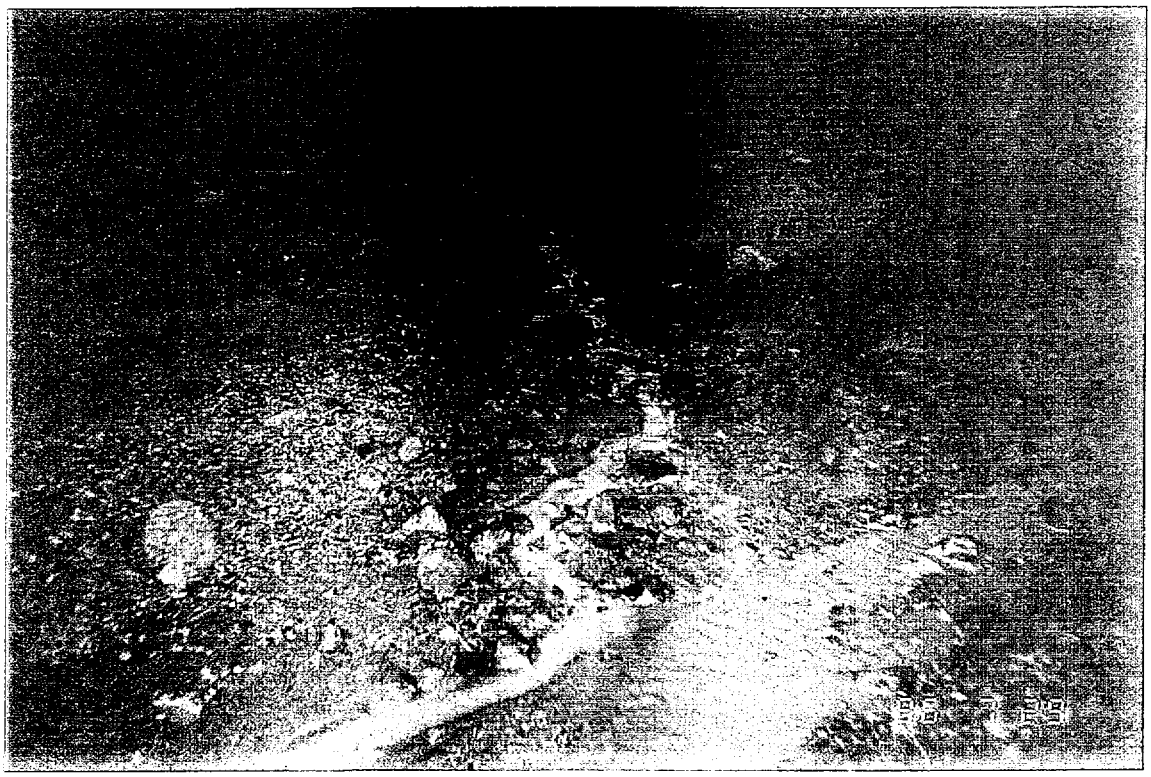

PHOTO 17
Rain/runoff offered opportunity for pH tests.

PHOTO 18
Checking pH below the extenuate waste rock dumps.

PHOTO 19
Runoff from the upper (east) dumps.

APPENDIX B

QA/QC Validation Report

Wellington Oro Mine
Field and Laboratory Analytical Data Evaluation Report

Thirty soil samples, collected at the Wellington Oro site in July 1996, were screened using a Spectrace 9000 XRF field instrument to indicate trends in metal concentrations. Nine of the thirty samples were submitted to Galson Laboratories in East Syracuse, New York for definitive analysis of EPA Target Analyte List metals and TCLP extractable metals plus nickel and zinc. The data are acceptable for the purpose of characterizing the metal contamination in the samples. Thirty-six soil samples that had been collected by the State of Colorado in October 1993 were also screened by the Spectrace 9000 XRF field instrument. None of the thirty-six samples were sent for definitive analysis.

The XRF data were successfully used to indicate rough trends in the metal contamination of the samples. The XRF data did not correlate well with the laboratory data, see Tables 5A and 5B. The Spectrace 9000 computer software assumes that soil samples are primarily silica. For mine tailings and waste rock, this assumption is not necessarily correct. The computer software program can account for up to 30% heavy metals. Once there is more than 30% heavy metals, the density of the sample is greater than normally expected. Therefore the accountability of the elements is skewed, some are biased high but most are biased low.

The data were validated by TechLaw, Inc. team subcontractor to UOS on the START contract. The "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," February 1994, were modified for use with the requested methods. The validation reports were reviewed by the START Quality Assurance Officer. The specified methods were taken from Test Methods for the Analysis of Solid Waste, SW 846 as follows:

Method 1311	(Toxicity Characteristic Leaching Procedure)
Method 6010	(Inductively coupled plasma, atomic emission spectroscopy, ICP)
Method Series 7000	(Atomic absorption methods)

The data were reviewed for the following:

- Deliverables/Documentation: All required data were provided.
- Data Report Narratives: Comments made in the data report narratives were correlated with the raw data. No errors were found.
- Form 1 Reports: Form 1 reports of analytical results were reviewed for correctness (dates, dilutions, sample identification).
- Holding Times: All metals with the exception of mercury were analyzed within the holding time specified in the analytical methods. The samples, collected in July 1996, were not sent to the laboratory until September 1996. The hold time for mercury is twenty-eight days.
- Blanks: Blanks were evaluated for possible contamination. Eight metals were detected in method blanks at concentrations below or close to laboratory reporting limits. The primary target metals (Pb, Zn, Cu, Fe) were not detected in the blanks
- Initial and Continuing Calibrations: All calibrations were in conformance with method requirements.

- Laboratory QC Samples: Data for matrix spike (MS), laboratory control spike (LCS) and sample replicates were reviewed.

  Laboratory precision was confirmed by review of sample replicate relative percent difference (RPD) which was within control limits (80% - 120%) for all metals with the exception of lead in the TCLP leachate.

  Two MS samples were analyzed, one for soil and one for the TCLP leachate. For the soil MS, four of twenty-two metals exhibited low % Rec of the spike metals. Selenium and thallium spike recoveries were 0%, causing these data to be rejected (R).

  For the TCLP extract, the metals used in preparing the spiked sample were recovered within acceptable ranges with the exception of lead which was recovered at 330%. This high value may reflect inaccurate analysis of the sample itself which was reported at 11.4 ppm. Lead concentration was reported at 23 ppm in the spiked leachate (after subtraction of the known spike concentration) and also at 23 ppm in the sample replicate, suggesting that the initial sample concentration was reported inaccurately.

The XRF duplicate analyses indicated that the precision was acceptable. The analysis of standard SRM-2709 indicated that the accuracy was outside acceptable ranges for several elements. The XRF data are biased high for arsenic, manganese and silver. The XRF data are biased low for barium, copper, iron, lead and zinc. The chromium, cobalt and nickel data are unusable. The bias' are probably due to the high metal content within the samples. The software program can only correct for up to 30% heavy metals.

XRF data discussion by:	Kenton J. Alexander, Senior Chemist
Lab data discussion by:	Lori Raschke, Quality Assurance Officer
Submitted by:	Lori Raschke, Quality Assurance Officer
	November 21, 1996

TABLE #1
WELLINGTON ORO DATA (ppm)

ID	Mn	Fe	Cu	Zn	As	Pb	Cd	Ag
WO-DD-03								
LAB-Galson	8970	72200	436	12500	124	3360	70.6	22.5
LAB - SVL	9600	83400	457	15100	66.6	3690	73.8	24.6
XRF-SOIL	15000	63000	330 J	9000	260 U	2600	240 U	140 U
XRF-TAIL	13000	75000	310 J	13000	440 U	4400	NA	NA
WO-OP-06								
LAB-Galson	5990	90400	17000	304000	30.7	72700	1470	135
LAB - SVL	5410	103000	16700	318000	6.2 U	82400	1330	121
XRF-SOIL	5400	41000	7700	154000	3100 U	31000	1000	210 J
XRF-TAIL	8000	81000	17000	340000	9400 U	94000	NA	NA
WO-OP-08								
LAB-Galson	108	91700	504	1760	292	24100	3.1	45.6
LAB - SVL	114	116000	557	2400	243	78100	12.3	71.3
XRF-SOIL	1880 U	114000	430 J	2000	2000 U	20000	240 U	200 J
XRF-TAIL	570 J	180000	960	3800	4400 U	44000	NA	NA
WO-OP-08D								
LAB-Galson	NA	NA	NA	NA	NA	NA	NA	NA
LAB - SVL	NA	NA	NA	NA	NA	NA	NA	NA
XRF-SOIL	880 J	115000	580	1900	2000 U	20000	270 J	210 J
XRF-TAIL	570 J	170000	920	3700	4400 U	44000	NA	NA
WO-OP-10A								
LAB-Galson	954	135000	955	5520	386	25000	11.5	94.7
LAB - SVL	907	158000	959	5260	311	34500	16.4	88.1
XRF-SOIL	1800 U	128000	690	4700	2000 U	20000	240 U	320 J
XRF-TAIL	900 J	170000	1300	7100	3700 U	37000	NA	NA
WO-WR-01								
LAB-Galson	NA	NA	NA	NA	NA	NA	NA	NA
LAB - SVL	NA	NA	NA	NA	NA	NA	NA	NA
XRF-SOIL	770 J	70000	190 J	1200	570 U	5700	230 U	180 J
XRF-TAIL	760 J	92000	470 J	2100	1200 U	12000	NA	NA
WO-WTL-02								
LAB-Galson	4540	47500	216	14700	392	7230	78	10.3
LAB - SVL	3890	67900	337	31300	457	42000	134	36
XRF-SOIL	4900	36000	180 J	9200	260 U	2600	230 U	100 U
XRF-TAIL	4900	41000	180 U	15000	500 U	5000	NA	NA
WO-WTL-04								
LAB-Galson	3920	67100	261	17600	162	10900	85.5	17.3
LAB - SVL	3190	93400	274	12600	118	13100	43.2	20.1
XRF-SOIL	5400	90000	270 J	6700	850 U	8500	230 U	140 J
XRF-TAIL	4900	120000	280 J	11000	1700 U	17000	NA	NA
WO-WWR-01								
LAB-Galson	3830	70500	630	34300	131	10600	187	27.8
LAB - SVL	4580	103000	392	27500	81.4	32200	129	85.5
XRF-SOIL	6300	47000	360 J	18000	480 U	4800	230 U	140 J
XRF-TAIL	6300	56000	400.000 J	26000	950 U	9500	NA	NA
WO-WWR-02								
LAB-Galson	3930	29200	96.1	14300	81.3	2930	79	5.9
LAB - SVL	5280	40400	110	20600	88.2	4280	112	12.3
XRF-SOIL	8200	41000	160 J	10000	210	1400	240 J	120 J
XRF-TAIL	8000	47000	180 U	13000	270 U	2700	NA	NA

J - The associated numerical value is an estimated quantity between 3 and 10 times the standard deviation of a control sample.
NA - Not Applicable
U - The analyte was not detected above the reported concentration which is 3 times the standard deviation of a control sample.

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300 UNION BOULEVARD, SUITE 510, LAKEWOOD, COLORADO 80228 U.S.A.

TECHLAW INC.

PHONE: (303) 763-7188 FAX: (303) 763-4896

October 31, 1996

Ms. Lori Raschke
URS Operating Systems, Inc.
1099 18th Street, Suite 710
Denver, CO 80202

RE: Transmittal of Data Validation Report

Dear Ms. Raschke:

Please find the enclosed validation report 9609-0004 for metals by SW-846 methodology for the Wellington Oro Project.

The report was prepared in accordance with USEPA Region VIII validation formats and requirements.

If you have any questions regarding this report, please contact me at (303) 763-7188.

Yours sincerely,
TECHLAW, INC.

Richard Kantrowitz
Staff Consultant

enclosure

IF: 0252-013

REGION VIII
SUMMARY OF DATA QUALITY ASSURANCE REVIEW
INORGANIC

TDD NO.	Site Name		Operable Unit
9609-0004	Wellington Oro		
RPM/OSC Name			
Johanna Miller			
Contractor Laboratory	**Contract No.**	**Report No.**	**Laboratory DPO/Region**
Galson Laboratories		L32198	

Review Assigned Date October 15, 1996 Data Validator Richard Kantrowitz
Review Completion Date October 31, 1996 Report Reviewer Lyle Ryman

Sample ID	Sample Location	Matrix
WOWR01	WOWR01	Soil/TCLP Leachate
WOOP10A	WO-OP10A	
WOOP06	WOOP06	
WOOP08	WOOP08	
WODD03	WODD03	
WOWTL02	WOWTL02	
WOWTL04	WOWTL04	
WOWWR01	WOWWR01	
WOWWR02	WOWWR02	

DATA QUALITY STATEMENT

( ) Data are ACCEPTABLE according to EPA Functional guidelines with no qualifiers (flags) added by the reviewer.
( ) Data are UNACCEPTABLE according to EPA Functional Guidelines.
(X) Data are acceptable with QUALIFICATIONS noted in review.

Telephone/Communication Logs Enclosed? Yes _____ No X

TPO Attention Required? Yes _____ No X If yes, list the items that require attention:

INORGANIC DATA QUALITY ASSURANCE REVIEW

REVIEW NARRATIVE SUMMARY

This data package was reviewed according to "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," February 1994, modified for the method.

The data package, TDD 9609-0004, SDG L32198 consisted of nine soil samples for total metals and TCLP metals analyses.

The following table lists the data qualifiers added to the sample analyses. Please see Data Qualifier Definitions, attached to the end of this report.

Sample ID	Elements	Qualifiers	Reason for Qualification	Review Section
All	Mercury	J	Holding times	II
WOWWR02 (Soil)	Antimony	U	Blank contamination	VII
WOWR01 (TCLP) WOOP08 (TCLP)	Chromium			
WOOP08 (Soil)	Cobalt			
WOWR01 (Soil) WOOP10A (Soil) WODD03 (TCLP) WOOP08 (TCLP) WOOP10A (TCLP) WOWR01 (TCLP) WOWWR01 (TCLP)	Nickel			
WOOP06 (Soil)	Potassium			
All TCLP	Selenium			
WOOP06 (Soil) WOWTL02 (Soil) WOWTL04 (Soil) WOWWR01 (Soil) WOWWR02 (Soil) WOOP08 (Soil)	Thallium			
WOWR01 (Soil) WOOP08 (Soil)	Sodium	J	Negative blank bias	
All Soil	Antimony, Mercury	J	Matrix spike recovery	IX
	Selenium, Thallium	J/R		

Sample ID	Elements	Qualifiers	Reason for Qualification	Review Section
All TCLP	Lead	J	Matrix spike recovery	IX
All TCLP	Lead	J	Duplicate precision	XI
All Soil	Cadmium, Nickel, Sodum	J	Serial dilution	XV

Method/SOW Number SW-846/6010/7470/7471
Revision 0.0

Inorganic Deliverables Completeness Checklist

P Inorganic Cover Page
P Inorganic Analysis Data Sheets (Form I)
P Initial Calibration and Calibration Verification Results (Form II)
P Continuing Calibration Verification Results (Form II)
P CRDL Standard for ICP and AA (Form II, Part 2)
P Blank Analysis Results (Form III)
P ICP Interference Check Sample Results (Form IV)
P Spiked Sample Results (Form V)
NA Post-digest Spiked Sample Analysis (Form V, Part 2)
P Duplicate Sample Results (Form VI)
P Instrument Detection Limits (Form VII) or (Form X - Quarterly)
P Laboratory Control Sample results (Form VII)
NA Standard Addition Results (Form VIII)
P ICP Serial Dilution Results (Form IX)
NR Holding Times Summary Sheet (Form X)
P ICP Interelement Correction Factors (Form XII - Quarterly _, or Form XI - Annually)
P ICP Linear Ranges (Form XII (XII) - Quarterly)
P Raw Data
- P Samples
- P Calibration Standards
- P Blanks
- P Spikes
- P Duplicates
- P ICP QC (ICS and Serial Dilution
- P LCS
- NA Furnace AA
- P Mercury Analysis
- NA Cyanide Analysis

P Percent Solids Calculations - Solids Only
P Sample Prep/Digestion Logs (Form XIII)
P Analysis Run Log (Form XIV)
P Chain-of-Custody
P Sample Description
P Case Narrative
P Method References

KEY:
- P = Provided in original data package, as required by the SOW
- R = Provided as Resubmission
- NP = Not provided in original data package or as resubmission
- NR = Not required under the SOW
- NA = Not applicable to this data package or analysis

Comments:

I. DELIVERABLES

All Deliverables were present as specified in the Statement of Work.

Yes _X_ No ___

Comments: None.

II. HOLDING TIMES

All CLP-SOW holding times were met.

Yes ___ No _X_

Comments: SW-846 methodology was used to evaluate the data. Mercury was analyzed outside holding times. Soils were analyzed 21 days outside holding times and TCLP results were analyzed 13 days outside holding times. The samples were received at the laboratory after the 28 day holding time had expired.

All 40 CFR Part 136 technical holding times were met.

Yes ___ No _X_

Comments: None.

III. INSTRUMENT CALIBRATIONS: STANDARDS AND BLANKS

Initial instrument calibrations were performed according to SOW requirements.

Yes _X_ No ___

Comments: None.

The instruments were calibrated daily and each time an analysis run was performed.

Yes _X_ No ___

Comments: None.

The instruments were calibrated using one blank and the appropriate number of standards.

Yes _X_ No ___

Comments: None.

IV. FORM 1 - SAMPLE ANALYSIS RESULTS

Sample analyses were entered correctly on Form Is.

Yes _X_ No ___

Comments: None.

V. FORM 2A - INITIAL AND CONTINUING CALIBRATION VERIFICATION

The initial and continuing calibration verification standards (ICV and CCV, respectively) met SOW requirements.

Yes _X_ No ___

Comments: None.

The calibration verification results were within 90-110% recovery for metals, 85-115% for cyanide, and 80-120% for mercury.

Yes _X_ No ___

Comments: None.

The continuing calibration standards were run at 10% frequency.

Yes _X_ No ___

Comments: Continuing calibration standards wre run every 10 samples.

VI. FORM 2B - CRDL STANDARD FOR ICP AND AA

ICP Analysis: Standards (CRI) at two times the CRDL or the IDL (whichever were greater) were analyzed at the beginning and the end of each sample run, or at a minimum of twice per eight hours, whichever was more frequent.

Yes _X_ No __

Comments: SW-846 methodology was used to evaluate the data and all criteria were met.

GFAA Analysis: Standards (CRA) at two times CRDL were analyzed at the beginning of each sample run.

Yes _X_ No __

Comments: SW-846 methodology criteria were met.

The CRI and/or the CRA were analyzed after the ICV.

Yes _X_ No __

Comments: None.

VII. FORM 3 - BLANKS

The initial and continuing calibration blanks (ICB and CCB, respectively) met SOW requirements.

Yes _X_ No __

Comments: None.

The continuing calibration blanks were run at 10% frequency.

Yes _X_ No __

Comments: Continuing calibration blanks were run every 10 samples.

A laboratory/preparation blank was run at the frequency of one per twenty samples, or per sample delivery group (whichever is more frequent), and for each matrix analyzed.

Yes _X_ No __

Comments: None.

All analyzed blanks were free of contamination.

Yes __ No _X_

Comments: The following table lists the blanks with contamination, elements present, affected samples, and data qualifiers.

Blank Target Compounds

Blank ID	Date	Contaminant	Concentration Found in Blank (ug/L)	CRQL (ug/L)	Associated Samples	Concentration Found in Sample (ug/L)	Qualifier/ Adjustment
PBS	9/22/96	Antimony	9.7	60	WOWWR02 (Soil)	41.6	U
CCB	9/22/96	Cobalt	2.5	50	WOOP08 (Soil)	7.4	U
CCB	9/22/96	Nickel	3.0	40	WOWR01 (Soil) WOOP10A (Soil)	12.4 10.5	U
CCB	9/22/96	Potassium	4.7	5000	WOOP06 (Soil)	550	U
CCB	9/22/96	Sodium	-856	5000	WOWR01 (Soil) WOOP08 (Soil)	2673 3678	J
CCB	9/22/96	Thallium	6.2	10	WOOP06 (Soil) WOWTL02 (Soil) WOWTL04 (Soil) WOWWR01 (Soil) WOWWR02 (Soil) WOOP08 (Soil)	10.9 28.1 17.4 3.1 28.4 2.5	U
PBW	9/19/96	Chromium	24.7	1000	WOOP08 (TCLP) WOWR01	4.0 12.9	U
PBW	9/19/96	Nickel	17.5	40	WODD03 WOOP08 WOOP10A WOWR01 WOWWR01	84.7 17.3 41.6 24.2 57.3	U
PBW	9/19/96	Selenium	8.0	100	WODD03 WOOP06 WOOP08 WOOP10A WOWR01 WOWTL02 WOWTL04 WOWWR01 WOWWR02	24.7 20.5 6.4 17.5 6.0 25.2 20.7 13.8 25.4	U

VIII. FORM 4 - ICP INTERFERENCE CHECK SAMPLE

The ICP interference check sample (ICS) was run twice per eight hour shift and/or at the beginning and end of each sample set analysis sequence (whichever is more frequent).

Yes _X_ No ___

Comments: SW-846 methodology criteria were met.

Percent recovery of the analytes in solution ICSAB were within the range of 80-120%.

Yes _X_ No ___

Comments: None.

IX. FORM 5A - MATRIX SPIKE SAMPLE ANALYSIS

A matrix spike sample was analyzed with every twenty or fewer samples of a similar matrix, or one per sample delivery group (whichever is more frequent).

Yes _X_ No ___

Comments: None.

The percent recoveries (%R) were calculated correctly.

$$\%\ Recovery = \frac{(SSR - SR)}{SA} \times 100$$

SSR = spiked sample result
SR = sample result
SA = spike added

Yes _X_ No ___

Comments: None.

Spike recoveries were within the range of 75-125% (an exception is granted where the sample concentration is four times the spike concentration.

Yes ___ No _X_

Comments: The following table lists the spike recoveries outside control limits, matrix, samples affected, and data qualifiers.

Element	Spike Recovery	Matrix	Samples Affected	Qualifiers
Antimony	38.9%	Soil	All	J
Mercury	67.6%	Soil	All	J
Selenium	0.0%	Soil	All	J/R
Thallium	0.0%	Soil	All	J/R
Lead	330.4%	TCLP Leachate	All	J

X. FORM 5B - POST DIGEST SPIKE RECOVERY

A post-digest spike was performed for those elements that did not meet the specified criteria (i.e., Pre-digestion/pre-distillation spike recovery falls outside of control limits and sample result is less than four times the spike amount added, exception: Ag, Hg).

Yes___ No ___ Not Required _X_

Comments: SW-846 methodology criteria were met.

XI. FORM 6 - DUPLICATE SAMPLE ANALYSIS

Duplicate sample analysis was performed with every twenty or fewer samples of a similar matrix, or one per sample delivery group (whichever is more frequent).

Yes _X_ No ___

Comments: None.

The RPDs were calculated correctly.

$$RPD = \frac{(S - D)}{(S + D)/2} \times 100$$

S = sample
D = duplicate

Yes _X_ No ___

Comments: None.

For sample concentrations greater than five times the CRDL, RPDs were within ±20% (limits of ±35% apply for soil/sediments/tailings samples).

Yes _X_ No __

Comments: SW-846 methodology criteria were met.

For sample concentrations less than five times the CRDL, duplicate analysis results were within the control window of ± CRDL (two times CRDL for soils).

Yes __ No _X_

Comments: The following table lists the laboratory duplicates outside control limits, samples affected, and data qualifiers:

Element	Matrix	RPD	Samples Affected	Qualifiers
Lead	TCLP Leachate	67.0	All	J

XII. GFAA QC

Duplicate injections were performed on all GFAA samples and the RSD was within ± 20%.

Yes __ No __ NA _X_

Comments: Duplicate injections are not required for SW-846 methodology.

Analytical spikes were performed on all GFAA samples and the percent recovery was 85 - 115%.

Yes __ No __ NA _X_

Comments: SW-846 methodology does not require analytical spikes to be performed on all GFAA samples.

MSAs were analyzed when required and the correlation coefficient was > 0.995.

Yes __ No __ NA _X_

Comments: None.

XIII. FORM 7 - LABORATORY CONTROL SAMPLE

The laboratory control sample (LCS) was prepared and analyzed with every twenty or fewer samples of a similar matrix, or one per sample delivery group (whichever is more frequent).

Yes _X_ No __

Comments: None.

All results were within control limits.

Yes _X_ No __

Comments: None.

XIV. FORM 8 - STANDARD ADDITION RESULTS

Results from graphite furnace standard additions were entered on Form VIII as directed in the SOW.

Yes __ No __ NA _X_

Comments: None.

XV. FORM 9 - ICP QC

A serial dilution was performed for ICP analysis with every twenty or fewer samples of a similar matrix, or one per sample delivery group, whichever is more frequent.

Yes _X_ No __

Comments: None.

The serial dilution was without interference problems as defined by the SOW.

Yes __ No _X_

Comments: The following serial dilution %D results were outside the SW-846 criteria:

Element	% Difference	Samples Affected	Qualifiers
Cadmium	79.7	All Soil	J
Nickel	11.4	All Soil	J
Sodium	20.9	All Soil	J

XVI. FORM 10 - QUARTERLY INSTRUMENT DETECTION LIMITS (IDL)

IDLs were provided for all elements on the target analyte list.

Yes _X_ No ___

Comments: None.

Reported IDLs met SOW requirements.

Yes _X_ No ___

Comments: None.

XVII. FORM 11 - INTERELEMENT CORRECTION FACTORS FOR ICP

Interelement corrections for ICP were reported.

Yes _X_ No ___

Comments: SW-846 methodology was used to evaluate the data. Interelement corrections were reported.

XVIII. FORM 12 - ICP LINEAR RANGES

ICP linear ranges were reported.

Yes _X_ No ___

Comments: None.

XIX. LINEAR RANGE VERIFICATION ANALYSIS

Linear Range Verification Analysis (LRA) was performed and results were within control limits of ± 5% of the true value.

Yes _X_ No ___

Comments: SW-846 methodology criteria were met.

XX. FORM 13 - PREPARATION LOG

Information on the preparation of samples for analysis was reported on Form XIII.

Yes _X_ No ___

Comments: None.

XXI. FORM 14 - ANALYSIS RUN LOG

A Form XIV with the required information was filled out for each analysis run in the data package.

Yes _X_ No ___

Comments: None.

XXII. Additional Comments or Problems/Resolutions not addressed above.

Hand written entries on the summary forms were not always initialed and dated.

INORGANIC DATA QUALITY ASSURANCE REVIEW

Region VIII

DATA QUALIFIER DEFINITIONS

For the purpose of Data Validation, the following code letters and associated definitions are provided for use by the data validator to summarize the data quality. Use of additional qualifiers should be carefully considered. Definitions for all qualifiers used should be provided with each report.

GENERAL QUALIFIERS for use with both INORGANIC and ORGANIC DATA

R - Reported value is "rejected." Resampling or reanalysis may be necessary to verify the presence or absence of the compound.

J - The associated numerical value is an estimated quantity because the Quality Control criteria were not met.

U J - The reported amount is estimated because Quality Control criteria were not met. Element or compound was not detected.

N J - The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

N - The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.

ACRONYMS

AA	Atomic Absorption
Ag	Silver
CCB	Continuing Calibration Blank
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CRA	CRDL standard required for AA
CRDL	Contract Required Detection Limit
CRI	CRDL standard required for ICP
CV	Cold Vapor
EPA	U.S. Environmental Protection Agency
GFAA	Graphite Furnace Atomic Absorption
Hg	Mercury
ICB	Initial Calibration Blank
ICP	Inductively Coupled Plasma
ICS	Interference Check Sample
ICSA	Interference Check Sample (Solution A)
ICSAB	Interference Check Sample (Solution AB)
ICV	Initial Calibration Verification
IDL	Instrument Detection Limit
LCS	Laboratory Control Sample
LRA	Linear Range Verification Analysis
MSA	Method of Standard Additions
PDS	Post Digestion Spike
QC	Quality Control
RPD	Relative Percent Difference
RPM	Regional Project Manager
RSD	Percent Relative Standard Deviation
SA	Spike Added
SAS	Special Analytical Services
SDG	Sample Delivery Group
SOW	Statement of Work
SR	Sample Result
SSR	Spiked Sample Result
TPO	Technical Project Officer

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOWR01

Lab Name: Galson Laboratories Contract: URS

Lab Code: 10186 Case No.: SAS No.: SDG No.: L32198

Matrix (soil/water): Soil Lab Sample ID: L32198-1

Level (low/med): LOW Date Received: 09/05/96

% Solids: 89.2

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	1580			P	
7440-36-0	Antimony	16.1		N	P	J
7440-38-2	Arsenic	169			P	
7440-39-3	Barium	60.3			P	
7440-41-7	Beryllium	0.17	B		P	
7440-43-9	Cadmium	3.7		E	P	J
7440-70-2	Calcium	7730			P	
7440-47-3	Chromium	2.9			P	
7440-48-4	Cobalt	3.2	B		P	
7440-50-8	Copper	327			P	
7439-89-6	Iron	139000			P	
7439-92-1	Lead	30500			P	
7439-95-4	Magnesium	406	B		P	
7439-96-5	Manganese	234			P	
7439-97-6	Mercury	0.38		N*	AV	J
7440-02-0	Nickel	1.4	B	E	P	J
7440-09-7	Potassium	1350			P	
7782-49-2	Selenium	2.3	U	N	P	R
7440-22-4	Silver	73.5			P	
7440-23-5	Sodium	303	B	E	P	~~U~~ RK J
7440-28-0	Thallium	1.1	U	N	P	R
7440-62-2	Vanadium	23.9			P	
7440-66-6	Zinc	2070			P	
57-12-5	Cyanide				NR	

RK 10/24/96

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: ORANGE Clarity After: CLOUDY Artifacts: YES

Comments:

ROCKS

FE AND PB WERE ANALYZED AT A 10X DILUTION.

SELENIUM AND THALLIUM WERE ANALYZED AT A 5X DILUTION.

FORM I - IN

12/91

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOWR01

Lab Name: GALSON_LABORATORIES_____ Contract: URS_____

Lab Code: 10186_ Case No.: _____ SAS No.: _____ SDG No.: T32198

Matrix (soil/water): LEACHATE Lab Sample ID: TL32198-1

Level (low/med): LOW__ Date Received: 09/~~19~~ 05/96

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum_				NR	
7440-36-0	Antimony_				NR	
7440-38-2	Arsenic__	5.0_	U		P_	
7440-39-3	Barium___	707_	B		P_	
7440-41-7	Beryllium				NR	
7440-43-9	Cadmium__	82.2_	B		P_	
7440-70-2	Calcium__				NR	
7440-47-3	Chromium_	12.9_	B		P_	U
7440-48-4	Cobalt___				NR	
7440-50-8	Copper___				NR	
7439-89-6	Iron_____				NR	
7439-92-1	Lead_____	11400_		N*	P_	J
7439-95-4	Magnesium				NR	
7439-96-5	Manganese				NR	
7439-97-6	Mercury__	0.10_	U		AV	J
7440-02-0	Nickel___	24.2_	B		P_	U
7440-09-7	Potassium				NR	
7782-49-2	Selenium_	6.0_	B		P_	U
7440-22-4	Silver___	3.0_	U		P_	
7440-23-5	Sodium___				NR	
7440-28-0	Thallium_				NR	
7440-62-2	Vanadium_				NR	
7440-66-6	Zinc_____	16600_			P_	
_____	Cyanide__				NR	
_____	_____					

RK 10/29/96

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: _____

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ___

Comments:

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NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WODD03

Lab Name: Galson Laboratories Contract: URS

Lab Code: 10186 Case No.: SAS No.: SDG No.: L32198

Matrix (soil/water): Soil Lab Sample ID: L32198-7

Level (low/med): LOW Date Received: 09/05/96

% Solids: 90.4

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	2280			P	
7440-36-0	Antimony	9.5		N	P	J
7440-38-2	Arsenic	124			P	
7440-39-3	Barium	519			P	
7440-41-7	Beryllium	0.77			P	
7440-43-9	Cadmium	70.6		E	P	J
7440-70-2	Calcium	8350			P	
7440-47-3	Chromium	5.9			P	
7440-48-4	Cobalt	9.4			P	
7440-50-8	Copper	436			P	
7439-89-6	Iron	72200			P	
7439-92-1	Lead	3360			P	
7439-95-4	Magnesium	6100			P	
7439-96-5	Manganese	8970			P	
7439-97-6	Mercury	0.39		N*	AV	J
7440-02-0	Nickel	14.0		E	P	J
7440-09-7	Potassium	1780			P	
7782-49-2	Selenium	3.5		N	P	J
7440-22-4	Silver	22.5			P	
7440-23-5	Sodium	1380		E	P	J
7440-28-0	Thallium	5.5		N	P	J
7440-62-2	Vanadium	26.3			P	
7440-66-6	Zinc	12500			P	
57-12-5	Cyanide				NR	

RK 10/24/96

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: CLEAR Artifacts: YES

Comments:
ROCKS
FE, MN, AND ZN WERE ANALYZED AT A 10X DILUTION.

FORM I - IN

12/91

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WODD03

Lab Name: GALSON_LABORATORIES_____ Contract: URS_____

Lab Code: 10186_ Case No.: _____ SAS No.: _____ SDG No.: T32198

Matrix (soil/water): LEACHATE Lab Sample ID: TL32198-7

Level (low/med): LOW__ Date Received: 09/~~19~~ 05/96

ESB 9.24.96

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum_				NR	
7440-36-0	Antimony_				NR	
7440-38-2	Arsenic__	5.0_	U		P_	
7440-39-3	Barium___	1580_	B		P_	
7440-41-7	Beryllium				NR	
7440-43-9	Cadmium__	1020_			P_	
7440-70-2	Calcium__				NR	
7440-47-3	Chromium_	3.0_	U		P_	
7440-48-4	Cobalt___				NR	
7440-50-8	Copper___				NR	
7439-89-6	Iron____				NR	
7439-92-1	Lead____	29500_		N*__	P_	J
7439-95-4	Magnesium				NR	
7439-96-5	Manganese				NR	
7439-97-6	Mercury__	0.10_	U		AV	J
7440-02-0	Nickel___	84.7_			P_	U
7440-09-7	Potassium				NR	
7782-49-2	Selenium_	24.7_	B		P_	U
7440-22-4	Silver___	3.0_	U		P_	
7440-23-5	Sodium___				NR	
7440-28-0	Thallium_				NR	
7440-62-2	Vanadium_				NR	
7440-66-6	Zinc____	128000_			P_	
	Cyanide__				NR	

RK 10/25/96

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: _____

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ___

Comments:

ZINC_WAS_ANALYZED_AT_A_10X_DILUTION.

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NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOOP06

Lab Name: Galson Laboratories Contract: URS

Lab Code: 10186 Case No.: SAS No.: SDG No.: L32198

Matrix (soil/water): Soil Lab Sample ID: L32198-5

Level (low/med): LOW Date Received: 09/05/96

% Solids: 94.1

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	197			P	
7440-36-0	Antimony	14.0		N	P	J
7440-38-2	Arsenic	30.7			P	
7440-39-3	Barium	7.2	B		P	
7440-41-7	Beryllium	0.11	U		P	
7440-43-9	Cadmium	1470		E	P	J
7440-70-2	Calcium	4720			P	
7440-47-3	Chromium	20.5			P	
7440-48-4	Cobalt	18.7			P	
7440-50-8	Copper	17000			P	
7439-89-6	Iron	90400			P	
7439-92-1	Lead	72700			P	
7439-95-4	Magnesium	1940			P	
7439-96-5	Manganese	5990			P	
7439-97-6	Mercury	3.0		N*	AV	J
7440-02-0	Nickel	22.7		E	P	J
7440-09-7	Potassium	58.5	B		P	U
7782-49-2	Selenium	1.8		N	P	J
7440-22-4	Silver	135			P	
7440-23-5	Sodium	37400		E	P	J
7440-28-0	Thallium	1.2		N	P	U R
7440-62-2	Vanadium	2.1	B		P	
7440-66-6	Zinc	304000			P	
57-12-5	Cyanide				NR	

RK 10/25/96

Color Before: GRAY Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: CLEAR Artifacts: YES

Comments:

ROCKS

CD, CU, MN, FE, PB, AND NA WERE ANALYZED AT A 10X DILUTION.

ZN WAS ANALYZED AT A 100X DILUTION.

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NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOOP06

Lab Name: GALSON_LABORATORIES_____ Contract: URS_____

Lab Code: 10186_ Case No.: _____ SAS No.: _____ SDG No.: T32198

Matrix (soil/water): LEACHATE Lab Sample ID: TL32198-5

Level (low/med): LOW__ Date Received: 09/~~19~~ 05/96

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum_				NR	
7440-36-0	Antimony_				NR	
7440-38-2	Arsenic__	5.0_	U		P_	
7440-39-3	Barium___	1140_	B		P_	
7440-41-7	Beryllium				NR	
7440-43-9	Cadmium__	7410_			P_	
7440-70-2	Calcium__				NR	
7440-47-3	Chromium_	3.0_	U		P_	
7440-48-4	Cobalt___				NR	
7440-50-8	Copper___				NR	
7439-89-6	Iron_____				NR	
7439-92-1	Lead_____	43300_		N*	P_	J
7439-95-4	Magnesium				NR	
7439-96-5	Manganese				NR	
7439-97-6	Mercury__	0.10_	U		AV	J
7440-02-0	Nickel___	187_			P_	
7440-09-7	Potassium				NR	
7782-49-2	Selenium_	20.5_	B		P_	4
7440-22-4	Silver___	3.0_	U		P_	
7440-23-5	Sodium___				NR	
7440-28-0	Thallium_				NR	
7440-62-2	Vanadium_				NR	
7440-66-6	Zinc_____	1560000_			P_	
	Cyanide__				NR	

RK 10/29/96

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: _____

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ___

Comments:

ZINC_WAS_ANALYZED_AT_A_5X_DILUTION.

FORM I - IN

12/91

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOOP08

Lab Name: Galson Laboratories Contract: URS

Lab Code: 10186 Case No.: SAS No.: SDG No.: L32198

Matrix (soil/water): Soil Lab Sample ID: L32198-6

Level (low/med): LOW Date Received: 09/05/96

% Solids: 91.8

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	923			P	
7440-36-0	Antimony	11.7		N	P	J
7440-38-2	Arsenic	292			P	
7440-39-3	Barium	53.1			P	
7440-41-7	Beryllium	0.11	U		P	
7440-43-9	Cadmium	3.1		E	P	J
7440-70-2	Calcium	13300			P	
7440-47-3	Chromium	3.7			P	
7440-48-4	Cobalt	0.79	B		P	U
7440-50-8	Copper	504			P	
7439-89-6	Iron	91700			P	
7439-92-1	Lead	24100			P	
7439-95-4	Magnesium	133	B		P	
7439-96-5	Manganese	108			P	
7439-97-6	Mercury	0.64		N*	AV	J
7440-02-0	Nickel	0.11	U	E	P	J
7440-09-7	Potassium	1970			P	
7782-49-2	Selenium	4.6		N	P	J
7440-22-4	Silver	45.6			P	
7440-23-5	Sodium	397	B	E	P	~~U~~ RE J
7440-28-0	Thallium	1.1	B	N	P	U R
7440-62-2	Vanadium	41.9			P	
7440-66-6	Zinc	1760			P	
57-12-5	Cyanide				NR	

RK 10/21/96

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: CLEAR Artifacts: YES

Comments:

ROCKS

FE WAS ANALYZED AT A 10X DILUTION.

TL WAS ANALYZED AT A 4X DILUTION.

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOOP08

Lab Name: GALSON_LABORATORIES_____ Contract: URS_____

Lab Code: 10186_ Case No.: _____ SAS No.: _____ SDG No.: T32198

Matrix (soil/water): LEACHATE Lab Sample ID: TL32198-6

Level (low/med): LOW__ Date Received: 09/~~19~~ 05/96

KSK 9.24.96

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum_		_		NR	
7440-36-0	Antimony_		_		NR	
7440-38-2	Arsenic__	5.0_	U		P_	
7440-39-3	Barium___	1170_	B		P_	
7440-41-7	Beryllium		_		NR	
7440-43-9	Cadmium__	68.2_	B		P_	
7440-70-2	Calcium__		_		NR	
7440-47-3	Chromium_	4.0_	B		P_	U
7440-48-4	Cobalt___		_		NR	
7440-50-8	Copper___		_		NR	
7439-89-6	Iron_____		_		NR	
7439-92-1	Lead_____	25600_	_	N*__	P_	J
7439-95-4	Magnesium		_		NR	
7439-96-5	Manganese		_		NR	
7439-97-6	Mercury__	0.10_	U		AV	J
7440-02-0	Nickel___	17.3_	B		P_	U
7440-09-7	Potassium		_		NR	
7782-49-2	Selenium_	6.4_	B		P_	U
7440-22-4	Silver___	3.0_	U		P_	
7440-23-5	Sodium___		_		NR	
7440-28-0	Thallium_		_		NR	
7440-62-2	Vanadium_		_		NR	
7440-66-6	Zinc_____	9250_	_		P_	
_____	Cyanide__		_		NR	

RK 10/29/96

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: _____

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ___

Comments:

FORM I - IN

12/91

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOOP10A

Lab Name: Galson Laboratories Contract: URS

Lab Code: 10186 Case No.: SAS No.: SDG No.: L32198

Matrix (soil/water): Soil Lab Sample ID: L32198-4

Level (low/med): LOW Date Received: 09/05/96

% Solids: 88

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	1800			P	
7440-36-0	Antimony	68.6		N	P	J
7440-38-2	Arsenic	386			P	
7440-39-3	Barium	676			P	
7440-41-7	Beryllium	0.21	B		P	
7440-43-9	Cadmium	11.5		E	P	J
7440-70-2	Calcium	18000			P	
7440-47-3	Chromium	6.5			P	
7440-48-4	Cobalt	2.5	B		P	
7440-50-8	Copper	955			P	
7439-89-6	Iron	135000			P	
7439-92-1	Lead	25000			P	
7439-95-4	Magnesium	981			P	
7439-96-5	Manganese	954			P	
7439-97-6	Mercury	0.83		N*	AV	J
7440-02-0	Nickel	1.2	B	E	P	UJ
7440-09-7	Potassium	3010			P	
7782-49-2	Selenium	1.8	U	N	P	R
7440-22-4	Silver	94.7			P	
7440-23-5	Sodium	676		E	P	J
7440-28-0	Thallium	0.23	U	N	P	R
7440-62-2	Vanadium	28.2			P	
7440-66-6	Zinc	5520			P	
57-12-5	Cyanide				NR	

RK 10/27/96

Color Before: TAN Clarity Before: Texture: MEDIUM

Color After: ORANGE Clarity After: CLOUDY Artifacts: YES

Comments:

ROCKS

FE AND ZN WERE ANALYZED AT A 10X DILUTION.

SELENIUM WAS ANALYZED AT A 4X DILUTION.

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOOP10A

Lab Name: GALSON_LABORATORIES_____ Contract: URS_____

Lab Code: 10186_ Case No.: _____ SAS No.: _____ SDG No.: T32198

Matrix (soil/water): LEACHATE Lab Sample ID: TL32198-4

Level (low/med): LOW__ Date Received: 09/~~18~~ 05/96

KSG 9.26.96

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum_		_		NR	
7440-36-0	Antimony_		_		NR	
7440-38-2	Arsenic__	5.0_	U		P_	
7440-39-3	Barium___	1150_	B		P_	
7440-41-7	Beryllium		_		NR	
7440-43-9	Cadmium__	288_	_		P_	
7440-70-2	Calcium__		_		NR	
7440-47-3	Chromium_	3.0_	U		P_	
7440-48-4	Cobalt___		_		NR	
7440-50-8	Copper___		_		NR	
7439-89-6	Iron_____		_		NR	
7439-92-1	Lead_____	21300_	_	N*	P_	J
7439-95-4	Magnesium		_		NR	
7439-96-5	Manganese		_		NR	
7439-97-6	Mercury__	0.50_	B		AV	J
7440-02-0	Nickel___	41.6_	_		P_	U
7440-09-7	Potassium		_		NR	
7782-49-2	Selenium_	17.5_	B		P_	U
7440-22-4	Silver___	3.0_	U		P_	
7440-23-5	Sodium___		_		NR	
7440-28-0	Thallium_		_		NR	
7440-62-2	Vanadium_		_		NR	
7440-66-6	Zinc_____	45100_	_		P_	
_____	Cyanide__		_		NR	

KK 10/25/96

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: _____

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ___

Comments:

ZINC_WAS_ANALYZED_AT_A_10X_DILUTION.

FORM I - IN

12/91

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOWTL02

Lab Name: Galson Laboratories Contract: URS

Lab Code: 10186 Case No.: SAS No.: SDG No.: L32198

Matrix (soil/water): Soil Lab Sample ID: L32198-8

Level (low/med): LOW Date Received: 09/05/96

% Solids: 96.8

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	1240			P	
7440-36-0	Antimony	6.2	B	N	P	J
7440-38-2	Arsenic	392			P	
7440-39-3	Barium	96.9			P	
7440-41-7	Beryllium	0.64			P	
7440-43-9	Cadmium	78.0		E	P	J
7440-70-2	Calcium	14100			P	
7440-47-3	Chromium	7.4			P	
7440-48-4	Cobalt	8.6			P	
7440-50-8	Copper	216			P	
7439-89-6	Iron	47500			P	
7439-92-1	Lead	7230			P	
7439-95-4	Magnesium	4620			P	
7439-96-5	Manganese	4540			P	
7439-97-6	Mercury	0.45		N*	AV	J
7440-02-0	Nickel	25.3		E	P	J
7440-09-7	Potassium	816			P	
7782-49-2	Selenium	1.7		N	P	J
7440-22-4	Silver	10.3			P	
7440-23-5	Sodium	1610		E	P	J
7440-28-0	Thallium	2.9		N	P	UR
7440-62-2	Vanadium	49.5			P	
7440-66-6	Zinc	14700			P	
57-12-5	Cyanide				NR	

SK 10/21/96

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: CLEAR Artifacts: YES

Comments:
ROCKS
FE, MN, ZN WERE ANALYZED AT A 10X DILUTION.

FORM I - IN

12/91

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOWTL02

Lab Name: GALSON_LABORATORIES_____ Contract: URS_____

Lab Code: 10186_ Case No.: _____ SAS No.: _____ SDG No.: T32198

Matrix (soil/water): LEACHATE Lab Sample ID: TL32198-8

Level (low/med): LOW__ Date Received: 09/~~18~~ 05/96

KSG 9.20.96

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum_				NR	
7440-36-0	Antimony_				NR	
7440-38-2	Arsenic__	7.6_	B		P_	
7440-39-3	Barium___	1590_	B		P_	
7440-41-7	Beryllium				NR	
7440-43-9	Cadmium__	394_			P_	
7440-70-2	Calcium__				NR	
7440-47-3	Chromium_	3.0_	U		P_	
7440-48-4	Cobalt___				NR	
7440-50-8	Copper___				NR	
7439-89-6	Iron_____				NR	
7439-92-1	Lead_____	32100_		N*__	P_	J
7439-95-4	Magnesium				NR	
7439-96-5	Manganese				NR	
7439-97-6	Mercury__	0.14_	B		AV	J
7440-02-0	Nickel___	190_			P_	
7440-09-7	Potassium				NR	
7782-49-2	Selenium_	25.2_	B		P_	U
7440-22-4	Silver___	3.0_	U		P_	
7440-23-5	Sodium___				NR	
7440-28-0	Thallium_				NR	
7440-62-2	Vanadium_				NR	
7440-66-6	Zinc_____	59200_			P_	
	Cyanide__				NR	

KK 10/29/96

Color Before: YELLOW___ Clarity Before: CLEAR_ Texture: _____

Color After: YELLOW___ Clarity After: CLEAR_ Artifacts: ___

Comments:

ZINC_WAS_ANALYZED_AT_A_10X_DILUTION.

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12/91

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOWTL04

Lab Name: Galson Laboratories Contract: URS

Lab Code: 10186 Case No.: SAS No.: SDG No.: L32198

Matrix (soil/water): Soil Lab Sample ID: L32198-9

Level (low/med): LOW Date Received: 09/05/96

% Solids: 94.1

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	1690			P	
7440-36-0	Antimony	6.6		N	P	J
7440-38-2	Arsenic	162			P	
7440-39-3	Barium	41.6			P	
7440-41-7	Beryllium	0.67			P	
7440-43-9	Cadmium	85.5		E	P	J
7440-70-2	Calcium	10000			P	
7440-47-3	Chromium	6.9			P	
7440-48-4	Cobalt	7.6			P	
7440-50-8	Copper	261			P	
7439-89-6	Iron	67100			P	
7439-92-1	Lead	10900			P	
7439-95-4	Magnesium	2270			P	
7439-96-5	Manganese	3920			P	
7439-97-6	Mercury	0.43		N*	AV	J
7440-02-0	Nickel	12.9		E	P	J
7440-09-7	Potassium	1290			P	
7782-49-2	Selenium	2.1		N	P	J
7440-22-4	Silver	17.3			P	
7440-23-5	Sodium	2030		E	P	J
7440-28-0	Thallium	1.8		N	P	UR
7440-62-2	Vanadium	30.1			P	
7440-66-6	Zinc	17600			P	
57-12-5	Cyanide				NR	

RK 10/29/96

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: CLEAR Artifacts: YES

Comments:
ROCKS
FE, MN, ZND ZN WERE ANALYZED AT A 10X DILUTION.

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12/91

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOWTL04

Lab Name: GALSON_LABORATORIES_____ Contract: URS_____

Lab Code: 10186_ Case No.: _____ SAS No.: _____ SDG No.: T32198

Matrix (soil/water): LEACHATE Lab Sample ID: TL32198-9

Level (low/med): LOW__ Date Received: 09/~~19~~ 05/96

136 9.24.96

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum_				NR	
7440-36-0	Antimony_				NR	
7440-38-2	Arsenic__	5.0	U		P_	
7440-39-3	Barium___	1090	B		P_	
7440-41-7	Beryllium				NR	
7440-43-9	Cadmium__	481			P_	
7440-70-2	Calcium__				NR	
7440-47-3	Chromium_	3.0	U		P_	
7440-48-4	Cobalt___				NR	
7440-50-8	Copper___				NR	
7439-89-6	Iron_____				NR	
7439-92-1	Lead_____	42700		N*	P_	J
7439-95-4	Magnesium				NR	
7439-96-5	Manganese				NR	
7439-97-6	Mercury__	0.10	U		AV	J
7440-02-0	Nickel___	190			P_	
7440-09-7	Potassium				NR	
7782-49-2	Selenium_	20.7	B		P_	4
7440-22-4	Silver___	3.0	U		P_	
7440-23-5	Sodium___				NR	
7440-28-0	Thallium_				NR	
7440-62-2	Vanadium_				NR	
7440-66-6	Zinc_____	83900			P_	
	Cyanide__				NR	

RK 10/29/96

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: _____

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ___

Comments:
ZINC_WAS_ANALYZED_AT_A_10X_DILUTION.

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NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOWWR01

Lab Name: Galson Laboratories Contract: URS

Lab Code: 10186 Case No.: SAS No.: SDG No.: L32198

Matrix (soil/water): Soil Lab Sample ID: L32198-10

Level (low/med): LOW Date Received: 09/05/96

% Solids: 94.6

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	2210			P	
7440-36-0	Antimony	7.9		N	P	J
7440-38-2	Arsenic	131			P	
7440-39-3	Barium	49.6			P	
7440-41-7	Beryllium	0.66			P	
7440-43-9	Cadmium	187		E	P	J
7440-70-2	Calcium	16900			P	
7440-47-3	Chromium	4.9			P	
7440-48-4	Cobalt	14.5			P	
7440-50-8	Copper	630			P	
7439-89-6	Iron	70500			P	
7439-92-1	Lead	10600			P	
7439-95-4	Magnesium	5680			P	
7439-96-5	Manganese	3830			P	
7439-97-6	Mercury	0.98		N*	AV	J
7440-02-0	Nickel	17.3		E	P	J
7440-09-7	Potassium	1110			P	
7782-49-2	Selenium	1.6		N	P	J
7440-22-4	Silver	27.8			P	
7440-23-5	Sodium	3920		E	P	J
7440-28-0	Thallium	0.33	B	N	P	UR
7440-62-2	Vanadium	20.3			P	
7440-66-6	Zinc	34300			P	
57-12-5	Cyanide				NR	

RK 10/21/96

Color Before: BROWN Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: CLEAR Artifacts: YES

Comments:

ROCKS

FE, MN, AND ZN WERE ANALYZED AT A 10X DILUTION.

FORM I - IN

12/91

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOWWR01

Lab Name: GALSON_LABORATORIES_____ Contract: URS_____

Lab Code: 10186_ Case No.: _____ SAS No.: _____ SDG No.: T32198

Matrix (soil/water): LEACHATE Lab Sample ID: TL32198-10

Level (low/med): LOW__ Date Received: 09/~~19~~ 09/96

KSB 9.26.96

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum_		_		NR	
7440-36-0	Antimony_		_		NR	
7440-38-2	Arsenic__	5.0_	U		P_	
7440-39-3	Barium___	1540_	B		P_	
7440-41-7	Beryllium		_		NR	
7440-43-9	Cadmium__	806_	_		P_	
7440-70-2	Calcium__		_		NR	
7440-47-3	Chromium_	3.0_	U		P_	
7440-48-4	Cobalt___		_		NR	
7440-50-8	Copper___		_		NR	
7439-89-6	Iron_____		_		NR	
7439-92-1	Lead_____	53200_	_	N*	P_	J
7439-95-4	Magnesium		_		NR	
7439-96-5	Manganese		_		NR	
7439-97-6	Mercury__	0.10_	U		AV	J
7440-02-0	Nickel___	57.3_	_		P_	U
7440-09-7	Potassium		_		NR	
7782-49-2	Selenium_	13.8_	B		P_	U
7440-22-4	Silver___	3.0_	U		P_	
7440-23-5	Sodium___		_		NR	
7440-28-0	Thallium_		_		NR	
7440-62-2	Vanadium_		_		NR	
7440-66-6	Zinc_____	145000_	_		P_	
_____	Cyanide__		_		NR	
_____	_____	_____	_	_____	__	

SK 10/21/96

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: _____

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ___

Comments:

ZINC_WAS_ANALYZED_AT_A_10X_DILUTION.

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NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOWWR02

Lab Name: Galson Laboratories Contract: URS

Lab Code: 10186 Case No.: SAS No.: SDG No.: L32198

Matrix (soil/water): Soil Lab Sample ID: L32198-11

Level (low/med): LOW Date Received: 09/05/96

% Solids: 97.7

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	642			P	
7440-36-0	Antimony	4.3	B	N	P	UJ
7440-38-2	Arsenic	81.3			P	
7440-39-3	Barium	10.6	B		P	
7440-41-7	Beryllium	0.58			P	
7440-43-9	Cadmium	79.0		E	P	J
7440-70-2	Calcium	31500			P	
7440-47-3	Chromium	5.3			P	
7440-48-4	Cobalt	6.8			P	
7440-50-8	Copper	96.1			P	
7439-89-6	Iron	29200			P	
7439-92-1	Lead	2930			P	
7439-95-4	Magnesium	9000			P	
7439-96-5	Manganese	3930			P	
7439-97-6	Mercury	0.57		N*	AV	J
7440-02-0	Nickel	45.8		E	P	J
7440-09-7	Potassium	362	B		P	
7782-49-2	Selenium	14.1		N	P	J
7440-22-4	Silver	5.9			P	
7440-23-5	Sodium	1510		E	P	J
7440-28-0	Thallium	2.9		N	P	UR
7440-62-2	Vanadium	45.4			P	
7440-66-6	Zinc	14300			P	
57-12-5	Cyanide				NR	

NK 10/27/96

Color Before: BLACK Clarity Before: Texture: COARSE

Color After: YELLOW Clarity After: CLEAR Artifacts: YES

Comments:
ROCKS
FE, MN, AND ZN WERE ANALYZED AT A 10X DILUTION.

NYSDEC ASP

1

INORGANIC ANALYSES DATA SHEET

NYSDEC SAMPLE NO.

WOWWR02

Lab Name: GALSON_LABORATORIES_____ Contract: URS_____

Lab Code: 10186_ Case No.: _____ SAS No.: _____ SDG No.: T32198

Matrix (soil/water): LEACHATE Lab Sample ID: TL32198-11

Level (low/med): LOW__ Date Received: 09/~~19~~ 05/96

KSB 9.20.96

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum_				NR	
7440-36-0	Antimony_				NR	
7440-38-2	Arsenic__	5.0_	U		P_	
7440-39-3	Barium___	1350_	B		P_	
7440-41-7	Beryllium				NR	
7440-43-9	Cadmium__	293_			P_	
7440-70-2	Calcium__				NR	
7440-47-3	Chromium_	3.0_	U		P_	
7440-48-4	Cobalt___				NR	
7440-50-8	Copper___				NR	
7439-89-6	Iron____				NR	
7439-92-1	Lead____	4080_		N*	P_	J
7439-95-4	Magnesium				NR	
7439-96-5	Manganese				NR	
7439-97-6	Mercury__	0.10_	U		AV	J
7440-02-0	Nickel___	233_			P_	
7440-09-7	Potassium				NR	
7782-49-2	Selenium_	25.4_	B		P_	U
7440-22-4	Silver___	3.0_	U		P_	
7440-23-5	Sodium___				NR	
7440-28-0	Thallium_				NR	
7440-62-2	Vanadium_				NR	
7440-66-6	Zinc____	26700_			P_	
	Cyanide__				NR	

RK 10/29/96

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: _____

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: ___

Comments:

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TECHLAW, INC.

VERSION 2.0
SEPT. 1996

METAL ANALYSIS WORKSHEET--HOLDING TIMES

BATCH: 9609-0004

List all analytes which do not meet holding time criteria

SAMPLE ID	Matrix	PRE-SERVED Y/N	DATE COLLECTED	METALS ANALYSIS DATE/S	Hg CVAA ANALYSIS DATE	CN ANALYSIS DATE	TCLP Prep ~~ANALYSIS~~ DATE/S	NO. OF DAYS PAST HOLDING TIME	ACTION
NOWR01 (TOTAL)	Soil	N	7/21/96	9/22/96	9/16/96	N/A	N/A	Hg -21	J
00P10A									
00P06									
00P08									
00B03									
OWTL02									
OWTL04									
OWWR01									
OWWR02									
OWR01 TCLP	Soil	N	7/21/96	9/19-20/96	9/12/96	N/A	9/8/96	Hg -13	J
00P10A									
00P06									
00P08									
NOOB03									
OWTL02									
OWTL04									
OWWR01									
OWWR02									

COMMENTS Matrix not listed on COC.
Samples received at Lab on 9/5/96 - outside its Holding time.

Notes:
1. If holding times are exceeded, all sample results are estimated (J)/(UJ).
2. If holding times are grossly exceeded (>= 2*holding time), detected results are estimated (J), and non-detected results are rejected (R).

Validated By: Richard Kathy Date: 10/22/96

Reviewed By: Lyle Ryman Date: 10/28/96

ANALYTE	HOLDING TIME	PRESERVATIVE	
		AQUEOUS	SOIL
Metals	180 days	pH < 2 w/HNO3, 4 Deg. C	4 Deg. C
Mercury	28 days	pH < 2 w/HNO3, 4 Deg. C	4 Deg. C
Cyanide	14 days	pH > 12 w/NaOH, 4 Deg. C	4 Deg. C

Holding Time = Analysis Date - Collection Date

met1/techlaw/policy7

TECHLAW, INC.

VERSION 2.0
SEPT. 1996

IIA METAL ANALYSIS WORKSHEET -- ICP CALIBRATIONS

BATCH: 9609-0004

List all ICP analytes that did not meet the percent recovery criteria for initial calibration verification (ICV) and continuing calibration verification (CCV).

ANALYTE	ICV CCV	TRUE	FOUND	% R	ACTION	SAMPLES AFFECTED
				None		

Was a CRDL check sample (CRI) analyzed at the beginning and at the end of each sample run? (Yes) No

COMMENTS SW-846 Criteria were Met.

Actions:

ICV/CCV Actions:

	PERCENT RECOVERY				
	<75%	75-89%	90-110%	111-125%	>125%
Detected results	R	J	V	J	R
Non-detected Results	R	UJ	V	V	V

1. If the instrument was not calibrated daily and each time the instrument was set up, qualify the data as rejected (R).

TECHLAW, INC.

VERSION 2.0
SEPT. 1996

IIB METAL ANALYSIS WORKSHEET -- AA CALIBRATIONS

BATCH: 9604-0004

List all AA analytes that did not meet the percent recovery criteria for initial calibration verification (ICV) and continuing calibration verification (CCV).

ANALYTE	ICV CCV	TRUE	FOUND	% R	ACTION	SAMPLES AFFECTED

N/A

1. Were the correct number of standards and blanks used to calibrate the instrument? Yes No N/A
2. Is the initial calibrations correlation coefficient > 0.995? Yes No N/A

   If no, list affected analytes and samples.
3. Was a CRDL check sample (CRA) analyzed at the beginning of each sample run? Yes No N/A

COMMENTS

Actions:

ICV/CCV Actions:

	PERCENT RECOVERY				
	<75%	75–89%	90–110%	111–125%	>125%
Detected results	R	J	V	J	R
Non-detected Results	R	UJ	V	V	V

1. If three standards and a blank were not used for initial calibration, or the instrument was not calibrated daily and each time the instrument was set up, qualify the data as rejected (R).
2. If the initial calibration correlation coefficient was less than 0.995, qualify sample results as estimated (J)/(UJ).

TECHLAW, INC.

VERSION 2.0
SEPT. 1996

IIC METAL ANALYSIS WORKSHEET -- Hg CALIBRATIONS

BATCH: 9607-0004

List all mercury results that did not meet the percent recovery criteria for the ICV and/or CCV standards.

ICV CCV	TRUE	FOUND	% R	ACTION	SAMPLES AFFECTED

None

1. Were the correct number of standards and blanks used to calibrate the instrument? (Yes) No
2. Is the initial calibration correlation coefficient > 0.995? Yes No 0.9998 0.9999

   If no, list affected samples:
3. Was a CRDL check sample (CRA) analyzed at the beginning of each sample run? (Yes) No

COMMENTS

SW-846 Method 7470 & 7471 criteria met.

Actions:

	PERCENT RECOVERY				
	<65%	65–79%	80–120%	121–135%	>135%
Detected results	R	J	V	J	R
Non-detected results	R	UJ	V	V	V

1. If four standards and a blank were not used for initial calibration, or the instrument was not calibrated daily and each time the instrument was set up, qualify the data as rejected (R).
2. If the initial calibration correlation coefficient was less than 0.995, qualify sample results as estimated (J)/(UJ).

TECHLAW, INC.

VERSION 2.0
SEPT. 1996

IID METAL ANALYSIS WORKSHEET -- CN CALIBRATIONS

BATCH: 9609-0004

List all cyanide results that did not meet the percent recovery criteria for the ICV and/or CCV standards.

ICV CCV	TRUE	FOUND	%R	ACTION	SAMPLES AFFECTED

1. Were the correct number of standards and blanks used to calibrate the instrument? Yes No N/A
2. Is the initial calibration correlation coefficient > 0.995? Yes No N/A
   If no, list affected samples:
3. Was a mid-range calibration standard and an ICV distilled? Yes No N/A
   If no, list affected samples:

COMMENTS

Actions:

	PERCENT RECOVERY				
	<70%	70-84%	85-115%	116-130%	>130%
Detected results	R	J	V	J	R
Non-detected results	R	UJ	V	V	V

1. If three standards and a blank were not used for initial calibration, or the instrument was not calibrated daily and each time the instrument was set up, qualify the data as rejected (R).
2. If the initial calibration correlation coefficient was less than 0.995, qualify samples results as estimated (J)/(UJ).
3. If a mid-range standard (or ICV) was not distilled, qualify sample results as estimated (J)/(UJ).

III METAL ANALYSIS WORKSHEET -- BLANKS

MATRIX: Soil/Leachate BATCH: 9609-0004

List the highest positive AND negative blank result >= |IDL| below. Use one worksheet for soil matrix and another for water matrix.

ANALYTE	ICB CCB PB/MB	IDL	BLANK CONC.	5 * Bl. Conc.	ACTION	SAMPLES AFFECTED
Soil						
Sb	ICB	5.0	-7.6	38.0		None
Se	PB	5.0	9.7	48.5	U	11
Be	CCB3	1.0	1.4	7.0		None
Cr	PB	3.0	3.1	15.5		None
Co	CCB3	2.0	2.5	12.5	U	6,
Fe	PB	30.0	33.2	416		None
Pb	ICB	2.0	-2.9	14.5		None
Pb	PB	2.0	6.3	31.5		None
Mg	PB	44.0	45.3	226.5		None
Ni	ICB	1.0	-1.5	7.5		None
Ni	CCB3	1.0	3.0	15.0	U	1,4,
K	CCB4	222	417.4	2087	U	5,
Ag	CCB3	3.0	6.4	32.0		None
Na	CCB2	416	-856	4280	J	1,6
Tl	CCB3	2.0	6.2	31.0	U	5,8,9,10,11,6
V	CCB3	1.0	3.5	17.5		None
Zn	CCB1	5.0	8.1	40.5		None
Leachate						
Cr	PB	3.0	24.7	123.5	U	6,1
Pb	ICB	2.0	-2.7	13.5		None
Pb	CCB1	2.0	2.6	13.0		None
Ni	PB	1.0	17.5	87.5	U	7,6,4,1,10
Se	PB	4.0	8.0	40.0	U	7,5,6,4,1,8,9,10,11
Ag	PB	3.0	-4.25	21.3		None
Zn	CCB2	5.0	18.2	91.0		None

NOTE: Verify that the absolute value of any analyte concentration in the PB or MB is < CRDL.

COMMENTS: Blank results were compared to raw data values.

Actions:

1. If |Blank| < IDL, no action is taken.
2. If Blank >= IDL, then all sample results >= IDL and < 5*Blank are non-detected (U).
3. If Blank =< -IDL, all sample results >= IDL and < 5*|Blank| are estimated (J).
4. If Blank =< -IDL and raw data sample result is =< IDL:
   a. If |Blank-Sample| >= IDL, then non-detected results are estimated (UJ).
   b. If |Blank-Sample| < IDL, then no action is taken.

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IVA METAL ANALYSIS WORKSHEET -- ICP INTERFERENCE CHECK SAMPLE

BATCH: 9609-0004

NOTE: The sample results can be accepted without qualification, if the sample concentrations of Al, Ca, Fe, and Mg are less than or equal to the concentration found in the ICSA solution.

Examine the sample results in ug/l and list any Al, Ca, Fe, or Mg results that are greater than the ICSA values.

SAMPLE ID	ANALYTE	SAMPLE RESULT	ICS VALUE	COMMENTS
WOWWR01	Fe	667,000	200,000	10X Dilution
WOWTL04	Fe	631,000	200,000	" "
WOWTL02	Fe	460,000	200,000	" "
WOOD03	Fe	653,000	200,000	" "
WOOP05	Fe	850,000	200,000	" "
WOOP06	Fe	856,000	200,000	" "
WOOP10A	Fe	1,170,000	200,000	" "
WOWR01	Fe	1,230,000	200,000	" "
WOWWR02	Fe	782,000	200,000	" "

List any analytes in the ICS AB solution that did not meet the criteria of 80-120% R.

ANALYTE	% R	ACTION	SAMPLES AFFECTED
			None

Were Interference Check Samples run at the beginning and end of each sample analysis run, or a minimum of twice per 8-hour shift (whichever is more frequent)? (Yes) No SW-846 methodology criteria met

COMMENTS

Actions:

	PERCENT RECOVERY			
	<50%	50-79%	80-120%	>120%
Detected results	R	J	V	J
Non-detected results	R	UJ	V	V

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IVB METAL ANALYSIS WORKSHEET -- ICP INTERFERENCE CHECK SAMPLE

BATCH: 9609-0004

Report the concentration of any analytes detected in the ICSA solution > |IDL| that should not be present.

ANALYTE	ICSA RESULT	ACTION	SAMPLE/ RESULT	SAMPLE/ RESULT	SAMPLE/ RESULT	SAMPLE/ RESULT	SAMPLE/ RESULT
Ba	4		None				

Actions:

If the ICSA value > the positive IDL:
1. For non-detected results, no action is taken.
2. Estimate (J) all detected results <= 5*ICSA.

If the ICSA value < -IDL:
1. Estimate (J) detected results <= 5*|ICSA|.
2. Estimate (UJ) non-detected results.

Al, Mg, Fe, Ca results not printed out for TCLP results.

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V METAL ANALYSIS WORKSHEET -- PRE-DIGESTION MATRIX SPIKE

MATRIX: Soil / Leachate BATCH: 9609-0004

List all parameters that do not meet the percent recovery criteria. Note: The pre-digestion spike recovery criteria are not evaluated for Ca, Mg, K, Na, Al, and Fe for soil samples, and Ca, Mg, K, and Na for water samples. If the sample result exceeds the spike added by a factor of 4 or more, no action is taken.

SAMPLE ID	ANALYTE	SPIKED SAMPLE RESULT	SAMPLE RESULT	SPIKE ADDED	% R	ACTION	SAMPLES AFFECTED
WOWR01	Sb	37.9	16.1	56.1	38.9	J	All
	Hg	0.757	0.378	0.560	67.6	J	All
	Se	0.448U	2.26U	1.12	0.0		J - 5,6,7,8,9,10,11 R - 4,1
	Tl	0.224U	1.13U	5.61	0.0		J - 7 R - 5,6,4,1,8,9,10,11
Leachate							
WOWR01	Pb	27951	11431	5000	330.4	J	All

1. Was a pre-digestion matrix spike prepared at the required frequency of once every 20 samples, or every SDG (whichever is more frequent)? (Yes) No
2. Was a post-digestion matrix spike analyzed for all ICP elements, except Silver, that did not meet the pre-digestion matrix spike recovery criteria? (Yes) No

COMMENTS

Soil verified: Sb, Ba, Cr, Hg, Ni, Se, Tl
Leachate verified: As, Cr, Pb, Hg

1. If any analyte does not meet the % R criteria, qualify all associated samples using the following criteria:

Actions:

	Percent Recovery			
	<30%	30-74%	75-125%	>125%
Detected results	J	J	V	J
Non-detected results	R	UJ	V	V

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VI METAL ANALYSIS WORKSHEET -- LABORATORY DUPLICATES

MATRIX: Soil / Leachate

BATCH: 9609-0004

List all parameters that do not meet % difference or CRDL criteria.

SAMPLE ID	ANALYTE	SAMPLE VALUE	DUP. VALUE	RPD	DIFFERENCE	ACTION	SAMPLES AFFECTED
Soil - None							
Aqueous							
WCW2CID	Pb	11431	22943	67.0		J	

COMMENTS

Soil - Hg - within 2XCRDL - NOT Qualified
Verified: Al, Ca Fe, Pb, Mg
Aqueous - verified All

Actions:

1. AQUEOUS
If sample value > 5*CRDL, estimate (J) all sample results of the same matrix if the RPD is > 20%.
If sample value < 5*CRDL, and the difference between the duplicate and the original is > CRDL, estimate (J)/(UJ) all sample results of the same matrix.

2. SOLID
If sample value > 5*CRDL, estimate (J) all sample results of the same matrix if the RPD is > 35%.
If sample value < 5*CRDL, and the difference between the duplicate and the original is > 2*CRDL, estimate (J)/(UJ) all sample results of the same matrix.
*Difference = |Sample result – Duplicate sample result|

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VII METAL ANALYSIS WORKSHEET--LABORATORY CONTROL SAMPLES

MATRIX: Soil / Leachate BATCH: 9607-0004

List all parameters that do not meet the percent recovery criteria.

LCS ID	ANALYTE	TRUE VALUE	FOUND VALUE	% R	ACTION	SAMPLES AFFECTED
Soil - None						
Aqueous - None						
COMMENTS						
Soil verified - All						
Aqueous verified - All						

Actions:

Exception: antimony and silver have no control limits. An aqueous LCS is not required for CN and mercury.

1. AQUEOUS LCS

	PERCENT RECOVERY			
	<50%	50–79%	80–120%	>120%
Detected results	R	J	V	J
Non–detected results	R	UJ	V	V

2. SOLID LCS

	BELOW CONTROL LIMITS	WITHIN CONTROL LIMITS	ABOVE CONTROL LIMITS
Detected results	J	V	J
Non–detected results	UJ	V	V

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VIIIA METAL ANALYSIS WORKSHEET -- ANALYTICAL SPIKE ANALYSIS

BATCH: 9609-0004

List all samples whose analytical spike recovery did not meet the 85-115 % recovery criteria.

ANALYTE	SAMPLE ID	SAMPLE RESULT	SPIKED SAMPLE RESULT	TRUE SPIKE VALUE	%R	ACTION	COMMENT
			N/A				

1. Spike Recovery: One point analytical spikes were performed for all GFAA samples? Yes No N/A

COMMENTS

If the sample result is <50% of the spike result, or the sample result is >50% of the spike result* and the percent recovery is <40% or between 85-115%, the following apply.

Actions:	<10%	10-84%	85-115%	>115%
	PERCENT RECOVERY			
Detected results	J	J	V	J
Non-detected results	R	UJ	V	V

*Spike result = |spiked sample result - sample result|

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VIIIB METAL ANALYSIS WORKSHEET -- FURNACE AA ANALYSIS

BATCH: 9607-0004

If the sample result is >= 50% of the spike result and the percent recovery was between 40–84% or >115%, then MSA must be performed.
List all samples for which an MSA analysis was required but not performed, or MSA results were outside control limits.

ANALYTE	SAMPLE ID	1st. CORR. COEFF.	2nd. CORR. COEFF.	ACTION	COMMENT

N/A

Actions:
1. Estimate (J) if an MSA was required and not performed.
2. If the correlation coefficient was <0.995, the MSA should be performed a second time. Estimate (J) all sample results if a reanalysis was not performed, or the reanalysis correlation coefficient was < 0.995, or result from the highest correlation coefficient was not reported.

List all samples > CRDL whose duplicate injections did not agree within 20% RSD or CV, or samples in which duplicate injections were not performed

ANALYTE	SAMPLE ID	SAMPLE RESULT	DUPLICATE RESULT	%RSD or CV	CRDL	ACTION	COMMENT

N/A

*Spike result = |spiked sample result – sample result|

Actions:
1. Estimate (J) detected results greater than the CRDL if duplicate injections are outside 20% RSD.
2. Estimate (J) all sample results if duplicate injections were not performed.

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IX METAL ANALYSIS WORKSHEET -- ICP SERIAL DILUTION ANALYSIS

MATRIX: Soil / Leachate BATCH: 9609-0004

Serial dilution criteria only applies if the original sample result is at least 50*IDL and %D >10%.

ANALYTE	IDL	10 ~~50~~*IDL	SAMPLE RESULT	SERIAL DILUTION RESULT	% D	ACTION	SAMPLES AFFECTED
Soil							
Ni	1.0	10.0	213	237	11.4	J	All
Na	416	4160	357803	278405	20.4	J	All
Cd	2.0	20	100	180	79.7	J	All
Leachate							
	None						

INDUCTIVELY COUPLED PLASMA SERIAL DILUTION ANALYSIS:

Serial dilutions were performed for each matrix and results of the diluted sample analysis agreed within ten percent of the original undiluted analysis. (Yes) No

Serial dilutions were not performed for the following:

COMMENTS SW-846 Criteria: Result >10xIDL & <10%D

Verified: Ni, Na, Cd, Pb, Cu - Soil ~~None~~ All - Leachate

Actions:
Estimate (J) detected results if %D is > 10%.

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X METAL ANALYSIS WORKSHEET -- SAMPLE RESULT VERIFICATION

BATCH: 9609-0004

1. Describe any raw data anomalies (i.e. baseline shifts, negative absorbances, transcription or calculation errors, legibility, etc.)

See Blanks

2. List results that fall outside the linear range of the ICP instrument or the calibrated range of the AA or Cyanide instrument, and were not reanalyzed. None

3. Were ICP linear ranges obtained within 3 months of, and preceding, the sample analyses? Yes No (NA) 8/13/96

4. Were ICP interelement corrections obtained within 12 months of, and preceding, the sample analyses? Yes No (NA) 8/11/96

5. Were instrument detection limits present, found to be less than or equal to the CRDL, and obtained within 3 months of, and preceeding, the sample analyses? Yes No (NA)

6. Were all sample results reported down to the IDL? (Yes) No

7. Were sample weights, volumes, percent solids, and dilutions used correctly when reporting the results? Yes No

COMMENTS Handwritten entries on the data forms not initialed & dated.

met10/techlaw/policy7

APPENDIX C

BOR XRD Report

United States Department of the Interior

BUREAU OF RECLAMATION
Reclamation Service Center
P.O. Box 25007
Building 67, Denver Federal Center
Denver, Colorado 80225-0007

IN REPLY REFER TO:
D-8340
RES-3.40

OCT 11 1996

MEMORANDUM

To: Manager, Geotechnical Engineering Group 3
Attention: T. Brown, D-8313

From: D. Hurcomb
Geologist, Earth Sciences and Research Laboratory Group

Subject: Mineralogic Composition of Waste Rock, Roaster Fines, and Mill Tailing Samples - Wellington-Oro Mine Complex - French Gulch Project, near Breckenridge, Colorado

Earth Sciences and Research Laboratory Referral Number: 8340-96-45

Petrographic Referral Code: 96-16

INTRODUCTION

Nine samples collected from the Wellington-Oro Mine Complex, French Gulch Project, were submitted to the Petrographic Laboratory for analysis. The site and the data quality objectives were described in the draft Sampling and Analysis & Quality Assurance Project Plan - Waste Rock, Roaster Fines, and Mill Tailing Samples - Wellington-Oro Mine Complex - French Gulch Project, near Breckenridge, Colorado dated September 16, 1996.

The purpose of the X-ray diffraction (XRD) analyses was to provide qualitative mineralogical compositions of the submitted samples for documentation of minerals susceptible to chemical reactions resulting in acid mine or acid rock drainage.

RESULTS AND DISCUSSION

The mineralogy of the minus-100-sieve-size fraction of the submitted samples is summarized in attached table 1. Table 2 lists the minerals identified by X-ray diffraction with their general formulae. The diffraction patterns are available upon request.

QUALITY ASSURANCE AND ANALYSIS PROCEDURES

Quality Assurance

To provide a measure of the quality of the X-ray diffraction data, reference materials were used to check the performance of the XRD system before and during analyses. The following is a brief description of the reference materials and their purpose.

> Mineral mixture EFM1 was fabricated in Reclamation's Petrographic Laboratory, June 1978, and consists of 25.0 wt. percent quartz, 12.5 wt. percent dolomite, 12.5 wt. percent calcite, 15.0 wt. percent kaolinite, and 35.0 wt. percent montmorillonite. EFM1 shows diffraction peak intensity of these minerals for comparison with the diffraction peak intensity of the same minerals in samples.
>
> SRM 1976 is a sintered alumina plate developed by NIST for calibration of X-ray powder diffraction intensity as a function of degrees two theta which is a measure of the instrument sensitivity. The NIST SRM 1976 alumina standard was analyzed monthly.

Analysis

The samples were prepared for analyses in the Earth Sciences Environmental Laboratory and the Petrographic Laboratory per the SAP. Minus 100-sieve-size material from the submitted sample prepared specifically for XRD analysis was further ground to less than 20 micron size (impalpable) with a mortar and pestle. The samples were prepared and analyzed as part of the following analytical sequence.

Daily Analytical Sequence:

1. Mineral mixture - (EFM1) - Initial verification calibration
2. Quartz powder
3. Samples
4. Mineral mixture - (EFM1) - Final verification calibration

The analyses were performed with the Scintag XDS 2000 Automated X-ray Diffraction System.

Method of Mineral Identification

The method of mineral identification described in ASTM designation D 934 - 80, Standard Practices for Identification of Crystalline Compounds in Water-Formed Deposits by X-ray

Diffraction, Practice B, was followed. The Joint Committee on Powder Diffraction Standards (JCPDS) Powder Diffraction File (PDF) was used for X-ray diffraction sample identification and interpretation. The PDF is a collection of single-mineral X-ray diffraction patterns.

DISCUSSION

Iron sulfide minerals including pyrite (FeS_2) appear to be present in significant amounts in the minus 100 sieve size fraction of six samples listed in table 1. Some of these samples also contain the carbonate minerals ankerite ($Ca(Mg, Fe)(CO_3)_2$) and siderite ($FeCO_3$). Iron sulfide oxidation may produce acidic water, but carbonate minerals generally tend to effectively neutralize acidic waters. It appears samples WO-WR-01 and WO-OP 06 may potentially produce acid when wet due to the presence of fine grained iron sulfides and the absence of carbonate minerals. Samples WO-DD-03, WO-WTL-02, WO-WWR-01, and WO-WWR-02 contain both iron sulfide and carbonate minerals. If present in sufficient amounts, the carbonate minerals may potentially neutralize any acidity produced by iron sulfide. The presence of the aluminosilicates feldspar and illite/mica may also buffer the acidity produced by iron sulfide weathering reactions. However, those reaction rates are slow regardless of the amount of aluminosilicate minerals present. Quartz (SiO_2) has no buffering capacity. The sulfate minerals gypsum ($CaSO_4 \cdot 2H_2O$), anglesite ($PbSO_4$), jarosite ($(K, Na, H_3O, NH_4, Ag, Pb)Fe_3(SO_4)_2(OH)_6$), and alunite ($(K,Na)Al_3(SO_4)_2(OH)_6$) as well as the iron oxide minerals hematite (Fe_2O_3) and goethite ($FeO(OH)$) are products formed during sulfide rock weathering processes.

XRD appears to be a quick, cost-effective analytical method to evaluate potentially acid producing soils containing sulfide rock particles. It should be noted that many complicating factors including the geology, geochemistry, and mineralogy of the material as well as grain size and texture of the iron sulfide can control the weathering process. Additional laboratory techniques such as humidity cell testing may be required to simulate weathering processes and better predict the acid rock/soil drainage capacity of the samples.

Attachments

cc: D-8250, D-8313 (T. Brown), D-8321 (Rood, Sullivan), D-8550 (Schaefer), D-8340 (3) (w/att to each)

Table 1 - Sample No. and mineralogical compositions. "Major" indicates a significant portion of the mineral is present in the sample evidenced by multiple diffraction peaks with relatively strong intensity. "X" indicates the mineral is present in the sample evidenced by multiple diffraction peaks. "?" indicates the mineral is probably present in the sample evidenced by only one diffraction peak. A blank space indicates no diffraction peaks were identified. - Wellington-Oro Mine Complex - French Gulch Project, near Breckenridge, Colorado

Sample No.	Quartz	Feldspar	Smectite	Illite/mica	Kaolinite	Ankerite	Siderite	Gypsum	Anglesite	Jarosites	Alunites	Goethite	Hematite	Pyrite-Sphalerite	Other 1/
WO-WR-01 (57)	Major	X		X	X			Major		Major	?	X		?	
WO-OP-10A (58)	Major	?		X	X			Major		Major	?	?			?
WO-OP-05 (59)	X			X			?	X	Major				X	Major	?
WO-OP-08 (60)	X			X	X			Major		Major	?	?			
WO-DD-03 (61)	Major	?	?	Major	X	X	X							X	
WO-WTL-02 (62)	Major	?		Major	Major	X	?	?						?	
WO-WTL-04 (63)	Major	X		Major	Major			X		Major		?			
WO-WWR-01 (64)	Major	?		Major	Major	?	?	?						X	
WO-WWR-02 (65)	Major			X	X	Major								Major	X

1/ See table 2

APPENDIX D

DMG Saturation Paste Extraction Data

To: CSU Soils Lab

From: Jim Herron, Bruce Stover-866-3567

Date: March 14, 1994

Re: FRENCH GULCH MINE WASTE SAMPLES

The following is the list of samples submitted to CSU soils lab for metals analysis:

Hole No.	Sample No.	Depth	Comments/Notes/Tests
RF-1	RF-1-3	10'-14'	*
RF-3	RF-3-2	4'-5'	*
RF-3	RF-3-3	10'	*
RF-3	RF-3-4	13'	*
RF-4	RF-4-2	5'-10'	*
RF-5	RF-5-2	4'-6'	*
MW-1	MW-1-1	SURFACE	*
MW-1	MW-1-4	10'-14'	*
MW-3	MW-3-2	18'	*
MW-3	MW-3-3	34'	*
MW-2	MW-2-2	1'-26'	*
MW-2	MW-2-4	27'	*
MW-1	MW-1-3	7'-10'	*
DP-1	DP-1-1	0'-3'	*
DP-1	DP-1-2	3'-6'	*
DP-1	DP-1-3	8'	*
DP-1	DP-1-4	12'-14'	*

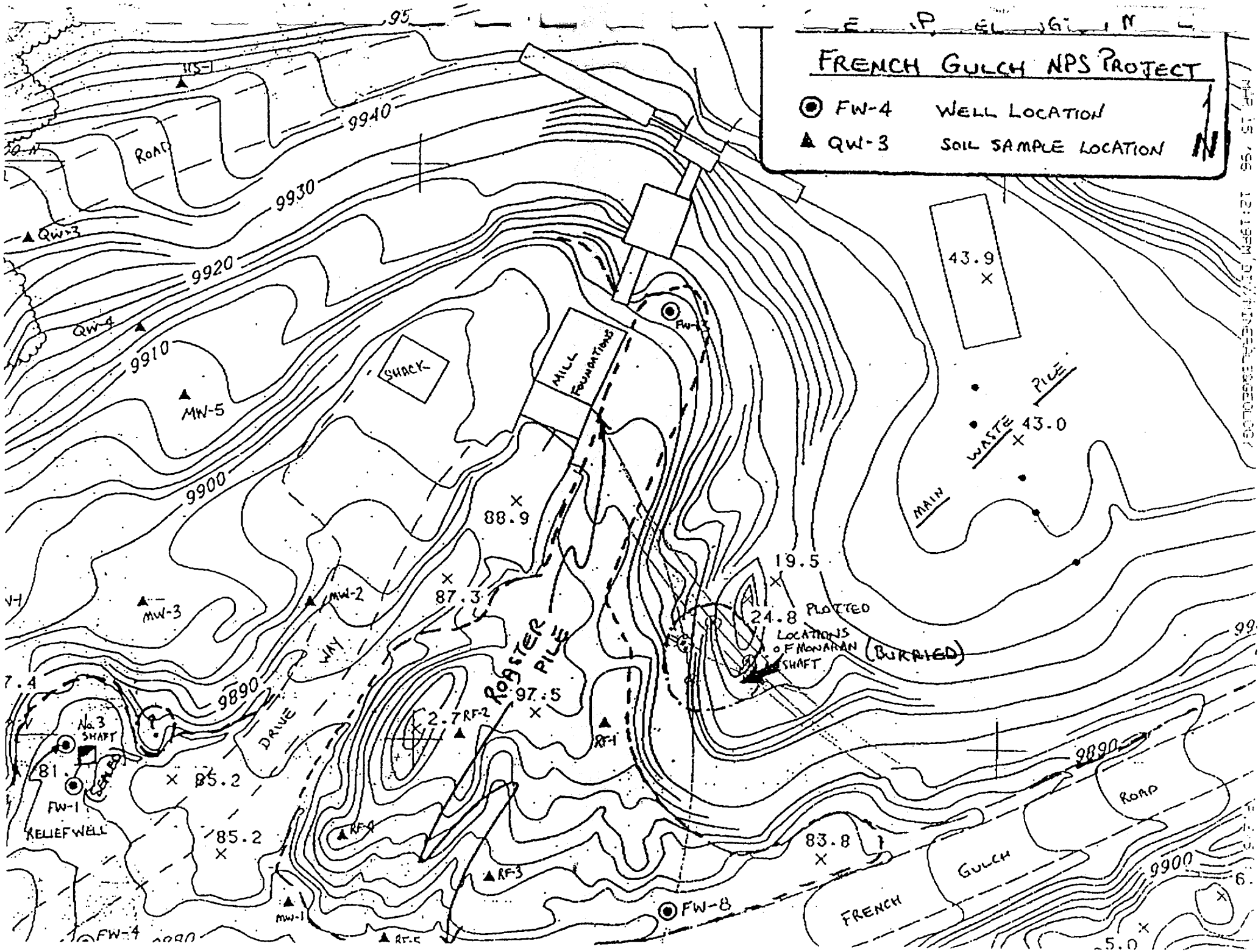
*-Conduct ICP full metals analysis by Saturation Paste extract.

TABLE 4. MINE WASTE ANALYSES

Lab #	Sample ID #	Saturation Paste Extract mg/l Mo	Cd	Si	Cr	Sr	B	Ba	Pb	V	% SAT
R6270	RF-1-2	0.15	2.30	1.62	0.03	0.04	0.38	<0.01	0.22	0.03	31.4
R6271	RF-3-2	0.41	9.73	0.69	0.05	<0.01	1.50	<0.01	0.61	0.12	22.2
R6272	RF-3-3	0.15	2.63	1.63	0.03	0.02	0.41	<0.01	0.24	0.04	42.0
R6273	RF-3-4	0.13	2.69	0.81	0.04	0.01	0.63	<0.01	0.33	0.06	33.5
R6274	RF-4-2	0.21	0.24	0.63	0.07	<0.01	1.86	<0.01	0.72	0.15	36.4
R6275	RF-5-2	0.14	0.59	1.45	0.07	0.12	1.41	<0.01	0.49	0.14	31.3
R6276	MW-1-1	0.14	0.19	1.66	0.12	0.07	2.11	<0.01	0.58	0.18	21.1
R6277	MW-1-4	0.05	0.11	1.82	0.03	0.01	0.01	<0.01	0.14	<0.01	38.7
R6278	MW-3-2	<0.01	<0.01	0.11	<0.01	0.01	<0.01	<0.01	<0.05	<0.01	34.5
R6279	MW-3-3	0.02	<0.01	0.15	<0.01	0.02	<0.01	0.01	<0.05	<0.01	29.9
R6280	MW-2-2	0.08	0.12	0.78	0.09	0.10	1.02	0.01	0.38	0.11	36.6
R6281	MW-2-4	0.01	0.17	0.57	0.01	0.06	<0.01	<0.01	<0.05	<0.01	37.0
R6282	MW-1-3	0.03	0.05	1.74	0.05	0.01	0.12	<0.01	0.07	0.01	36.8
R6283	DP-1-1	0.01	0.06	0.15	0.02	0.03	<0.01	<0.01	0.08	0.02	31.4
R6284	DP-1-2	0.03	0.03	0.35	0.04	0.01	0.05	<0.01	0.15	0.03	38.7
R6285	DP-1-3	0.03	0.15	0.26	0.03	0.14	0.01	<0.01	0.12	0.03	30.9
R6286	DP-1-4	0.02	0.02	0.14	0.02	0.06	<0.01	<0.01	0.07	0.02	29.8
*R6286A	RF-4-1	0.14	2.75	1.09	0.06	<0.01	0.76	<0.01	0.32	0.07	25.4

*R6286A Extra sample not on list

RF - Roaster Fines; MW - Mine Waste (waste Rock); DP - Mine Tailings (Atop Placer Dredge Waste);
Note: First number is sample location. Specific Location of tailings are not available


FRENCH GULCH NPS PROJECT
FW-4 WELL LOCATION
QW-3 SOIL SAMPLE LOCATION
N
95
9940
9930
9920
9910
9900
9890
ROAD
QW-3
QW-4
MW-5
SHACK
MILL FOUNDATIONS
FW-13
43.9
WASTE PILE
43.0
MAIN
88.9
87.3
19.5
24.8
PLOTTED LOCATIONS OF MONAHAN SHAFT (BURIED)
MW-2
MW-3
DRIVE WAY
ROASTER PILE
97.5
2.7
RF-2
RF-1
RF-4
RF-3
RF-5
No. 3 SHAFT
CAPPED
81
FW-1
RELIEF WELL
85.2
85.2
83.8
MW-1
FW-8
FW-4
FRENCH GULCH
ROAD
9900
5.0

Appendix 8-4

Evaluation of Proposed Surface Waste Remediation Alternatives French Gulch Colorado

December 1997

Submitted to:
Northwest Colorado Council of Governments
Silverthorne, Colorado

Prepared by:
Gigi A. Richard
Colorado State University
Fort Collins, Colorado

Disclaimer

The purpose of this study is to evaluate the proposed surface waste remediation alternatives based on criteria approved by the French Gulch Remediation Opportunities Group (FROG). It should not be construed that this analysis is a recommendation for a particular alternative or a suggestion for a specific course of action. Additionally, it is not intended that the information in this report be used as the sole basis for selection and/or design of any type of remediation strategy.

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1. Introduction

The French Gulch Remediation Opportunities Group (FROG) has identified several remediation strategies to address the water quality and potential human health impacts from the surface mining waste located on the Wellington-Oro mining complex in French Gulch, Summit County, Colorado (Figure 1.1). The remediation alternatives range from large-scale excavation and removal of mining waste to no action at all. The FROG has also outlined specific criteria for evaluation of the alternatives. The criteria include

- the degree of reduction in metal loading in French Creek and the Blue River,
- impacts to historical mining structures and features,
- non-water related exposure risks, and
- cost.

The purpose of this study is to evaluate the proposed surface waste remediation alternatives based on the specified criteria and to identify how well each remediation alternative satisfies the specified criteria. It is not meant to make any sort of recommendation regarding which alternative is preferred. It is anticipated that this report will be one of the many tools that the FROG will use to make a recommendation regarding how to deal with the surface waste.

This report is intended to be clear and understandable to non-technical people familiar with French Gulch and to provide brief introductions to the site, the characteristics of the surface waste, and the relationship between the surface waste piles and the water quality of French Creek. Chapters 2, 3 and 4 present background information regarding the W-O site, the surface waste and the remediation alternatives. Chapters 5, 6, 7, and 8 provide evaluations of the remediation strategies based on the criteria listed above. Chapter 5 also provides a brief explanation of the connection between surface and ground water quality and the surface waste piles. The final chapter summarizes the results of the evaluation.

The W-O site is complex – hydraulically, hydrologically, geologically and chemically. As a result, there are numerous metal sources and pathways through which these metals can reach French Creek. This study focuses on the metal sources located on the surface of the valley and does not address the impacts of the underground mine pool on the water quality of French Creek.

Evaluating remediation strategies is an important step in the abandoned mine reclamation process. The U.S. Environmental Protection Agency (1995) states that "Remedial actions based on a partial picture of a site may overlook important contaminant sources or pathways, resulting in no improvement to water quality". Such actions can be extremely costly and therefore, studies such as this one are valuable tools in the decision-making process.

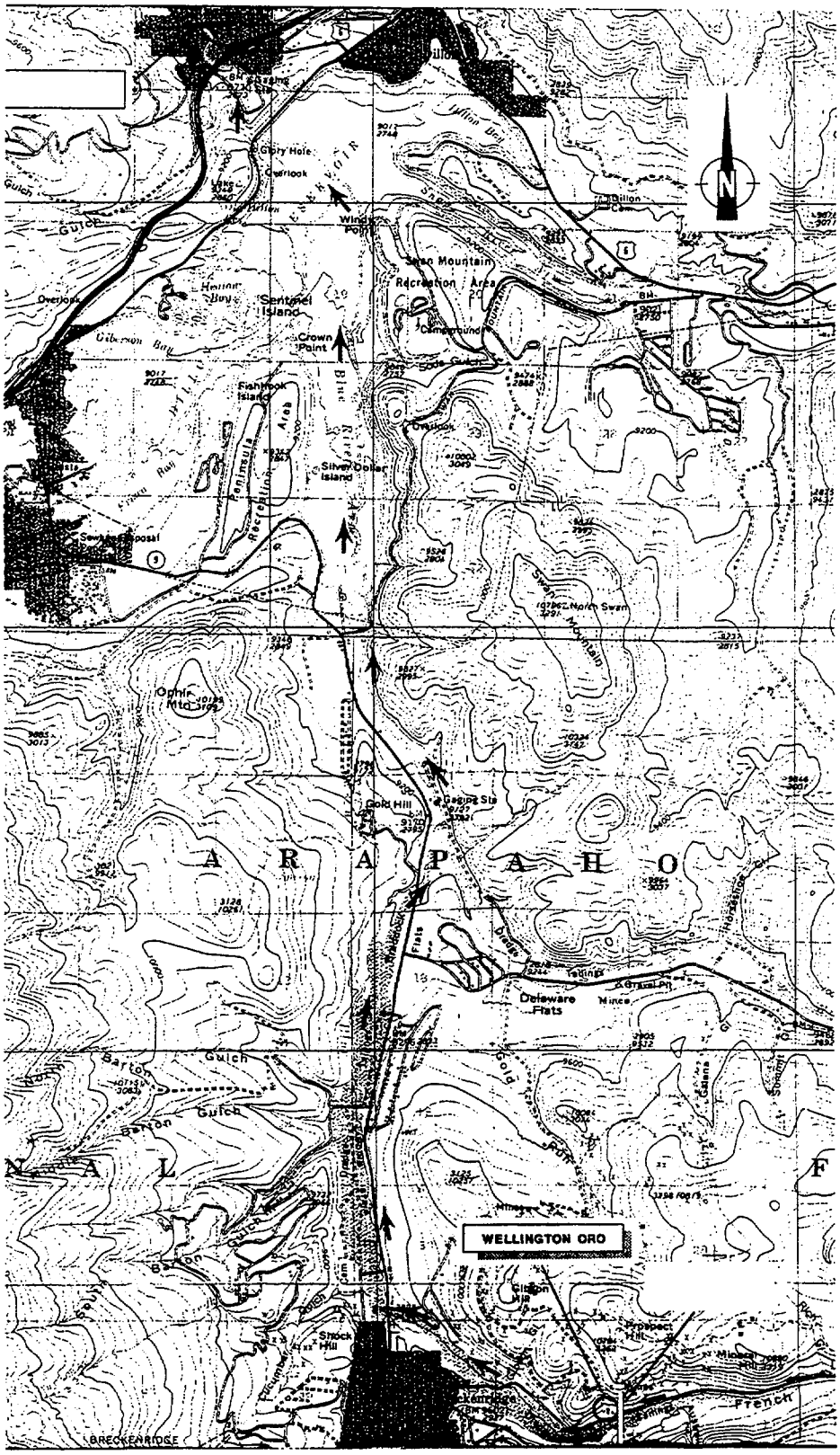


Figure 1.1 - Map of French Gulch and Surrounding Area

2. Site Description and Background

The Wellington-Oro Complex is located in French Gulch, a valley situated to the northeast of the Town of Breckenridge, Colorado (Figure 2.1). During the late 1800's and early 1900's French Gulch was the site of several metal mining operations. The spoils from these operations are evident on the surface of the valley in the form of waste rock piles, mill tailings, roaster fines, and dredge tailings. Many of these piles contain elevated levels of metals, including zinc, cadmium, iron, lead, and manganese.

For the purposes of this report, the term Wellington-Oro (W-O) Complex will be used to refer to the main W-O mill site, the Wellington Mine, the Oro Mine, and the Extenuate (or X.10.U.8.) Shaft area (Figure 2.1). The Union Mill site, located downstream from the W-O mill site, is not included in the scope of this evaluation.

French Creek, the principal drainage of French Gulch, is a tributary to the Blue River which flows into Dillon Reservoir, a major water source for the city of Denver, Colorado. Through extensive water quality studies of French Creek by various state and federal agencies, it has been determined that the concentration of metals in the water of French Creek increases significantly as it flows through the W-O complex. In addition, the concentration of metals in the Blue River increases following its confluence with French Creek. Additional studies and sampling efforts are currently being conducted in an attempt to clearly describe the flow of French Creek as it passes through the W-O complex and to identify the specific sources of the metal contamination.

2.1 Topography

2.1.1 Placer mining

Placer mining by dredge boats around the turn of the century greatly influenced the flow of French Creek through the Wellington-Oro site. The spoils of the placer mining are present in the form of dredge piles or tailings on the valley floor. These tailings cover the entire width of the valley for a distance of 3.5 miles upstream from French Creek's confluence with the Blue River. The impact of the dredging on the creek was to effectively turn the riverbed upside down, leaving behind 50-foot high piles of boulders, cobbles and coarse gravels dredged from the streambed. The creek is forced to flow in an unnatural channel and via subsurface flow through the dredge piles (Colorado Division of Minerals and Geology 1990).

2.1.2 Milling and Hardrock mining

Lode mining began in French Gulch in the early 1880's on the north side of the valley, with the Wellington-Oro site being the most extensively mined area. The Wellington and Oro mines were originally operated separately, and were later consolidated into one property. The mines were working a lead-zinc-silver sulfide vein that proved to be very productive. The Colorado Division of Minerals and Geology (1990) explains that most of the zinc was discarded with the other tailings materials and that much of the pyrite was sold. A mill was constructed on site in 1908

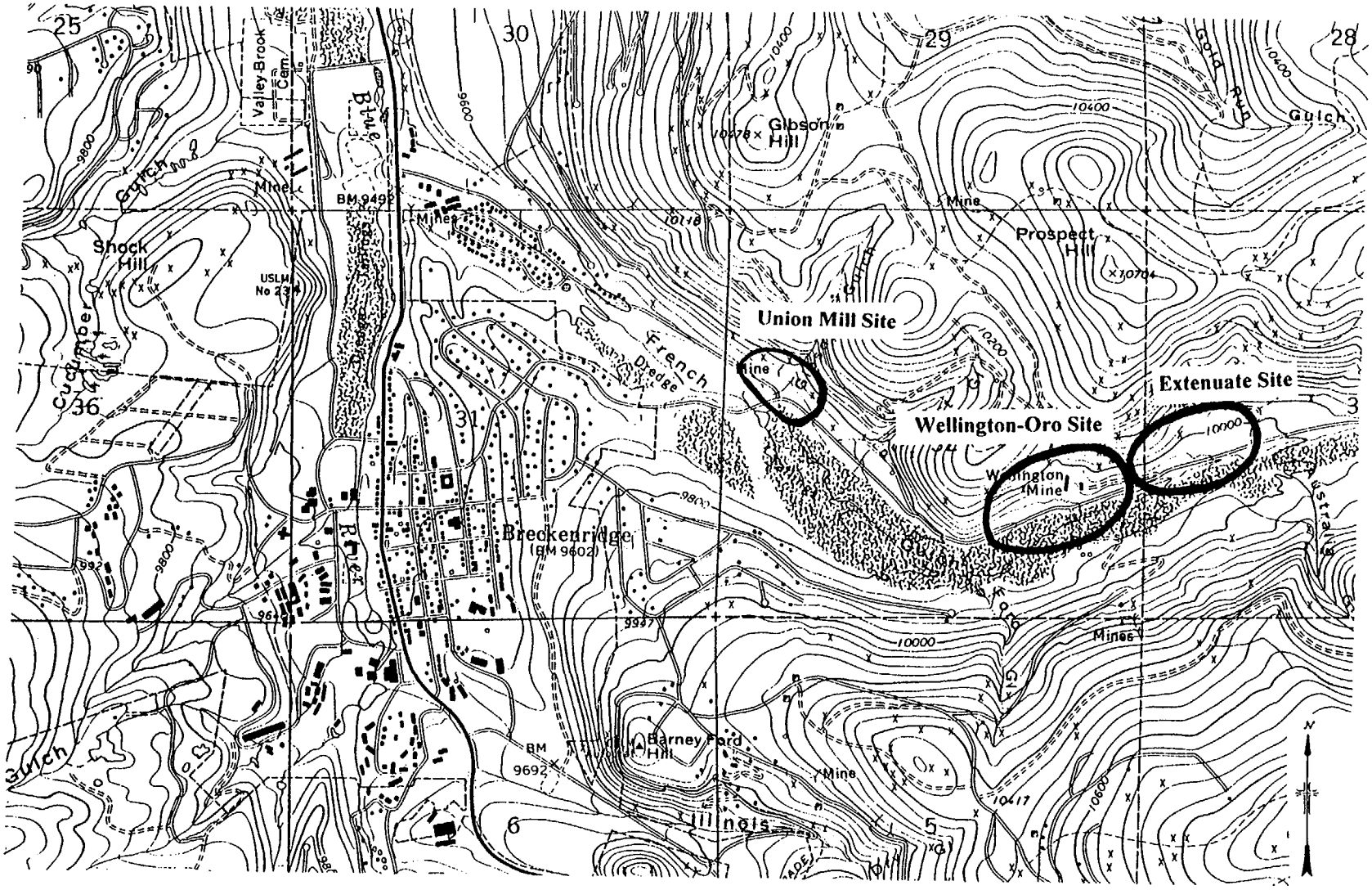


Figure 2.1 - Map delineating the Wellington-Oro Site

near the Oro shaft. The W-O and Extenuate mines are comprised of an extensive system of underground tunnels on at least 18 levels. Six of the levels are below the level of French Creek and are now mostly caved in and flooded. During mine operation, the lower levels of the mine had to be pumped. The water in underground tunnels and mine workings is commonly referred to the as the mine pool.

The waste or tailings from the hard rock mining activity has also greatly affected the topography of the valley. Mill tailings were placed in the bottom of the valley adjacent to French Creek. The roaster fines piles are located near the mill foundations. Mine waste rock is present on the hillside at both the Oro shaft area and the Wellington and X.10.U.8 tunnel entrances. The characteristics of these waste piles are described in greater detail in Chapter 3.

2.2 Hydrology of the Site

Through studies of the isotope signature of water from various sources in the valley, it has been speculated that the subsurface flow is significantly connected to the flow in French Creek. In other words, a majority of the water in the Creek comes from below rather than from runoff over the surface of the valley. This is not an intuitive observation; however, it is a common occurrence in mountain valleys such as French Gulch.

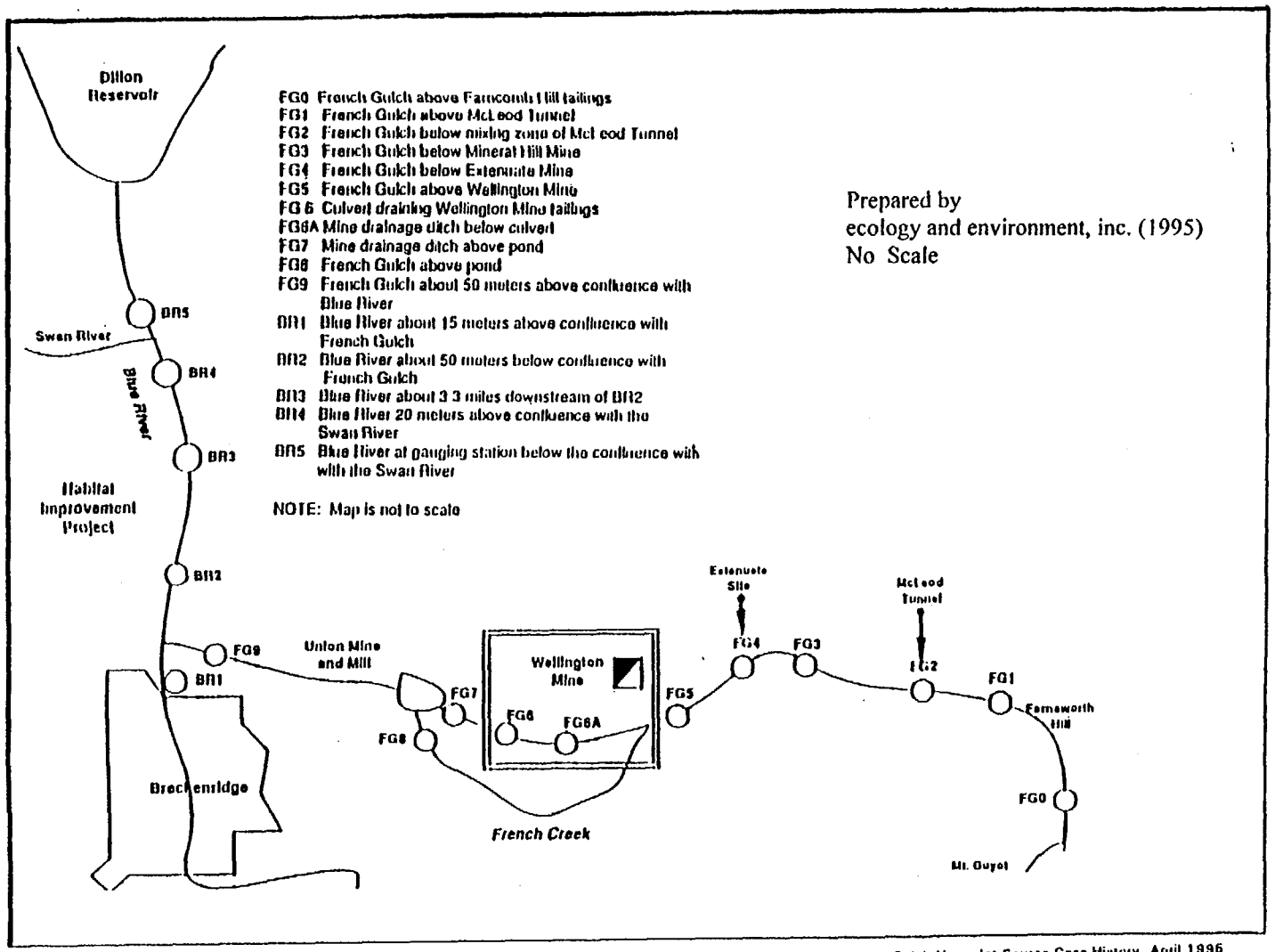
French Creek then flows into the Blue River, which is a major source of water for the City of Denver's Dillon Reservoir. The Blue River is highly impacted by the quality of water in French Creek, as is evidenced by the exceedance of water quality standards in the Blue River downstream of its confluence with French Creek. Downstream of its confluence with French Creek, the Blue River is also affected by the tailings piles left by the dredge boats that operated along that stretch of the river.

2.3 Sampling and Monitoring History

A number of local, state and federal agencies have been involved in water chemistry sampling of French Creek since 1992. Data is available from the Colorado Department of Public Health and the Environment (CDPHE), the Colorado Division of Minerals and Geology (CDMG), the U.S. Environmental Protection Agency (USEPA), the U.S. Geological Survey (USGS), and the Breckenridge Sanitation District. A majority of the sampling has been of the surface water in French Creek and the Blue River. Some of the data sets also include samples retrieved from groundwater wells in French Gulch. The most recent and comprehensive data set is being collected by the USGS National Water Quality Assessment Program (NAWQA) and includes water chemistry and daily discharge data.

2.3.1 Sampling Sites

An attempt has been made to maintain uniformity in the location and nomenclature of sampling sites between the studies. Table 2.1 describes the locations of the sites that are pertinent to this study and Figure 2.2 shows the locations on a map.



Source: SAIC, French Gulch Nonpoint Source Case History, April 1996

Figure 2. 2 - Map showing locations of sampling sites on French Creek and the Blue River

Table 2.1 - Locations of Surface Water Sampling Sites

Sampling Site ID	*Description of Location*
FG-5	French Gulch upstream of Wellington Mine and upstream of a small pond alongside the road.
FG-7	Mine drainage ditch upstream of confluence with Dead Elk Pond. (Located on left side of pond when looking toward the mining site).
FG-8	French Gulch upstream of confluence with Dead Elk Pond on southeast side.
FG-9A	French Gulch 450 feet downstream of Dead Elk Pond.
FG-9	French Creek about 50 meters upstream of confluence with the Blue River.
BR-1	Blue River about 15 to 50 meters upstream of confluence with French Creek.
BR-2	Blue River about 50 meters below confluence with French Gulch.
BR-3	Blue River about 3.25 miles downstream of BR-2 at Tiger Run Resort (at parking lot entryway).

2.3.2 Survey Dates and Data Available

Table 2.2 summarizes the dates of water chemistry sampling and the types of data collected.

The U.S. Bureau of Reclamation (USBR) and USEPA have performed additional sampling of the surface waste piles. This sampling included determining the sediment sizes and the chemical makeup of the material in the piles. This data is summarized in Section 3.

2.4 Water Chemistry of the Site

Elevated levels of several metals have been detected in French Creek. This study will focus on the impacts of cadmium, iron, manganese and zinc due to their particularly high levels and their potential for toxic effects to humans and aquatic life. In addition, levels of these metals often exceed the established water quality standards for French Creek and the Blue River. Some of these standards are not set numbers but are based on the hardness of the water, which varies with stream flow.

Table 2. 2 - Summary of Water Chemistry Sampling Activities in French Gulch

Sampling Date	Discharge	Surface Water Chemistry	Ground Water Chemistry	Agency
September 22, 1992	✓	✓		Colorado Division of Minerals and Geology (CDMG)
October 21, 1993		✓		CDMG
November 16-17, 1993		✓	✓	CDMG
August 22-24, 1994	✓	✓	✓	CDMG
March 20, 1996	✓	✓	✓	USGS
June 10-12, 1996	✓	✓	✓	USEPA
June 27, 1996	✓	✓	✓	USGS
July 22-23, 1996	✓	✓	✓	USEPA
October 1995 through February 1997	Daily	Monthly	Monthly	USGS NAWQA
April 1986 through October 1994		Monthly	Monthly	Breckenridge Sanitation District (Blue River only)

In low concentrations, many metals are beneficial and essential to aquatic and human life, but at high concentrations may become toxic. Toxicities of pollutants are usually classified as either acute or immediate and chronic or gradual effects. The impacts differ by species also. For example, fish are much more sensitive to zinc and copper concentrations than humans are. And, some species of fish are more sensitive than other species.

2.4.1 Cadmium (Cd)

High concentrations of cadmium are rarely found in surface waters unless they are impacted by mining or industrial drainage. Average concentration of cadmium in unpolluted surface water ranges from no detection to 0.5 micrograms per liter (μg/l). Cadmium does not stay in solution for long in natural waters as it is either precipitated out as carbonate or adsorbed (or adhered) onto particles and incorporated into bottom sediments. The adsorption of cadmium to sediment increases with increasing pH and it readily accumulates in aquatic organisms (Dojlido and Best 1993). Figure 2.3 summarizes measured concentrations of cadmium in French Creek and the Blue River and standards and reference levels for cadmium to aid in understanding the values.

The federal drinking water standard for cadmium is 10 μg/l (Dojlido and Best 1993) and the state of Colorado's drinking water supply standard is 5 μg/l. The U.S. Geological Survey's National Water Quality Assessment Program (NAWQA) data for metal concentration at the mouth of French Creek (station FG-9) shows cadmium concentration varying from approximately 6 μg/l to

11 µg/l. The average value of dissolved cadmium at FG-9 from previous water quality samples is 6.12 µg/l. The average value of dissolved cadmium at BR-2 is 3.82 µg/l. The measured cadmium concentration in the Blue River and French Creek do not vary significantly between the dissolved and the total recoverable form.

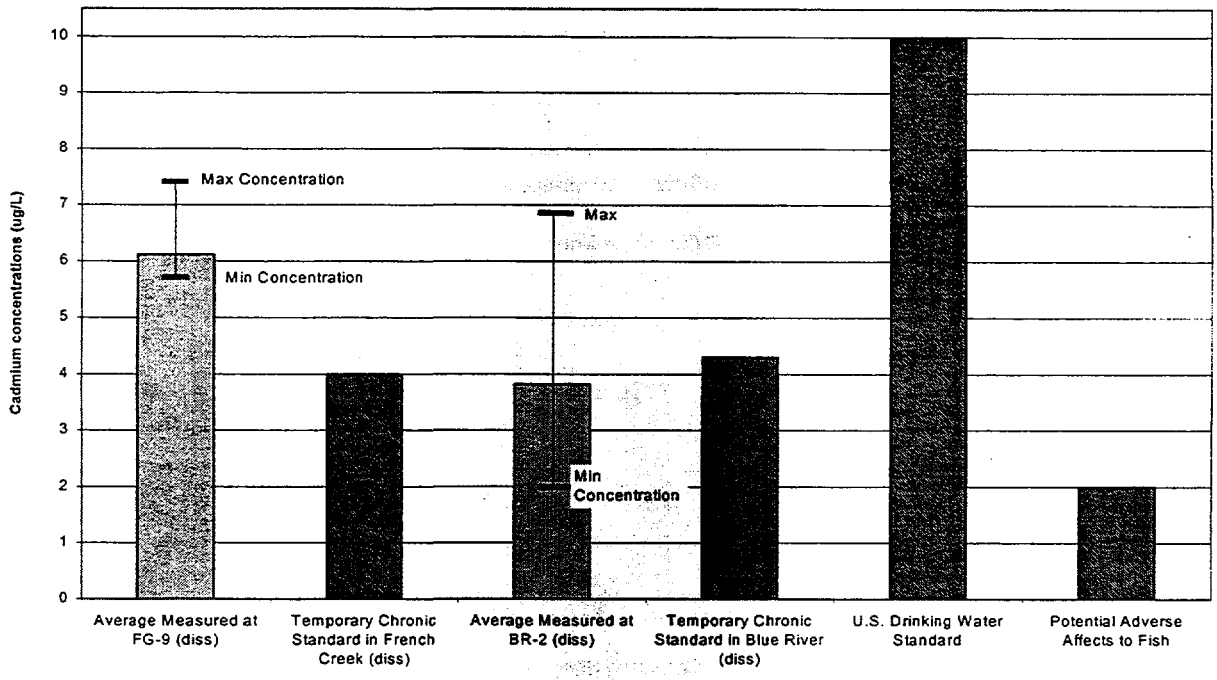


Figure 2. 3 - Cadmium Concentrations, Standards and Reference Levels

The State Water Quality Control Commission has established temporary standards for cadmium in the Blue River downstream of French Creek based on existing ambient conditions. The standard for dissolved cadmium in French Creek has been established at 4 µg/l and at 4.3 µg/l in the Blue River. The established standard for agricultural use is 10 µg/l.

Cadmium is highly toxic to humans and to aquatic life and readily accumulates in the liver, kidneys, pancreas and thyroid of exposed animals. Once concentrated in these organs, cadmium tends to remain. Lethal concentrations of cadmium to fish vary from about 10 to 10,000 µg/l depending on the test species, temperature, and time of exposure (Martin and Mills 1976).

2.4.2 Iron (Fe)

Iron is the second most abundant metal in the earth's crust and occurs naturally in surface waters from the weathering and leaching of rocks and soils. Average concentrations of iron in unpolluted natural waters range from no detection to 54,000 µg/l. The federal drinking water standard for iron is 300 µg/l (Dojlido and Best 1993).

The concentration of iron measured in French Creek varies greatly between the dissolved and total recoverable forms. The total recoverable concentration is significantly higher than the dissolved (See Figure 2.4). Dissolved iron concentrations in French Creek range from 3 µg/l to 370 µg/l during the USGS NAWQA study period from October 1995 through February 1997.

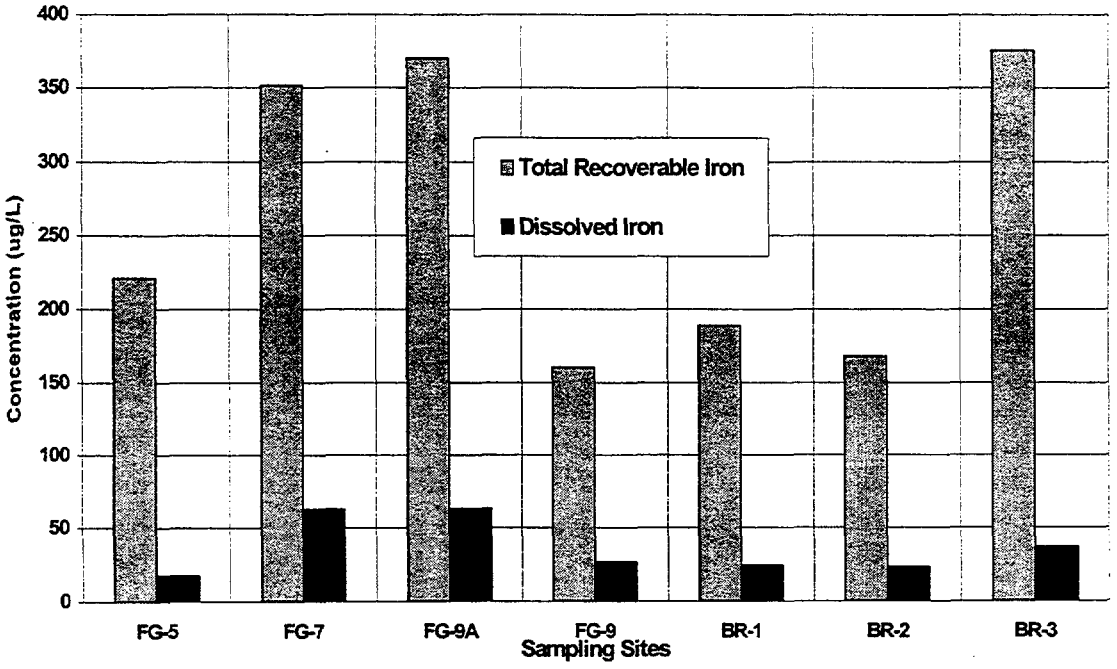


Figure 2. 4 - Average Iron Concentrations September 1992 through July 1996

For the studies conducted from 1992 through 1996 (See Table 2.2 for exact date and sampling agency), the average dissolved iron concentration at FG-9 was 26.45 µg/l and average total recoverable was 160.34 µg/l. The average concentrations at BR-2 were 23.03 µg/l dissolved and 168.12 µg/l total. The established chronic water quality standard for the protection of aquatic life for dissolved iron in French Creek is 1,000 µg/l dissolved. In the Blue River, the standards are 300 µg/l for dissolved and 1,000 µg/l for total recoverable iron for the protection of drinking water supplies. See Figure 2.5 for a summary of these average concentrations and standards.

Iron can harm the biological community of streams in a number of ways depending on its form and concentration. Deposition of iron on the gills of fish can cause irritation and blockage of the

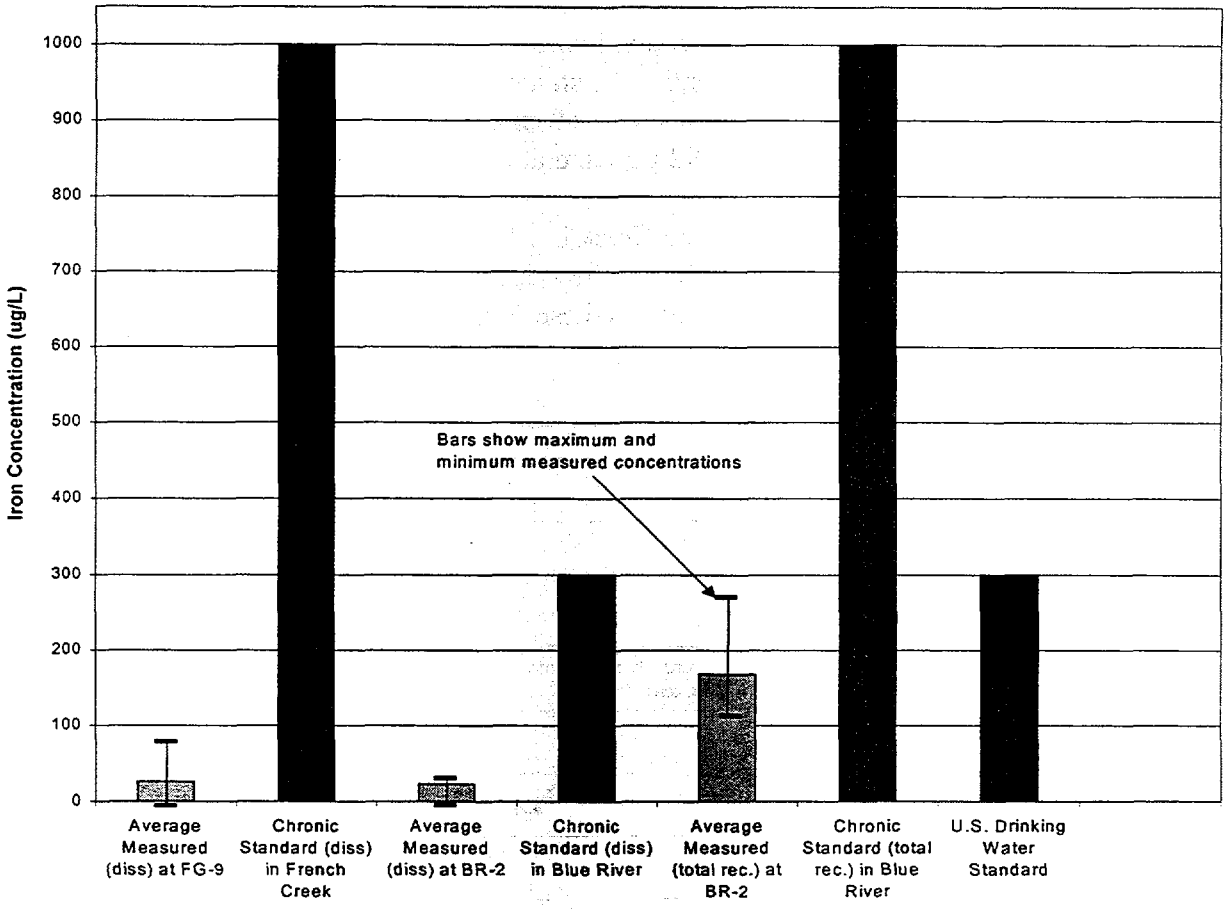


Figure 2. 5 - Iron Concentrations, Standards, and Reference Levels

respiratory canals. Similar deposition on the streambed can smother fish eggs and disturb the benthic or insect and microbial community (Martin and Mills 1976). Studies cited by Dojlido and Best (1993) report that a maximum annual value of 2,000 µg/l of total iron is tolerable to most fish.

2.4.3 Manganese (Mn)

Manganese is an abundant element of the earth's crust and may be found in natural waters through normal leaching from rocks and soils. The average concentration of manganese in unpolluted natural waters is about 100 to 1,000 µg/l. The federal drinking water standard for manganese is 50 µg/l (dissolved) (Dojlido and Best 1993) and is a secondary standard to protect the aesthetics, taste, odor and staining of a drinking water source. The standard for agricultural use is 200 µg/l total recoverable manganese.

The concentrations of manganese in the dissolved and total recoverable forms are similar in French Creek and the Blue River and are used interchangeably in this report. Concentrations of manganese in French Creek often exceed 100 µg/l and even exceed 1,000 µg/l at times. The

USGS NAWQA data for October 1995 through February 1997 show the concentration of Mn at FG-9 varying from 10 µg/l to over 300 µg/l. The studies conducted from 1992 through 1996 (See Table 2.2 for a listing of when samples were taken and by whom) result in an average concentration of manganese at FG-9 of 292 µg/l and at BR-2 of 179 µg/l.

The established chronic standard for French Creek is 1,000 µg/l and for the Blue River 50 µg/l (dissolved) and 1,000 µg/l (total recoverable). The standard for agricultural use is 200 µg/l total recoverable manganese. Figure 2.6 summarizes these standards and average concentrations.

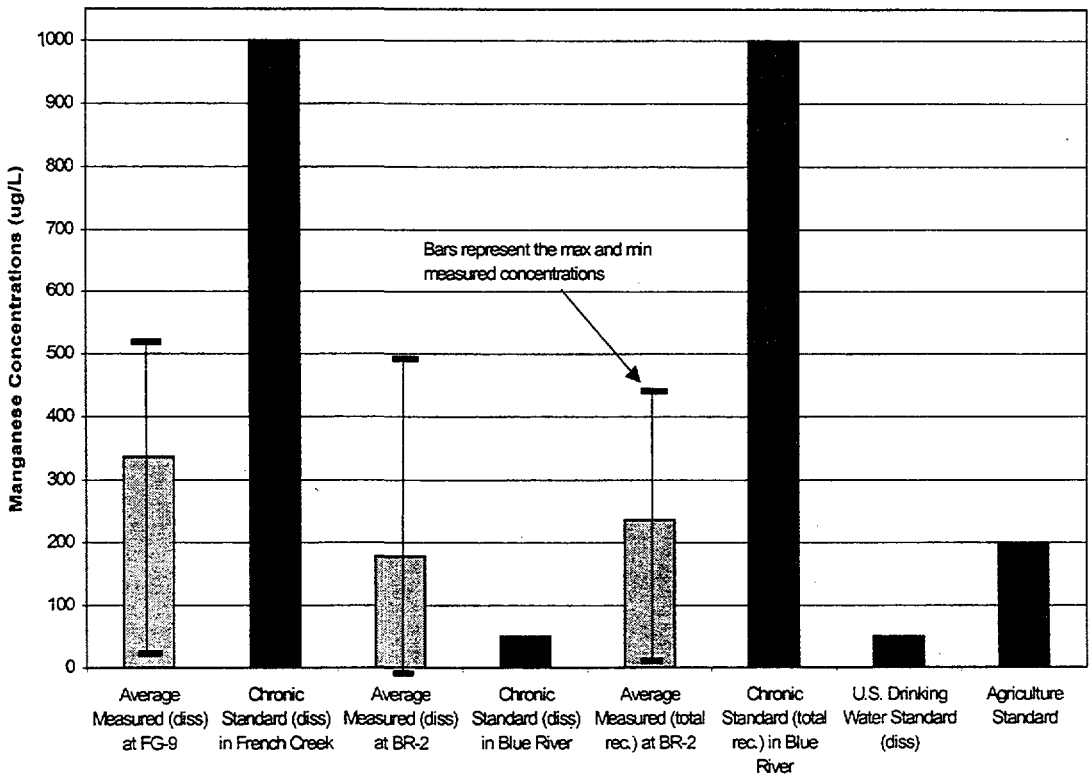


Figure 2. 6 - Manganese Concentrations, Standards and Reference Levels

Martin and Mills (1976) report that manganese has a limited toxicity to fish and also limits the toxicity of nickel to fish. Concentrations of 1,000 to 2,700,000 µg/l have been shown to be toxic to various fish species. The toxicity of Mn increases with decreasing pH. It is also essential in the diet of animals and for plant growth in lower concentrations. Manganese concentrations of 500 to 500,000 µg/l have been reported to be toxic to various plant species (Martin and Mills 1976).

2.4.4 Zinc (Zn)

Zinc is one of the most commonly occurring heavy metals and has a variety of uses. It readily forms complexes with organic and inorganic compounds, adsorbs on to suspended solids, and becomes incorporated into sediment. Studies summarized by Dojlido and Best (1993) show that dissolved concentrations of zinc decrease at high flow due to increased adsorption potential associated with the increased suspended sediment load. Average concentrations of zinc in unpolluted surface water range from 5 to 15 µg/l. The drinking water standard for zinc in the U.S. is 5,000 µg/l (Dojlido and Best 1993). The standard for agricultural use is 2,000 µg/l.

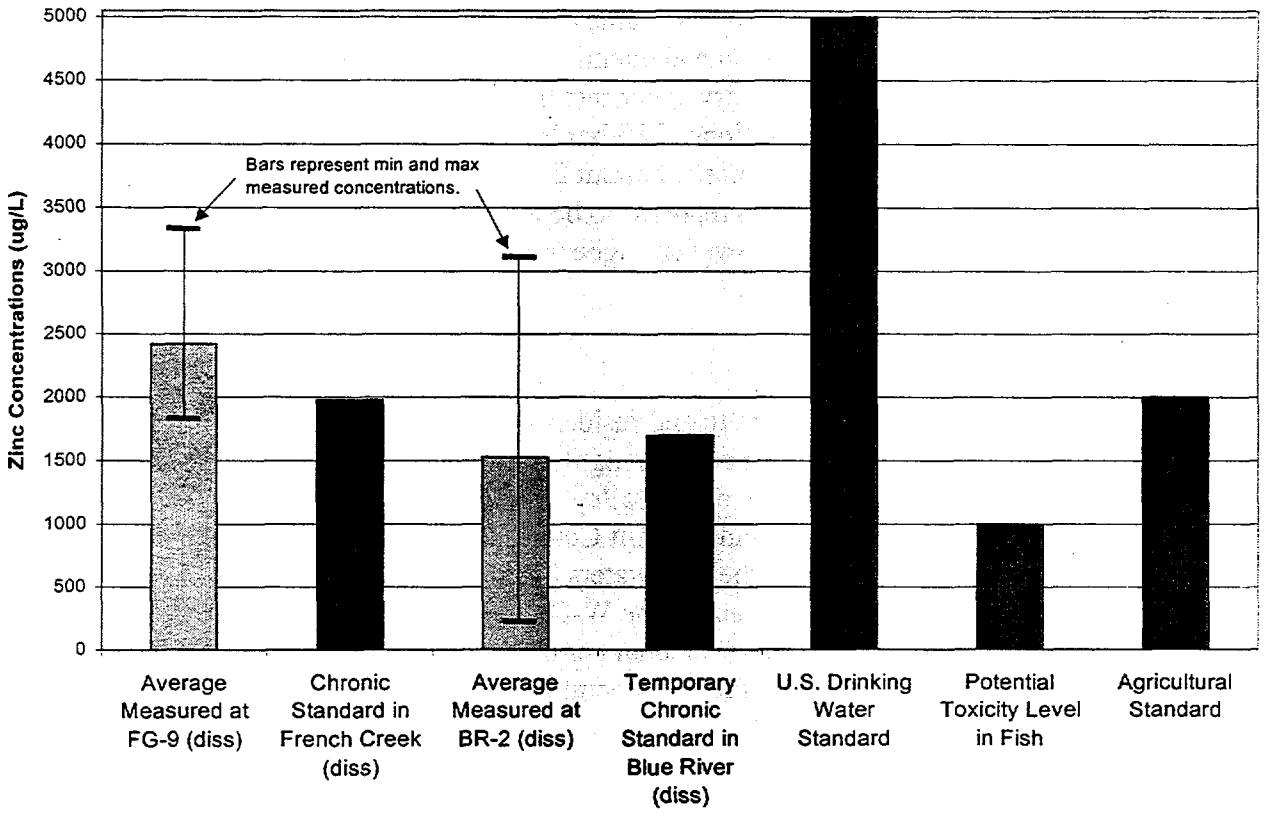


Figure 2.7 - Zinc Concentrations and Standards

Figure 2. 7 - Zinc Concentrations, Standards and Reference Levels

The State Water Quality Control Commission established temporary chronic standards for zinc - 1,700 µg/l dissolved zinc in the Blue River downstream of French Creek and a temporary chronic standard for French Creek below the W-O of 1,980 µg/l of dissolved zinc. According to the data collected by the USGS NAWQA program at FG-9 from October 1995 through February 1997, the concentration of zinc in French Creek varies from approximately 1,800 µg/l to 4,500

μg/l. In the Blue River at County Road #3, the zinc concentration was greater than 100 μg/l from April 1986 through September 1994 (based on Breckenridge Sanitation District data). The concentration of zinc in the Blue River decreases significantly with distance downstream from the confluence with French Creek. The concentration varies from greater than 2,000 μg/l at French Creek to less than 100 μg/l at the confluence with the Swan River (Art Morrissey, Plot of Breckenridge Sanitation District Data, Dated 6/10/97). The average concentration of zinc from other data collected from 1992 through 1996 (See Table 2.2 for exact sampling dates and sampling entities) is 2,421 μg/l at FG-9 and 1,528 μg/l at BR-2. This data and the standards for zinc are summarized in Figure 2.7.

The toxicity of zinc to various fish species is variable depending on the species, age, and condition of the fish as well as the physical and chemical characteristics of the water, such as hardness, temperature and pH. In laboratory experiments, some fish have been shown to be able to acclimatize to elevated zinc concentrations. The hardness of the water also impacts the toxicity level of zinc. In soft water (hardness of about 20 mg $CaCO_3$/L), concentrations of zinc ranging from 100 to 1,000 μg/l have been reported to be lethal. Small quantities of zinc are necessary for nutrition in many plants; however, higher concentrations can be harmful (Martin and Mills 1976).

2.5 Current Uses

French Gulch is currently used by visitors to and residents of Summit County for hiking, skiing, and mountain biking. The Wellington-Oro site is highly visible to all visitors to the valley. In addition, residential use and development of the valley are increasing. Most of the land located above the junction of Wellington Road and Summit County Road 450 is zoned agricultural except for small subdivisions located at the headwaters of French Gulch and some additional mining claims located about 3 to 4 miles above the W-O. Downstream of the W-O, there is residential development and subdivisions (Personal communication with Brian Peters, Summit County Community Development Department, December 1997).

3. Description of Surface Waste

The surface waste piles of interest in this study are the roaster fines, mill tailings and waste rock piles at the W-O site and the mine waste rock at the Extenuate site. The extent of these piles is delineated in Figure 3.1 and 3.2. The dredge tailings in the creek are not being considered for remediation activities at this point in time and are therefore not covered in this report.

The capacity for each of the types of surface waste to contribute metals to French Creek varies with the total metal content, particle size, and mineralogy of the piles and the location of the piles relative to surface water. The variation of water level in each of the piles also contributes to the ability of the material to leach metals into the creek (U.S. Bureau of Reclamation 1996b).

3.1 Roaster Fines

The roaster fines are made up of 43,000 cubic yards of material (U.S. Bureau of Reclamation 1996a), and according to a URS Operating Services, Inc. study of the waste piles; they are chiefly composed of iron with elevated levels of lead and zinc. The zinc in the roaster fines is in a more leachable form than the zinc in the other waste piles (Sullivan 1997). Two samples taken from the roaster fines reveal significant potential to produce acid mine drainage when wet due to the presence of fine grained iron sulfides and the absence of carbonate minerals (Hurcomb 1996). The increased potential to generate acid mine drainage combined with the high metal concentrations can result in leaching of lead, zinc, and iron from the roaster fines (USBR 1996b). Figure 3.3 shows the average metal content of the samples collected from each of the surface waste piles.

Sieve analysis performed by the U.S. Bureau of Reclamation (USBR) on samples collected in October 1996 classify most of the samples collected from the roaster fines as either silty sand or sandy silt. The median grain size varied from less than 0.075 to 0.33 mm. Samples were taken from depths ranging from 2.5 to 16.7 feet (USBR 1996a). The small particle size results in relatively high surface area compared to the waste rock, increasing the leachability of metals from the material (USBR 1996b). See Table 3.1 for a summary of the results of the USBR's data for the roaster fines.

During spring and summer high flow months (May to August), almost complete saturation (to an elevation of 9,882 feet based on reports from Art Morrissey regarding the level of water in the wells in the roaster fines) of the roaster fines is assumed. During the winter or low flow season, approximately 17,000 cubic yards are saturated with ground water (USBR 1996a). The only data available for the chemistry of the groundwater that is saturating the roaster fines is a sample that was taken in June 1996 by the U.S. Environmental Protection Agency. The analysis of this sample reveals elevated levels of zinc, iron, cadmium, copper, aluminum, nickel, and manganese. The metal concentrations from this sample are presented in Figure 3.4.

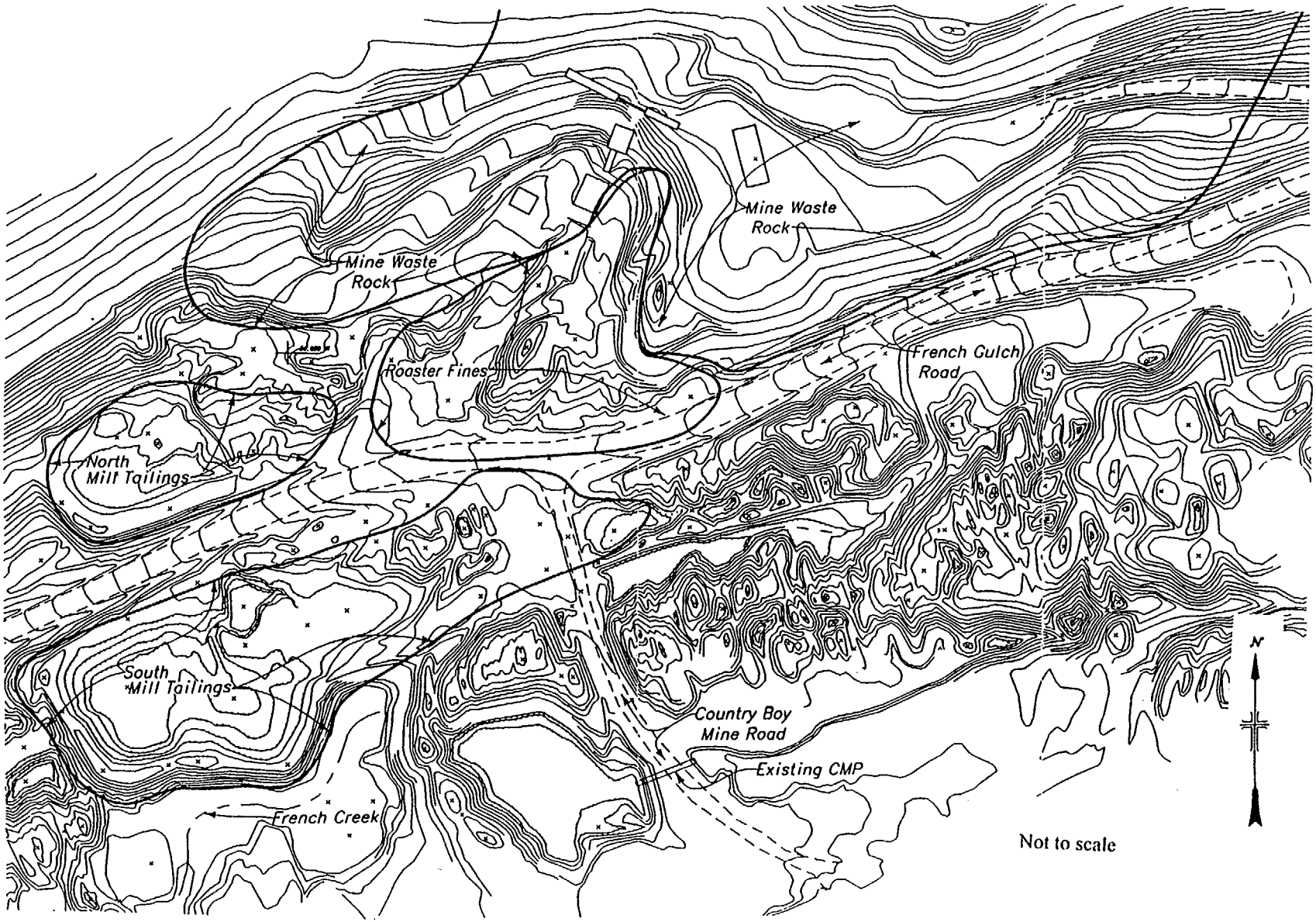


Figure 3.1 – Map of Surface Waste Piles at the W-O Mill Site

(USBR 1996b)

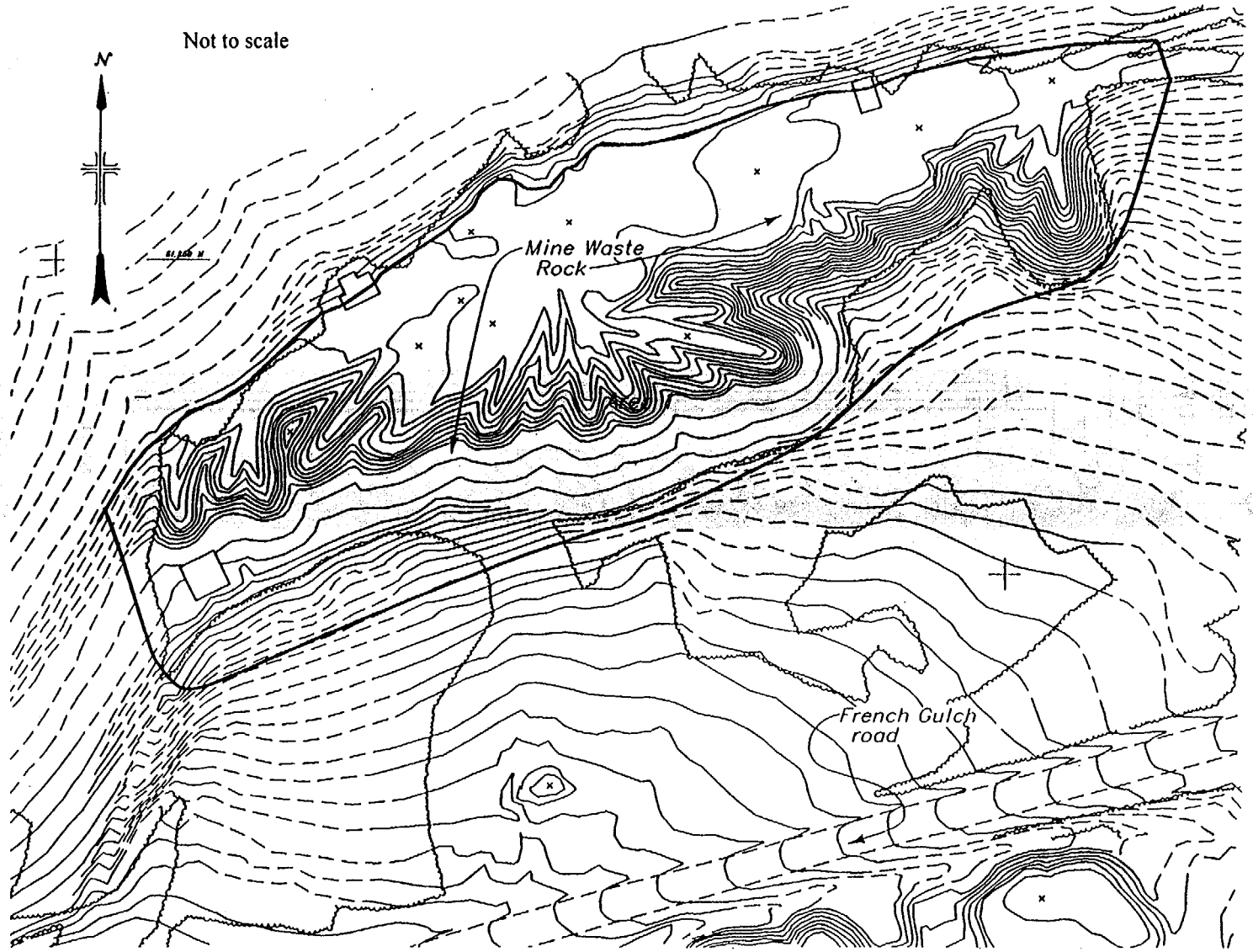


Figure 3.2 – Map of Surface Waste Piles at the Extenuate Site

(USBR 1996b)

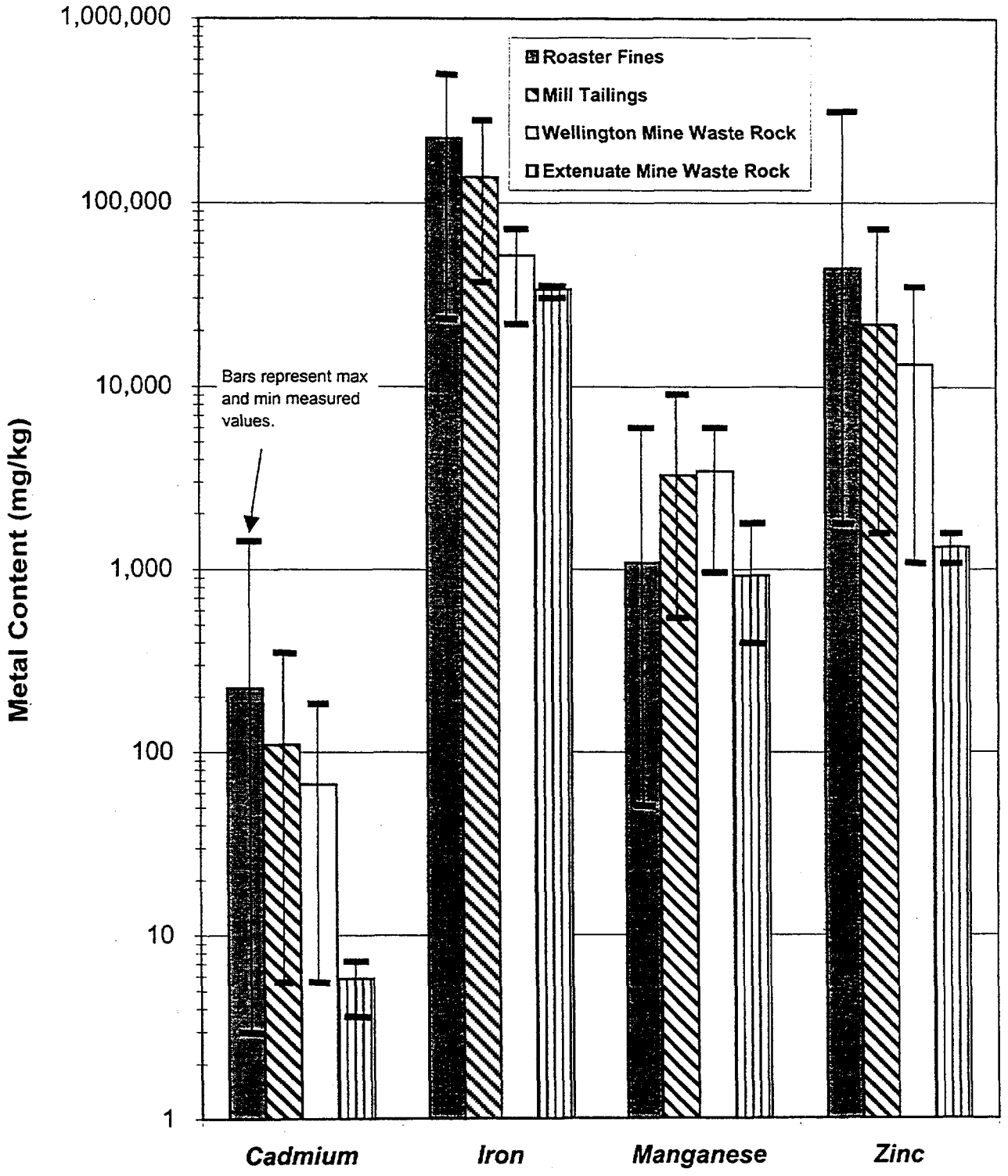


Figure 3.3 - Average Metal Content in Surface Waste Piles
Data compiled from USBR (1996a) and Sullivan (1997)

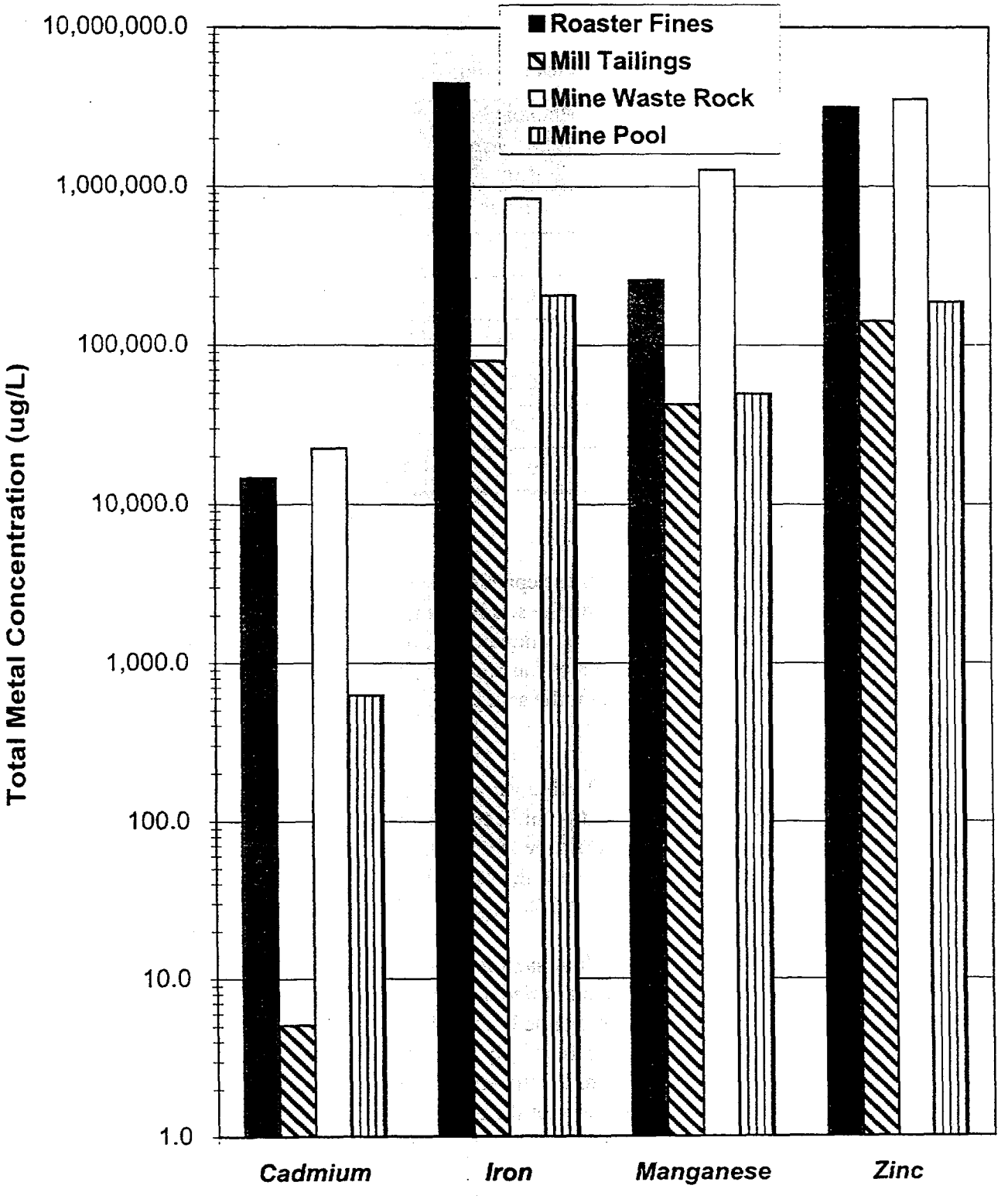


Figure 3.4 - Average groundwater metal concentrations in the roaster fines, mill tailings, mine waste rock and mine pool at the W-O Site.

Table 3.1 - Roaster Fines Particle Size Data (USBR 1996a)

Sample ID Number	Depth of Sample (feet)	Median Grain Size of Sample (mm)	Description of Material
70C-13T	4.3 - 6.7	< 0.075	Sandy Silt
70C-13B	4.3 - 6.7	0.1	Silty Sand
70C-15T	9.2 - 11.7	0.22	Silty Sand
70C-15B	9.2 - 11.7	0.36	Poorly graded Sand w/ Silt
70C-22B	9.5 - 12.0	0.22	Silty Sand
70C-22T	9.5 - 12.0	0.26	Silty Sand
70C-24	14.5 - 16.7	0.15	Silty Gravel w/Sand

3.2 Mill Tailings

The mill tailings are comprised of two sites separated by French Gulch Road and are referred to in this report as the north mill tailings and the south mill tailings. Minimal data is available regarding the chemical and physical composition of the north mill tailings. As a result, it is necessary to assume that the composition of the north mill tailings is similar to that of the south mill tailings and that the data collected on the south mill tailings is applicable to the north for analysis purposes.

The north mill tailings consist of 13,000 cubic yards of material and the south mill tailings consist of 42,000 cubic yards. They contain high concentrations of sulfitic minerals, resulting in an increased ability to generate acidic drainage and leaching of metals (See Figure 3.2) (USBR 1996b). The metal content measurements for the mill tailings samples by USBR (1996a) and URS (Sullivan 1997) are reported in Table 3.2.

Sieve analyses were performed on only four samples from the south mill tailings and none from the north. Three of these samples were classified as silty sand and the fourth as poorly graded gravel. The poorly graded gravel was contained in the deepest sample taken (11.0 feet) (USBR 1996a). The small particle size results in relatively high surface area compared to the waste rock, increasing the leachability of metals from the material (USBR 1996b). See Table 3.3 for a summary of the results of the USBR's data for the mill tailings.

Table 3. 2 - Metal Content from Mill Tailings Samples

Map ID	*Sample ID*	*Depth (feet)*	*Cd (mg/kg)*	*Fe (mg/kg)*	*Mn (mg/kg)*	*Zn (mg/kg)*
USBR Samples						
B-WTL01DHST-01	70C-52	27.3 - 29.8	42	36,800	549	7,590
	70C - 41	2.5 - 4.4	48	84,000	2,540	9,060
	70C - 44	9.8 - 12.3	194	265,000	5,210	37,900
	70C - 49	19.8 - 21.8	156	200,000	3,340	29,200
BWTL09TP01	70C-62	0.0 - 2.0	6	42,100	668	1,600
BWTL02TP01	70C-73	5	350	270,000	3,950	70,300
URS Surface Samples						
WOOP10A			12	135,000	954	5,520
WODD03			71	72,200	8,970	12,500

Table 3. 3 - Mill Tailings Particle Size Data (USBR 1996a)

Sample ID Number	Depth of Sample (feet)	Median Grain Size of Sample (mm)	Description of Material
70C-64	0.0 - 5.0	0.237	Silty Sand
70C-65	0.0 - 3.5	0.173	Silty Sand
70C-66	3.5 - 11.0	26.669	Poorly Graded Gravel
70C-73	5	0.342	Silty Sand

Approximately 20,000 cubic yards of the mill tailings are saturated (USBR 1996a). The only data available for the chemistry of the groundwater that saturates the mill tailings is one sample that was taken from the south mill tailings in January 1997. The sample analysis found elevated levels of zinc, iron, cadmium, and manganese. The concentrations from this sample are shown in Figure 3.4 (HydroLogic Laboratories, Inc. 1997).

3.3 Wellington-Oro Mine Waste Rock

The Wellington-Oro mine waste rock piles are located to the north of French Gulch Road surrounding the Oro shaft and the Wellington-Oro mill site. Mine waste rock is crushed rock that is removed from the mine in order to reach the mineralized vein of interest. Mine waste rock usually contains no minerals of value.

The material that comprises the waste rock piles is generally coarser than that of the roaster fines and mill tailings. See Table 3.4 for a summary of the results of the USBR's sampling of the W-O mine waste rock. The metal content of the piles is shown in Figure 3.3.

Table 3. 4 - Wellington Site Mine Waste Rock Particle Size Data (USBR 1996a)

Sample ID Number	Depth of Sample (feet)	Median Grain Size of Sample (mm)	Description of Material
70C-57A	0.0 - 7.0	16.719	Gravel
70C-57B	7.0 - 9.0	5.625	Silty Gravel w/ Sand
70C-61	0.0 - 9.0	5.235	Clayey Gravel w/ Sand

The USBR (1996a) states that an unknown quantity of mine waste rock remains on site above the groundwater table. The water quality sample WP-1 (collected June 12, 1996 during a USEPA sampling effort) is water from a seep that flows from the base of the mine waste rock piles. The metal concentrations in this sample were used to estimate the potential metal loading contribution of the mine waste rock piles. These concentrations are presented in Figure 3.4. The concentrations of metals found in this sample are similar to those found in the roaster fines. There is some uncertainty regarding the source of the water in the seep. It is possible that the water could be from either the mine pool or the roaster fines, though it appears to be from the water saturating the mine waste rock. For the purposes of this study, the source is assumed to be the mine waste rock.

3.4 Extenuate Site Mine Waste Rock

The Extenuate mine site is located to the east of the main W-O site. The Wellington tunnel is actually located on the Extenuate waste rock piles. The piles are comprised of crushed rock that was removed from the Wellington and Extenuate mines while the miners were trying to reach the valuable minerals. The metal content of the piles is not as high as the mill tailings or roaster fines.

The French Creek Project Implementation Plan (Colorado Division of Minerals and Geology 1990) states that a sample of surface runoff was collected from the Extenuate waste rock piles

that contained elevated levels of cadmium, iron, lead, manganese and zinc and had a pH of 3.74. However, the metal concentrations in French Creek immediately downstream from the Extenuate do not show elevated levels of any of these metals. The Colorado Division of Minerals and Geology (1990) hypothesizes that between FG-4 and FG-5 French Creek gains considerable flow and passes underneath several dredge piles which may accelerate metal adsorption/precipitation reactions. Later sampling for this study revealed no surface runoff from the Extenuate waste rock piles. The study concludes that "...surface runoff from the Extenuate mine is probably sporadic and of secondary importance to the total metal loading entering French Creek."

Three samples of waste rock from the Extenuate site were analyzed for particle size distribution. The median particle sizes from these samples vary from 0.037 mm to 0.5 mm (USBR 1996a). The results of these surveys are summarized in Table 3.5. The grain sizes are smaller than the W-O waste rock and potentially decrease the infiltration capacity and increase the surface runoff potential of the piles.

For the purposes of the water quality impacts portion of this study, the Extenuate mine waste rock piles are not considered. The assumption that surface runoff over the piles does not contribute significantly to metal loading in French Creek and that the piles are not significantly saturated with groundwater are both supported by the concentrations of metals in French Creek at FG-5. Cadmium, manganese and zinc all increase significantly between FG-5 and FG-7 indicating that a majority of the metal loading is coming from the W-O site rather than the Extenuate site surface piles. There is not a clear trend in the concentration of iron through the Extenuate and W-O sites. There is enough naturally occurring iron in the valley to create background concentrations at upstream sites that exceed the concentration at FG-5 during some of the sampling events.

Table 3. 5 – Extenuate Waste Rock Particle Size Data (USBR 1996a)

Sample ID Number	Depth of Sample (feet)	Median Grain Size of Sample (mm)	Description of Material
70C-26	2.4 – 4.7	0.037	Lean clay w/sand
70C-29	9.2 – 9.7	0.09	Clayey sand w/gravel
70C-37	4.7 – 7.2	0.5	Clayey sand w/gravel

4. Remediation Alternatives

Several potential remediation strategies for addressing the possible contamination in French Creek due to the surface waste piles were identified by the USEPA and reviewed by the FROG at their November 1996 meeting. The USBR, Technical Service Center developed conceptual designs for the proposed alternatives in order to estimate costs. Brief descriptions of the proposed strategies are presented in this section based on the USBR's conceptual designs as presented in their 1996 draft cost estimate report (USBR 1996b).

The options that entail excavation and removal of the mill tailings and roaster fines piles include variations depending on whether the piles are moved wet or dry. The dry excavation involves dewatering the piles prior to moving them. The wet excavation alternatives move the piles in their present form and transport them to a centrifuge for drying. In either case, the water that is removed from the piles has to be treated, adding to the cost of the alternatives. Other items that significantly increase the cost of all of the alternatives are grading of the roads into and out of the work areas, working around the dewatering system (if applicable), dust abatement and traffic control.

4.1 Option A - On-site Repository of Mill Tailings and Roaster Fines

This option involves containing the mill tailings and roaster fines on-site in a lined, aboveground repository that is covered and capped. The repository would be designed to reduce interaction with both surface and ground water and would be above the ground water table and outside of the floodplain. The location for the repository was not determined.

The roaster fines and mill tailings would be treated with a small amount of calcium carbonate before being placed in the repository to reduce the potential for acid leaching from the waste material.

The USBR identifies 12 different varieties of this option. The variations include the type of cap, the type of excavation, and the type of waste remediated. The variations are presented in the Table 4.1.

Table 4.1 - Summary of variations of remediation Option A.

Option #	Type of Waste	Cap	Excavation
A1	Mill Tailings and Roaster Fines	Multiple Defense	Dry
A2	Mill Tailings and Roaster Fines	Simple	Dry
A3	Roaster Fines	Multiple Defense	Dry
A4	Mill Tailings	Multiple Defense	Dry
A5	Roaster Fines	Simple	Dry
A6	Mill Tailings	Simple	Dry
A7	Mill Tailings and Roaster Fines	Multiple Defense	Wet
A8	Mill Tailings and Roaster Fines	Simple	Wet
A9	Roaster Fines	Multiple Defense	Wet
A10	Mill Tailings	Multiple Defense	Wet
A11	Roaster Fines	Simple	Wet
A12	Mill Tailings	Simple	Wet

The multiple cap option consists of a more extensive cap and liner comprised of several layers of synthetic geotechnical liners. In the simple cap option, the waste is placed directly on the compacted ground surface and the cap is comprised of both native and synthetic material.

4.2 Option B - On-site Repository of Stabilized and Solidified Mill Tailings and Roaster Fines

This option is similar to Option A, except that the waste is stabilized and solidified before being placed in the repository. The roaster fines and mill tailings would be combined with a mixture of Portland cement and fly ash before being deposited in the repository. This combination of materials will then harden and may not require an impermeable cap and cover. The alternatives that are evaluated are listed in Table 4.2.

Table 4. 2 - Summary of alternatives of remediation Option B.

Option #	Type of Waste
B1	Mill Tailings and Roaster Fines
B2	Mill Tailings
B3	Roaster Fines

4.3 Option C - Re-Processing of Roaster Fines

Due to the high metal concentrations present in the roaster fines, this alternative considers the possibility of processing the piles to recover any valuable metals. Both off-site and on-site processing were considered by the USBR. Off-site processing facilities stated that the level of metals in the waste piles is not sufficient to effectively process. Smelting, flotation, and hydrometallurgical processing were considered. All three take place on site and require disposal of a waste product and operation and maintenance of the facility.

4.4 Option D - Removal and Off-site Disposal of Roaster Fines and Mill Tailings

This option involves transporting the waste material to an off-site disposal facility. Due to the nature and high level of the metals content of the material it would be necessary to dispose of the waste at a hazardous waste landfill. The material would have to be dried before transporting and amended with a substance such as fly ash in order to meet landfill and shipping regulations for hazardous substances. All disturbed and excavated areas on-site would be backfilled, reshaped, and revegetated.

4.5 Option F - Encapsulation of Roaster Fines and Mill Tailings Inside Mine Workings

This option involves placing the roaster fines and the mill tailings back into the mine workings in either a dry or slurry form. Three methods are considered:

1. drilling and pumping the roaster fines and mill tailings in slurry form below the mine's water table at the W-O site
2. reopen the abandoned Extenuate Adit, and pump the roaster fines and mill tailings in slurry form into the mine workings above the mine's water table; or,
3. transport the mine waste in dry form into the Extenuate mine workings and place it above the water table.

The first and second methods include amending the waste material with an alkaline additive and stabilizing it with Portland cement. This slurry mixture, with 20% moisture content, would then be injected into the mine workings. The third method involves transporting stabilized waste material into the mine workings via a rail car system. Methods 2 and 3 would involve reopening the Extenuate Adit or tunnel and bringing the mine up to current safety standards.

4.6 Option G - In-place Mine Waste Rock Reclamation

Two methods are presented for reshaping the mine waste rock piles at the W-O site and the Extenuate site. Both methods involve shaping, cut and fill of the waste rock, surface water control, and a simple cap and cover for the top portion of the waste rock piles. The difference in the methods is the steepness of the design side slope of the reshaped piles, 2H:1V and 3H:1V. The steeper slope requires less total cut and fill of the existing piles but would require

stabilization of the side slopes to reduce infiltration potential, therefore reducing the acid generation potential and mobility of metals within the waste rock.

Reshaping of the piles is intended to limit surface water infiltration, reduce erosion, and provide a suitable subgrade for the surface cover materials. The designs are intended to maintain the current configuration of the piles, particularly in the area around the Wellington mine foundation. In addition, drainage ditches are included to divert surface runoff around and away from the waste rock piles.

4.7 Option H - In-place Shaping and Covering of Roaster Fines and Mill Tailings

This design is similar to that presented in Option G, except that it is applied to the roaster fines and mill tailings. The piles would be reshaped and covered to minimize interaction with surface runoff. The infiltration of surface water from rain and snowmelt that falls directly onto the piles would not be reduced, nor would any of the saturated waste that is interacting with the ground water be removed. Portions of the piles including the small roaster fines pile just west of the main roaster fines pile and the mill tailings on either side of the Country Boy Mine Road, would be added to the main piles to consolidate the waste material. Shaping and drainage control would include construction of ditches to divert surface water away from the piles and a maximum 2H:1V side slope.

4.8 Option I - No Action

No action leaves all of the mine surface waste piles in their existing condition with no control or cleanup. This alternative can serve as a baseline for comparison with other strategies, and may be a viable alternative for waste that is considered to be of minimal impact to water quality or other toxicity concerns. This alternative does not reduce the toxicity, mobility, or volume of contaminants in the surface waste piles.

5. Water Quality Impacts

The W-O site has proven to be extremely complex - hydrologically, geologically and chemically. Though the wastes present on the surface of the valley may appear to be the only obvious source of metal contamination to French Creek, there are also underground sources. As explained in Chapter 2, six levels of the mine workings are below the level of French Creek and are flooded with water. This water is connected with the water in the creek through underground faults and seepage through the valley floor. As a result, there are numerous sources of metal loading to the creek that are not evident on the surface. It is only through characterization work and study of the ground and surface water interaction that an accurate estimation of the metals' sources can be obtained (USEPA 1995).

The chemical and physical processes that result in increased levels of metals in French Creek are complicated. There are several pathways through which metals can reach the creek and a multitude of factors that influence the rate and magnitude of this movement. Precisely estimating the amount of metals that specific portions of the mine site contribute to the creek is nearly impossible with the amount of data available at the present time. However, it is possible to determine a rough estimate of relative contributions of the different metal sources. In order to simplify the analysis, a number of assumptions are made based on a thorough literature review and discussions with professionals familiar with the W-O site.

The basic methodology employed to estimate the potential impacts to water quality in French Creek and the Blue River involves estimating the metal contribution through two major pathways: groundwater base flow and surface runoff. The ground water base flow is the flow entering the creek from ground water and soil contributions even in the absence of rainfall. The surface runoff is the water that reaches the creek during a storm or snowmelt event that does not infiltrate into the ground. The assumption that these two pathways are the major sources of metal loading from the surface waste includes the assumption that the loading via other pathways is negligible. The simplifications and assumptions made in the analysis are presented in greater detail in later sections and in the appendices.

This section explains the basic chemical and physical processes involved in the transport of metals from mine waste piles to surface waters. Brief summaries of the analyses performed to estimate the base flow and surface runoff metal loading from the waste piles are presented. Detailed descriptions of the analyses are included in the appendices. In conclusion, an attempt is made to estimate how much the different remediation alternatives reduce the metal loading in French Creek and the Blue River.

5.1 Water Chemistry Interactions with the Surface Waste

The dissolution of metals is a natural weathering process and can result in high metal concentrations in areas undisturbed by mining. Mining practices can greatly accelerate this process by increasing the surface area of rock exposed to weathering which results in increased impacts to the quality of the receiving waters (Martin and Mills 1976). The excavation and tunneling associated with metal mines such as the W-O expose minerals in the earth's crust to water, oxygen and bacteria. This exposure allows the metals in the rock to become chemically altered. As surface water or ground water flows through and over the exposed rock, metals that were once locked within the rock can dissolve in the water. Metals such as zinc, iron, cadmium, lead and copper can contaminate surface water and ground water and can reach levels that are toxic to aquatic life and harmful to human health (USEPA 1995).

The chemical reactions that result in high concentrations of dissolved metals also create acidic runoff which is often called acid mine drainage (AMD). AMD can be more acidic than lemon juice (citric acid) or vinegar (acetic acid) (pH<4). The acidic runoff can dissolve more minerals from the surrounding rocks, elevating levels of dissolved minerals in surface and ground water. Once the reaction gets started with the exposure of pyrite to oxygen and water, it is self-perpetuating and is difficult to arrest (Amacher et al. 1993). In very simplified terms, the lower the pH of the water, the more metals are dissolved and the more metals are dissolved, the more acidity is produced.

The chemical reactions involved in this process are complex and are influenced by a variety of factors. The rate of the reaction is affected by factors such as the surface area of the sulfide minerals, type and composition of the sulfide minerals, the presence of acid-neutralizing minerals (especially calcite and dolomite), and temperature and salinity of the ground water (Smith 1994). Bacteria can also cause these reactions to proceed at an accelerated rate. The presence of calcerous rock, such as limestone, can slow the process by reducing the acidity of the water (Martin and Mills 1976).

As the drainage migrates off of the site, further reactions can create iron-rich precipitates and more acid. These processes are illustrated in Figure 5.1 (Smith 1994). When the contaminated mine drainage mixes with relatively clean water, additional changes take place. Some elements remain dissolved in the runoff or ground water; some are adsorbed or become attached to particulates in the water or the stream bottom, and some precipitate out of the flow. Orange iron-rich precipitates are visible in several of the mine drainage channels at the W-O site.

An illustration of the impacts of these processes is a study by Amacher et al. (1993), which showed that increasing the pH of the receiving water could cause precipitation of several of these metal contaminants. Their study showed decreased concentrations of iron, copper, zinc, manganese and aluminum during an injection of sodium hydroxide to a stream affected by acid mine drainage in the Beartooth Mountains of Montana.

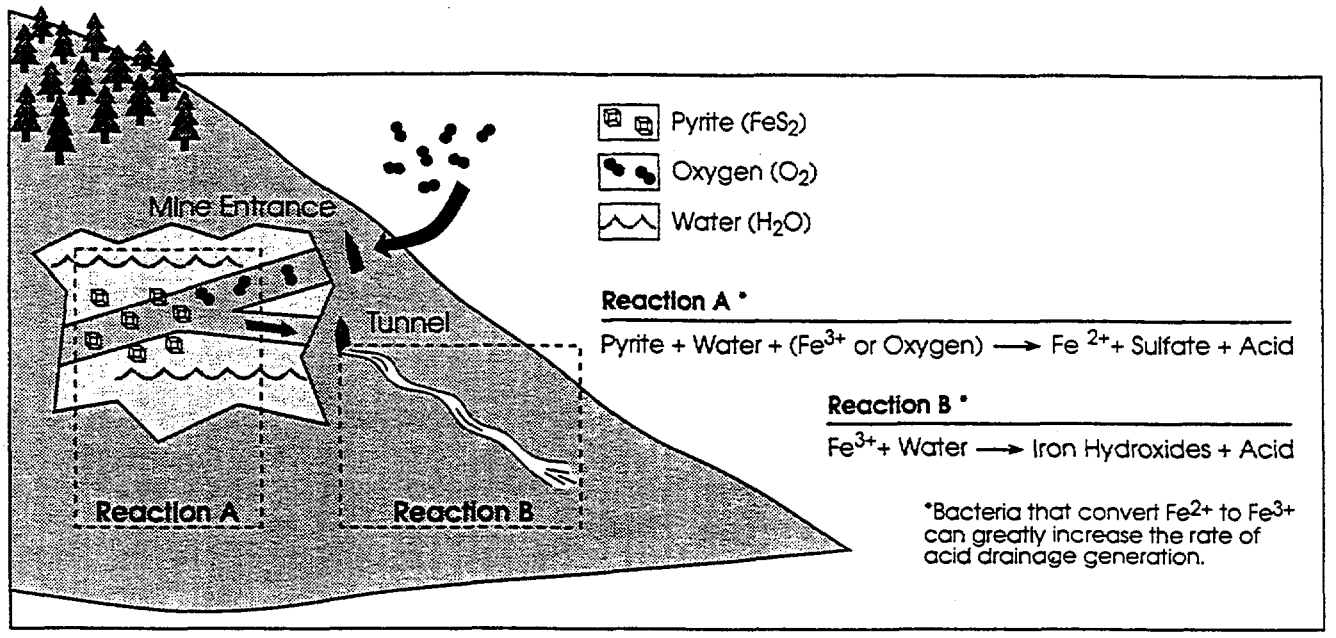


Figure 5.1 – Schematic of mine drainage reactions (Smith 1994)

The minerals and precipitates introduced into streams and rivers from mine drainage can adversely affect the quality, ecology, and chemistry of the receiving waters for many miles downstream (Smith 1994). This effect is illustrated by the degradation in the water quality of the Blue River downstream of the confluence with French Creek. The impacts of the metals entering from the W-O site are still evident in the Blue River more than a mile downstream from its confluence with French Creek.

Factors such as flow rate can also impact the concentration of metals in surface waters in unexpected ways. For example, the removal of some metals from surface water via adsorption onto precipitated iron is less during periods of high flow due to high stream velocities. On the other hand, dissolved zinc concentrations may decrease during high flow due to the greater quantity of suspended sediment to which the zinc can attach. During periods of low flow, metals can precipitate and settle to the stream bottom. These precipitated metals may then be scoured, resuspended and deposited further downstream during later high flow periods (Martin and Mills 1976).

5.2 Transport of pollutants from surface waste

There are many factors that influence the transport of pollutants from the surface waste to the water in French Creek. These factors include the composition of the waste piles, the slope of the piles, the characteristics of storm events, and the presence of sediment, and pollutant sinks, such as grassy areas, riparian wetlands, and forest litter (Novotny and Olem 1994).

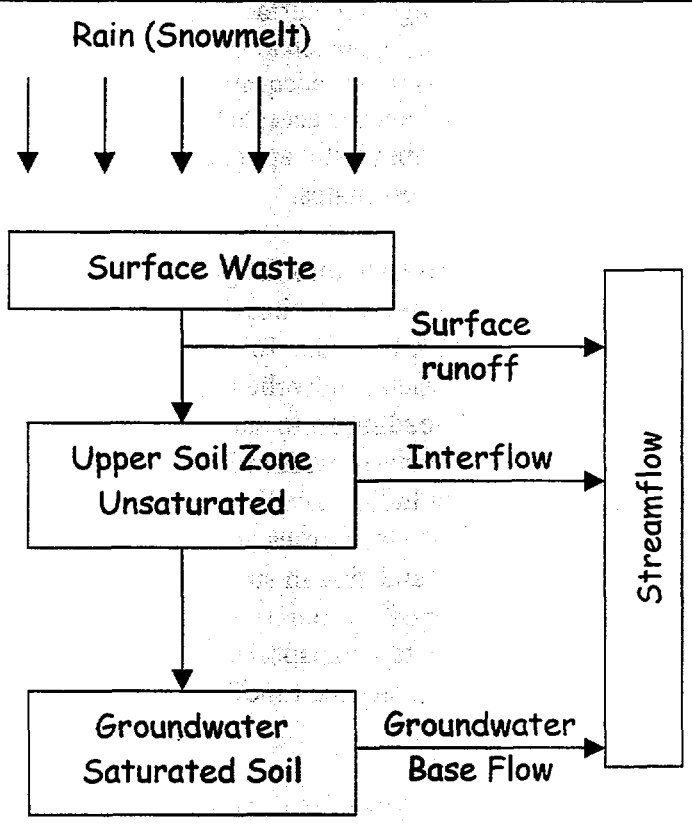


Figure 5.2 – Schematic of major pathways through which metals can reach surface water.

Pollutants can follow three paths from surface waste to surface water depending on whether the metals are associated with the sediment or are dissolved in the subsurface water (Novotny and Olem 1994):

- Soil erosion and overland transport will carry metals that are adsorbed or complexed to soil particles.
- Metals dissolved in the soil water can be transported either by surface runoff or by interflow.

- Dissolved metals can reach the groundwater and reappear on the surface with the base-flow groundwater discharge.

These three major pathways are illustrated in a simplified schematic diagram in Figure 5.2.

The estimation of loading from metals in the dissolved form is complex because dissolved metals can be transported via all three flow routes, surface runoff, interflow, and base flow groundwater. In contrast, metals adsorbed to sediments can only be transported via surface runoff. Regarding the complexity of estimating metal loading from surface waste, Novotny and Olem (1994) note:

> It is therefore evident that a simplistic approach to the determination of pollutant loadings from pervious surfaces (soils) may fail to provide adequate results, and prognoses using such approaches must be treated with caution and accepted only as rough estimates.

The analyses presented in this report are simplistic approaches with many assumptions and therefore should be treated only as rough estimates.

Surface runoff is water that does not infiltrate into the ground, is not evaporated, and is not stored in pools or depression on the surface. It reaches the creek via overland flow and, in route, it picks up sediment particles and dissolved metals. In order to estimate the metal loading from surface runoff, the metal loading due to metals adsorbed to sediment particles was assumed to be a reasonable estimate of the total metal loading from surface runoff. Mills et al. (1985) explains that estimating the loading of metals associated with sediment particles is often considered to be an estimate of total chemical loading (including the dissolved form), particularly for heavy metals. Based on this information and the similarities between dissolved and total metal concentrations for cadmium, manganese and zinc in surface water, the estimates made in this analysis are based only on the surface runoff of metals associated with sediment yield. Estimating the loading from dissolved metals transported via surface runoff would require field sampling of the metal concentration in the surface runoff or in the creek during a storm event (Mills et al. 1985).

Interflow is the horizontal, underground flow of water through the upper soil zones that are not normally saturated with water. It occurs during and following storm events and snowmelt. Interflow is often considered to be part of direct surface runoff and is often not estimated as a separate quantity (Novotny and Olem 1994). The shape of the valley, banks of the creek and permeability of the soil all impact the magnitude and rate of interflow (Bedient and Huber 1988). For the purposes of this analysis, the interflow contribution of dissolved metals from the surface waste piles is assumed to be negligible due to shape of the valley, the location of the piles relative to the creek and the configuration of the banks of the creek.

Base flow is the groundwater discharge that reaches the creek in the absence of storm events. In valleys such as French Gulch, this is the biggest contributor of water to streamflow in the valley. The volume of this base flow entering the creek through the W-O site can be estimated by looking at the difference between the flow in French Creek upstream of the site and the flow

downstream of the site. A similar method is used to estimate the total metal loading from groundwater base flow from the W-O site. These methods and their results are explained in greater detail in Section 5.3 and Appendix 1.

The base flow can also increase during a storm event due to the increased infiltration to the underground saturated soil zone. However, this increase is difficult to quantify (Bedient and Huber 1988). Comparisons of water surface levels in monitoring wells at the W-O site with precipitation data from the National Weather Service station in Dillon, Colorado indicate that in general, summer storm events do not create a noticeable change in the groundwater level in French Gulch. There is not enough information available at present to estimate how the quality of base-flow water is affected by individual rain events. For the purposes of this study, it is assumed that these impacts are negligible.

Snow cover and the freezing of soils in winter can affect the transport of metals via all of these pathways. Novotny and Olem (1994) note that interflow can increase when subsoils are frozen creating an impermeable layer. In addition, water can still flow through soils that are below the freezing point. Numerous other factors influence the flow rate such as the formation of ice crystals and the change in the viscosity of the water. The impacts of snow cover and frozen soils on the metal loading rates are considered either to be negligible or are taken into account with seasonal variation of flow rates as described in later sections.

5.3 Surface Runoff

Two methods were used to attempt to estimate the metal loading potential from the surface waste piles. The first method used the Universal Soil Loss Equation to estimate potential metal loading associated with sediment carried from the piles during storm events. The second method was a comparison of rainfall data from Dillon, Colorado with discharge and metal concentration records in French Creek to see if a correlation exists between storms and peaks in metal loading in the creek.

5.3.1 Universal Soil Loss Equation – Potential Metal Loading Associated with Sediment Transport

The metal loading due to surface runoff was estimated assuming that the metals are transported with sediment particles. The Universal Soil Loss Equation (USLE) was used to estimate annual sediment yield from the waste piles and the adsorbed or complexed metal loading. This methodology is presented in detail in Appendix 2 and the results are presented in Tables 5.3, 5.4 and 5.5.

This method was applied only to the mill tailings and roaster fines because the surface samples from the mine waste rock piles indicate that the median particle size of the mine waste rock (See Table 3.4) is gravel. The USLE method is only applicable through sand sized particles. There are minimal sediment transport capabilities associated with particle sizes greater than sand.

However, transport of metals from the piles to the creek via surface runoff could occur in the dissolved form from the mine waste rock piles. It is unlikely that this is a significant quantity due to the amount of time necessary to dissolve metals. As a result, this quantity was not estimated in this study.

5.3.1.1 Results and Limitations of USLE Analysis

The USLE is a very rough estimate of soil loss from a parcel of land based on regional factors that take into account climate and rainfall. Once the soil loss is estimated, a factor is applied that accounts for the fact that all of the soil that erodes from the piles does not actually reach the creek. All of these factors are estimated based on very limited data. Therefore, the results of this analysis should be assumed to be very rough estimates. The results are helpful in showing potential relative contributions. For instance, it is clear (See Tables 5.4 and 5.5) that the roaster fines most likely contribute more cadmium and zinc during a storm event than the mill tailings.

5.3.2 Comparison of Rainfall Data with Measured Metal Loading

Water quality samples taken from the creek before, during, and after a storm event could provide an excellent prediction of the potential metal loading from surface runoff. At the Summitville mine site in Colorado storm runoff sampling showed that the concentration of some metals in the downstream receiving waters increased as much as 400 times while stream flow increased by a factor of three during a summer rainfall event (King 1995). Unfortunately, such data is not available for analysis for French Gulch.

An attempt was made to perform a similar analysis on French Creek by comparing loading estimates with recorded rainfall events from the National Weather Service station in Dillon, CO. The data collected by the USGS NAWQA program is the most comprehensive set of discharge and metal concentration data for French Creek and was used for this analysis. Plots based on NAWQA dissolved metal concentration data and daily discharge data for October 1995 through February 1997 were prepared. Daily loading for the period was calculated by multiplying the daily dissolved metal concentration (estimated by linear interpolation between data points) by the daily discharge measured at FG-9.

The period of study (October 1995 – February 1997) encompasses one peak spring runoff event. This spring runoff event is comprised of two peaks due to a cold front and snowstorm during late May that slowed the rate of snowmelt. Each of the peak discharge rates is about 80 cfs with the second peak containing a larger volume of runoff than the first. The following sections include a qualitative discussion of the plots for cadmium, iron, manganese, and zinc.

5.3.2.1 Cadmium

The plot of dissolved cadmium concentration and loading with water flow in French Creek is presented in Figure 5.3. The concentration of cadmium does not vary as much seasonally as the other metal concentrations. The peak in concentration occurs just before the peak runoff and the

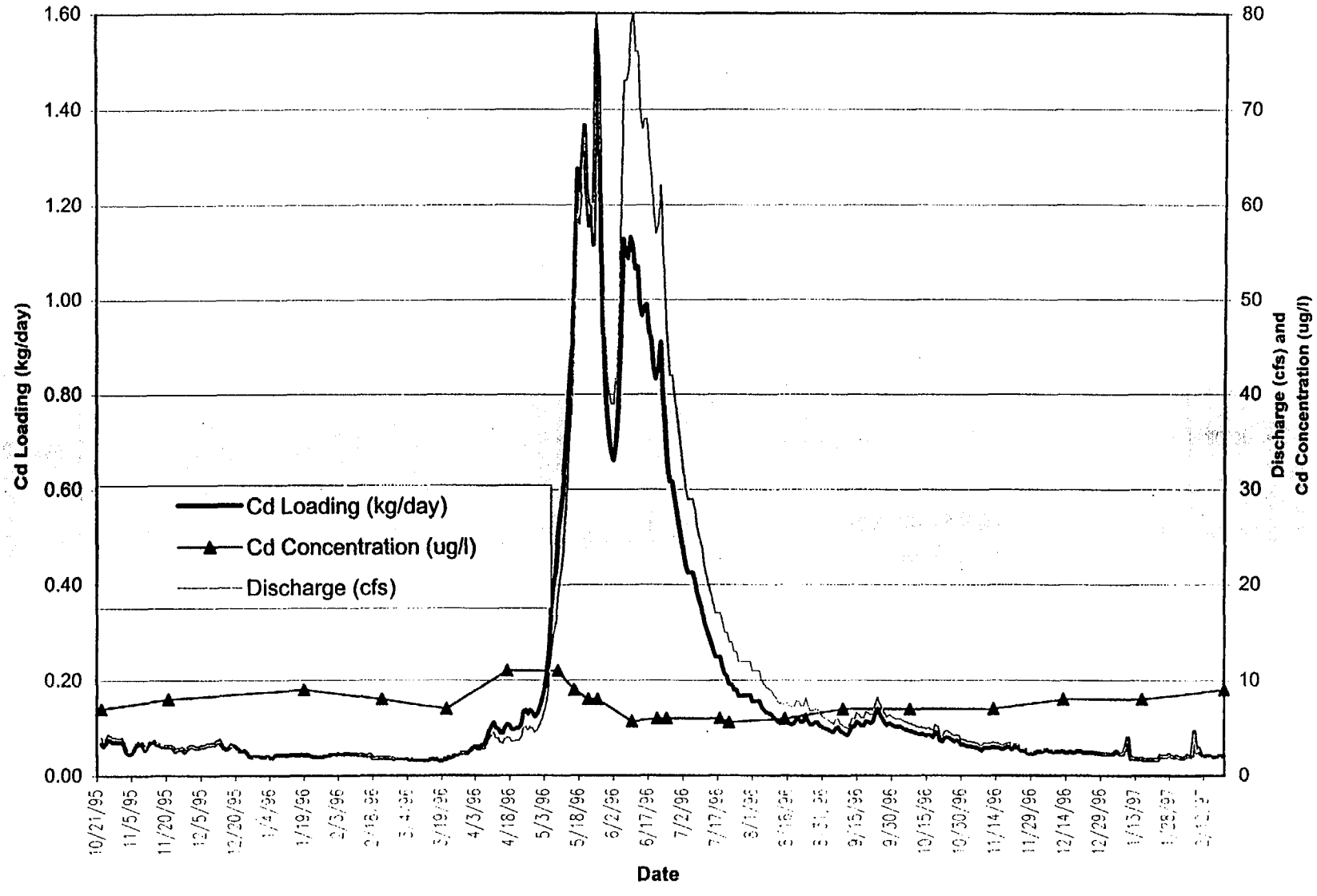


Figure 5.3 - Cadmium Loading and Concentration at FG-9

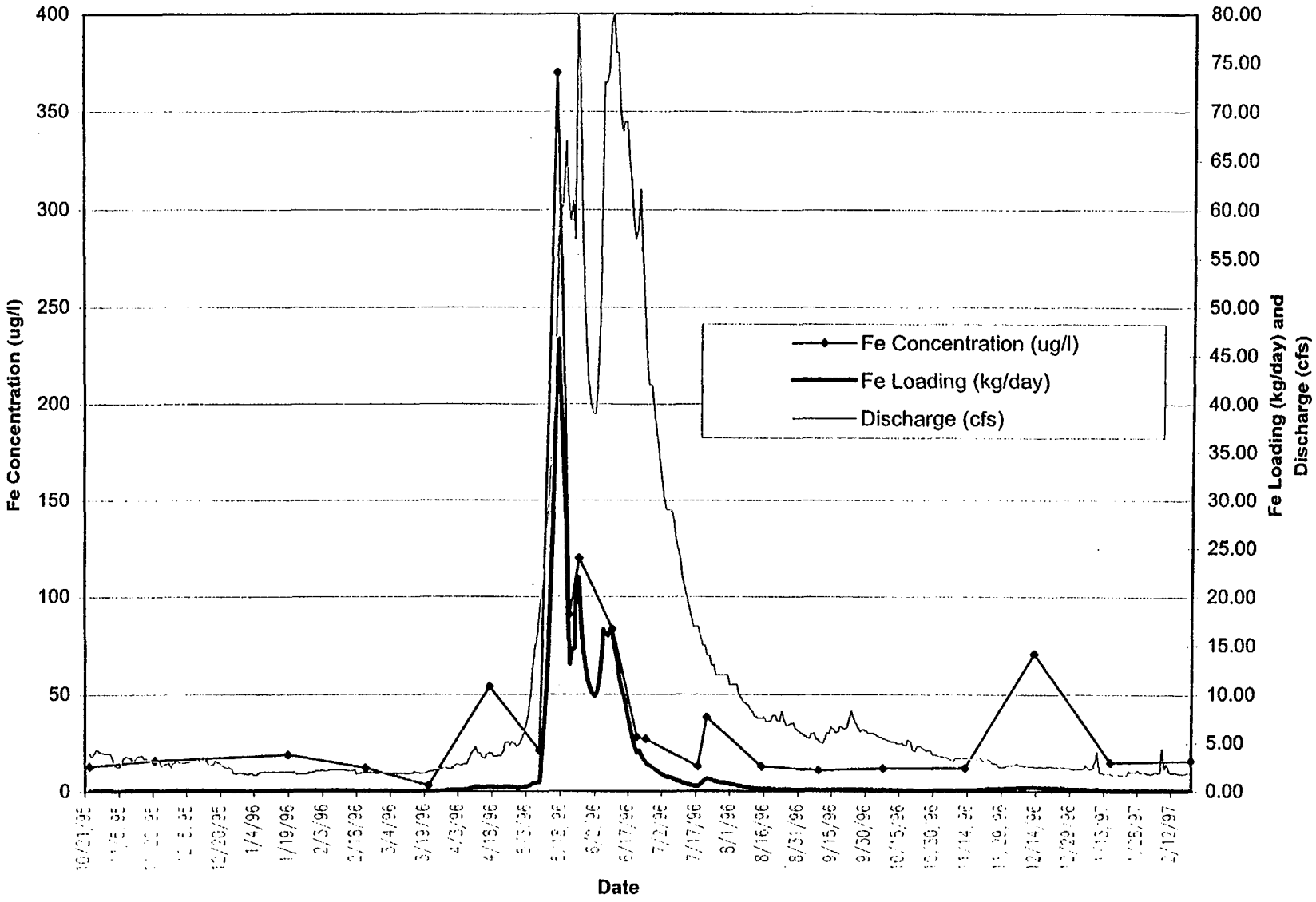


Figure 5.4 - Iron Loading and Concentration at FG-9

concentration decreases as the runoff increases. The second peak in the loading curve is significantly lower than the first indicating the impacts of the decreased concentration. This suggests an early spring "flush" of cadmium as the spring snowmelt begins and mobilizes the available cadmium. After the initial flush, it appears that dilution effects from the increased spring runoff prevail.

5.3.2.2 Iron

The concentration of dissolved iron in French Creek behaves similarly to manganese, increasing with the increased runoff (Figure 5.4). The peak occurs earlier than the manganese peak and decreases much more rapidly. Three other peaks in concentration occur during April 1996, July 1996, and December 1996. The July peak does not appear to be associated with a storm event. However the only available weather data is from Dillon, CO. It is conceivable that summer thunderstorm could occur in French Gulch and not be recorded in Dillon. The December peak is associated with a significantly warm period with temperatures exceeding 35° F for five days and a snow event. It is possible that this event, despite the snowcover could have mobilized additional iron, increasing the concentration in the creek. Weather data for April 1996 was not available at the time of this analysis.

5.3.2.3 Manganese

Dissolved manganese concentration increases with discharge as shown in Figure 5.5. The manganese concentration plot includes one large peak that spans the time period of the two spring runoff peaks. The shape of the loading curve follows that of the discharge hydrograph for the period.

5.3.2.4 Zinc

The plot in Figure 5.6 shows that dissolved zinc behaves similarly to cadmium, with concentration decreasing during the peak spring runoff. The peak in zinc concentration occurs just before spring runoff. As the flow rate decreases and stabilizes during the fall and winter, the zinc concentration in the creek increases steadily. As with cadmium, it appears that there is an early flush of zinc before the dilution associated with spring runoff takes over.

5.3.2.5 Results and Limitations of Storm Event Comparison

Two storms in August and September correlate to small peaks in the stream flow hydrograph for French Creek. It is difficult to extrapolate these peaks into actual metal loading rates for a number of reasons. The major limitation is that concentration data is not available during the storms. The loadings presented in the plots are calculated from concentration estimates that are interpolated between measured values as described above. The actual concentration during a rainstorm could be significantly higher if more metals are transported or significantly lower if dilution effects prevail.

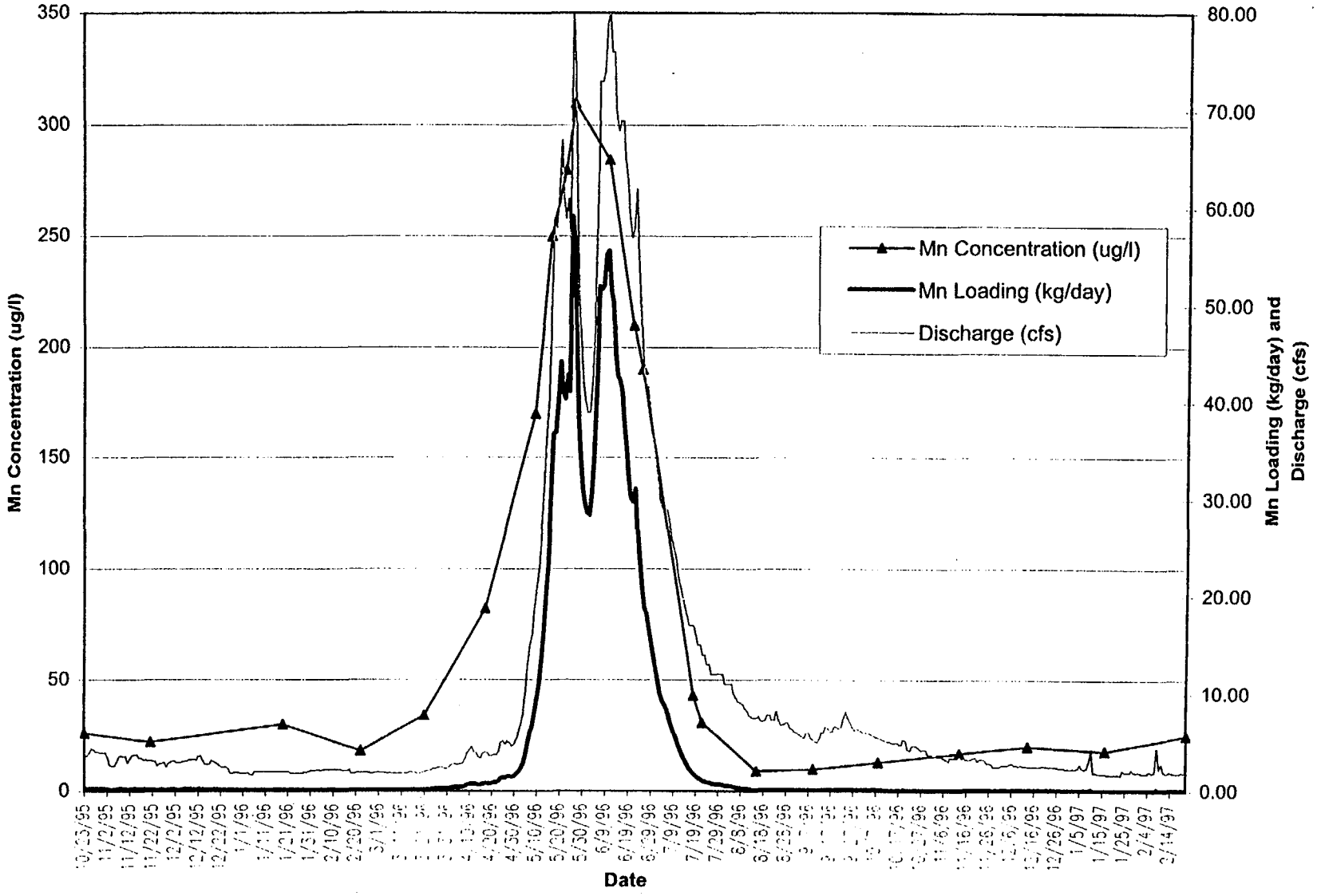


Figure 5.5 - Manganese Loading and Concentration at FG-9

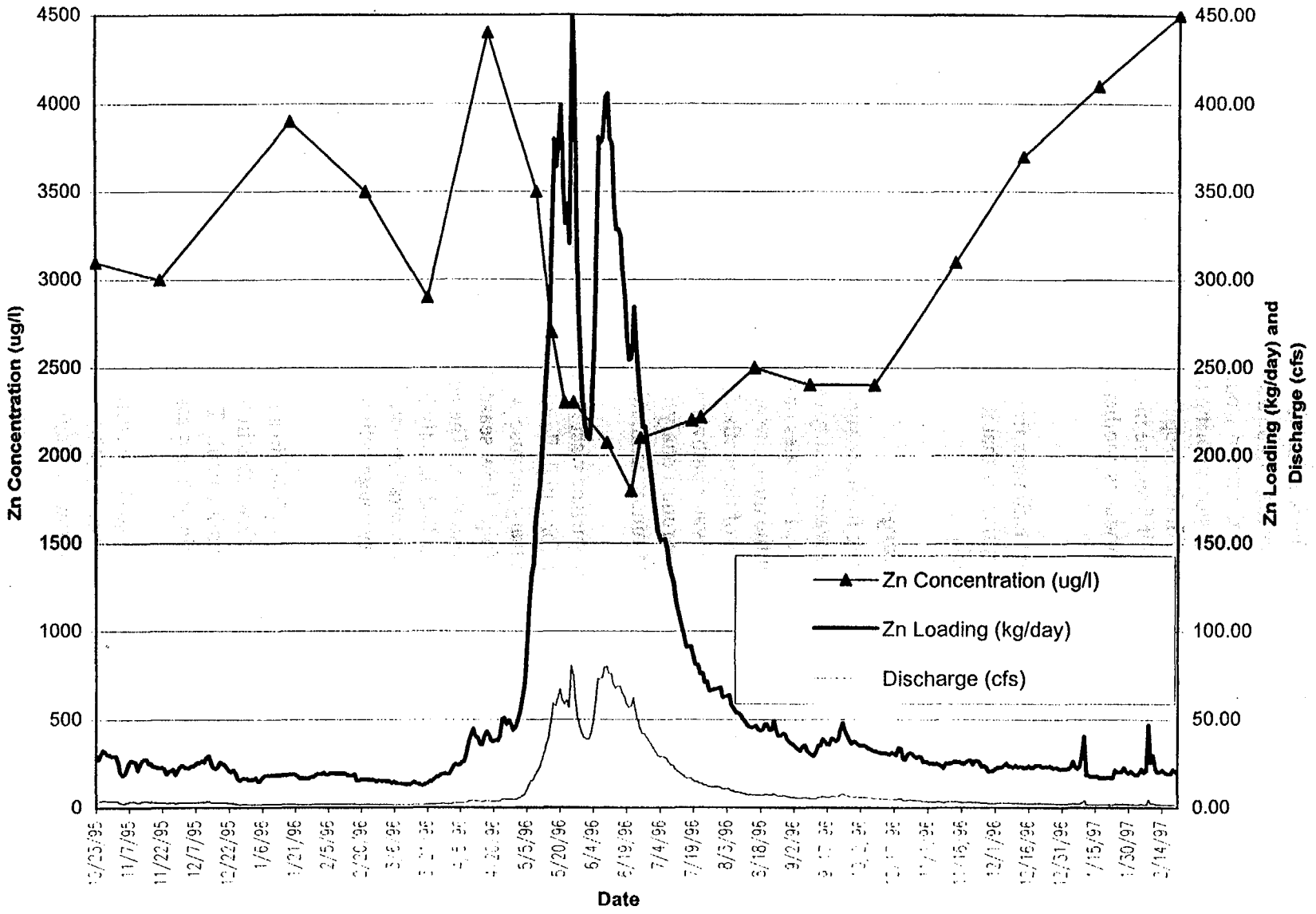


Figure 5.6 - Zinc Loading and Concentration at FG-9

Other limitations in this analysis are that the weather service data is from Dillon which is several miles from French Gulch. It is possible for there to be a summer thunderstorm in Dillon and not in French Gulch or vice versa. In addition, the storm would have to occur during the months when the mine site is not snow covered. A storm during the spring peak runoff would also be difficult to analyze because it would be difficult to separate the possible impacts of cooler temperatures reducing the normal snowmelt from the impacts from the storm runoff. The interpolation of the concentration data introduces another possible error particularly during the longer time intervals between samples.

As a result of these limitations, no loading estimates from surface runoff were made from this analysis. A benefit gained from this analysis was that it verified the total annual loading estimate used in the groundwater base flow analysis.

5.4 Groundwater Base Flow Discharge

The contribution of metals to French Creek from the surface waste piles and the mine pool via groundwater base flow is estimated using water quality data from groundwater samples and estimates of groundwater flow rates. These flow rates or discharges were estimated based on geologic and hydrologic data collected at the mine site and the physical characteristics of the surface waste piles. A detailed description of the methodology used for estimating the annual metal loading to French Creek via ground water pathways is presented in Appendix 1. Due to the potential inaccuracies in the USLE surface runoff analysis, the groundwater base flow estimates are not adjusted to account for the surface runoff estimates.

The metal loading via base flow from the surface waste piles was estimated by first approximating the groundwater flow rate for a high flow season and for a low flow season. Varying seasonal flow estimates are necessary because water level in the waste piles increases significantly during the spring snowmelt (high flow season). The flow estimate is then multiplied by a representative metal concentration. The concentrations are determined from well-water samples collected from wells drilled directly into the surface waste piles. A major limitation in this analysis is that metal concentration data is not available for each pile for every season. Additionally, the flow rate is a very rough estimate based on assumptions regarding the physical characteristics of the waste piles.

The metal loading from the mine pool is calculated in a similar manner. The flow rate is estimated base on actual measurements of flow rates in wells at the mine site that are used to approximate the entire flow rate out of the mine pool. The limited metal concentration data for the mine pool is extrapolated over the whole year and assumed to be representative.

The relative loading estimates for the mine pool and surface waste are then applied to the measured metal loading in French Creek between FG-5 (upstream of the W-O site) and FG-7 and FG-8 (just upstream of Dead Elk Pond). Figure 2.2 shows the location of the sampling sites and

Figure 11.1 is a schematic of the metal loading sources. Due to the sporadic nature of both the concentration and discharge data available for the creek, many assumptions regarding the seasonality of the data had to be made. These assumptions are described in detail in Appendix 1. Another major assumption in the analysis is that the only contributors of metals to the creek between FG-5 and Dead Elk pond are the mine pool, the mill tailings, the roaster fines, the mine waste rock piles, and the Country Boy Mine adit drainage (See Figure 11.1). Table 5.1 presents the annual metal loading estimates in kilograms per year for the various waste sources.

5.5 Impacts to French Creek and the Blue River

Figures 5.7 through 5.10 summarize the estimated potential metal contribution to French Creek via groundwater base flow. Table 5.2 shows sensitivities for these estimates. It should be noted that the mine waste rock is assumed to contribute to the metal loading only during the peak flows of May and June. During these months, the mine waste rock piles are estimated to contribute up to 50% of the Cd, Mn and Zn loading to French Creek. It should also be noted that the remediation option that caps and covers the mine waste rock will not reduce this percentage because the ground water is assumed to be recharged from below, not from the surface. However, the interconnection between the mine pool, mine waste rock and roaster fines is not completely understood. It is also possible that some of the loading attributed to the mine waste rock could be coming from the roaster fines and/or the mine pool. The mill tailings do not appear to contribute a significant amount to the loading in French Creek.

Table 5.1 – Annual Base Flow Metal Loading Estimate – kg/year

	Cadmium Kg/year	Iron Kg/year	Manganese Kg/year	Zinc Kg/year
Background	0.1	2,014	218	266
Country Boy Mine	0.8	297	242	815
Roaster Fines	2	90	36	437
Mill Tailings	0.01	0.02	0.1	0.2
Mine Waste Rock	8	70	520	1,369
Mine Pool	69	3,159	6,203	26,673
Annual Total	***80***	***5,629***	***7,219***	***29,561***

The surface runoff analyses result in very rough estimates of potential metal loading from surface runoff over the waste piles using the USLE method. The values should not be construed as accurate predictors of how much the different remediation strategies will reduce the

concentration of metals in French Creek. The results are presented in Tables 5.3, 5.4, and 5.5. The conclusions that can be drawn are that capping and covering the roaster fines will most likely result in a greater reduction of cadmium and zinc than capping and covering of the mill tailings. The estimated percentage reduction in iron loading is much greater for both piles. However, iron readily precipitates out of surface waters. As a result, this estimate could be over estimating the surface runoff impacts of the various piles.

The impacts of the AMD from French Creek to the water quality of the Blue River are affected by a couple of different variables. The quality of water in the Blue River upstream of the confluence with French Creek and its buffering capacity or its ability to neutralize the acidity of the incoming AMD affect the quality of the water downstream of the confluence with French Creek. Additionally, any tributary water or other inflows to the Blue River downstream of French Creek will affect the quality of the Blue River through dilution and buffering (Martin and Mills 1976).

The loading estimates in this section should only be used to determine relative contributions. They should not be interpreted as exact values. It is difficult, if not impossible, to relate these loading estimates to how the remediation strategies will impact the water quality in French Creek or how well the strategies will work to make the creek and the Blue River meet the stream water quality standards.

Table 5.2 – Estimated Annual Metal Loading from Groundwater Base Flow. Expressed as a % of total loading in French Creek measured at FG-7 + FG-8 (See Figure 2.2 for location of sampling sites).

	Mine Pool	*Mine Waste Rock at W-O*	*Roaster Fines*	*Country Boy Adit Drainage*
Cadmium	70% - 90%	10% - 30%	1% - 2%	1%
Iron	40% - 60%	1% - 10%	0% - 13%	5%
Manganese	58% - 86%	7% - 33%	0% - 5%	3%
Zinc	65% - 90%	5% - 25%	0% - 12%	3%

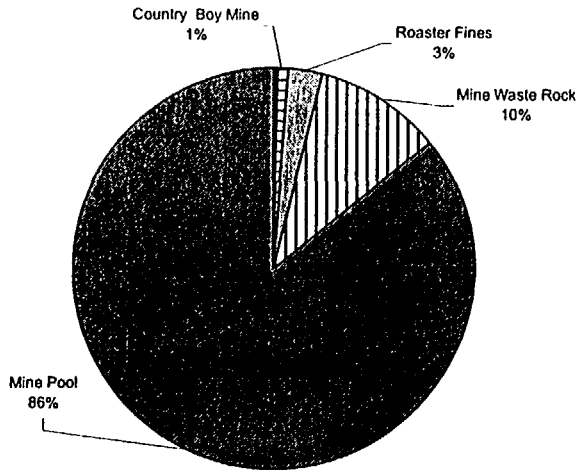


Figure 5.7 - Annual Cadmium Loading Estimate to French Creek from Groundwater Base Flow Expressed as % Loading at FG-7 + FG-8

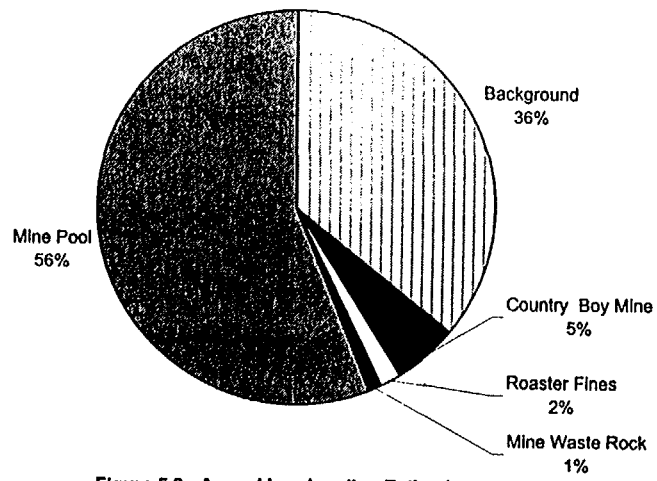


Figure 5.8 - Annual Iron Loading Estimate to French Creek from Groundwater Base Flow Expressed as % of FG-7 + FG-8 Measured Loading

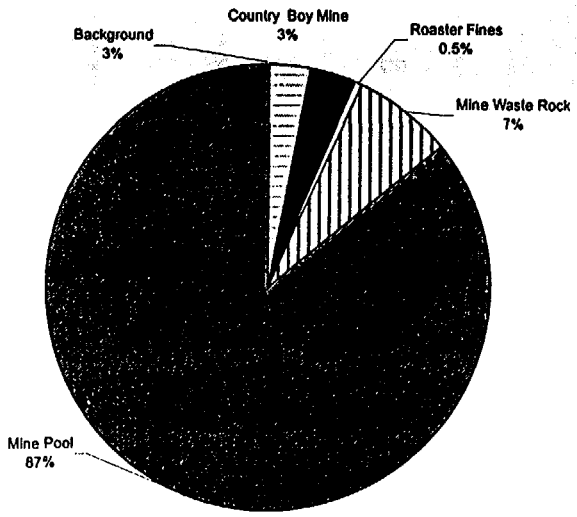


Figure 5.9 - Annual Manganese Loading Estimate to French Creek from Groundwater Base Flow Expressed as % of FG-7 + FG-8 Measured Loading

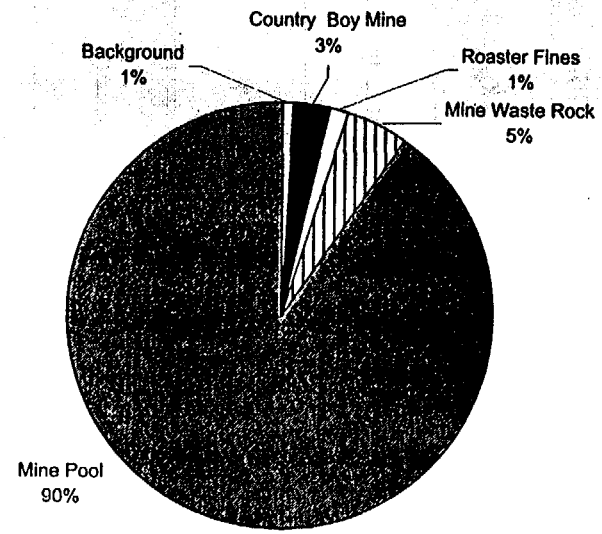


Figure 5.10 - Annual Zinc Loading Estimate to French Creek from Groundwater Base Flow Expressed as % of FG-7 + FG-8 Measured Loading

Table 5.3 - Potential Metal Loading from Surface Runoff over the Roaster Fines and Mill Tailings

	Cd (kg/yr)	*Fe (kg/yr)*	*Mn (kg/yr)*	*Zn (kg/yr)*
Roaster Fines Estimated Surface Runoff Loading	3 – 8	676 – 1,777	13 - 35	648 – 1,703
Mill Tailings Estimated Surface Runoff Loading	1	1,459	62	115
Total Estimated Surface Runoff Loading from Mill Tailings and Roaster Fines	4 – 9	2,135 - 3,236	75 - 97	763 – 1,818
Annual Base Flow Loading Estimate from Stream Data (Section 5.5)	80	5,629	7,219	29,561
Potential Surface Runoff as Percentage of Annual Base Flow Loading	5% - 11%	38% - 57%	1%	3% - 6%

Table 5.4 - Potential Metal Loading from Surface Runoff over the Roaster Fines

	Cd (kg/yr)	*Fe (kg/yr)*	*Mn (kg/yr)*	*Zn (kg/yr)*
Roaster Fines Estimated Surface Runoff Loading	3 – 8	676 – 1,777	13 - 35	648 – 1,703
Potential Metal Loading from Roaster Fines Surface Runoff as Percentage of Annual Base Flow Loading	3% - 10%	12% - 32%	< 1%	2% - 6%

Table 5.5 - Potential Metal Loading from Surface Runoff over the Mill Tailings

	Cd (kg/yr)	Fe (kg/yr)	Mn (kg/yr)	Zn (kg/yr)
Mill Tailings Estimated Surface Runoff Loading	1	1,459	62	115
Potential Metal Loading from Mill Tailings Surface Runoff as Percentage of Annual Base Flow Loading	1%	26%	1%	< 1%

6. Cost Estimates

The USBR has prepared a very detailed cost estimation report (1996b). The costs of the proposed remediation alternatives are summarized in Table 6.1 in order from least expensive to most expensive. The in-place shaping and covering of the piles are the least expensive options.

Table 6.1 – Summary of Cost Estimates
Surface Waste Remediation Alternatives Prepared by the USBR (1996b)

Remediation Option	Estimated Cost
Option H - In-place shaping and covering of roaster fines and mill tailings	$65,000 to $110,000
Option G - In-place shaping and covering of mine waste rock	$480,00 to $810,000
Option A - On-site repository of roaster fines and mill tailings	$1.1 to 5.6 million
Option B - On-site repository of stabilized roaster fines and mill tailings	$2.4 to 7.6 million
Option F - Encapsulation of roaster fines and mill tailings in mine workings	$9.5 to $10 million
Option D - Removal and off-site disposal of roaster fines and mill tailings	$19 to 44 million

7. Historic Features

There are numerous structures and features at the W-O site that remain from the region's early mining days. Local residents expressed concern that remediation of the site could detract from or completely destroy the historic mining character of the valley. Additionally, impacting potentially historic features through remediation strategies can trigger review by historic preservation agencies on local, state and federal levels. This section explores the impacts of the proposed surface waste remediation strategies on the structures and features at the W-O site that have the potential to be deemed historic. The local, state and federal regulations that have jurisdiction in this area are also reviewed.

7.1 Definition of Historic Significance

The determination of the historic significance of a structure, feature, or site can be a very subjective and difficult process. Often historical significance is determined based solely on the age of the feature, with fifty years being the typical defining age. Sometimes economic, social or cultural values are used when considering the potential historic importance of a feature. The "historic" value of a site is often considered to increase as the total number of sites decreases. In Colorado, many manmade historic cultural assets related to the mining industry are being lost due to weathering, vandalism, and competing economic land uses (Jones, 1996). The destruction of the original Oro Mill buildings by fire in 1962 (Gilliland, 1988) is an example of this process.

In order to protect and aid in the preservation of historic sites, agencies at the federal, state, and local levels establish guidelines or criteria for determination of historic significance of structures, landscapes, and districts. In addition, individual members of communities have their own criteria and values regarding what constitutes a historically significant feature that should be preserved. The proposed surface waste remediation activities on the Wellington-Oro site have the potential for review on all of these different levels.

7.2 Potential Historically Significant Features at the Wellington-Oro Complex

There are a few important historical facts about the Wellington-Oro mine complex that may make preservation of the mining character of the site important. The Wellington-Oro mine complex was one of the biggest mining operations in Summit County. Mary Ellen Gilliland, in her book *Breckenridge* describes the Wellington as "...Summit County's longest-producing and richest mine." It is estimated that the mine yielded $32 million worth of lead, zinc, gold, and silver. In addition, Barney Ford, an important figure in the history of the State of Colorado, was one of the first people to discover gold in French Gulch in the 1860's at the site of the Oro Mine. He later went on to invest in the Oro Mine in the 1880's and was also inducted into the Colorado Association of Pioneers (Gilliland 1980, 1988).

There are several features located on the Wellington-Oro mine complex that may be of local

concern regarding their significance in maintaining the mining character of the area. These features are identified in Figures 7.1 and 7.2 and are listed below:

- Oro Site
  - Mill foundations
  - Mine waste rock piles
  - Railway trestle
- Wellington Site
  - Tunnel house
  - Mine waste rock piles
- Extenuate Site
  - Tailings
  - Remnants of buildings

The roaster fines and the mill tailings do not appear to have any historical significance. The mill tailings were created in the 1960's and the roaster fines are just additional shipping product from the mine that was never shipped (Theobold 1997). They do not appear to add significantly to the "mining character" of the site and, therefore, their removal or reshaping and capping would not detract from the aesthetics of the site.

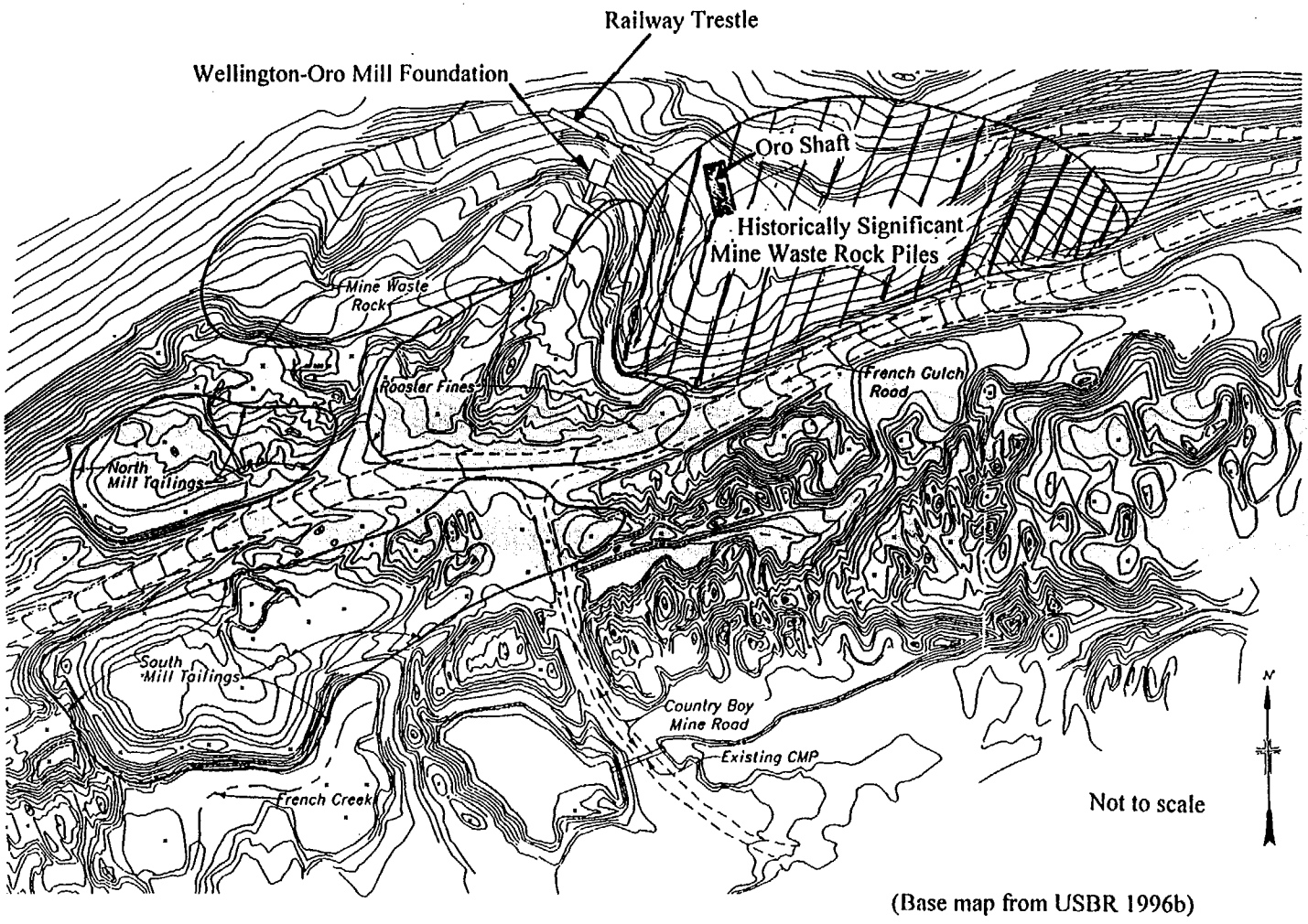
7.3 Federal and State Review

On the federal and state levels, the USEPA's involvement in the cleanup of the Wellington-Oro mine complex will trigger a review under Section 106 of the National Historic Preservation Act. This section requires that any undertaking of a Federal agency be reviewed for potential impact on "...any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register." In the state of Colorado, the agency empowered with such reviews is the Office of Archaeology and Historic Preservation within the Colorado Historical Society (Colorado Historical Society 1992).

In response to a letter from the FROG explaining the proposed surface waste remediation alternatives, the Colorado Historical Society stated that the Wellington-Oro site is not eligible for inclusion in the National Register of Historic Places. As a result, it explained that no further contact with their office is necessary "...unless there is additional information regarding the significance of either property that would warrant a re-evaluation." Copies of this correspondence are presented in Appendix 3.

7.4 Local Review

In January 1997, the Summit County Board of County Commissioners adopted a resolution that established a Historic Preservation Advisory Board and criteria for designation of historic sites.



(Base map from USBR 1996b)

Figure 7.1 – Map Showing Potential Historically Significant Features at W-O Mill Site

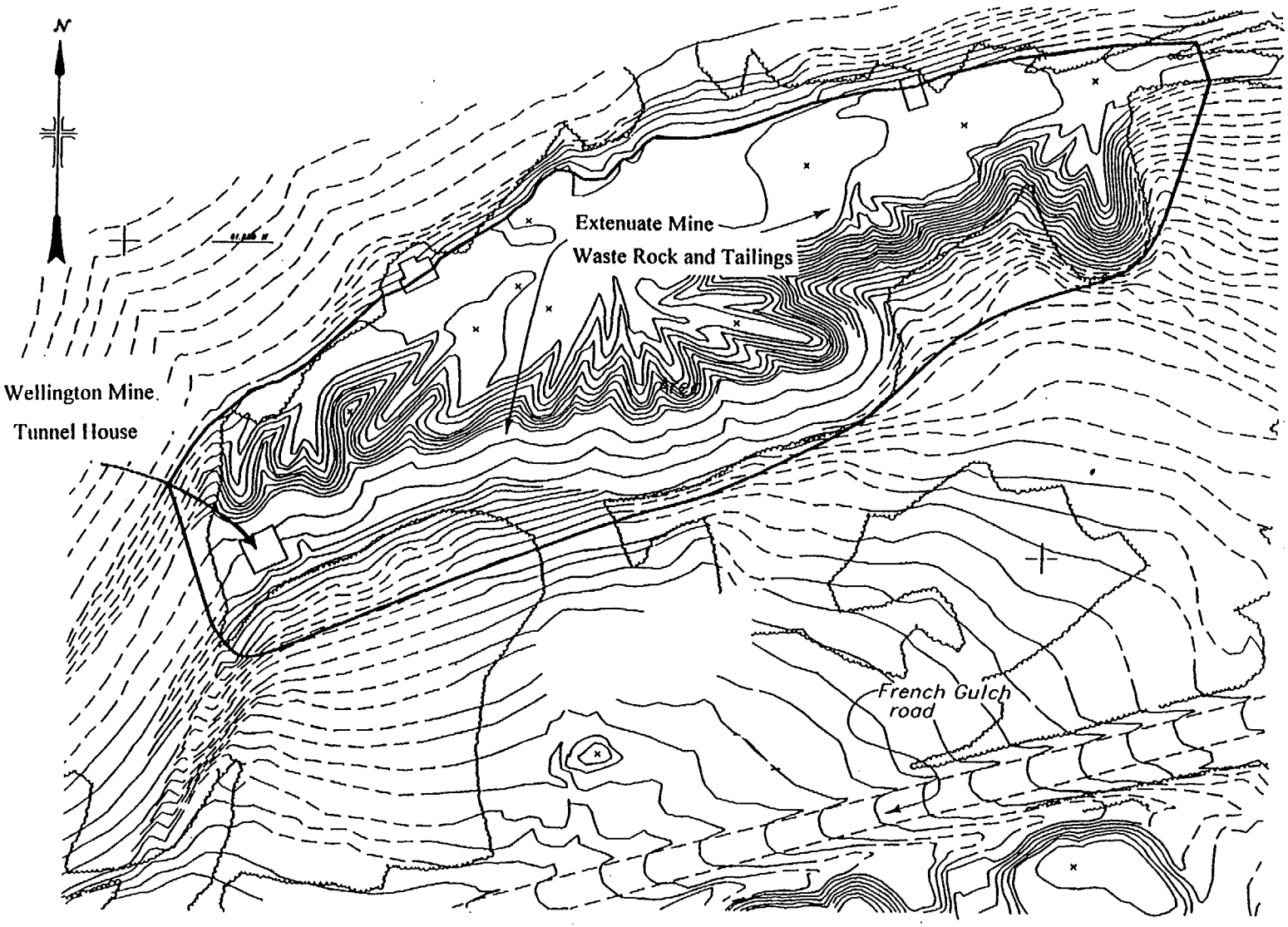


Figure 7.2 – Map Showing Potential Historically Significant Features at the Extenuate Site

The factors identified in Section 3 of Resolution 97-03 to be used in determining historic significance that apply to the Wellington-Oro site are listed below:

(a) Its character, interest or value as part of the development, heritage or cultural characteristics of Summit County, State of Colorado or the United States.

(c) Its identification with a person(s) who significantly contributed to the culture and development of Summit County, State of Colorado or the United States.

(d) Its exemplification of the cultural, economic, social or historic heritage of Summit County, State of Colorado or the United States.

Due to its size and productivity, the Wellington-Oro mine complex appears to have played a significant role in the cultural and economic development and heritage of Summit County. In addition, Barney Ford's role in the development of the site identifies the site with a person "...who significantly contributed to the culture and development of Summit County..." and the State of Colorado. Satisfaction of the criteria listed above demonstrates that the Wellington-Oro site has the potential for historic designation in Summit County. As a result, local concern regarding preservation of the mining character of the site may be an important factor in the design of surface waste remediation strategies.

The Board of County Commissioners makes the final decision regarding historic designation. Designation as a historic site through this resolution allows property owners to pursue special funding and tax credits through the State Historic Preservation Office. It is not intended for use as a planning mechanism and the designation can also be easily reversed (Summit County 1997).

7.5 Impacts of Proposed Surface Waste Remediation Alternatives on Potential Historically Significant Features

The proposed surface waste remediation alternatives that deal with the roaster fines and the mill tailings (Options A through F, and H) do not impact the features identified above as potentially historically significant. It should be noted, however, that the Colorado Historical Society will require additional evaluation of the site "...if subsurface archaeological resources are encountered during ground disturbing activities..." (See Appendix 3). Options A through F will involve major excavations on the site that could uncover resources requiring additional evaluation.

The only alternative that would impact the potential historically significant features is the in-place mine waste rock reclamation, Option G, which involves reshaping and revegetating the mine waste rock piles at the Wellington-Oro site and the Extenuate site. The reshaping is intended to help control surface runoff and erosion and to allow for greater stability for surface cover materials. The design of the shape of the piles by the Bureau of Reclamation has been refined to reflect the current appearance of the piles (U.S. Bureau of Reclamation 1996b). This refinement could serve to maintain the historic mining character of the site.

8. Non-Water Related Exposure Risks

All of the surface waste piles exhibit elevated levels of metals that have the potential to pose an exposure risk to humans via inhalation and ingestion. Concern has been raised regarding the possible exposure risks to recreational users of the valley and to the residents living on site.

The USEPA conducted studies in September 1997, when the piles were the driest, to determine the magnitude of the exposure risk. The sampling efforts included indoor dust samples from the County Boy mine, soil samples from the Union Mill site, the W-O site and the Extenuate, and air samples from the valley. The samples will be analyzed for lead, arsenic and cadmium. The investigation focused on the roaster fines and mill tailings, which contain high concentrations of fine particulate size material (Sullivan 1997b). The results of their study were not available at the time of publication of this report.

If their study determines that there is a human health concern associated with the W-O surface waste piles, Options G and H that simply reshape and cover the piles appear to be the most straightforward means of addressing this exposure risk. Until the results of the study are released, it is not possible to evaluate the proposed strategies based on this criteria.

9. Conclusion

Encapsulation and/or removal of the roaster fines (Options A, B, D and F) may remove up to 13% of the metal loading in French Creek. These options are relatively expensive compared to the metal reduction they will achieve. They do not impact potential historically significant features, and they do address concerns regarding non-water related exposure risks.

The options that entail in-place shaping and covering of surface waste are the most least expensive of the options (Options G and H), but these options do not address the water quality impacts to the creek through groundwater inputs, only the surface runoff impacts. It appears that the surface runoff loading is not a huge contributor to the elevated metal concentrations in French Creek and the Blue River. However, there would be some benefit gained in covering the roaster fines piles by reducing the potential airborne exposure risks and by improving the aesthetics of valley.

The in-place shaping and covering of the mine waste rock (Option G) is the only alternative that could impact features or structures that have to the potential to be designated as having historic value. It appears that the historical mining character of the site could be preserved by careful design of the shaping of the mine waste rock piles.

Based on the limited data available and the rough loading estimates performed in this study, it appears that the alternatives that address the roaster fines have greater potential to reduce metal loading to the creek than those that address the mill tailings. In addition, it appears that the mine waste rock has the potential to contribute to metal loading in the creek via groundwater pathways during the high flow months of May and June. None of the remediation alternatives address this loading potential.

There is no data available for determination of non-water related exposure risks. However, if an exposure risk is determined, the in-place shaping and covering of the roaster fines and/or mill tailings is the least expensive alternative that will address those concerns.

Collection and analysis of stream samples during a rainfall event could greatly enhance the ability to predict water quality benefits from the surface waste remediation strategies. There are several possibilities for future studies that could improve the accuracy of the surface runoff estimate:

1. Model a specific storm event. Predict the surface runoff using hydrologic models.
2. Establish a weather station on site. Knowing actual time and magnitude of storm events could be correlated with small peaks in the creek's hydrograph and possibly be related to peaks in loading.

3. Sample during a storm event. Conductivity is a good estimate of total metal concentration and could provide a simple way to get quick and easy samples while it's raining.

In summary, the more expensive surface-waste remediation alternatives (Options A, B, D and F) provide the greatest potential benefits. They reduce the non-water related exposure risks as well as eliminating the metal loading sources via both ground and surface water. Due to the lack of data available at this time, it is difficult to accurately estimate the magnitude of these potential loading reductions. Additionally, these statements are based on the assumption that Option F, encapsulation of the roaster fines and mill tailings in the mine workings, will actually decrease the total loading to the creek and not add to the groundwater loading from the mine pool.

The less expensive alternatives (Options G and H) do not address the metal loading to the creek via groundwater. Additionally, Option G would have to be carefully designed to minimize the impacts to the historic character of the site.

The goal of this study was to evaluate proposed surface-waste remediation strategies based on outlined criteria. Due to limited data, it is difficult to perform a thorough analysis of the proposed alternative based on potential water quality improvements and potential non-water related exposure risks. A summary of the results of the evaluation is presented in Table 9.1.

Remediation Alternative	No Impacts to Historic Features	Potential Water Quality Improvements via Groundwater	Potential Water Quality Improvements via Surface Runoff	Potential Reduction of Non-water Related Exposure Risk	Cost
Option I – No Action	✓				✓
Option H - In-place shaping and covering of roaster fines and mill tailings	✓		✓	✓	$
Option G - In-place shaping and covering of mine waste rock			✓	?	$$
Option A - On-site repository of roaster fines and mill tailings	✓	✓	✓	✓	$$$
Option B - On-site repository of stabilized roaster fines and mill tailings	✓	✓	✓	✓	$$$
Option F - Encapsulation of roaster fines and mill tailings in mine workings	✓	✓?	✓	✓	$$$$
Option D - Removal and off-site disposal of roaster fines and mill tailings	✓	✓	✓	✓	$$$$$

Table 9.1 – Summary of Evaluation of Remediation Alternatives

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11. Appendix 1 - Methodology for Groundwater Loading Calculations

The methodology used to estimate the groundwater base flow metal contribution to French Creek from the various sources is simplistic and provides a rough estimate of the relative contribution from the different sources. Alpers and Hamlin (1995) use this method and state the following about its accuracy:

> Additional ground-water monitoring and numerical modeling of ground-water flow and transport would help to refine these crude estimates and to quantify uncertainties.

This statement applies to the situation in French Gulch. The estimates presented in this section are crude and are based on many uncertainties due to the limited data available.

11.1 Assumptions and Basic Methodology

The fundamental assumption behind the groundwater loading calculations is that the proportion that each waste source contributes to an estimated loading rate can be applied to the measured loading in French Creek. In other words, the loading from the roaster fines, mine pool, mill tailings, and mine waste rock is estimated using accepted methods. The sum total of these estimated loading rates greatly exceeds the measured loading in the creek; therefore, it is assumed that there is some "sink" removing some of the metals before they reach the creek. The assumption is that the proportional makeup of the estimated loading can be applied to the measured loading in the creek to determine the annual loading rate per source.

In addition, the following assumptions have been made:

- The only inputs of metals to French Creek between FG-5 and Dead Elk Pond (FG-7 and FG-8) are the W-O Complex, background sources, and the Country Boy Mine Adit drainage (See Figure 11.1). There are no other surface or groundwater inputs. For a discussion of surface runoff, see Appendix 2.

- The loading rate at sampling site FG-8 is mostly contributed by water from the main stem of French Creek. The concentration of metals in the runoff from the south side of the valley at this station is negligible relative to that in the flow from the main stem.

- Darcy's law is a reasonable estimator of groundwater flow.

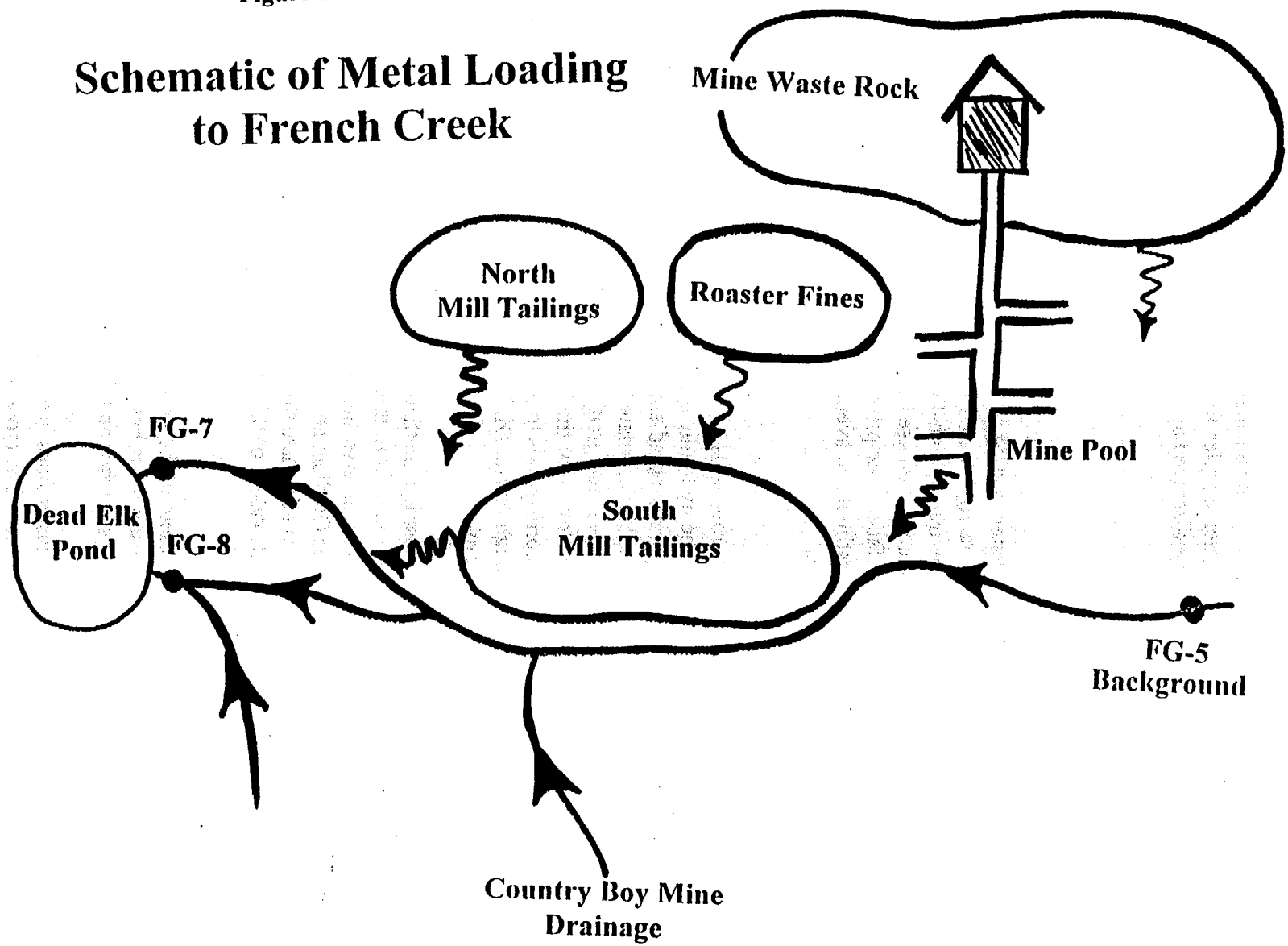
- The characteristics of the north mill tailings and the south mill tailings are similar and the metal concentration in the groundwater in the piles is also similar.

- Grain size distribution is uniform throughout waste piles.

- Metals behave conservatively.

Figure 11.1

Schematic of Metal Loading to French Creek



- Concentrations of total recoverable metals are used in the groundwater analysis. The concentrations in the groundwater samples for all of the metals analyzed in this study do not vary greatly between the dissolved and total forms.

11.2 Roaster Fines

11.2.1 Introduction

The method used to estimate the groundwater loading from the surface waste piles is outlined in Alpers and Hamlin (1995) and consists of using Darcy's Law to estimate the groundwater flow through the surface water piles during a saturated, high-flow condition and a partially saturated, low-flow condition. The discharge estimate is then used with measured metal concentration from groundwater wells located in the surface waste piles to estimate a daily loading rate for each month. The daily rates are used to estimate an average loading per month, which are then summed for seasonal and annual estimates.

11.2.2 Flow calculation

The movement of ground water through porous soils can be estimated by the application of Darcy's Law, which relates water flow to the hydraulic gradient of the groundwater and the hydraulic conductivity of the soil. The hydraulic gradient, hydraulic conductivity, and the cross-sectional area of the saturated waste must all be estimated in order to calculate the flow rate based on Darcy's Law. The groundwater level and gradient vary with the level of runoff, resulting in a variation in the groundwater flow. For the purposes of this study, two conditions are considered. The high flow condition corresponds to the months of May through August, and the low flow condition to September through April. Different cross-sectional areas and hydraulic gradients were used for the different seasons.

The hydraulic conductivity was estimated using a method described in Fetter (1994) based on the measured D_{50} grain size of the piles. The results from this estimation are presented in Appendix 4. The estimates from this method were quite diverse and upon comparison with representative hydraulic conductivities from other sources (Bedient and Huber 1988; Chow, Maidment and Mays 1988; Bouwer 1978) it was decided to eliminate the extremely high values. Upon recommendation from Tom Brown, USBR, values of 0.3 and 3 ft/day were used in the calculations.

Art Morrissey estimated the hydraulic gradient of the ground water in the roaster fines piles from his ground water mapping activities. The estimate is based on comparing the head at various monitoring wells. The high flow estimate is 0.1 ft/ft and the low flow is 0.05 ft/ft.

For the high flow case, saturation of the roaster fines is assumed to an elevation of 9,882 feet creating an average saturated depth of 15 feet. The cross-sectional area of the waste piles was

estimated by dividing the waste pile volume estimate determined by the USBR (1996b) by the plan area of the waste pile to determine the average depth of the pile. That depth was then multiplied by the width of the pile to calculate an average cross-section area. For the low flow case, the average water surface elevation was assumed to be 9,877 feet creating an average saturated depth of 10 feet.

Estimate saturated cross-sectional area, A:

Volume/Plan Area = Average Depth of Piles
Average depth of pile at high flow = 15 feet.
Maximum width = 250 feet.
Average depth of piles X Maximum Width = Average Cross-section Area

High flow - assume entire pile is saturated – water surface elevation 9,882 feet.
A_{HF} = 3,750 sq. ft.
Low flow - assume partial saturation - below 9,877 feet elevation.
A_{LF} = 2,500 sq. ft.

The following equation is Darcy's Law for estimating groundwater flow:

$$Q = K\,(dh/dl)\,A$$

Where,
Q = Groundwater discharge,
K = Hydraulic conductivity,
dh/dl = Hydraulic gradient, and
A = Cross-section area.

11.2.3 Concentration calculation

Only one sample of water quality from the roaster fines is available. It is assumed that the metal concentration data from this sample is a reasonable estimate for year-round metal concentration in the water saturating the roaster fines. The sample was taken in June 1996 at sampling site SBRF-3. The concentration of metals in the groundwater saturating the piles most likely varies throughout the year. Until more data is collected there is no way of knowing how the concentration varies and how accurate this estimate is.

11.2.4 Loading calculation

The loading rate for each metal is estimated monthly by multiplying the monthly groundwater discharge estimate by the metal concentration.

Loading - L = Q x C for each month

The data and calculations for each metal are presented in Appendix 4.

11.3 Mill Tailings

11.3.1 Introduction

The same methodology that is explained in Section 11.2.1 for the roaster fines is applied to the mill tailings piles. The loading for the north mill tailings and the south mill tailings are combined. The characteristics of the piles are assumed to be similar.

11.3.2 Flow Calculations

A range of hydraulic conductivities was used based on a recommendation from Tom Brown, USBR.

Hydraulic conductivity - K = 0.3 - 3 ft/day

The hydraulic gradient estimate is based on Art Morrissey's groundwater study:

Hydraulic Gradient dh/dl = 0.025 ft/ft

The saturated cross-section area is estimated from the maps and cross-sections of the surface waste piles created by the USBR (1996b) and from Art Morrissey's groundwater study:

Volume/Plan Area = Average Depth of Piles
Average depth of piles X Maximum Width = Average Cross-section Area

North Mill Tailings:
- High flow - assume entire pile is saturated
  - Average depth = 10 feet
  - Maximum width = 300 feet
  - Cross-section area = 3,000 sq. ft.
- Low flow – assumed to be dry, totally unsaturated.

South Mill Tailings:
- High flow – water surface elevation 9,853 feet
  - Average depth = 15 feet
  - Maximum width = 250 feet
  - Cross-section area = 3,750 sq. ft.
- Low flow – water surface elevation 9,850 feet
  - Average depth = 12 feet
  - Maximum width = 250 feet
  - Cross-section area = 3,000 sq. ft.

Hydraulic Conductivity Calculations

Roaster Fines Area

DRILL HOLE OR TEST PIT ID	Depth of Sample (ft)	Median Grain Size d (mm)	Description of Material	Hydraulic Conductivity Estimates	
				$100*d^{1.5}$	$450*d^{1.65}$
B-WR02DHAT-01	4.3 - 6.7	0.1	Silty sand	3.16	10.07
B-WR02DHAT-01		<0.075	Sandy silt	2.05	6.27
B-WR02DHAT-01	9.2 - 11.7	0.32	Poorly graded sand with silt	18.10	68.66
B-WR02DHAT-01		0.2	Silty sand	8.94	31.62
B-WR01DHAT-01	2.5 - 4.6	<0.075	Sandy silt	2.05	6.27
B-WR01DHAT-01		<0.075	Sandy silt	2.05	6.27
B-WR01DHAT-01	9.5 - 12.0	0.32	Silty sand	18.10	68.66
B-WR01DHAT-01		0.33	Silty sand	18.96	72.24
B-WR01DHAT-01	14.5 - 16.7	0.15	Silty Gravel with sand	5.81	19.67

South Mill Tailings Area

DRILL HOLE OR TEST PIT ID	Depth of Sample (ft)	Median Grain Size d (mm)	Description of Material	Hydraulic Conductivity Estimates	
				$100*d^{1.5}$	$450*d^{1.65}$
BWTL08TP01	0.0 - 5.0	0.237	Silty sand	11.54	41.84
BWTL07TP01	0.0 - 3.5	0.173	Silty sand	7.20	24.89
BWTL07TP01	3.5 - 11.0	26.669	Poorly graded gravel	13772.41	101420.00
BWTL02TP01	5	0.342	Silty sand	20.00	76.62

Mine Waste Rock

DRILL HOLE OR TEST PIT ID	Depth of Sample (ft)	Median Grain Size d (mm)	Description of Material	Hydraulic Conductivity Estimates	
				$100*d^{1.5}$	$450*d^{1.65}$
BWTU04TP01	0.0 - 7.0	16.719	Poorly graded gravel	6836.21	46936.37
BWTU04TP01	7.0 - 9.0	5.625	Silty gravel w/sand	1334.09	7778.84
BWTU05TP01	0.0 - 9.0	5.235	Clayey gravel w/sand	1197.77	6909.16

A discharge estimate for each of the high and low flow condition is calculated by applying Darcy's law:

Discharge estimate $Q = K\ (dh/dl)\ A$

11.3.3 Concentration calculation

Only one water quality sample is available from the water saturating the mill tailings. This sample is from January 1997 sampling for WTL-02 and is assumed to be representative of the concentration in the mill tailings for the entire year.

11.3.4 Loading calculation

The loading rate for each metal is estimated monthly by multiplying the monthly groundwater discharge estimate by the metal concentration.

Loading - $L = Q \times C$ for each month

The data and calculations for the mill tailings are presented in Appendix 4.

11.4 Mine Waste Rock

11.4.1 Introduction

The same methodology that is explained in Section 11.2.1 for the roaster fines is applied to the mine waste rock at the W-O mill site. It is assumed that the mine waste rock are only saturated during the months of May and June and that they are completely unsaturated during the rest of the year and do not contribute to the metal loading in French Creek during those months.

11.4.2 Flow Calculations

A range of hydraulic conductivities was used based on a recommendation from Tom Brown, USBR.

Hydraulic conductivity - $K = 0.3 - 3$ ft/day

The hydraulic gradient estimate is based on Art Morrissey's groundwater study:

Hydraulic Gradient $dh/dl = 0.1$ ft/ft

The saturated cross-section area is estimated from the maps and cross-sections of the surface waste piles created by the USBR (1996b) and from Art Morrissey's groundwater study:

High flow – water surface elevation 9,886 feet
Average saturated depth = 10 feet

Groundwater Flow Estimates

Roaster Fines

High Flow - Totally Saturated - May - August

	Avg. Hyd. Conductivity (ft/day)	Hydraulic Gradient (ft/ft)	Area (sq. ft.)	Q (cu.ft./day)	Q cfs
Minimum Estimate	0.30	0.03	3750	34	0.0004
	3	0.03	3750	338	0.0039
	30	0.03	3750	3,375	0.0391
Maximum Estimate	72	0.03	3750	8,100	0.09

Low Flow - Sept - April

	Avg. Hyd. Conductivity (ft/day)	Hydraulic Gradient (ft/ft)	Area (sq. ft.)	Q (cu.ft./day)	Q cfs
Minimum Estimate	0.30	0.02	2500	15	0.0002
	3	0.02	2500	150	0.0017
	30	0.02	2500	1,500	0.0174
Maximum Estimate	72	0.02	2500	3,600	0.04

North Mill Tailings - High Flow

	Avg. Hyd. Conductivity (ft/day)	Hydraulic Gradient (ft/ft)	Area (sq. ft.)	Q (cu.ft./day)	Q cfs
Minimum Estimate	0.3	0.04	3,000	36	0.0004
	3.0	0.04	3,000	360	0.0042
Maximum Estimate	30	0.04	3,000	3,600	0.0417

South Mill Tailings - High Flow

	Avg. Hyd. Conductivity (ft/day)	Hydraulic Gradient (ft/ft)	Area (sq. ft.)	Q (cu.ft./day)	Q cfs
Minimum Estimate	0.30	0.03	3,750	28	0.000
	3	0.03	3,750	281	0.003
Maximum Estimate	30	0.03	3,750	2,813	0.033

South Mill Tailings - Low Flow

	Avg. Hyd. Conductivity (ft/day)	Hydraulic Gradient (ft/ft)	Area (sq. ft.)	Q (cu.ft./day)	Q cfs
Minimum Estimate	0.3	0.03	3,000	23	0.0003
	3.0	0.03	3,000	225	0.0026
Maximum Estimate	30	0.03	3,000	2,250	0.0260

Mine Waste Rock

High Flow - Totally Saturated

	Avg. Hyd. Conductivity (ft/day)	Hydraulic Gradient (ft/ft)	Area (sq. ft.)	Q (cu.ft./day)	Q cfs
Minimum Estimate	0.30	0.10	6,000	180	0.0021
	3.00	0.10	6,000	1,800	0.0208
Maximum Estimate	30	0.10	6,000	18,000	0.21

Low Flow - Partially Saturated

	Avg. Hyd. Conductivity (ft/day)	Hydraulic Gradient (ft/ft)	Area (sq. ft.)	Q (cu.ft./day)	Q cfs
Minimum Estimate	0.30	0.05	0	0	0.0000
Maximum Estimate	30	0.05	0	0	0.00

Maximum width = 600 feet
Cross-section area = 6,000 sq. ft.

A discharge estimate for the high flow condition is calculated by applying Darcy's law:

Discharge estimate Q = K (dh/dl) A

The piles are assumed to be totally unsaturated during the rest of the year; therefore, the flow is zero during those months.

11.4.3 Concentration calculation

Only one water quality sample is available from the water saturating the mine waste rock. This sample is from the seep that flows out of the base of the mine waste rock piles. A sample was collected and analyzed from this seep (WP-1) in June 1996. The concentrations from this sample are assumed to be representative for the entire year.

11.4.4 Loading calculation

The loading rate for each metal is estimated monthly by multiplying the monthly groundwater discharge estimate by the metal concentration.

Loading - L = Q x C for each month

The data and calculations for the mine waste rock are presented in Appendix 4.

11.5 Mine Pool

11.5.1 Flow Calculation

Art Morrissey estimated flow rates out of the mine pool based on measurements of flow in wells and estimates of flow through the faults crossing the valley.

Q(high flow) = 3 cfs
Q(low flow) = 2.5 cfs

11.5.2 Concentration Estimate

The high flow concentration is estimated from four samples collected in June and July 1996 at the number 3 relief well. The low flow concentration is based on a sample collected from this well in March 1996.

11.5.3 Loading Estimate

The loading rate for each metal is estimated monthly by multiplying the monthly groundwater discharge estimate by the metal concentration.

Groundwater Base Flow Loading Estimates for the Roaster Fines Piles

Cadmium

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	14,600	0.002	0.06	1.9
February	14,600	0.002	0.06	1.7
March	14,600	0.002	0.06	1.9
April	14,600	0.002	0.06	1.8
May	14,600	0.004	0.14	4.3
June	14,600	0.004	0.14	4.2
July	14,600	0.004	0.14	4.3
August	14,600	0.004	0.14	4.3
September	14,600	0.002	0.06	1.8
October	14,600	0.002	0.06	1.9
November	14,600	0.002	0.06	1.8
December	14,600	0.002	0.06	1.9
Total Annual Loading (kg/year)				31.9

Iron

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	4,467,030	0.002	18.6	576.8
February	4,467,030	0.002	18.6	520.9
March	4,467,030	0.002	18.6	576.8
April	4,467,030	0.002	18.6	558.2
May	4,467,030	0.004	42.7	1323.2
June	4,467,030	0.004	42.7	1280.5
July	4,467,030	0.004	42.7	1323.2
August	4,467,030	0.004	42.7	1323.2
September	4,467,030	0.002	18.6	558.2
October	4,467,030	0.002	18.6	576.8
November	4,467,030	0.002	18.6	558.2
December	4,467,030	0.002	18.6	576.8
Total Annual Loading (kg/year)				9752.4

Manganese

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	253,984	0.002	1.06	32.8
February	253,984	0.002	1.06	29.6
March	253,984	0.002	1.06	32.8
April	253,984	0.002	1.06	31.7
May	253,984	0.004	2.43	75.2
June	253,984	0.004	2.43	72.8
July	253,984	0.004	2.43	75.2
August	253,984	0.004	2.43	75.2
September	253,984	0.002	1.06	31.7
October	253,984	0.002	1.06	32.8
November	253,984	0.002	1.06	31.7
December	253,984	0.002	1.06	32.8
Total Annual Loading (kg/year)				554.5

Zinc

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	3,155,500	0.002	13.14	407.4
February	3,155,500	0.002	13.14	368.0
March	3,155,500	0.002	13.14	407.4
April	3,155,500	0.002	13.14	394.3
May	3,155,500	0.004	30.15	934.7
June	3,155,500	0.004	30.15	904.5
July	3,155,500	0.004	30.15	934.7
August	3,155,500	0.004	30.15	934.7
September	3,155,500	0.002	13.14	394.3
October	3,155,500	0.002	13.14	407.4
November	3,155,500	0.002	13.14	394.3
December	3,155,500	0.002	13.14	407.4
Total Annual Loading (kg/year)				6889.1

Loading - L = Q x C for each month

The data and calculations for the mine pool are presented in Appendix 4.

11.6 Loading Estimates for French Creek

11.6.1 Flow Calculation

Discharge data for FG-5, FG-7 and FG-8 is available for June 1996, July 1996, Aug. 1994, and Sept 1992. The average percentage that the flow at each of these stations, Q_{sta}, makes up of the flow at the mouth of French Creek, Q_{FG-9} was calculated:

$$\text{Avg } \% = \text{Avg of } Q_{sta}/Q_{FG-9}$$

That percentage was applied to the mean daily flow for each month of 1996 at FG-9 to determine a mean daily flow for each month at each station. The Country Boy Mine adit drainage is estimated in a similar manner except that data is available from only one sampling date.

11.6.2 Concentration Estimate

Metal concentration data is available for June 1996, July 1996, Aug. 1994, Sept 1992, October 1993 and November 1993. The table below shows which concentration data was applied to each month for a representative monthly concentration estimate. Additional error is introduced by this assumption due to the different hydrologic circumstances during different years.

	Metal concentration data used to represent each month
January	March 1996
February	March 1996
March	March 1996
April	November 1993
May	June 1996
June	June 1996
July	July 1996
August	August 1994

Groundwater Base Flow Loading Estimates for the Mill Tailings Piles

Cadmium

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	5	0.026	0.00	0.0
February	5	0.026	0.00	0.0
March	5	0.026	0.00	0.0
April	5	0.026	0.00	0.0
May	5	0.037	0.00	0.0
June	5	0.037	0.00	0.0
July	5	0.037	0.00	0.0
August	5	0.037	0.00	0.0
September	5	0.026	0.00	0.0
October	5	0.026	0.00	0.0
November	5	0.026	0.00	0.0
December	5	0.026	0.00	0.0
Total Annual Loading (kg/year)				0.1

Manganese

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	43	0.026	0.00	0.1
February	43	0.026	0.00	0.1
March	43	0.026	0.00	0.1
April	43	0.026	0.00	0.1
May	43	0.037	0.00	0.1
June	43	0.037	0.00	0.1
July	43	0.037	0.00	0.1
August	43	0.037	0.00	0.1
September	43	0.026	0.00	0.1
October	43	0.026	0.00	0.1
November	43	0.026	0.00	0.1
December	43	0.026	0.00	0.1
Total Annual Loading (kg/year)				1.1

Iron

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	80	0.026	0.0	0.2
February	80	0.026	0.0	0.1
March	80	0.026	0.0	0.2
April	80	0.026	0.0	0.2
May	80	0.037	0.0	0.2
June	80	0.037	0.0	0.2
July	80	0.037	0.0	0.2
August	80	0.037	0.0	0.2
September	80	0.026	0.0	0.2
October	80	0.026	0.0	0.2
November	80	0.026	0.0	0.2
December	80	0.026	0.0	0.2
Total Annual Loading (kg/year)				2.1

Zinc

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	141	0.026	0.01	0.3
February	141	0.026	0.01	0.3
March	141	0.026	0.01	0.3
April	141	0.026	0.01	0.3
May	141	0.037	0.01	0.4
June	141	0.037	0.01	0.4
July	141	0.037	0.01	0.4
August	141	0.037	0.01	0.4
September	141	0.026	0.01	0.3
October	141	0.026	0.01	0.3
November	141	0.026	0.01	0.3
December	141	0.026	0.01	0.3
Total Annual Loading (kg/year)				3.8

September	September 1992
October	October 1993
November	November 1993
December	March 1996

11.6.3 Loading Estimate

The mean daily discharge for each month was multiplied by the representative monthly metal concentration resulting in a daily loading estimate for each metal. The daily estimates are summed to get monthly and seasonal estimates. The monthly estimates are then summed for an annual estimate. The data and calculations for these sites are presented in Appendix 4.

11.7 Total Loading Calculations:

It is assumed that the measured loading at FG-7 and FG-8 is equal to the sum of the metal loading from the W-O complex groundwater sources, the Country Boy drainage and the background loading measured at FG-5. It is also assumed that the loading from the south side of the valley into FG-8 is negligible.

FG-7 + FG-8 = Loading from W-O Complex + Country Boy + FG-5 (Background)

Rearranging this equation results in the following:

Eq. (1)

Loading from W-O Complex = FG-7 + FG-8 - Country Boy - FG-5

The total loading from the W-O complex is based on summing the loading estimates from the individual sources (the calculations for these estimates are described in the sections above):

Eq. (2)

Loading from W-O Complex = Roaster Fines + Mill Tailings + Mine Pool + Mine Waste Rock

This estimate is much greater than loading predicted from creek measurements (Eq. 1). So, the relative contribution of each source of loading in W-O complex is estimated in the following manner (RF = roaster fines estimated annual loading, MT = mill tailings estimated annual loading, MP = mine pool estimated annual loading, and MWR = mine waste rock estimated annual loading):

Groundwater Base Flow Loading Estimates for the Mine Waste Rock

Cadmium

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	22,500	0.000	0.00	0.0
February	22,500	0.000	0.00	0.0
March	22,500	0.000	0.00	0.0
April	22,500	0.000	0.00	0.0
May	22,500	0.021	1.16	35.9
June	22,500	0.021	1.16	34.7
July	22,500	0.000	0.00	0.0
August	22,500	0.000	0.00	0.0
September	22,500	0.000	0.00	0.0
October	22,500	0.000	0.00	0.0
November	22,500	0.000	0.00	0.0
December	22,500	0.000	0.00	0.0
Total Annual Loading (kg/year)				70.6

Iron

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	837,588	0.000	0.0	0.0
February	837,588	0.000	0.0	0.0
March	837,588	0.000	0.0	0.0
April	837,588	0.000	0.0	0.0
May	837,588	0.021	43.1	1335.9
June	837,588	0.021	43.1	1292.8
July	837,588	0.000	0.0	0.0
August	837,588	0.000	0.0	0.0
September	837,588	0.000	0.0	0.0
October	837,588	0.000	0.0	0.0
November	837,588	0.000	0.0	0.0
December	837,588	0.000	0.0	0.0
Total Annual Loading (kg/year)				2628.7

Manganese

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	1,276,690	0.000	0.00	0.0
February	1,276,690	0.000	0.00	0.0
March	1,276,690	0.000	0.00	0.0
April	1,276,690	0.000	0.00	0.0
May	1,276,690	0.021	65.69	2036.3
June	1,276,690	0.021	65.69	1970.6
July	1,276,690	0.000	0.00	0.0
August	1,276,690	0.000	0.00	0.0
September	1,276,690	0.000	0.00	0.0
October	1,276,690	0.000	0.00	0.0
November	1,276,690	0.000	0.00	0.0
December	1,276,690	0.000	0.00	0.0
Total Annual Loading (kg/year)				4006.8

Zinc

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	3,538,000	0.000	0.00	0.0
February	3,538,000	0.000	0.00	0.0
March	3,538,000	0.000	0.00	0.0
April	3,538,000	0.000	0.00	0.0
May	3,538,000	0.021	182.03	5642.9
June	3,538,000	0.021	182.03	5460.9
July	3,538,000	0.000	0.00	0.0
August	3,538,000	0.000	0.00	0.0
September	3,538,000	0.000	0.00	0.0
October	3,538,000	0.000	0.00	0.0
November	3,538,000	0.000	0.00	0.0
December	3,538,000	0.000	0.00	0.0
Total Annual Loading (kg/year)				11103.8

% Roaster Fines = Roaster Fines / (RF + MT + MP + MWR)

%Mill Tailings = Mill Tailings / (RF + MT + MP + MWR)

%Mine Waste Rock = Mine Waste Rock / (RF + MT + MP + MWR)

%Mine Pool = Mine Pool / (RF + MT + MP + MWR)

This percentage is applied to the loading approximated from the creek data to determine the annual metal loading contributed by the roaster fines, mill tailings and mine pool per year. All of the data and calculations are presented in Appendix 4.

Groundwater Base Flow Loading Estimates for the Mine Pool

Cadmium

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	200	1.500	2.3	23
February	200	1.500	2.3	21
March	200	1.500	2.3	23
April	624	1.500	2.3	69
May	624	3.500	5.4	166
June	624	3.500	5.4	161
July	624	3.500	5.4	166
August	624	3.500	5.4	166
September	624	1.500	2.3	69
October	624	1.500	2.3	71
November	200	1.500	2.3	22
December	200	1.500	2.29	23
Total Annual Loading (kg/year)				978

Iron

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	175,407	1.5	645	19,983
February	175,407	1.5	645	18,049
March	175,407	1.5	645	19,983
April	175,407	1.5	645	19,339
May	175,407	3.5	1,504	46,627
June	175,407	3.5	1,504	45,123
July	175,407	3.5	1,504	46,627
August	175,407	3.5	1,504	46,627
September	175,407	1.5	645	19,339
October	175,407	1.5	645	19,983
November	175,407	1.5	645	19,339
December	175,407	1.5	645	19,983
Total Annual Loading (kg/year)				341,003

Manganese

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	49,605	1.500	182	5,651
February	49,605	1.500	182	5,104
March	49,605	1.500	182	5,651
April	49,605	1.500	182	5,469
May	49,605	3.500	425	13,186
June	49,605	3.500	425	12,761
July	49,605	3.500	425	13,186
August	49,605	3.500	425	13,186
September	49,605	1.500	182	5,469
October	49,605	1.500	182	5,651
November	49,605	1.500	182	5,469
December	49,605	1.500	182	5,651
Total Annual Loading (kg/year)				96,435

Zinc

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	215,285	1.5	791.17	24,526
February	215,285	1.5	791.17	22,153
March	215,285	1.5	791.17	24,526
April	215,285	1.5	791.17	23,735
May	215,285	3.5	1846.07	57,228
June	215,285	3.5	1846.07	55,382
July	215,285	3.5	1846.07	57,228
August	215,285	3.5	1846.07	57,228
September	215,285	1.5	791.17	23,735
October	215,285	1.5	791.17	24,526
November	215,285	1.5	791.17	23,735
December	215,285	1.5	791.17	24,526
Total Annual Loading (kg/year)				418,530

12. Appendix 2 - Methodology for Surface Runoff Metal Loading Calculations Based on the USLE

Surface runoff can transport metals from mine waste to surface water in two different forms: dissolved metals and metals associated with sediment particles. The following section explains the calculation of metal loading associated with sediment erosion from surface waste piles.

12.1 Introduction

The following variables influence sediment erosion:

- climate - rainfall, snowfall and temperature
- soil properties - soil texture and composition including the permeability and erodibility
- chemical composition of soils - loose soils are more easily eroded than clays.
- vegetation - dissipates rainfall energy, binds the soil, and increases the porosity of the soil with its roots.
- topographic factors - slope and the distance traversed by the flow.

These factors vary seasonal throughout the year resulting in seasonal variation in sediment yield and its associated chemical composition (Novotny and Olem 1994).

12.2 Universal Soil Loss Equation (USLE)

The USLE is a widely used and accepted method of estimating the soil loss from upland areas. It results in an annual estimate of tons of sediment lost from a unit area of land due to erosion by rain. It does not include wind erosion and does not give direct sediment yield estimates, a sediment delivery ratio must be applied to estimate sediment yield. It is an empirical equation whose parameters have been evaluated for a wide range of conditions and is therefore appropriate for application to the W-O surface waste (Mills et al. 1985, McElroy et al. 1976, and Novotny and Olem 1994).

The USLE as presented in Mills et al. (1985) is as follows:

$$X = 1.29\ E\ K\ LS\ C\ P$$

where,

X = Soil loss (tonnes/ha = 1000 kg/ha)

Annual Metal Loading Estimate for Background Sources (FG-5)

Cadmium

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	-	0.887	0.000	0.0
February	-	0.956	0.000	0.0
March	-	0.965	0.000	0.0
April	-	1.875	0.000	0.0
May	-	17.918	0.000	0.0
June	-	26.877	0.000	0.0
July	-	9.051	0.000	0.0
August	-	3.773	0.000	0.0
September	0.6	2.868	0.004	0.1
October	-	2.725	0.000	0.0
November	-	1.469	0.000	0.0
December	-	1.270	0.000	0.0
Total Annual Loading (kg/year)				0.1

Iron

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	62	0.9	0.1	4
February	62	1.0	0.1	4
March	62	1.0	0.1	5
April	62	1.9	0.3	9
May	567	17.9	24.9	771
June	567	26.9	37.3	1,119
July	26	9.1	0.6	18
August	151	3.8	1.4	43
September	52	2.9	0.4	11
October	83	2.7	0.6	17
November	62	1.5	0.2	7
December	62	1.3	0.2	6
Total Annual Loading (kg/year)				2,014

Manganese

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	18	0.887	0.0	1
February	18	0.956	0.0	1
March	18	0.965	0.0	1
April	18	1.875	0.1	2
May	57	17.918	2.5	78
June	57	26.877	3.8	113
July	3	9.051	0.1	2
August	31	3.773	0.3	9
September	12	2.868	0.1	3
October	17	2.725	0.1	4
November	18	1.469	0.1	2
December	18	1.270	0.06	2
Total Annual Loading (kg/year)				218

Zinc

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	80	0.9	0.2	5
February	80	1.0	0.2	5
March	80	1.0	0.2	6
April	80	1.9	0.4	11
May	46	17.9	2.0	63
June	46	26.9	3.0	91
July	15	9.1	0.3	10
August	70	3.8	0.6	20
September	115	2.9	0.8	24
October	67	2.7	0.4	14
November	80	1.5	0.3	9
December	80	1.3	0.2	8
Total Annual Loading (kg/year)				266

E = Rainfall/runoff erosivity index
K = Soil erodibility factor
LS = Topographic factor
C = Cover Management factor
P = Supporting practice factor
1.29 = conversion to metric units.

12.2.1 Roaster Fines

The values of the parameters applied for the roaster fines are described below.

The rainfall/runoff erosivity factor is related to rainfall intensity. Mills et al. (1985) presents average annual values for different regions of the U.S. Seasonal variations in this factor are accounted for in this annual average.

E = 1.735 x 50 (10^2 m-tonne-cm/ha-hr) (Mills et al. 1985)

Soil erodibility is based on the median grain size of the soil. Based on USBR (1996a) data, the roaster fines have median grain sizes varying from 0.075 mm (very fine sand) to 0.33 mm (medium sand). These values result in :

K = 0.16 to 0.42 for organic matter content = 0.5% (Mills et al. 1985, Novotny and Olem 1994).

The cover/management factors and the supporting practice factors are both equal to 1.0 for bare soil with no contouring (Mills et al. 1985, Novotny and Olem 1994).

The topographic factor is calculated for a runoff distance of 50 m and a slope of 10% derived from USBR (1996b) topographic maps. This results in LS = 1.75.

For K = 0.16, the soil loss estimate is:

X = 31.33 tonnes/ha = 31,300 kg/ha

And, for K = 0.42, the soil loss estimate is:

X = 82.25 tonnes/ha = 82,300 kg/ha

Applying an estimated runoff area of 62,000 sq. ft. and converting from hectares to square feet results in estimated annual soil loss from the roaster fines of approximately 18,000 kg to 47,400 kg. A sediment delivery ratio, which accounts for the attenuation of sediment through deposition and filtering as it travels from source areas to the surface waters, of 0.35 is applied to the

Annual Metal Loading Estimate
At FG-7

Cadmium

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	10	1.477	0.0	1
February	10	1.592	0.0	1
March	10	1.608	0.0	1
April	10	3.123	0.1	2
May	7	29.846	0.5	16
June	7	44.769	0.8	24
July	11	15.077	0.4	12
August	5	6.285	0.1	3
September	7	4.777	0.1	2
October	8	4.538	0.1	3
November	10	2.446	0.1	2
December	10	2.115	0.05	2
Total Annual Loading (kg/year)				69

Iron

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	296	1.5	1	33
February	296	1.6	1	32
March	296	1.6	1	36
April	296	3.1	2	68
May	749	29.8	55	1,698
June	749	44.8	82	2,465
July	284	15.1	10	325
August	225	6.3	3	107
September	302	4.8	4	106
October	282	4.5	3	97
November	296	2.4	2	53
December	296	2.1	2	48
Total Annual Loading (kg/year)				5,069

Manganese

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	850	1.477	3	95
February	850	1.592	3	93
March	850	1.608	3	104
April	850	3.123	7	195
May	734	29.846	54	1,664
June	734	44.769	80	2,415
July	1,166	15.077	43	1,335
August	565	6.285	9	270
September	699	4.777	8	245
October	708	4.538	8	244
November	850	2.446	5	153
December	850	2.115	4	137
Total Annual Loading (kg/year)				6,949

Zinc

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	4,183	1.5	15	469
February	4,183	1.6	16	457
March	4,183	1.6	16	511
April	4,183	3.1	32	960
May	2,674	29.8	195	6,060
June	2,674	44.8	293	8,797
July	4,618	15.1	171	5,288
August	2,300	6.3	35	1,098
September	3,000	4.8	35	1,053
October	3,193	4.5	36	1,101
November	4,183	2.4	25	752
December	4,183	2.1	22	672
Total Annual Loading (kg/year)				27,219

estimated soil loss to determine the approximate sediment yield from the piles. The resulting sediment yield is 6,300 kg per year to 16,600 kg per year (Mills et al. 1985).

This value for sediment yield is the multiplied by the content of metals in the roaster fines sediment resulting in an estimate for potential annual metal loading to the Creek from the roaster fines. The results are presented in Table 12.1.

12.2.2 Mill Tailings

The topographic factor is calculated for a runoff distance of 23 ft. and a slope of 15% derived from USBR (1996b) topographic maps. This results in LS = 2.22.

Soil erodibility is based on the median grain size of the soil. Based on USBR (1996a) data, the mill tailings have median grain sizes varying from 0.173 mm to 0.237 mm. These values result in (for fine sand):

K = 0.16 for organic matter content = 0.5% (Mills et al. 1985, Novotny and Olem 1994).

The cover/management factors and the supporting practice factors are both equal to 1.0 for bare soil with no contouring (Mills et al. 1985, Novotny and Olem 1994).

Rainfall/runoff erosivity factor is the same as for the roaster fines because it is related to rainfall intensity:

E = 86.75 = 1.735 x 50 (10^2 m-tonne-cm/ha-hr) (Mills et al. 1985)

The soil loss estimate is:

X = 39,700 kg/ha

Applying an estimated runoff area of 136,000 sq. ft. and converting from hectares to square feet results in estimated annual soil loss from the mill tailings of approximately 39,700 kg. A sediment delivery ratio, which accounts for the attenuation of sediment through deposition and filtering as it travels from source areas to the surface waters, of 0.35 is applied to the estimated soil loss to determine the approximate sediment yield from the piles. The resulting sediment yield is 6,300 kg per year to 19,700 kg per year (Mills et al. 1985).

This value for sediment yield is the multiplied by the content of metals in the roaster fines sediment resulting in an estimate for potential annual metal loading to the Creek from the roaster fines. The results are presented in Table 12.2.

Annual Metal Loading Estimate
At FG-8

Cadmium

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	5	0.459	0.01	0.16
February	5	0.495	0.01	0.16
March	5	0.500	0.01	0.17
April	5	0.971	0.01	0.33
May	5	9.275	0.11	3.45
June	4	13.913	0.13	3.78
July	3	4.685	0.04	1.14
August	3	1.953	0.02	0.50
September	5	1.485	0.02	0.53
October	3	1.410	0.01	0.32
November	5	0.760	0.01	0.26
December	5	0.657	0.01	0.23
Total Annual Loading (kg/year)				11

Iron

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	27	0.5	0.0	1
February	27	0.5	0.0	1
March	27	0.5	0.0	1
April	27	1.0	0.1	2
May	277	9.3	6.3	195
June	277	13.9	9.5	284
July	119	4.7	1.4	42
August	96	2.0	0.5	14
September	113	1.5	0.4	12
October	43	1.4	0.1	5
November	27	0.8	0.1	2
December	27	0.7	0.0	1
Total Annual Loading (kg/year)				560

Manganese

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	141	0.459	0.2	5
February	141	0.495	0.2	5
March	141	0.500	0.2	5
April	141	0.971	0.3	10
May	100	9.275	2.3	71
June	100	13.913	3.4	103
July	20	4.685	0.2	7
August	117	1.953	0.6	17
September	218	1.485	0.8	24
October	83	1.410	0.3	9
November	141	0.760	0.3	8
December	141	0.657	0.23	7
Total Annual Loading (kg/year)				270

Zinc

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	1,453	0.5	2	51
February	1,453	0.5	2	49
March	1,453	0.5	2	55
April	1,453	1.0	3	104
May	749	9.3	17	528
June	749	13.9	26	766
July	681	4.7	8	242
August	974	2.0	5	144
September	1,547	1.5	6	169
October	749	1.4	3	80
November	1,453	0.8	3	81
December	1,453	0.7	2	73
Total Annual Loading (kg/year)				2,342

Table 12.1 - Roaster Fines Surface Runoff Loading Estimate

	Average Roaster Fines Metal Content (mg/kg)	Soil Loss (Medium Sand) (kg/ha)	Loading (kg/ha)	Minimum Estimated Loading (kg/yr)	With Sediment Delivery Ratio (Sd = 0.35) (kg/year)
Cd	492	31,300	15	9	3
Fe	107,033	31,300	3,350	1,930	676
Mn	2,111	31,300	66	38	13
Zn	102,610	31,300	3,212	1,851	648

	Average Roaster Fines Metal Content (mg/kg)	Soil Loss (Very fine Sand) (kg/ha)	Loading (kg/ha)	Maximum Estimated Loading (kg/yr)	With Sediment Delivery Ratio (Sd = 0.35) (kg/year)
Cd	492	82,300	41	23	8
Fe	107,033	82,300	8,809	5,076	1,777
Mn	2,111	82,300	174	100	35
Zn	102,610	82,300	8,445	4,866	1,703

Note: Estimate based on annual soil loss estimated with the Universal Soil Loss Equation (USLE) (Mills et al. 1985).
Surface waste metal concentrations from URS Sampling Activities Report, February 12, 1997 (Sullivan 1997).
Concentrations are average values of URS roaster fines sampling.

Annual Metal Loading Estimate
At FG-9

Cadmium

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	8	1.920	0.04	1.22
February	8	2.070	0.04	1.19
March	8	2.090	0.04	1.33
April	8	4.060	0.08	2.51
May	7	38.800	0.67	20.63
June	7	58.200	1.00	29.94
July	6	19.600	0.29	9.01
August	6	8.170	0.12	3.79
September	6	6.210	0.09	2.69
October	7	5.900	0.10	3.05
November	8	3.180	0.07	1.96
December	8	2.750	0.06	1.75
Total Annual Loading (kg/year)				79

Iron

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	171	1.9	0.8	25
February	171	2.1	0.9	24
March	171	2.1	0.9	27
April	171	4.1	1.7	51
May	324	38.8	30.8	955
June	324	58.2	46.2	1,386
July	41	19.6	2.0	61
August	113	8.2	2.3	70
September	164	6.2	2.5	75
October	105	5.9	1.5	47
November	171	3.2	1.3	40
December	171	2.8	1.2	36
Total Annual Loading (kg/year)				2,797

Manganese

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	538	1.920	2.5	78
February	538	2.070	2.7	76
March	538	2.090	2.8	85
April	538	4.060	5.4	161
May	312	38.800	29.7	919
June	312	58.200	44.5	1,335
July	32	19.600	1.5	48
August	342	8.170	6.8	212
September	355	6.210	5.4	162
October	413	5.900	6.0	185
November	538	3.180	4.2	126
December	538	2.750	3.62	112
Total Annual Loading (kg/year)				3,500

Zinc

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	3,411	1.9	16	497
February	3,411	2.1	17	484
March	3,411	2.1	17	541
April	3,411	4.1	34	1,018
May	2,100	38.8	200	6,188
June	2,100	58.2	299	8,983
July	2,300	19.6	110	3,424
August	2,170	8.2	43	1,347
September	1,923	6.2	29	878
October	2,605	5.9	38	1,167
November	3,411	3.2	27	797
December	3,411	2.8	23	712
Total Annual Loading (kg/year)				26,038

Table 12.2 - Mill Tailings Surface Runoff Loading Estimate

	Average Mill Tailings Metal Concentration (mg/kg)	*Soil Loss (kg/ha)*	*Loading (kg/ha)*	*Estimated Loading (kg/yr)*	*With Sediment Delivery Ratio (Sd = 0.35) (kg/year)*
Cd	29	39,700	1	1	1
Fe	83,100	39,700	3,299	4,170	1,459
Mn	3,531	39,700	140	177	62
Zn	6,540	39,700	260	328	115

Note: Estimate based on annual soil loss estimated with the Universal Soil Loss Equation (USLE) (Mills et al. 1985).
Surface waste metal concentrations from USBR (1996a) and URS Sampling Activities Report, February 12, 1997 (Sullivan 1997).
Concentrations are average values of samples taken from the surface of the Mill Tailings.

Annual Metal Loading Estimate from the Country Boy Mine Adit Drainage

Cadmium

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	3	0.046	0.000	0.01
February	3	0.049	0.000	0.01
March	3	0.050	0.000	0.01
April	3	0.096	0.001	0.02
May	3	0.922	0.007	0.20
June	3	1.383	0.010	0.29
July	3	0.466	0.003	0.10
August	3	0.194	0.001	0.04
September	3	0.148	0.001	0.03
October	3	0.140	0.001	0.03
November	3	0.076	0.001	0.02
December	3	0.065	0.000	0.01
Total Annual Loading (kg/year)				0.8

Manganese

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	892	0.046	0.1	3
February	892	0.049	0.1	3
March	892	0.050	0.1	3
April	892	0.096	0.2	6
May	892	0.922	2.0	62
June	892	1.383	3.0	91
July	892	0.466	1.0	32
August	892	0.194	0.4	13
September	892	0.148	0.3	10
October	892	0.140	0.3	10
November	892	0.076	0.2	5
December	892	0.065	0.14	4
Total Annual Loading (kg/year)				242

Iron

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	1,096	0.0	0.1	4
February	1,096	0.0	0.1	4
March	1,096	0.0	0.1	4
April	1,096	0.1	0.3	8
May	1,096	0.9	2.5	77
June	1,096	1.4	3.7	111
July	1,096	0.5	1.3	39
August	1,096	0.2	0.5	16
September	1,096	0.1	0.4	12
October	1,096	0.1	0.4	12
November	1,096	0.1	0.2	6
December	1,096	0.1	0.2	5
Total Annual Loading (kg/year)				297

Zinc

	Metal Concentration (ug/L)	Discharge Estimate (cfs)	Daily Loading (kg/day)	Monthly Loading (kg/month)
January	3,000	0.0	0.3	10
February	3,000	0.0	0.4	10
March	3,000	0.0	0.4	11
April	3,000	0.1	0.7	21
May	3,000	0.9	6.8	210
June	3,000	1.4	10.2	305
July	3,000	0.5	3.4	106
August	3,000	0.2	1.4	44
September	3,000	0.1	1.1	33
October	3,000	0.1	1.0	32
November	3,000	0.1	0.6	17
December	3,000	0.1	0.5	15
Total Annual Loading (kg/year)				815

13. Appendix 3 – Correspondence Regarding Historic Features

Cadmium Loading Estimates

	Background FG-5 (kg/month)	Roaster Fines (kg/month)	Mill Tailings (kg/month)	Mine Waste Rock (kg/month)	Mine Pool (kg/month)	Country Boy Mine Adit (kg/month)	Total FG-7 + FG-8 (kg/month)	Total FG-9 (kg/month)
January	0	1.9	0.01	0	23	0.01	1	1
February	0	1.7	0.01	0	21	0.01	1	1
March	0	1.9	0.01	0	23	0.01	1	1
April	0	1.8	0.01	0	69	0.02	3	3
May	0	4.3	0.01	36	166	0.20	20	21
June	0	4.2	0.01	35	161	0.29	27	30
July	0	4.3	0.01	0	166	0.10	13	9
August	0	4.3	0.01	0	166	0.04	3	4
September	0.13	1.8	0.01	0	69	0.03	3	3
October	0	1.9	0.01	0	71	0.03	3	3
November	0	1.8	0.01	0	22	0.02	2	2
December	0	1.9	0.01	0	23	0.01	2	2
TOTAL (kg/yr)	**0.13**	**31.87**	**0.14**	**71**	**978**	**0.79**	**80**	**79**

	% Roaster Fines Contributes to Estimated Potential Loading from W-O RF/(RF+MP+MT +MWR)	% Mill Tailings Contributes to Estimated Potential Loading from W-O MT/(RF+MP+MT+MWR)	% Mine Waste Rock Contributes to Estimated Potential Loading from W-O MT/(RF+MP+MT+MWR)	% Mine Pool Contributes to Estimated Potential Loading from W-O MP/(RF+MP+MT+MWR)
January	8%	0%	0%	92%
February	8%	0%	0%	92%
March	8%	0%	0%	92%
April	3%	0%	0%	97%
May	2%	0%	17%	80%
June	2%	0%	17%	80%
July	3%	0%	0%	97%
August	3%	0%	0%	97%
September	3%	0%	0%	97%
October	3%	0%	0%	97%
November	8%	0%	0%	92%
December	8%	0%	0%	92%

	Annual Loading (kg/year)	Annual Loading as % of FG-7 + FG-8
Background	0.1	0%
Country Boy Mine	0.8	1%
Roaster Fines	2.2	3%
Mill Tailings	0.0	0%
Mine Waste Rock	8.1	10%
Mine Pool	68.4	86%
Total FG-7 + FG-8	79.7	

	Estimate of Loading in French Creek Contributed by Roaster Fines (kg/month)	Estimate of Loading in French Creek Contributed by Mill Tailings (kg/month)	Estimate of Loading in French Creek Contributed by Mine Waste Rock (kg/month)	Estimate of Loading in French Creek Contributed by Mine Pool (kg/month)	Estimate of Total Load in French Creek Contributed by W-O Complex FG-7 + FG-8 - FG-5 - CB (kg/month)
January	0.1	0.0	0	1.1	1.2
February	0.1	0.0	0	1.1	1.2
March	0.1	0.0	0	1.2	1.3
April	0.1	0.0	0	2.5	2.5
May	0.4	0.0	3.4	15.8	19.6
June	0.6	0.0	4.7	21.9	27.2
July	0.3	0.0	0	12.8	13.2
August	0.1	0.0	0	2.9	3.0
September	0.1	0.0	0	2.7	2.7
October	0.1	0.0	0	2.9	3.0
November	0.2	0.0	0	1.8	2.0
December	0.1	0.0	0	1.6	1.8
TOTAL (kg/yr)	**2.2**	**0.0**	**8.1**	**68.4**	**78.7**

GIGI A. RICHARD

Department of Civil Engineering
Colorado State University
Fort Collins, CO 80523

December 16, 1996

Ms. Karen Hardy-Hunt
Intergovernmental Services Director
Colorado History Museum
1300 Broadway
Denver, CO 80203

Dear Karen:

Thank you for speaking with me last week regarding potential historic impacts of surface waste remediation in French Gulch. I have not yet completed the maps that will accompany my report, but have enclosed two that I hope will be adequate for this preliminary analysis. My report will be an evaluation of several proposed surface waste remediation alternatives. As a part of the evaluation, I need to determine if there are any historic features or structures that may be impacted by the proposed remediation alternatives.

The proposed surface waste remediation alternatives that I will be evaluating range from no action at all to complete excavation and removal of the roaster fines and mill tailings piles. The roaster fines and mill tailings piles are indicated by the cross-hatched areas on the map labeled Figure 2. The disposal cell location indicated on that map is an area proposed as a potential repository for the waste piles, and thus should also be considered for potential historic features.

One of the remediation alternatives involves reshaping of the other waste rock piles located on the Wellington-Oro site higher up on the hillside. The potential historic features associated with these piles needs to be considered also. Unfortunately, their location is not indicated on these maps. When I get more information and better maps, I can forward them to you if they would be helpful.

Please let me know if you need more information or have any questions. The historic subcommittee of the FROG will be meeting on January 16, 1997. Any information you might have before then would be greatly appreciated. My phone number in Ft. Collins is (970)484-8154. Thank you for your time and consideration on this project and I look forward to hearing from you.

Sincerely,

Gigi A. Richard

Gigi A. Richard

Enclosures
cc: FROG Historic Subcommittee

Iron Loading Estimates

	Background FG-5 (kg/month)	Roaster Fines (kg/month)	Mill Tailings (kg/month)	Mine Waste Rock (kg/month)	Mine Pool (kg/month)	Country Boy Mine Adit (kg/month)	Total FG-7 + FG-8 (kg/month)	Total FG-9 (kg/month)
January	4	577	0.16	-	19,983	4	34	25
February	4	521	0.14	-	18,049	4	33	24
March	5	577	0.16	-	19,983	4	37	27
April	9	558	0.15	-	19,339	8	70	51
May	771	1,323	0.22	1,336	46,627	77	1,894	955
June	1,119	1,280	0.22	1,293	45,123	111	2,749	1,386
July	18	1,323	0.22	-	46,627	39	367	61
August	43	1,323	0.22	-	46,627	16	122	70
September	11	558	0.15	-	19,339	12	118	75
October	17	577	0.16	-	19,983	12	102	47
November	7	558	0.15	-	19,339	6	55	40
December	6	577	0.16	-	19,983	5	49	36
TOTAL (kg/yr)	**2,014**	**9,752**	**2.12**	**2,629**	**341,003**	**297**	**5,629**	**2,797**

	% Roaster Fines Contributes to Estimated Potential Loading from W-O RF/(RF+MP+MT +MWR)	% Mill Tailings Contributes to Estimated Potential Loading from W-O MT/(RF+MP+MT+MWR)	% Mine Waste Rock Contributes to Estimated Potential Loading from W-O MT/(RF+MP+MT+MWR)	% Mine Pool Contributes to Estimated Potential Loading from W-O MP/(RF+MP+MT+MWR)
January	3%	0%	0%	97%
February	3%	0%	0%	97%
March	3%	0%	0%	97%
April	3%	0%	0%	97%
May	3%	0%	3%	95%
June	3%	0%	3%	95%
July	3%	0%	0%	97%
August	3%	0%	0%	97%
September	3%	0%	0%	97%
October	3%	0%	0%	97%
November	3%	0%	0%	97%
December	3%	0%	0%	97%

	Annual Loading (kg/year)	Annual Loading as % of FG-7 + FG-8
Background	2,014	36%
Country Boy Mine	297	5%
Roaster Fines	90	2%
Mill Tailings	0	0%
Mine Waste Rock	70	1%
Mine Pool	3,159	56%
Total FG-7 + FG-8	5,629	

	Estimate of Loading in French Creek Contributed by Roaster Fines (kg/month)	Estimate of Loading in French Creek Contributed by Mill Tailings (kg/month)	Estimate of Loading in French Creek Contributed by Mine Waste Rock (kg/month)	Estimate of Loading in French Creek Contributed by Mine Pool (kg/month)	Estimate of Total Load in French Creek Contributed by W-O Complex FG-7 + FG-8 - FG-5 - CB (kg/month)
January	1	0	-	25	26
February	1	0	-	25	25
March	1	0	-	28	28
April	2	0	-	52	54
May	28	0	28	989	1,046
June	41	0	41	1,436	1,518
July	9	0	-	302	310
August	2	0	-	60	62
September	3	0	-	93	96
October	2	0	-	71	73
November	1	0	-	41	42
December	1	0	-	36	37
TOTAL (kg/yr)	**90**	**0**	**70**	**3,159**	**3,318**

COLORADO
HISTORICAL
SOCIETY

The Colorado History Museum 1300 Broadway Denver, Colorado 80203-2137

December 31, 1996

Gigi A. Richard
Department of Civil Engineering
Colorado State University
Fort Collins, CO 80523

Re: Surface Waste Remediation in French Gulch

Dear Ms. Richard:

Thank you for your correspondence dated December 16, 1996, concerning the above project having Environmental Protection Agency involvement.

A search of the Colorado Inventory of Cultural Resources indicates that the Wellington-Oro Mine (5ST390) and the Monohan Shaft (5ST549) are located within the area of potential effects (APE) of this project. However, both were determined not eligible for inclusion in the National Register of Historic Places on January 24, 1992. Further consultation with our office about these two properties will not be necessary unless there is additional information regarding the significance of either property that would warrant a re-evaluation.

However, if the project involves or is adjacent to other properties fifty or more years of age, it will be necessary to consult with our office regarding whether such properties meet the National Register of Historic Places eligibility criteria. In addition, if subsurface archaeological resources are encountered during ground disturbing activities, the work must be halted until such resources can be evaluated in consultation with our office. Finally, unless properties eligible for listing in the National Register are identified within the APE, there will be no effect on historic properties and no need for further consultation with our office. If we may be of further assistance, please contact Kaaren Hardy-Hunt, our Intergovernmental Services Director, at (303) 866-3398.

Sincerely,

James E. Hartmann
State Historic Preservation Officer

OFFICE OF ARCHAEOLOGY AND HISTORIC PRESERVATION
303-866-3392 Fax 303-866-4464

Manganese Loading Estimates

	Background FG-5 (kg/month)	Roaster Fines (kg/month)	Mill Tailings (kg/month)	Mine Waste Rock (kg/month)	Mine Pool (kg/month)	Country Boy Mine Adit (kg/month)	Total FG-7 + FG-8 (kg/month)	Total FG-9 (kg/month)
January	1.2	32.8	0.08	-	5,651	3	100	78
February	1.2	29.6	0.08	-	5,104	3	98	76
March	1.3	32.8	0.08	-	5,651	3	109	85
April	2.5	31.7	0.08	-	5,469	6	205	161
May	78.0	75.2	0.12	2,036	13,186	62	1,734	919
June	113.2	72.8	0.12	1,971	12,761	91	2,518	1,335
July	1.9	75.2	0.12	-	13,186	32	1,342	48
August	8.9	75.2	0.12	-	13,186	13	287	212
September	2.5	31.7	0.08	-	5,469	10	269	162
October	3.5	32.8	0.08	-	5,651	10	253	185
November	1.9	31.7	0.08	-	5,469	5	161	126
December	1.7	32.8	0.08	-	5,651	4	144	112
TOTAL (kg/yr)	217.9	554.50	1.14	4,007	96,435	242	7,219	3,500

	% Roaster Fines Contributes to Estimated Potential Loading from W-O RF/(RF+MP+MT +MWR)	% Mill Tailings Contributes to Estimated Potential Loading from W-O MT/(RF+MP+MT+MWR)	% Mine Waste Rock Contributes to Estimated Potential Loading from W-O MT/(RF+MP+MT+MWR)	% Mine Pool Contributes to Estimated Potential Loading from W-O MP/(RF+MP+MT+MWR)
January	1%	0%	0%	99%
February	1%	0%	0%	99%
March	1%	0%	0%	99%
April	1%	0%	0%	99%
May	0%	0%	13%	86%
June	0%	0%	13%	86%
July	1%	0%	0%	99%
August	1%	0%	0%	99%
September	1%	0%	0%	99%
October	1%	0%	0%	99%
November	1%	0%	0%	99%
December	1%	0%	0%	99%

	Annual Loading (kg/year)	Annual Loading as % of FG-7 + FG-8
Background	218	3%
Country Boy Mine	242	3%
Roaster Fines	36	0%
Mill Tailings	0	0%
Mine Waste Rock	520	7%
Mine Pool	6,203	86%
Total FG-7 + FG-8	7,219	

	Estimate of Loading in French Creek Contributed by Roaster Fines (kg/month)	Estimate of Loading in French Creek Contributed by Mill Tailings (kg/month)	Estimate of Loading in French Creek Contributed by Mine Waste Rock (kg/month)	Estimate of Loading in French Creek Contributed by Mine Pool (kg/month)	Estimate of Total Load in French Creek Contributed by W-O Complex FG-7 + FG-8 - FG-5 - CB (kg/month)
January	1	0	-	95	96
February	1	0	-	93	93
March	1	0	-	104	104
April	1	0	-	195	196
May	8	0	212	1,374	1,594
June	11	0	308	1,994	2,314
July	7	0	-	1,301	1,308
August	2	0	-	263	265
September	1	0	-	256	257
October	1	0	-	239	240
November	1	0	-	153	154
December	1	0	-	137	137
TOTAL (kg/yr)	36	0	520	6,203	6,759

14. Appendix 4 – Data and Calculations for Groundwater Base Flow Loading Estimates

Zinc Loading Estimates

	Background FG-5 (kg/month)	Roaster Fines (kg/month)	Mill Tailings (kg/month)	Mine Waste Rock (kg/month)	Mine Pool (kg/month)	Country Boy Mine Adit (kg/month)	Total FG-7 + FG-8 (kg/month)	Total FG-9 (kg/month)
January	5	407	0.28	-	24,526	10	520	497
February	5	368	0.25	-	22,153	10	506	484
March	6	407	0.28	-	24,526	11	566	541
April	11	394	0.27	-	23,735	21	1064	1018
May	63	935	0.40	5,643	57,228	210	6588	6188
June	91	905	0.39	5,461	55,382	305	9563	8983
July	10	935	0.40	-	57,228	106	5531	3424
August	20	935	0.40	-	57,228	44	1242	1347
September	24	394	0.27	-	23,735	33	1222	878
October	14	407	0.28	-	24,526	32	1181	1167
November	9	394	0.27	-	23,735	17	833	797
December	8	407	0.28	-	24,526	15	745	712
TOTAL (kg/yr)	266	6,889	3.75	11,104	418,530	815	29561	26038

	% Roaster Fines Contributes to Estimated Potential Loading from W-O RF/(RF+MP+MT +MWR)	% Mill Tailings Contributes to Estimated Potential Loading from W-O MT/(RF+MP+MT+MWR)	% Mine Waste Rock Contributes to Estimated Potential Loading from W-O MT/(RF+MP+MT+MWR)	% Mine Pool Contributes to Estimated Potential Loading from W-O MP/(RF+MP+MT+MWR)
January	2%	0%	0%	98%
February	2%	0%	0%	98%
March	2%	0%	0%	98%
April	2%	0%	0%	98%
May	1%	0%	9%	90%
June	1%	0%	9%	90%
July	2%	0%	0%	98%
August	2%	0%	0%	98%
September	2%	0%	0%	98%
October	2%	0%	0%	98%
November	2%	0%	0%	98%
December	2%	0%	0%	98%

	Annual Loading (kg/year)	Annual Loading as % of FG-7 + FG-8
Background	266	1%
Country Boy Mine	815	3%
Roaster Fines	437	1%
Mill Tailings	0	0%
Mine Waste Rock	1,369	5%
Mine Pool	26,673	90%
Total FG-7 + FG-8	29,561	

	Estimate of Loading in French Creek Contributed by Roaster Fines (kg/month)	Estimate of Loading in French Creek Contributed by Mill Tailings (kg/month)	Estimate of Loading in French Creek Contributed by Mine Waste Rock (kg/month)	Estimate of Loading in French Creek Contributed by Mine Pool (kg/month)	Estimate of Total Load in French Creek Contributed by W-O Complex FG-7 + FG-8 - FG-5 - CB (kg/month)
January	8	0	-	496	504
February	8	0	-	483	491
March	9	0	-	540	549
April	17	0	-	1,015	1,032
May	93	0	558	5,664	6,315
June	134	0	811	8,222	9,167
July	87	0	-	5,328	5,415
August	19	0	-	1,159	1,178
September	19	0	-	1,146	1,165
October	19	0	-	1,116	1,135
November	13	0	-	795	808
December	12	0	-	710	722
TOTAL (kg/yr)	437	0	1,369	26,673	28,480

Appendix 8-5

Appendix 8-5

Mine Outflow Model Based on Observed Groundwater Flow Rates and Mine Water Discharge Areas

High Flow

Mine Discharge via Fault Seepage

1. Flow Meter Study

Measurements

- MW-19 (Bullhide fault well) discharge w/HpL technique[1] = 0.63 gpm or 0.0014 cfs
- Total Zinc Concentration MW-5 (offset MW-19)[2] = 107 mg/L
- Total Zinc Concentration #3 Mine[3] = 217 mg/L

Assumptions

- Fault Discharge Length[4] = 500 ft (Bullhide Fault) + 500 ft (11-10 Fault) = 1000 ft
- Fault Width = 1 ft
- Fault Seepage due to Mine Discharge = 49% [(MW-5 Zn /Mine Zn) x 100]
- minimal zinc attenuation

Calculation

0.0014cfs (MW-19 Q) x 0.49 (mine water) x 1000 ft (length Q)/1 ft (width fault) = 0.686 cfs (308 gpm)

[1] Measured in May of 1996 (RAS, 1997a)
[2] EPA, 1994 (August)
[3] #3 Mine Relief Well June 1996 (EPA, 1996b)
[4] Distance between #3 Mine site and French Creek. Mine water discharge to creek via faults observed during July 1996 Salt Tracer Study (Kimball et.aL., 1997)

Mine Outflow Model Based on Observed Groundwater Flow Rates and Mine Water Discharge Areas

High Flow Mine Discharge via Fault Seepage (continued)

2. Salt Tracer Study

Measurements

- Combined Bullhide Fault & 11-10 Fault discharge to stream[5] = 0.8 cfs
- Total Zinc Concentration #3 Mine[6] = 214 mg/L

Assumptions

- Fault Discharge Length[7] = 500 ft (Bullhide Fault) + 500 ft (11-10 Fault) = 1000 ft
- Length of fault seepage contributing to stream (width flood plain) = 30 to 50 feet (60 to 100 feet for 11-10 and Bullhide faults combined)
- Bullhide Fault water zinc concentrations[8] = 24 mg/L
- 11-10 fault zinc concentration and flood plain width similar to Bullhide Fault
- Fault Seepage due to Mine Discharge = 11% [(Fault Zn /Mine Zn) x 100]
- minimal zinc attenuation

Calculation

((0.8 cfs x .11)/ 60 to 100 ft) x 1000 ft = 0.9 to 1.5 cfs (404 to 673 gpm)

Range High Flow Mine Discharge via Faults

0.68 cfs (308 gpm) to 1.5 cfs (673 gpm)

[5] Measured during Salt Tracer Study in July 1996 (Kimball et. al., 1997)
[6] #3 Mine Relief Well July 1996 (EPA,1996a)
[7] Distance between #3 Mine site and French Creek. Mine water discharge to creek via faults observed during July 1996 Salt Tracer Study (Kimball et.aL., 1997)
[8] Calculated from Salt Tracer Study Data

Appendix 8-5

Mine Outflow Model Based on Observed Groundwater Flow Rates and Mine Water Discharge Areas

High Flow

Mine Discharge via Mine workings and Fractured Bedrock in Vicinity of #3 Mine Site

Measurements

- High flow hydraulic gradients from historic water levels[9] = 0.04 to 0.06
- Hydraulic Conductivity[10] = 2.3 x 10^{-3} ft/sec
- Discharge area = 12,000 ft^2 (cross sectional area)

Assumptions

- Hydraulic gradients in the vicinity of the #3 Mine site area driven by mine discharge
- Cross sectional area = distance between Bullhide and 11-10 fault (300 ft) and saturated average thickness of alluvium (40 feet)

Calculation (Darcy Flow equation)

2.3 x 10^{-3} ft/sec *x* 12,000 ft^2 x (0.04 to 0.06) = 1.1 cfs to 1.7 cfs (495 to 763 gpm)

High Flow Mine Discharge via faults, fractured bedrock, and mine workings

low range: 494gpm (workings/bedrock) + 308 gpm (faults) = 802 gpm (1.8 cfs)

high range: 763 gpm (workings/bedrock) + 673 gpm (faults) = 1,436 gpm (3.2 cfs)

[9] Gradients measured between groundwater monitoring wells MW-1 and MW-4.
[10] Average calculated hydraulic conductivities for MW-1 and MW-5 from aquifer tests (Morrissey, 1995).

Appendix 8-5

Mine Outflow Model Based on Observed Groundwater Flow Rates and Mine Water Discharge Areas

Low Flow

Mine Discharge via Fault Seepage

Flow Meter Study

Measurements

- MW-19 (Bullhide fault well) discharge w/Heat Pulse flow meter[11] = 0.97 gpm or 0.0022 cfs
- Total Zinc Concentration MW-5 (offset MW-19)[12] = 130 mg/L
- Total Zinc Concentration #3 Mine[13] = 165 mg/L

Assumptions

- High Fault Discharge Length[14] = 300 ft (Bullhide Fault) + 300 ft (11-10 Fault) = 600 ft
- Low Fault Discharge Length[15] = 150 ft (Bullhide Fault) + 150 ft (11-10 Fault) = 300 ft
- Fault Width = 1 ft
- Fault Seepage due to Mine Discharge at MW-19= 79% [(MW-5 Zn /Mine Zn) x 100]
- minimal zinc attenuation

Calculations

MW-19
High Range

0.0022cfs (MW-19 Q) x 0.79 (mine water) x 600 ft (length Q)/1 ft (width fault) = 1.04 cfs (468 gpm)

MW-19
Low Range

0.0022cfs (MW-19 Q) x 0.79 (mine water) x 300 ft (length Q)/1 ft (width fault) = 0.52 cfs (234 gpm)

Low Flow Mine Discharge via Faults

0.52 cfs (234 gpm) to 1.04 cfs (468 gpm)

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[11] Measured in January of 1997 (RAS, 1997a)
[12] EPA, 1993 (November)
[13] #3 Mine Shaft March 1996 (RAS,1996a and 1997b)
[14] Distance from #3 Mine site to between groundwater monitoring wells MW-6 and MW-3. Mine water discharge to creek via faults was not evident during winter isotope and selected metal sampling in March 1997 (RAS, 1997b). Lower Zn concentrations in MW-6 versus MW-5 suggests significantly less mine water contribution at MW-6.
[15] Distance from #3 Mine site to French Gulch Road

Appendix 8-5

Mine Outflow Model Based on Observed Groundwater Flow Rates and Mine Water Discharge Areas

Low Flow

Mine Discharge via Mine Workings and Fractured Bedrock in Vicinity of #3 Mine Site

Measurements

- Low flow hydraulic gradients from historic water levels[16] = 0.02
- Hydraulic Conductivity[17] = 2.3×10^{-3} ft/sec
- Discharge area = 9,000 ft^2 (cross sectional area)

Assumptions

- Hydraulic gradients in the vicinity of the #3 Mine site area driven by mine discharge
- Cross sectional area = distance between Bullhide and 11-10 fault (300 ft) and saturated average thickness of alluvium (30 feet)

Calculation (Darcy Flow equation)

2.3×10^{-3} ft/sec x 9,000 ft^2 x 0.02 = 0.41 cfs (186 gpm)

Low Flow Mine Discharge via faults, fractured bedrock, and mine workings

low range: 186 gpm (workings/bedrock) + 234 gpm (faults) = 420 gpm (0.94 cfs)

high range: 186 gpm (workings/bedrock) + 469 gpm (faults) = 655 gpm (1.5 cfs)

[16] Gradients measured between groundwater monitoring wells MW-1 and MW-4.
[17] Average between calculated hydraulic conductivities for MW-1 and MW-5 from aquifer tests (Morrissey, 1995).

Appendix 8-6

Sulfate Flow Model
assumptions:
GW flow = 1 cfs
mine concentration = 2100 mg/L
mine contribution >92%
sulfate conservative
GW conc. = French Creek conc.

SO4 Production	FG-9									Combined surface & Groundwater		W-O Mine Pool					
	Surface			Minimal Groundwater Flow						FG-9		no attenuation				% Mine	
Month	Flow	Conc.	SO4 flux	SO4	Flow	Conc	SO4Flux	SO4		SO4Flux	SO4	Flow	Conc.	SO4 flux	SO4	Contr.	Mine Flow
	cfs	mg/L	lb/day	lb	cfs	mg/L	lb/day	lb		lb/day	lb	cfs	mg/L	lb/day	lb		(gpm)
Jan	1.9	110	1127	34945	1	110	593	18392		1721	53338	0.14	2100	1586	49157	92	62.72
Feb	2.1	110	1246	34886	1	110	593	16612		1839	51498	0.135	2100	1529	47402	92	60.48
Mar	2.1	100	1133	35112	1	100	539	16720		1672	51833	0.136	2100	1540	47753	92	60.928
Apr	4.1	95	2101	63025	1	95	512	15372		2613	78396	0.205	2100	2322	71981	92	91.84
May	38.8	58	12138	376272	1	58	313	9698		12451	385970	1.025	2100	11610	359903	93	459.2
Jun	60	37	11974	359215	1	37	200	5987		12173	365202	0.98	2100	11100	344102	94	439.04
Jul	19.6	50	5286	163858	1	50	270	8360		5555	172218	0.45	2100	5097	158006	92	201.6
Aug	10	56	3020	93633	1	56	302	9363		3322	102997	0.27	2100	3058	94804	92	120.96
Sep	8	66	2848	85435	1	66	356	10679		3204	96114	0.255	2100	2888	89537	93	114.24
Oct	5.9	75	2387	73987	1	75	405	12540		2791	86527	0.232	2100	2628	81461	94	103.936
Nov	3.2	87	1502	45048	1	87	469	14077		1971	59125	0.16	2100	1812	56180	95	71.68
Dec	2.8	95	1435	44478	1	95	512	15884		1947	60360	0.16	2100	1812	56180	93	71.68
Annual				1409893				153686			1563579				1456466		154.8587

Appendix 8-6

Sulfate Flow Model
assumptions:
GW flow = 5 cfs
mine concentration = 2100 mg/L
mine contribution >93%
sulfate conservative
GW conc. = French Creek conc.

SO4 Production	FG-9									Combined surface & Groundwater		W-O Mine Pool					
	Surface			Minor	Groundwater Flow					FG-9		no attenuation				% Mine	
Month	Flow	Conc.	SO4 flux	SO4	Flow	Conc	SO4Flux	SO4		SO4Flux	SO4	Flow	Conc.	SO4 flux	SO4	contr.	Mine Flow
	cfs	mg/L	lb/day	lb	cfs	mg/L	lb/day	lb		lb/day	lb	cfs	mg/L	lb/day	lb		(gpm)
Jan	1.9	110	1127	34945	5	110	2966	91961		4094	126907	0.335	2100	3794	117627	93	150.08
Feb	2.1	110	1246	34886	5	110	2966	83062		4212	117948	0.317	2100	3591	111307	94	142.016
Mar	2.1	100	1133	35112	5	100	2697	83601		3829	118714	0.318	2100	3602	111658	94	142.464
Apr	4.1	95	2101	63025	5	95	2562	76859		4663	139884	0.375	2100	4247	131672	94	168
May	38.8	58	12138	376272	5	58	1564	48489		13702	424761	1.14	2100	12912	400282	94	510.72
Jun	60	37	11974	359215	5	37	998	29935		12972	389150	1.05	2100	11893	368681	95	470.4
Jul	19.6	50	5286	163858	5	50	1348	41801		6634	205659	0.55	2100	6230	193119	94	246.4
Aug	10	56	3020	93633	5	56	1510	46817		4531	140450	0.38	2100	4304	133427	95	170.24
Sep	8	66	2846	85435	5	66	1780	53397		4628	138832	0.37	2100	4191	129916	94	165.76
Oct	5.9	75	2387	73987	5	75	2023	62701		4409	136688	0.365	2100	4134	128161	94	163.52
Nov	3.2	87	1502	45048	5	87	2346	70367		3848	115434	0.313	2100	3545	109902	95	140.224
Dec	2.8	95	1435	44476	5	95	2562	79421		3997	123897	0.335	2100	3794	117627	95	150.08
Annual				1409893				768430			2178323				2053379		218.3253

Appendix 8-6

Sulfate Flow Model
assumptions:
GW flow = 10 cfs
mine concentration = 2100 mg/L
mine contribution >90%
sulfate conservative
GW conc. = French Creek conc.

SO4 Production	FG-9									Combined surface & Groundwater		W-O Mine Pool					
	Surface			Moderate	Groundwater Flow					FG-9		no attenuation				% Mine	
Month	Flow	Conc.	SO4 flux	SO4	Flow	Conc	SO4Flux	SO4		SO4Flux	SO4	Flow	Conc.	SO4 flux	SO4	contr.	Mine Flow
	cfs	mg/L	lb/day	lb	cfs	mg/L	lb/day	lb		lb/day	lb	cfs	mg/L	lb/day	lb		(gpm)
Jan	1.9	110	1127	34945	10	110	5933	183923		7060	218868	0.58	2100	6569	203652	93	259.84
Feb	2.1	110	1246	34886	10	110	5933	166124		7179	201010	0.54	2100	6116	189607	94	241.92
Mar	2.1	100	1133	35112	10	100	5394	167202		6526	202315	0.542	2100	6139	190310	94	242.816
Apr	4.1	95	2101	63025	10	95	5124	153718		7225	216743	0.575	2100	6513	201897	93	257.6
May	38.8	58	12138	376272	10	58	3128	96977		15266	473250	1.25	2100	14158	438906	93	560
Jun	60	37	11974	359215	10	37	1996	59869		13969	419085	1.135	2100	12856	398527	95	508.48
Jul	19.6	50	5286	163858	10	50	2697	83601		7983	247459	0.665	2100	7532	233498	94	297.92
Aug	10	56	3020	93633	10	56	3020	93633		6041	187267	0.51	2100	5777	179074	96	228.48
Sep	8	66	2848	85435	10	66	3560	106794		6408	192229	0.51	2100	5777	179074	93	228.48
Oct	5.9	75	2387	73987	10	75	4045	125402		6432	199389	0.51	2100	5777	179074	90	228.48
Nov	3.2	87	1502	45048	10	87	4692	140774		6194	185821	0.5	2100	5663	175562	94	224
Dec	2.8	95	1435	44476	10	95	5124	158842		6559	203318	0.55	2100	6230	193119	95	246.4
Annual				1409893				1536859			2946752				2762300		293.7013

Appendix 8-6

Sulfate Flow Model
assumptions:
GW flow = 15 cfs
mine concentration = 2100 mg/L
mine contribution >91%
sulfate conservative
GW conc. = French Creek conc.

SO4 Production	FG-9									Combined surface & Groundwater		W-O Mine Pool					
	Surface			High	Groundwater Flow					FG-9		no attenuation				% Mine	
Month	Flow	Conc.	SO4 flux	SO4	Flow	Conc	SO4Flux	SO4		SO4Flux	SO4	Flow	Conc.	SO4 flux	SO4	contri.	Mine Flow
	cfs	mg/L	lb/day	lb	cfs	mg/L	lb/day	lb		lb/day	lb	cfs	mg/L	lb/day	lb		(gpm)
Jan	1.9	110	1127	34945	15	110	8899	275884		10027	310829	0.825	2100	9344	289678	93	369.6
Feb	2.1	110	1246	34886	15	110	8899	249185		10145	284071	0.75	2100	8495	263344	93	336
Mar	2.1	100	1133	35112	15	100	8090	250804		9223	285916	0.76	2100	8608	266855	93	340.48
Apr	4.1	95	2101	63025	15	95	7686	230577		9787	293602	0.78	2100	8835	273877	93	349.44
May	38.8	58	12138	376272	15	58	4692	145466		16830	521738	1.4	2100	15857	491575	94	627.2
Jun	60	37	11974	359215	15	37	2993	89804		14967	449019	1.2	2100	13592	421350	94	537.6
Jul	19.6	50	5286	163858	15	50	4045	125402		9331	289260	0.77	2100	8721	270366	93	344.96
Aug	10	56	3020	93633	15	56	4531	140450		7551	234083	0.63	2100	7136	221209	95	282.24
Sep	8	66	2848	85435	15	66	5340	160191		8188	245626	0.64	2100	7249	224720	91	286.72
Oct	5.9	75	2387	73987	15	75	6068	188103		8455	262090	0.68	2100	7702	238765	91	304.64
Nov	3.2	87	1502	45048	15	87	7039	211160		8540	256208	0.68	2100	7702	238765	93	304.64
Dec	2.8	95	1435	44476	15	95	7686	238263		9121	282739	0.75	2100	8495	263344	93	336
Annual				1409893				2305289			3715182				3463848		368.2933

Appendix 8-6
Sulfate Flow Model
assumptions:
GW flow = 20 cfs
mine concentration = 2100 mg/L
mine contribution >91%
sulfate conservative
GW conc. = French Creek conc.

SO4 Production	FG-9									Combined surface & Groundwater		W-O Mine Pool					
	Surface			V. High	Groundwater Flow					FG-9		no attenuation				% Mine	
Month	Flow	Conc.	SO4 flux	SO4	Flow	Conc	SO4Flux	SO4		SO4Flux	SO4	Flow	Conc.	SO4 flux	SO4	contri.	Mine Flow
	cfs	mg/L	lb/day	lb	cfs	mg/L	lb/day	lb		lb/day	lb	cfs	mg/L	lb/day	lb		(gpm)
Jan	1.9	110	1127	34945	20	110	11866	367845		12993	402790	1.05	2100	11893	368681	92	470.4
Feb	2.1	110	1246	34888	20	110	11866	332247		13112	367133	0.97	2100	10987	340591	93	434.56
Mar	2.1	100	1133	35112	20	100	10787	334405		11920	369517	0.96	2100	10874	337080	91	430.08
Apr	4.1	95	2101	63025	20	95	10248	307437		12349	370461	0.97	2100	10987	340591	92	434.56
May	38.8	58	12138	376272	20	58	6257	193955		18394	570227	1.55	2100	17556	544244	95	694.4
Jun	60	37	11974	359215	20	37	3991	119738		15965	478954	1.3	2100	14725	456462	95	582.4
Jul	19.6	50	5286	163858	20	50	5394	167202		10679	331061	0.9	2100	10194	316012	95	403.2
Aug	10	56	3020	93633	20	56	6041	187267		9061	280900	0.76	2100	8608	266855	95	340.48
Sep	8	66	2848	85435	20	66	7120	213588		9967	299023	0.78	2100	8835	273877	92	349.44
Oct	5.9	75	2387	73987	20	75	8090	250804		10477	324791	0.85	2100	9628	298456	92	380.8
Nov	3.2	87	1502	45048	20	87	9385	281547		10886	326595	0.86	2100	9741	301967	92	385.28
Dec	2.8	95	1435	44476	20	95	10248	317684		11683	362160	0.95	2100	10760	333569	92	425.6
Annual				1409893				3073719			4483612				4178387		444.2667

Appendix 8-6

Sulfate Flow Model

assumptions:

GW flow 9 to 18 cfs

mine concentration = 2100 mg/L

mine contribution 73% - 94%

sulfate conservative

GW conc. = French Creek conc.

SO4 Production	FG-9				Mod-High					Combined surface & Groundwater		W-O Mine Pool					
	Surface Flow				Groundwater Flow					FG-9		SO4 Production no attenuation					
Month	Flow	Conc.	SO4 flux	SO4	Flow	Conc	SO4Flux	SO4		SO4Flux	SO4	Flow	Conc.	SO4 flux	SO4	% Mine	Mine Flow
	cfs	mg/L	lb/day	lb	cfs	mg/L	lb/day	lb		lb/day	lb	cfs	mg/L	lb/day	lb	contr.	gpm
Jan	1.9	110	1127	34945	9	110	5340	165530		6467	200476	0.5	2100	5663	175562	88	224
Feb	2.1	110	1246	34886	10	110	5933	166124		7179	201010	0.5	2100	5663	175562	87	224
Mar	2.1	100	1133	35112	13	100	7012	217363		8144	252476	0.55	2100	6230	193119	76	246.4
Apr	4.1	95	2101	63025	14	95	7174	215206		9274	278230	0.58	2100	6569	203652	73	259.84
May	38.8	58	12138	376272	16	58	5005	155164		17143	531436	1.2	2100	13592	421350	79	537.6
Jun	60	37	11974	359215	18	37	3592	107765		15566	466980	1.25	2100	14158	438906	94	560
Jul	19.6	50	5286	163858	17	50	4585	142122		9870	305980	0.82	2100	9288	287922	94	367.36
Aug	10	56	3020	93633	16	56	4833	149813		7853	243447	0.65	2100	7362	228231	94	291.2
Sep	8	66	2848	85435	15	66	5340	160191		8188	245626	0.65	2100	7362	228231	93	291.2
Oct	5.9	75	2387	73987	14	75	5663	175562		8050	249550	0.63	2100	7136	221209	89	282.24
Nov	3.2	87	1502	45048	12	87	5631	168928		7133	213976	0.54	2100	6116	189607	89	241.92
Dec	2.8	95	1435	44476	10	95	5124	158842		6559	203318	0.51	2100	5777	179074	88	228.48
Annual				1409893				1982610			3392503	0.698333333			2942427	87	312.8533

Appendix 8-7

Appendix 8-7

Zinc Production Model at FG-9

Assumptions:
GW flow = 5.0 cfs
Transient flow = 20% stream flow
GW concentrations = French Creek concentrations

Zinc Production																		
	Surface	FG-9					Groundwater Flow		FG-9		Combined surface & Groundwater	FG-9		W-O Mine Pool	Flow & Zinc Production Model			
Month	Flow	Conc.	Zinc flux	Zinc	GW Flow	Trans. Flow	Subsurface Flow	Conc	ZincFlux	Zinc	Flow	ZincFlux	Zinc	Flow	Conc.	Zinc flux	Zinc	Est. % Zn
	cfs	mg/L	lb/day	lb			cfs	mg/L	lb/day	lb	cfs	lb/day	lb	cfs	mg/L	lb/day	lb	attenuated
Jan	1.9	3.4	35	1080	5	0.38	5.38	3.4	99	3058	7	134	4139	0.33	165	294	9104	43
Feb	2.1	3.4	39	1078	5	0.42	5.42	3.4	99	2783	8	138	3861	0.32	165	285	8828	42
Mar	2.1	4.8	54	1685	5	0.42	5.42	4.8	140	4350	8	195	6035	0.33	168	299	9270	62
Apr	4.1	4.2	93	2786	5	0.82	5.82	4.2	132	3955	10	225	6742	0.4	170	367	11370	56
May	38.8	3.1	649	20111	5	7.76	12.76	3.1	213	6614	52	862	26725	1.35	190	1383	42887	59
Jun	60	2.1	680	20388	5	12.00	17.00	2.1	193	5777	77	872	26164	1.25	220	1483	45981	54
Jul	19.6	2.3	243	7537	5	3.92	8.92	2.3	111	3430	29	354	10968	0.6	170	550	17055	61
Aug	10	2.2	119	3678	5	2.00	7.00	2.2	83	2575	17	202	6253	0.4	165	356	11035	54
Sep	8	1.9	82	2459	5	1.60	6.60	1.9	68	2029	15	150	4489	0.39	165	347	10759	40
Oct	5.9	2.6	83	2565	5	1.18	6.18	2.6	87	2687	12	169	5251	0.38	165	338	10484	48
Nov	3.2	3.4	59	1760	5	0.64	5.64	3.4	103	3103	9	162	4863	0.32	165	285	8828	52
Dec	2.8	3.4	51	1592	5	0.56	5.56	3.4	102	3161	8	153	4753	0.33	165	294	9104	50
Annual	13.20833	3.066667	182.1247	66722			7.6416667	3.066667	119.1272	43522	20.85	301.2519093	110243	0.533333333			194705	54

Appendix 8-8

Appendix 8-8 Comparison Zinc Production from W-O Mine Pool and Stream Station FG-9

Zinc Production									Combined surface & Groundwater			W-O Mine Pool				
	Surface	FG-9			Groundwater Flow		FG-9		FG-9			Flow & Zinc Production Model				
Month	Flow	Conc.	Zinc flux	Zinc	Flow	Conc	ZincFlux	Zinc	Flow	ZincFlux	Zinc	Flow	Conc.	Zinc flux	Zinc	Est. % Zn
	cfs	mg/L	lb/day	lb	cfs	mg/L	lb/day	lb	cfs	lb/day	lb	cfs	mg/L	lb/day	lb	attenuated
Jan	1.9	3.4	35	1080	9	3.4	165	5116	11	200	6197	0.5	165	445	13794	43
Feb	2.1	3.4	39	1078	10	3.4	183	5135	12	222	6213	0.5	165	445	13794	43
Mar	2.1	4.8	54	1685	13	4.8	337	10433	15	391	12119	0.55	168	498	15449	75
Apr	4.1	4.2	93	2786	14	4.2	317	9514	18	410	12301	0.58	170	532	16486	71
May	38.8	3.1	649	20111	16	3.1	268	8293	55	916	28404	1.2	190	1230	38122	71
Jun	60	2.1	680	20388	18	2.1	204	6116	78	883	26504	1.25	220	1483	45981	55
Jul	19.6	2.3	243	7537	17	2.3	211	6538	37	454	14075	0.82	170	752	23308	57
Aug	10	2.2	119	3678	16	2.2	190	5886	26	309	9564	0.65	165	578	17932	51
Sep	8	1.9	82	2459	15	1.9	154	4612	23	236	7071	0.65	165	578	17932	37
Oct	5.9	2.6	83	2565	14	2.6	196	6086	20	279	8651	0.63	165	561	17381	47
Nov	3.2	3.4	59	1760	12	3.4	220	6602	15	279	8362	0.54	165	481	14898	53
Dec	2.8	3.4	51	1592	10	3.4	183	5685	13	235	7277	0.51	165	454	14070	49
Annual	13.20833	3.066667	182.1247	66722	13.66667	3.066667	218.9812	80016	26.875	401.1058783	146738	0.698333333			249148	56